

# nRF52810

## Product Specification

v1.1

# Key features

Key features:	Applications:
<ul style="list-style-type: none"> <li>2.4 GHz transceiver <ul style="list-style-type: none"> <li>-96 dBm sensitivity in <i>Bluetooth</i><sup>®</sup> low energy mode</li> <li>Supported data rates: 1 Mbps, 2 Mbps <i>Bluetooth</i><sup>®</sup> low energy mode</li> <li>-20 to +4 dBm TX power, configurable in 4 dB steps</li> <li>On-chip balun (single-ended RF)</li> <li>4.6 mA peak current in TX (0 dBm)</li> <li>4.6 mA peak current in RX</li> <li>RSSI (1 dB resolution)</li> </ul> </li> <li>ARM<sup>®</sup> Cortex<sup>®</sup>-M4 32-bit processor, 64 MHz <ul style="list-style-type: none"> <li>144 EEMBC CoreMark<sup>®</sup> score running from flash memory</li> <li>34.4 µA/MHz running from flash memory</li> <li>32.8 µA/MHz running from RAM</li> <li>Serial wire debug (SWD)</li> </ul> </li> <li>Flexible power management <ul style="list-style-type: none"> <li>1.7 V-3.6 V supply voltage range</li> <li>Fully automatic LDO and DC/DC regulator system</li> <li>Fast wake-up using 64 MHz internal oscillator</li> <li>0.3 µA at 3 V in System OFF mode, no RAM retention</li> <li>0.5 µA at 3 V in System OFF mode with full 24 kB RAM retention</li> <li>1.5 µA at 3 V in System ON mode, with full 24 kB RAM retention, wake on RTC</li> </ul> </li> <li>192 kB flash and 24 kB RAM</li> <li>Nordic SoftDevice ready</li> <li>Support for concurrent multi-protocol</li> <li>12-bit, 200 ksp/s ADC - 8 configurable channels with programmable gain</li> <li>64 level comparator</li> <li>Temperature sensor</li> <li>Up to 32 general purpose I/O pins</li> <li>4-channel pulse width modulator (PWM) unit with EasyDMA</li> <li>Digital microphone interface (PDM)</li> <li>3x 32-bit timer with counter mode</li> <li>SPI master/slave with EasyDMA</li> <li>I2C compatible 2-wire master/slave</li> <li>UART (CTS/RTS) with EasyDMA</li> <li>Programmable peripheral interconnect (PPI)</li> <li>Quadrature decoder (QDEC)</li> <li>AES HW encryption with EasyDMA</li> <li>2x real-time counter (RTC)</li> <li>Single crystal operation</li> <li>Package variants <ul style="list-style-type: none"> <li>QFN48 package, 6 x 6 mm</li> <li>QFN32 package, 5 x 5 mm</li> </ul> </li> </ul>	<ul style="list-style-type: none"> <li>Computer peripherals and I/O devices <ul style="list-style-type: none"> <li>Mouse</li> <li>Keyboard</li> <li>Mobile HID</li> </ul> </li> <li>CE remote controls</li> <li>Network processor <ul style="list-style-type: none"> <li>Wearables</li> <li>Virtual reality headsets</li> </ul> </li> <li>Health and medical</li> <li>Enterprise lighting <ul style="list-style-type: none"> <li>Industrial</li> <li>Commercial</li> <li>Retail</li> </ul> </li> <li>Beacons</li> <li>Connectivity device in multi-chip solutions</li> </ul>

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# 1 Revision history

Date	Version	Description
November 2017	1.1	<p>The following content has been added or updated:</p> <ul style="list-style-type: none"><li>• <a href="#">RADIO — 2.4 GHz radio</a> on page 285: Table "Delay when disabling the RADIO" removed from electrical specifications as it contained duplicate information. Several 2 Mbps Bluetooth® low energy mode parameters added.</li><li>• <a href="#">NVMC — Non-volatile memory controller</a> on page 18: Updated electrical specifications.</li><li>• <a href="#">TWIM — I<sup>2</sup>C compatible two-wire interface master with EasyDMA</a> on page 411: Erroneous duplicate range value removed for registers TXD.MAXCNT, TXD.AMOUNT, RXD.MAXCNT and RXD.AMOUNT.</li><li>• <a href="#">Ordering information</a> on page 478: Updated MOQ numbers for nRF52810-QCAA-R7 and nRF52810-QCAA-R.</li></ul>
September 2017	1.0	First release

## 2 About this document

This product specification is organized into chapters based on the modules and peripherals that are available in this IC.

The peripheral descriptions are divided into separate sections that include the following information:

- A detailed functional description of the peripheral
- Register configuration for the peripheral
- Electrical specification tables, containing performance data which apply for the operating conditions described in [Recommended operating conditions](#) on page 476.

### 2.1 Document naming and status

Nordic uses three distinct names for this document, which are reflecting the maturity and the status of the document and its content.

Document name	Description
Objective Product Specification (OPS)	Applies to document versions up to 0.7.  This product specification contains target specifications for product development.
Preliminary Product Specification (PPS)	Applies to document versions 0.7 and up to 1.0.  This product specification contains preliminary data. Supplementary data may be published from Nordic Semiconductor ASA later.
Product Specification (PS)	Applies to document versions 1.0 and higher.  This product specification contains final product specifications. Nordic Semiconductor ASA reserves the right to make changes at any time without notice in order to improve design and supply the best possible product.

Table 1: Defined document names

### 2.2 Peripheral naming and abbreviations

Every peripheral has a unique capitalized name or an abbreviation of its name, e.g. TIMER, used for identification and reference. This name is used in chapter headings and references, and it will appear in the ARM<sup>®</sup> Cortex<sup>®</sup> Microcontroller Software Interface Standard (CMSIS) hardware abstraction layer to identify the peripheral.

The peripheral instance name, which is different from the peripheral name, is constructed using the peripheral name followed by a numbered postfix, starting with 0, for example, TIMER0. A postfix is normally only used if a peripheral can be instantiated more than once. The peripheral instance name is also used in the CMSIS to identify the peripheral instance.

## 2.3 Register tables

Individual registers are described using register tables. These tables are built up of two sections. The first three colored rows describe the position and size of the different fields in the register. The following rows describe the fields in more detail.

### 2.3.1 Fields and values

The **Id (Field Id)** row specifies the bits that belong to the different fields in the register. If a field has enumerated values, then every value will be identified with a unique value id in the **Value Id** column.

A blank space means that the field is reserved and read as undefined, and it also must be written as 0 to secure forward compatibility. If a register is divided into more than one field, a unique field name is specified for each field in the **Field** column. The **Value Id** may be omitted in the single-bit bit fields when values can be substituted with a Boolean type enumerator range, e.g. true/false, disable(d)/enable(d), on/off, and so on.

Values are usually provided as decimal or hexadecimal. Hexadecimal values have a 0x prefix, decimal values have no prefix.

The **Value** column can be populated in the following ways:

- Individual enumerated values, for example 1, 3, 9.
- Range of values, e.g. [0..4], indicating all values from and including 0 and 4.
- Implicit values. If no values are indicated in the **Value** column, all bit combinations are supported, or alternatively the field's translation and limitations are described in the text instead.

If two or more fields are closely related, the **Value Id**, **Value**, and **Description** may be omitted for all but the first field. Subsequent fields will indicate inheritance with '..'.

A feature marked **Deprecated** should not be used for new designs.

## 2.4 Registers

Register	Offset	Description
DUMMY	0x514	Example of a register controlling a dummy feature

Table 2: Register Overview

### 2.4.1 DUMMY

Address offset: 0x514

Example of a register controlling a dummy feature

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0																															
Id				D D D D				C C C				B				A A																			
Reset 0x00050002				0 0 0 0 0 0 0 0 0 0 0 0 0 1 0 1 0 0 0 0 0 0 0 0 0 0 0 0 0 0 1 0																															
Id	RW	Field	Value Id	Value		Description																													
A	RW	FIELD_A				Example of a field with several enumerated values																													
			Disabled	0		The example feature is disabled																													
			NormalMode	1		The example feature is enabled in normal mode																													
			ExtendedMode	2		The example feature is enabled along with extra functionality																													

Bit number										31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0			
Id														D	D	D	D					C	C	C					B									A	A					
Reset 0x00050002										0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0
Id	RW	Field	Value	Id	Value		Description																																					
B	RW	FIELD_B					Example of a deprecated field																							Deprecated														
			Disabled		0		The override feature is disabled																																					
			Enabled		1		The override feature is enabled																																					
C	RW	FIELD_C					Example of a field with a valid range of values																																					
			ValidRange		[2..7]		Example of allowed values for this field																																					
D	RW	FIELD_D					Example of a field with no restriction on the values																																					

# 3 Block diagram

This block diagram illustrates the overall system. Arrows with white heads indicate signals that share physical pins with other signals.

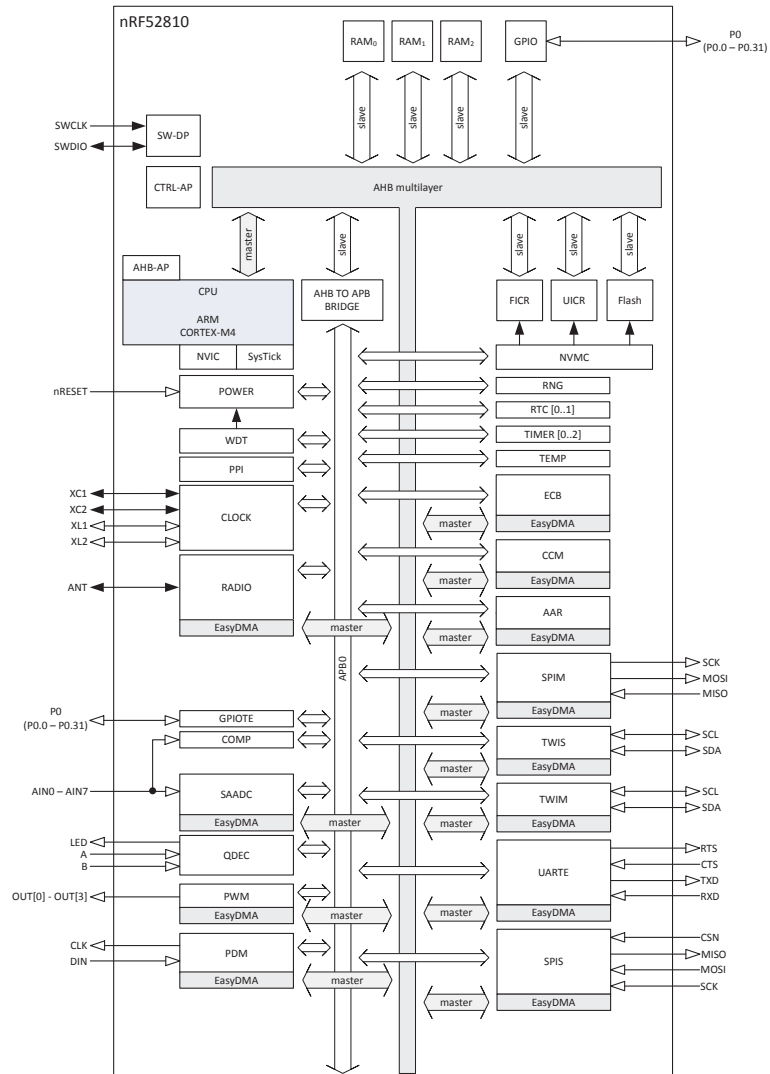


Figure 1: Block diagram

# 4 Core components

## 4.1 CPU

The ARM<sup>®</sup> Cortex<sup>®</sup>-M4 processor has a 32-bit instruction set (Thumb<sup>®</sup>-2 technology) that implements a superset of 16 and 32-bit instructions to maximize code density and performance.

This processor implements several features that enable energy-efficient arithmetic and high-performance signal processing including:

- Digital signal processing (DSP) instructions
- Single-cycle multiply and accumulate (MAC) instructions
- Hardware divide
- 8 and 16-bit single instruction multiple data (SIMD) instructions

The ARM Cortex Microcontroller Software Interface Standard (CMSIS) hardware abstraction layer for the ARM Cortex processor series is implemented and available for the M4 CPU.

Real-time execution is highly deterministic in thread mode, to and from sleep modes, and when handling events at configurable priority levels via the nested vectored interrupt controller (NVIC).

Executing code from flash will have a wait state penalty on the nRF52 Series. The section [Electrical specification](#) on page 14 shows CPU performance parameters including wait states in different modes, CPU current and efficiency, and processing power and efficiency based on the CoreMark<sup>®</sup> benchmark.

The ARM System Timer (SysTick) is present on the device. The SysTick's clock will only tick when the CPU is running or when the system is in debug interface mode.

### 4.1.1 Electrical specification

#### 4.1.1.1 CPU performance

The CPU clock speed is 64 MHz. Current and efficiency data is taken when in System ON and the CPU is executing the CoreMark<sup>®</sup> benchmark. It includes power regulator and clock base currents. All other blocks are IDLE.

Symbol	Description	Min.	Typ.	Max.	Units
W <sub>FLASH</sub>	CPU wait states, running from flash	0		2	
W <sub>RAM</sub>	CPU wait states, running from RAM			0	
CM <sub>FLASH</sub>	CoreMark <sup>1</sup> , running from flash		144		CoreMark
CM <sub>FLASH/MHz</sub>	CoreMark per MHz, running from flash		2.25		CoreMark/ MHz
CM <sub>FLASH/mA</sub>	CoreMark per mA, running from flash, DCDC 3V		60		CoreMark/ mA

### 4.1.2 CPU and support module configuration

The ARM<sup>®</sup> Cortex<sup>®</sup>-M4 processor has a number of CPU options and support modules implemented on the device.

<sup>1</sup> Using IAR v6.50.1.4452 with flags --endian=little --cpu=Cortex-M4 -e --fpu=VFPv4\_sp -Ohs --no\_size\_constraints

Option / Module	Description	Implemented
Core options		
NVIC	Nested vector interrupt controller	30 vectors
PRIORITIES	Priority bits	3
WIC	Wakeup interrupt controller	NO
Endianness	Memory system endianness	Little endian
Bit-banding	Bit banded memory	NO
DWT	Data watchpoint and trace	NO
SysTick	System tick timer	YES
Modules		
MPU	Memory protection unit	YES
FPU	Floating-point unit	NO
DAP	Debug access port	YES
ETM	Embedded trace macrocell	NO
ITM	Instrumentation trace macrocell	NO
TPIU	Trace port interface unit	NO
ETB	Embedded trace buffer	NO
FPB	Flash patch and breakpoint unit	YES
HTM	AMBA <sup>®</sup> AHB trace macrocell	NO

## 4.2 Memory

The nRF52810 contains flash and RAM that can be used for code and data storage.

The amount of RAM and flash will vary depending on variant, see [Memory variants](#) on page 15.

Device name	RAM	Flash	Comments
nRF52810-QFAA	24 kB	192 kB	

*Table 3: Memory variants*

The CPU and the EasyDMA can access memory via the AHB multilayer interconnect. The CPU is also able to access peripherals via the AHB multilayer interconnect, as illustrated in [Memory layout](#) on page 16.

See [AHB multilayer](#) on page 50 and [EasyDMA](#) on page 48 for more information about the AHB multilayer interconnect and the EasyDMA.

The same physical RAM is mapped to both the Data RAM region and the Code RAM region. It is up to the application to partition the RAM within these regions so that one does not corrupt the other.

The RAM interface is divided into multiple RAM AHB slaves.

Each RAM AHB slave is connected to two 4-kilobyte RAM sections, see Section 0 and Section 1 in [Memory layout](#) on page 16.

Each of the RAM sections have separate power control for System ON and System OFF mode operation, which is configured via RAM register (see the [POWER — Power supply](#) on page 61).

The flash can be read an unlimited number of times by the CPU, but it has restrictions on the number of times it can be written and erased, and also on how it can be written.

Writing to flash is managed by the non-volatile memory controller (NVMC), see [NVMC — Non-volatile memory controller](#) on page 18.

The flash is divided into multiple 4 kB pages that can be accessed by the CPU via both the ICODE and DCODE buses as shown in, [Memory layout](#) on page 16. Each page is divided into 8 blocks.

The complete memory map is shown in [Memory map](#) on page 17. As described in [Memory](#) on page 15, Code RAM and Data RAM are the same physical RAM.



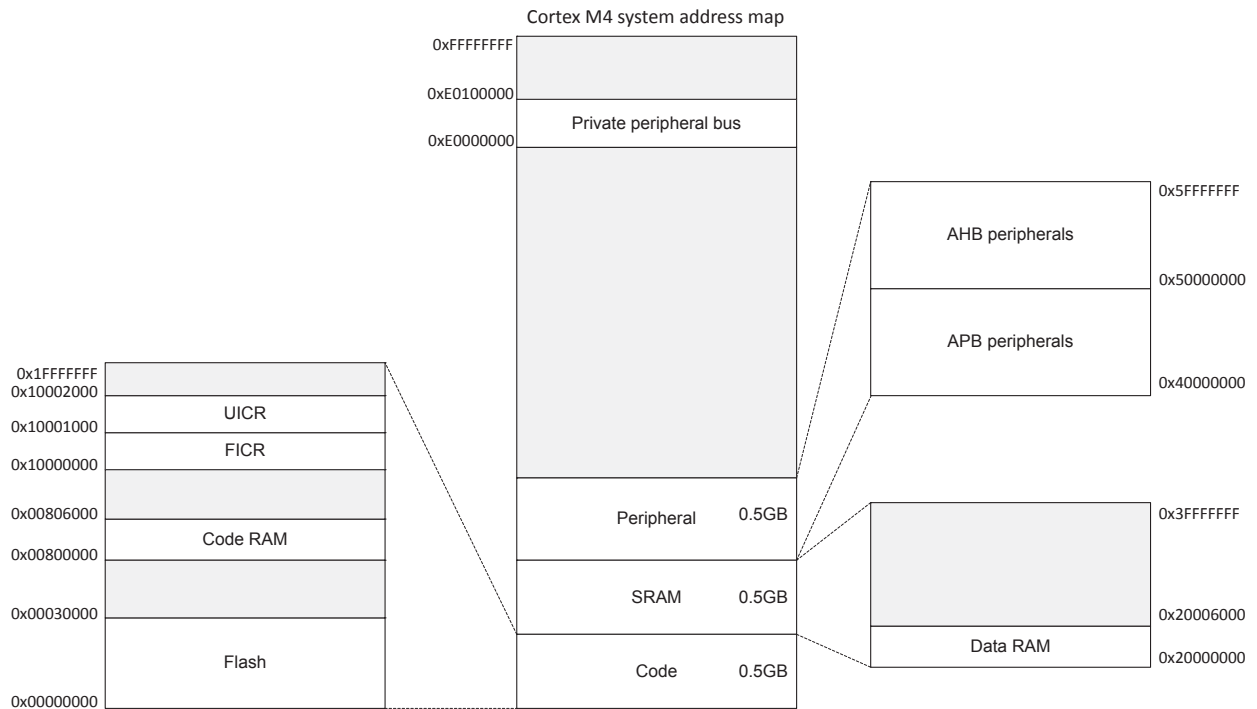


Figure 3: Memory map

## 4.2.4 Instantiation

ID	Base Address	Peripheral	Instance	Description
0	0x40000000	CLOCK	CLOCK	Clock control
0	0x40000000	BPROT	BPROT	Block protect
0	0x40000000	POWER	POWER	Power control
1	0x40001000	RADIO	RADIO	2.4 GHz radio
2	0x40002000	UARTE	UARTE0	Universal asynchronous receiver/transmitter with EasyDMA
3	0x40003000	TWIM	TWIM0	Two-wire interface master
3	0x40003000	TWIS	TWIS0	Two-wire interface slave
4	0x40004000	SPIS	SPIS0	SPI slave
4	0x40004000	SPIM	SPIM0	SPI master
6	0x40006000	GPOTE	GPOTE	GPIO tasks and events
7	0x40007000	SAADC	SAADC	Analog-to-digital converter
8	0x40008000	TIMER	TIMER0	Timer 0
9	0x40009000	TIMER	TIMER1	Timer 1
10	0x4000A000	TIMER	TIMER2	Timer 2
11	0x4000B000	RTC	RTC0	Real-time counter 0
12	0x4000C000	TEMP	TEMP	Temperature sensor
13	0x4000D000	RNG	RNG	Random number generator
14	0x4000E000	ECB	ECB	AES Electronic Codebook (ECB) mode block encryption
15	0x4000F000	AAR	AAR	Accelerated address resolver
15	0x4000F000	CCM	CCM	AES CCM mode encryption
16	0x40010000	WDT	WDT	Watchdog timer
17	0x40011000	RTC	RTC1	Real-time counter 1
18	0x40012000	QDEC	QDEC	Quadrature decoder
19	0x40013000	COMP	COMP	General purpose comparator
20	0x40014000	SWI	SWI0	Software interrupt 0
20	0x40014000	EGU	EGU0	Event generator unit 0

ID	Base Address	Peripheral	Instance	Description
21	0x40015000	EGU	EGU1	Event generator unit 1
21	0x40015000	SWI	SWI1	Software interrupt 1
22	0x40016000	SWI	SWI2	Software interrupt 2
23	0x40017000	SWI	SWI3	Software interrupt 3
24	0x40018000	SWI	SWI4	Software interrupt 4
25	0x40019000	SWI	SWI5	Software interrupt 5
28	0x4001C000	PWM	PWM0	Pulse-width modulation unit 0
29	0x4001D000	PDM	PDM	Pulse-density modulation (digital microphone interface)
30	0x4001E000	NVMC	NVMC	Non-volatile memory controller
31	0x4001F000	PPI	PPI	Programmable peripheral interconnect
0	0x50000000	GPIO	P0	General purpose input and output
N/A	0x10000000	FICR	FICR	Factory information configuration
N/A	0x10001000	UICR	UICR	User information configuration

Table 4: Instantiation table

## 4.3 NVMC — Non-volatile memory controller

The non-volatile memory controller (NVMC) is used for writing and erasing of the internal flash memory and the UICR (user information configuration registers).

The `CONFIG` on page 19 is used to enable the NVMC for writing (`CONFIG.WEN`) and erasing (`CONFIG.EEN`). The user must make sure that writing and erasing are not enabled at the same time. Having both enabled at the same time may result in unpredictable behavior.

### 4.3.1 Writing to flash

When writing is enabled, full 32-bit words are written to word-aligned addresses in flash.

As illustrated in [Memory](#) on page 15, the flash is divided into multiple pages. The same 32-bit word in the flash can only be written  $n_{\text{WRITE}}$  number of times before a page erase must be performed.

The NVMC is only able to write 0 to bits in the flash that are erased (set to 1). It cannot rewrite a bit back to 1. Only full 32-bit words can be written to flash using the NVMC interface. To write less than 32 bits, write the data as a full 32-bit word and set all the bits that should remain unchanged in the word to 1. Note that the restriction on the number of writes ( $n_{\text{WRITE}}$ ) still applies in this case.

Only word-aligned writes are allowed. Byte or half-word-aligned writes will result in a hard fault.

The time it takes to write a word to flash is specified by  $t_{\text{WRITE}}$ . The CPU is halted if the CPU executes code from the flash while the NVMC is writing to the flash.

### 4.3.2 Erasing a page in flash

When erase is enabled, the flash memory can be erased page by page using the `ERASEPAGE` on page 20.

After erasing a flash page, all bits in the page are set to 1. The time it takes to erase a page is specified by  $t_{\text{ERASEPAGE}}$ . The CPU is halted if the CPU executes code from the flash while the NVMC is writing to the flash.

### 4.3.3 Writing to user information configuration registers (UICR)

User information configuration registers (UICR) are written in the same way as flash. After UICR has been written, the new UICR configuration will take effect after a reset.

UICR can only be written  $n_{WRITE}$  number of times before an erase must be performed using [ERASEUICR](#) on page 21 or [ERASEALL](#) on page 20. The time it takes to write a word to UICR is specified by  $t_{WRITE}$ . The CPU is halted if the CPU executes code from the flash while the NVMC is writing to the UICR.

#### 4.3.4 Erasing user information configuration registers (UICR)

When erase is enabled, UICR can be erased using the [ERASEUICR](#) on page 21.

After erasing UICR all bits in UICR are set to 1. The time it takes to erase UICR is specified by  $t_{ERASEPAGE}$ . The CPU is halted if the CPU executes code from the flash while the NVMC performs the erase operation.

#### 4.3.5 Erase all

When erase is enabled, flash and UICR can be erased completely in one operation by using [ERASEALL](#) on page 20. This operation will not erase the factory information configuration registers (FICR).

The time it takes to perform an [ERASEALL](#) command is specified by  $t_{ERASEALL}$ . The CPU is halted if the CPU executes code from the flash while the NVMC performs the erase operation.

#### 4.3.6 Registers

Base address	Peripheral	Instance	Description	Configuration
0x4001E000	NVMC	NVMC	Non-volatile memory controller	

Table 5: Instances

Register	Offset	Description	
<a href="#">READY</a>	0x400	Ready flag	
<a href="#">CONFIG</a>	0x504	Configuration register	
<a href="#">ERASEPCR1</a>	0x508	Register for erasing a page in code area. Equivalent to <a href="#">ERASEPAGE</a> .	Deprecated
<a href="#">ERASEPAGE</a>	0x508	Register for erasing a page in code area	
<a href="#">ERASEALL</a>	0x50C	Register for erasing all non-volatile user memory	
<a href="#">ERASEPCR0</a>	0x510	Register for erasing a page in code area. Equivalent to <a href="#">ERASEPAGE</a> .	Deprecated
<a href="#">ERASEUICR</a>	0x514	Register for erasing user information configuration registers	

Table 6: Register Overview

##### 4.3.6.1 READY

Address offset: 0x400

Ready flag

Bit number			31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0																															
Id			A																															
Reset 0x00000001			0 0																															

##### 4.3.6.2 CONFIG

Address offset: 0x504

Configuration register

Bit number					31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0																															
Id					A A																															
Reset 0x00000000					0 0																															
Id	RW	Field	Value	Id	Value	Description																														
A	RW	WEN				Program memory access mode. It is strongly recommended to activate erase and write modes only when they are actively used.																														
			Ren		0	Read only access																														
			Wen		1	Write enabled																														
			Een		2	Erase enabled																														

#### 4.3.6.3 ERASEPCR1 ( Deprecated )

Address offset: 0x508

Register for erasing a page in code area. Equivalent to ERASEPAGE.

Bit number					31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0																															
Id					A A																															
Reset 0x00000000					0 0																															
Id	RW	Field	Value	Id	Value	Description																														
A	RW	ERASEPCR1				Register for erasing a page in code area. Equivalent to ERASEPAGE.																														

#### 4.3.6.4 ERASEPAGE

Address offset: 0x508

Register for erasing a page in code area

Bit number					31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0																															
Id					A A																															
Reset 0x00000000					0 0																															
Id	RW	Field	Value	Id	Value	Description																														
A	RW	ERASEPAGE				Register for starting erase of a page in code area.																														
						The value is the address to the page to be erased (addresses of first word in page). Note that the erase must be enabled using CONFIG.WEN before the page can be erased. Attempts to erase pages that are outside the code area may result in undesirable behavior, e.g. the wrong page may be erased.																														

#### 4.3.6.5 ERASEALL

Address offset: 0x50C

Register for erasing all non-volatile user memory

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0																															
Id				A																															
Reset 0x00000000				0 0																															
Id	RW	Field	Value Id	Value	Description																														
A	RW	ERASEALL			Erase all non-volatile memory including UICR registers. Note that the erase must be enabled using CONFIG.WEN before the non-volatile memory can be erased.																														
			NoOperation	0	No operation																														
			Erase	1	Start erase of chip																														

#### 4.3.6.6 ERASEPCRO ( Deprecated )

Address offset: 0x510

Register for erasing a page in code area. Equivalent to ERASEPAGE.

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0																															
Id				A A																															
Reset 0x00000000				0 0																															
Id	RW	Field	Value Id	Value				Description																											
A	RW	ERASEPCRO						Register for starting erase of a page in code area. Equivalent to ERASEPAGE.																											

#### 4.3.6.7 ERASEUICR

Address offset: 0x514

Register for erasing user information configuration registers

Bit number					31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0		
Id					A																																	
Reset 0x00000000					0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0		
Id	RW	Field	Value Id	Value	Description																																	
A	RW	ERASEUICR			Register starting erase of all user information configuration registers. Note that the erase must be enabled using CONFIG.WEN before the UICR can be erased.																																	
			NoOperation	0	No operation																																	
			Erase	1	Start erase of UICR																																	

### 4.3.7 Electrical specification

#### 4.3.7.1 Flash programming

Symbol	Description	Min.	Typ.	Max.	Units
$n_{WRITE}$	Number of times a 32-bit word can be written before erase			2	
$n_{ENDURANCE}$	Erase cycles per page	10000			
$t_{WRITE}$	Time to write one 32-bit word			41 <sup>2</sup>	μs
$t_{ERASEPAGE}$	Time to erase one page			85 <sup>2</sup>	ms
$t_{ERASEALL}$	Time to erase all flash			169 <sup>2</sup>	ms

<sup>2</sup> HFXO is used here

## 4.4 FICR — Factory information configuration registers

Factory information configuration registers (FICR) are pre-programmed in factory and cannot be erased by the user. These registers contain chip-specific information and configuration.

### 4.4.1 Registers

Base address	Peripheral	Instance	Description	Configuration
0x10000000	FICR	FICR	Factory information configuration	

Table 7: Instances

Register	Offset	Description
CODEPAGESIZE	0x010	Code memory page size
CODESIZE	0x014	Code memory size
DEVICEID[0]	0x060	Device identifier
DEVICEID[1]	0x064	Device identifier
ER[0]	0x080	Encryption root, word 0
ER[1]	0x084	Encryption root, word 1
ER[2]	0x088	Encryption root, word 2
ER[3]	0x08C	Encryption root, word 3
IR[0]	0x090	Identity root, word 0
IR[1]	0x094	Identity root, word 1
IR[2]	0x098	Identity root, word 2
IR[3]	0x09C	Identity root, word 3
DEVICEADDRTYPE	0x0A0	Device address type
DEVICEADDR[0]	0x0A4	Device address 0
DEVICEADDR[1]	0x0A8	Device address 1
INFO.PART	0x100	Part code
INFO.VARIANT	0x104	Part variant, hardware version and production configuration
INFO.PACKAGE	0x108	Package option
INFO.RAM	0x10C	RAM variant
INFO.FLASH	0x110	Flash variant
	0x114	Reserved
	0x118	Reserved
	0x11C	Reserved
TEMP.A0	0x404	Slope definition A0
TEMP.A1	0x408	Slope definition A1
TEMP.A2	0x40C	Slope definition A2
TEMP.A3	0x410	Slope definition A3
TEMP.A4	0x414	Slope definition A4
TEMP.A5	0x418	Slope definition A5
TEMP.B0	0x41C	Y-intercept B0
TEMP.B1	0x420	Y-intercept B1
TEMP.B2	0x424	Y-intercept B2
TEMP.B3	0x428	Y-intercept B3
TEMP.B4	0x42C	Y-intercept B4
TEMP.B5	0x430	Y-intercept B5
TEMP.T0	0x434	Segment end T0
TEMP.T1	0x438	Segment end T1
TEMP.T2	0x43C	Segment end T2
TEMP.T3	0x440	Segment end T3

Register	Offset	Description
TEMP.T4	0x444	Segment end T4

Table 8: Register Overview

#### 4.4.1.1 CODEPAGESIZE

Address offset: 0x010

Code memory page size

Bit number	31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0																													
Id	A A																													
Reset 0x00001000	0 0																													
Id	RW	Field	Value	Id	Value	Description																								
A	R	CODEPAGESIZE				Code memory page size																								

#### 4.4.1.2 CODESIZE

Address offset: 0x014

Code memory size

Bit number					31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0																															
Id					A A																															
Reset 0x00000030					0 0																															
Id	RW	Field	Value	Id	Value	Description																														
A	R	CODESIZE				Code memory size in number of pages																														
Total code space is: CODEPAGESIZE * CODESIZE																																				

#### 4.4.1.3 DEVICEID[0]

Address offset: 0x060

Device identifier

Bit number					31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0																															
Id					A A																															
Reset 0xFFFFFFFF					1 1																															
Id	RW	Field	Value	Id	Value				Description																											
A	R	DEVICEID							64 bit unique device identifier																											

#### 4.4.1.4 DEVICEID[1]

Address offset: 0x064

Device identifier

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0																															
Id				A A																															
Reset 0xFFFFFFFF				1 1																															
Id	RW	Field	Value Id	Value								Description																							
A	R	DEVICEID										64 bit unique device identifier																							
				DEVICEID[0] contains the least significant bits of the device identifier. DEVICEID[1] contains the most significant bits of the device identifier.																															

#### 4.4.1.5 ER[0]

Address offset: 0x080

Encryption root, word 0

Bit number	31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0																													
Id	A A																													
Reset 0xFFFFFFFF	1 1																													
Id	RW	Field	Value Id	Value	Description																									
A	R	ER			Encryption root, word n																									

#### 4.4.1.6 ER[1]

Address offset: 0x084

Encryption root, word 1

Bit number	31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0																													
Id	A A																													
Reset 0xFFFFFFFF	1 1																													
Id	RW	Field	Value Id	Value	Description																									
A	R	ER			Encryption root, word n																									

#### 4.4.1.7 ER[2]

Address offset: 0x088

Encryption root, word 2

Bit number	31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0																													
Id	A A																													
Reset 0xFFFFFFFF	1 1																													
Id	RW	Field	Value Id	Value	Description																									
A	R	ER			Encryption root, word n																									

#### 4.4.1.8 ER[3]

Address offset: 0x08C

Encryption root, word 3



Address offset: 0x090  
Identity root, word 0

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0																															
Id				A A																															

Address offset: 0x094  
Identity root, word 1

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0																															
Id				A A																															

Address offset: 0x098  
Identity root, word 2

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0																															
Id				A A																															
Reset 0xFFFFFFFF				1 1																															
Id		RW		Field		Value		Id		Value		Description																							
A		R		IR								Identity root, word n																							

Address offset: 0x09C  
Identity root, word 3

Bit number				31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
Id				A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A
Reset 0xFFFFFFFF				1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Id	RW	Field	Value	Id	Value			Description																											
A	R	IR						Identity root, word n																											

#### 4.4.1.13 DEVICEADDRTYPE

Address offset: 0x0A0

Device address type

Bit number			31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0																															
Id			A																															
Reset 0xFFFFFFFF			1 1																															
Id	RW	Field	Value Id	Value	Description																													
A	R	DEVICEADDRTYPE			Device address type																													
			Public	0	Public address																													
			Random	1	Random address																													

#### 4.4.1.14 DEVICEADDR[0]

Address offset: 0x0A4

Device address 0

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0																															
Id				A A																															

#### 4.4.1.15 DEVICEADDR[1]

Address offset: 0x0A8

Device address 1

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0																															
Id				A A																															
Reset 0xFFFFFFFF				1 1																															
Id	RW	Field	Value Id	Value				Description																											
A	R	DEVICEADDR						48 bit device address																											
				DEVICEADDR[0] contains the least significant bits of the device address. DEVICEADDR[1] contains the most significant bits of the device address. Only bits [15:0] of DEVICEADDR[1] are used.																															

#### 4.4.1.16 INFO.PART

Address offset: 0x100

Part code

Bit number				31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0	
Id				A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	
Reset 0x00052810				0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1	0	0	1	0	1	0	0	0	0	0	0	0	1	0	0	0	0
Id	RW	Field	Value Id	Value		Description																														
A	R	PART				Part code																														
			N52810	0x52810		nRF52810																														
			Unspecified	0xFFFFFFFF		Unspecified																														

#### 4.4.1.17 INFO.VARIANT

Address offset: 0x104

Part variant, hardware version and production configuration

Bit number				31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
Id				A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A
Reset 0xFFFFFFFF				1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	
Id	RW	Field	Value Id	Value	Description																														
A	R	VARIANT			Part variant, hardware version and production configuration, encoded as ASCII																														
			AAAA	0x41414141	AAAA																														
			AAA0	0x41414130	AAA0																														
			AABA	0x41414241	AABA																														
			AABB	0x41414242	AABB																														
			AAB0	0x41414230	AAB0																														
			AACA	0x41414341	AACA																														
			AACB	0x41414342	AACB																														
			AACO	0x41414330	AACO																														
			Unspecified	0xFFFFFFFF	Unspecified																														

#### 4.4.1.18 INFO.PACKAGE

Address offset: 0x108

Package option

Bit number	31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0																														
Id	A A																														
Reset 0xFFFFFFFF	1 1																														
Id	RW	Field	Value Id	Value	Description																										
A	R	PACKAGE			Package option																										
			QF	0x2000	QFxx - 48-pin QFN																										
			QC	0x2003	QCxx - 32-pin QFN																										
			Unspecified	0xFFFFFFFF	Unspecified																										

#### 4.4.1.19 INFO.RAM

Address offset: 0x10C

RAM variant

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0																															
Id				A A																															
Reset 0x00000018				0 1 1 0 0 0 0																															
Id	RW	Field	Value Id	Value			Description																												
A	R	RAM					RAM variant																												
			K24	0x18			24 kByte RAM																												
			Unspecified	0xFFFFFFFF			Unspecified																												

#### 4.4.1.20 INFO.FLASH

Address offset: 0x110

Flash variant

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0																															
Id				A A																															
Reset 0x000000C0				0 1 1 0 0 0 0 0 0																															
Id	RW	Field	Value Id	Value			Description																												
A	R	FLASH					Flash variant																												
			K192	0xC0			192 kByte flash																												
			Unspecified	0xFFFFFFFF			Unspecified																												

#### 4.4.1.21 TEMP.A0

Address offset: 0x404

Slope definition A0

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0																															
Id				A A																															
Reset 0x00000320				0 0																															

#### 4.4.1.22 TEMP.A1

Address offset: 0x408

Slope definition A1

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0																															
Id				A A																															
Reset 0x00000343				0 1 1 0 1 0 0 0 0 0 1 1																															
Id		RW		Field		Value Id		Value		Description																									
A		R		A						A (slope definition) register																									

#### 4.4.1.23 TEMP.A2

Address offset: 0x40C

Slope definition A2

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0																															
Id				A A																															

#### 4.4.1.24 TEMP.A3

Address offset: 0x410

Slope definition A3

Bit number					31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0																															
Id					A A																															

#### 4.4.1.25 TEMP.A4

Address offset: 0x414

Slope definition A4

Bit number					31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0																															
Id					A A																															

#### 4.4.1.26 TEMP.A5

Address offset: 0x418

Slope definition A5

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0																															
Id				A A																															

#### 4.4.1.27 TEMP.B0

Address offset: 0x41C

Y-intercept B0

Bit number					31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0																															
Id					A A																															



Bit number	31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0																													
Id	A A																													
Reset 0x00003E10	0 0																													
Id	RW	Field	Value Id		Value		Description																							
A	R	B					B (y-intercept)																							

#### 4.4.1.33 TEMP.T0

Address offset: 0x434

Segment end T0

Bit number					31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0																															
Id					A A																															
Reset 0x00000E2					0 0																															
Id		RW	Field		Value Id		Value		Description																											
A		R	T						T (segment end) register																											

#### 4.4.1.34 TEMP.T1

Address offset: 0x438

Segment end T1

Bit number					31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0																															
Id					A A																															
Reset 0x00000000					0 0																															
Id		RW	Field		Value Id		Value		Description																											
A		R	T						T (segment end) register																											

#### 4.4.1.35 TEMP.T2

Address offset: 0x43C

Segment end T2

Bit number					31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0																															
Id					A A																															
Reset 0x00000014					0 0																															
Id		RW	Field		Value Id		Value		Description																											
A		R	T						T (segment end) register																											

#### 4.4.1.36 TEMP.T3

Address offset: 0x440

Segment end T3

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0																															
Id				A A																															
Reset 0x00000019				0 0																															
Id		RW		Field		Value Id		Value		Description																									
A		R		T						T (segment end) register																									





Register	Offset	Description
NRFFHW[5]	0x064	Reserved for Nordic hardware design
NRFFHW[6]	0x068	Reserved for Nordic hardware design
NRFFHW[7]	0x06C	Reserved for Nordic hardware design
NRFFHW[8]	0x070	Reserved for Nordic hardware design
NRFFHW[9]	0x074	Reserved for Nordic hardware design
NRFFHW[10]	0x078	Reserved for Nordic hardware design
NRFFHW[11]	0x07C	Reserved for Nordic hardware design
CUSTOMER[0]	0x080	Reserved for customer
CUSTOMER[1]	0x084	Reserved for customer
CUSTOMER[2]	0x088	Reserved for customer
CUSTOMER[3]	0x08C	Reserved for customer
CUSTOMER[4]	0x090	Reserved for customer
CUSTOMER[5]	0x094	Reserved for customer
CUSTOMER[6]	0x098	Reserved for customer
CUSTOMER[7]	0x09C	Reserved for customer
CUSTOMER[8]	0x0A0	Reserved for customer
CUSTOMER[9]	0x0A4	Reserved for customer
CUSTOMER[10]	0x0A8	Reserved for customer
CUSTOMER[11]	0x0AC	Reserved for customer
CUSTOMER[12]	0x0B0	Reserved for customer
CUSTOMER[13]	0x0B4	Reserved for customer
CUSTOMER[14]	0x0B8	Reserved for customer
CUSTOMER[15]	0x0BC	Reserved for customer
CUSTOMER[16]	0x0C0	Reserved for customer
CUSTOMER[17]	0x0C4	Reserved for customer
CUSTOMER[18]	0x0C8	Reserved for customer
CUSTOMER[19]	0x0CC	Reserved for customer
CUSTOMER[20]	0x0D0	Reserved for customer
CUSTOMER[21]	0x0D4	Reserved for customer
CUSTOMER[22]	0x0D8	Reserved for customer
CUSTOMER[23]	0x0DC	Reserved for customer
CUSTOMER[24]	0x0E0	Reserved for customer
CUSTOMER[25]	0x0E4	Reserved for customer
CUSTOMER[26]	0x0E8	Reserved for customer
CUSTOMER[27]	0x0EC	Reserved for customer
CUSTOMER[28]	0x0F0	Reserved for customer
CUSTOMER[29]	0x0F4	Reserved for customer
CUSTOMER[30]	0x0F8	Reserved for customer
CUSTOMER[31]	0x0FC	Reserved for customer
PSELRESET[0]	0x200	Mapping of the nRESET function (see POWER chapter for details)
PSELRESET[1]	0x204	Mapping of the nRESET function (see POWER chapter for details)
APPROTECT	0x208	Access port protection

Table 10: Register Overview

#### 4.5.1.1 NRFFHW[0]

Address offset: 0x014

Reserved for Nordic firmware design



#### 4.5.1.6 NRFFW[5]

Address offset: 0x028

Reserved for Nordic firmware design

Bit number	31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0																													
Id	A A																													
Reset 0xFFFFFFFF	1 1																													
Id	RW	Field	Value	Id	Value	Description																								
A	RW	NRFFW				Reserved for Nordic firmware design																								

#### 4.5.1.7 NRFFW[6]

Address offset: 0x02C

Reserved for Nordic firmware design

Bit number	31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0																													
Id	A A																													
Reset 0xFFFFFFFF	1 1																													
Id	RW	Field	Value	Id	Value	Description																								
A	RW	NRFFW				Reserved for Nordic firmware design																								

#### 4.5.1.8 NRFFW[7]

Address offset: 0x030

Reserved for Nordic firmware design

Bit number	31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0																													
Id	A A																													
Reset 0xFFFFFFFF	1 1																													
Id	RW	Field	Value	Id	Value	Description																								
A	RW	NRFFW				Reserved for Nordic firmware design																								

#### 4.5.1.9 NRFFW[8]

Address offset: 0x034

Reserved for Nordic firmware design

Bit number	31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0																													
Id	A A																													
Reset 0xFFFFFFFF	1 1																													
Id	RW	Field	Value	Id	Value	Description																								
A	RW	NRFFW				Reserved for Nordic firmware design																								

#### 4.5.1.10 NRFFW[9]

Address offset: 0x038

Reserved for Nordic firmware design

Bit number	31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0																													
Id	A A																													
Reset 0xFFFFFFFF	1 1																													
Id	RW	Field	Value	Id	Value	Description																								
A	RW	NRFFW				Reserved for Nordic firmware design																								

#### 4.5.1.11 NRFFW[10]

Address offset: 0x03C

Reserved for Nordic firmware design

Bit number					31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0																															
Id					A A																															
Reset 0xFFFFFFFF					1 1																															
Id		RW	Field		Value	Id	Value	Description																												
A		RW	NRFFW					Reserved for Nordic firmware design																												

#### 4.5.1.12 NRFFW[11]

Address offset: 0x040

Reserved for Nordic firmware design

Bit number					31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0																															
Id					A A																															
Reset 0xFFFFFFFF					1 1																															
Id		RW	Field	Value	Id	Value	Description																													
A		RW	NRFFW				Reserved for Nordic firmware design																													

#### 4.5.1.13 NRFFW[12]

Address offset: 0x044

Reserved for Nordic firmware design

Bit number					31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0																															
Id					A A																															
Reset 0xFFFFFFFF					1 1																															
Id		RW	Field	Value	Id	Value	Description																													
A		RW	NRFFW				Reserved for Nordic firmware design																													

#### 4.5.1.14 NRFFW[13]

Address offset: 0x048

Reserved for Nordic firmware design

Bit number					31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0																															
Id					A A																															
Reset 0xFFFFFFFF					1 1																															
Id		RW	Field	Value	Id	Value	Description																													
A		RW	NRFFW				Reserved for Nordic firmware design																													

#### 4.5.1.15 NRFFW[14]

Address offset: 0x04C

Reserved for Nordic firmware design

Bit number	31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0																													
Id	A A																													
Reset 0xFFFFFFFF	1 1																													
Id	RW	Field	Value	Id	Value	Description																								
A	RW	NRFFW				Reserved for Nordic firmware design																								

#### 4.5.1.16 NRFHW[0]

Address offset: 0x050

Reserved for Nordic hardware design

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0																															
Id				A A																															
Reset 0xFFFFFFFF				1 1																															
Id	RW	Field	Value	Id	Value	Description																													
A	RW	NRFHW				Reserved for Nordic hardware design																													

#### 4.5.1.17 NRFHW[1]

Address offset: 0x054

Reserved for Nordic hardware design

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0																															
Id				A A																															
Reset 0xFFFFFFFF				1 1																															
Id	RW	Field	Value	Id	Value	Description																													
A	RW	NRFHW				Reserved for Nordic hardware design																													

#### 4.5.1.18 NRFHW[2]

Address offset: 0x058

Reserved for Nordic hardware design

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0																															
Id				A A																															
Reset 0xFFFFFFFF				1 1																															
Id	RW	Field	Value	Id	Value	Description																													
A	RW	NRFHW				Reserved for Nordic hardware design																													

#### 4.5.1.19 NRFHW[3]

Address offset: 0x05C

Reserved for Nordic hardware design

Bit number	31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0																													
Id	A A																													
Reset 0xFFFFFFFF	1 1																													
Id	RW	Field	Value	Id	Value	Description																								
A	RW	NRFHW				Reserved for Nordic hardware design																								

#### 4.5.1.20 NRFHW[4]

Address offset: 0x060

Reserved for Nordic hardware design

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0																															
Id				A A																															
Reset 0xFFFFFFFF				1 1																															
Id	RW	Field	Value	Id	Value			Description																											
A	RW	NRFHW						Reserved for Nordic hardware design																											

#### 4.5.1.21 NRFHW[5]

Address offset: 0x064

Reserved for Nordic hardware design

Bit number					31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0																															
Id					A A																															
Reset 0xFFFFFFFF					1 1																															
Id		RW	Field		Value	Id	Value	Description																												
A		RW	NRFHW					Reserved for Nordic hardware design																												

#### 4.5.1.22 NRFHW[6]

Address offset: 0x068

Reserved for Nordic hardware design

Bit number					31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0																															
Id					A A																															
Reset 0xFFFFFFFF					1 1																															
Id	RW	Field	Value	Id	Value	Description																														
A	RW	NRFHW				Reserved for Nordic hardware design																														

#### 4.5.1.23 NRFHW[7]

Address offset: 0x06C

Reserved for Nordic hardware design

Bit number					31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0																															
Id					A A																															
Reset 0xFFFFFFFF					1 1																															
Id		RW	Field		Value	Id	Value	Description																												
A		RW	NRFHW					Reserved for Nordic hardware design																												

#### 4.5.1.24 NRFHW[8]

Address offset: 0x070

Reserved for Nordic hardware design

Bit number	31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0																													
Id	A A																													
Reset 0xFFFFFFFF	1 1																													
Id	RW	Field	Value	Id	Value	Description																								
A	RW	NRFHW				Reserved for Nordic hardware design																								

#### 4.5.1.25 NRFHW[9]

Address offset: 0x074

Reserved for Nordic hardware design

Bit number					31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0																															
Id					A A																															
Reset 0xFFFFFFFF					1 1																															
Id		RW	Field		Value	Id	Value	Description																												
A		RW	NRFHW					Reserved for Nordic hardware design																												

#### 4.5.1.26 NRFHW[10]

Address offset: 0x078

Reserved for Nordic hardware design

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0																															
Id				A A																															
Reset 0xFFFFFFFF				1 1																															
Id	RW	Field	Value	Id	Value	Description																													
A	RW	NRFHW				Reserved for Nordic hardware design																													

#### 4.5.1.27 NRFHW[11]

Address offset: 0x07C

Reserved for Nordic hardware design

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0																															
Id				A A																															
Reset 0xFFFFFFFF				1 1																															
Id	RW	Field	Value	Id	Value	Description																													
A	RW	NRFHW				Reserved for Nordic hardware design																													

#### 4.5.1.28 CUSTOMER[0]

Address offset: 0x080

Reserved for customer

Bit number	31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0																													
Id	A A																													
Reset 0xFFFFFFFF	1 1																													
Id	RW	Field	Value	Id	Value	Description																								
A	RW	CUSTOMER				Reserved for customer																								

#### 4.5.1.29 CUSTOMER[1]

Address offset: 0x084

Reserved for customer

Bit number					31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0																															
Id					A A																															
Reset 0xFFFFFFFF					1 1																															
Id	RW	Field	Value	Id	Value	Description																														
A	RW	CUSTOMER				Reserved for customer																														

#### 4.5.1.30 CUSTOMER[2]

Address offset: 0x088

Reserved for customer

Bit number					31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0																															
Id					A A																															
Reset 0xFFFFFFFF					1 1																															
Id		RW	Field	Value	Id	Value	Description																													
A		RW	CUSTOMER				Reserved for customer																													

#### 4.5.1.31 CUSTOMER[3]

Address offset: 0x08C

Reserved for customer

Bit number					31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0																															
Id					A A																															
Reset 0xFFFFFFFF					1 1																															
Id		RW	Field	Value	Id	Value	Description																													
A		RW	CUSTOMER				Reserved for customer																													

#### 4.5.1.32 CUSTOMER[4]

Address offset: 0x090

Reserved for customer

Bit number					31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0																															
Id					A A																															
Reset 0xFFFFFFFF					1 1																															
Id	RW	Field	Value	Id	ValueDescription																															
A	RW	CUSTOMER			Reserved for customer																															



### 4.5.1.33 CUSTOMER[5]

Address offset: 0x094

Reserved for customer

Bit number	31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0																													
Id	A A																													
Reset 0xFFFFFFFF	1 1																													
Id	RW	Field	Value	Id	Value	Description																								
A	RW	CUSTOMER				Reserved for customer																								

### 4.5.1.34 CUSTOMER[6]

Address offset: 0x098

Reserved for customer

Bit number					31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0																															
Id					A A																															
Reset 0xFFFFFFFF					1 1																															
Id		RW	Field		Value Id	Value	Description																													
A		RW	CUSTOMER				Reserved for customer																													

### 4.5.1.35 CUSTOMER[7]

Address offset: 0x09C

Reserved for customer

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0																															
Id				A A																															
Reset 0xFFFFFFFF				1 1																															
Id		RW		Field		Value Id		Value		Description																									
A		RW		CUSTOMER						Reserved for customer																									

### 4.5.1.36 CUSTOMER[8]

Address offset: 0x0A0

Reserved for customer

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0																															
Id				A A																															
Reset 0xFFFFFFFF				1 1																															
Id	RW	Field	Value	Id	Value			Description																											
A	RW	CUSTOMER						Reserved for customer																											

### 4.5.1.37 CUSTOMER[9]

Address offset: 0x0A4

Reserved for customer

Reserved for customer

Reserved for customer

Reserved for customer

Reserved for customer

4430\_161 v1.1



Bit number	31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0																													
Id	A A																													
Reset 0xFFFFFFFF	1 1																													
Id	RW	Field	Value	Id	Value	Description																								
A	RW	CUSTOMER				Reserved for customer																								

#### 4.5.1.47 CUSTOMER[19]

Address offset: 0x0CC

Reserved for customer

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0																															
Id				A A																															
Reset 0xFFFFFFFF				1 1																															
Id	RW	Field	Value	Id	Value	Description																													
A	RW	CUSTOMER				Reserved for customer																													

#### 4.5.1.48 CUSTOMER[20]

Address offset: 0x0D0

Reserved for customer

Bit number					31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0																															
Id					A A																															
Reset 0xFFFFFFFF					1 1																															
Id		RW	Field	Value	Id	Value	Description																													
A		RW	CUSTOMER				Reserved for customer																													

#### 4.5.1.49 CUSTOMER[21]

Address offset: 0x0D4

Reserved for customer

Bit number					31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0																															
Id					A A																															
Reset 0xFFFFFFFF					1 1																															
Id		RW	Field	Value	Id	Value	Description																													
A		RW	CUSTOMER				Reserved for customer																													

#### 4.5.1.50 CUSTOMER[22]

Address offset: 0x0D8

Reserved for customer

Bit number					31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0																															
Id					A A																															
Reset 0xFFFFFFFF					1 1																															
Id	RW	Field	Value	Id	ValueDescription																															
A	RW	CUSTOMER			Reserved for customer																															

#### 4.5.1.51 CUSTOMER[23]

Address offset: 0x0DC

Reserved for customer

Bit number	31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0																													
Id	A A																													
Reset 0xFFFFFFFF	1 1																													
Id	RW	Field	Value Id	Value	Description																									
A	RW	CUSTOMER			Reserved for customer																									

#### 4.5.1.52 CUSTOMER[24]

Address offset: 0x0E0

Reserved for customer

Bit number	31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0																													
Id	A A																													
Reset 0xFFFFFFFF	1 1																													
Id	RW	Field	Value Id	Value	Description																									
A	RW	CUSTOMER			Reserved for customer																									

#### 4.5.1.53 CUSTOMER[25]

Address offset: 0x0E4

Reserved for customer

Bit number	31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0																													
Id	A A																													
Reset 0xFFFFFFFF	1 1																													
Id	RW	Field	Value Id	Value	Description																									
A	RW	CUSTOMER			Reserved for customer																									

#### 4.5.1.54 CUSTOMER[26]

Address offset: 0x0E8

Reserved for customer

Bit number	31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0																													
Id	A A																													
Reset 0xFFFFFFFF	1 1																													
Id	RW	Field	Value Id	Value	Description																									
A	RW	CUSTOMER			Reserved for customer																									

#### 4.5.1.55 CUSTOMER[27]

Address offset: 0x0EC

Reserved for customer

Bit number	31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0																													
Id	A A																													
Reset 0xFFFFFFFF	1 1																													
Id	RW	Field	Value	Id	Value	Description																								
A	RW	CUSTOMER				Reserved for customer																								

#### 4.5.1.56 CUSTOMER[28]

Address offset: 0x0F0

Reserved for customer

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0																															
Id				A A																															
Reset 0xFFFFFFFF				1 1																															
Id	RW	Field	Value	Id	Value	Description																													
A	RW	CUSTOMER				Reserved for customer																													

#### 4.5.1.57 CUSTOMER[29]

Address offset: 0x0F4

Reserved for customer

Bit number					31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0																															
Id					A A																															
Reset 0xFFFFFFFF					1 1																															
Id		RW	Field	Value	Id	Value	Description																													
A		RW	CUSTOMER				Reserved for customer																													

#### 4.5.1.58 CUSTOMER[30]

Address offset: 0x0F8

Reserved for customer

Bit number					31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0																															
Id					A A																															
Reset 0xFFFFFFFF					1 1																															
Id		RW	Field	Value	Id	Value	Description																													
A		RW	CUSTOMER				Reserved for customer																													

#### 4.5.1.59 CUSTOMER[31]

Address offset: 0x0FC

Reserved for customer

Bit number					31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0																															
Id					A A																															
Reset 0xFFFFFFFF					1 1																															
Id	RW	Field	Value	Id	ValueDescription																															
A	RW	CUSTOMER			Reserved for customer																															

#### 4.5.1.60 PSELRESET[0]

Address offset: 0x200

Mapping of the nRESET function (see POWER chapter for details)

All PSELRESET registers have to contain the same value for a pin mapping to be valid. If values are not the same, there will be no nRESET function exposed on a GPIO. As a result, the device will always start independently of the levels present on any of the GPIOs.

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0																																							
Id				B																												A				A		A		A		A	
Reset 0xFFFFFFFF				1 1																																							
Id	RW	Field	Value Id	Value				Description																																			
A	RW	PIN		21				GPIO number P0.n onto which reset is exposed																																			
B	RW	CONNECT						Connection																																			
			Disconnected	1				Disconnect																																			
			Connected	0				Connect																																			

#### 4.5.1.61 PSELRESET[1]

Address offset: 0x204

Mapping of the nRESET function (see POWER chapter for details)

All PSELRESET registers have to contain the same value for a pin mapping to be valid. If values are not the same, there will be no nRESET function exposed on a GPIO. As a result, the device will always start independently of the levels present on any of the GPIOs.

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0																																			
Id				B																																A A A A A A			
Reset 0xFFFFFFFF				1 1																																			
Id	RW	Field	Value Id	Value				Description																															
A	RW	PIN		21				GPIO number P0.n onto which reset is exposed																															
B	RW	CONNECT						Connection																															
			Disconnected	1				Disconnect																															
			Connected	0				Connect																															

#### 4.5.1.62 APPROTECT

Address offset: 0x208

Access port protection

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0																															
Id				A A A A A A A A																															
Reset 0xFFFFFFFF				1 1																															
Id	RW	Field	Value Id	Value	Description																														
A	RW	PALL			Enable or disable access port protection.																														
					See <a href="#">Debug</a> on page 50 for more information.																														
			Disabled	0xFF	Disable																														
			Enabled	0x00	Enable																														

## 4.6 EasyDMA

EasyDMA is a module implemented by some peripherals to gain direct access to Data RAM.

EasyDMA is an AHB bus master similar to CPU and is connected to the AHB multilayer interconnect for direct access to Data RAM. EasyDMA is not able to access flash.

A peripheral can implement multiple EasyDMA instances to provide dedicated channels. For example, for reading and writing of data between the peripheral and RAM. This concept is illustrated in [EasyDMA example](#) on page 48.

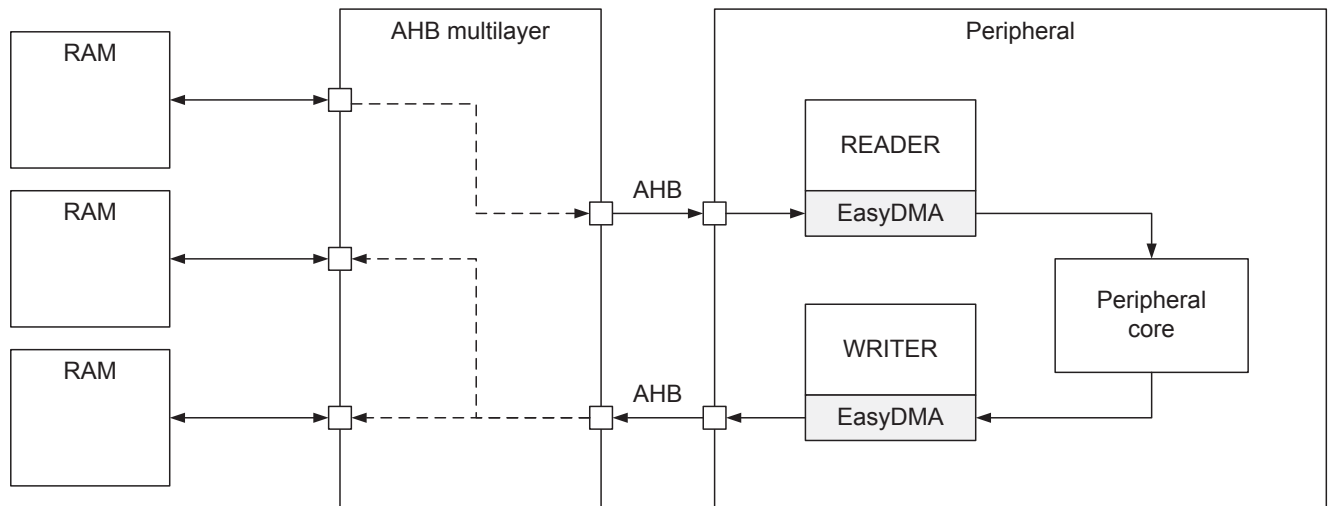


Figure 4: EasyDMA example

An EasyDMA channel is usually implemented like illustrated by the code below, but some variations may occur:

```

READERBUFFER_SIZE 5
WRITERBUFFER_SIZE 6

uint8_t readerBuffer[READERBUFFER_SIZE] __at__ 0x20000000;
uint8_t writerBuffer[WRITERBUFFER_SIZE] __at__ 0x20000005;

// Configuring the READER channel
MYPERIPHERAL->READER.MAXCNT = READERBUFFER_SIZE;
MYPERIPHERAL->READER.PTR = &readerBuffer;

// Configure the WRITER channel
MYPERIPHERAL->WRITER.MAXCNT = WRITERBUFFER_SIZE;
MYPERIPHERAL->WRITER.PTR = &writerBuffer;

```

This example shows a peripheral called MYPERIPHERAL that implements two EasyDMA channels - one for reading called READER, and one for writing called WRITER. When the peripheral is started, it is assumed that the peripheral will:

- Read 5 bytes from the readerBuffer located in RAM at address 0x20000000.
- Process the data.



- Write no more than 6 bytes back to the writerBuffer located in RAM at address 0x20000005.

The memory layout of these buffers is illustrated in [EasyDMA memory layout](#) on page 49.

0x20000000	readerBuffer[0]	readerBuffer[1]	readerBuffer[2]	readerBuffer[3]
0x20000004	readerBuffer[4]	writerBuffer[0]	writerBuffer[1]	writerBuffer[2]
0x20000008	writerBuffer[3]	writerBuffer[4]	writerBuffer[5]	

*Figure 5: EasyDMA memory layout*

The WRITER.MAXCNT register should not be specified larger than the actual size of the buffer (writerBuffer). Otherwise, the channel would overflow the writerBuffer.

Once an EasyDMA transfer is completed, the AMOUNT register can be read by the CPU to see how many bytes were transferred. For example, CPU can read MYPERIPHERAL->WRITER.AMOUNT register to see how many bytes WRITER wrote to RAM.

#### 4.6.1 EasyDMA array list

EasyDMA is able to operate in a mode called array list.

The array list does not provide a mechanism to explicitly specify where the next item in the list is located. Instead, it assumes that the list is organized as a linear array where items are located one after the other in RAM.

The EasyDMA array list can be implemented by using the data structure ArrayList\_type as illustrated in the code example below:

```
#define BUFFER_SIZE 4

typedef struct ArrayList
{
    uint8_t buffer[BUFFER_SIZE];
} ArrayList_type;

ArrayList_type ReaderList[3];

READER.MAXCNT = BUFFER_SIZE;
READER.PTR = &ReaderList;
```

The data structure only includes a buffer with size equal to the size of READER.MAXCNT register. EasyDMA uses the READER.MAXCNT register to determine when the buffer is full.

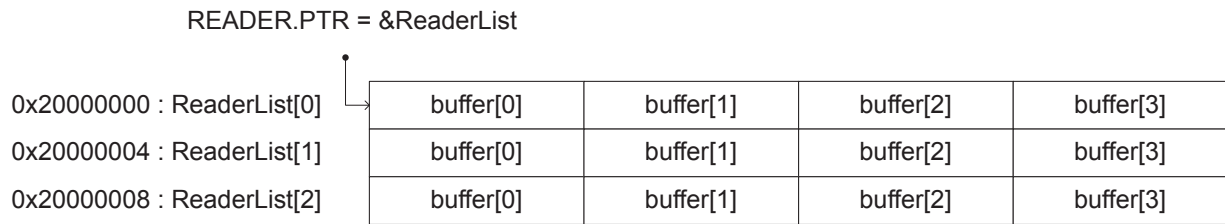


Figure 6: EasyDMA array list

## 4.7 AHB multilayer

AHB multilayer enables parallel access paths between multiple masters and slaves in a system. Access is resolved using priorities.

Each bus master is connected to the slave devices using an interconnection matrix. The bus masters are assigned priorities. Priorities are used to resolve access when two (or more) bus masters request access to the same slave device. The following applies:

- If two (or more) bus masters request access to the same slave device, the master with the highest priority is granted the access first.
- Bus masters with lower priority are stalled until the higher priority master has completed its transaction.
- If the higher priority master pauses at any point during its transaction, the lower priority master in queue is temporarily granted access to the slave device until the higher priority master resumes its activity.
- Bus masters that have the same priority are mutually exclusive, thus cannot be used concurrently.

Below is a list of bus masters in the system and their priorities.

Bus master name	Description
CPU	
SPIM0/SPI0	Same priority and mutually exclusive
RADIO	
CCM/ECB/AAR	Same priority and mutually exclusive
SAADC	
UARTE0	
TWIM0/TWIS0	Same priority and mutually exclusive
PDM	
PWM	

Table 11: AHB bus masters (listed in priority order, highest to lowest)

Defined bus masters are the CPU and the peripherals with implemented EasyDMA, and the available slaves are RAM AHB slaves. How the bus masters and slaves are connected using the interconnection matrix is illustrated in [Memory](#) on page 15.

## 4.8 Debug

The debug system offers a flexible and powerful mechanism for non-intrusive debugging.

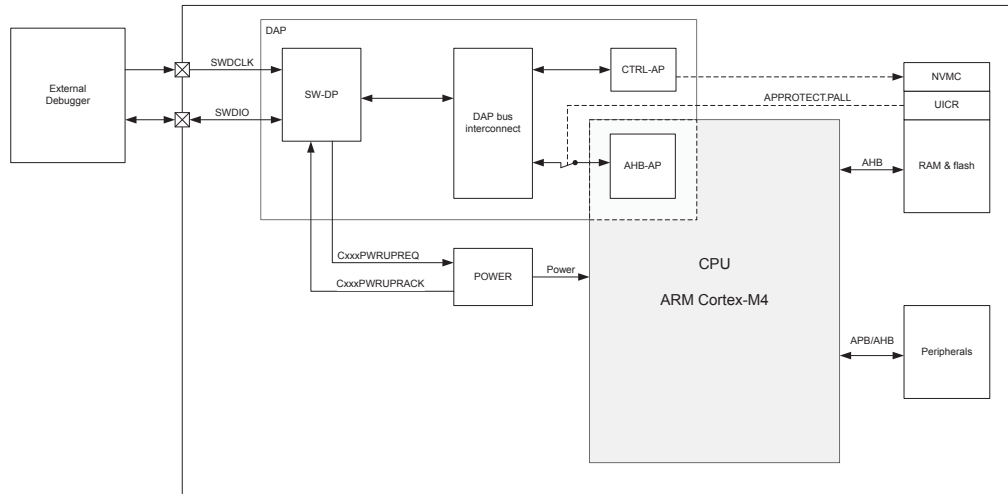


Figure 7: Overview

The main features of the debug system are:

- Two-pin Serial Wire Debug (SWD) interface
- Flash Patch and Breakpoint Unit (FPB) supports:
  - Two literal comparators
  - Six instruction comparators

### 4.8.1 DAP - Debug Access Port

An external debugger can access the device via the DAP.

The DAP implements a standard ARM® CoreSight™ Serial Wire Debug Port (SW-DP).

The SW-DP implements the Serial Wire Debug protocol (SWD) that is a two-pin serial interface, see SWDCLK and SWDIO in [Overview](#) on page 51.

In addition to the default access port in the CPU (AHB-AP), the DAP includes a custom Control Access Port (CTRL-AP). The CTRL-AP is described in more detail in [CTRL-AP - Control Access Port](#) on page 51.

#### Important:

- The SWDIO line has an internal pull-up resistor.
- The SWDCLK line has an internal pull-down resistor.

### 4.8.2 CTRL-AP - Control Access Port

The Control Access Port (CTRL-AP) is a custom access port that enables control of the device even if the other access ports in the DAP are being disabled by the access port protection.

Access port protection blocks the debugger from read and write access to all CPU registers and memory-mapped addresses. See the UICR register [APPROTECT](#) on page 47 for more information about enabling access port protection.

This access port enables the following features:

- Soft reset, see [Reset](#) on page 65 for more information
- Disable access port protection

Access port protection can only be disabled by issuing an ERASEALL command via CTRL-AP. This command will erase the Flash, UICR, and RAM.

### 4.8.2.1 Registers

Register	Offset	Description
RESET	0x000	Soft reset triggered through CTRL-AP
ERASEALL	0x004	Erase all
ERASEALLSTATUS	0x008	Status register for the ERASEALL operation
APPROTECTSTATUS	0x00C	Status register for access port protection
IDR	0x0FC	CTRL-AP Identification Register, IDR

Table 12: Register Overview

#### 4.8.2.1.1 RESET

Address offset: 0x000

Soft reset triggered through CTRL-AP

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0																															
Id				A																															
Reset 0x00000000				0 0																															
Id	RW	Field	Value Id	Value	Description																														
A	RW	RESET			Soft reset triggered through CTRL-AP. See Reset Behaviour in POWER chapter for more details.																														
			NoReset	0	Reset is not active																														
			Reset	1	Reset is active. Device is held in reset																														

#### 4.8.2.1.2 ERASEALL

Address offset: 0x004

Erase all

Bit number			31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0																															
Id			A																															
Reset 0x00000000			0 0																															
Id	RW	Field	Value Id	Value	Description																													
A	W	ERASEALL			Erase all FLASH and RAM																													
		NoOperation	0	No operation																														
		Erase	1	Erase all FLASH and RAM																														

#### 4.8.2.1.3 ERASEALLSTATUS

Address offset: 0x008

Status register for the ERASEALL operation

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0																															
Id				A																															
Reset 0x00000000				0 0																															
Id	RW	Field	Value Id	Value	Description																														
A	R	ERASEALLSTATUS			Status register for the ERASEALL operation																														
			Ready	0	ERASEALL is ready																														
			Busy	1	ERASEALL is busy (on-going)																														

#### 4.8.2.1.4 APPROTECTSTATUS

Address offset: 0x00C

Status register for access port protection

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0																															
Id				A																															
Reset 0x00000000				0 0																															
Id	RW	Field	Value Id	Value	Description																														
A	R	APPROTECTSTATUS			Status register for access port protection																														
			Enabled	0	Access port protection enabled																														
			Disabled	1	Access port protection not enabled																														

#### 4.8.2.1.5 IDR

Address offset: 0x0FC

CTRL-AP Identification Register, IDR

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0																															
Id				E E E E D D D D C C C C C C C C B B B B A A A A A A A A																															
Reset 0x02880000				0 0 0 0 0 0 1 0 1 0 0 0 1 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0																															
Id	RW	Field	Value Id	Value	Description																														
A	R	APID			AP Identification																														
B	R	CLASS			Access Port (AP) class																														
			NotDefined	0x0	No defined class																														
			MEMAP	0x8	Memory Access Port																														
C	R	JEP106ID			JEDEC JEP106 identity code																														
D	R	JEP106CONT			JEDEC JEP106 continuation code																														
E	R	REVISION			Revision																														

### 4.8.2.2 Electrical specification

#### 4.8.2.2.1 Control access port

Symbol	Description	Min.	Typ.	Max.	Units
R <sub>pull</sub>	Internal SWDIO and SWDCLK pull up/down resistance		13		kΩ

### 4.8.3 Debug interface mode

Before the external debugger can access the CPU's access port (AHB-AP) or the Control Access Port (CTRL-AP), the debugger must first request the device to power up via CxxxPWRUPREQ in the SWJ-DP.

As long as the debugger is requesting power via CxxxPWRUPREQ, the device will be in debug interface mode. If the debugger is not requesting power via CxxxPWRUPREQ, the device will be in normal mode.

Some peripherals will behave differently in debug interface mode compared to normal mode. These differences are described in more detail in the chapters of the peripherals that are affected.

When a debug session is over, the external debugger must make sure to put the device back into normal mode since the overall power consumption will be higher in debug interface mode compared to normal mode.

For details on how to use the debug capabilities please read the debug documentation of your IDE.

If the device is in System OFF when power is requested via CxxxPWRUPREQ, the system will wake up and the DIF flag in [RESETREAS](#) on page 68 will be set.

#### 4.8.4 Real-time debug

The nRF52810 supports real-time debugging.

Real-time debugging will allow interrupts to execute to completion in real time when breakpoints are set in Thread mode or lower priority interrupts. This enables the developer to set a breakpoint and single-step through their code without a failure of the real-time event-driven threads running at higher priority. For example, this enables the device to continue to service the high-priority interrupts of an external controller or sensor without failure or loss of state synchronization while the developer steps through code in a low-priority thread.

# 5 Power and clock management

## 5.1 Power management unit (PMU)

Power and clock management in nRF52810 is designed to automatically ensure maximum power efficiency.

The core of the power and clock management system is the power management unit (PMU) illustrated in [Power management unit](#) on page 55.

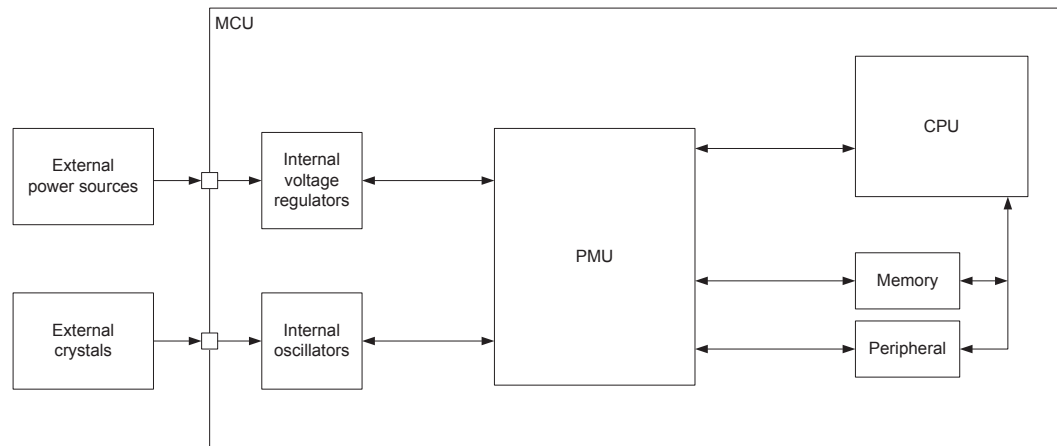


Figure 8: Power management unit

The PMU automatically detects which power and clock resources are required by the different components in the system at any given time. It will then start/stop and choose operation modes in supply regulators and clock sources, without user interaction, to achieve the lowest power consumption possible.

## 5.2 Current consumption

As the system is being constantly tuned by the [Power management unit \(PMU\)](#) on page 55, estimating the current consumption of an application can be challenging if the designer is not able to perform measurements directly on the hardware. To facilitate the estimation process, a set of current consumption scenarios are provided to show the typical current drawn from the VDD supply.

Each scenario specifies a set of operations and conditions applying to the given scenario. [Current consumption scenarios, common conditions](#) on page 56 shows a set of common conditions used in all scenarios, unless otherwise is stated in the description of a given scenario. All scenarios are listed in [Electrical specification](#) on page 56

Condition	Value
VDD	3 V
Temperature	25°C
CPU	WFI (wait for interrupt)/WFE (wait for event) sleep
Peripherals	All idle
Clock	Not running
Regulator	LDO
RAM	Full 24 kB retention
Compiler <sup>3</sup>	GCC v4.9.3 20150529 (arm-none-eabi-gcc). Compiler flags: -O0 -falign-functions=16 -fno-strict-aliasing -mcpu=cortex-m4 -mfloat-abi=soft -msoft-float -mthumb.
32 MHz crystal <sup>4</sup>	SMD 2520, 32 MHz, 10 pF +/- 10 ppm

Table 13: Current consumption scenarios, common conditions

## 5.2.1 Electrical specification

### 5.2.1.1 CPU running

Symbol	Description	Min.	Typ.	Max.	Units
I <sub>CPU0</sub>	CPU running CoreMark @64 MHz from flash, Clock = HFXO, Regulator = DCDC		2.2		mA
I <sub>CPU1</sub>	CPU running CoreMark @64 MHz from flash, Clock = HFXO		4.2		mA
I <sub>CPU2</sub>	CPU running CoreMark @64 MHz from RAM, Clock = HFXO, Regulator = DCDC		2.1		mA
I <sub>CPU3</sub>	CPU running CoreMark @64 MHz from RAM, Clock = HFXO		4		mA
I <sub>CPU4</sub>	CPU running CoreMark @64 MHz from flash, Clock = HFINT, Regulator = DCDC		2		mA

<sup>3</sup> Applying only when CPU is running

<sup>4</sup> Applying only when HFXO is running



### 5.2.1.2 Radio transmitting/receiving

Symbol	Description	Min.	Typ.	Max.	Units
$I_{\text{RADIO\_TX0}}$	Radio transmitting @ 4 dBm output power, 1 Mbps Bluetooth low energy mode, Clock = HFXO, Regulator = DCDC		8		mA
$I_{\text{RADIO\_TX1}}$	Radio transmitting @ 0 dBm output power, 1 Mbps Bluetooth low energy mode, Clock = HFXO, Regulator = DCDC		5.8		mA
$I_{\text{RADIO\_TX2}}$	Radio transmitting @ -40 dBm output power, 1 Mbps Bluetooth low energy mode, Clock = HFXO, Regulator = DCDC		3.4		mA
$I_{\text{RADIO\_RX0}}$	Radio receiving @ 1 Mbps Bluetooth low energy mode, Clock = HFXO, Regulator = DCDC		6.1		mA
$I_{\text{RADIO\_TX3}}$	Radio transmitting @ 0 dBm output power, 1 Mbps Bluetooth low energy mode, Clock = HFXO		10.5		mA
$I_{\text{RADIO\_TX4}}$	Radio transmitting @ -40 dBm output power, 1 Mbps Bluetooth low energy mode, Clock = HFXO		5.1		mA
$I_{\text{RADIO\_RX1}}$	Radio receiving @ 1 Mbps Bluetooth low energy mode, Clock = HFXO		10.8		mA

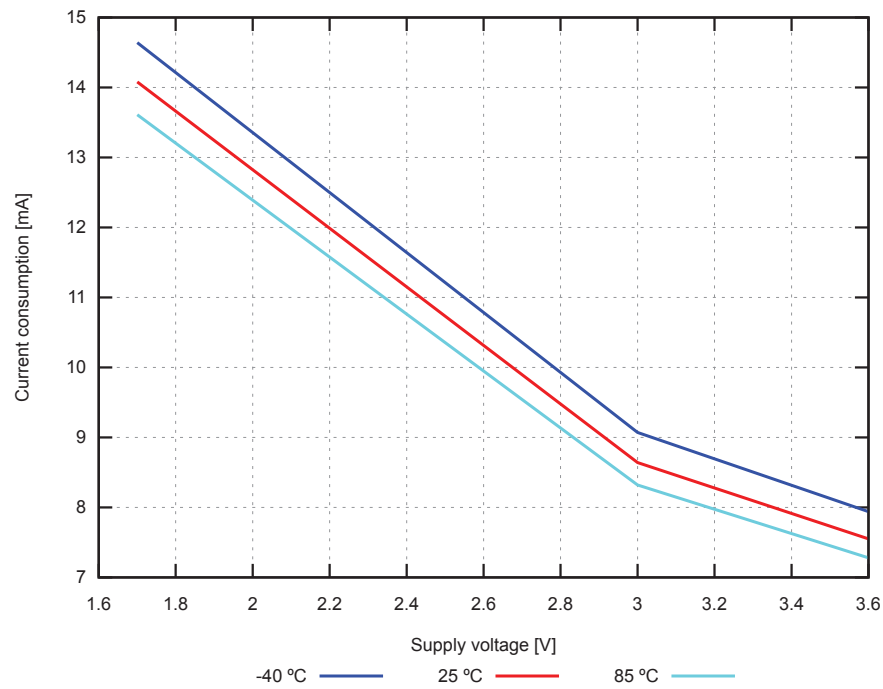


Figure 9: Radio transmitting @ 4 dBm output power, 1 Mbps Bluetooth low energy mode, Clock = HFXO, Regulator = DCDC (typical values)

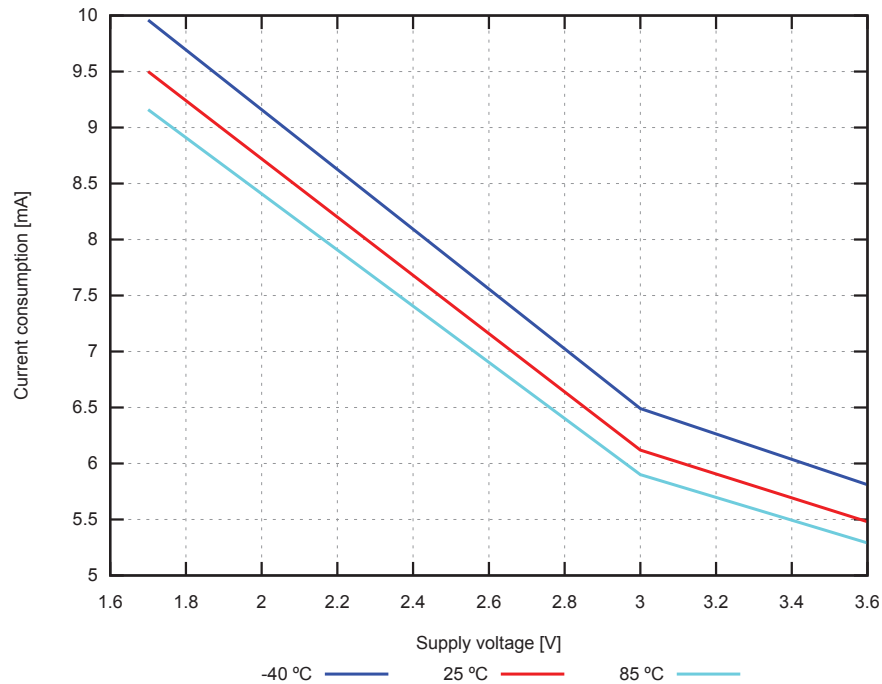


Figure 10: Radio transmitting @ 0 dBm output power, 1 Mbps Bluetooth low energy mode, Clock = HFXO, Regulator = DCDC (typical values)

### 5.2.1.3 Sleep

Symbol	Description	Min.	Typ.	Max.	Units
$I_{ON\_RAMOFF\_EVENT}$	System ON, No RAM retention, Wake on any event		0.6		$\mu A$
$I_{ON\_RAMON\_EVENT}$	System ON, Full 24 kB RAM retention, Wake on any event		0.8		$\mu A$
$I_{ON\_RAMON\_POF}$	System ON, Full 24 kB RAM retention, Wake on any event, Power fail comparator enabled		0.8		$\mu A$
$I_{ON\_RAMON\_GPIOTE}$	System ON, Full 24 kB RAM retention, Wake on GPIOTE input (Event mode)		3.3		$\mu A$
$I_{ON\_RAMON\_GPIOTEPORT}$	System ON, Full 24 kB RAM retention, Wake on GPIOTE PORT event		0.8		$\mu A$
$I_{ON\_RAMON\_RTC}$	System ON, Full 24 kB RAM retention, Wake on RTC (running from LFRC clock)		1.5		$\mu A$
$I_{OFF\_RAMOFF\_RESET}$	System OFF, No RAM retention, Wake on reset		0.3		$\mu A$
$I_{OFF\_RAMON\_RESET}$	System OFF, Full 24 kB RAM retention, Wake on reset		0.5		$\mu A$

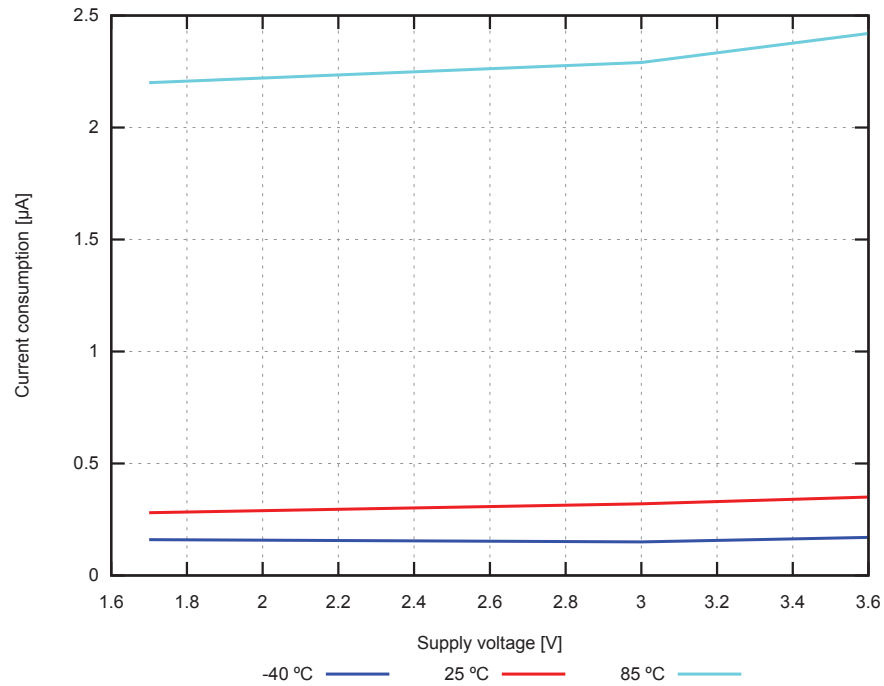


Figure 11: System OFF, No RAM retention, Wake on reset (typical values)

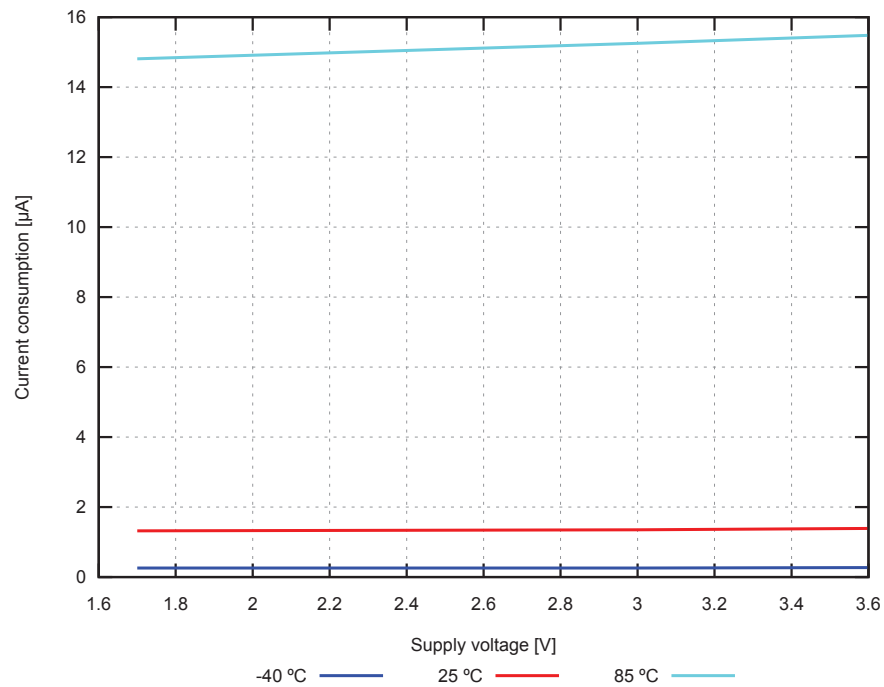


Figure 12: System ON, Full 24 kB RAM retention, Wake on any event (typical values)

### 5.2.1.4 Compounded

Symbol	Description	Min.	Typ.	Max.	Units
I <sub>S0</sub>	CPU running CoreMark from flash, Radio transmitting @ 0 dBm output power, 1 Mbps Bluetooth low energy mode, Clock = HFXO, Regulator = DCDC		7.4		mA
I <sub>S1</sub>	CPU running CoreMark from flash, Radio receiving @ 1 Mbps Bluetooth low energy mode, Clock = HFXO, Regulator = DCDC		7.6		mA
I <sub>S2</sub>	CPU running CoreMark from flash, Radio transmitting @ 0 dBm output power, 1 Mbps Bluetooth low energy mode, Clock = HFXO		13.8		mA
I <sub>S3</sub>	CPU running CoreMark from flash, Radio receiving @ 1 Mbps Bluetooth low energy mode, Clock = HFXO		14.2		mA

### 5.2.1.5 TIMER running

Symbol	Description	Min.	Typ.	Max.	Units
I <sub>TIMER0</sub>	One TIMER instance running @ 1 MHz, Clock = HFINT		432		μA
I <sub>TIMER1</sub>	Two TIMER instances running @ 1 MHz, Clock = HFINT		432		μA
I <sub>TIMER2</sub>	One TIMER instance running @ 1 MHz, Clock = HFXO		730		μA
I <sub>TIMER3</sub>	One TIMER instance running @ 16 MHz, Clock = HFINT		495		μA
I <sub>TIMER4</sub>	One TIMER instance running @ 16 MHz, Clock = HFXO		792		μA

### 5.2.1.6 RNG active

Symbol	Description	Min.	Typ.	Max.	Units
I <sub>RNG0</sub>	RNG running		539		μA

### 5.2.1.7 TEMP active

Symbol	Description	Min.	Typ.	Max.	Units
I <sub>TEMP0</sub>	TEMP started		998		μA

### 5.2.1.8 SAADC active

Symbol	Description	Min.	Typ.	Max.	Units
I <sub>SAADC,RUN</sub>	SAADC sampling @ 16 ksp/s, Acquisition time = 20 μs, Clock = HFXO, Regulator = DCDC		1.1		mA

### 5.2.1.9 COMP active

Symbol	Description	Min.	Typ.	Max.	Units
I <sub>COMP,LP</sub>	COMP enabled, low power mode		17.2		μA
I <sub>COMP,NORM</sub>	COMP enabled, normal mode		21		μA
I <sub>COMP,HS</sub>	COMP enabled, high-speed mode		28.7		μA

### 5.2.1.10 WDT active

Symbol	Description	Min.	Typ.	Max.	Units
$I_{WDT,STARTED}$	WDT started		1.3		$\mu A$

## 5.3 POWER — Power supply

This device has the following power supply features:

- On-chip LDO and DC/DC regulators
- Global System ON/OFF modes with individual RAM section power control
- Analog or digital pin wakeup from System OFF
- Supervisor HW to manage power on reset, brownout, and power fail
- Auto-controlled refresh modes for LDO and DC/DC regulators to maximize efficiency
- Automatic switching between LDO and DC/DC regulator based on load to maximize efficiency

**Note:** Two additional external passive components are required to use the DC/DC regulator.

### 5.3.1 Regulators

The following internal power regulator alternatives are supported:

- Internal LDO regulator
- Internal DC/DC regulator

The LDO is the default regulator.

The DC/DC regulator can be used as an alternative to the LDO regulator and is enabled through the [DCDCEN](#) on page 70 register. Using the DC/DC regulator will reduce current consumption compared to when using the LDO regulator, but the DC/DC regulator requires an external LC filter to be connected, as shown in [DC/DC regulator setup](#) on page 62.

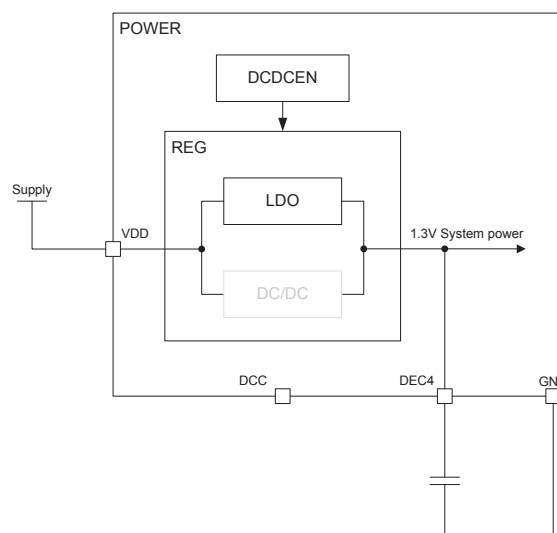


Figure 13: LDO regulator setup

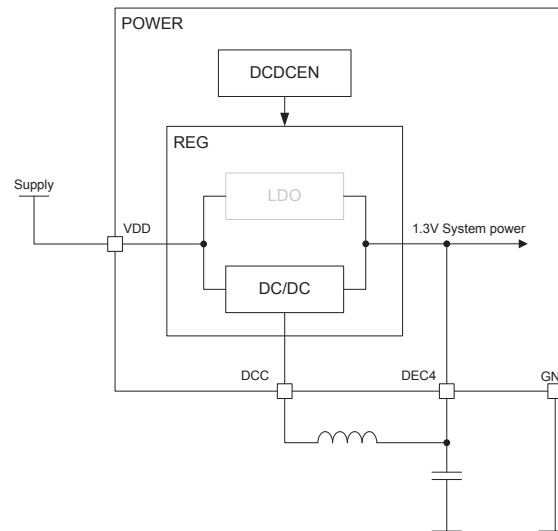


Figure 14: DC/DC regulator setup

### 5.3.2 System OFF mode

System OFF is the deepest power saving mode the system can enter. In this mode, the system's core functionality is powered down and all ongoing tasks are terminated.

The device can be put into System OFF mode using the POWER register interface. When in System OFF mode, the device can be woken up through one of the following:

1. The DETECT signal, optionally generated by the GPIO peripheral
2. A reset

When the system wakes up from System OFF mode, it gets reset. For more details, see [Reset behavior](#) on page 66.

One or more RAM sections can be retained in System OFF mode depending on the settings in the RAM[n].POWER registers.

RAM[n].POWER are retained registers, see [Reset behavior](#). Note that these registers are usually overwritten by the startup code provided with the nRF application examples.

Before entering System OFF mode, the user must make sure that all on-going EasyDMA transactions have been completed. This is usually accomplished by making sure that the EasyDMA enabled peripheral is not active when entering System OFF.

#### 5.3.2.1 Emulated System OFF mode

If the device is in debug interface mode, System OFF will be emulated to secure that all required resources needed for debugging are available during System OFF.

See [Debug](#) on page 50 for more information. Required resources needed for debugging include the following key components: [Debug](#) on page 50, [CLOCK — Clock control](#) on page 83, [POWER — Power supply](#) on page 61, [NVMC — Non-volatile memory controller](#) on page 18, CPU, Flash, and RAM. Since the CPU is kept on in an emulated System OFF mode, it is recommended to add an infinite loop directly after entering System OFF, to prevent the CPU from executing code that normally should not be executed.

### 5.3.3 System ON mode

System ON is the default state after power-on reset. In System ON, all functional blocks such as the CPU or peripherals, can be in IDLE or RUN mode, depending on the configuration set by the software and the state of the application executing.

Register [RESETRAS](#) on page 68 provides information about the source that caused the wakeup or reset.

The system can switch on and off the appropriate internal power sources, depending on how much power is needed at any given time. The power requirement of a peripheral is directly related to its activity level, and the activity level of a peripheral is usually raised and lowered when specific tasks are triggered or events are generated.

#### 5.3.3.1 Sub power modes

In System ON mode, when both the CPU and all the peripherals are in IDLE mode, the system can reside in one of the two sub power modes.

The sub power modes are:

- Constant latency
- Low power

In constant latency mode the CPU wakeup latency and the PPI task response will be constant and kept at a minimum. This is secured by forcing a set of base resources on while in sleep. The advantage of having a constant and predictable latency will be at the cost of having increased power consumption. The constant latency mode is selected by triggering the CONSTLAT task.

In low power mode the automatic power management system, described in [System ON mode](#) on page 63, ensures the most efficient supply option is chosen to save the most power. The advantage of having the lowest power possible will be at the cost of having varying CPU wakeup latency and PPI task response. The low power mode is selected by triggering the LOWPWR task.

When the system enters System ON mode, it will, by default, reside in the low power sub-power mode.

### 5.3.4 Power supply supervisor

The power supply supervisor initializes the system at power-on and provides an early warning of impending power failure.

In addition, the power supply supervisor puts the system in a reset state if the supply voltage is too low for safe operation (brownout). The power supply supervisor is illustrated in [Power supply supervisor](#) on page 64.

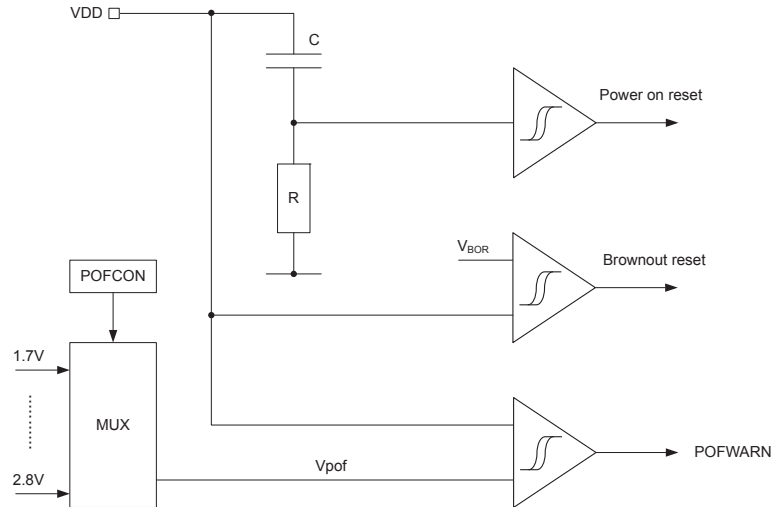


Figure 15: Power supply supervisor

### 5.3.4.1 Power-fail comparator

The power-fail comparator (POF) can provide the CPU with an early warning of impending power failure. It will not reset the system, but give the CPU time to prepare for an orderly power-down.

The comparator features a hysteresis of  $V_{\text{HYST}}$ , as illustrated in [Power-fail comparator \(BOR = Brownout reset\)](#) on page 64. The threshold  $V_{\text{POF}}$  is set in register [POFCON](#) on page 69. If the POF is enabled and the supply voltage falls below  $V_{\text{POF}}$ , the POWARN event will be generated. This event will also be generated if the supply voltage is already below  $V_{\text{POF}}$  at the time the POF is enabled, or if  $V_{\text{POF}}$  is re-configured to a level above the supply voltage.

If power-fail warning is enabled and the supply voltage is below  $V_{\text{POF}}$  the power-fail comparator will prevent the NVMC from performing write operations to the NVM. See [NVMC — Non-volatile memory controller](#) on page 18 for more information about the NVMC.

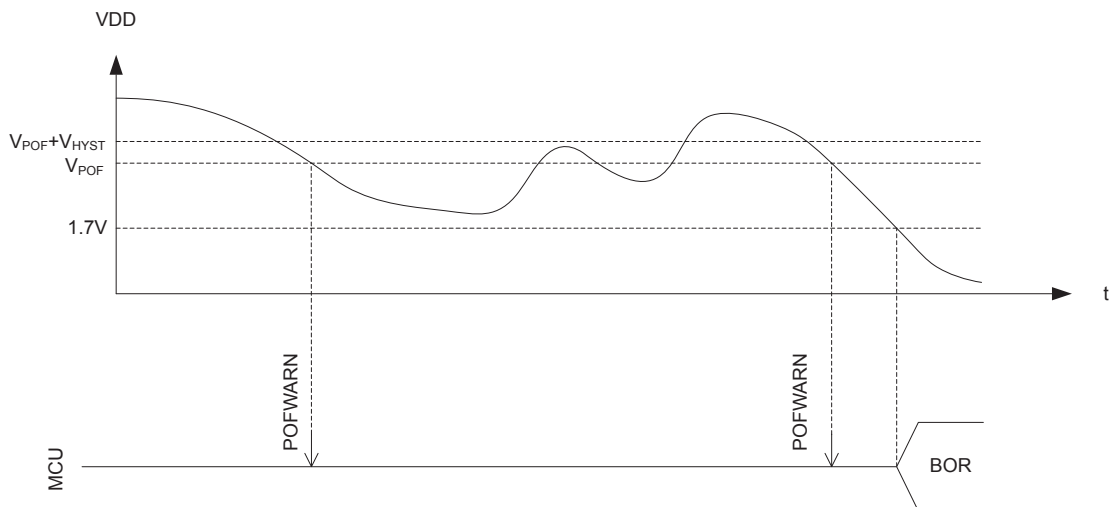


Figure 16: Power-fail comparator (BOR = Brownout reset)

To save power, the power-fail comparator is not active in System OFF or in System ON when HFCLK is not running.



### 5.3.5 RAM sections

RAM section power control is used for retention in System OFF mode and for powering down unused sections in System ON mode.

Each RAM section can power up and down independently in both System ON and System OFF mode. See chapter [Memory](#) on page 15 for more information on RAM sections.

### 5.3.6 Reset

There are multiple sources that may trigger a reset.

After a reset has occurred, register [RESETRAS](#) can be read to determine which source generated the reset.

#### 5.3.6.1 Power-on reset

The power-on reset generator initializes the system at power-on.

The system is held in reset state until the supply has reached the minimum operating voltage and the internal voltage regulators have started.

A step increase in supply voltage of 300 mV or more, with rise time of 300 ms or less, within the valid supply range, may result in a system reset.

#### 5.3.6.2 Pin reset

A pin reset is generated when the physical reset pin on the device is asserted.

Pin reset is configured via the [PSELRESET\[0\]](#) and [PSELRESET\[1\]](#) registers.

**Note:** Pin reset is not available on all pins.

#### 5.3.6.3 Wakeup from System OFF mode reset

The device is reset when it wakes up from System OFF mode.

The DAP is not reset following a wake up from System OFF mode if the device is in debug interface mode. Refer to chapter [Debug](#) on page 50 for more information.

#### 5.3.6.4 Soft reset

A soft reset is generated when the SYSRESETREQ bit of the Application Interrupt and Reset Control Register (AIRCR register) in the ARM® core is set.

Refer to [ARM documentation](#) for more details.

A soft reset can also be generated via the [RESET](#) on page 52 register in the CTRL-AP.

#### 5.3.6.5 Watchdog reset

A Watchdog reset is generated when the watchdog times out.

Refer to chapter [WDT — Watchdog timer](#) on page 454 for more information.

#### 5.3.6.6 Brown-out reset

The brown-out reset generator puts the system in reset state if the supply voltage drops below the brownout reset (BOR) threshold.

Refer to section [Power fail comparator](#) on page 83 for more information.

### 5.3.7 Retained registers

A retained register is a register that will retain its value in System OFF mode and through a reset, depending on reset source. See individual peripheral chapters for information of which registers are retained for the various peripherals.

### 5.3.8 Reset behavior

Reset source	Reset target							
	CPU	Peripherals	GPIO	Debug <sup>a</sup>	SWJ-DP	RAM	WDT	Retained registers
CPU lockup <sup>5</sup>	x	x	x					
Soft reset	x	x	x					
Wakeup from System OFF mode reset	x	x		x <sup>6</sup>		x <sup>7</sup>		
Watchdog reset <sup>8</sup>	x	x	x	x		x	x	x
Pin reset	x	x	x	x		x	x	x
Brownout reset	x	x	x	x	x	x	x	x
Power on reset	x	x	x	x	x	x	x	x

**Note:** The RAM is never reset, but depending on reset source, RAM content may be corrupted.

### 5.3.9 Registers

Base address	Peripheral	Instance	Description	Configuration
0x40000000	POWER	POWER	Power control	For 24 kB RAM variant, only RAM[0].x to RAM[2].x registers are in use.

Table 14: Instances

Register	Offset	Description
TASKS_CONSTLAT	0x078	Enable constant latency mode
TASKS_LOWPWR	0x07C	Enable low power mode (variable latency)
EVENTS_POFWARN	0x108	Power failure warning
EVENTS_SLEEPEXIT	0x114	CPU entered WFI/WFE sleep
EVENTS_SLEEPEXIT	0x118	CPU exited WFI/WFE sleep
INTENSET	0x304	Enable interrupt
INTENCLR	0x308	Disable interrupt
RESETRAS	0x400	Reset reason
SYSTEMOFF	0x500	System OFF register
POFCON	0x510	Power failure comparator configuration
GPREGRET	0x51C	General purpose retention register

<sup>a</sup> All debug components excluding SWJ-DP. See [Debug](#) on page 50 chapter for more information about the different debug components in the system.

<sup>5</sup> Reset from CPU lockup is disabled if the device is in debug interface mode. CPU lockup is not possible in System OFF.

<sup>6</sup> The Debug components will not be reset if the device is in debug interface mode.

<sup>7</sup> RAM is not reset on wakeup from OFF mode, but depending on settings in the RAM register parts, or the whole RAM, may not be retained after the device has entered System OFF mode.

<sup>8</sup> Watchdog reset is not available in System OFF.

Register	Offset	Description
GPREGRET2	0x520	General purpose retention register
DCDCEN	0x578	DC/DC enable register
RAM[0].POWER	0x900	RAM0 power control register
RAM[0].POWERSET	0x904	RAM0 power control set register
RAM[0].POWERCLR	0x908	RAM0 power control clear register
RAM[1].POWER	0x910	RAM1 power control register
RAM[1].POWERSET	0x914	RAM1 power control set register
RAM[1].POWERCLR	0x918	RAM1 power control clear register
RAM[2].POWER	0x920	RAM2 power control register
RAM[2].POWERSET	0x924	RAM2 power control set register
RAM[2].POWERCLR	0x928	RAM2 power control clear register
RAM[3].POWER	0x930	RAM3 power control register
RAM[3].POWERSET	0x934	RAM3 power control set register
RAM[3].POWERCLR	0x938	RAM3 power control clear register
RAM[4].POWER	0x940	RAM4 power control register
RAM[4].POWERSET	0x944	RAM4 power control set register
RAM[4].POWERCLR	0x948	RAM4 power control clear register
RAM[5].POWER	0x950	RAM5 power control register
RAM[5].POWERSET	0x954	RAM5 power control set register
RAM[5].POWERCLR	0x958	RAM5 power control clear register
RAM[6].POWER	0x960	RAM6 power control register
RAM[6].POWERSET	0x964	RAM6 power control set register
RAM[6].POWERCLR	0x968	RAM6 power control clear register
RAM[7].POWER	0x970	RAM7 power control register
RAM[7].POWERSET	0x974	RAM7 power control set register
RAM[7].POWERCLR	0x978	RAM7 power control clear register

Table 15: Register Overview

### 5.3.9.1 INTENSET

Address offset: 0x304

Enable interrupt

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0																																			
Id																																				C	B	A	
Reset 0x00000000				0 0																																			
Id	RW	Field	Value Id	Value	Description																																		
A	RW	POFWARN			Write '1' to Enable interrupt for POFWARN event																																		
					See <a href="#">EVENTS_POFWARN</a>																																		
		Set		1	Enable																																		
		Disabled		0	Read: Disabled																																		
		Enabled		1	Read: Enabled																																		
B	RW	SLEEPENTER			Write '1' to Enable interrupt for SLEEPENTER event																																		
					See <a href="#">EVENTS_SLEEPENTER</a>																																		
		Set		1	Enable																																		
		Disabled		0	Read: Disabled																																		
		Enabled		1	Read: Enabled																																		
C	RW	SLEEPEXIT			Write '1' to Enable interrupt for SLEEPEXIT event																																		
					See <a href="#">EVENTS_SLEEPEXIT</a>																																		
		Set		1	Enable																																		
		Disabled		0	Read: Disabled																																		

Bit number					31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0			
Id																													C		B					A			
Reset 0x00000000					0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0		
Id	RW	Field	Value	Id	Value		Description																																
Enabled				1	Read: Enabled																																		

### 5.3.9.2 INTENCLR

Address offset: 0x308

Disable interrupt

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0																														
Id																																C B		A
Reset 0x00000000				0 0																														
Id	RW	Field	Value	Id	Value	Description																												
A	RW	POFWARN				Write '1' to Disable interrupt for POFWARN event																												
						See <a href="#">EVENTS_POFWARN</a>																												
			Clear		1	Disable																												
			Disabled		0	Read: Disabled																												
			Enabled		1	Read: Enabled																												
B	RW	SLEEPENTER				Write '1' to Disable interrupt for SLEEPENTER event																												
						See <a href="#">EVENTS_SLEEPENTER</a>																												
			Clear		1	Disable																												
			Disabled		0	Read: Disabled																												
			Enabled		1	Read: Enabled																												
C	RW	SLEEPEXIT				Write '1' to Disable interrupt for SLEEPEXIT event																												
						See <a href="#">EVENTS_SLEEPEXIT</a>																												
			Clear		1	Disable																												
			Disabled		0	Read: Disabled																												
			Enabled		1	Read: Enabled																												

### 5.3.9.3 RESETREAS

Address offset: 0x400

Reset reason

Unless cleared, the RESETREAS register will be cumulative. A field is cleared by writing '1' to it. If none of the reset sources are flagged, this indicates that the chip was reset from the on-chip reset generator, which will indicate a power-on-reset or a brownout reset.

Bit number				31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0			
Id																F	E													D	C	B	A					
Reset 0x00000000				0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0			
Id	RW	Field	Value	Id	Value	Description																																
A	RW	RESETPIN				Reset from pin-reset detected																																
			NotDetected		0	Not detected																																
			Detected		1	Detected																																
B	RW	DOG				Reset from watchdog detected																																
			NotDetected		0	Not detected																																
			Detected		1	Detected																																
C	RW	SREQ				Reset from soft reset detected																																
			NotDetected		0	Not detected																																

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0																																															
Id				F																E																D				C				B				A			
Reset 0x00000000				0 0																																															

### 5.3.9.4 SYSTEMOFF

Address offset: 0x500

System OFF register

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0																															
Id				A																															
Reset 0x00000000				0 0																															
Id	RW	Field	Value	Id	Value	Description																													
A	W	SYSTEMOFF				Enable System OFF mode																													
			Enter	1		Enable System OFF mode																													

### 5.3.9.5 POFCON

Address offset: 0x510

Power failure comparator configuration

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0																															
Id				B B B B A																															
Reset 0x00000000				0 0																															
Id	RW	Field	Value Id	Value	Description																														
A	RW	POF			Enable or disable power failure comparator																														
			Disabled	0	Disable																														
			Enabled	1	Enable																														
B	RW	THRESHOLD			Power failure comparator threshold setting																														
			V17	4	Set threshold to 1.7 V																														
			V18	5	Set threshold to 1.8 V																														
			V19	6	Set threshold to 1.9 V																														
			V20	7	Set threshold to 2.0 V																														
			V21	8	Set threshold to 2.1 V																														
			V22	9	Set threshold to 2.2 V																														
			V23	10	Set threshold to 2.3 V																														
			V24	11	Set threshold to 2.4 V																														
			V25	12	Set threshold to 2.5 V																														
			V26	13	Set threshold to 2.6 V																														
			V27	14	Set threshold to 2.7 V																														

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0																															
Id				B B B B A																															
Reset 0x00000000				0 0																															
Id		RW		Field		Value Id		Value		Description																									
						V28		15		Set threshold to 2.8 V																									

### 5.3.9.6 GPREGRET

Address offset: 0x51C

General purpose retention register

Bit number					31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0																					
Id																													A	A	A	A	A	A	A	A	A																				
Reset 0x00000000					0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0																				
Id	RW	Field	Value Id		Value		Description																																																		
A	RW	GPREGRET					General purpose retention register																																																		
																																This register is a retained register																									

### 5.3.9.7 GPREGRET2

Address offset: 0x520

General purpose retention register

Bit number					31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0																					
Id																													A	A	A	A	A	A	A	A	A																				
Reset 0x00000000					0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0																				
Id	RW	Field	Value Id		Value		Description																																																		
A	RW	GPREGRET					General purpose retention register																																																		
																																This register is a retained register																									

### 5.3.9.8 DCDCEEN

Address offset: 0x578

DC/DC enable register

Bit number	31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
Id																																A
Reset	0x00000000																															0
Id	RW	Field	Value Id		Value		Description																									
A	RW	DCDCEN					Enable or disable DC/DC converter																									
			Disabled		0		Disable																									
			Enabled		1		Enable																									

### 5.3.9.9 RAM[0].POWER

Address offset: 0x900

RAM0 power control register

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0																															
Id				D C B A																															
Reset 0x0000FFFF				0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1																															
Id	RW	Field	Value	Id	Value	Description																													
A	RW	S0POWER				Keep RAM section S0 ON or OFF in System ON mode.																													
			Off	0	Off	RAM sections are always retained when ON, but can also be retained when OFF dependent on the settings in S0RETENTION. All RAM sections will be OFF in System OFF mode.																													
			On	1	On																														
B	RW	S1POWER				Keep RAM section S1 ON or OFF in System ON mode.																													
			Off	0	Off	RAM sections are always retained when ON, but can also be retained when OFF dependent on the settings in S1RETENTION. All RAM sections will be OFF in System OFF mode.																													
			On	1	On																														
C	RW	S0RETENTION				Keep retention on RAM section S0 when RAM section is in OFF																													
			Off	0	Off																														
			On	1	On																														
D	RW	S1RETENTION				Keep retention on RAM section S1 when RAM section is in OFF																													
			Off	0	Off																														
			On	1	On																														

### 5.3.9.10 RAM[0].POWERSET

Address offset: 0x904

RAM0 power control set register

When read, this register will return the value of the POWER register.

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0																															
Id				D C																B A															
Reset 0x0000FFFF				0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 1 1 1 1 1 1 1 1 1 1 1 1 1 1																															
Id	RW	Field	Value	Id	Value	Description																													
A	W	S0POWER	On	1	On	Keep RAM section S0 of RAM0 on or off in System ON mode																													
B	W	S1POWER	On	1	On	Keep RAM section S1 of RAM0 on or off in System ON mode																													
C	W	S0RETENTION	On	1	On	Keep retention on RAM section S0 when RAM section is switched off																													
D	W	S1RETENTION	On	1	On	Keep retention on RAM section S1 when RAM section is switched off																													

### 5.3.9.11 RAM[0].POWERCLR

Address offset: 0x908

RAM0 power control clear register

When read, this register will return the value of the POWER register.

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0																															
Id				D C																B A															
Reset 0x0000FFFF				0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1																															
Id	RW	Field	Value Id	Value	Description																														
A	W	S0POWER	Off	1	Keep RAM section S0 of RAM0 on or off in System ON mode																														
					Off																														
B	W	S1POWER	Off	1	Keep RAM section S1 of RAM0 on or off in System ON mode																														
					Off																														
C	W	S0RETENTION	Off	1	Keep retention on RAM section S0 when RAM section is switched off																														
					Off																														
D	W	S1RETENTION	Off	1	Keep retention on RAM section S1 when RAM section is switched off																														
					Off																														

### 5.3.9.12 RAM[1].POWER

Address offset: 0x910

RAM1 power control register

Bit number			31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0																															
Id			D C B A																															
Reset 0x0000FFFF			0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1																															
Id	RW	Field	Value Id	Value	Description																													
A	RW	S0POWER			Keep RAM section S0 ON or OFF in System ON mode.																													
					RAM sections are always retained when ON, but can also be retained when OFF dependent on the settings in S0RETENTION. All RAM sections will be OFF in System OFF mode.																													
			Off	0	Off																													
			On	1	On																													
B	RW	S1POWER			Keep RAM section S1 ON or OFF in System ON mode.																													
					RAM sections are always retained when ON, but can also be retained when OFF dependent on the settings in S1RETENTION. All RAM sections will be OFF in System OFF mode.																													
			Off	0	Off																													
			On	1	On																													
C	RW	S0RETENTION			Keep retention on RAM section S0 when RAM section is in OFF																													
			Off	0	Off																													
			On	1	On																													
D	RW	S1RETENTION			Keep retention on RAM section S1 when RAM section is in OFF																													
			Off	0	Off																													
			On	1	On																													

### 5.3.9.13 RAM[1].POWERSET

Address offset: 0x914



## RAM1 power control set register

When read, this register will return the value of the POWER register.

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0																															
Id				D C																B A															
Reset 0x0000FFFF				0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1																															
Id	RW	Field	Value Id	Value	Description																														
A	W	S0POWER	On	1	Keep RAM section S0 of RAM1 on or off in System ON mode On																														
B	W	S1POWER	On	1	Keep RAM section S1 of RAM1 on or off in System ON mode On																														
C	W	S0RETENTION	On	1	Keep retention on RAM section S0 when RAM section is switched off On																														
D	W	S1RETENTION	On	1	Keep retention on RAM section S1 when RAM section is switched off On																														

## 5.3.9.14 RAM[1].POWERCLR

Address offset: 0x918

## RAM1 power control clear register

When read, this register will return the value of the POWER register.

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0																															
Id				D C																B A															
Reset 0x0000FFFF				0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1																															
Id	RW	Field	Value Id	Value	Description																														
A	W	S0POWER	Off	1	Keep RAM section S0 of RAM1 on or off in System ON mode Off																														
B	W	S1POWER	Off	1	Keep RAM section S1 of RAM1 on or off in System ON mode Off																														
C	W	S0RETENTION	Off	1	Keep retention on RAM section S0 when RAM section is switched off Off																														
D	W	S1RETENTION	Off	1	Keep retention on RAM section S1 when RAM section is switched off Off																														

## 5.3.9.15 RAM[2].POWER

Address offset: 0x920

## RAM2 power control register

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0																															
Id				D C B A																															
Reset 0x0000FFFF				0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1																															
Id	RW	Field	Value Id	Value	Description																														
A	RW	S0POWER			Keep RAM section S0 ON or OFF in System ON mode.																														
					RAM sections are always retained when ON, but can also be retained when OFF dependent on the settings in S0RETENTION. All RAM sections will be OFF in System OFF mode.																														
			Off	0	Off																														
			On	1	On																														
B	RW	S1POWER			Keep RAM section S1 ON or OFF in System ON mode.																														
					RAM sections are always retained when ON, but can also be retained when OFF dependent on the settings in S1RETENTION. All RAM sections will be OFF in System OFF mode.																														
			Off	0	Off																														
			On	1	On																														
C	RW	S0RETENTION			Keep retention on RAM section S0 when RAM section is in OFF																														
			Off	0	Off																														
			On	1	On																														
D	RW	S1RETENTION			Keep retention on RAM section S1 when RAM section is in OFF																														
			Off	0	Off																														
			On	1	On																														

### 5.3.9.16 RAM[2].POWERSET

Address offset: 0x924

RAM2 power control set register

When read, this register will return the value of the POWER register.

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0																															
Id				D C																B A															
Reset 0x0000FFFF				0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 1 1 1 1 1 1 1 1 1 1 1 1 1 1																															
Id	RW	Field	Value Id	Value	Description																														
A	W	S0POWER	On	1	Keep RAM section S0 of RAM2 on or off in System ON mode On																														
B	W	S1POWER	On	1	Keep RAM section S1 of RAM2 on or off in System ON mode On																														
C	W	S0RETENTION	On	1	Keep retention on RAM section S0 when RAM section is switched off On																														
D	W	S1RETENTION	On	1	Keep retention on RAM section S1 when RAM section is switched off On																														

### 5.3.9.17 RAM[2].POWERCLR

Address offset: 0x928

RAM2 power control clear register

When read, this register will return the value of the POWER register.

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0																															
Id				D C																B A															
Reset 0x0000FFFF				0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 1 1 1 1 1 1 1 1 1 1 1 1 1 1																															
Id	RW	Field	Value Id	Value	Description																														
A	W	S0POWER	Off	1	Keep RAM section S0 of RAM2 on or off in System ON mode																														
					Off																														
B	W	S1POWER	Off	1	Keep RAM section S1 of RAM2 on or off in System ON mode																														
					Off																														
C	W	S0RETENTION	Off	1	Keep retention on RAM section S0 when RAM section is switched off																														
					Off																														
D	W	S1RETENTION	Off	1	Keep retention on RAM section S1 when RAM section is switched off																														
					Off																														

### 5.3.9.18 RAM[3].POWER

Address offset: 0x930

RAM3 power control register

Bit number			31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0																															
Id			D C B A																															
Reset 0x0000FFFF			0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 1 1 1 1 1 1 1 1 1 1 1 1 1 1																															
Id	RW	Field	Value Id	Value	Description																													
A	RW	S0POWER			Keep RAM section S0 ON or OFF in System ON mode.																													
					RAM sections are always retained when ON, but can also be retained when OFF dependent on the settings in S0RETENTION. All RAM sections will be OFF in System OFF mode.																													
			Off	0	Off																													
			On	1	On																													
B	RW	S1POWER			Keep RAM section S1 ON or OFF in System ON mode.																													
					RAM sections are always retained when ON, but can also be retained when OFF dependent on the settings in S1RETENTION. All RAM sections will be OFF in System OFF mode.																													
			Off	0	Off																													
			On	1	On																													
C	RW	S0RETENTION			Keep retention on RAM section S0 when RAM section is in OFF																													
			Off	0	Off																													
			On	1	On																													
D	RW	S1RETENTION			Keep retention on RAM section S1 when RAM section is in OFF																													
			Off	0	Off																													
			On	1	On																													

### 5.3.9.19 RAM[3].POWERSET

Address offset: 0x934

## RAM3 power control set register

When read, this register will return the value of the POWER register.

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0																															
Id				D C																B A															
Reset 0x0000FFFF				0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 1 1 1 1 1 1 1 1 1 1 1 1 1 1																															
Id	RW	Field	Value Id	Value	Description																														
A	W	S0POWER	On	1	Keep RAM section S0 of RAM3 on or off in System ON mode On																														
B	W	S1POWER	On	1	Keep RAM section S1 of RAM3 on or off in System ON mode On																														
C	W	S0RETENTION	On	1	Keep retention on RAM section S0 when RAM section is switched off On																														
D	W	S1RETENTION	On	1	Keep retention on RAM section S1 when RAM section is switched off On																														

## 5.3.9.20 RAM[3].POWERCLR

Address offset: 0x938

## RAM3 power control clear register

When read, this register will return the value of the POWER register.

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0																															
Id				D C																B A															
Reset 0x0000FFFF				0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 1 1 1 1 1 1 1 1 1 1 1 1 1 1																															
Id	RW	Field	Value Id	Value	Description																														
A	W	S0POWER	Off	1	Keep RAM section S0 of RAM3 on or off in System ON mode Off																														
B	W	S1POWER	Off	1	Keep RAM section S1 of RAM3 on or off in System ON mode Off																														
C	W	S0RETENTION	Off	1	Keep retention on RAM section S0 when RAM section is switched off Off																														
D	W	S1RETENTION	Off	1	Keep retention on RAM section S1 when RAM section is switched off Off																														

## 5.3.9.21 RAM[4].POWER

Address offset: 0x940

## RAM4 power control register

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0																															
Id				D C B A																															
Reset 0x0000FFFF				0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1																															
Id	RW	Field	Value Id	Value	Description																														
A	RW	S0POWER			Keep RAM section S0 ON or OFF in System ON mode.																														
					RAM sections are always retained when ON, but can also be retained when OFF dependent on the settings in S0RETENTION. All RAM sections will be OFF in System OFF mode.																														
			Off	0	Off																														
			On	1	On																														
B	RW	S1POWER			Keep RAM section S1 ON or OFF in System ON mode.																														
					RAM sections are always retained when ON, but can also be retained when OFF dependent on the settings in S1RETENTION. All RAM sections will be OFF in System OFF mode.																														
			Off	0	Off																														
			On	1	On																														
C	RW	S0RETENTION			Keep retention on RAM section S0 when RAM section is in OFF																														
			Off	0	Off																														
			On	1	On																														
			D	RW	S1RETENTION			Keep retention on RAM section S1 when RAM section is in OFF																											
Off	0	Off																																	
On	1	On																																	

### 5.3.9.22 RAM[4].POWERSET

Address offset: 0x944

RAM4 power control set register

When read, this register will return the value of the POWER register.

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0																															
Id				D C																B A															
Reset 0x0000FFFF				0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 1 1 1 1 1 1 1 1 1 1 1 1 1 1																															
Id	RW	Field	Value Id	Value	Description																														
A	W	S0POWER	On	1	Keep RAM section S0 of RAM4 on or off in System ON mode																														
B	W	S1POWER	On	1	Keep RAM section S1 of RAM4 on or off in System ON mode																														
C	W	S0RETENTION	On	1	Keep retention on RAM section S0 when RAM section is switched off																														
D	W	S1RETENTION	On	1	Keep retention on RAM section S1 when RAM section is switched off																														

### 5.3.9.23 RAM[4].POWERCLR

Address offset: 0x948

RAM4 power control clear register

When read, this register will return the value of the POWER register.

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0																															
Id				D C																B A															
Reset 0x0000FFFF				0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1																															
Id	RW	Field	Value Id	Value	Description																														
A	W	S0POWER	Off	1	Keep RAM section S0 of RAM4 on or off in System ON mode																														
B	W	S1POWER	Off	1	Keep RAM section S1 of RAM4 on or off in System ON mode																														
C	W	S0RETENTION	Off	1	Keep retention on RAM section S0 when RAM section is switched off																														
D	W	S1RETENTION	Off	1	Keep retention on RAM section S1 when RAM section is switched off																														

### 5.3.9.24 RAM[5].POWER

Address offset: 0x950

RAM5 power control register

Bit number			31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0																															
Id			D C B A																															
Reset 0x0000FFFF			0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1																															
Id	RW	Field	Value Id	Value	Description																													
A	RW	S0POWER			Keep RAM section S0 ON or OFF in System ON mode.																													
					RAM sections are always retained when ON, but can also be retained when OFF dependent on the settings in S0RETENTION. All RAM sections will be OFF in System OFF mode.																													
			Off	0	Off																													
			On	1	On																													
B	RW	S1POWER			Keep RAM section S1 ON or OFF in System ON mode.																													
					RAM sections are always retained when ON, but can also be retained when OFF dependent on the settings in S1RETENTION. All RAM sections will be OFF in System OFF mode.																													
			Off	0	Off																													
			On	1	On																													
C	RW	S0RETENTION			Keep retention on RAM section S0 when RAM section is in OFF																													
			Off	0	Off																													
			On	1	On																													
D	RW	S1RETENTION			Keep retention on RAM section S1 when RAM section is in OFF																													
			Off	0	Off																													
			On	1	On																													

### 5.3.9.25 RAM[5].POWERSET

Address offset: 0x954

## RAM5 power control set register

When read, this register will return the value of the POWER register.

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0																																
Id				D C																B A																
Reset 0x0000FFFF				0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1																																
Id	RW	Field	Value Id	Value	Description																															
A	W	S0POWER	On	1	Keep RAM section S0 of RAM5 on or off in System ON mode																															
B	W	S1POWER	On	1	Keep RAM section S1 of RAM5 on or off in System ON mode																															
C	W	S0RETENTION	On	1	Keep retention on RAM section S0 when RAM section is switched off																															
D	W	S1RETENTION	On	1	Keep retention on RAM section S1 when RAM section is switched off																															

## 5.3.9.26 RAM[5].POWERCLR

Address offset: 0x958

## RAM5 power control clear register

When read, this register will return the value of the POWER register.

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0																															
Id				D C B A																															
Reset 0x0000FFFF				0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 1 1 1 1 1 1 1 1 1 1 1 1 1 1																															
Id	RW	Field	Value Id	Value	Description																														
A	W	S0POWER	Off	1	Keep RAM section S0 of RAM5 on or off in System ON mode																														
B	W	S1POWER	Off	1	Keep RAM section S1 of RAM5 on or off in System ON mode																														
C	W	S0RETENTION	Off	1	Keep retention on RAM section S0 when RAM section is switched off																														
D	W	S1RETENTION	Off	1	Keep retention on RAM section S1 when RAM section is switched off																														

## 5.3.9.27 RAM[6].POWER

Address offset: 0x960

## RAM6 power control register

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0																															
Id				D C B A																															
Reset 0x0000FFFF				0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 1 1 1 1 1 1 1 1 1 1 1 1 1 1																															
Id	RW	Field	Value	Id	Value	Description																													
A	RW	S0POWER				Keep RAM section S0 ON or OFF in System ON mode.																													
			Off	0	Off	RAM sections are always retained when ON, but can also be retained when OFF dependent on the settings in S0RETENTION. All RAM sections will be OFF in System OFF mode.																													
			On	1	On																														
B	RW	S1POWER				Keep RAM section S1 ON or OFF in System ON mode.																													
			Off	0	Off	RAM sections are always retained when ON, but can also be retained when OFF dependent on the settings in S1RETENTION. All RAM sections will be OFF in System OFF mode.																													
			On	1	On																														
C	RW	S0RETENTION				Keep retention on RAM section S0 when RAM section is in OFF																													
			Off	0	Off																														
			On	1	On																														
D	RW	S1RETENTION				Keep retention on RAM section S1 when RAM section is in OFF																													
			Off	0	Off																														
			On	1	On																														

### 5.3.9.28 RAM[6].POWERSET

Address offset: 0x964

RAM6 power control set register

When read, this register will return the value of the POWER register.

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0																															
Id				D C B A																															
Reset 0x0000FFFF				0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 1 1 1 1 1 1 1 1 1 1 1 1 1 1																															
Id	RW	Field	Value	Id	Value	Description																													
A	W	S0POWER	On		1	Keep RAM section S0 of RAM6 on or off in System ON mode																													
B	W	S1POWER	On		1	Keep RAM section S1 of RAM6 on or off in System ON mode																													
C	W	S0RETENTION	On		1	Keep retention on RAM section S0 when RAM section is switched off																													
D	W	S1RETENTION	On		1	Keep retention on RAM section S1 when RAM section is switched off																													

### 5.3.9.29 RAM[6].POWERCLR

Address offset: 0x968

RAM6 power control clear register



When read, this register will return the value of the POWER register.

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0																															
Id				D C																B A															
Reset 0x0000FFFF				0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1																															
Id	RW	Field	Value Id	Value	Description																														
A	W	S0POWER	Off	1	Keep RAM section S0 of RAM6 on or off in System ON mode																														
B	W	S1POWER	Off	1	Keep RAM section S1 of RAM6 on or off in System ON mode																														
C	W	S0RETENTION	Off	1	Keep retention on RAM section S0 when RAM section is switched off																														
D	W	S1RETENTION	Off	1	Keep retention on RAM section S1 when RAM section is switched off																														

### 5.3.9.30 RAM[7].POWER

Address offset: 0x970

RAM7 power control register

Bit number			31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0																															
Id			D C B A																															
Reset 0x0000FFFF			0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1																															
Id	RW	Field	Value Id	Value	Description																													
A	RW	S0POWER			Keep RAM section S0 ON or OFF in System ON mode.																													
					RAM sections are always retained when ON, but can also be retained when OFF dependent on the settings in S0RETENTION. All RAM sections will be OFF in System OFF mode.																													
			Off	0	Off																													
			On	1	On																													
B	RW	S1POWER			Keep RAM section S1 ON or OFF in System ON mode.																													
					RAM sections are always retained when ON, but can also be retained when OFF dependent on the settings in S1RETENTION. All RAM sections will be OFF in System OFF mode.																													
			Off	0	Off																													
			On	1	On																													
C	RW	S0RETENTION			Keep retention on RAM section S0 when RAM section is in OFF																													
			Off	0	Off																													
			On	1	On																													
D	RW	S1RETENTION			Keep retention on RAM section S1 when RAM section is in OFF																													
			Off	0	Off																													
			On	1	On																													

### 5.3.9.31 RAM[7].POWERSET

Address offset: 0x974

## RAM7 power control set register

When read, this register will return the value of the POWER register.

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0																															
Id				D C																B A															
Reset 0x0000FFFF				0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 1 1 1 1 1 1 1 1 1 1 1 1 1 1																															
Id	RW	Field	Value Id	Value	Description																														
A	W	S0POWER	On	1	Keep RAM section S0 of RAM7 on or off in System ON mode																														
B	W	S1POWER	On	1	Keep RAM section S1 of RAM7 on or off in System ON mode																														
C	W	S0RETENTION	On	1	Keep retention on RAM section S0 when RAM section is switched off																														
D	W	S1RETENTION	On	1	Keep retention on RAM section S1 when RAM section is switched off																														

## 5.3.9.32 RAM[7].POWERCLR

Address offset: 0x978

## RAM7 power control clear register

When read, this register will return the value of the POWER register.

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0																															
Id				D C																B A															
Reset 0x0000FFFF				0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 1 1 1 1 1 1 1 1 1 1 1 1 1 1																															
Id	RW	Field	Value Id	Value	Description																														
A	W	S0POWER	Off	1	Keep RAM section S0 of RAM7 on or off in System ON mode																														
B	W	S1POWER	Off	1	Keep RAM section S1 of RAM7 on or off in System ON mode																														
C	W	S0RETENTION	Off	1	Keep retention on RAM section S0 when RAM section is switched off																														
D	W	S1RETENTION	Off	1	Keep retention on RAM section S1 when RAM section is switched off																														

## 5.3.10 Electrical specification

## 5.3.10.1 Device startup times

Symbol	Description	Min.	Typ.	Max.	Units
$t_{POR}$	Time in Power on Reset after VDD reaches 1.7 V for all supply voltages and temperatures. Dependent on supply rise time. <sup>9</sup>				
$t_{POR,10\mu s}$	VDD rise time 10 $\mu s$		1		ms

<sup>9</sup> A step increase in supply voltage of 300 mV or more, with rise time of 300 ms or less, within the valid supply range, may result in a system reset.

Symbol	Description	Min.	Typ.	Max.	Units
$t_{POR,10ms}$	VDD rise time 10ms		9		ms
$t_{POR,60ms}$	VDD rise time 60ms		23		ms
$t_{PINR}$	If a GPIO pin is configured as reset, the maximum time taken to pull up the pin and release reset after power on reset. Dependent on the pin capacitive load (C) <sup>10</sup> : $t=5RC$ , $R=13k\Omega$				
$t_{PINR,500nF}$	$C=500nF$			32.5	ms
$t_{PINR,10uF}$	$C=10uF$			650	ms
$t_{R2ON}$	Time from reset to ON (CPU execute)				
$t_{R2ON,NOTCONF}$	If reset pin not configured	$t_{POR}$			ms
$t_{R2ON,CONF}$	If reset pin configured	$t_{POR} + t_{PINR}$			ms
$t_{OFF2ON}$	Time from OFF to CPU execute		16.5		$\mu s$
$t_{IDLE2CPU}$	Time from IDLE to CPU execute		3.0		$\mu s$
$t_{EVTSET,CL1}$	Time from HW event to PPI event in Constant Latency System ON mode		0.0625		$\mu s$
$t_{EVTSET,CL0}$	Time from HW event to PPI event in Low Power System ON mode		0.0625		$\mu s$

### 5.3.10.2 Power fail comparator

Symbol	Description	Min.	Typ.	Max.	Units
$V_{POF}$	Nominal power level warning thresholds (falling supply voltage). Levels are configurable between Min. and Max. in 100mV increments.	1.7		2.8	V
$V_{POFTOL}$	Threshold voltage tolerance		$\pm 1$	$\pm 5$	%
$V_{POFHYS}$	Threshold voltage hysteresis		50		mV
$V_{BOR,OFF}$	Brown out reset voltage range SYSTEM OFF mode	1.2		1.7	V
$V_{BOR,ON}$	Brown out reset voltage range SYSTEM ON mode	1.48		1.7	V

## 5.4 CLOCK — Clock control

The clock control system can source the system clocks from a range of internal or external high and low frequency oscillators and distribute them to modules based upon a module's individual requirements. Clock distribution is automated and grouped independently by module to limit current consumption in unused branches of the clock tree.

Listed here are the main features for CLOCK:

- 64 MHz on-chip oscillator
- 64 MHz crystal oscillator, using external 32 MHz crystal
- 32.768 kHz +/-500 ppm RC oscillator
- 32.768 kHz crystal oscillator, using external 32.768 kHz crystal
- 32.768 kHz oscillator synthesized from 64 MHz oscillator
- Firmware (FW) override control of oscillator activity for low latency start up
- Automatic oscillator and clock control, and distribution for ultra-low power

<sup>10</sup> To decrease maximum time a device could hold in reset, a strong external pullup resistor can be used.

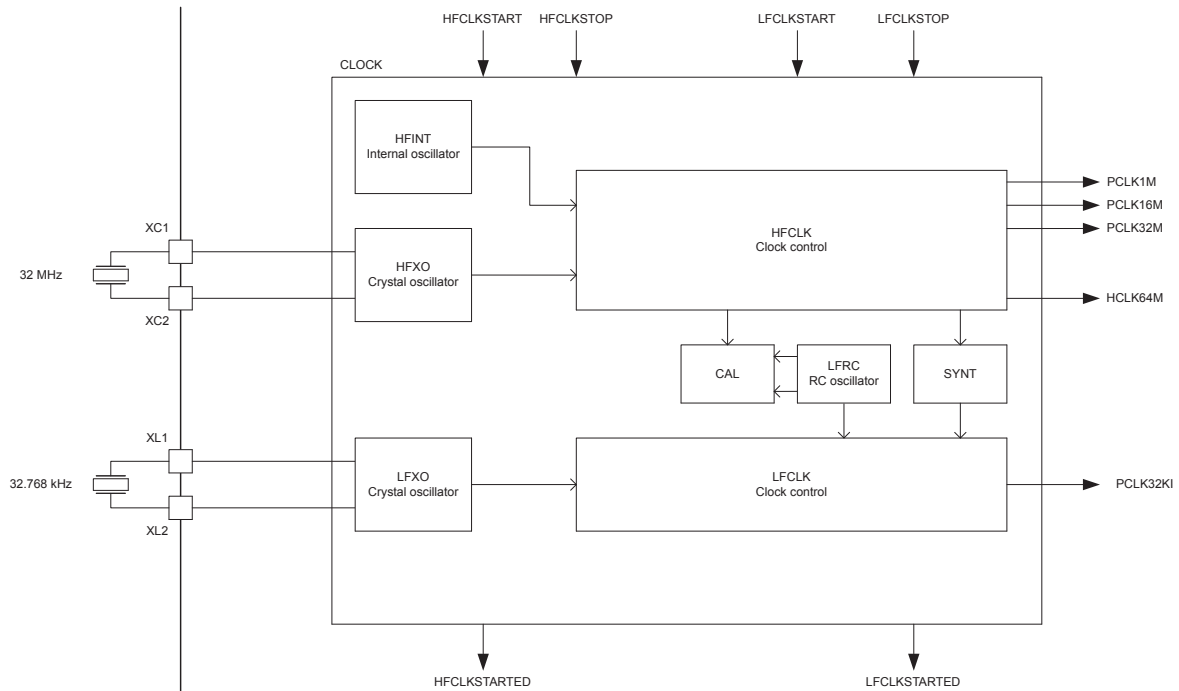


Figure 17: Clock control

### 5.4.1 HFCLK clock controller

The HFCLK clock controller provides the following clocks to the system.

- HCLK64M: 64 MHz CPU clock
- PCLK1M: 1 MHz peripheral clock
- PCLK16M: 16 MHz peripheral clock
- PCLK32M: 32 MHz peripheral clock

The HFCLK controller supports the following high frequency clock (HFCLK) sources:

- 64 MHz internal oscillator (HFINT)
- 64 MHz crystal oscillator (HFXO)

For illustration, see [Clock control](#) on page 84.

When the system requests one or more clocks from the HFCLK controller, the HFCLK controller will automatically provide them. If the system does not request any clocks provided by the HFCLK controller, the controller will enter a power saving mode.

These clocks are only available when the system is in ON mode. When the system enters ON mode, the internal oscillator (HFINT) clock source will automatically start to be able to provide the required HFCLK clock(s) for the system.

The HFINT will be used when HFCLK is requested and HFXO has not been started. The HFXO is started by triggering the HFCLKSTART task and stopped using the HFCLKSTOP task. A HFCLKSTARTED event will be generated when the HFXO has started and its frequency is stable.

The HFXO must be running to use the RADIO or the calibration mechanism associated with the 32.768 kHz RC oscillator.

#### 5.4.1.1 64 MHz crystal oscillator (HFXO)

The 64 MHz crystal oscillator (HFXO) is controlled by a 32 MHz external crystal

The crystal oscillator is designed for use with an AT-cut quartz crystal in parallel resonant mode. To achieve correct oscillation frequency, the load capacitance must match the specification in the crystal data sheet.

[Circuit diagram of the 64 MHz crystal oscillator](#) on page 85 shows how the 32 MHz crystal is connected to the 64 MHz crystal oscillator.

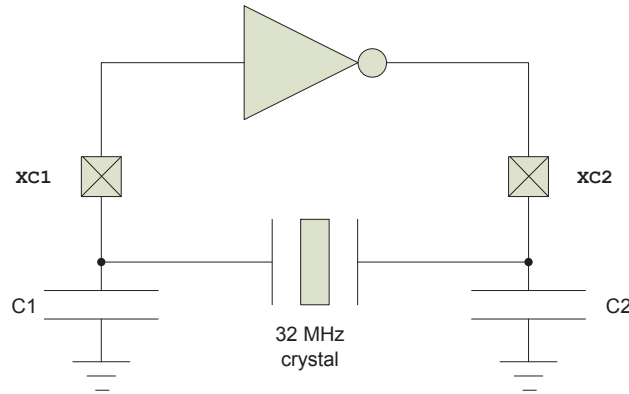


Figure 18: Circuit diagram of the 64 MHz crystal oscillator

The load capacitance (CL) is the total capacitance seen by the crystal across its terminals and is given by:

$$CL = \frac{(C1' \cdot C2')}{(C1' + C2')}$$

$$C1' = C1 + C_{pcb1} + C_{pin}$$

$$C2' = C2 + C_{pcb2} + C_{pin}$$

C1 and C2 are ceramic SMD capacitors connected between each crystal terminal and ground. For more information, see [Reference circuitry](#) on page 468.  $C_{pcb1}$  and  $C_{pcb2}$  are stray capacitances on the PCB.  $C_{pin}$  is the pin input capacitance on the XC1 and XC2 pins. See table [64 MHz crystal oscillator \(HFXO\)](#) on page 92. The load capacitors C1 and C2 should have the same value.

For reliable operation, the crystal load capacitance, shunt capacitance, equivalent series resistance, and drive level must comply with the specifications in table [64 MHz crystal oscillator \(HFXO\)](#) on page 92. It is recommended to use a crystal with lower than maximum load capacitance and/or shunt capacitance. A low load capacitance will reduce both start up time and current consumption.

### 5.4.2 LFCLK clock controller

The system supports several low frequency clock sources.

As illustrated in [Clock control](#) on page 84, the system supports the following low frequency clock sources:

- 32.768 kHz RC oscillator (LFRC)
- 32.768 kHz crystal oscillator (LFXO)
- 32.768 kHz synthesized from HFCLK (LFSYNT)

The LFCLK clock is started by first selecting the preferred clock source in register [LFCLKSRC](#) on page 91 and then triggering the LFCLKSTART task. If the LFXO is selected as the clock source, the LFCLK will initially start running from the 32.768 kHz LFRC while the LFXO is starting up and automatically switch to using the LFXO once this oscillator is running. The LFCLKSTARTED event will be generated when the LFXO has been started.

The LFCLK clock is stopped by triggering the LFCLKSTOP task.

It is not allowed to write to register [LFCLKSRC](#) on page 91 when the LFCLK is running.

A LFCLKSTOP task will stop the LFCLK oscillator. However, the LFCLKSTOP task can only be triggered after the STATE field in register [LFCLKSTAT](#) on page 90 indicates a 'LFCLK running' state.

The LFCLK clock controller and all of the LFCLK clock sources are always switched off when in OFF mode.

#### 5.4.2.1 32.768 kHz RC oscillator (LFRC)

The default source of the low frequency clock (LFCLK) is the 32.768 kHz RC oscillator (LFRC).

The LFRC frequency will be affected by variation in temperature. The LFRC oscillator can be calibrated to improve accuracy by using the HFXO as a reference oscillator during calibration. See Table [32.768 kHz RC oscillator \(LFRC\)](#) on page 92 for details on the default and calibrated accuracy of the LFRC oscillator.

The LFRC oscillator does not require additional external components.

#### 5.4.2.2 Calibrating the 32.768 kHz RC oscillator

After the 32.768 kHz RC oscillator is started and running, it can be calibrated by triggering the CAL task. In this case, the HFCLK will be temporarily switched on and used as a reference.

A DONE event will be generated when calibration has finished. The calibration mechanism will only work as long as HFCLK is generated from the HFCLK crystal oscillator, it is therefore necessary to explicitly start this crystal oscillator before calibration can be started, see HFCLKSTART task.

It is not allowed to stop the LFRC during an ongoing calibration.

#### 5.4.2.3 Calibration timer

The calibration timer can be used to time the calibration interval of the 32.768 kHz RC oscillator.

The calibration timer is started by triggering the CTSTART task and stopped by triggering the CTSTOP task. The calibration timer will always start counting down from the value specified in CTIV and generate a CTTO timeout event when it reaches 0. The Calibration timer will stop by itself when it reaches 0.

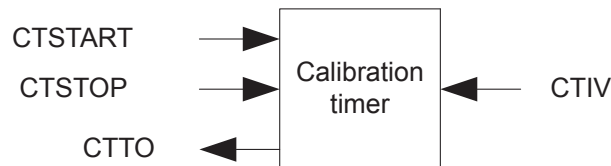


Figure 19: Calibration timer

Due to limitations in the calibration timer, only one task related to calibration, that is, CAL, CTSTART and CTSTOP, can be triggered for every period of LFCLK.

#### 5.4.2.4 32.768 kHz crystal oscillator (LFXO)

For higher LFCLK accuracy the low frequency crystal oscillator (LFXO) must be used.

The following external clock sources are supported:

- Low swing clock signal applied to the XL1 pin. The XL2 pin shall then be grounded.
- Rail-to-rail clock signal applied to the XL1 pin. The XL2 pin shall then be grounded or left unconnected.

The [LFCLKSRC](#) on page 91 register controls the clock source, and its allowed swing. The truth table for various situations is as follows:

SRC	EXTERNAL	BYPASS	Comment
0	0	0	Normal operation, RC is source
0	0	1	DO NOT USE
0	1	X	DO NOT USE
1	0	0	Normal XTAL operation
1	1	0	Apply external low swing signal to XL1, ground XL2
1	1	1	Apply external full swing signal to XL1, leave XL2 grounded or unconnected
1	0	1	DO NOT USE
2	0	0	Normal operation, synth is source
2	0	1	DO NOT USE
2	1	X	DO NOT USE

Table 16: LFCLKSRC configuration depending on clock source

To achieve correct oscillation frequency, the load capacitance must match the specification in the crystal data sheet. [Circuit diagram of the 32.768 kHz crystal oscillator](#) on page 87 shows the LFXO circuitry.

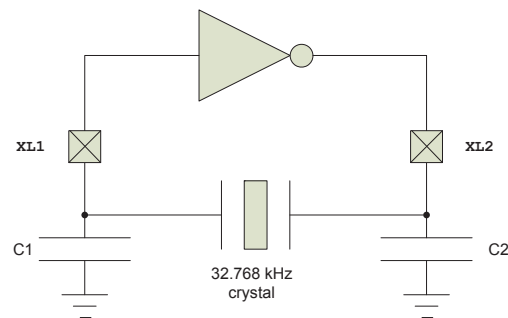


Figure 20: Circuit diagram of the 32.768 kHz crystal oscillator

The load capacitance (CL) is the total capacitance seen by the crystal across its terminals and is given by:

$$CL = \frac{(C1' \cdot C2')}{(C1' + C2')}$$

$$C1' = C1 + C_{pcb1} + C_{pin}$$

$$C2' = C2 + C_{pcb2} + C_{pin}$$

C1 and C2 are ceramic SMD capacitors connected between each crystal terminal and ground.  $C_{pcb1}$  and  $C_{pcb2}$  are stray capacitances on the PCB.  $C_{pin}$  is the pin input capacitance on the XC1 and XC2 pins (see [32.768 kHz crystal oscillator \(LFXO\)](#) on page 92). The load capacitors C1 and C2 should have the same value.

For more information, see [Reference circuitry](#) on page 468.

#### 5.4.2.5 32.768 kHz synthesized from HFCLK (LFSYNT)

LFCLK can also be synthesized from the HFCLK clock source. The accuracy of LFCLK will then be the accuracy of the HFCLK.

Using the LFSYNT clock avoids the requirement for a 32.768 kHz crystal, but increases average power consumption as the HFCLK will need to be requested in the system.

### 5.4.3 Registers

Base address	Peripheral	Instance	Description	Configuration
0x40000000	CLOCK	CLOCK	Clock control	

Table 17: Instances

Register	Offset	Description
TASKS_HFCLKSTART	0x000	Start HFCLK crystal oscillator
TASKS_HFCLKSTOP	0x004	Stop HFCLK crystal oscillator
TASKS_LFCLKSTART	0x008	Start LFCLK source
TASKS_LFCLKSTOP	0x00C	Stop LFCLK source
TASKS_CAL	0x010	Start calibration of LFRC oscillator
TASKS_CTSTART	0x014	Start calibration timer
TASKS_CTSTOP	0x018	Stop calibration timer
EVENTS_HFCLKSTARTED	0x100	HFCLK oscillator started
EVENTS_LFCLKSTARTED	0x104	LFCLK started
EVENTS_DONE	0x10C	Calibration of LFCLK RC oscillator complete event
EVENTS_CTTO	0x110	Calibration timer timeout
INTENSET	0x304	Enable interrupt
INTENCLR	0x308	Disable interrupt
HFCLKRUN	0x408	Status indicating that HFCLKSTART task has been triggered
HFCLKSTAT	0x40C	HFCLK status
LFCLKRUN	0x414	Status indicating that LFCLKSTART task has been triggered
LFCLKSTAT	0x418	LFCLK status
LFCLKSRC	0x41C	Copy of LFCLKSRC register, set when LFCLKSTART task was triggered
LFCLKSRC	0x518	Clock source for the LFCLK
CTIV	0x538	Calibration timer interval

Retained

Table 18: Register Overview

#### 5.4.3.1 INTENSET

Address offset: 0x304

Enable interrupt

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0																															
Id				D C B A																															
Reset 0x00000000				0 0																															
Id	RW	Field	Value	Id	Value	Description																													
A	RW	HFCLKSTARTED				Write '1' to Enable interrupt for HFCLKSTARTED event																													
						See <a href="#">EVENTS_HFCLKSTARTED</a>																													
		Set	1			Enable																													
		Disabled	0			Read: Disabled																													
		Enabled	1			Read: Enabled																													
B	RW	LFCLKSTARTED				Write '1' to Enable interrupt for LFCLKSTARTED event																													
						See <a href="#">EVENTS_LFCLKSTARTED</a>																													
		Set	1			Enable																													
		Disabled	0			Read: Disabled																													
		Enabled	1			Read: Enabled																													



Bit number					31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0																															
Id																																				
Reset 0x00000000					0 0																															
Id	RW	Field	Value Id	Value	Description																															
C	RW	DONE			Write '1' to Enable interrupt for DONE event																															
					See <a href="#">EVENTS_DONE</a>																															
			Set	1	Enable																															
			Disabled	0	Read: Disabled																															
			Enabled	1	Read: Enabled																															
D	RW	CTTO			Write '1' to Enable interrupt for CTTO event																															
					See <a href="#">EVENTS_CTTO</a>																															
			Set	1	Enable																															
			Disabled	0	Read: Disabled																															
			Enabled	1	Read: Enabled																															

### 5.4.3.2 INTENCLR

Address offset: 0x308

Disable interrupt

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0																															
Id				D C B A																															
Reset 0x00000000				0 0																															
Id	RW	Field	Value Id	Value	Description																														
A	RW	HFCLKSTARTED			Write '1' to Disable interrupt for HFCLKSTARTED event																														
					See <a href="#">EVENTS_HFCLKSTARTED</a>																														
			Clear	1	Disable																														
			Disabled	0	Read: Disabled																														
			Enabled	1	Read: Enabled																														
B	RW	LFCLKSTARTED			Write '1' to Disable interrupt for LFCLKSTARTED event																														
					See <a href="#">EVENTS_LFCLKSTARTED</a>																														
			Clear	1	Disable																														
			Disabled	0	Read: Disabled																														
			Enabled	1	Read: Enabled																														
C	RW	DONE			Write '1' to Disable interrupt for DONE event																														
					See <a href="#">EVENTS_DONE</a>																														
			Clear	1	Disable																														
			Disabled	0	Read: Disabled																														
			Enabled	1	Read: Enabled																														
D	RW	CTTO			Write '1' to Disable interrupt for CTTO event																														
					See <a href="#">EVENTS_CTTO</a>																														
			Clear	1	Disable																														
			Disabled	0	Read: Disabled																														
			Enabled	1	Read: Enabled																														

### 5.4.3.3 HFCLKRUN

Address offset: 0x408

Status indicating that HFCLKSTART task has been triggered

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0																															
Id				A																															
Reset 0x00000000				0 0																															
Id	RW	Field	Value Id	Value	Description																														
A	R	STATUS			HFCLKSTART task triggered or not																														
			NotTriggered	0	Task not triggered																														
			Triggered	1	Task triggered																														

#### 5.4.3.4 HFCLKSTAT

Address offset: 0x40C

HFCLK status

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0																															
Id				B																												A			
Reset 0x00000000				0 0																															
Id	RW	Field	Value Id	Value	Description																														
A	R	SRC			Source of HFCLK																														
			RC	0	64 MHz internal oscillator (HFINT)																														
			Xtal	1	64 MHz crystal oscillator (HFXO)																														
B	R	STATE			HFCLK state																														
			NotRunning	0	HFCLK not running																														
			Running	1	HFCLK running																														

#### 5.4.3.5 LFCLKRUN

Address offset: 0x414

Status indicating that LFCLKSTART task has been triggered

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0																															
Id				A																															
Reset 0x00000000				0 0																															
Id	RW	Field	Value Id	Value	Description																														
A	R	STATUS			LFCLKSTART task triggered or not																														
			NotTriggered	0	Task not triggered																														
			Triggered	1	Task triggered																														

#### 5.4.3.6 LFCLKSTAT

Address offset: 0x418

LFCLK status

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0																																
Id				B																												A		A		
Reset 0x00000000				0 0																																
Id	RW	Field	Value Id	Value	Description																															
A	R	SRC			Source of LFCLK																															
			RC	0	32.768 kHz RC oscillator																															
			Xtal	1	32.768 kHz crystal oscillator																															
			Synth	2	32.768 kHz synthesized from HFCLK																															
B	R	STATE			LFCLK state																															
			NotRunning	0	LFCLK not running																															
			Running	1	LFCLK running																															

### 5.4.3.7 LFCLKSRCCOPY

Address offset: 0x41C

Copy of LFCLKSRC register, set when LFCLKSTART task was triggered

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0																															
Id				A A																															
Reset 0x00000000				0 0																															
Id	RW	Field	Value Id	Value	Description																														
A	R	SRC			Clock source																														
			RC	0	32.768 kHz RC oscillator																														
			Xtal	1	32.768 kHz crystal oscillator																														
			Synth	2	32.768 kHz synthesized from HFCLK																														

### 5.4.3.8 LFCLKSRC

Address offset: 0x518

Clock source for the LFCLK

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0																															
Id				C B A A																															
Reset 0x00000000				0 0																															
Id	RW	Field	Value Id	Value	Description																														
A	RW	SRC			Clock source																														
			RC	0	32.768 kHz RC oscillator																														
			Xtal	1	32.768 kHz crystal oscillator																														
			Synth	2	32.768 kHz synthesized from HFCLK																														
B	RW	BYPASS			Enable or disable bypass of LFCLK crystal oscillator with external clock source																														
			Disabled	0	Disable (use with Xtal or low-swing external source)																														
			Enabled	1	Enable (use with rail-to-rail external source)																														
C	RW	EXTERNAL			Enable or disable external source for LFCLK																														
			Disabled	0	Disable external source (use with Xtal)																														
			Enabled	1	Enable use of external source instead of Xtal (SRC needs to be set to Xtal)																														

### 5.4.3.9 CTIV ( Retained )

Address offset: 0x538

This register is a retained register

## Calibration timer interval

Bit number					31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0																															
Id					A A A A A A A A																															
Reset 0x00000000					0 0																															
Id	RW	Field	Value Id	Value	Description																															
A	RW	CTIV			Calibration timer interval in multiple of 0.25 seconds. Range: 0.25 seconds to 31.75 seconds.																															

## 5.4.4 Electrical specification

## 5.4.4.1 64 MHz internal oscillator (HFINT)

Symbol	Description	Min.	Typ.	Max.	Units
$f_{\text{NOM\_HFINT}}$	Nominal output frequency		64		MHz
$f_{\text{TOL\_HFINT}}$	Frequency tolerance	$<\pm 1.5$		$<\pm 8$	%
$t_{\text{START\_HFINT}}$	Startup time		3		us

## 5.4.4.2 64 MHz crystal oscillator (HFXO)

Symbol	Description	Min.	Typ.	Max.	Units
$f_{\text{NOM\_HFXO}}$	Nominal output frequency		64		MHz
$f_{\text{XTAL\_HFXO}}$	External crystal frequency		32		MHz
$f_{\text{TOL\_HFXO}}$	Frequency tolerance requirement for 2.4 GHz proprietary radio applications			$\pm 60$	ppm
$f_{\text{TOL\_HFXO\_BLE}}$	Frequency tolerance requirement, Bluetooth low energy applications			$\pm 40$	ppm
$C_{\text{L\_HFXO}}$	Load capacitance			12	pF
$C_{\text{O\_HFXO}}$	Shunt capacitance			7	pF
$R_{\text{S\_HFXO\_7PF}}$	Equivalent series resistance $C_0 = 7$ pF			60	ohm
$R_{\text{S\_HFXO\_5PF}}$	Equivalent series resistance $C_0 = 5$ pF			60	ohm
$R_{\text{S\_HFXO\_3PF}}$	Equivalent series resistance $C_0 = 3$ pF			100	ohm
$P_{\text{D\_HFXO}}$	Drive level			100	uW
$C_{\text{PIN\_HFXO}}$	Input capacitance XC1 and XC2		4		pF
$t_{\text{START\_HFXO}}$	Startup time		0.36		ms

## 5.4.4.3 32.768 kHz RC oscillator (LFRC)

Symbol	Description	Min.	Typ.	Max.	Units
$f_{\text{NOM\_LFRC}}$	Nominal frequency		32.768		kHz
$f_{\text{TOL\_LFRC}}$	Frequency tolerance			$\pm 2$	%
$f_{\text{TOL\_CAL\_LFRC}}$	Frequency tolerance for LFRC after calibration <sup>11</sup>			$\pm 500$	ppm
$t_{\text{START\_LFRC}}$	Startup time for 32.768 kHz RC oscillator		600		us

## 5.4.4.4 32.768 kHz crystal oscillator (LFXO)

<sup>11</sup> Constant temperature within  $\pm 0.5$  °C and calibration performed at least every 8 seconds, defined as 3 sigma

Symbol	Description	Min.	Typ.	Max.	Units
$f_{\text{NOM\_LFXO}}$	Crystal frequency		32.768		kHz
$f_{\text{TOL\_LFXO\_BLE}}$	Frequency tolerance requirement for BLE stack			±250	ppm
$f_{\text{TOL\_LFXO\_ANT}}$	Frequency tolerance requirement for ANT stack			±50	ppm
$C_{\text{L\_LFXO}}$	Load capacitance			12.5	pF
$C_{\text{O\_LFXO}}$	Shunt capacitance			2	pF
$R_{\text{S\_LFXO}}$	Equivalent series resistance			100	kohm
$P_{\text{D\_LFXO}}$	Drive level			1	uW
$C_{\text{pin}}$	Input capacitance on XL1 and XL2 pads		4		pF
$t_{\text{START\_LFXO}}$	Startup time for 32.768 kHz crystal oscillator		0.25		s
$V_{\text{AMP\_IN\_XO\_LOW}}$	Peak to peak amplitude for external low swing clock. Input signal must not swing outside supply rails.	200		1000	mV

#### 5.4.4.5 32.768 kHz synthesized from HFCLK (LFSYNT)

Symbol	Description	Min.	Typ.	Max.	Units
$f_{\text{NOM\_LFSYNT}}$	Nominal frequency		32.768		kHz
$f_{\text{TOL\_LFSYNT}}$	Frequency tolerance in addition to HFCLK tolerance <sup>12</sup>		8		ppm
$t_{\text{START\_LFSYNT}}$	Startup time for synthesized 32.768 kHz		100		us

<sup>12</sup> Frequency tolerance will be derived from the HFCLK source clock plus the LFSYNT tolerance

# 6 Peripherals

## 6.1 Peripheral interface

Peripherals are controlled by the CPU by writing to configuration registers and task registers. Peripheral events are indicated to the CPU by event registers and interrupts if they are configured for a given event.

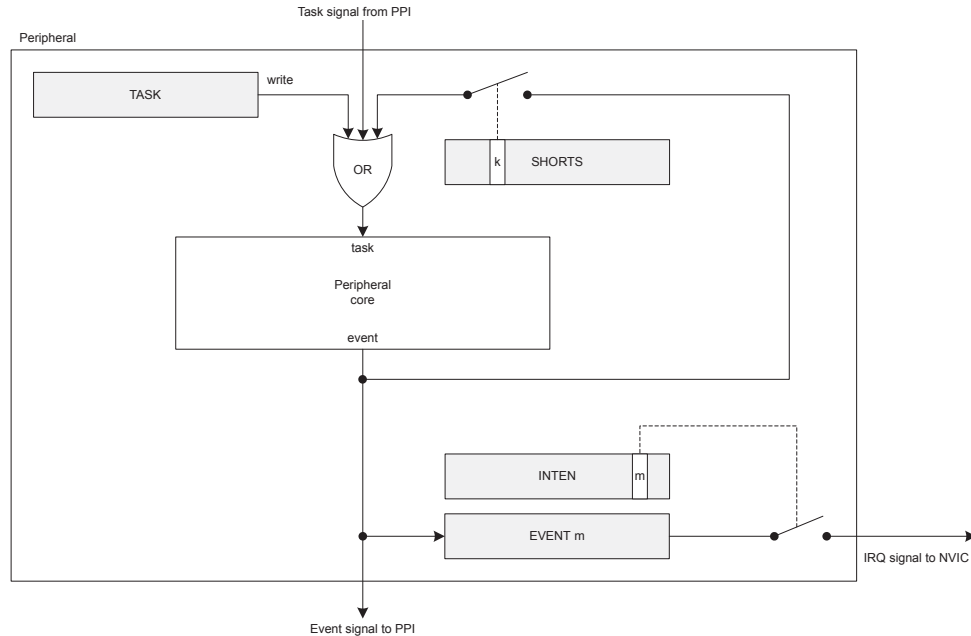


Figure 21: Tasks, events, shortcuts, and interrupts

### 6.1.1 Peripheral ID

Every peripheral is assigned a fixed block of 0x1000 bytes of address space, which is equal to 1024 x 32 bit registers.

See [Instantiation](#) on page 17 for more information about which peripherals are available and where they are located in the address map.

There is a direct relationship between the peripheral ID and base address. For example, a peripheral with base address 0x40000000 is assigned ID=0, a peripheral with base address 0x40001000 is assigned ID=1, and a peripheral with base address 0x4001F000 is assigned ID=31.

Peripherals may share the same ID, which may impose one or more of the following limitations:

- Some peripherals share some registers or other common resources.
- Operation is mutually exclusive. Only one of the peripherals can be used at a time.
- Switching from one peripheral to another must follow a specific pattern (disable the first, then enable the second peripheral).

## 6.1.2 Peripherals with shared ID

In general, and with the exception of ID 0, peripherals sharing an ID and base address may not be used simultaneously. The user can only enable one at the time on this specific ID.

When switching between two peripherals that share an ID, the user should do the following to prevent unwanted behavior:

- Disable the previously used peripheral
- Remove any PPI connections set up for the peripheral that is being disabled
- Clear all bits in the INTEN register, i.e. `INTENCLR = 0xFFFFFFFF`.
- Explicitly configure the peripheral that you enable and do not rely on configuration values that may be inherited from the peripheral that was disabled.
- Enable the now configured peripheral.

See [Instantiation](#) on page 17 to see which peripherals are sharing ID.

## 6.1.3 Peripheral registers

Most peripherals feature an ENABLE register. Unless otherwise specified in the relevant chapter, the peripheral registers (in particular the PSEL registers) must be configured before enabling the peripheral.

Note that the peripheral must be enabled before tasks and events can be used.

## 6.1.4 Bit set and clear

Registers with multiple single-bit bit fields may implement the "set-and-clear" pattern. This pattern enables firmware to set and clear individual bits in a register without having to perform a read-modify-write operation on the main register.

This pattern is implemented using three consecutive addresses in the register map where the main register is followed by a dedicated SET and CLR register in that order.

The SET register is used to set individual bits in the main register while the CLR register is used to clear individual bits in the main register. Writing a '1' to a bit in the SET or CLR register will set or clear the same bit in the main register respectively. Writing a '0' to a bit in the SET or CLR register has no effect. Reading the SET or CLR registers returns the value of the main register.

**Restriction:** The main register may not be visible and hence not directly accessible in all cases.

## 6.1.5 Tasks

Tasks are used to trigger actions in a peripheral, for example, to start a particular behavior. A peripheral can implement multiple tasks with each task having a separate register in that peripheral's task register group.

A task is triggered when firmware writes a '1' to the task register or when the peripheral itself or another peripheral toggles the corresponding task signal. See [Tasks, events, shortcuts, and interrupts](#) on page 94.

## 6.1.6 Events

Events are used to notify peripherals and the CPU about events that have happened, for example, a state change in a peripheral. A peripheral may generate multiple events with each event having a separate register in that peripheral's event register group.

An event is generated when the peripheral itself toggles the corresponding event signal, and the event register is updated to reflect that the event has been generated. See [Tasks, events, shortcuts, and interrupts](#) on page 94. An event register is only cleared when firmware writes a '0' to it.

Events can be generated by the peripheral even when the event register is set to '1'.

### 6.1.7 Shortcuts

A shortcut is a direct connection between an event and a task within the same peripheral. If a shortcut is enabled, its associated task is automatically triggered when its associated event is generated.

Using a shortcut is the equivalent to making the same connection outside the peripheral and through the PPI. However, the propagation delay through the shortcut is usually shorter than the propagation delay through the PPI.

Shortcuts are predefined, which means their connections cannot be configured by firmware. Each shortcut can be individually enabled or disabled through the shortcut register, one bit per shortcut, giving a maximum of 32 shortcuts for each peripheral.

### 6.1.8 Interrupts

All peripherals support interrupts. Interrupts are generated by events.

A peripheral only occupies one interrupt, and the interrupt number follows the peripheral ID. For example, the peripheral with ID=4 is connected to interrupt number 4 in the Nested Vectored Interrupt Controller (NVIC).

Using the INTEN, INTENSET and INTENCLR registers, every event generated by a peripheral can be configured to generate that peripheral's interrupt. Multiple events can be enabled to generate interrupts simultaneously. To resolve the correct interrupt source, the event registers in the event group of peripheral registers will indicate the source.

Some peripherals implement only INTENSET and INTENCLR, and the INTEN register is not available on those peripherals. Refer to the individual chapters for details. In all cases, however, reading back the INTENSET or INTENCLR register returns the same information as in INTEN.

Each event implemented in the peripheral is associated with a specific bit position in the INTEN, INTENSET and INTENCLR registers.

The relationship between tasks, events, shortcuts, and interrupts is shown in [Tasks, events, shortcuts, and interrupts](#) on page 94.

### Interrupt clearing

When clearing an interrupt by writing "0" to an event register, or disabling an interrupt using the INTENCLR register, it can take up to four CPU clock cycles to take effect. This means that an interrupt may reoccur immediately even if a new event has not come, if the program exits an interrupt handler after the interrupt is cleared or disabled, but before four clock cycles have passed.

**Important:** To avoid an interrupt reoccurring before a new event has come, the program should perform a read from one of the peripheral registers, for example, the event register that has been cleared, or the INTENCLR register that has been used to disable the interrupt.

This will cause a one to three-cycle delay and ensure the interrupt is cleared before exiting the interrupt handler. Care should be taken to ensure the compiler does not remove the read operation as an optimization. If the program can guarantee a four-cycle delay after event clear or interrupt disable another way, then a read of a register is not required.



## 6.2 AAR — Accelerated address resolver

Accelerated address resolver is a cryptographic support function for implementing the "Resolvable Private Address Resolution Procedure" described in the *Bluetooth Core specification* v4.0. "Resolvable private address generation" should be achieved using ECB and is not supported by AAR.

The procedure allows two devices that share a secret key to generate and resolve a hash based on their device address. The AAR block enables real-time address resolution on incoming packets when configured as described in this chapter. This allows real-time packet filtering (whitelisting) using a list of known shared keys (Identity Resolving Keys (IRK) in *Bluetooth*).

### 6.2.1 EasyDMA

The AAR implements EasyDMA for reading and writing to the RAM. The EasyDMA will have finished accessing the RAM when the END, RESOLVED, and NOTRESOLVED events are generated.

If the [IRKPTR](#) on page 101, [ADDRPTR](#) on page 101 and the [SCRATCHPTR](#) on page 101 is not pointing to the Data RAM region, an EasyDMA transfer may result in a HardFault or RAM corruption. See [Memory](#) on page 15 for more information about the different memory regions.

### 6.2.2 Resolving a resolvable address

As per *Bluetooth* specification, a private resolvable address is composed of six bytes.

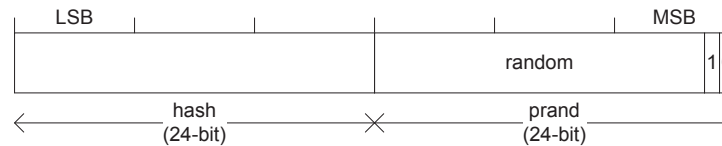


Figure 22: Resolvable address

To resolve an address the [ADDRPTR](#) on page 101 register must point to the start of packet. The resolver is started by triggering the START task. A RESOLVED event is generated when the AAR manages to resolve the address using one of the Identity Resolving Keys (IRK) found in the IRK data structure. The AAR will use the IRK specified in the register IRK0 to IRK15 starting from IRK0. How many to be used is specified by the NIRK register. The AAR module will generate a NOTRESOLVED event if it is not able to resolve the address using the specified list of IRKs.

The AAR will go through the list of available IRKs in the IRK data structure and for each IRK try to resolve the address according to the Resolvable Private Address Resolution Procedure described in the *Bluetooth Specification*<sup>13</sup>. The time it takes to resolve an address may vary depending on where in the list the resolvable address is located. The resolution time will also be affected by RAM accesses performed by other peripherals and the CPU. See the [Electrical specifications](#) for more information about resolution time.

The AAR will only do a comparison of the received address to those programmed in the module. And not check what type of address it actually is.

The AAR will stop as soon as it has managed to resolve the address, or after trying to resolve the address using NIRK number of IRKs from the IRK data structure. The AAR will generate an END event after it has stopped.

<sup>13</sup> *Bluetooth Specification* Version 4.0 [Vol 3] chapter 10.8.2.3.

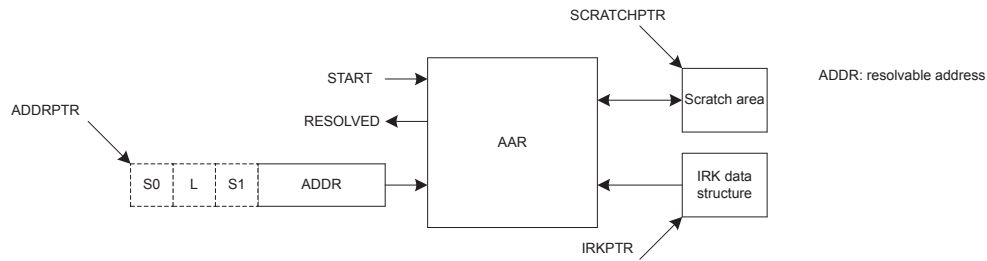


Figure 23: Address resolution with packet preloaded into RAM

### 6.2.3 Use case example for chaining RADIO packet reception with address resolution using AAR

The AAR may be started as soon as the 6 bytes required by the AAR have been received by the RADIO and stored in RAM. The ADDRPTR pointer must point to the start of packet.

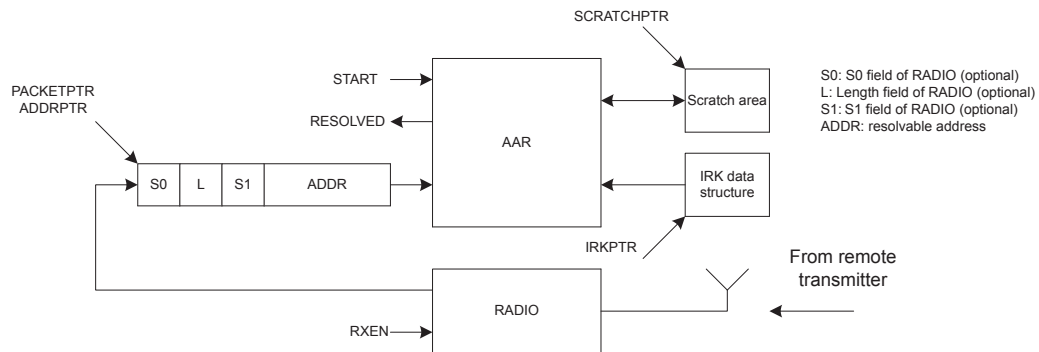


Figure 24: Address resolution with packet loaded into RAM by the RADIO

### 6.2.4 IRK data structure

The IRK data structure is located in RAM at the memory location specified by the IRKPTR register.

Property	Address offset	Description
IRK0	0	IRK number 0 (16 - byte)
IRK1	16	IRK number 1 (16 - byte)
..	..	..
IRK15	240	IRK number 15 (16 - byte)

Table 19: IRK data structure overview

### 6.2.5 Registers

Base address	Peripheral	Instance	Description	Configuration
0x4000F000	AAR	AAR	Accelerated address resolver	

Table 20: Instances

Register	Offset	Description
TASKS_START	0x000	Start resolving addresses based on IRKs specified in the IRK data structure
TASKS_STOP	0x008	Stop resolving addresses
EVENTS_END	0x100	Address resolution procedure complete

Register	Offset	Description
EVENTS_RESOLVED	0x104	Address resolved
EVENTS_NOTRESOLVED	0x108	Address not resolved
INTENSET	0x304	Enable interrupt
INTENCLR	0x308	Disable interrupt
STATUS	0x400	Resolution status
ENABLE	0x500	Enable AAR
NIRK	0x504	Number of IRKs
IRKPTR	0x508	Pointer to IRK data structure
ADDRPTR	0x510	Pointer to the resolvable address
SCRATCHPTR	0x514	Pointer to data area used for temporary storage

Table 21: Register Overview

### 6.2.5.1 INTENSET

Address offset: 0x304

Enable interrupt

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0																															
Id				C B A																															
Reset 0x00000000				0 0																															
Id	RW	Field	Value Id	Value	Description																														
A	RW	END			Write '1' to Enable interrupt for END event																														
					See <a href="#">EVENTS_END</a>																														
			Set	1	Enable																														
			Disabled	0	Read: Disabled																														
			Enabled	1	Read: Enabled																														
B	RW	RESOLVED			Write '1' to Enable interrupt for RESOLVED event																														
					See <a href="#">EVENTS_RESOLVED</a>																														
			Set	1	Enable																														
			Disabled	0	Read: Disabled																														
			Enabled	1	Read: Enabled																														
C	RW	NOTRESOLVED			Write '1' to Enable interrupt for NOTRESOLVED event																														
					See <a href="#">EVENTS_NOTRESOLVED</a>																														
			Set	1	Enable																														
			Disabled	0	Read: Disabled																														
			Enabled	1	Read: Enabled																														

### 6.2.5.2 INTENCLR

Address offset: 0x308

Disable interrupt

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0																															
Id				C B A																															
Reset 0x00000000				0 0																															
Id	RW	Field	Value Id	Value	Description																														
A	RW	END			Write '1' to Disable interrupt for END event																														
					See <a href="#">EVENTS_END</a>																														
			Clear	1	Disable																														
			Disabled	0	Read: Disabled																														



### 6.2.5.6 IRKPTR

Address offset: 0x508

Pointer to IRK data structure

Bit number					31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
Id					A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A
Reset 0x00000000					0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Id	RW	Field	Value Id		Value			Description																												
A	RW	IRKPTR						Pointer to the IRK data structure																												

### 6.2.5.7 ADDRPTR

Address offset: 0x510

Pointer to the resolvable address

Bit number				31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0			
Id				A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A			
Reset 0x00000000				0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0			
Id	RW	Field	Value Id	Value		Description																																
A	RW	ADDRPTR				Pointer to the resolvable address (6-bytes)																																

### 6.2.5.8 SCRATCHPTR

Address offset: 0x514

Pointer to data area used for temporary storage

Bit number				31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0			
Id				A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A			
Reset 0x00000000				0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0			
Id	RW	Field	Value Id	Value		Description																																
A	RW	SCRATCHPTR				Pointer to a scratch data area used for temporary storage during resolution.A space of minimum 3 bytes must be reserved.																																

## 6.2.6 Electrical specification

### 6.2.6.1 AAR Electrical Specification

Symbol	Description	Min.	Typ.	Max.	Units
$t_{AAR}$	Address resolution time per IRK. Total time for several IRKs is given as $(1 \mu s + n * t_{AAR})$ , where n is the number of IRKs. (Given priority to the actual destination RAM block).	..	..	..	$\mu s$
$t_{AAR,8}$	Time for address resolution of 8 IRKs. (Given priority to the actual destination RAM block).		48		$\mu s$

## 6.3 BPROT — Block protection

The mechanism for protecting non-volatile memory can be used to prevent erroneous application code from erasing or writing to protected blocks.

Non-volatile memory can be protected from erases and writes depending on the settings in the CONFIG registers. One bit in a CONFIG register represents one protected block of 4 kB. There are multiple CONFIG registers to cover the whole range of the flash. [Protected regions of program memory](#) on page 102 illustrates how the CONFIG bits map to the program memory space.

**Important:** If an erase or write to a protected block is detected, the CPU will hard fault. If an ERASEALL operation is attempted from the CPU while any block is protected it will be blocked and the CPU will hard fault.

On reset, all the protection bits are cleared. To ensure safe operation, the first task after reset must be to set the protection bits. The only way of clearing protection bits is by resetting the device from any reset source.

The protection mechanism is turned off when in debug mode (a debugger is connected) and the DISABLEINDEBUG register is set to disable.

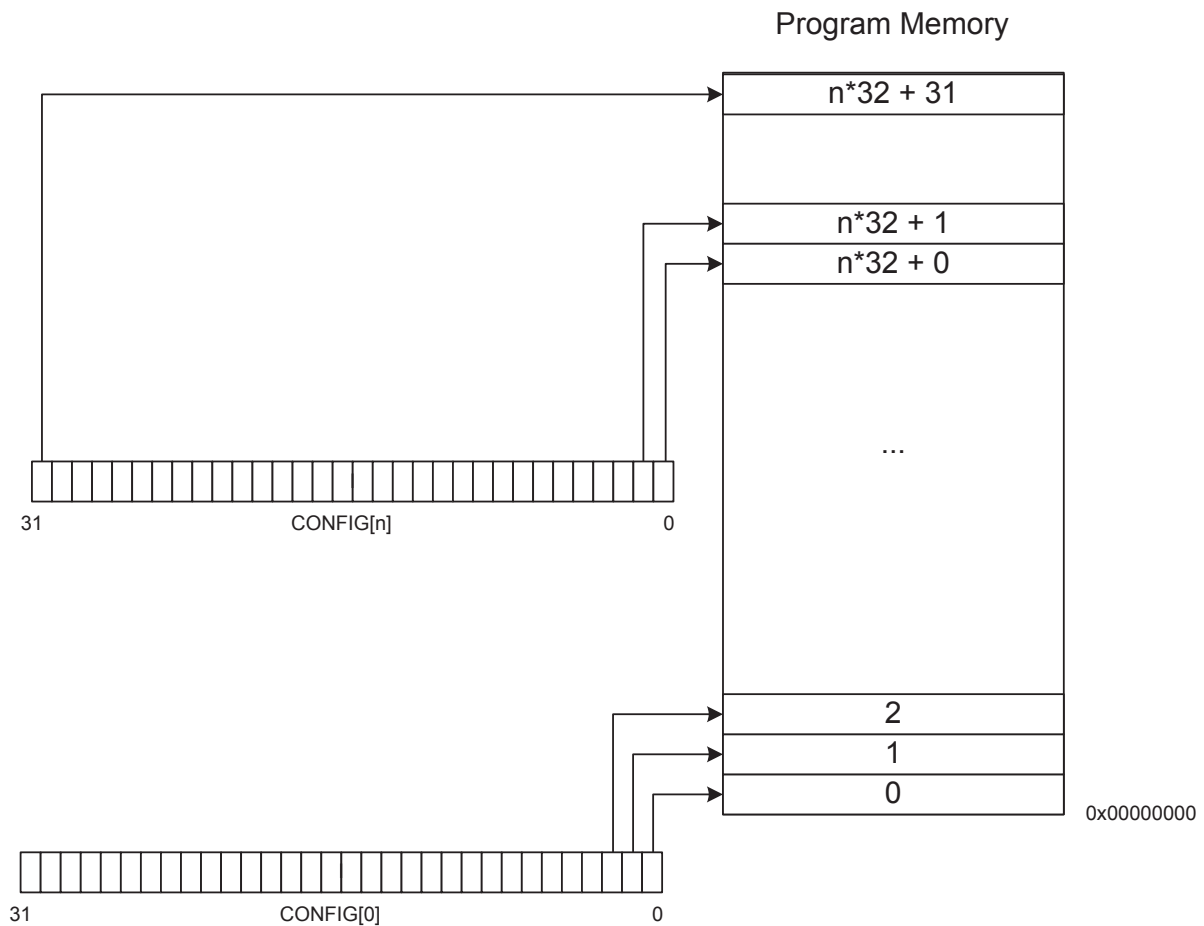


Figure 25: Protected regions of program memory

## 6.3.1 Registers

Base address	Peripheral	Instance	Description	Configuration
0x40000000	BPROT	BPROT	Block protect	

Table 22: Instances

Register	Offset	Description
CONFIG0	0x600	Block protect configuration register 0
CONFIG1	0x604	Block protect configuration register 1
DISABLEINDEBUG	0x608	Disable protection mechanism in debug mode
	0x60C	Reserved

Table 23: Register Overview

### 6.3.1.1 CONFIG0

Address offset: 0x600

Block protect configuration register 0

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0																															
Id				f e d c b a Z Y X W V U T S R Q P O N M L K J I H G F E D C B A																															
Reset 0x00000000				0 0																															
Id	RW	Field	Value	Id	Value	Description																													
A	RW	REGION0				Enable protection for region 0. Write '0' has no effect.																													
			Disabled	0	Protection disabled																														
			Enabled	1	Protection enabled																														
B	RW	REGION1				Enable protection for region 1. Write '0' has no effect.																													
			Disabled	0	Protection disabled																														
			Enabled	1	Protection enabled																														
C	RW	REGION2				Enable protection for region 2. Write '0' has no effect.																													
			Disabled	0	Protection disabled																														
			Enabled	1	Protection enabled																														
D	RW	REGION3				Enable protection for region 3. Write '0' has no effect.																													
			Disabled	0	Protection disabled																														
			Enabled	1	Protection enabled																														
E	RW	REGION4				Enable protection for region 4. Write '0' has no effect.																													
			Disabled	0	Protection disabled																														
			Enabled	1	Protection enabled																														
F	RW	REGION5				Enable protection for region 5. Write '0' has no effect.																													
			Disabled	0	Protection disabled																														
			Enabled	1	Protection enabled																														
G	RW	REGION6				Enable protection for region 6. Write '0' has no effect.																													
			Disabled	0	Protection disabled																														
			Enabled	1	Protection enabled																														
H	RW	REGION7				Enable protection for region 7. Write '0' has no effect.																													
			Disabled	0	Protection disabled																														
			Enabled	1	Protection enabled																														
I	RW	REGION8				Enable protection for region 8. Write '0' has no effect.																													
			Disabled	0	Protection disabled																														
			Enabled	1	Protection enabled																														
J	RW	REGION9				Enable protection for region 9. Write '0' has no effect.																													

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0																															
Id				f e d c b a Z Y X W V U T S R Q P O N M L K J I H G F E D C B A																															
Reset 0x00000000				0 0																															
Id	RW	Field	Value Id	Value	Description																														
			Disabled	0	Protection disabled																														
			Enabled	1	Protection enabled																														
K	RW	REGION10			Enable protection for region 10. Write '0' has no effect.																														
Disabled	0	Protection disabled																																	
			Enabled	1	Protection enabled																														
						Enable protection for region 11. Write '0' has no effect.																													
Disabled	0	Protection disabled																																	
			Enabled	1	Protection enabled																														
						Enable protection for region 12. Write '0' has no effect.																													
Disabled	0	Protection disabled																																	
			Enabled	1	Protection enabled																														
						Enable protection for region 13. Write '0' has no effect.																													
Disabled	0	Protection disabled																																	
			Enabled	1	Protection enabled																														
						Enable protection for region 14. Write '0' has no effect.																													
Disabled	0	Protection disabled																																	
			Enabled	1	Protection enabled																														
						Enable protection for region 15. Write '0' has no effect.																													
Disabled	0	Protection disabled																																	
			Enabled	1	Protection enabled																														
						Enable protection for region 16. Write '0' has no effect.																													
Disabled	0	Protection disabled																																	
			Enabled	1	Protection enabled																														
						Enable protection for region 17. Write '0' has no effect.																													
Disabled	0	Protection disabled																																	
			Enabled	1	Protection enabled																														
						Enable protection for region 18. Write '0' has no effect.																													
Disabled	0	Protection disabled																																	
			Enabled	1	Protection enabled																														
						Enable protection for region 19. Write '0' has no effect.																													
Disabled	0	Protection disabled																																	
			Enabled	1	Protection enabled																														
						Enable protection for region 20. Write '0' has no effect.																													
Disabled	0	Protection disabled																																	
			Enabled	1	Protection enabled																														
						Enable protection for region 21. Write '0' has no effect.																													
Disabled	0	Protection disabled																																	
			Enabled	1	Protection enabled																														
						Enable protection for region 22. Write '0' has no effect.																													
Disabled	0	Protection disabled																																	
			Enabled	1	Protection enabled																														
						Enable protection for region 23. Write '0' has no effect.																													
Disabled	0	Protection disabled																																	
			Enabled	1	Protection enabled																														
						Enable protection for region 24. Write '0' has no effect.																													
Disabled	0	Protection disabled																																	
			Enabled	1	Protection enabled																														
						Enable protection for region 25. Write '0' has no effect.																													
Disabled	0	Protection disabled																																	
			Enabled	1	Protection enabled																														



Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0																															
Id				f e d c b a Z Y X W V U T S R Q P O N M L K J I H G F E D C B A																															
Reset 0x00000000				0 0																															
Id	RW	Field	Value Id	Value	Description																														
a	RW	REGION26			Enable protection for region 26. Write '0' has no effect.																														
			Disabled	0	Protection disabled																														
			Enabled	1	Protection enabled																														
b	RW	REGION27			Enable protection for region 27. Write '0' has no effect.																														
			Disabled	0	Protection disabled																														
			Enabled	1	Protection enabled																														
c	RW	REGION28			Enable protection for region 28. Write '0' has no effect.																														
			Disabled	0	Protection disabled																														
			Enabled	1	Protection enabled																														
d	RW	REGION29			Enable protection for region 29. Write '0' has no effect.																														
			Disabled	0	Protection disabled																														
			Enabled	1	Protection enabled																														
e	RW	REGION30			Enable protection for region 30. Write '0' has no effect.																														
			Disabled	0	Protection disabled																														
			Enabled	1	Protection enabled																														
f	RW	REGION31			Enable protection for region 31. Write '0' has no effect.																														
			Disabled	0	Protection disabled																														
			Enabled	1	Protection enabled																														

### 6.3.1.2 CONFIG1

Address offset: 0x604

Block protect configuration register 1

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0																															
Id				P O N M L K J I H G F E D C B A																															
Reset 0x00000000				0 0																															
Id	RW	Field	Value Id	Value	Description																														
A	RW	REGION32			Enable protection for region 32. Write '0' has no effect.																														
			Disabled	0	Protection disabled																														
			Enabled	1	Protection enabled																														
B	RW	REGION33			Enable protection for region 33. Write '0' has no effect.																														
			Disabled	0	Protection disabled																														
			Enabled	1	Protection enabled																														
C	RW	REGION34			Enable protection for region 34. Write '0' has no effect.																														
			Disabled	0	Protection disabled																														
			Enabled	1	Protection enabled																														
D	RW	REGION35			Enable protection for region 35. Write '0' has no effect.																														
			Disabled	0	Protection disabled																														
			Enabled	1	Protection enabled																														
E	RW	REGION36			Enable protection for region 36. Write '0' has no effect.																														
			Disabled	0	Protection disabled																														
			Enabled	1	Protection enabled																														
F	RW	REGION37			Enable protection for region 37. Write '0' has no effect.																														
			Disabled	0	Protection disabled																														
			Enabled	1	Protection enabled																														
G	RW	REGION38			Enable protection for region 38. Write '0' has no effect.																														
			Disabled	0	Protection disabled																														
			Enabled	1	Protection enabled																														

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0																															
Id				P O N M L K J I H G F E D C B A																															
Reset 0x00000000				0 0																															
Id	RW	Field	Value	Id	Value	Description																													
H	RW	REGION39				Enable protection for region 39. Write '0' has no effect.																													
			Disabled	0	Protection disabled																														
			Enabled	1	Protection enabled																														
I	RW	REGION40				Enable protection for region 40. Write '0' has no effect.																													
			Disabled	0	Protection disabled																														
			Enabled	1	Protection enabled																														
J	RW	REGION41				Enable protection for region 41. Write '0' has no effect.																													
			Disabled	0	Protection disabled																														
			Enabled	1	Protection enabled																														
K	RW	REGION42				Enable protection for region 42. Write '0' has no effect.																													
			Disabled	0	Protection disabled																														
			Enabled	1	Protection enabled																														
L	RW	REGION43				Enable protection for region 43. Write '0' has no effect.																													
			Disabled	0	Protection disabled																														
			Enabled	1	Protection enabled																														
M	RW	REGION44				Enable protection for region 44. Write '0' has no effect.																													
			Disabled	0	Protection disabled																														
			Enabled	1	Protection enabled																														
N	RW	REGION45				Enable protection for region 45. Write '0' has no effect.																													
			Disabled	0	Protection disabled																														
			Enabled	1	Protection enabled																														
O	RW	REGION46				Enable protection for region 46. Write '0' has no effect.																													
			Disabled	0	Protection disabled																														
			Enabled	1	Protection enabled																														
P	RW	REGION47				Enable protection for region 47. Write '0' has no effect.																													
			Disabled	0	Protection disabled																														
			Enabled	1	Protection enabled																														

### 6.3.1.3 DISABLEINDEBUG

Address offset: 0x608

Disable protection mechanism in debug mode

Bit number					31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0																															
Id					A																															
Reset 0x00000001					0 1																															
Id	RW	Field	Value	Id	Value	Description																														
A	RW	DISABLEINDEBUG				Disable the protection mechanism for NVM regions while in debug mode. This register will only disable the protection mechanism if the device is in debug mode.																														
			Disabled		1	Disabled in debug																														
			Enabled		0	Enabled in debug																														

## 6.4 CCM — AES CCM mode encryption

Cipher block chaining - message authentication code (CCM) mode is an authenticated encryption algorithm designed to provide both authentication and confidentiality during data transfer. CCM combines counter mode encryption and CBC-MAC authentication. The CCM terminology "Message authentication

code (MAC)" is called the "Message integrity check (MIC)" in *Bluetooth* terminology and also in this document.

The CCM block generates an encrypted keystream that is applied to input data using the XOR operation and generates the 4 byte MIC field in one operation. The CCM and radio can be configured to work synchronously. The CCM will encrypt in time for transmission and decrypt after receiving bytes into memory from the radio. All operations can complete within the packet RX or TX time. CCM on this device is implemented according to *Bluetooth* requirements and the algorithm as defined in IETF [RFC3610](#), and depends on the AES-128 block cipher. A description of the CCM algorithm can also be found in [NIST Special Publication 800-38C](#). The *Bluetooth* specification describes the configuration of counter mode blocks and encryption blocks to implement compliant encryption for BLE.

The CCM block uses EasyDMA to load key, counter mode blocks (including the nonce required), and to read/write plain text and cipher text.

The AES CCM supports three operations: key-stream generation, packet encryption, and packet decryption. All these operations are done in compliance with the *Bluetooth* specification.<sup>14</sup>

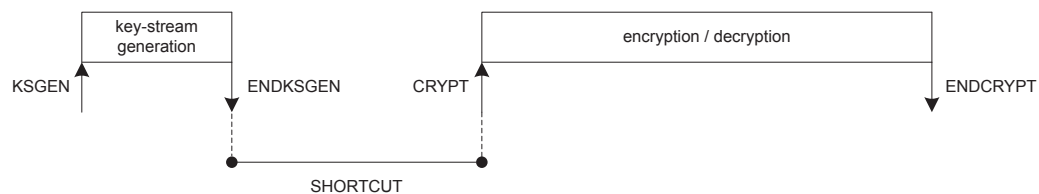


Figure 26: Key-stream generation followed by encryption or decryption. The shortcut is optional.

### 6.4.1 Key-stream generation

A new key-stream needs to be generated before a new packet encryption or packet decryption operation can be started.

A key-stream is generated by triggering the KSGEN task and an ENDKSGEN event will be generated when the key-stream has been generated.

Key-stream generation, packet encryption, and packet decryption operations utilize the configuration specified in the data structure pointed to by [CNFPTR](#) on page 115. It is necessary to configure this pointer and its underlying data structure, and the [MODE](#) on page 114 register before the KSGEN task is triggered.

The key-stream will be stored in the AES CCM's temporary memory area, specified by the [SCRATCHPTR](#) on page 116, where it will be used in subsequent encryption and decryption operations.

For default length packets (MODE.LENGTH = Default) the size of the generated key-stream is 27 bytes. When using extended length packets (MODE.LENGTH = Extended) the [MAXPACKETSIZE](#) on page 116 register specifies the length of the key-stream to be generated. The length of the generated key-stream must be greater or equal to the length of the subsequent packet payload to be encrypted or decrypted. The maximum length of the key-stream in extended mode is 251 bytes, which means that the maximum packet payload size is 251.

If a shortcut is used between ENDKSGEN event and CRYPT task, the [INPTR](#) on page 115 pointer and the [OUTPTR](#) on page 115 pointers must also be configured before the KSGEN task is triggered.

### 6.4.2 Encryption

During packet encryption, the AES CCM will read the unencrypted packet located in RAM at the address specified in the INPTR pointer, encrypt the packet and append a four byte long Message Integrity Check (MIC) field to the packet.

<sup>14</sup> *Bluetooth* AES CCM 128 bit block encryption, see *Bluetooth* Core specification Version 4.0.

Encryption is started by triggering the CRYPT task with the **MODE** on page 114 register set to ENCRYPTION. An ENDCRYPT event will be generated when packet encryption is completed

The AES CCM will also modify the length field of the packet to adjust for the appended MIC field, that is, add four bytes to the length, and store the resulting packet back into RAM at the address specified in the **OUTPTR** on page 115 pointer, see [Encryption](#) on page 108.

Empty packets (length field is set to 0) will not be encrypted but instead moved unmodified through the AES CCM.

The CCM supports different widths of the LENGTH field in the data structure for encrypted packets. This is configured in the **MODE** on page 114 register.

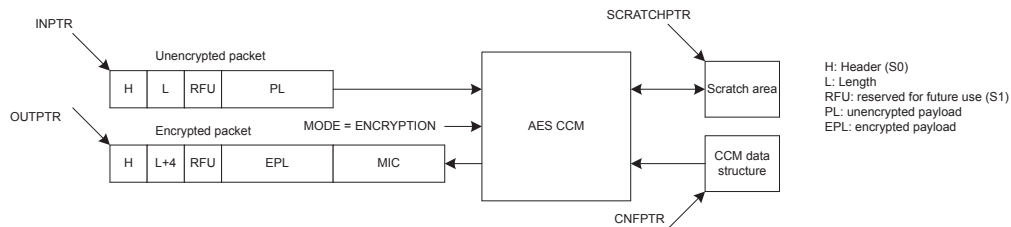


Figure 27: Encryption

### 6.4.3 Decryption

During packet decryption, the AES CCM will read the encrypted packet located in RAM at the address specified in the **INPTR** pointer, decrypt the packet, authenticate the packet's MIC field and generate the appropriate MIC status.

Decryption is started by triggering the CRYPT task with the **MODE** on page 114 register set to DECRYPTION. An ENDCRYPT event will be generated when packet decryption is completed

The AES CCM will also modify the length field of the packet to adjust for the MIC field, that is, subtract four bytes from the length, and then store the decrypted packet into RAM at the address pointed to by the **OUTPTR** pointer, see [Decryption](#) on page 108.

The CCM is only able to decrypt packet payloads that are at least 5 bytes long, that is, 1 byte or more encrypted payload (EPL) and 4 bytes of MIC. The CCM will therefore generate a MIC error for packets where the length field is set to 1, 2, 3 or 4.

Empty packets (length field is set to 0) will not be decrypted but instead moved unmodified through the AES CCM, these packets will always pass the MIC check.

The CCM supports different widths of the LENGTH field in the data structure for decrypted packets. This is configured in the **MODE** on page 114 register.

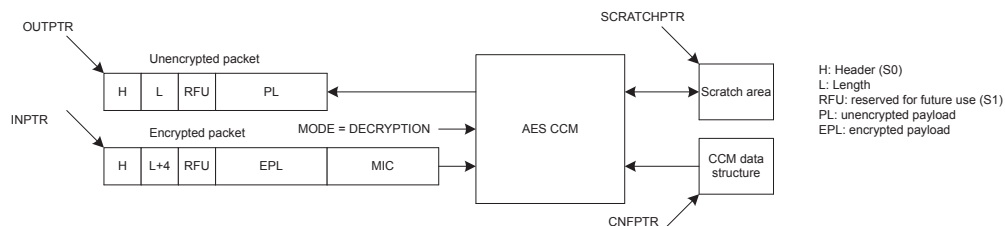


Figure 28: Decryption

### 6.4.4 AES CCM and RADIO concurrent operation

The CCM module is able to encrypt/decrypt data synchronously to data being transmitted or received on the radio.

In order for the CCM module to run synchronously with the radio, the data rate setting in the **MODE** on page 114 register needs to match the radio data rate. The settings in this register apply whenever either the KSGEN or CRYPT tasks are triggered.

The data rate setting of the **MODE** on page 114 register can also be overridden on-the-fly during an ongoing encrypt/decrypt operation by the contents of the **RATEOVERRIDE** on page 116 register. The data rate setting in this register applies whenever the RATEOVERRIDE task is triggered. This feature can be useful in cases where the radio data rate is changed during an ongoing packet transaction.

### 6.4.5 Encrypting packets on-the-fly in radio transmit mode

When the AES CCM is encrypting a packet on-the-fly at the same time as the radio is transmitting it, the radio must read the encrypted packet from the same memory location as the AES CCM is writing to.

The **OUTPTR** on page 115 pointer in the AES CCM must therefore point to the same memory location as the **PACKETPTR** pointer in the radio, see [Configuration of on-the-fly encryption](#) on page 109.

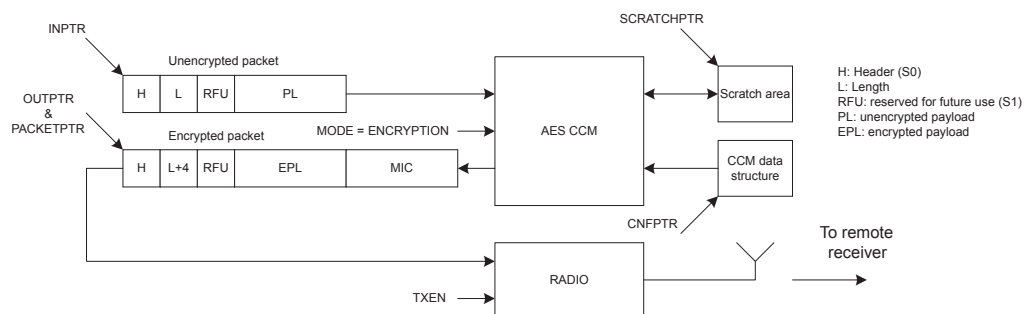


Figure 29: Configuration of on-the-fly encryption

In order to match the RADIO's timing, the KSGEN task must be triggered early enough to allow the key-stream generation to complete before the encryption of the packet shall start.

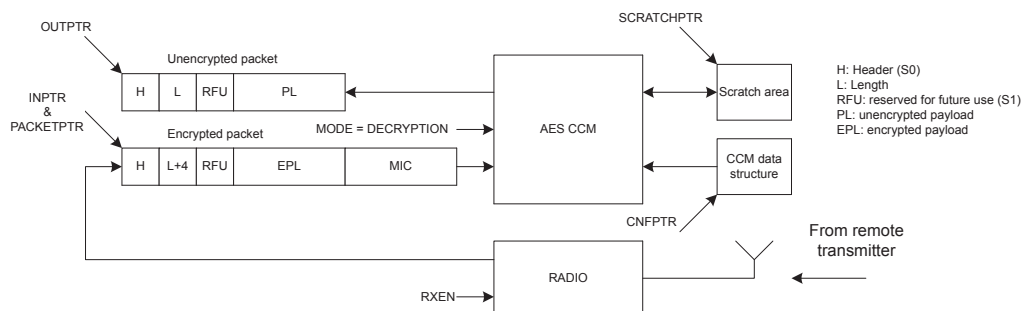
For short packets (**MODE.LENGTH** = Default) the KSGEN task must be triggered no later than when the **START** task in the RADIO is triggered. In addition the shortcut between the **ENDKSGEN** event and the **CRYPT** task must be enabled. This use-case is illustrated in [On-the-fly encryption of short packets \(MODE.LENGTH = Default\) using a PPI connection](#) on page 110 using a PPI connection between the **READY** event in the RADIO and the **KSGEN** task in the AES CCM.

For long packets (**MODE.LENGTH** = Extended) the key-stream generation will need to be started even earlier, for example at the time when the **TXEN** task in the RADIO is triggered.

**Important:** Refer to [Timing specification](#) on page 117 for information about the time needed for generating a key-stream.

### 6.4.6 Decrypting packets on-the-fly in radio receive mode

The [INPTR](#) on page 115 pointer in the AES CCM must therefore point to the same memory location as the [PACKETPTR](#) pointer in the [RADIO](#), see [Configuration of on-the-fly decryption](#) on page 110.



For long packets (MODE.LENGTH = Extended) the key-stream generation will need to be started even earlier, for example at the time when the RXEN task in the RADIO is triggered.

**Important:** Refer to [Timing specification](#) on page 117 for information about the time needed for generating a key-stream.

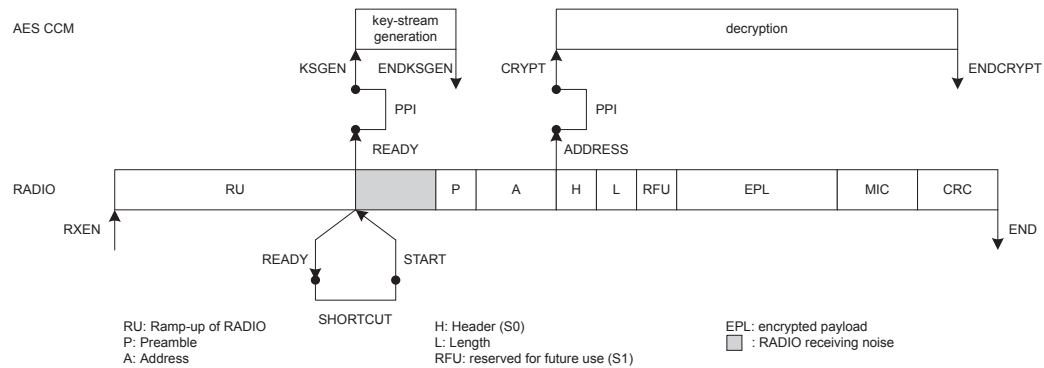


Figure 32: On-the-fly decryption of short packets (MODE.LENGTH = Default) using a PPI connection

### 6.4.7 CCM data structure

The CCM data structure is located in Data RAM at the memory location specified by the CNFPTR pointer register.

Property	Address offset	Description
KEY	0	16 byte AES key
PKTCTR	16	Octet0 (LSO) of packet counter
	17	Octet1 of packet counter
	18	Octet2 of packet counter
	19	Octet3 of packet counter
	20	Bit 6 – Bit 0: Octet4 (7 most significant bits of packet counter, with Bit 6 being the most significant bit) Bit7: Ignored
	21	Ignored
	22	Ignored
	23	Ignored
	24	Bit 0: Direction bit Bit 7 – Bit 1: Zero padded
IV	25	8 byte initialization vector (IV) Octet0 (LSO) of IV, Octet1 of IV, ..., Octet7 (MSO) of IV

Table 24: CCM data structure overview

The NONCE vector (as specified by the *Bluetooth* Core Specification) will be generated by hardware based on the information specified in the CCM data structure from [CCM data structure overview](#) on page 111 .

Property	Address offset	Description
HEADER	0	Packet Header
LENGTH	1	Number of bytes in unencrypted payload
RFU	2	Reserved Future Use
PAYLOAD	3	Unencrypted payload

Table 25: Data structure for unencrypted packet

Property	Address offset	Description
HEADER	0	Packet Header
LENGTH	1	Number of bytes in encrypted payload including length of MIC
		<b>Important:</b> LENGTH will be 0 for empty packets since the MIC is not added to empty packets
RFU	2	Reserved Future Use
PAYLOAD	3	Encrypted payload
MIC	3 + payload length	ENCRYPT: 4 bytes encrypted MIC
		<b>Important:</b> MIC is not added to empty packets

Table 26: Data structure for encrypted packet

## 6.4.8 EasyDMA and ERROR event

The CCM implements an EasyDMA mechanism for reading and writing to the RAM.

In cases where the CPU and other EasyDMA enabled peripherals are accessing the same RAM block at the same time, a high level of bus collisions may cause too slow operation for correct on the fly encryption. In this case the ERROR event will be generated.

The EasyDMA will have finished accessing the RAM when the ENDKSGEN and ENDCRYPT events are generated.

If the CNFPTR, SCRATCHPTR, INPTR and the OUTPTR are not pointing to the Data RAM region, an EasyDMA transfer may result in a HardFault or RAM corruption. See [Memory](#) on page 15 for more information about the different memory regions.

## 6.4.9 Registers

Base address	Peripheral	Instance	Description	Configuration
0x4000F000	CCM	CCM	AES CCM mode encryption	

Table 27: Instances

Register	Offset	Description
TASKS_KSGEN	0x000	Start generation of key-stream. This operation will stop by itself when completed.
TASKS_CRYPT	0x004	Start encryption/decryption. This operation will stop by itself when completed.
TASKS_STOP	0x008	Stop encryption/decryption
TASKS_RATEOVERRIDE	0x00C	Override DATARATE setting in MODE register with the contents of the RATEOVERRIDE register for any ongoing encryption/decryption
EVENTS_ENDKSGEN	0x100	Key-stream generation complete
EVENTS_ENDCRYPT	0x104	Encrypt/decrypt complete
EVENTS_ERROR	0x108	CCM error event
SHORTS	0x200	Shortcut register
INTENSET	0x304	Enable interrupt
INTENCLR	0x308	Disable interrupt
MICSTATUS	0x400	MIC check result
ENABLE	0x500	Enable
MODE	0x504	Operation mode
CNFPTR	0x508	Pointer to data structure holding AES key and NONCE vector
INPTR	0x50C	Input pointer
OUTPTR	0x510	Output pointer
SCRATCHPTR	0x514	Pointer to data area used for temporary storage



Register	Offset	Description
MAXPACKETSIZE	0x518	Length of key-stream generated when MODE.LENGTH = Extended.
RATEOVERRIDE	0x51C	Data rate override setting.

Table 28: Register Overview

### 6.4.9.1 SHORTS

Address offset: 0x200

Shortcut register

Bit number					31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0																															
Id					A																															
Reset 0x00000000					0 0																															
Id	RW	Field	Value Id	Value	Description																															
A	RW	ENDKSGEN_CRYPT			Shortcut between ENDKSGEN event and CRYPT task																															
					See <a href="#">EVENTS_ENDKSGEN</a> and <a href="#">TASKS_CRYPT</a>																															
			Disabled	0	Disable shortcut																															
			Enabled	1	Enable shortcut																															

### 6.4.9.2 INTENSET

Address offset: 0x304

Enable interrupt

Bit number			31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0																															
Id			C B A																															
Reset 0x00000000			0 0																															
Id	RW	Field	Value	Id	Value	Description																												
A	RW	ENDKSGEN				Write '1' to Enable interrupt for ENDKSGEN event																												
						See <a href="#">EVENTS_ENDKSGEN</a>																												
			Set	1		Enable																												
			Disabled	0		Read: Disabled																												
			Enabled	1		Read: Enabled																												
B	RW	ENDCRYPT				Write '1' to Enable interrupt for ENDCRYPT event																												
						See <a href="#">EVENTS_ENDCRYPT</a>																												
			Set	1		Enable																												
			Disabled	0		Read: Disabled																												
			Enabled	1		Read: Enabled																												
C	RW	ERROR				Write '1' to Enable interrupt for ERROR event																												
						See <a href="#">EVENTS_ERROR</a>																												
			Set	1		Enable																												
			Disabled	0		Read: Disabled																												
			Enabled	1		Read: Enabled																												

### 6.4.9.3 INTENCLR

Address offset: 0x308

Disable interrupt

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0																															
Id				C B A																															
Reset 0x00000000				0 0																															
Id	RW	Field	Value	Id	Value	Description																													
A	RW	ENDKSGEN				Write '1' to Disable interrupt for ENDKSGEN event																													
						See <a href="#">EVENTS_ENDKSGEN</a>																													
			Clear	1		Disable																													
			Disabled	0		Read: Disabled																													
			Enabled	1		Read: Enabled																													
B	RW	ENDCRYPT				Write '1' to Disable interrupt for ENDCRYPT event																													
						See <a href="#">EVENTS_ENDCRYPT</a>																													
			Clear	1		Disable																													
			Disabled	0		Read: Disabled																													
			Enabled	1		Read: Enabled																													
C	RW	ERROR				Write '1' to Disable interrupt for ERROR event																													
						See <a href="#">EVENTS_ERROR</a>																													
			Clear	1		Disable																													
			Disabled	0		Read: Disabled																													
			Enabled	1		Read: Enabled																													

#### 6.4.9.4 MICSTATUS

Address offset: 0x400

MIC check result

Bit number					31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0	
Id																																					A
Reset 0x00000000					0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Id	RW	Field	Value	Id	Value	Description																															
A	R	MICSTATUS				The result of the MIC check performed during the previous decryption operation																															
		CheckFailed	0			MIC check failed																															
		CheckPassed	1			MIC check passed																															

#### 6.4.9.5 ENABLE

Address offset: 0x500

Enable

Bit number				31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0		
Id																																				A	A
Reset 0x00000000				0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0		
Id	RW	Field	Value	Id	Value	Description																															
A	RW	ENABLE				Enable or disable CCM																															
			Disabled	0		Disable																															
			Enabled	2		Enable																															

#### 6.4.9.6 MODE

Address offset: 0x504

Operation mode

Bit number				31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0	
Id				C												B												A								
Reset 0x00000001				0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	
Id	RW	Field	Value Id	Value	Description																															
A	RW	MODE			The mode of operation to be used. The settings in this register apply whenever either the KSGEN or CRYPT tasks are triggered.																															
			Encryption	0	AES CCM packet encryption mode																															
			Decryption	1	AES CCM packet decryption mode																															
B	RW	DATARATE			Radio data rate that the CCM shall run synchronous with																															
			1Mbit	0	1 Mbps																															
			2Mbit	1	2 Mbps																															
			125Kbps	2	125 Kbps																															
			500Kbps	3	500 Kbps																															
C	RW	LENGTH			Packet length configuration																															
			Default	0	Default length. Effective length of LENGTH field in encrypted/decrypted packet is 5 bits. A key-stream for packet payloads up to 27 bytes will be generated.																															
			Extended	1	Extended length. Effective length of LENGTH field in encrypted/decrypted packet is 8 bits. A key-stream for packet payloads up to MAXPACKETSIZE bytes will be generated.																															

#### 6.4.9.7 CNFPTR

Address offset: 0x508

Pointer to data structure holding AES key and NONCE vector

Bit number					31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
Id					A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A
Reset 0x00000000					0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Id	RW	Field		Value	Id		Value		Description																											
A	RW	CNFPTR							Pointer to the data structure holding the AES key and the CCM NONCE vector (see Table 1 CCM data structure overview)																											

#### 6.4.9.8 INPTR

Address offset: 0x50C

Input pointer

Bit number				31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
Id				A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A
Reset 0x00000000				0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Id	RW	Field	Value	Id	Value		Description																												
A	RW	INPTR					Input pointer																												

#### 6.4.9.9 OUTPTR

Address offset: 0x510

Output pointer

Bit number	31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0																													
Id	A A																													
Reset 0x00000000	0 0																													
Id	RW	Field	Value	Id	Value	Description																								
A	RW	OUTPTR				Output pointer																								

#### 6.4.9.10 SCRATCHPTR

Address offset: 0x514

Pointer to data area used for temporary storage

Bit number					31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0																															
Id					A A																															
Reset 0x00000000					0 0																															
Id	RW	Field	Value	Id	Value	Description																														
A	RW	SCRATCHPTR				<p>Pointer to a scratch data area used for temporary storage during key-stream generation, MIC generation and encryption/decryption.</p> <p>The scratch area is used for temporary storage of data during key-stream generation and encryption.</p> <p>When MODE.LENGTH = Default, a space of 43 bytes is required for this temporary storage. MODE.LENGTH = Extended (16 + MAXPACKETSIZE) bytes of storage is required.</p>																														

#### 6.4.9.11 MAXPACKETSIZE

Address offset: 0x518

Length of key-stream generated when MODE.LENGTH = Extended.

Bit number	31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0																													
Id	A A																													
Reset 0x000000FB	0 0																													
Id	RW	Field	Value	Id	Value	Description																								
A	RW	MAXPACKETSIZE			[0x001B..0x00FB]	<p>Length of key-stream generated when MODE.LENGTH = Extended. This value must be greater or equal to the subsequent packet payload to be encrypted/decrypted.</p>																								

#### 6.4.9.12 RATEOVERRIDE

Address offset: 0x51C

Data rate override setting.

Override value to be used instead of the setting of MODE.DATARATE. This override value applies when the RATEOVERRIDE task is triggered.

Bit number					31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0																															
Id					A A																															
Reset 0x00000000					0 0																															
Id	RW	Field	Value	Id	Value	Description																														
A	RW	RATEOVERRIDE				Data rate override setting.																														
			1Mbit		0	1 Mbps																														
			2Mbit		1	2 Mbps																														
			125Kbps		2	125 Kbps																														
			500Kbps		3	500 Kbps																														

## 6.4.10 Electrical specification

### 6.4.10.1 Timing specification

Symbol	Description	Min.	Typ.	Max.	Units
$t_{\text{kgen}}$	Time needed for key-stream generation (given priority access to destination RAM block).	..	..	..	$\mu\text{s}$

## 6.5 COMP — Comparator

The comparator (COMP) compares an input voltage (VIN+) against a second input voltage (VIN-). VIN+ can be derived either from an analog input pin (AIN0-AIN6) or VDD/2. VIN- can be derived from multiple sources depending on the operation mode of the comparator.

Main features of the comparator are:

- Input range from 0 V to VDD
- Single-ended mode
  - Fully flexible hysteresis using a 64-level reference ladder
- Differential mode
  - Configurable hysteresis
- Reference inputs (VREF):
  - VDD
  - External reference from AIN0 to AIN7 (between 0 V and VDD)
  - Internal references 1.2 V, 1.8 V and 2.4 V
- Three speed/power consumption modes: low-power, normal and high-speed
- Event generation on output changes
  - UP event on VIN- > VIN+
  - DOWN event on VIN- < VIN+
  - CROSS event on VIN+ and VIN- crossing
  - READY event on core and internal reference (if used) ready

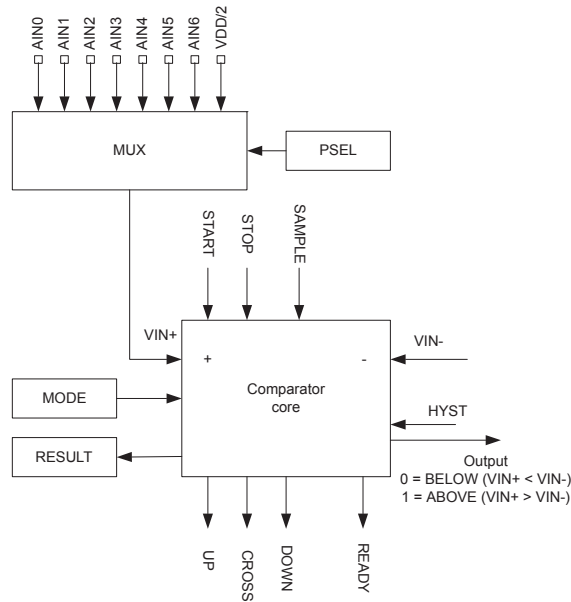


Figure 33: Comparator overview

Once enabled (using the [ENABLE](#) register), the comparator is started by triggering the START task and stopped by triggering the STOP task. After a start-up time of  $t_{\text{COMP,START}}$ , the comparator will generate a READY event to indicate that it is ready for use and that its output is correct. When the COMP module is started, events will be generated every time VIN+ crosses VIN-.

## Operation modes

The comparator can be configured to operate in two main operation modes, differential mode and single-ended mode. See the [MODE](#) register for more information. In both operation modes, the comparator can operate in different speed and power consumption modes (low-power, normal and high-speed). High-speed mode will consume more power compared to low-power mode, and low-power mode will result in slower response time compared to high-speed mode.

Use the [PSEL](#) register to select any of the AIN0-AIN6 pins (or VDD/2) as VIN+ input, regardless of the operation mode selected for the comparator. The source of VIN- depends on which operation mode is used:

- Differential mode: Derived directly from AIN0 to AIN7
- Single-ended mode: Derived from VREF. VREF can be derived from VDD, AIN0-AIN7 or internal 1.2 V, 1.8 V and 2.4 V references.

The selected analog pins will be acquired by the comparator once it is enabled.

An optional hysteresis on VIN+ and VIN- can be enabled when the module is used in differential mode through the [HYST](#) register. In single-ended mode, VUP and VDOWN thresholds can be set to implement a hysteresis using the reference ladder (see [Comparator in single-ended mode](#) on page 120). This hysteresis is in the order of magnitude of 30 mV, and shall prevent noise on the signal to create unwanted events. See [Hysteresis example where VIN+ starts below VUP](#) on page 121 for illustration of the effect of an active hysteresis on a noisy input signal.

An upward crossing will generate an UP event and a downward crossing will generate a DOWN event. The CROSS event will be generated every time there is a crossing, independent of direction.

The immediate value of the comparator can be sampled to [RESULT](#) register by triggering the SAMPLE task.

## 6.5.1 Differential mode

In differential mode, the reference input VIN- is derived directly from one of the AINx pins.

Before enabling the comparator via the [ENABLE](#) register, the following registers must be configured for the differential mode:

- [PSEL](#)
- [MODE](#)
- [EXTREFSEL](#)

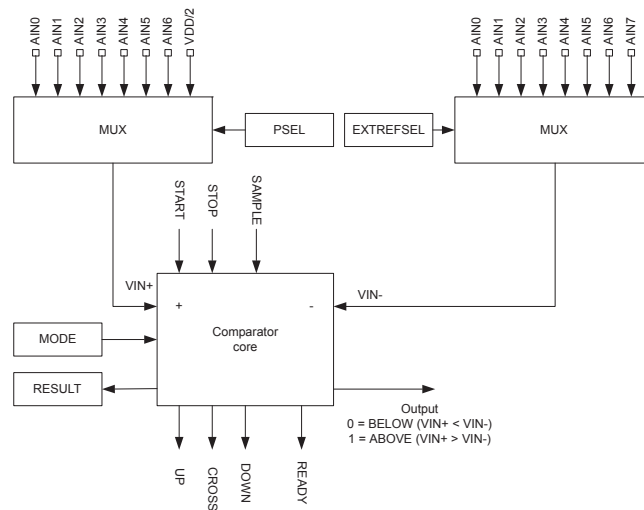


Figure 34: Comparator in differential mode

**Restriction:** Depending on the device, not all the analog inputs may be available for each MUX. See definitions for [PSEL](#) and [EXTREFSEL](#) for more information about which analog pins are available on a particular device.

When [HYST](#) register is turned on while in this mode, the output of the comparator (and associated events) will change from ABOVE to BELOW whenever VIN+ becomes lower than VIN- ( $V_{\text{DIFFHYST}} / 2$ ). It will also change from BELOW to ABOVE whenever VIN+ becomes higher than VIN- + ( $V_{\text{DIFFHYST}} / 2$ ). This behavior is illustrated in [Hysteresis enabled in differential mode](#) on page 119.

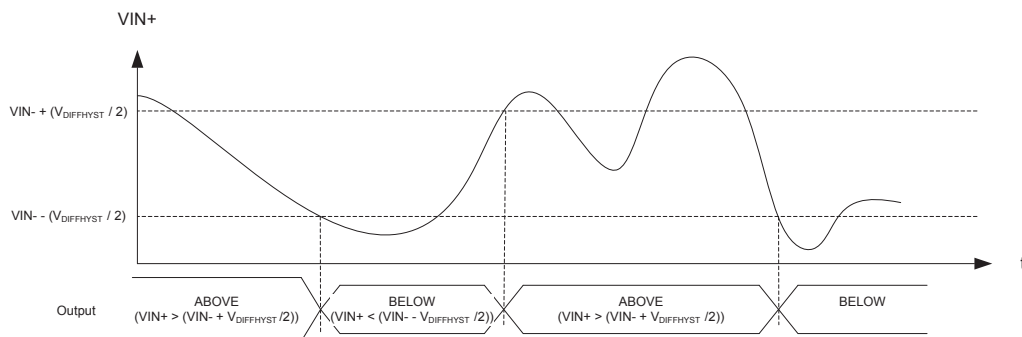


Figure 35: Hysteresis enabled in differential mode

## 6.5.2 Single-ended mode

In single-ended mode, VIN- is derived from the reference ladder.

Before enabling the comparator via the [ENABLE](#) register, the following registers must be configured for the single-ended mode:

- [PSEL](#)
- [MODE](#)
- [REFSEL](#)
- [EXTREFSEL](#)
- [TH](#)

The reference ladder uses the reference voltage (VREF) to derive two new voltage references, VUP and VDOWN. VUP and VDOWN are configured using THUP and THDOWN respectively in the [TH](#) register. VREF can be derived from any of the available reference sources, configured using the [EXTREFSEL](#) and [REFSEL](#) registers as illustrated in [Comparator in single-ended mode](#) on page 120. When AREF is selected in the [REFSEL](#) register, the [EXTREFSEL](#) register is used to select one of the AIN0-AIN7 analog input pins as reference input. The selected analog pins will be acquired by the comparator once it is enabled.

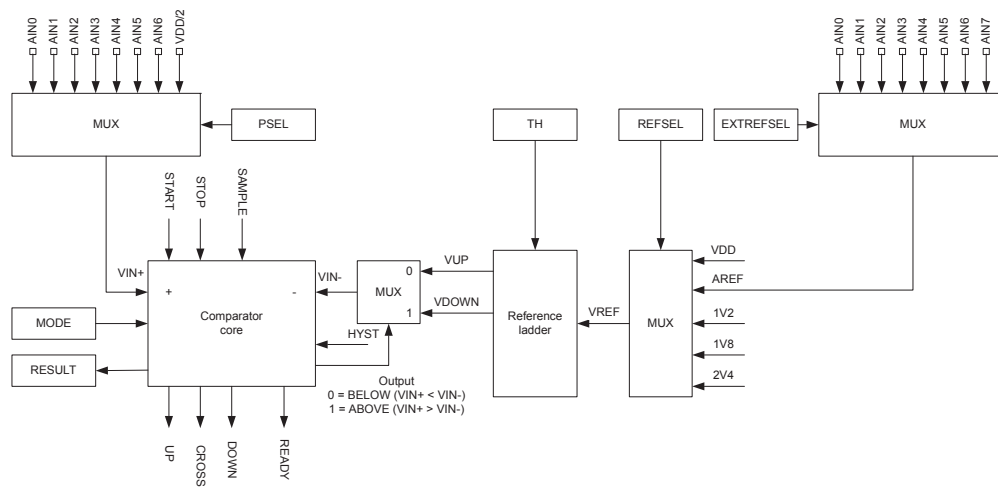


Figure 36: Comparator in single-ended mode

**Restriction:** Depending on the device, not all the analog inputs may be available for each MUX. See definitions for [PSEL](#) and [EXTREFSEL](#) for more information about which analog pins are available on a particular device.

When the comparator core detects that  $VIN+ > VIN-$ , i.e. ABOVE as per the [RESULT](#) register,  $VIN-$  will switch to VDOWN. When  $VIN+$  falls below  $VIN-$  again,  $VIN-$  will be switched back to VUP. By specifying VUP larger than VDOWN, a hysteresis can be generated as illustrated in [Hysteresis example where  \$VIN+\$  starts below VUP](#) on page 121 and [Hysteresis example where  \$VIN+\$  starts above VUP](#) on page 121.

Writing to [HYST](#) has no effect in single-ended mode, and the content of this register is ignored.



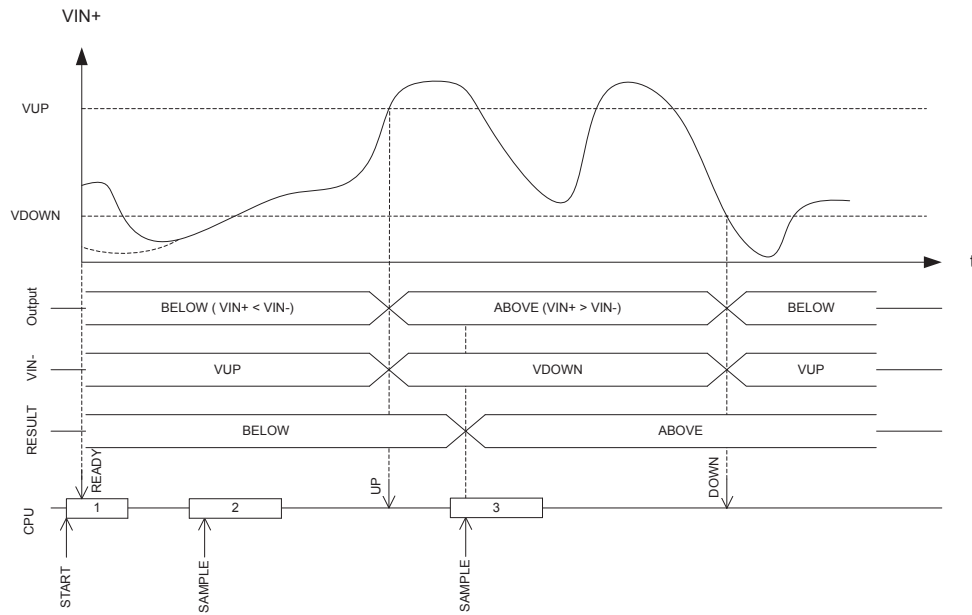


Figure 37: Hysteresis example where  $VIN+$  starts below  $VUP$

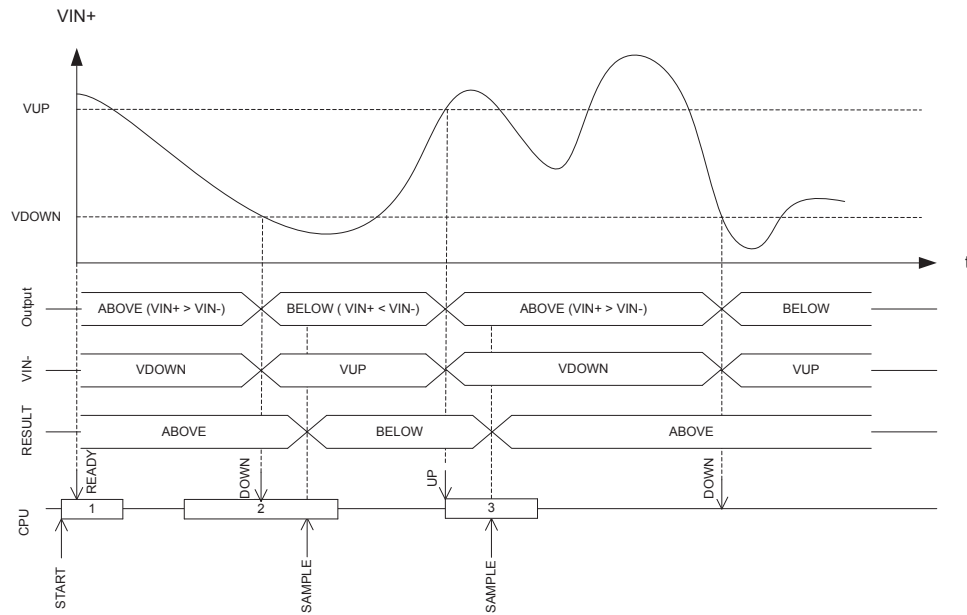


Figure 38: Hysteresis example where  $VIN+$  starts above  $VUP$

### 6.5.3 Registers

Base address	Peripheral	Instance	Description	Configuration
0x40013000	COMP	COMP	General purpose comparator	

Table 29: Instances

Register	Offset	Description
TASKS_START	0x000	Start comparator

Register	Offset	Description
TASKS_STOP	0x004	Stop comparator
TASKS_SAMPLE	0x008	Sample comparator value
EVENTS_READY	0x100	COMP is ready and output is valid
EVENTS_DOWN	0x104	Downward crossing
EVENTS_UP	0x108	Upward crossing
EVENTS_CROSS	0x10C	Downward or upward crossing
SHORTS	0x200	Shortcut register
INTEN	0x300	Enable or disable interrupt
INTENSET	0x304	Enable interrupt
INTENCLR	0x308	Disable interrupt
RESULT	0x400	Compare result
ENABLE	0x500	COMP enable
PSEL	0x504	Pin select
REFSEL	0x508	Reference source select for single-ended mode
EXTREFSEL	0x50C	External reference select
TH	0x530	Threshold configuration for hysteresis unit
MODE	0x534	Mode configuration
HYST	0x538	Comparator hysteresis enable

Table 30: Register Overview

### 6.5.3.1 SHORTS

Address offset: 0x200

Shortcut register

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0																															
Id				E D C B A																															
Reset 0x00000000				0 0																															
Id	RW	Field	Value Id	Value	Description																														
A	RW	READY_SAMPLE			Shortcut between READY event and SAMPLE task																														
					See <a href="#">EVENTS_READY</a> and <a href="#">TASKS_SAMPLE</a>																														
			Disabled	0	Disable shortcut																														
			Enabled	1	Enable shortcut																														
B	RW	READY_STOP			Shortcut between READY event and STOP task																														
					See <a href="#">EVENTS_READY</a> and <a href="#">TASKS_STOP</a>																														
			Disabled	0	Disable shortcut																														
			Enabled	1	Enable shortcut																														
C	RW	DOWN_STOP			Shortcut between DOWN event and STOP task																														
					See <a href="#">EVENTS_DOWN</a> and <a href="#">TASKS_STOP</a>																														
			Disabled	0	Disable shortcut																														
			Enabled	1	Enable shortcut																														
D	RW	UP_STOP			Shortcut between UP event and STOP task																														
					See <a href="#">EVENTS_UP</a> and <a href="#">TASKS_STOP</a>																														
			Disabled	0	Disable shortcut																														
			Enabled	1	Enable shortcut																														
E	RW	CROSS_STOP			Shortcut between CROSS event and STOP task																														
					See <a href="#">EVENTS_CROSS</a> and <a href="#">TASKS_STOP</a>																														
			Disabled	0	Disable shortcut																														
			Enabled	1	Enable shortcut																														

### 6.5.3.2 INTEN

Address offset: 0x300

Enable or disable interrupt

Bit number			31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0																																					
Id																																					D	C	B	A
Reset 0x00000000			0 0																																					
Id	RW	Field	Value Id	Value	Description																																			
A	RW	READY			Enable or disable interrupt for READY event																																			
					See <a href="#">EVENTS_READY</a>																																			
			Disabled	0	Disable																																			
			Enabled	1	Enable																																			
B	RW	DOWN			Enable or disable interrupt for DOWN event																																			
					See <a href="#">EVENTS_DOWN</a>																																			
			Disabled	0	Disable																																			
			Enabled	1	Enable																																			
C	RW	UP			Enable or disable interrupt for UP event																																			
					See <a href="#">EVENTS_UP</a>																																			
			Disabled	0	Disable																																			
			Enabled	1	Enable																																			
D	RW	CROSS			Enable or disable interrupt for CROSS event																																			
					See <a href="#">EVENTS_CROSS</a>																																			
			Disabled	0	Disable																																			
			Enabled	1	Enable																																			

### 6.5.3.3 INTENSET

Address offset: 0x304

Enable interrupt

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0																															
Id				D C B A																															
Reset 0x00000000				0 0																															
Id	RW	Field	Value Id	Value	Description																														
A	RW	READY			Write '1' to Enable interrupt for READY event																														
					See <a href="#">EVENTS_READY</a>																														
			Set	1	Enable																														
			Disabled	0	Read: Disabled																														
			Enabled	1	Read: Enabled																														
B	RW	DOWN			Write '1' to Enable interrupt for DOWN event																														
					See <a href="#">EVENTS_DOWN</a>																														
			Set	1	Enable																														
			Disabled	0	Read: Disabled																														
			Enabled	1	Read: Enabled																														
C	RW	UP			Write '1' to Enable interrupt for UP event																														
					See <a href="#">EVENTS_UP</a>																														
			Set	1	Enable																														
			Disabled	0	Read: Disabled																														
			Enabled	1	Read: Enabled																														

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0																															
Id				D C B A																															
Reset 0x00000000				0 0																															
Id	RW	Field	Value Id	Value	Description																														
D	RW	CROSS			Write '1' to Enable interrupt for CROSS event																														
					See <a href="#">EVENTS_CROSS</a>																														
			Set	1	Enable																														
			Disabled	0	Read: Disabled																														
			Enabled	1	Read: Enabled																														

### 6.5.3.4 INTENCLR

Address offset: 0x308

Disable interrupt

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0																															
Id				D C B A																															
Reset 0x00000000				0 0																															
Id	RW	Field	Value Id	Value	Description																														
A	RW	READY			Write '1' to Disable interrupt for READY event																														
					See <a href="#">EVENTS_READY</a>																														
			Clear	1	Disable																														
			Disabled	0	Read: Disabled																														
			Enabled	1	Read: Enabled																														
B	RW	DOWN			Write '1' to Disable interrupt for DOWN event																														
					See <a href="#">EVENTS_DOWN</a>																														
			Clear	1	Disable																														
			Disabled	0	Read: Disabled																														
			Enabled	1	Read: Enabled																														
C	RW	UP			Write '1' to Disable interrupt for UP event																														
					See <a href="#">EVENTS_UP</a>																														
			Clear	1	Disable																														
			Disabled	0	Read: Disabled																														
			Enabled	1	Read: Enabled																														
D	RW	CROSS			Write '1' to Disable interrupt for CROSS event																														
					See <a href="#">EVENTS_CROSS</a>																														
			Clear	1	Disable																														
			Disabled	0	Read: Disabled																														
			Enabled	1	Read: Enabled																														

### 6.5.3.5 RESULT

Address offset: 0x400

Compare result

Bit number				31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0	
Id																																				A
Reset 0x00000000				0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
Id	RW	Field	Value Id	Value	Description																															
A	R	RESULT			Result of last compare. Decision point SAMPLE task.																															
			Below	0	Input voltage is below the threshold (VIN+ < VIN-)																															
			Above	1	Input voltage is above the threshold (VIN+ > VIN-)																															

### 6.5.3.6 ENABLE

Address offset: 0x500

COMP enable

Bit number				31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0		
Id																																				A	A
Reset 0x00000000				0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
Id	RW	Field	Value Id	Value	Description																																
A	RW	ENABLE			Enable or disable COMP																																
			Disabled	0	Disable																																
			Enabled	2	Enable																																

### 6.5.3.7 PSEL

Address offset: 0x504

Pin select

Bit number				31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0						
Id																																							A	A	A
Reset 0x00000000				0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0					
Id	RW	Field	Value Id	Value	Description																																				
A	RW	PSEL			Analog pin select																																				
			AnalogInput0	0	AIN0 selected as analog input																																				
			AnalogInput1	1	AIN1 selected as analog input																																				
			AnalogInput2	2	AIN2 selected as analog input																																				
			AnalogInput3	3	AIN3 selected as analog input																																				
			AnalogInput4	4	AIN4 selected as analog input																																				
			AnalogInput5	5	AIN5 selected as analog input																																				
			AnalogInput6	6	AIN6 selected as analog input																																				
			VddDiv2	7	VDD/2 selected as analog input																																				

### 6.5.3.8 REFSEL

Address offset: 0x508

Reference source select for single-ended mode

Bit number		31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0				
Id				A	A	A
Reset 0x00000004		0 0		1	0	0
Id	RW	Field	Value Id	Value	Description	
A	RW	REFSEL			Reference select	
			Int1V2	0	VREF = internal 1.2 V reference (VDD >= 1.7 V)	
			Int1V8	1	VREF = internal 1.8 V reference (VDD >= VREF + 0.2 V)	
			Int2V4	2	VREF = internal 2.4 V reference (VDD >= VREF + 0.2 V)	
			VDD	4	VREF = VDD	
			AREF	5	VREF = AREF (VDD >= VREF >= AREFMIN)	

### 6.5.3.9 EXTREFSEL

Address offset: 0x50C

External reference select

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0																																		
Id																																				A	A	A
Reset 0x00000000				0 0																																		
Id	RW	Field	Value Id	Value	Description																																	
A	RW	EXTREFSEL			External analog reference select																																	
			AnalogReference0	0	Use AIN0 as external analog reference																																	
			AnalogReference1	1	Use AIN1 as external analog reference																																	
			AnalogReference2	2	Use AIN2 as external analog reference																																	
			AnalogReference3	3	Use AIN3 as external analog reference																																	
			AnalogReference4	4	Use AIN4 as external analog reference																																	
			AnalogReference5	5	Use AIN5 as external analog reference																																	
			AnalogReference6	6	Use AIN6 as external analog reference																																	
			AnalogReference7	7	Use AIN7 as external analog reference																																	

### 6.5.3.10 TH

Address offset: 0x530

Threshold configuration for hysteresis unit

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0																															
Id				B B B B B B A A A A A A																															
Reset 0x00000000				0 0																															
Id	RW	Field	Value Id	Value	Description																														
A	RW	THDOWN		[63:0]	VDOWN = (THDOWN+1)/64*VREF																														
B	RW	THUP		[63:0]	VUP = (THUP+1)/64*VREF																														

### 6.5.3.11 MODE

Address offset: 0x534

Mode configuration

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0																																	
Id																																B		A		A	
Reset 0x00000000				0 0																																	
Id	RW	Field	Value Id	Value	Description																																
A	RW	SP			Speed and power modes																																
			Low	0	Low-power mode																																
			Normal	1	Normal mode																																
			High	2	High-speed mode																																
B	RW	MAIN			Main operation modes																																
			SE	0	Single-ended mode																																
			Diff	1	Differential mode																																

### 6.5.3.12 HYST

Address offset: 0x538

Comparator hysteresis enable

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0																															
Id																																			
Reset 0x00000000				0 0																															
Id	RW	Field	Value Id	Value	Description																														
A	RW	HYST			Comparator hysteresis																														
			NoHyst	0	Comparator hysteresis disabled																														
			Hyst50mV	1	Comparator hysteresis enabled																														

## 6.5.4 Electrical specification

### 6.5.4.1 COMP Electrical Specification

Symbol	Description	Min.	Typ.	Max.	Units
$t_{\text{PROPDLY,LP}}$	Propagation delay, low-power mode <sup>a</sup>		0.6		$\mu\text{S}$
$t_{\text{PROPDLY,N}}$	Propagation delay, normal mode <sup>a</sup>		0.2		$\mu\text{S}$
$t_{\text{PROPDLY,HS}}$	Propagation delay, high-speed mode <sup>a</sup>		0.1		$\mu\text{S}$
$V_{\text{DIFFHYST}}$	Optional hysteresis applied to differential input		30		mV
$V_{\text{VDD-VREF}}$	Required difference between VDD and a selected VREF, VDD > VREF	0.3			V
$t_{\text{INT\_REF,START}}$	Startup time for the internal bandgap reference		50	80	$\mu\text{S}$
$E_{\text{INT\_REF}}$	Internal bandgap reference error	-3		3	%
$V_{\text{INPUTOFFSET}}$	Input offset	-10		10	mV
$t_{\text{COMP,START}}$	Startup time for the comparator core		3		$\mu\text{S}$

## 6.6 ECB — AES electronic codebook mode encryption

The AES electronic codebook mode encryption (ECB) can be used for a range of cryptographic functions like hash generation, digital signatures, and keystream generation for data encryption/decryption. The ECB encryption block supports 128 bit AES encryption (encryption only, not decryption).

<sup>a</sup> Propagation delay is with 10 mV overdrive.

AES ECB operates with EasyDMA access to system Data RAM for in-place operations on cleartext and ciphertext during encryption. ECB uses the same AES core as the CCM and AAR blocks and is an asynchronous operation which may not complete if the AES core is busy.

AES ECB features:

- 128 bit AES encryption
- Supports standard AES ECB block encryption
- Memory pointer support
- DMA data transfer

AES ECB performs a 128 bit AES block encrypt. At the STARTECB task, data and key is loaded into the algorithm by EasyDMA. When output data has been written back to memory, the ENDECB event is triggered.

AES ECB can be stopped by triggering the STOPECB task.

### 6.6.1 Shared resources

The ECB, CCM, and AAR share the same AES module. The ECB will always have lowest priority and if there is a sharing conflict during encryption, the ECB operation will be aborted and an ERRORECB event will be generated.

### 6.6.2 EasyDMA

The ECB implements an EasyDMA mechanism for reading and writing to the Data RAM. This DMA cannot access the program memory or any other parts of the memory area except RAM.

If the ECBDATAPTR is not pointing to the Data RAM region, an EasyDMA transfer may result in a HardFault or RAM corruption. See [Memory](#) on page 15 for more information about the different memory regions.

The EasyDMA will have finished accessing the Data RAM when the ENDECB or ERRORECB is generated.

### 6.6.3 ECB data structure

Input to the block encrypt and output from the block encrypt are stored in the same data structure. ECBDATAPTR should point to this data structure before STARTECB is initiated.

Property	Address offset	Description
KEY	0	16 byte AES key
CLEARTTEXT	16	16 byte AES cleartext input block
CIPHERTEXT	32	16 byte AES ciphertext output block

Table 31: ECB data structure overview

### 6.6.4 Registers

Base address	Peripheral	Instance	Description	Configuration
0x4000E000	ECB	ECB	AES Electronic Codebook (ECB) mode block encryption	

Table 32: Instances



Register	Offset	Description
TASKS_STARTECB	0x000	Start ECB block encrypt
TASKS_STOPECB	0x004	Abort a possible executing ECB operation
EVENTS_ENDECB	0x100	ECB block encrypt complete
EVENTS_ERROR ECB	0x104	ECB block encrypt aborted because of a STOPECB task or due to an error
INTENSET	0x304	Enable interrupt
INTENCLR	0x308	Disable interrupt
ECBDATAPTR	0x504	ECB block encrypt memory pointers

Table 33: Register Overview

### 6.6.4.1 INTENSET

Address offset: 0x304

Enable interrupt

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0																															
Id				B A																															
Reset 0x00000000				0 0																															
Id	RW	Field	Value	Id	Value	Description																													
A	RW	ENDECB				Write '1' to Enable interrupt for ENDECB event																													
						See <a href="#">EVENTS_ENDECB</a>																													
		Set	1			Enable																													
		Disabled	0			Read: Disabled																													
		Enabled	1			Read: Enabled																													
B	RW	ERROR ECB				Write '1' to Enable interrupt for ERROR ECB event																													
						See <a href="#">EVENTS_ERROR ECB</a>																													
		Set	1			Enable																													
		Disabled	0			Read: Disabled																													
		Enabled	1			Read: Enabled																													

### 6.6.4.2 INTENCLR

Address offset: 0x308

Disable interrupt

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0																															
Id				B A																															
Reset 0x00000000				0 0																															
Id	RW	Field	Value	Id	Value	Description																													
A	RW	ENDECB				Write '1' to Disable interrupt for ENDECB event																													
						See <a href="#">EVENTS_ENDECB</a>																													
		Clear	1			Disable																													
		Disabled	0			Read: Disabled																													
		Enabled	1			Read: Enabled																													
B	RW	ERROR ECB				Write '1' to Disable interrupt for ERROR ECB event																													
						See <a href="#">EVENTS_ERROR ECB</a>																													
		Clear	1			Disable																													
		Disabled	0			Read: Disabled																													
		Enabled	1			Read: Enabled																													

### 6.6.4.3 ECBDATAPTR

Address offset: 0x504

ECB block encrypt memory pointers

Bit number				31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0			
Id				A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A			
Reset 0x00000000				0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0			
Id	RW	Field	Value Id	Value		Description																																
A	RW	ECBDATAPTR				Pointer to the ECB data structure (see Table 1 ECB data structure overview)																																

## 6.6.5 Electrical specification

### 6.6.5.1 ECB Electrical Specification

Symbol	Description	Min.	Typ.	Max.	Units
$t_{ECB}$	Run time per 16 byte block in all modes		6		$\mu s$

## 6.7 EGU — Event generator unit

The Event generator unit (EGU) provides support for inter-layer signaling. This means support for atomic triggering of both CPU execution and hardware tasks from both firmware (by CPU) and hardware (by PPI). This feature can, for instance, be used for triggering CPU execution at a lower priority execution from a higher priority execution, or to handle a peripheral's ISR execution at a lower priority for some of its events. However, triggering any priority from any priority is possible.

Listed here are the main EGU features:

- Enables SW triggering of interrupts
- Separate interrupt vectors for every EGU instance
- Up to 16 separate event flags per interrupt for multiplexing

Each instance of The EGU implements a set of tasks which can individually be triggered to generate the corresponding event, i.e., the corresponding event for TASKS\_TRIGGER[n] is EVENTS\_TRIGGERED[n].

Refer to [Instances](#) on page 130 for a list of the various EGU instances

### 6.7.1 Registers

Base address	Peripheral	Instance	Description	Configuration
0x40014000	EGU	EGU0	Event generator unit 0	
0x40015000	EGU	EGU1	Event generator unit 1	

Table 34: Instances

Register	Offset	Description
TASKS_TRIGGER[0]	0x000	Trigger 0 for triggering the corresponding TRIGGERED[0] event
TASKS_TRIGGER[1]	0x004	Trigger 1 for triggering the corresponding TRIGGERED[1] event
TASKS_TRIGGER[2]	0x008	Trigger 2 for triggering the corresponding TRIGGERED[2] event
TASKS_TRIGGER[3]	0x00C	Trigger 3 for triggering the corresponding TRIGGERED[3] event
TASKS_TRIGGER[4]	0x010	Trigger 4 for triggering the corresponding TRIGGERED[4] event

Register	Offset	Description
TASKS_TRIGGER[5]	0x014	Trigger 5 for triggering the corresponding TRIGGERED[5] event
TASKS_TRIGGER[6]	0x018	Trigger 6 for triggering the corresponding TRIGGERED[6] event
TASKS_TRIGGER[7]	0x01C	Trigger 7 for triggering the corresponding TRIGGERED[7] event
TASKS_TRIGGER[8]	0x020	Trigger 8 for triggering the corresponding TRIGGERED[8] event
TASKS_TRIGGER[9]	0x024	Trigger 9 for triggering the corresponding TRIGGERED[9] event
TASKS_TRIGGER[10]	0x028	Trigger 10 for triggering the corresponding TRIGGERED[10] event
TASKS_TRIGGER[11]	0x02C	Trigger 11 for triggering the corresponding TRIGGERED[11] event
TASKS_TRIGGER[12]	0x030	Trigger 12 for triggering the corresponding TRIGGERED[12] event
TASKS_TRIGGER[13]	0x034	Trigger 13 for triggering the corresponding TRIGGERED[13] event
TASKS_TRIGGER[14]	0x038	Trigger 14 for triggering the corresponding TRIGGERED[14] event
TASKS_TRIGGER[15]	0x03C	Trigger 15 for triggering the corresponding TRIGGERED[15] event
EVENTS_TRIGGERED[0]	0x100	Event number 0 generated by triggering the corresponding TRIGGER[0] task
EVENTS_TRIGGERED[1]	0x104	Event number 1 generated by triggering the corresponding TRIGGER[1] task
EVENTS_TRIGGERED[2]	0x108	Event number 2 generated by triggering the corresponding TRIGGER[2] task
EVENTS_TRIGGERED[3]	0x10C	Event number 3 generated by triggering the corresponding TRIGGER[3] task
EVENTS_TRIGGERED[4]	0x110	Event number 4 generated by triggering the corresponding TRIGGER[4] task
EVENTS_TRIGGERED[5]	0x114	Event number 5 generated by triggering the corresponding TRIGGER[5] task
EVENTS_TRIGGERED[6]	0x118	Event number 6 generated by triggering the corresponding TRIGGER[6] task
EVENTS_TRIGGERED[7]	0x11C	Event number 7 generated by triggering the corresponding TRIGGER[7] task
EVENTS_TRIGGERED[8]	0x120	Event number 8 generated by triggering the corresponding TRIGGER[8] task
EVENTS_TRIGGERED[9]	0x124	Event number 9 generated by triggering the corresponding TRIGGER[9] task
EVENTS_TRIGGERED[10]	0x128	Event number 10 generated by triggering the corresponding TRIGGER[10] task
EVENTS_TRIGGERED[11]	0x12C	Event number 11 generated by triggering the corresponding TRIGGER[11] task
EVENTS_TRIGGERED[12]	0x130	Event number 12 generated by triggering the corresponding TRIGGER[12] task
EVENTS_TRIGGERED[13]	0x134	Event number 13 generated by triggering the corresponding TRIGGER[13] task
EVENTS_TRIGGERED[14]	0x138	Event number 14 generated by triggering the corresponding TRIGGER[14] task
EVENTS_TRIGGERED[15]	0x13C	Event number 15 generated by triggering the corresponding TRIGGER[15] task
INTEN	0x300	Enable or disable interrupt
INTENSET	0x304	Enable interrupt
INTENCLR	0x308	Disable interrupt

Table 35: Register Overview

### 6.7.1.1 INTEN

Address offset: 0x300

Enable or disable interrupt

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0																															
Id				P O N M L K J I H G F E D C B A																															
Reset 0x00000000				0 0																															
Id	RW	Field	Value Id	Value	Description																														
A	RW	TRIGGERED0			Enable or disable interrupt for TRIGGERED[0] event																														
					See <a href="#">EVENTS_TRIGGERED[0]</a>																														
			Disabled	0	Disable																														
			Enabled	1	Enable																														
B	RW	TRIGGERED1			Enable or disable interrupt for TRIGGERED[1] event																														
					See <a href="#">EVENTS_TRIGGERED[1]</a>																														
			Disabled	0	Disable																														
			Enabled	1	Enable																														
C	RW	TRIGGERED2			Enable or disable interrupt for TRIGGERED[2] event																														
					See <a href="#">EVENTS_TRIGGERED[2]</a>																														

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0																															
Id				P O N M L K J I H G F E D C B A																															
Reset 0x00000000				0 0																															
Id	RW	Field	Value Id	Value	Description																														
			Disabled	0	Disable																														
			Enabled	1	Enable																														
D	RW	TRIGGERED3			Enable or disable interrupt for TRIGGERED[3] event																														
					See <a href="#">EVENTS_TRIGGERED[3]</a>																														
			Disabled	0	Disable																														
			Enabled	1	Enable																														
E	RW	TRIGGERED4			Enable or disable interrupt for TRIGGERED[4] event																														
					See <a href="#">EVENTS_TRIGGERED[4]</a>																														
			Disabled	0	Disable																														
			Enabled	1	Enable																														
F	RW	TRIGGERED5			Enable or disable interrupt for TRIGGERED[5] event																														
					See <a href="#">EVENTS_TRIGGERED[5]</a>																														
			Disabled	0	Disable																														
			Enabled	1	Enable																														
G	RW	TRIGGERED6			Enable or disable interrupt for TRIGGERED[6] event																														
					See <a href="#">EVENTS_TRIGGERED[6]</a>																														
			Disabled	0	Disable																														
			Enabled	1	Enable																														
H	RW	TRIGGERED7			Enable or disable interrupt for TRIGGERED[7] event																														
					See <a href="#">EVENTS_TRIGGERED[7]</a>																														
			Disabled	0	Disable																														
			Enabled	1	Enable																														
I	RW	TRIGGERED8			Enable or disable interrupt for TRIGGERED[8] event																														
					See <a href="#">EVENTS_TRIGGERED[8]</a>																														
			Disabled	0	Disable																														
			Enabled	1	Enable																														
J	RW	TRIGGERED9			Enable or disable interrupt for TRIGGERED[9] event																														
					See <a href="#">EVENTS_TRIGGERED[9]</a>																														
			Disabled	0	Disable																														
			Enabled	1	Enable																														
K	RW	TRIGGERED10			Enable or disable interrupt for TRIGGERED[10] event																														
					See <a href="#">EVENTS_TRIGGERED[10]</a>																														
			Disabled	0	Disable																														
			Enabled	1	Enable																														
L	RW	TRIGGERED11			Enable or disable interrupt for TRIGGERED[11] event																														
					See <a href="#">EVENTS_TRIGGERED[11]</a>																														
			Disabled	0	Disable																														
			Enabled	1	Enable																														
M	RW	TRIGGERED12			Enable or disable interrupt for TRIGGERED[12] event																														
					See <a href="#">EVENTS_TRIGGERED[12]</a>																														
			Disabled	0	Disable																														
			Enabled	1	Enable																														
N	RW	TRIGGERED13			Enable or disable interrupt for TRIGGERED[13] event																														
					See <a href="#">EVENTS_TRIGGERED[13]</a>																														
			Disabled	0	Disable																														
			Enabled	1	Enable																														

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0																															
Id				P O N M L K J I H G F E D C B A																															
Reset 0x00000000				0 0																															
Id	RW	Field	Value	Id	Value	Description																													
O	RW	TRIGGERED14				Enable or disable interrupt for TRIGGERED[14] event																													
						See <a href="#">EVENTS_TRIGGERED[14]</a>																													
			Disabled		0	Disable																													
			Enabled		1	Enable																													
P	RW	TRIGGERED15				Enable or disable interrupt for TRIGGERED[15] event																													
						See <a href="#">EVENTS_TRIGGERED[15]</a>																													
			Disabled		0	Disable																													
			Enabled		1	Enable																													

### 6.7.1.2 INTENSET

Address offset: 0x304

Enable interrupt

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0																															
Id				P O N M L K J I H G F E D C B A																															
Reset 0x00000000				0 0																															
Id	RW	Field	Value	Id	Value	Description																													
A	RW	TRIGGERED0				Write '1' to Enable interrupt for TRIGGERED[0] event																													
						See <a href="#">EVENTS_TRIGGERED[0]</a>																													
			Set		1	Enable																													
			Disabled		0	Read: Disabled																													
			Enabled		1	Read: Enabled																													
B	RW	TRIGGERED1				Write '1' to Enable interrupt for TRIGGERED[1] event																													
						See <a href="#">EVENTS_TRIGGERED[1]</a>																													
			Set		1	Enable																													
			Disabled		0	Read: Disabled																													
			Enabled		1	Read: Enabled																													
C	RW	TRIGGERED2				Write '1' to Enable interrupt for TRIGGERED[2] event																													
						See <a href="#">EVENTS_TRIGGERED[2]</a>																													
			Set		1	Enable																													
			Disabled		0	Read: Disabled																													
			Enabled		1	Read: Enabled																													
D	RW	TRIGGERED3				Write '1' to Enable interrupt for TRIGGERED[3] event																													
						See <a href="#">EVENTS_TRIGGERED[3]</a>																													
			Set		1	Enable																													
			Disabled		0	Read: Disabled																													
			Enabled		1	Read: Enabled																													
E	RW	TRIGGERED4				Write '1' to Enable interrupt for TRIGGERED[4] event																													
						See <a href="#">EVENTS_TRIGGERED[4]</a>																													
			Set		1	Enable																													
			Disabled		0	Read: Disabled																													
			Enabled		1	Read: Enabled																													
F	RW	TRIGGERED5				Write '1' to Enable interrupt for TRIGGERED[5] event																													
						See <a href="#">EVENTS_TRIGGERED[5]</a>																													
			Set		1	Enable																													
			Disabled		0	Read: Disabled																													

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0																															
Id				P O N M L K J I H G F E D C B A																															
Reset 0x00000000				0 0																															
Id	RW	Field	Value Id	Value	Description																														
G	RW	TRIGGERED6	Enabled	1	Read: Enabled																														
			Write '1' to Enable interrupt for TRIGGERED[6] event																																
			See <a href="#">EVENTS_TRIGGERED[6]</a>																																
			Set	1	Enable																														
			Disabled	0	Read: Disabled																														
H	RW	TRIGGERED7	Enabled	1	Read: Enabled																														
			Write '1' to Enable interrupt for TRIGGERED[7] event																																
			See <a href="#">EVENTS_TRIGGERED[7]</a>																																
			Set	1	Enable																														
			Disabled	0	Read: Disabled																														
I	RW	TRIGGERED8	Enabled	1	Read: Enabled																														
			Write '1' to Enable interrupt for TRIGGERED[8] event																																
			See <a href="#">EVENTS_TRIGGERED[8]</a>																																
			Set	1	Enable																														
			Disabled	0	Read: Disabled																														
J	RW	TRIGGERED9	Enabled	1	Read: Enabled																														
			Write '1' to Enable interrupt for TRIGGERED[9] event																																
			See <a href="#">EVENTS_TRIGGERED[9]</a>																																
			Set	1	Enable																														
			Disabled	0	Read: Disabled																														
K	RW	TRIGGERED10	Enabled	1	Read: Enabled																														
			Write '1' to Enable interrupt for TRIGGERED[10] event																																
			See <a href="#">EVENTS_TRIGGERED[10]</a>																																
			Set	1	Enable																														
			Disabled	0	Read: Disabled																														
L	RW	TRIGGERED11	Enabled	1	Read: Enabled																														
			Write '1' to Enable interrupt for TRIGGERED[11] event																																
			See <a href="#">EVENTS_TRIGGERED[11]</a>																																
			Set	1	Enable																														
			Disabled	0	Read: Disabled																														
M	RW	TRIGGERED12	Enabled	1	Read: Enabled																														
			Write '1' to Enable interrupt for TRIGGERED[12] event																																
			See <a href="#">EVENTS_TRIGGERED[12]</a>																																
			Set	1	Enable																														
			Disabled	0	Read: Disabled																														
N	RW	TRIGGERED13	Enabled	1	Read: Enabled																														
			Write '1' to Enable interrupt for TRIGGERED[13] event																																
			See <a href="#">EVENTS_TRIGGERED[13]</a>																																
			Set	1	Enable																														
			Disabled	0	Read: Disabled																														
O	RW	TRIGGERED14	Enabled	1	Read: Enabled																														
			Write '1' to Enable interrupt for TRIGGERED[14] event																																
			See <a href="#">EVENTS_TRIGGERED[14]</a>																																
			Set	1	Enable																														
			Disabled	0	Read: Disabled																														

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0																															
Id				P O N M L K J I H G F E D C B A																															
Reset 0x00000000				0 0																															
Id	RW	Field	Value Id	Value	Description																														
P	RW	TRIGGERED15			Write '1' to Enable interrupt for TRIGGERED[15] event																														
					See <a href="#">EVENTS_TRIGGERED[15]</a>																														
			Set	1	Enable																														
			Disabled	0	Read: Disabled																														
			Enabled	1	Read: Enabled																														

### 6.7.1.3 INTENCLR

Address offset: 0x308

Disable interrupt

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0																															
Id				P O N M L K J I H G F E D C B A																															
Reset 0x00000000				0 0																															
Id	RW	Field	Value Id	Value	Description																														
A	RW	TRIGGERED0			Write '1' to Disable interrupt for TRIGGERED[0] event																														
					See <a href="#">EVENTS_TRIGGERED[0]</a>																														
			Clear	1	Disable																														
			Disabled	0	Read: Disabled																														
			Enabled	1	Read: Enabled																														
B	RW	TRIGGERED1			Write '1' to Disable interrupt for TRIGGERED[1] event																														
					See <a href="#">EVENTS_TRIGGERED[1]</a>																														
			Clear	1	Disable																														
			Disabled	0	Read: Disabled																														
			Enabled	1	Read: Enabled																														
C	RW	TRIGGERED2			Write '1' to Disable interrupt for TRIGGERED[2] event																														
					See <a href="#">EVENTS_TRIGGERED[2]</a>																														
			Clear	1	Disable																														
			Disabled	0	Read: Disabled																														
			Enabled	1	Read: Enabled																														
D	RW	TRIGGERED3			Write '1' to Disable interrupt for TRIGGERED[3] event																														
					See <a href="#">EVENTS_TRIGGERED[3]</a>																														
			Clear	1	Disable																														
			Disabled	0	Read: Disabled																														
			Enabled	1	Read: Enabled																														
E	RW	TRIGGERED4			Write '1' to Disable interrupt for TRIGGERED[4] event																														
					See <a href="#">EVENTS_TRIGGERED[4]</a>																														
			Clear	1	Disable																														
			Disabled	0	Read: Disabled																														
			Enabled	1	Read: Enabled																														
F	RW	TRIGGERED5			Write '1' to Disable interrupt for TRIGGERED[5] event																														
					See <a href="#">EVENTS_TRIGGERED[5]</a>																														
			Clear	1	Disable																														
			Disabled	0	Read: Disabled																														
			Enabled	1	Read: Enabled																														
G	RW	TRIGGERED6			Write '1' to Disable interrupt for TRIGGERED[6] event																														
					See <a href="#">EVENTS_TRIGGERED[6]</a>																														

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0																															
Id				P O N M L K J I H G F E D C B A																															
Reset 0x00000000				0 0																															
Id	RW	Field	Value Id	Value	Description																														
			Clear	1	Disable																														
			Disabled	0	Read: Disabled																														
			Enabled	1	Read: Enabled																														
H	RW	TRIGGERED7			Write '1' to Disable interrupt for TRIGGERED[7] event																														
					See <a href="#">EVENTS_TRIGGERED[7]</a>																														
			Clear	1	Disable																														
			Disabled	0	Read: Disabled																														
			Enabled	1	Read: Enabled																														
I	RW	TRIGGERED8			Write '1' to Disable interrupt for TRIGGERED[8] event																														
					See <a href="#">EVENTS_TRIGGERED[8]</a>																														
			Clear	1	Disable																														
			Disabled	0	Read: Disabled																														
			Enabled	1	Read: Enabled																														
J	RW	TRIGGERED9			Write '1' to Disable interrupt for TRIGGERED[9] event																														
					See <a href="#">EVENTS_TRIGGERED[9]</a>																														
			Clear	1	Disable																														
			Disabled	0	Read: Disabled																														
			Enabled	1	Read: Enabled																														
K	RW	TRIGGERED10			Write '1' to Disable interrupt for TRIGGERED[10] event																														
					See <a href="#">EVENTS_TRIGGERED[10]</a>																														
			Clear	1	Disable																														
			Disabled	0	Read: Disabled																														
			Enabled	1	Read: Enabled																														
L	RW	TRIGGERED11			Write '1' to Disable interrupt for TRIGGERED[11] event																														
					See <a href="#">EVENTS_TRIGGERED[11]</a>																														
			Clear	1	Disable																														
			Disabled	0	Read: Disabled																														
			Enabled	1	Read: Enabled																														
M	RW	TRIGGERED12			Write '1' to Disable interrupt for TRIGGERED[12] event																														
					See <a href="#">EVENTS_TRIGGERED[12]</a>																														
			Clear	1	Disable																														
			Disabled	0	Read: Disabled																														
			Enabled	1	Read: Enabled																														
N	RW	TRIGGERED13			Write '1' to Disable interrupt for TRIGGERED[13] event																														
					See <a href="#">EVENTS_TRIGGERED[13]</a>																														
			Clear	1	Disable																														
			Disabled	0	Read: Disabled																														
			Enabled	1	Read: Enabled																														
O	RW	TRIGGERED14			Write '1' to Disable interrupt for TRIGGERED[14] event																														
					See <a href="#">EVENTS_TRIGGERED[14]</a>																														
			Clear	1	Disable																														
			Disabled	0	Read: Disabled																														
			Enabled	1	Read: Enabled																														
P	RW	TRIGGERED15			Write '1' to Disable interrupt for TRIGGERED[15] event																														
					See <a href="#">EVENTS_TRIGGERED[15]</a>																														
			Clear	1	Disable																														
			Disabled	0	Read: Disabled																														



Bit number					31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0								
Id																													P	O	N	M	L	K	J	I	H	G	F	E	D	C	B	A
Reset 0x00000000					0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0							
Id	RW	Field	Value Id		Value		Description																																					
			Enabled		1		Read: Enabled																																					

## 6.7.2 Electrical specification

### 6.7.2.1 EGU Electrical Specification

Symbol	Description	Min.	Typ.	Max.	Units
$t_{\text{EGU,EVT}}$	Latency between setting an EGU event flag and the system setting an interrupt		1		cycles

## 6.8 GPIO — General purpose input/output

The general purpose input/output pins (GPIOs) are grouped as one or more ports with each port having up to 32 GPIOs.

The number of ports and GPIOs per port might vary with product variant and package. Refer to [Registers](#) on page 139 and [Pin assignments](#) on page 461 for more information about the number of GPIOs that are supported.

GPIO has the following user-configurable features:

- Up to 32 GPIO pins per GPIO port
- Configurable output drive strength
- Internal pull-up and pull-down resistors
- Wake-up from high or low level triggers on all pins
- Trigger interrupt on state changes on any pin
- All pins can be used by the PPI task/event system
- One or more GPIO outputs can be controlled through PPI and GPIOTE channels
- All pins can be individually mapped to interface blocks for layout flexibility
- GPIO state changes captured on SENSE signal can be stored by LATCH register

The GPIO port peripheral implements up to 32 pins, `PIN0` through `PIN31`. Each of these pins can be individually configured in the `PIN_CNF[n]` registers ( $n=0..31$ ).

The following parameters can be configured through these registers:

- Direction
- Drive strength
- Enabling of pull-up and pull-down resistors
- Pin sensing
- Input buffer disconnect
- Analog input (for selected pins)

The `PIN_CNF` registers are retained registers. See [POWER — Power supply](#) on page 61 chapter for more information about retained registers.

### 6.8.1 Pin configuration

Pins can be individually configured, through the `SENSE` field in the `PIN_CNF[n]` register, to detect either a high level or a low level on their input.

When the correct level is detected on any such configured pin, the sense mechanism will set the DETECT signal high. Each pin has a separate DETECT signal. Default behavior, defined by the DETECTMODE register, is that the DETECT signals from all pins in the GPIO port are combined into one common DETECT signal that is routed throughout the system, which then can be utilized by other peripherals. This mechanism is functional in both System ON mode and System OFF mode. See [GPIO port and the GPIO pin details](#) on page 138.

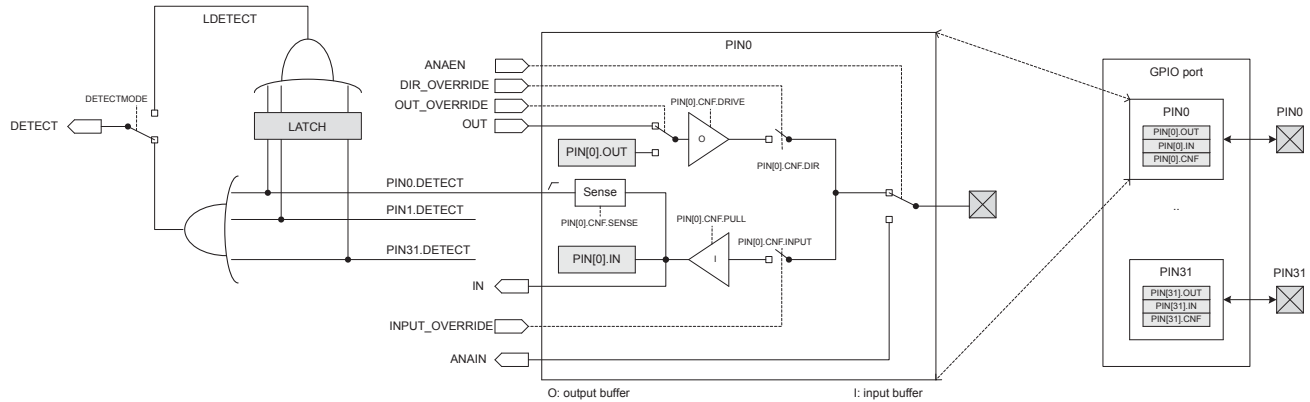


Figure 39: GPIO port and the GPIO pin details

[GPIO port and the GPIO pin details](#) on page 138 illustrates the GPIO port containing 32 individual pins, where PIN0 is illustrated in more detail as a reference. All signals on the left side in the illustration are used by other peripherals in the system and therefore not directly available to the CPU.

Make sure that a pin is in a level that cannot trigger the sense mechanism before enabling it. The DETECT signal will go high immediately if the SENSE condition configured in the PIN\_CNF registers is met when the sense mechanism is enabled. This will trigger a PORT event if the DETECT signal was low before enabling the sense mechanism. See [GPiOTE — GPiO tasks and events](#) on page 188.

See the following peripherals for more information about how the DETECT signal is used:

- POWER: uses the DETECT signal to exit from System OFF mode.
- GPiOTE: uses the DETECT signal to generate the PORT event.

When a pin's PINx.DETECT signal goes high, a flag will be set in the LATCH register. For example, when the PIN0.DETECT signal goes high, bit 0 in the LATCH register will be set to '1'. If the CPU performs a clear operation on a bit in the LATCH register when the associated PINx.DETECT signal is high, the bit in the LATCH register will not be cleared. The LATCH register will only be cleared if the CPU explicitly clears it by writing a '1' to the bit that shall be cleared, i.e. the LATCH register will not be affected by a PINx.DETECT signal being set low.

The LDETECT signal will be set high when one or more bits in the LATCH register are '1'. The LDETECT signal will be set low when all bits in the LATCH register are successfully cleared to '0'.

If one or more bits in the LATCH register are '1' after the CPU has performed a clear operation on the LATCH registers, a rising edge will be generated on the LDETECT signal. This is illustrated in [DETECT signal behavior](#) on page 139.

**Important:** The CPU can read the LATCH register at any time to check if a SENSE condition has been met on one or more of the the GPIO pins, even if that condition is no longer met at the time the CPU queries the LATCH register. This mechanism will work even if the LDETECT signal is not used as the DETECT signal.

The LDETECT signal is by default not connected to the GPIO port's DETECT signal, but via the DETECTMODE register it is possible to change from default behavior to DETECT signal being derived directly from the

LDETECT signal instead. See [GPIO port and the GPIO pin details](#) on page 138. [DETECT signal behavior](#) on page 139 illustrates the DETECT signal behavior for these two alternatives.

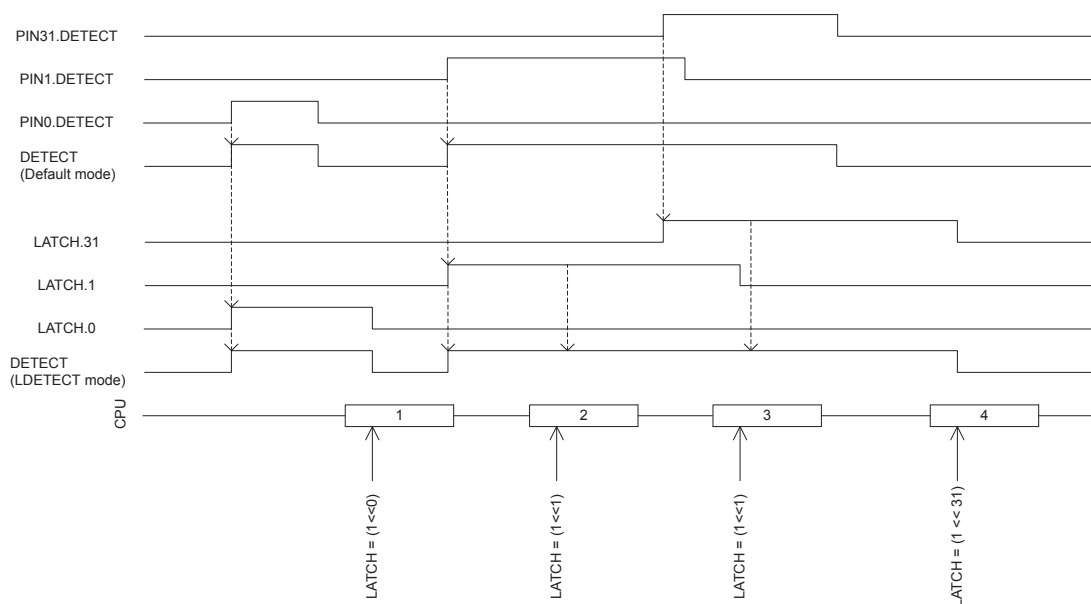


Figure 40: DETECT signal behavior

The input buffer of a GPIO pin can be disconnected from the pin to enable power savings when the pin is not used as an input, see [GPIO port and the GPIO pin details](#) on page 138. Inputs must be connected to get a valid input value in the IN register, and for the sense mechanism to get access to the pin.

Other peripherals in the system can connect to GPIO pins and override their output value and configuration, or read their analog or digital input value. See [GPIO port and the GPIO pin details](#) on page 138.

Selected pins also support analog input signals, see ANAIN in [GPIO port and the GPIO pin details](#) on page 138. The assignment of the analog pins can be found in [Pin assignments](#) on page 461.

**Important:** When a pin is configured as digital input, care has been taken to minimize increased current consumption when the input voltage is between  $V_{IL}$  and  $V_{IH}$ . However, it is a good practice to ensure that the external circuitry does not drive that pin to levels between  $V_{IL}$  and  $V_{IH}$  for a long period of time.

## 6.8.2 Registers

Base address	Peripheral	Instance	Description	Configuration
0x50000000	GPIO	P0	General purpose input and output	

Table 36: Instances

Register	Offset	Description
OUT	0x504	Write GPIO port
OUTSET	0x508	Set individual bits in GPIO port
OUTCLR	0x50C	Clear individual bits in GPIO port

Register	Offset	Description
IN	0x510	Read GPIO port
DIR	0x514	Direction of GPIO pins
DIRSET	0x518	DIR set register
DIRCLR	0x51C	DIR clear register
LATCH	0x520	Latch register indicating what GPIO pins that have met the criteria set in the PIN_CNF[n].SENSE registers
DETECTMODE	0x524	Select between default DETECT signal behaviour and LDETECT mode
PIN_CNF[0]	0x700	Configuration of GPIO pins
PIN_CNF[1]	0x704	Configuration of GPIO pins
PIN_CNF[2]	0x708	Configuration of GPIO pins
PIN_CNF[3]	0x70C	Configuration of GPIO pins
PIN_CNF[4]	0x710	Configuration of GPIO pins
PIN_CNF[5]	0x714	Configuration of GPIO pins
PIN_CNF[6]	0x718	Configuration of GPIO pins
PIN_CNF[7]	0x71C	Configuration of GPIO pins
PIN_CNF[8]	0x720	Configuration of GPIO pins
PIN_CNF[9]	0x724	Configuration of GPIO pins
PIN_CNF[10]	0x728	Configuration of GPIO pins
PIN_CNF[11]	0x72C	Configuration of GPIO pins
PIN_CNF[12]	0x730	Configuration of GPIO pins
PIN_CNF[13]	0x734	Configuration of GPIO pins
PIN_CNF[14]	0x738	Configuration of GPIO pins
PIN_CNF[15]	0x73C	Configuration of GPIO pins
PIN_CNF[16]	0x740	Configuration of GPIO pins
PIN_CNF[17]	0x744	Configuration of GPIO pins
PIN_CNF[18]	0x748	Configuration of GPIO pins
PIN_CNF[19]	0x74C	Configuration of GPIO pins
PIN_CNF[20]	0x750	Configuration of GPIO pins
PIN_CNF[21]	0x754	Configuration of GPIO pins
PIN_CNF[22]	0x758	Configuration of GPIO pins
PIN_CNF[23]	0x75C	Configuration of GPIO pins
PIN_CNF[24]	0x760	Configuration of GPIO pins
PIN_CNF[25]	0x764	Configuration of GPIO pins
PIN_CNF[26]	0x768	Configuration of GPIO pins
PIN_CNF[27]	0x76C	Configuration of GPIO pins
PIN_CNF[28]	0x770	Configuration of GPIO pins
PIN_CNF[29]	0x774	Configuration of GPIO pins
PIN_CNF[30]	0x778	Configuration of GPIO pins
PIN_CNF[31]	0x77C	Configuration of GPIO pins

Table 37: Register Overview

### 6.8.2.1 OUT

Address offset: 0x504

Write GPIO port

Bit number	31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0																													
Id	f e d c b a Z Y X W V U T S R Q P O N M L K J I H G F E D C B A																													
Reset 0x00000000	0 0																													
Id	RW	Field	Value	Id	Value	Description																								
A	RW	PINO				Pin 0																								
			Low		0	Pin driver is low																								

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0																																
Id				f e d c b a z Y X W V U T S R Q P O N M L K J I H G F E D C B A																																
Reset 0x00000000				0 0																																
Id	RW	Field	Value Id	Value	Description																															
B	RW	PIN1	High	1	Pin driver is high																															
			Low	0	Pin driver is low																															
			High	1	Pin driver is high																															
C	RW	PIN2			Pin 2																															
			Low	0	Pin driver is low																															
			High	1	Pin driver is high																															
D	RW	PIN3			Pin 3																															
			Low	0	Pin driver is low																															
			High	1	Pin driver is high																															
E	RW	PIN4			Pin 4																															
			Low	0	Pin driver is low																															
			High	1	Pin driver is high																															
F	RW	PIN5			Pin 5																															
			Low	0	Pin driver is low																															
			High	1	Pin driver is high																															
G	RW	PIN6			Pin 6																															
			Low	0	Pin driver is low																															
			High	1	Pin driver is high																															
H	RW	PIN7			Pin 7																															
			Low	0	Pin driver is low																															
			High	1	Pin driver is high																															
I	RW	PIN8			Pin 8																															
			Low	0	Pin driver is low																															
			High	1	Pin driver is high																															
J	RW	PIN9			Pin 9																															
			Low	0	Pin driver is low																															
			High	1	Pin driver is high																															
K	RW	PIN10			Pin 10																															
			Low	0	Pin driver is low																															
			High	1	Pin driver is high																															
L	RW	PIN11			Pin 11																															
			Low	0	Pin driver is low																															
			High	1	Pin driver is high																															
M	RW	PIN12			Pin 12																															
			Low	0	Pin driver is low																															
			High	1	Pin driver is high																															
N	RW	PIN13			Pin 13																															
			Low	0	Pin driver is low																															
			High	1	Pin driver is high																															
O	RW	PIN14			Pin 14																															
			Low	0	Pin driver is low																															
			High	1	Pin driver is high																															
P	RW	PIN15			Pin 15																															
			Low	0	Pin driver is low																															
			High	1	Pin driver is high																															
Q	RW	PIN16			Pin 16																															
			Low	0	Pin driver is low																															
			High	1	Pin driver is high																															
R	RW	PIN17			Pin 17																															

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0																														
Id				f e d c b a Z Y X W V U T S R Q P O N M L K J I H G F E D C B A																														
Reset 0x00000000				0 0																														
Id	RW	Field	Value Id	Value	Description																													
			Low	0	Pin driver is low																													
			High	1	Pin driver is high																													
S	RW	PIN18			Pin 18																													
			Low	0	Pin driver is low																													
			High	1	Pin driver is high																													
T	RW	PIN19			Pin 19																													
			Low	0	Pin driver is low																													
			High	1	Pin driver is high																													
U	RW	PIN20			Pin 20																													
			Low	0	Pin driver is low																													
			High	1	Pin driver is high																													
V	RW	PIN21			Pin 21																													
			Low	0	Pin driver is low																													
			High	1	Pin driver is high																													
W	RW	PIN22			Pin 22																													
			Low	0	Pin driver is low																													
			High	1	Pin driver is high																													
X	RW	PIN23			Pin 23																													
			Low	0	Pin driver is low																													
			High	1	Pin driver is high																													
Y	RW	PIN24			Pin 24																													
			Low	0	Pin driver is low																													
			High	1	Pin driver is high																													
Z	RW	PIN25			Pin 25																													
			Low	0	Pin driver is low																													
			High	1	Pin driver is high																													
a	RW	PIN26			Pin 26																													
			Low	0	Pin driver is low																													
			High	1	Pin driver is high																													
b	RW	PIN27			Pin 27																													
			Low	0	Pin driver is low																													
			High	1	Pin driver is high																													
c	RW	PIN28			Pin 28																													
			Low	0	Pin driver is low																													
			High	1	Pin driver is high																													
d	RW	PIN29			Pin 29																													
			Low	0	Pin driver is low																													
			High	1	Pin driver is high																													
e	RW	PIN30			Pin 30																													
			Low	0	Pin driver is low																													
			High	1	Pin driver is high																													
f	RW	PIN31			Pin 31																													
			Low	0	Pin driver is low																													
			High	1	Pin driver is high																													

#### 6.8.2.2 OUTSET

Address offset: 0x508

### Set individual bits in GPIO port

Read: reads value of OUT register.

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0																															
Id				f e d c b a Z Y X W V U T S R Q P O N M L K J I H G F E D C B A																															
Reset 0x00000000				0 0																															
Id	RW	Field	Value Id	Value	Description																														
A	RW	PIN0			Pin 0																														
			Low	0	Read: pin driver is low																														
			High	1	Read: pin driver is high																														
			Set	1	Write: writing a '1' sets the pin high; writing a '0' has no effect																														
B	RW	PIN1			Pin 1																														
			Low	0	Read: pin driver is low																														
			High	1	Read: pin driver is high																														
			Set	1	Write: writing a '1' sets the pin high; writing a '0' has no effect																														
C	RW	PIN2			Pin 2																														
			Low	0	Read: pin driver is low																														
			High	1	Read: pin driver is high																														
			Set	1	Write: writing a '1' sets the pin high; writing a '0' has no effect																														
D	RW	PIN3			Pin 3																														
			Low	0	Read: pin driver is low																														
			High	1	Read: pin driver is high																														
			Set	1	Write: writing a '1' sets the pin high; writing a '0' has no effect																														
E	RW	PIN4			Pin 4																														
			Low	0	Read: pin driver is low																														
			High	1	Read: pin driver is high																														
			Set	1	Write: writing a '1' sets the pin high; writing a '0' has no effect																														
F	RW	PIN5			Pin 5																														
			Low	0	Read: pin driver is low																														
			High	1	Read: pin driver is high																														
			Set	1	Write: writing a '1' sets the pin high; writing a '0' has no effect																														
G	RW	PIN6			Pin 6																														
			Low	0	Read: pin driver is low																														
			High	1	Read: pin driver is high																														
			Set	1	Write: writing a '1' sets the pin high; writing a '0' has no effect																														
H	RW	PIN7			Pin 7																														
			Low	0	Read: pin driver is low																														
			High	1	Read: pin driver is high																														
			Set	1	Write: writing a '1' sets the pin high; writing a '0' has no effect																														
I	RW	PIN8			Pin 8																														
			Low	0	Read: pin driver is low																														
			High	1	Read: pin driver is high																														
			Set	1	Write: writing a '1' sets the pin high; writing a '0' has no effect																														
J	RW	PIN9			Pin 9																														
			Low	0	Read: pin driver is low																														
			High	1	Read: pin driver is high																														
			Set	1	Write: writing a '1' sets the pin high; writing a '0' has no effect																														

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0																															
Id				f e d c b a Z Y X W V U T S R Q P O N M L K J I H G F E D C B A																															
Reset 0x00000000				0 0																															
Id	RW	Field	Value Id	Value	Description																														
K	RW	PIN10			Pin 10																														
			Low	0	Read: pin driver is low																														
			High	1	Read: pin driver is high																														
			Set	1	Write: writing a '1' sets the pin high; writing a '0' has no effect																														
L	RW	PIN11			Pin 11																														
			Low	0	Read: pin driver is low																														
			High	1	Read: pin driver is high																														
			Set	1	Write: writing a '1' sets the pin high; writing a '0' has no effect																														
M	RW	PIN12			Pin 12																														
			Low	0	Read: pin driver is low																														
			High	1	Read: pin driver is high																														
			Set	1	Write: writing a '1' sets the pin high; writing a '0' has no effect																														
N	RW	PIN13			Pin 13																														
			Low	0	Read: pin driver is low																														
			High	1	Read: pin driver is high																														
			Set	1	Write: writing a '1' sets the pin high; writing a '0' has no effect																														
O	RW	PIN14			Pin 14																														
			Low	0	Read: pin driver is low																														
			High	1	Read: pin driver is high																														
			Set	1	Write: writing a '1' sets the pin high; writing a '0' has no effect																														
P	RW	PIN15			Pin 15																														
			Low	0	Read: pin driver is low																														
			High	1	Read: pin driver is high																														
			Set	1	Write: writing a '1' sets the pin high; writing a '0' has no effect																														
Q	RW	PIN16			Pin 16																														
			Low	0	Read: pin driver is low																														
			High	1	Read: pin driver is high																														
			Set	1	Write: writing a '1' sets the pin high; writing a '0' has no effect																														
R	RW	PIN17			Pin 17																														
			Low	0	Read: pin driver is low																														
			High	1	Read: pin driver is high																														
			Set	1	Write: writing a '1' sets the pin high; writing a '0' has no effect																														
S	RW	PIN18			Pin 18																														
			Low	0	Read: pin driver is low																														
			High	1	Read: pin driver is high																														
			Set	1	Write: writing a '1' sets the pin high; writing a '0' has no effect																														
T	RW	PIN19			Pin 19																														
			Low	0	Read: pin driver is low																														
			High	1	Read: pin driver is high																														
			Set	1	Write: writing a '1' sets the pin high; writing a '0' has no effect																														



Bit number					31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0		
Id					f	e	d	c	b	a	Z	Y	X	W	V	U	T	S	R	Q	P	O	N	M	L	K	J	I	H	G	F	E	D	C	B	A		
Reset 0x00000000					0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0		
Id	RW	Field	Value Id	Value	Description																																	
U	RW	PIN20			Pin 20																																	
			Low	0	Read: pin driver is low																																	
			High	1	Read: pin driver is high																																	
			Set	1	Write: writing a '1' sets the pin high; writing a '0' has no effect																																	
V	RW	PIN21			Pin 21																																	
			Low	0	Read: pin driver is low																																	
			High	1	Read: pin driver is high																																	
			Set	1	Write: writing a '1' sets the pin high; writing a '0' has no effect																																	
W	RW	PIN22			Pin 22																																	
			Low	0	Read: pin driver is low																																	
			High	1	Read: pin driver is high																																	
			Set	1	Write: writing a '1' sets the pin high; writing a '0' has no effect																																	
X	RW	PIN23			Pin 23																																	
			Low	0	Read: pin driver is low																																	
			High	1	Read: pin driver is high																																	
			Set	1	Write: writing a '1' sets the pin high; writing a '0' has no effect																																	
Y	RW	PIN24			Pin 24																																	
			Low	0	Read: pin driver is low																																	
			High	1	Read: pin driver is high																																	
			Set	1	Write: writing a '1' sets the pin high; writing a '0' has no effect																																	
Z	RW	PIN25			Pin 25																																	
			Low	0	Read: pin driver is low																																	
			High	1	Read: pin driver is high																																	
			Set	1	Write: writing a '1' sets the pin high; writing a '0' has no effect																																	
a	RW	PIN26			Pin 26																																	
			Low	0	Read: pin driver is low																																	
			High	1	Read: pin driver is high																																	
			Set	1	Write: writing a '1' sets the pin high; writing a '0' has no effect																																	
b	RW	PIN27			Pin 27																																	
			Low	0	Read: pin driver is low																																	
			High	1	Read: pin driver is high																																	
			Set	1	Write: writing a '1' sets the pin high; writing a '0' has no effect																																	
c	RW	PIN28			Pin 28																																	
			Low	0	Read: pin driver is low																																	
			High	1	Read: pin driver is high																																	
			Set	1	Write: writing a '1' sets the pin high; writing a '0' has no effect																																	
d	RW	PIN29			Pin 29																																	
			Low	0	Read: pin driver is low																																	
			High	1	Read: pin driver is high																																	
			Set	1	Write: writing a '1' sets the pin high; writing a '0' has no effect																																	

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0																																			
Id				f e d c b a Z Y X W V U T S R Q P O N M L K J I H G F E D C B A																																			
Reset 0x00000000				0 0																																			
Id	RW	Field	Value Id	Value	Description																																		
e	RW	PIN30			Pin 30																																		
			Low	0	Read: pin driver is low																																		
			High	1	Read: pin driver is high																																		
			Set	1	Write: writing a '1' sets the pin high; writing a '0' has no effect																																		
f	RW	PIN31			Pin 31																																		
			Low	0	Read: pin driver is low																																		
			High	1	Read: pin driver is high																																		
			Set	1	Write: writing a '1' sets the pin high; writing a '0' has no effect																																		

### 6.8.2.3 OUTCLR

Address offset: 0x50C

Clear individual bits in GPIO port

Read: reads value of OUT register.

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0																															
Id				f e d c b a Z Y X W V U T S R Q P O N M L K J I H G F E D C B A																															
Reset 0x00000000				0 0																															
Id	RW	Field	Value Id	Value	Description																														
A	RW	PIN0			Pin 0																														
			Low	0	Read: pin driver is low																														
			High	1	Read: pin driver is high																														
			Clear	1	Write: writing a '1' sets the pin low; writing a '0' has no effect																														
B	RW	PIN1			Pin 1																														
			Low	0	Read: pin driver is low																														
			High	1	Read: pin driver is high																														
			Clear	1	Write: writing a '1' sets the pin low; writing a '0' has no effect																														
C	RW	PIN2			Pin 2																														
			Low	0	Read: pin driver is low																														
			High	1	Read: pin driver is high																														
			Clear	1	Write: writing a '1' sets the pin low; writing a '0' has no effect																														
D	RW	PIN3			Pin 3																														
			Low	0	Read: pin driver is low																														
			High	1	Read: pin driver is high																														
			Clear	1	Write: writing a '1' sets the pin low; writing a '0' has no effect																														
E	RW	PIN4			Pin 4																														
			Low	0	Read: pin driver is low																														
			High	1	Read: pin driver is high																														
			Clear	1	Write: writing a '1' sets the pin low; writing a '0' has no effect																														
F	RW	PIN5			Pin 5																														
			Low	0	Read: pin driver is low																														
			High	1	Read: pin driver is high																														

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0																															
Id				f e d c b a Z Y X W V U T S R Q P O N M L K J I H G F E D C B A																															
Reset 0x00000000				0 0																															
Id	RW	Field	Value Id	Value	Description																														
G	RW	PIN6	Clear	1	Write: writing a '1' sets the pin low; writing a '0' has no effect																														
			Low	0	Read: pin driver is low																														
			High	1	Read: pin driver is high																														
			Clear	1	Write: writing a '1' sets the pin low; writing a '0' has no effect																														
H	RW	PIN7	Low	0	Read: pin driver is low																														
			High	1	Read: pin driver is high																														
			Clear	1	Write: writing a '1' sets the pin low; writing a '0' has no effect																														
I	RW	PIN8	Low	0	Read: pin driver is low																														
			High	1	Read: pin driver is high																														
			Clear	1	Write: writing a '1' sets the pin low; writing a '0' has no effect																														
J	RW	PIN9	Low	0	Read: pin driver is low																														
			High	1	Read: pin driver is high																														
			Clear	1	Write: writing a '1' sets the pin low; writing a '0' has no effect																														
K	RW	PIN10	Low	0	Read: pin driver is low																														
			High	1	Read: pin driver is high																														
			Clear	1	Write: writing a '1' sets the pin low; writing a '0' has no effect																														
L	RW	PIN11	Low	0	Read: pin driver is low																														
			High	1	Read: pin driver is high																														
			Clear	1	Write: writing a '1' sets the pin low; writing a '0' has no effect																														
M	RW	PIN12	Low	0	Read: pin driver is low																														
			High	1	Read: pin driver is high																														
			Clear	1	Write: writing a '1' sets the pin low; writing a '0' has no effect																														
N	RW	PIN13	Low	0	Read: pin driver is low																														
			High	1	Read: pin driver is high																														
			Clear	1	Write: writing a '1' sets the pin low; writing a '0' has no effect																														
O	RW	PIN14	Low	0	Read: pin driver is low																														
			High	1	Read: pin driver is high																														
			Clear	1	Write: writing a '1' sets the pin low; writing a '0' has no effect																														
P	RW	PIN15	Low	0	Read: pin driver is low																														
			High	1	Read: pin driver is high																														

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0																															
Id				f e d c b a Z Y X W V U T S R Q P O N M L K J I H G F E D C B A																															
Reset 0x00000000				0 0																															
Id	RW	Field	Value Id	Value	Description																														
Q	RW	PIN16	Clear	1	Write: writing a '1' sets the pin low; writing a '0' has no effect																														
			Low	0	Read: pin driver is low																														
			High	1	Read: pin driver is high																														
			Clear	1	Write: writing a '1' sets the pin low; writing a '0' has no effect																														
R	RW	PIN17	Low	0	Read: pin driver is low																														
			High	1	Read: pin driver is high																														
			Clear	1	Write: writing a '1' sets the pin low; writing a '0' has no effect																														
S	RW	PIN18	Low	0	Read: pin driver is low																														
			High	1	Read: pin driver is high																														
			Clear	1	Write: writing a '1' sets the pin low; writing a '0' has no effect																														
T	RW	PIN19	Low	0	Read: pin driver is low																														
			High	1	Read: pin driver is high																														
			Clear	1	Write: writing a '1' sets the pin low; writing a '0' has no effect																														
U	RW	PIN20	Low	0	Read: pin driver is low																														
			High	1	Read: pin driver is high																														
			Clear	1	Write: writing a '1' sets the pin low; writing a '0' has no effect																														
V	RW	PIN21	Low	0	Read: pin driver is low																														
			High	1	Read: pin driver is high																														
			Clear	1	Write: writing a '1' sets the pin low; writing a '0' has no effect																														
W	RW	PIN22	Low	0	Read: pin driver is low																														
			High	1	Read: pin driver is high																														
			Clear	1	Write: writing a '1' sets the pin low; writing a '0' has no effect																														
X	RW	PIN23	Low	0	Read: pin driver is low																														
			High	1	Read: pin driver is high																														
			Clear	1	Write: writing a '1' sets the pin low; writing a '0' has no effect																														
Y	RW	PIN24	Low	0	Read: pin driver is low																														
			High	1	Read: pin driver is high																														
			Clear	1	Write: writing a '1' sets the pin low; writing a '0' has no effect																														
Z	RW	PIN25	Low	0	Read: pin driver is low																														
			High	1	Read: pin driver is high																														

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0																															
Id				f e d c b a Z Y X W V U T S R Q P O N M L K J I H G F E D C B A																															
Reset 0x00000000				0 0																															
Id	RW	Field	Value Id	Value	Description																														
a	RW	PIN26	Clear	1	Write: writing a '1' sets the pin low; writing a '0' has no effect																														
			Low	0	Read: pin driver is low																														
			High	1	Read: pin driver is high																														
			Clear	1	Write: writing a '1' sets the pin low; writing a '0' has no effect																														
b	RW	PIN27			Pin 27																														
			Low	0	Read: pin driver is low																														
			High	1	Read: pin driver is high																														
			Clear	1	Write: writing a '1' sets the pin low; writing a '0' has no effect																														
c	RW	PIN28			Pin 28																														
			Low	0	Read: pin driver is low																														
			High	1	Read: pin driver is high																														
			Clear	1	Write: writing a '1' sets the pin low; writing a '0' has no effect																														
d	RW	PIN29			Pin 29																														
			Low	0	Read: pin driver is low																														
			High	1	Read: pin driver is high																														
			Clear	1	Write: writing a '1' sets the pin low; writing a '0' has no effect																														
e	RW	PIN30			Pin 30																														
			Low	0	Read: pin driver is low																														
			High	1	Read: pin driver is high																														
			Clear	1	Write: writing a '1' sets the pin low; writing a '0' has no effect																														
f	RW	PIN31			Pin 31																														
			Low	0	Read: pin driver is low																														
			High	1	Read: pin driver is high																														
			Clear	1	Write: writing a '1' sets the pin low; writing a '0' has no effect																														

## 6.8.2.4 IN

Address offset: 0x510

Read GPIO port

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0																															
Id				f e d c b a Z Y X W V U T S R Q P O N M L K J I H G F E D C B A																															
Reset 0x00000000				0 0																															
Id	RW	Field	Value Id	Value	Description																														
A	R	PIN0			Pin 0																														
			Low	0	Pin input is low																														
			High	1	Pin input is high																														
B	R	PIN1			Pin 1																														
			Low	0	Pin input is low																														
			High	1	Pin input is high																														
C	R	PIN2			Pin 2																														

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0																															
Id				f e d c b a Z Y X W V U T S R Q P O N M L K J I H G F E D C B A																															
Reset 0x00000000				0 0																															
Id	RW	Field	Value Id	Value	Description																														
			Low	0	Pin input is low																														
			High	1	Pin input is high																														
D	R	PIN3			Pin 3																														
			Low	0	Pin input is low																														
			High	1	Pin input is high																														
E	R	PIN4			Pin 4																														
			Low	0	Pin input is low																														
			High	1	Pin input is high																														
F	R	PIN5			Pin 5																														
			Low	0	Pin input is low																														
			High	1	Pin input is high																														
G	R	PIN6			Pin 6																														
			Low	0	Pin input is low																														
			High	1	Pin input is high																														
H	R	PIN7			Pin 7																														
			Low	0	Pin input is low																														
			High	1	Pin input is high																														
I	R	PIN8			Pin 8																														
			Low	0	Pin input is low																														
			High	1	Pin input is high																														
J	R	PIN9			Pin 9																														
			Low	0	Pin input is low																														
			High	1	Pin input is high																														
K	R	PIN10			Pin 10																														
			Low	0	Pin input is low																														
			High	1	Pin input is high																														
L	R	PIN11			Pin 11																														
			Low	0	Pin input is low																														
			High	1	Pin input is high																														
M	R	PIN12			Pin 12																														
			Low	0	Pin input is low																														
			High	1	Pin input is high																														
N	R	PIN13			Pin 13																														
			Low	0	Pin input is low																														
			High	1	Pin input is high																														
O	R	PIN14			Pin 14																														
			Low	0	Pin input is low																														
			High	1	Pin input is high																														
P	R	PIN15			Pin 15																														
			Low	0	Pin input is low																														
			High	1	Pin input is high																														
Q	R	PIN16			Pin 16																														
			Low	0	Pin input is low																														
			High	1	Pin input is high																														
R	R	PIN17			Pin 17																														
			Low	0	Pin input is low																														
			High	1	Pin input is high																														
S	R	PIN18			Pin 18																														
			Low	0	Pin input is low																														
			High	1	Pin input is high																														

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0																															
Id				f e d c b a Z Y X W V U T S R Q P O N M L K J I H G F E D C B A																															
Reset 0x00000000				0 0																															
Id	RW	Field	Value Id	Value	Description																														
T	R	PIN19			Pin 19																														
			Low	0	Pin input is low																														
			High	1	Pin input is high																														
U	R	PIN20			Pin 20																														
			Low	0	Pin input is low																														
			High	1	Pin input is high																														
V	R	PIN21			Pin 21																														
			Low	0	Pin input is low																														
			High	1	Pin input is high																														
W	R	PIN22			Pin 22																														
			Low	0	Pin input is low																														
			High	1	Pin input is high																														
X	R	PIN23			Pin 23																														
			Low	0	Pin input is low																														
			High	1	Pin input is high																														
Y	R	PIN24			Pin 24																														
			Low	0	Pin input is low																														
			High	1	Pin input is high																														
Z	R	PIN25			Pin 25																														
			Low	0	Pin input is low																														
			High	1	Pin input is high																														
a	R	PIN26			Pin 26																														
			Low	0	Pin input is low																														
			High	1	Pin input is high																														
b	R	PIN27			Pin 27																														
			Low	0	Pin input is low																														
			High	1	Pin input is high																														
c	R	PIN28			Pin 28																														
			Low	0	Pin input is low																														
			High	1	Pin input is high																														
d	R	PIN29			Pin 29																														
			Low	0	Pin input is low																														
			High	1	Pin input is high																														
e	R	PIN30			Pin 30																														
			Low	0	Pin input is low																														
			High	1	Pin input is high																														
f	R	PIN31			Pin 31																														
			Low	0	Pin input is low																														
			High	1	Pin input is high																														

### 6.8.2.5 DIR

Address offset: 0x514

Direction of GPIO pins

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0																														
Id				f e d c b a Z Y X W V U T S R Q P O N M L K J I H G F E D C B A																														
Reset 0x00000000				0 0																														
Id	RW	Field	Value	Id	Value	Description																												
A	RW	PIN0				Pin 0																												
			Input		0	Pin set as input																												
			Output		1	Pin set as output																												
B	RW	PIN1				Pin 1																												
			Input		0	Pin set as input																												
			Output		1	Pin set as output																												
C	RW	PIN2				Pin 2																												
			Input		0	Pin set as input																												
			Output		1	Pin set as output																												
D	RW	PIN3				Pin 3																												
			Input		0	Pin set as input																												
			Output		1	Pin set as output																												
E	RW	PIN4				Pin 4																												
			Input		0	Pin set as input																												
			Output		1	Pin set as output																												
F	RW	PIN5				Pin 5																												
			Input		0	Pin set as input																												
			Output		1	Pin set as output																												
G	RW	PIN6				Pin 6																												
			Input		0	Pin set as input																												
			Output		1	Pin set as output																												
H	RW	PIN7				Pin 7																												
			Input		0	Pin set as input																												
			Output		1	Pin set as output																												
I	RW	PIN8				Pin 8																												
			Input		0	Pin set as input																												
			Output		1	Pin set as output																												
J	RW	PIN9				Pin 9																												
			Input		0	Pin set as input																												
			Output		1	Pin set as output																												
K	RW	PIN10				Pin 10																												
			Input		0	Pin set as input																												
			Output		1	Pin set as output																												
L	RW	PIN11				Pin 11																												
			Input		0	Pin set as input																												
			Output		1	Pin set as output																												
M	RW	PIN12				Pin 12																												
			Input		0	Pin set as input																												
			Output		1	Pin set as output																												
N	RW	PIN13				Pin 13																												
			Input		0	Pin set as input																												
			Output		1	Pin set as output																												
O	RW	PIN14				Pin 14																												
			Input		0	Pin set as input																												
			Output		1	Pin set as output																												
P	RW	PIN15				Pin 15																												
			Input		0	Pin set as input																												
			Output		1	Pin set as output																												
Q	RW	PIN16				Pin 16																												
			Input		0	Pin set as input																												



Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0																																
Id				f e d c b a Z Y X W V U T S R Q P O N M L K J I H G F E D C B A																																
Reset 0x00000000				0 0																																
Id	RW	Field	Value Id	Value	Description																															
R	RW	PIN17	Output	1	Pin set as output																															
			Input	0	Pin set as input																															
			Output	1	Pin set as output																															
S	RW	PIN18	Input	0	Pin set as input																															
			Output	1	Pin set as output																															
			Pin 18																																	
T	RW	PIN19	Input	0	Pin set as input																															
			Output	1	Pin set as output																															
			Pin 19																																	
U	RW	PIN20	Input	0	Pin set as input																															
			Output	1	Pin set as output																															
			Pin 20																																	
V	RW	PIN21	Input	0	Pin set as input																															
			Output	1	Pin set as output																															
			Pin 21																																	
W	RW	PIN22	Input	0	Pin set as input																															
			Output	1	Pin set as output																															
			Pin 22																																	
X	RW	PIN23	Input	0	Pin set as input																															
			Output	1	Pin set as output																															
			Pin 23																																	
Y	RW	PIN24	Input	0	Pin set as input																															
			Output	1	Pin set as output																															
			Pin 24																																	
Z	RW	PIN25	Input	0	Pin set as input																															
			Output	1	Pin set as output																															
			Pin 25																																	
a	RW	PIN26	Input	0	Pin set as input																															
			Output	1	Pin set as output																															
			Pin 26																																	
b	RW	PIN27	Input	0	Pin set as input																															
			Output	1	Pin set as output																															
			Pin 27																																	
c	RW	PIN28	Input	0	Pin set as input																															
			Output	1	Pin set as output																															
			Pin 28																																	
d	RW	PIN29	Input	0	Pin set as input																															
			Output	1	Pin set as output																															
			Pin 29																																	
e	RW	PIN30	Input	0	Pin set as input																															
			Output	1	Pin set as output																															
			Pin 30																																	
f	RW	PIN31	Input	0	Pin set as input																															
			Output	1	Pin set as output																															
			Pin 31																																	

### 6.8.2.6 DIRSET

Address offset: 0x518

## DIR set register

Read: reads value of DIR register.

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0																																			
Id				f e d c b a z y x w v u t s r q p o n m l k j i h g f e d c b a																																			
Reset 0x00000000				0 0																																			
Id	RW	Field	Value Id	Value	Description																																		
A	RW	PIN0			Set as output pin 0																																		
			Input	0	Read: pin set as input																																		
			Output	1	Read: pin set as output																																		
			Set	1	Write: writing a '1' sets pin to output; writing a '0' has no effect																																		
B	RW	PIN1			Set as output pin 1																																		
			Input	0	Read: pin set as input																																		
			Output	1	Read: pin set as output																																		
			Set	1	Write: writing a '1' sets pin to output; writing a '0' has no effect																																		
C	RW	PIN2			Set as output pin 2																																		
			Input	0	Read: pin set as input																																		
			Output	1	Read: pin set as output																																		
			Set	1	Write: writing a '1' sets pin to output; writing a '0' has no effect																																		
D	RW	PIN3			Set as output pin 3																																		
			Input	0	Read: pin set as input																																		
			Output	1	Read: pin set as output																																		
			Set	1	Write: writing a '1' sets pin to output; writing a '0' has no effect																																		
E	RW	PIN4			Set as output pin 4																																		
			Input	0	Read: pin set as input																																		
			Output	1	Read: pin set as output																																		
			Set	1	Write: writing a '1' sets pin to output; writing a '0' has no effect																																		
F	RW	PIN5			Set as output pin 5																																		
			Input	0	Read: pin set as input																																		
			Output	1	Read: pin set as output																																		
			Set	1	Write: writing a '1' sets pin to output; writing a '0' has no effect																																		
G	RW	PIN6			Set as output pin 6																																		
			Input	0	Read: pin set as input																																		
			Output	1	Read: pin set as output																																		
			Set	1	Write: writing a '1' sets pin to output; writing a '0' has no effect																																		
H	RW	PIN7			Set as output pin 7																																		
			Input	0	Read: pin set as input																																		
			Output	1	Read: pin set as output																																		
			Set	1	Write: writing a '1' sets pin to output; writing a '0' has no effect																																		
I	RW	PIN8			Set as output pin 8																																		
			Input	0	Read: pin set as input																																		
			Output	1	Read: pin set as output																																		
			Set	1	Write: writing a '1' sets pin to output; writing a '0' has no effect																																		
J	RW	PIN9			Set as output pin 9																																		

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0																															
Id				f e d c b a Z Y X W V U T S R Q P O N M L K J I H G F E D C B A																															
Reset 0x00000000				0 0																															
Id	RW	Field	Value	Id	Value	Description																													
			Input	0	Read: pin set as input																														
			Output	1	Read: pin set as output																														
			Set	1	Write: writing a '1' sets pin to output; writing a '0' has no effect																														
K	RW	PIN10				Set as output pin 10																													
			Input	0	Read: pin set as input																														
			Output	1	Read: pin set as output																														
			Set	1	Write: writing a '1' sets pin to output; writing a '0' has no effect																														
L	RW	PIN11				Set as output pin 11																													
			Input	0	Read: pin set as input																														
			Output	1	Read: pin set as output																														
			Set	1	Write: writing a '1' sets pin to output; writing a '0' has no effect																														
M	RW	PIN12				Set as output pin 12																													
			Input	0	Read: pin set as input																														
			Output	1	Read: pin set as output																														
			Set	1	Write: writing a '1' sets pin to output; writing a '0' has no effect																														
N	RW	PIN13				Set as output pin 13																													
			Input	0	Read: pin set as input																														
			Output	1	Read: pin set as output																														
			Set	1	Write: writing a '1' sets pin to output; writing a '0' has no effect																														
O	RW	PIN14				Set as output pin 14																													
			Input	0	Read: pin set as input																														
			Output	1	Read: pin set as output																														
			Set	1	Write: writing a '1' sets pin to output; writing a '0' has no effect																														
P	RW	PIN15				Set as output pin 15																													
			Input	0	Read: pin set as input																														
			Output	1	Read: pin set as output																														
			Set	1	Write: writing a '1' sets pin to output; writing a '0' has no effect																														
Q	RW	PIN16				Set as output pin 16																													
			Input	0	Read: pin set as input																														
			Output	1	Read: pin set as output																														
			Set	1	Write: writing a '1' sets pin to output; writing a '0' has no effect																														
R	RW	PIN17				Set as output pin 17																													
			Input	0	Read: pin set as input																														
			Output	1	Read: pin set as output																														
			Set	1	Write: writing a '1' sets pin to output; writing a '0' has no effect																														
S	RW	PIN18				Set as output pin 18																													
			Input	0	Read: pin set as input																														
			Output	1	Read: pin set as output																														
			Set	1	Write: writing a '1' sets pin to output; writing a '0' has no effect																														
T	RW	PIN19				Set as output pin 19																													

Bit number			31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0																															
Id			f e d c b a Z Y X W V U T S R Q P O N M L K J I H G F E D C B A																															
Reset 0x00000000			0 0																															
Id	RW	Field	Value Id	Value	Description																													
			Input	0	Read: pin set as input																													
			Output	1	Read: pin set as output																													
			Set	1	Write: writing a '1' sets pin to output; writing a '0' has no effect																													
U	RW	PIN20			Set as output pin 20																													
			Input	0	Read: pin set as input																													
			Output	1	Read: pin set as output																													
			Set	1	Write: writing a '1' sets pin to output; writing a '0' has no effect																													
V	RW	PIN21			Set as output pin 21																													
			Input	0	Read: pin set as input																													
			Output	1	Read: pin set as output																													
			Set	1	Write: writing a '1' sets pin to output; writing a '0' has no effect																													
W	RW	PIN22			Set as output pin 22																													
			Input	0	Read: pin set as input																													
			Output	1	Read: pin set as output																													
			Set	1	Write: writing a '1' sets pin to output; writing a '0' has no effect																													
X	RW	PIN23			Set as output pin 23																													
			Input	0	Read: pin set as input																													
			Output	1	Read: pin set as output																													
			Set	1	Write: writing a '1' sets pin to output; writing a '0' has no effect																													
Y	RW	PIN24			Set as output pin 24																													
			Input	0	Read: pin set as input																													
			Output	1	Read: pin set as output																													
			Set	1	Write: writing a '1' sets pin to output; writing a '0' has no effect																													
Z	RW	PIN25			Set as output pin 25																													
			Input	0	Read: pin set as input																													
			Output	1	Read: pin set as output																													
			Set	1	Write: writing a '1' sets pin to output; writing a '0' has no effect																													
a	RW	PIN26			Set as output pin 26																													
			Input	0	Read: pin set as input																													
			Output	1	Read: pin set as output																													
			Set	1	Write: writing a '1' sets pin to output; writing a '0' has no effect																													
b	RW	PIN27			Set as output pin 27																													
			Input	0	Read: pin set as input																													
			Output	1	Read: pin set as output																													
			Set	1	Write: writing a '1' sets pin to output; writing a '0' has no effect																													
c	RW	PIN28			Set as output pin 28																													
			Input	0	Read: pin set as input																													
			Output	1	Read: pin set as output																													
			Set	1	Write: writing a '1' sets pin to output; writing a '0' has no effect																													
d	RW	PIN29			Set as output pin 29																													

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0																															
Id				f e d c b a Z Y X W V U T S R Q P O N M L K J I H G F E D C B A																															
Reset 0x00000000				0 0																															
Id	RW	Field	Value Id	Value	Description																														
			Input	0	Read: pin set as input																														
			Output	1	Read: pin set as output																														
			Set	1	Write: writing a '1' sets pin to output; writing a '0' has no effect																														
e	RW	PIN30			Set as output pin 30																														
			Input	0	Read: pin set as input																														
			Output	1	Read: pin set as output																														
			Set	1	Write: writing a '1' sets pin to output; writing a '0' has no effect																														
f	RW	PIN31			Set as output pin 31																														
			Input	0	Read: pin set as input																														
			Output	1	Read: pin set as output																														
			Set	1	Write: writing a '1' sets pin to output; writing a '0' has no effect																														

### 6.8.2.7 DIRCLR

Address offset: 0x51C

DIR clear register

Read: reads value of DIR register.

Bit number					31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0																															
Id					f e d c b a Z Y X W V U T S R Q P O N M L K J I H G F E D C B A																															
Reset 0x00000000					0 0																															
Id	RW	Field	Value	Id	Value	Description																														
A	RW	PIN0				Set as input pin 0																														
			Input	0	Read: pin set as input																															
			Output	1	Read: pin set as output																															
			Clear	1	Write: writing a '1' sets pin to input; writing a '0' has no effect																															
B	RW	PIN1				Set as input pin 1																														
			Input	0	Read: pin set as input																															
			Output	1	Read: pin set as output																															
			Clear	1	Write: writing a '1' sets pin to input; writing a '0' has no effect																															
C	RW	PIN2				Set as input pin 2																														
			Input	0	Read: pin set as input																															
			Output	1	Read: pin set as output																															
			Clear	1	Write: writing a '1' sets pin to input; writing a '0' has no effect																															
D	RW	PIN3				Set as input pin 3																														
			Input	0	Read: pin set as input																															
			Output	1	Read: pin set as output																															
			Clear	1	Write: writing a '1' sets pin to input; writing a '0' has no effect																															
E	RW	PIN4				Set as input pin 4																														
			Input	0	Read: pin set as input																															
			Output	1	Read: pin set as output																															

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0																															
Id				f e d c b a Z Y X W V U T S R Q P O N M L K J I H G F E D C B A																															
Reset 0x00000000				0 0																															
Id	RW	Field	Value Id	Value	Description																														
F	RW	PIN5	Clear	1	Write: writing a '1' sets pin to input; writing a '0' has no effect																														
					Set as input pin 5																														
			Input	0	Read: pin set as input																														
			Output	1	Read: pin set as output																														
			Clear	1	Write: writing a '1' sets pin to input; writing a '0' has no effect																														
G	RW	PIN6			Set as input pin 6																														
			Input	0	Read: pin set as input																														
			Output	1	Read: pin set as output																														
			Clear	1	Write: writing a '1' sets pin to input; writing a '0' has no effect																														
			H	RW	PIN7			Set as input pin 7																											
Input	0	Read: pin set as input																																	
Output	1	Read: pin set as output																																	
Clear	1	Write: writing a '1' sets pin to input; writing a '0' has no effect																																	
I	RW	PIN8						Set as input pin 8																											
			Input	0	Read: pin set as input																														
			Output	1	Read: pin set as output																														
			Clear	1	Write: writing a '1' sets pin to input; writing a '0' has no effect																														
			J	RW	PIN9			Set as input pin 9																											
Input	0	Read: pin set as input																																	
Output	1	Read: pin set as output																																	
Clear	1	Write: writing a '1' sets pin to input; writing a '0' has no effect																																	
K	RW	PIN10						Set as input pin 10																											
			Input	0	Read: pin set as input																														
			Output	1	Read: pin set as output																														
			Clear	1	Write: writing a '1' sets pin to input; writing a '0' has no effect																														
			L	RW	PIN11			Set as input pin 11																											
Input	0	Read: pin set as input																																	
Output	1	Read: pin set as output																																	
Clear	1	Write: writing a '1' sets pin to input; writing a '0' has no effect																																	
M	RW	PIN12						Set as input pin 12																											
			Input	0	Read: pin set as input																														
			Output	1	Read: pin set as output																														
			Clear	1	Write: writing a '1' sets pin to input; writing a '0' has no effect																														
			N	RW	PIN13			Set as input pin 13																											
Input	0	Read: pin set as input																																	
Output	1	Read: pin set as output																																	
Clear	1	Write: writing a '1' sets pin to input; writing a '0' has no effect																																	
O	RW	PIN14						Set as input pin 14																											
			Input	0	Read: pin set as input																														
			Output	1	Read: pin set as output																														

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0																															
Id				f e d c b a Z Y X W V U T S R Q P O N M L K J I H G F E D C B A																															
Reset 0x00000000				0 0																															
Id	RW	Field	Value Id	Value	Description																														
		PIN15	Clear	1	Write: writing a '1' sets pin to input; writing a '0' has no effect																														
			Input	0	Set as input pin 15																														
			Output	1	Read: pin set as input																														
			Clear	1	Read: pin set as output																														
P	RW	PIN15	Clear	1	Write: writing a '1' sets pin to input; writing a '0' has no effect																														
			Input	0	Set as input pin 16																														
			Output	1	Read: pin set as input																														
			Clear	1	Read: pin set as output																														
Q	RW	PIN16	Clear	1	Write: writing a '1' sets pin to input; writing a '0' has no effect																														
			Input	0	Set as input pin 17																														
			Output	1	Read: pin set as input																														
			Clear	1	Read: pin set as output																														
R	RW	PIN17	Clear	1	Write: writing a '1' sets pin to input; writing a '0' has no effect																														
			Input	0	Set as input pin 18																														
			Output	1	Read: pin set as input																														
			Clear	1	Read: pin set as output																														
S	RW	PIN18	Clear	1	Write: writing a '1' sets pin to input; writing a '0' has no effect																														
			Input	0	Set as input pin 19																														
			Output	1	Read: pin set as input																														
			Clear	1	Read: pin set as output																														
T	RW	PIN19	Clear	1	Write: writing a '1' sets pin to input; writing a '0' has no effect																														
			Input	0	Set as input pin 20																														
			Output	1	Read: pin set as input																														
			Clear	1	Read: pin set as output																														
U	RW	PIN20	Clear	1	Write: writing a '1' sets pin to input; writing a '0' has no effect																														
			Input	0	Set as input pin 21																														
			Output	1	Read: pin set as input																														
			Clear	1	Read: pin set as output																														
V	RW	PIN21	Clear	1	Write: writing a '1' sets pin to input; writing a '0' has no effect																														
			Input	0	Set as input pin 22																														
			Output	1	Read: pin set as input																														
			Clear	1	Read: pin set as output																														
W	RW	PIN22	Clear	1	Write: writing a '1' sets pin to input; writing a '0' has no effect																														
			Input	0	Set as input pin 23																														
			Output	1	Read: pin set as input																														
			Clear	1	Read: pin set as output																														
X	RW	PIN23	Clear	1	Write: writing a '1' sets pin to input; writing a '0' has no effect																														
			Input	0	Set as input pin 24																														
			Output	1	Read: pin set as input																														
			Clear	1	Read: pin set as output																														
Y	RW	PIN24	Clear	1	Write: writing a '1' sets pin to input; writing a '0' has no effect																														
			Input	0	Set as input pin 24																														
			Output	1	Read: pin set as input																														
					Read: pin set as output																														

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0																															
Id				f e d c b a Z Y X W V U T S R Q P O N M L K J I H G F E D C B A																															
Reset 0x00000000				0 0																															
Id	RW	Field	Value Id	Value	Description																														
			Clear	1	Write: writing a '1' sets pin to input; writing a '0' has no effect																														
Z	RW	PIN25			Set as input pin 25																														
			Input	0	Read: pin set as input																														
			Output	1	Read: pin set as output																														
			Clear	1	Write: writing a '1' sets pin to input; writing a '0' has no effect																														
a	RW	PIN26			Set as input pin 26																														
			Input	0	Read: pin set as input																														
			Output	1	Read: pin set as output																														
			Clear	1	Write: writing a '1' sets pin to input; writing a '0' has no effect																														
b	RW	PIN27			Set as input pin 27																														
			Input	0	Read: pin set as input																														
			Output	1	Read: pin set as output																														
			Clear	1	Write: writing a '1' sets pin to input; writing a '0' has no effect																														
c	RW	PIN28			Set as input pin 28																														
			Input	0	Read: pin set as input																														
			Output	1	Read: pin set as output																														
			Clear	1	Write: writing a '1' sets pin to input; writing a '0' has no effect																														
d	RW	PIN29			Set as input pin 29																														
			Input	0	Read: pin set as input																														
			Output	1	Read: pin set as output																														
			Clear	1	Write: writing a '1' sets pin to input; writing a '0' has no effect																														
e	RW	PIN30			Set as input pin 30																														
			Input	0	Read: pin set as input																														
			Output	1	Read: pin set as output																														
			Clear	1	Write: writing a '1' sets pin to input; writing a '0' has no effect																														
f	RW	PIN31			Set as input pin 31																														
			Input	0	Read: pin set as input																														
			Output	1	Read: pin set as output																														
			Clear	1	Write: writing a '1' sets pin to input; writing a '0' has no effect																														

### 6.8.2.8 LATCH

Address offset: 0x520

Latch register indicating what GPIO pins that have met the criteria set in the PIN\_CNF[n].SENSE registers

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0																															
Id				f e d c b a Z Y X W V U T S R Q P O N M L K J I H G F E D C B A																															
Reset 0x00000000				0 0																															
Id	RW	Field	Value	Id	Value	Description																													
A	RW	PIN0				Status on whether PIN0 has met criteria set in PIN_CNF0.SENSE register. Write '1' to clear.																													



Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0																															
Id				f e d c b a Z Y X W V U T S R Q P O N M L K J I H G F E D C B A																															
Reset 0x00000000				0 0																															
Id	RW	Field	Value Id	Value	Description																														
			NotLatched	0	Criteria has not been met																														
			Latched	1	Criteria has been met																														
B	RW	PIN1			Status on whether PIN1 has met criteria set in PIN_CNF1.SENSE register. Write '1' to clear.																														
			NotLatched	0	Criteria has not been met																														
			Latched	1	Criteria has been met																														
C	RW	PIN2			Status on whether PIN2 has met criteria set in PIN_CNF2.SENSE register. Write '1' to clear.																														
			NotLatched	0	Criteria has not been met																														
			Latched	1	Criteria has been met																														
D	RW	PIN3			Status on whether PIN3 has met criteria set in PIN_CNF3.SENSE register. Write '1' to clear.																														
			NotLatched	0	Criteria has not been met																														
			Latched	1	Criteria has been met																														
E	RW	PIN4			Status on whether PIN4 has met criteria set in PIN_CNF4.SENSE register. Write '1' to clear.																														
			NotLatched	0	Criteria has not been met																														
			Latched	1	Criteria has been met																														
F	RW	PIN5			Status on whether PIN5 has met criteria set in PIN_CNF5.SENSE register. Write '1' to clear.																														
			NotLatched	0	Criteria has not been met																														
			Latched	1	Criteria has been met																														
G	RW	PIN6			Status on whether PIN6 has met criteria set in PIN_CNF6.SENSE register. Write '1' to clear.																														
			NotLatched	0	Criteria has not been met																														
			Latched	1	Criteria has been met																														
H	RW	PIN7			Status on whether PIN7 has met criteria set in PIN_CNF7.SENSE register. Write '1' to clear.																														
			NotLatched	0	Criteria has not been met																														
			Latched	1	Criteria has been met																														
I	RW	PIN8			Status on whether PIN8 has met criteria set in PIN_CNF8.SENSE register. Write '1' to clear.																														
			NotLatched	0	Criteria has not been met																														
			Latched	1	Criteria has been met																														
J	RW	PIN9			Status on whether PIN9 has met criteria set in PIN_CNF9.SENSE register. Write '1' to clear.																														
			NotLatched	0	Criteria has not been met																														
			Latched	1	Criteria has been met																														
K	RW	PIN10			Status on whether PIN10 has met criteria set in PIN_CNF10.SENSE register. Write '1' to clear.																														
			NotLatched	0	Criteria has not been met																														
			Latched	1	Criteria has been met																														
L	RW	PIN11			Status on whether PIN11 has met criteria set in PIN_CNF11.SENSE register. Write '1' to clear.																														
			NotLatched	0	Criteria has not been met																														
			Latched	1	Criteria has been met																														
M	RW	PIN12			Status on whether PIN12 has met criteria set in PIN_CNF12.SENSE register. Write '1' to clear.																														
			NotLatched	0	Criteria has not been met																														
			Latched	1	Criteria has been met																														

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0																															
Id				f e d c b a Z Y X W V U T S R Q P O N M L K J I H G F E D C B A																															
Reset 0x00000000				0 0																															
Id	RW	Field	Value Id	Value	Description																														
N	RW	PIN13			Status on whether PIN13 has met criteria set in PIN_CNF13.SENSE register. Write '1' to clear.																														
			NotLatched	0	Criteria has not been met																														
			Latched	1	Criteria has been met																														
O	RW	PIN14			Status on whether PIN14 has met criteria set in PIN_CNF14.SENSE register. Write '1' to clear.																														
			NotLatched	0	Criteria has not been met																														
			Latched	1	Criteria has been met																														
P	RW	PIN15			Status on whether PIN15 has met criteria set in PIN_CNF15.SENSE register. Write '1' to clear.																														
			NotLatched	0	Criteria has not been met																														
			Latched	1	Criteria has been met																														
Q	RW	PIN16			Status on whether PIN16 has met criteria set in PIN_CNF16.SENSE register. Write '1' to clear.																														
			NotLatched	0	Criteria has not been met																														
			Latched	1	Criteria has been met																														
R	RW	PIN17			Status on whether PIN17 has met criteria set in PIN_CNF17.SENSE register. Write '1' to clear.																														
			NotLatched	0	Criteria has not been met																														
			Latched	1	Criteria has been met																														
S	RW	PIN18			Status on whether PIN18 has met criteria set in PIN_CNF18.SENSE register. Write '1' to clear.																														
			NotLatched	0	Criteria has not been met																														
			Latched	1	Criteria has been met																														
T	RW	PIN19			Status on whether PIN19 has met criteria set in PIN_CNF19.SENSE register. Write '1' to clear.																														
			NotLatched	0	Criteria has not been met																														
			Latched	1	Criteria has been met																														
U	RW	PIN20			Status on whether PIN20 has met criteria set in PIN_CNF20.SENSE register. Write '1' to clear.																														
			NotLatched	0	Criteria has not been met																														
			Latched	1	Criteria has been met																														
V	RW	PIN21			Status on whether PIN21 has met criteria set in PIN_CNF21.SENSE register. Write '1' to clear.																														
			NotLatched	0	Criteria has not been met																														
			Latched	1	Criteria has been met																														
W	RW	PIN22			Status on whether PIN22 has met criteria set in PIN_CNF22.SENSE register. Write '1' to clear.																														
			NotLatched	0	Criteria has not been met																														
			Latched	1	Criteria has been met																														
X	RW	PIN23			Status on whether PIN23 has met criteria set in PIN_CNF23.SENSE register. Write '1' to clear.																														
			NotLatched	0	Criteria has not been met																														
			Latched	1	Criteria has been met																														
Y	RW	PIN24			Status on whether PIN24 has met criteria set in PIN_CNF24.SENSE register. Write '1' to clear.																														
			NotLatched	0	Criteria has not been met																														
			Latched	1	Criteria has been met																														
Z	RW	PIN25			Status on whether PIN25 has met criteria set in PIN_CNF25.SENSE register. Write '1' to clear.																														

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0																															
Id				f e d c b a Z Y X W V U T S R Q P O N M L K J I H G F E D C B A																															
Reset 0x00000000				0 0																															
Id	RW	Field	Value Id	Value	Description																														
a	RW	PIN26	NotLatched	0	Criteria has not been met																														
			Latched	1	Criteria has been met																														
			Status on whether PIN26 has met criteria set in PIN_CNF26.SENSE register. Write '1' to clear.																																
			NotLatched	0	Criteria has not been met																														
b	RW	PIN27	Latched	1	Criteria has been met																														
			Status on whether PIN27 has met criteria set in PIN_CNF27.SENSE register. Write '1' to clear.																																
			NotLatched	0	Criteria has not been met																														
			Latched	1	Criteria has been met																														
c	RW	PIN28	Status on whether PIN28 has met criteria set in PIN_CNF28.SENSE register. Write '1' to clear.																																
			NotLatched	0	Criteria has not been met																														
			Latched	1	Criteria has been met																														
			Status on whether PIN28 has met criteria set in PIN_CNF28.SENSE register. Write '1' to clear.																																
d	RW	PIN29	Status on whether PIN29 has met criteria set in PIN_CNF29.SENSE register. Write '1' to clear.																																
			NotLatched	0	Criteria has not been met																														
			Latched	1	Criteria has been met																														
			Status on whether PIN29 has met criteria set in PIN_CNF29.SENSE register. Write '1' to clear.																																
e	RW	PIN30	Status on whether PIN30 has met criteria set in PIN_CNF30.SENSE register. Write '1' to clear.																																
			NotLatched	0	Criteria has not been met																														
			Latched	1	Criteria has been met																														
			Status on whether PIN30 has met criteria set in PIN_CNF30.SENSE register. Write '1' to clear.																																
f	RW	PIN31	Status on whether PIN31 has met criteria set in PIN_CNF31.SENSE register. Write '1' to clear.																																
			NotLatched	0	Criteria has not been met																														
			Latched	1	Criteria has been met																														
			Status on whether PIN31 has met criteria set in PIN_CNF31.SENSE register. Write '1' to clear.																																

### 6.8.2.9 DETECTMODE

Address offset: 0x524

Select between default DETECT signal behaviour and LDETECT mode

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0																															
Id				A																															
Reset 0x00000000				0 0																															
Id	RW	Field	Value Id	Value	Description																														
A	RW	DETECTMODE			Select between default DETECT signal behaviour and LDETECT mode																														
			Default	0	DETECT directly connected to PIN DETECT signals																														
			LDETECT	1	Use the latched LDETECT behaviour																														

### 6.8.2.10 PIN\_CNF[0]

Address offset: 0x700

Configuration of GPIO pins

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0																															
Id		E E														D D D								C C B A											
Reset 0x00000002				0 1 0																															
Id	RW	Field	Value Id	Value	Description																														
A	RW	DIR			Pin direction. Same physical register as DIR register																														
			Input	0	Configure pin as an input pin																														
			Output	1	Configure pin as an output pin																														
B	RW	INPUT			Connect or disconnect input buffer																														
			Connect	0	Connect input buffer																														
			Disconnect	1	Disconnect input buffer																														
C	RW	PULL			Pull configuration																														
			Disabled	0	No pull																														
			Pulldown	1	Pull down on pin																														
			Pullup	3	Pull up on pin																														
D	RW	DRIVE			Drive configuration																														
			S0S1	0	Standard '0', standard '1'																														
			H0S1	1	High drive '0', standard '1'																														
			S0H1	2	Standard '0', high drive '1'																														
			H0H1	3	High drive '0', high 'drive '1''																														
			D0S1	4	Disconnect '0' standard '1' (normally used for wired-or connections)																														
			D0H1	5	Disconnect '0', high drive '1' (normally used for wired-or connections)																														
			S0D1	6	Standard '0'. disconnect '1' (normally used for wired-and connections)																														
H0D1	7	High drive '0', disconnect '1' (normally used for wired-and connections)																																	
E	RW	SENSE			Pin sensing mechanism																														
			Disabled	0	Disabled																														
			High	2	Sense for high level																														
			Low	3	Sense for low level																														

### 6.8.2.11 PIN\_CNF[1]

Address offset: 0x704

Configuration of GPIO pins

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0																															
Id				E E														D D D								C C B A									
Reset 0x00000002				0 1 0																															
Id	RW	Field	Value Id	Value	Description																														
A	RW	DIR			Pin direction. Same physical register as DIR register																														
			Input	0	Configure pin as an input pin																														
			Output	1	Configure pin as an output pin																														
B	RW	INPUT			Connect or disconnect input buffer																														
			Connect	0	Connect input buffer																														
			Disconnect	1	Disconnect input buffer																														
C	RW	PULL			Pull configuration																														
			Disabled	0	No pull																														
			Pulldown	1	Pull down on pin																														
			Pullup	3	Pull up on pin																														
D	RW	DRIVE			Drive configuration																														
			S0S1	0	Standard '0', standard '1'																														

Address offset: 0x708

Bit number				31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
Id		RW	Field	Value Id	Value	Description																													
<b>Reset 0x00000002</b>				<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>1</b>	<b>0</b>	
ID	RW	Field	Value ID	Value	Description																														
A	RW	DIR			Pin direction. Same physical register as DIR register																														
			Input	0	Configure pin as an input pin																														
			Output	1	Configure pin as an output pin																														
B	RW	INPUT			Connect or disconnect input buffer																														
			Connect	0	Connect input buffer																														
			Disconnect	1	Disconnect input buffer																														
C	RW	PULL			Pull configuration																														
			Disabled	0	No pull																														
			Pulldown	1	Pull down on pin																														
			Pullup	3	Pull up on pin																														
D	RW	DRIVE			Drive configuration																														
			SOS1	0	Standard '0', standard '1'																														
			HOS1	1	High drive '0', standard '1'																														
			SOH1	2	Standard '0', high drive '1'																														
			HOH1	3	High drive '0', high 'drive '1''																														
			DOS1	4	Disconnect '0' standard '1' (normally used for wired-or connections)																														
			DOH1	5	Disconnect '0', high drive '1' (normally used for wired-or connections)																														
			SOD1	6	Standard '0'. disconnect '1' (normally used for wired-and connections)																														
			HOD1	7	High drive '0', disconnect '1' (normally used for wired-and connections)																														
E	RW	SENSE			Pin sensing mechanism																														

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0																															
Id				E E															D D D			C C B A													
Reset 0x00000002				0 1 0																															
Id	RW	Field	Value	Id	Value			Description																											
			Disabled	0				Disabled																											
			High	2				Sense for high level																											
			Low	3				Sense for low level																											

### 6.8.2.13 PIN\_CNF[3]

Address offset: 0x70C

Configuration of GPIO pins

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0																														
Id				E E															D D D			C C B A												
Reset 0x00000002				0 1 0																														
Id	RW	Field	Value Id	Value	Description																													
A	RW	DIR			Pin direction. Same physical register as DIR register																													
			Input	0	Configure pin as an input pin																													
			Output	1	Configure pin as an output pin																													
B	RW	INPUT			Connect or disconnect input buffer																													
			Connect	0	Connect input buffer																													
			Disconnect	1	Disconnect input buffer																													
C	RW	PULL			Pull configuration																													
			Disabled	0	No pull																													
			Pulldown	1	Pull down on pin																													
			Pullup	3	Pull up on pin																													
D	RW	DRIVE			Drive configuration																													
			S0S1	0	Standard '0', standard '1'																													
			H0S1	1	High drive '0', standard '1'																													
			S0H1	2	Standard '0', high drive '1'																													
			H0H1	3	High drive '0', high 'drive '1''																													
			D0S1	4	Disconnect '0' standard '1' (normally used for wired-or connections)																													
			D0H1	5	Disconnect '0', high drive '1' (normally used for wired-or connections)																													
			S0D1	6	Standard '0'. disconnect '1' (normally used for wired-and connections)																													
			H0D1	7	High drive '0', disconnect '1' (normally used for wired-and connections)																													
E	RW	SENSE			Pin sensing mechanism																													
			Disabled	0	Disabled																													
			High	2	Sense for high level																													
			Low	3	Sense for low level																													

### 6.8.2.14 PIN\_CNF[4]

Address offset: 0x710

Configuration of GPIO pins

Bit number				31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
Id																				E	E				D	D	D				C	C	B	A	
Reset 0x00000002				0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0
Id	RW	Field	Value Id	Value	Description																														
A	RW	DIR			Pin direction. Same physical register as DIR register																														
			Input	0	Configure pin as an input pin																														
			Output	1	Configure pin as an output pin																														
B	RW	INPUT			Connect or disconnect input buffer																														
			Connect	0	Connect input buffer																														
			Disconnect	1	Disconnect input buffer																														
C	RW	PULL			Pull configuration																														
			Disabled	0	No pull																														
			Pulldown	1	Pull down on pin																														
			Pullup	3	Pull up on pin																														
D	RW	DRIVE			Drive configuration																														
			S0S1	0	Standard '0', standard '1'																														
			H0S1	1	High drive '0', standard '1'																														
			S0H1	2	Standard '0', high drive '1'																														
			H0H1	3	High drive '0', high 'drive '1''																														
			D0S1	4	Disconnect '0' standard '1' (normally used for wired-or connections)																														
			D0H1	5	Disconnect '0', high drive '1' (normally used for wired-or connections)																														
			S0D1	6	Standard '0'. disconnect '1' (normally used for wired-and connections)																														
H0D1	7	High drive '0', disconnect '1' (normally used for wired-and connections)																																	
E	RW	SENSE			Pin sensing mechanism																														
			Disabled	0	Disabled																														
			High	2	Sense for high level																														
			Low	3	Sense for low level																														

#### 6.8.2.15 PIN\_CNF[5]

Address offset: 0x714

### Configuration of GPIO pins

Bit number				31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0			
Id																E	E				D	D	D				C	C	B	A								
Reset 0x00000002				0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0			
Id	RW	Field	Value Id	Value	Description																																	
A	RW	DIR			Pin direction. Same physical register as DIR register																																	
			Input	0	Configure pin as an input pin																																	
			Output	1	Configure pin as an output pin																																	
B	RW	INPUT			Connect or disconnect input buffer																																	
			Connect	0	Connect input buffer																																	
			Disconnect	1	Disconnect input buffer																																	
C	RW	PULL			Pull configuration																																	
			Disabled	0	No pull																																	
			Pulldown	1	Pull down on pin																																	
			Pullup	3	Pull up on pin																																	
D	RW	DRIVE			Drive configuration																																	
			S0S1	0	Standard '0', standard '1'																																	

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0																															
Id				E E																D D D			C C B A												
Reset 0x00000002				0 1 0																															
Id	RW	Field	Value Id	Value	Description																														
			H0S1	1	High drive '0', standard '1'																														
			S0H1	2	Standard '0', high drive '1'																														
			H0H1	3	High drive '0', high 'drive '1''																														
			D0S1	4	Disconnect '0' standard '1' (normally used for wired-or connections)																														
			D0H1	5	Disconnect '0', high drive '1' (normally used for wired-or connections)																														
			S0D1	6	Standard '0'. disconnect '1' (normally used for wired-and connections)																														
			H0D1	7	High drive '0', disconnect '1' (normally used for wired-and connections)																														
E	RW	SENSE			Pin sensing mechanism																														
			Disabled	0	Disabled																														
			High	2	Sense for high level																														
			Low	3	Sense for low level																														

### 6.8.2.16 PIN\_CNF[6]

Address offset: 0x718

Configuration of GPIO pins

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0																															
Id				E E																D D D			C C B A												
Reset 0x00000002				0 1 0																															
Id	RW	Field	Value Id	Value	Description																														
A	RW	DIR			Pin direction. Same physical register as DIR register																														
			Input	0	Configure pin as an input pin																														
			Output	1	Configure pin as an output pin																														
B	RW	INPUT			Connect or disconnect input buffer																														
			Connect	0	Connect input buffer																														
			Disconnect	1	Disconnect input buffer																														
C	RW	PULL			Pull configuration																														
			Disabled	0	No pull																														
			Pulldown	1	Pull down on pin																														
			Pullup	3	Pull up on pin																														
D	RW	DRIVE			Drive configuration																														
			S0S1	0	Standard '0', standard '1'																														
			H0S1	1	High drive '0', standard '1'																														
			S0H1	2	Standard '0', high drive '1'																														
			H0H1	3	High drive '0', high 'drive '1''																														
			D0S1	4	Disconnect '0' standard '1' (normally used for wired-or connections)																														
			D0H1	5	Disconnect '0', high drive '1' (normally used for wired-or connections)																														
			S0D1	6	Standard '0'. disconnect '1' (normally used for wired-and connections)																														
			H0D1	7	High drive '0', disconnect '1' (normally used for wired-and connections)																														
E	RW	SENSE			Pin sensing mechanism																														



Bit number					31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0											
Id																			E	E											D	D	D											C	C	B	A
Reset 0x00000002					0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0									
Id	RW	Field	Value	Id	Value				Description																																						
			Disabled		0				Disabled																																						
			High		2				Sense for high level																																						
			Low		3				Sense for low level																																						

### 6.8.2.17 PIN\_CNF[7]

Address offset: 0x71C

Configuration of GPIO pins

Bit number					31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0		
Id					E E																D D D			C C B A														
Reset 0x00000002					0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0		
Id	RW	Field	Value	Id	Value	Description																																
A	RW	DIR				Pin direction. Same physical register as DIR register																																
			Input	0	Configure pin as an input pin																																	
			Output	1	Configure pin as an output pin																																	
B	RW	INPUT				Connect or disconnect input buffer																																
			Connect	0	Connect input buffer																																	
			Disconnect	1	Disconnect input buffer																																	
C	RW	PULL				Pull configuration																																
			Disabled	0	No pull																																	
			Pulldown	1	Pull down on pin																																	
			Pullup	3	Pull up on pin																																	
D	RW	DRIVE				Drive configuration																																
			S0S1	0	Standard '0', standard '1'																																	
			H0S1	1	High drive '0', standard '1'																																	
			S0H1	2	Standard '0', high drive '1'																																	
			H0H1	3	High drive '0', high 'drive '1'																																	
			D0S1	4	Disconnect '0' standard '1' (normally used for wired-or connections)																																	
			D0H1	5	Disconnect '0', high drive '1' (normally used for wired-or connections)																																	
			S0D1	6	Standard '0'. disconnect '1' (normally used for wired-and connections)																																	
E	RW	SENSE				Pin sensing mechanism																																
			Disabled	0	Disabled																																	
			High	2	Sense for high level																																	
			Low	3	Sense for low level																																	

### 6.8.2.18 PIN\_CNF[8]

Address offset: 0x720

Configuration of GPIO pins

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0																														
Id				E E															D D D			C C B A												
Reset 0x00000002				0 1 0																														
Id	RW	Field	Value Id	Value	Description																													
A	RW	DIR	Input	0	Pin direction. Same physical register as DIR register																													
			Output	1	Configure pin as an input pin																													
			Output	1	Configure pin as an output pin																													
B	RW	INPUT	Connect	0	Connect or disconnect input buffer																													
			Connect	0	Connect input buffer																													
			Disconnect	1	Disconnect input buffer																													
C	RW	PULL	Disabled	0	Pull configuration																													
			Pulldown	1	No pull																													
			Pulldown	1	Pull down on pin																													
			Pullup	3	Pull up on pin																													
D	RW	DRIVE	S0S1	0	Drive configuration																													
			H0S1	1	Standard '0', standard '1'																													
			S0H1	2	High drive '0', standard '1'																													
			H0H1	3	Standard '0', high drive '1'																													
			D0S1	4	High drive '0', high 'drive '1''																													
			D0H1	5	Disconnect '0' standard '1' (normally used for wired-or connections)																													
			S0D1	6	Disconnect '0', high drive '1' (normally used for wired-or connections)																													
			H0D1	7	Standard '0'. disconnect '1' (normally used for wired-and connections)																													
E	RW	SENSE	Disabled	0	High drive '0', disconnect '1' (normally used for wired-and connections)																													
			High	2	Pin sensing mechanism																													
			High	2	Disabled																													
			Low	3	Sense for high level																													
Low	3	Sense for low level																																

#### 6.8.2.19 PIN\_CNF[9]

Address offset: 0x724

## Configuration of GPIO pins

Bit number				31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0			
Id																E	E				D	D	D				C	C	B	A								
Reset 0x00000002				0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0			
Id	RW	Field	Value Id	Value	Description																																	
A	RW	DIR			Pin direction. Same physical register as DIR register																																	
			Input	0	Configure pin as an input pin																																	
			Output	1	Configure pin as an output pin																																	
B	RW	INPUT			Connect or disconnect input buffer																																	
			Connect	0	Connect input buffer																																	
			Disconnect	1	Disconnect input buffer																																	
C	RW	PULL			Pull configuration																																	
			Disabled	0	No pull																																	
			Pulldown	1	Pull down on pin																																	
			Pullup	3	Pull up on pin																																	
D	RW	DRIVE			Drive configuration																																	
			S0S1	0	Standard '0', standard '1'																																	

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0																															
Id				E E																D D D			C C B A												
Reset 0x00000002				0 1 0																															
Id	RW	Field	Value Id	Value	Description																														
			H0S1	1	High drive '0', standard '1'																														
			S0H1	2	Standard '0', high drive '1'																														
			H0H1	3	High drive '0', high 'drive '1''																														
			D0S1	4	Disconnect '0' standard '1' (normally used for wired-or connections)																														
			D0H1	5	Disconnect '0', high drive '1' (normally used for wired-or connections)																														
			S0D1	6	Standard '0'. disconnect '1' (normally used for wired-and connections)																														
			H0D1	7	High drive '0', disconnect '1' (normally used for wired-and connections)																														
E	RW	SENSE			Pin sensing mechanism																														
			Disabled	0	Disabled																														
			High	2	Sense for high level																														
			Low	3	Sense for low level																														

### 6.8.2.20 PIN\_CNF[10]

Address offset: 0x728

Configuration of GPIO pins

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0																														
Id				E E															D D D			C C B A												
Reset 0x00000002				0 1 0																														
Id	RW	Field	Value Id	Value	Description																													
A	RW	DIR			Pin direction. Same physical register as DIR register																													
			Input	0	Configure pin as an input pin																													
			Output	1	Configure pin as an output pin																													
B	RW	INPUT			Connect or disconnect input buffer																													
			Connect	0	Connect input buffer																													
			Disconnect	1	Disconnect input buffer																													
C	RW	PULL			Pull configuration																													
			Disabled	0	No pull																													
			Pulldown	1	Pull down on pin																													
			Pullup	3	Pull up on pin																													
D	RW	DRIVE			Drive configuration																													
			S0S1	0	Standard '0', standard '1'																													
			H0S1	1	High drive '0', standard '1'																													
			S0H1	2	Standard '0', high drive '1'																													
			H0H1	3	High drive '0', high 'drive '1''																													
			D0S1	4	Disconnect '0' standard '1' (normally used for wired-or connections)																													
			D0H1	5	Disconnect '0', high drive '1' (normally used for wired-or connections)																													
			S0D1	6	Standard '0'. disconnect '1' (normally used for wired-and connections)																													
H0D1	7	High drive '0', disconnect '1' (normally used for wired-and connections)																																
E	RW	SENSE			Pin sensing mechanism																													

Bit number	31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0																																						
Id	E E																D D D				C C B A																		
<b>Reset 0x00000002</b>																																							
Id	RW	Field	Value	Id	Value	Description																																	
			Disabled		0	Disabled																																	
			High		2	Sense for high level																																	
			Low		3	Sense for low level																																	

### 6.8.2.21 PIN\_CNF[11]

Address offset: 0x72C

Configuration of GPIO pins

Bit number					31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0																														
Id					E E																D D D			C C B A											
Reset 0x00000002					0 1 0																														
Id	RW	Field	Value Id	Value	Description																														
A	RW	DIR			Pin direction. Same physical register as DIR register																														
			Input	0	Configure pin as an input pin																														
			Output	1	Configure pin as an output pin																														
B	RW	INPUT			Connect or disconnect input buffer																														
			Connect	0	Connect input buffer																														
			Disconnect	1	Disconnect input buffer																														
C	RW	PULL			Pull configuration																														
			Disabled	0	No pull																														
			Pulldown	1	Pull down on pin																														
			Pullup	3	Pull up on pin																														
D	RW	DRIVE			Drive configuration																														
			S0S1	0	Standard '0', standard '1'																														
			H0S1	1	High drive '0', standard '1'																														
			S0H1	2	Standard '0', high drive '1'																														
			H0H1	3	High drive '0', high 'drive '1''																														
			D0S1	4	Disconnect '0' standard '1' (normally used for wired-or connections)																														
			D0H1	5	Disconnect '0', high drive '1' (normally used for wired-or connections)																														
			S0D1	6	Standard '0'. disconnect '1' (normally used for wired-and connections)																														
E	RW	SENSE			Pin sensing mechanism																														
			Disabled	0	Disabled																														
			High	2	Sense for high level																														
			Low	3	Sense for low level																														

### 6.8.2.22 PIN\_CNF[12]

Address offset: 0x730

Configuration of GPIO pins

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0																														
Id				E E															D D D			C C B A												
Reset 0x00000002				0 1 0																														
Id	RW	Field	Value Id	Value	Description																													
A	RW	DIR	Input	0	Pin direction. Same physical register as DIR register																													
			Output	1	Configure pin as an input pin																													
			Output	1	Configure pin as an output pin																													
B	RW	INPUT	Connect	0	Connect or disconnect input buffer																													
			Connect	0	Connect input buffer																													
			Disconnect	1	Disconnect input buffer																													
C	RW	PULL	Disabled	0	Pull configuration																													
			Pulldown	1	No pull																													
			Pulldown	1	Pull down on pin																													
			Pullup	3	Pull up on pin																													
D	RW	DRIVE	S0S1	0	Drive configuration																													
			H0S1	1	Standard '0', standard '1'																													
			S0H1	2	High drive '0', standard '1'																													
			H0H1	3	Standard '0', high drive '1'																													
			D0S1	4	High drive '0', high 'drive '1''																													
			D0H1	5	Disconnect '0' standard '1' (normally used for wired-or connections)																													
			S0D1	6	Disconnect '0', high drive '1' (normally used for wired-or connections)																													
			H0D1	7	Standard '0'. disconnect '1' (normally used for wired-and connections)																													
E	RW	SENSE	Disabled	0	High drive '0', disconnect '1' (normally used for wired-and connections)																													
			High	2	Pin sensing mechanism																													
			High	2	Disabled																													
			Low	3	Sense for high level																													
Low	3	Sense for low level																																

#### 6.8.2.23 PIN\_CNF[13]

Address offset: 0x734

## Configuration of GPIO pins

Bit number				31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0			
Id																E	E				D	D	D				C	C	B	A								
Reset 0x00000002				0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0			
Id	RW	Field	Value Id	Value	Description																																	
A	RW	DIR			Pin direction. Same physical register as DIR register																																	
			Input	0	Configure pin as an input pin																																	
			Output	1	Configure pin as an output pin																																	
B	RW	INPUT			Connect or disconnect input buffer																																	
			Connect	0	Connect input buffer																																	
			Disconnect	1	Disconnect input buffer																																	
C	RW	PULL			Pull configuration																																	
			Disabled	0	No pull																																	
			Pulldown	1	Pull down on pin																																	
			Pullup	3	Pull up on pin																																	
D	RW	DRIVE			Drive configuration																																	
			S0S1	0	Standard '0', standard '1'																																	

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0																															
Id				E E																D D D			C C B A												
Reset 0x00000002				0 1 0																															
Id	RW	Field	Value Id	Value	Description																														
			H0S1	1	High drive '0', standard '1'																														
			S0H1	2	Standard '0', high drive '1'																														
			H0H1	3	High drive '0', high 'drive '1"																														
			D0S1	4	Disconnect '0' standard '1' (normally used for wired-or connections)																														
			D0H1	5	Disconnect '0', high drive '1' (normally used for wired-or connections)																														
			S0D1	6	Standard '0'. disconnect '1' (normally used for wired-and connections)																														
			H0D1	7	High drive '0', disconnect '1' (normally used for wired-and connections)																														
E	RW	SENSE			Pin sensing mechanism																														
			Disabled	0	Disabled																														
			High	2	Sense for high level																														
			Low	3	Sense for low level																														

#### 6.8.2.24 PIN\_CNF[14]

Address offset: 0x738

## Configuration of GPIO pins

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0																														
Id				E E															D D D			C C B A												
Reset 0x00000002				0 0																														
Id	RW	Field	Value Id	Value	Description																													
A	RW	DIR			Pin direction. Same physical register as DIR register																													
			Input	0	Configure pin as an input pin																													
			Output	1	Configure pin as an output pin																													
B	RW	INPUT			Connect or disconnect input buffer																													
			Connect	0	Connect input buffer																													
			Disconnect	1	Disconnect input buffer																													
C	RW	PULL			Pull configuration																													
			Disabled	0	No pull																													
			Pulldown	1	Pull down on pin																													
			Pullup	3	Pull up on pin																													
D	RW	DRIVE			Drive configuration																													
			S0S1	0	Standard '0', standard '1'																													
			H0S1	1	High drive '0', standard '1'																													
			S0H1	2	Standard '0', high drive '1'																													
			H0H1	3	High drive '0', high 'drive '1''																													
			D0S1	4	Disconnect '0' standard '1' (normally used for wired-or connections)																													
			D0H1	5	Disconnect '0', high drive '1' (normally used for wired-or connections)																													
S0D1	6	Standard '0'. disconnect '1' (normally used for wired-and connections)																																
H0D1	7	High drive '0', disconnect '1' (normally used for wired-and connections)																																
E	RW	SENSE			Pin sensing mechanism																													

Bit number					31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0																																							
Id					E E																D D D				C C B A																			
Reset 0x00000002					0 1 0																																							
Id	RW	Field	Value	Id	Value	Description																																						
			Disabled		0	Disabled																																						
			High		2	Sense for high level																																						
			Low		3	Sense for low level																																						

### 6.8.2.25 PIN\_CNF[15]

Address offset: 0x73C

Configuration of GPIO pins

Bit number					31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0																														
Id					E E																D D D			C C B A											
Reset 0x00000002					0 1 0																														
Id	RW	Field	Value Id	Value	Description																														
A	RW	DIR			Pin direction. Same physical register as DIR register																														
			Input	0	Configure pin as an input pin																														
			Output	1	Configure pin as an output pin																														
B	RW	INPUT			Connect or disconnect input buffer																														
			Connect	0	Connect input buffer																														
			Disconnect	1	Disconnect input buffer																														
C	RW	PULL			Pull configuration																														
			Disabled	0	No pull																														
			Pulldown	1	Pull down on pin																														
			Pullup	3	Pull up on pin																														
D	RW	DRIVE			Drive configuration																														
			S0S1	0	Standard '0', standard '1'																														
			H0S1	1	High drive '0', standard '1'																														
			S0H1	2	Standard '0', high drive '1'																														
			H0H1	3	High drive '0', high 'drive '1''																														
			D0S1	4	Disconnect '0' standard '1' (normally used for wired-or connections)																														
			D0H1	5	Disconnect '0', high drive '1' (normally used for wired-or connections)																														
			S0D1	6	Standard '0'. disconnect '1' (normally used for wired-and connections)																														
			H0D1	7	High drive '0', disconnect '1' (normally used for wired-and connections)																														
E	RW	SENSE			Pin sensing mechanism																														
			Disabled	0	Disabled																														
			High	2	Sense for high level																														
			Low	3	Sense for low level																														

### 6.8.2.26 PIN\_CNF[16]

Address offset: 0x740

Configuration of GPIO pins

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0																															
Id				E E															D D D			C C B A													
Reset 0x00000002				0 1 0																															
Id	RW	Field	Value Id	Value	Description																														
A	RW	DIR			Pin direction. Same physical register as DIR register																														
			Input	0	Configure pin as an input pin																														
			Output	1	Configure pin as an output pin																														
B	RW	INPUT			Connect or disconnect input buffer																														
			Connect	0	Connect input buffer																														
			Disconnect	1	Disconnect input buffer																														
C	RW	PULL			Pull configuration																														
			Disabled	0	No pull																														
			Pulldown	1	Pull down on pin																														
			Pullup	3	Pull up on pin																														
D	RW	DRIVE			Drive configuration																														
			S0S1	0	Standard '0', standard '1'																														
			H0S1	1	High drive '0', standard '1'																														
			S0H1	2	Standard '0', high drive '1'																														
			H0H1	3	High drive '0', high 'drive '1''																														
			D0S1	4	Disconnect '0' standard '1' (normally used for wired-or connections)																														
			D0H1	5	Disconnect '0', high drive '1' (normally used for wired-or connections)																														
			S0D1	6	Standard '0'. disconnect '1' (normally used for wired-and connections)																														
			H0D1	7	High drive '0', disconnect '1' (normally used for wired-and connections)																														
E	RW	SENSE			Pin sensing mechanism																														
			Disabled	0	Disabled																														
			High	2	Sense for high level																														
			Low	3	Sense for low level																														

### 6.8.2.27 PIN\_CNF[17]

Address offset: 0x744

Configuration of GPIO pins

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0																															
Id				E E															D D D			C C B A													
Reset 0x00000002				0 1 0																															
Id	RW	Field	Value Id	Value	Description																														
A	RW	DIR			Pin direction. Same physical register as DIR register																														
			Input	0	Configure pin as an input pin																														
			Output	1	Configure pin as an output pin																														
B	RW	INPUT			Connect or disconnect input buffer																														
			Connect	0	Connect input buffer																														
			Disconnect	1	Disconnect input buffer																														
C	RW	PULL			Pull configuration																														
			Disabled	0	No pull																														
			Pulldown	1	Pull down on pin																														
			Pullup	3	Pull up on pin																														
D	RW	DRIVE			Drive configuration																														
			S0S1	0	Standard '0', standard '1'																														



Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0																															
Id				E E																D D D			C C B A												
Reset 0x00000002				0 1 0																															
Id	RW	Field	Value Id	Value	Description																														
			H0S1	1	High drive '0', standard '1'																														
			S0H1	2	Standard '0', high drive '1'																														
			H0H1	3	High drive '0', high 'drive '1''																														
			D0S1	4	Disconnect '0' standard '1' (normally used for wired-or connections)																														
			D0H1	5	Disconnect '0', high drive '1' (normally used for wired-or connections)																														
			S0D1	6	Standard '0'. disconnect '1' (normally used for wired-and connections)																														
			H0D1	7	High drive '0', disconnect '1' (normally used for wired-and connections)																														
E	RW	SENSE			Pin sensing mechanism																														
			Disabled	0	Disabled																														
			High	2	Sense for high level																														
			Low	3	Sense for low level																														

### 6.8.2.28 PIN\_CNF[18]

Address offset: 0x748

Configuration of GPIO pins

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0																														
Id				E E															D D D			C C B A												
Reset 0x00000002				0 1 0																														
Id	RW	Field	Value Id	Value	Description																													
A	RW	DIR			Pin direction. Same physical register as DIR register																													
			Input	0	Configure pin as an input pin																													
			Output	1	Configure pin as an output pin																													
B	RW	INPUT			Connect or disconnect input buffer																													
			Connect	0	Connect input buffer																													
			Disconnect	1	Disconnect input buffer																													
C	RW	PULL			Pull configuration																													
			Disabled	0	No pull																													
			Pulldown	1	Pull down on pin																													
			Pullup	3	Pull up on pin																													
D	RW	DRIVE			Drive configuration																													
			S0S1	0	Standard '0', standard '1'																													
			H0S1	1	High drive '0', standard '1'																													
			S0H1	2	Standard '0', high drive '1'																													
			H0H1	3	High drive '0', high 'drive '1''																													
			D0S1	4	Disconnect '0' standard '1' (normally used for wired-or connections)																													
			D0H1	5	Disconnect '0', high drive '1' (normally used for wired-or connections)																													
			S0D1	6	Standard '0'. disconnect '1' (normally used for wired-and connections)																													
H0D1	7	High drive '0', disconnect '1' (normally used for wired-and connections)																																
E	RW	SENSE			Pin sensing mechanism																													

Bit number					31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0											
Id																			E	E											D	D	D											C	C	B	A
Reset 0x00000002					0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0									
Id	RW	Field	Value	Id	Value				Description																																						
			Disabled		0				Disabled																																						
			High		2				Sense for high level																																						
			Low		3				Sense for low level																																						

### 6.8.2.29 PIN\_CNF[19]

Address offset: 0x74C

Configuration of GPIO pins

Bit number					31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0								
Id					E																E			D			D			D			C			C			B			A		
Reset 0x00000002					0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0							
Id	RW	Field	Value	Id	Value	Description																																						
A	RW	DIR				Pin direction. Same physical register as DIR register																																						
			Input	0	Configure pin as an input pin																																							
			Output	1	Configure pin as an output pin																																							
B	RW	INPUT				Connect or disconnect input buffer																																						
			Connect	0	Connect input buffer																																							
			Disconnect	1	Disconnect input buffer																																							
C	RW	PULL				Pull configuration																																						
			Disabled	0	No pull																																							
			Pulldown	1	Pull down on pin																																							
			Pullup	3	Pull up on pin																																							
D	RW	DRIVE				Drive configuration																																						
			S0S1	0	Standard '0', standard '1'																																							
			H0S1	1	High drive '0', standard '1'																																							
			S0H1	2	Standard '0', high drive '1'																																							
			H0H1	3	High drive '0', high 'drive '1''																																							
			D0S1	4	Disconnect '0' standard '1' (normally used for wired-or connections)																																							
			D0H1	5	Disconnect '0', high drive '1' (normally used for wired-or connections)																																							
			S0D1	6	Standard '0'. disconnect '1' (normally used for wired-and connections)																																							
E	RW	SENSE				Pin sensing mechanism																																						
			Disabled	0	Disabled																																							
			High	2	Sense for high level																																							
			Low	3	Sense for low level																																							

### 6.8.2.30 PIN\_CNF[20]

Address offset: 0x750

Configuration of GPIO pins

Address offset: 0x754

## Configuration of GPIO pins

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0																															
Id																				E	E				D	D	D				C	C	B	A	
Reset 0x00000002				0 1 0																															
Id	RW	Field	Value Id	Value	Description																														
A	RW	DIR			Pin direction. Same physical register as DIR register																														
			Input	0	Configure pin as an input pin																														
			Output	1	Configure pin as an output pin																														
B	RW	INPUT			Connect or disconnect input buffer																														
			Connect	0	Connect input buffer																														
			Disconnect	1	Disconnect input buffer																														
C	RW	PULL			Pull configuration																														
			Disabled	0	No pull																														
			Pulldown	1	Pull down on pin																														
			Pullup	3	Pull up on pin																														
D	RW	DRIVE			Drive configuration																														
			S0S1	0	Standard '0', standard '1'																														

Bit number				31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0			
Id																				E	E				D	D	D				C	C	B	A				
Reset 0x00000002				0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0		
Id	RW	Field	Value Id	Value	Description																																	
			H0S1	1	High drive '0', standard '1'																																	
			S0H1	2	Standard '0', high drive '1'																																	
			H0H1	3	High drive '0', high 'drive '1''																																	
			D0S1	4	Disconnect '0' standard '1' (normally used for wired-or connections)																																	
			D0H1	5	Disconnect '0', high drive '1' (normally used for wired-or connections)																																	
			S0D1	6	Standard '0'. disconnect '1' (normally used for wired-and connections)																																	
			H0D1	7	High drive '0', disconnect '1' (normally used for wired-and connections)																																	
E	RW	SENSE			Pin sensing mechanism																																	
			Disabled	0	Disabled																																	
			High	2	Sense for high level																																	
			Low	3	Sense for low level																																	

### 6.8.2.32 PIN\_CNF[22]

Address offset: 0x758

Configuration of GPIO pins

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0																															
Id				E E																D D D			C C B A												
Reset 0x00000002				0 1 0																															
Id	RW	Field	Value Id	Value	Description																														
A	RW	DIR			Pin direction. Same physical register as DIR register																														
			Input	0	Configure pin as an input pin																														
			Output	1	Configure pin as an output pin																														
B	RW	INPUT			Connect or disconnect input buffer																														
			Connect	0	Connect input buffer																														
			Disconnect	1	Disconnect input buffer																														
C	RW	PULL			Pull configuration																														
			Disabled	0	No pull																														
			Pulldown	1	Pull down on pin																														
			Pullup	3	Pull up on pin																														
D	RW	DRIVE			Drive configuration																														
			S0S1	0	Standard '0', standard '1'																														
			H0S1	1	High drive '0', standard '1'																														
			S0H1	2	Standard '0', high drive '1'																														
			H0H1	3	High drive '0', high 'drive '1''																														
			D0S1	4	Disconnect '0' standard '1' (normally used for wired-or connections)																														
			D0H1	5	Disconnect '0', high drive '1' (normally used for wired-or connections)																														
			S0D1	6	Standard '0'. disconnect '1' (normally used for wired-and connections)																														
			H0D1	7	High drive '0', disconnect '1' (normally used for wired-and connections)																														
E	RW	SENSE			Pin sensing mechanism																														

Bit number	31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0																																				
Id	E E															D D D			C C B A																		
Reset 0x00000002		0 1 0																																			
Id	RW	Field	Value	Id	Value	Description																															
			Disabled	0	Disabled																																
			High	2	Sense for high level																																
			Low	3	Sense for low level																																

### 6.8.2.33 PIN\_CNF[23]

Address offset: 0x75C

Configuration of GPIO pins

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0																															
Id				E E																D D D			C C B A												
Reset 0x00000002				0 1 0																															
Id	RW	Field	Value Id	Value	Description																														
A	RW	DIR	Input	0	Pin direction. Same physical register as DIR register																														
			Output	1	Configure pin as an input pin																														
			Output	1	Configure pin as an output pin																														
B	RW	INPUT	Connect	0	Connect or disconnect input buffer																														
			Connect	0	Connect input buffer																														
			Disconnect	1	Disconnect input buffer																														
C	RW	PULL	Disabled	0	Pull configuration																														
			Pulldown	1	No pull																														
			Pulldown	1	Pull down on pin																														
			Pullup	3	Pull up on pin																														
D	RW	DRIVE	S0S1	0	Drive configuration																														
			H0S1	1	Standard '0', standard '1'																														
			S0H1	2	High drive '0', standard '1'																														
			H0H1	3	Standard '0', high drive '1'																														
			H0H1	3	High drive '0', high 'drive '1''																														
			D0S1	4	Disconnect '0' standard '1' (normally used for wired-or connections)																														
			D0H1	5	Disconnect '0', high drive '1' (normally used for wired-or connections)																														
			S0D1	6	Standard '0'. disconnect '1' (normally used for wired-and connections)																														
E	RW	SENSE	Disabled	0	Pin sensing mechanism																														
			High	2	Disabled																														
			Low	3	Sense for high level																														
			Low	3	Sense for low level																														

### 6.8.2.34 PIN\_CNF[24]

Address offset: 0x760

Configuration of GPIO pins

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0																															
Id		E E															D D D			C C B A															
Reset 0x00000002				0 1 0																															
Id	RW	Field	Value Id	Value	Description																														
A	RW	DIR			Pin direction. Same physical register as DIR register																														
			Input	0	Configure pin as an input pin																														
			Output	1	Configure pin as an output pin																														
B	RW	INPUT			Connect or disconnect input buffer																														
			Connect	0	Connect input buffer																														
			Disconnect	1	Disconnect input buffer																														
C	RW	PULL			Pull configuration																														
			Disabled	0	No pull																														
			Pulldown	1	Pull down on pin																														
			Pullup	3	Pull up on pin																														
D	RW	DRIVE			Drive configuration																														
			S0S1	0	Standard '0', standard '1'																														
			H0S1	1	High drive '0', standard '1'																														
			S0H1	2	Standard '0', high drive '1'																														
			H0H1	3	High drive '0', high 'drive '1''																														
			D0S1	4	Disconnect '0' standard '1' (normally used for wired-or connections)																														
			D0H1	5	Disconnect '0', high drive '1' (normally used for wired-or connections)																														
			S0D1	6	Standard '0'. disconnect '1' (normally used for wired-and connections)																														
			H0D1	7	High drive '0', disconnect '1' (normally used for wired-and connections)																														
E	RW	SENSE			Pin sensing mechanism																														
			Disabled	0	Disabled																														
			High	2	Sense for high level																														
			Low	3	Sense for low level																														

### 6.8.2.35 PIN\_CNF[25]

Address offset: 0x764

Configuration of GPIO pins

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0																															
Id				E E																D D D			C C B A												
Reset 0x00000002				0 1 0																															
Id	RW	Field	Value Id	Value	Description																														
A	RW	DIR			Pin direction. Same physical register as DIR register																														
			Input	0	Configure pin as an input pin																														
			Output	1	Configure pin as an output pin																														
B	RW	INPUT			Connect or disconnect input buffer																														
			Connect	0	Connect input buffer																														
			Disconnect	1	Disconnect input buffer																														
C	RW	PULL			Pull configuration																														
			Disabled	0	No pull																														
			Pulldown	1	Pull down on pin																														
			Pullup	3	Pull up on pin																														
D	RW	DRIVE			Drive configuration																														
			S0S1	0	Standard '0', standard '1'																														

Bit number				31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0			
Id																				E	E				D	D	D				C	C	B	A				
Reset 0x00000002				0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0		
Id	RW	Field	Value Id	Value	Description																																	
			H0S1	1	High drive '0', standard '1'																																	
			S0H1	2	Standard '0', high drive '1'																																	
			H0H1	3	High drive '0', high 'drive '1''																																	
			D0S1	4	Disconnect '0' standard '1' (normally used for wired-or connections)																																	
			D0H1	5	Disconnect '0', high drive '1' (normally used for wired-or connections)																																	
			S0D1	6	Standard '0'. disconnect '1' (normally used for wired-and connections)																																	
			H0D1	7	High drive '0', disconnect '1' (normally used for wired-and connections)																																	
E	RW	SENSE			Pin sensing mechanism																																	
			Disabled	0	Disabled																																	
			High	2	Sense for high level																																	
			Low	3	Sense for low level																																	

### 6.8.2.36 PIN\_CNF[26]

Address offset: 0x768

Configuration of GPIO pins

Bit number				31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
Id																				E	E	D			D	D	C			C	B	A			
Reset 0x00000002				0 1 0																															
Id	RW	Field	Value Id	Value	Description																														
A	RW	DIR			Pin direction. Same physical register as DIR register																														
			Input	0	Configure pin as an input pin																														
			Output	1	Configure pin as an output pin																														
B	RW	INPUT			Connect or disconnect input buffer																														
			Connect	0	Connect input buffer																														
			Disconnect	1	Disconnect input buffer																														
C	RW	PULL			Pull configuration																														
			Disabled	0	No pull																														
			Pulldown	1	Pull down on pin																														
			Pullup	3	Pull up on pin																														
D	RW	DRIVE			Drive configuration																														
			S0S1	0	Standard '0', standard '1'																														
			H0S1	1	High drive '0', standard '1'																														
			S0H1	2	Standard '0', high drive '1'																														
			H0H1	3	High drive '0', high 'drive '1''																														
			D0S1	4	Disconnect '0' standard '1' (normally used for wired-or connections)																														
			D0H1	5	Disconnect '0', high drive '1' (normally used for wired-or connections)																														
			S0D1	6	Standard '0'. disconnect '1' (normally used for wired-and connections)																														
H0D1	7	High drive '0', disconnect '1' (normally used for wired-and connections)																																	
E	RW	SENSE			Pin sensing mechanism																														





Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0																															
Id				E E																D D D			C C B A												
Reset 0x00000002				0 1 0																															
Id	RW	Field	Value Id	Value	Description																														
A	RW	DIR			Pin direction. Same physical register as DIR register																														
			Input	0	Configure pin as an input pin																														
			Output	1	Configure pin as an output pin																														
B	RW	INPUT			Connect or disconnect input buffer																														
			Connect	0	Connect input buffer																														
			Disconnect	1	Disconnect input buffer																														
C	RW	PULL			Pull configuration																														
			Disabled	0	No pull																														
			Pulldown	1	Pull down on pin																														
			Pullup	3	Pull up on pin																														
D	RW	DRIVE			Drive configuration																														
			S0S1	0	Standard '0', standard '1'																														
			H0S1	1	High drive '0', standard '1'																														
			S0H1	2	Standard '0', high drive '1'																														
			H0H1	3	High drive '0', high 'drive '1''																														
			D0S1	4	Disconnect '0' standard '1' (normally used for wired-or connections)																														
			D0H1	5	Disconnect '0', high drive '1' (normally used for wired-or connections)																														
			S0D1	6	Standard '0'. disconnect '1' (normally used for wired-and connections)																														
			H0D1	7	High drive '0', disconnect '1' (normally used for wired-and connections)																														
E	RW	SENSE			Pin sensing mechanism																														
			Disabled	0	Disabled																														
			High	2	Sense for high level																														
			Low	3	Sense for low level																														

### 6.8.2.39 PIN\_CNF[29]

Address offset: 0x774

## Configuration of GPIO pins

Bit number				31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0	
Id				E																E	D			D	D	C			C	B	A					
Reset 0x00000002				0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0
Id	RW	Field	Value	Id	Value		Description																													
A	RW	DIR					Pin direction. Same physical register as DIR register																													
		Input	0	Configure pin as an input pin																																
		Output	1	Configure pin as an output pin																																
B	RW	INPUT					Connect or disconnect input buffer																													
		Connect	0	Connect input buffer																																
		Disconnect	1	Disconnect input buffer																																
C	RW	PULL					Pull configuration																													
		Disabled	0	No pull																																
		Pulldown	1	Pull down on pin																																
		Pullup	3	Pull up on pin																																
D	RW	DRIVE					Drive configuration																													
		S0S1	0	Standard '0', standard '1'																																



Bit number				31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0	
Id																				E	E					D	D	D					C	C	B	A
Reset 0x00000002				0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0
Id	RW	Field	Value	Id	Value			Description																												
			Disabled	0	0			Disabled																												
			High	2	2			Sense for high level																												
			Low	3	3			Sense for low level																												

### 6.8.2.41 PIN\_CNF[31]

Address offset: 0x77C

Configuration of GPIO pins

Bit number				31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
Id		RW	Field	Value	Id	Value		Description																											
A	RW	DIR		Input	0	Pin direction. Same physical register as DIR register																													
				Output	1	Configure pin as an input pin																													
						Configure pin as an output pin																													
B	RW	INPUT		Connect	0	Connect or disconnect input buffer																													
				Disconnect	1	Connect input buffer																													
						Disconnect input buffer																													
C	RW	PULL		Disabled	0	Pull configuration																													
				Pulldown	1	No pull																													
				Pullup	3	Pull down on pin																													
						Pull up on pin																													
D	RW	DRIVE		S0S1	0	Drive configuration																													
				H0S1	1	Standard '0', standard '1'																													
				S0H1	2	High drive '0', standard '1'																													
				H0H1	3	Standard '0', high drive '1'																													
				D0S1	4	High drive '0', high 'drive '1''																													
				D0H1	5	Disconnect '0' standard '1' (normally used for wired-or connections)																													
				S0D1	6	Disconnect '0', high drive '1' (normally used for wired-or connections)																													
				H0D1	7	Standard '0'. disconnect '1' (normally used for wired-and connections)																													
						High drive '0', disconnect '1' (normally used for wired-and connections)																													
E	RW	SENSE		Disabled	0	Pin sensing mechanism																													
				High	2	Disabled																													
				Low	3	Sense for high level																													
						Sense for low level																													

## 6.8.3 Electrical specification

### 6.8.3.1 GPIO Electrical Specification

Symbol	Description	Min.	Typ.	Max.	Units
V <sub>IH</sub>	Input high voltage	0.7 x VDD		VDD	V

Symbol	Description	Min.	Typ.	Max.	Units
V <sub>IL</sub>	Input low voltage	VSS		0.3 x VDD	V
V <sub>OH,SD</sub>	Output high voltage, standard drive, 0.5 mA, VDD ≥ 1.7	VDD-0.4		VDD	V
V <sub>OH,HDL</sub>	Output high voltage, high drive, 5 mA, VDD ≥ 2.7 V	VDD-0.4		VDD	V
V <sub>OH,HDL</sub>	Output high voltage, high drive, 3 mA, VDD ≥ 1.7 V	VDD-0.4		VDD	V
V <sub>OL,SD</sub>	Output low voltage, standard drive, 0.5 mA, VDD ≥ 1.7	VSS		VSS+0.4	V
V <sub>OL,HDL</sub>	Output low voltage, high drive, 5 mA, VDD ≥ 2.7 V	VSS		VSS+0.4	V
V <sub>OL,HDL</sub>	Output low voltage, high drive, 3 mA, VDD ≥ 1.7 V	VSS		VSS+0.4	V
I <sub>OL,SD</sub>	Current at VSS+0.4 V, output set low, standard drive, VDD ≥ 1.7	1	2	4	mA
I <sub>OL,HDL</sub>	Current at VSS+0.4 V, output set low, high drive, VDD ≥ 2.7 V	6	10	15	mA
I <sub>OL,HDL</sub>	Current at VSS+0.4 V, output set low, high drive, VDD ≥ 1.7 V	3			mA
I <sub>OH,SD</sub>	Current at VDD-0.4 V, output set high, standard drive, VDD ≥ 1.7	1	2	4	mA
I <sub>OH,HDL</sub>	Current at VDD-0.4 V, output set high, high drive, VDD ≥ 2.7 V	6	9	14	mA
I <sub>OH,HDL</sub>	Current at VDD-0.4 V, output set high, high drive, VDD ≥ 1.7 V	3			mA
t <sub>RF,15pF</sub>	Rise/fall time, standard drive mode, 10-90%, 15 pF load <sup>1</sup>		9		ns
t <sub>RF,25pF</sub>	Rise/fall time, standard drive mode, 10-90%, 25 pF load <sup>1</sup>		13		ns
t <sub>RF,50pF</sub>	Rise/fall time, standard drive mode, 10-90%, 50 pF load <sup>1</sup>		25		ns
t <sub>HRF,15pF</sub>	Rise/Fall time, high drive mode, 10-90%, 15 pF load <sup>1</sup>		4		ns
t <sub>HRF,25pF</sub>	Rise/Fall time, high drive mode, 10-90%, 25 pF load <sup>1</sup>		5		ns
t <sub>HRF,50pF</sub>	Rise/Fall time, high drive mode, 10-90%, 50 pF load <sup>1</sup>		8		ns
R <sub>PU</sub>	Pull-up resistance	11	13	16	kΩ
R <sub>PD</sub>	Pull-down resistance	11	13	16	kΩ
C <sub>PAD</sub>	Pad capacitance		3		pF

## 6.9 GPIOTE — GPIO tasks and events

The GPIOTE tasks and events (GPIOTE) module provides functionality for accessing GPIO pins using tasks and events. Each GPIOTE channel can be assigned to one pin.

A GPIOTE block enables GPIOs to generate events on pin state change which can be used to carry out tasks through the PPI system. A GPIO can also be driven to change state on system events using the PPI system. Low power detection of pin state changes is possible when in System ON or System OFF.

Instance	Number of GPIOTE channels
GPIOTE	8

Table 38: GPIOTE properties

Up to three tasks can be used in each GPIOTE channel for performing write operations to a pin. Two tasks are fixed (SET and CLR), and one (OUT) is configurable to perform following operations:

- Set
- Clear
- Toggle

<sup>1</sup> Rise and fall times based on simulations

An event can be generated in each GPIOTE channel from one of the following input conditions:

- Rising edge
- Falling edge
- Any change

### 6.9.1 Pin events and tasks

The GPIOTE module has a number of tasks and events that can be configured to operate on individual GPIO pins.

The tasks (SET[n], CLR[n] and OUT[n]) can be used for writing to individual pins, and the events (IN[n]) can be generated from changes occurring at the inputs of individual pins.

The SET task will set the pin selected in CONFIG[n].PSEL to high.

The CLR task will set the pin low.

The effect of the OUT task on the pin is configurable in CONFIG[n].POLARITY, and can either set the pin high, set it low, or toggle it.

The tasks and events are configured using the CONFIG[n] registers. Every set of SET, CLR and OUT[n] tasks and IN[n] events has one CONFIG[n] register associated with it.

As long as a SET[n], CLR[n] and OUT[n] task or an IN[n] event is configured to control a pin *n*, the pin's output value will only be updated by the GPIOTE module. The pin's output value as specified in the GPIO will therefore be ignored as long as the pin is controlled by GPIOTE. Attempting to write a pin as a normal GPIO pin will have no effect. When the GPIOTE is disconnected from a pin, see MODE field in CONFIG[n] register, the associated pin will get the output and configuration values specified in the GPIO module.

When conflicting tasks are triggered simultaneously (i.e. during the same clock cycle) in one channel, the precedence of the tasks will be as described in [Task priorities](#) on page 189.

Priority	Task
1	OUT
2	CLR
3	SET

Table 39: Task priorities

When setting the CONFIG[n] registers, MODE=Disabled does not have the same effect as MODE=Task and POLARITY=None. In the latter case, a CLR or SET task occurring at the exact same time as OUT will end up with no change on the pin, according to the priorities described in the table above.

When a GPIOTE channel is configured to operate on a pin as a task, the initial value of that pin is configured in the OUTINIT field of CONFIG[n].

### 6.9.2 Port event

PORT is an event that can be generated from multiple input pins using the GPIO DETECT signal.

The event will be generated on the rising edge of the DETECT signal. See [GPIO — General purpose input/output](#) on page 137 for more information about the DETECT signal.

Putting the system into System ON IDLE while DETECT is high will not cause DETECT to wake the system up again. Make sure to clear all DETECT sources before entering sleep. If the LATCH register is used as a source, if any bit in LATCH is still high after clearing all or part of the register (for instance due to one of the PINx.DETECT signal still high), a new rising edge will be generated on DETECT, see [Pin configuration](#) on page 137.

Trying to put the system to System OFF while DETECT is high will cause a wakeup from System OFF reset.

This feature is always enabled although the peripheral itself appears to be IDLE, that is, no clocks or other power intensive infrastructure have to be requested to keep this feature enabled. This feature can therefore be used to wake up the CPU from a WFI or WFE type sleep in System ON with all peripherals and the CPU idle, that is, lowest power consumption in System ON mode.

In order to prevent spurious interrupts from the PORT event while configuring the sources, the user shall first disable interrupts on the PORT event (through INTENCLR.PORT), then configure the sources (PIN\_CNF[n].SENSE), clear any potential event that could have occurred during configuration (write '1' to EVENTS\_PORT), and finally enable interrupts (through INTENSET.PORT).

### 6.9.3 Tasks and events pin configuration

Each GPIOTE channel is associated with one physical GPIO pin through the CONFIG.PSEL field.

When Event mode is selected in CONFIG.MODE, the pin specified by CONFIG.PSEL will be configured as an input, overriding the DIR setting in GPIO. Similarly, when Task mode is selected in CONFIG.MODE, the pin specified by CONFIG.PSEL will be configured as an output overriding the DIR setting and OUT value in GPIO. When Disabled is selected in CONFIG.MODE, the pin specified by CONFIG.PSEL will use its configuration from the PIN[n].CNF registers in GPIO.

Only one GPIOTE channel can be assigned to one physical pin. Failing to do so may result in unpredictable behavior.

### 6.9.4 Registers

Base address	Peripheral	Instance	Description	Configuration
0x40006000	GPIOTE	GPIOTE	GPIO tasks and events	

Table 40: Instances

Register	Offset	Description
TASKS_OUT[0]	0x000	Task for writing to pin specified in CONFIG[0].PSEL. Action on pin is configured in CONFIG[0].POLARITY.
TASKS_OUT[1]	0x004	Task for writing to pin specified in CONFIG[1].PSEL. Action on pin is configured in CONFIG[1].POLARITY.
TASKS_OUT[2]	0x008	Task for writing to pin specified in CONFIG[2].PSEL. Action on pin is configured in CONFIG[2].POLARITY.
TASKS_OUT[3]	0x00C	Task for writing to pin specified in CONFIG[3].PSEL. Action on pin is configured in CONFIG[3].POLARITY.
TASKS_OUT[4]	0x010	Task for writing to pin specified in CONFIG[4].PSEL. Action on pin is configured in CONFIG[4].POLARITY.
TASKS_OUT[5]	0x014	Task for writing to pin specified in CONFIG[5].PSEL. Action on pin is configured in CONFIG[5].POLARITY.
TASKS_OUT[6]	0x018	Task for writing to pin specified in CONFIG[6].PSEL. Action on pin is configured in CONFIG[6].POLARITY.
TASKS_OUT[7]	0x01C	Task for writing to pin specified in CONFIG[7].PSEL. Action on pin is configured in CONFIG[7].POLARITY.
TASKS_SET[0]	0x030	Task for writing to pin specified in CONFIG[0].PSEL. Action on pin is to set it high.
TASKS_SET[1]	0x034	Task for writing to pin specified in CONFIG[1].PSEL. Action on pin is to set it high.
TASKS_SET[2]	0x038	Task for writing to pin specified in CONFIG[2].PSEL. Action on pin is to set it high.
TASKS_SET[3]	0x03C	Task for writing to pin specified in CONFIG[3].PSEL. Action on pin is to set it high.
TASKS_SET[4]	0x040	Task for writing to pin specified in CONFIG[4].PSEL. Action on pin is to set it high.
TASKS_SET[5]	0x044	Task for writing to pin specified in CONFIG[5].PSEL. Action on pin is to set it high.
TASKS_SET[6]	0x048	Task for writing to pin specified in CONFIG[6].PSEL. Action on pin is to set it high.
TASKS_SET[7]	0x04C	Task for writing to pin specified in CONFIG[7].PSEL. Action on pin is to set it high.

Register	Offset	Description
TASKS_CLR[0]	0x060	Task for writing to pin specified in CONFIG[0].PSEL. Action on pin is to set it low.
TASKS_CLR[1]	0x064	Task for writing to pin specified in CONFIG[1].PSEL. Action on pin is to set it low.
TASKS_CLR[2]	0x068	Task for writing to pin specified in CONFIG[2].PSEL. Action on pin is to set it low.
TASKS_CLR[3]	0x06C	Task for writing to pin specified in CONFIG[3].PSEL. Action on pin is to set it low.
TASKS_CLR[4]	0x070	Task for writing to pin specified in CONFIG[4].PSEL. Action on pin is to set it low.
TASKS_CLR[5]	0x074	Task for writing to pin specified in CONFIG[5].PSEL. Action on pin is to set it low.
TASKS_CLR[6]	0x078	Task for writing to pin specified in CONFIG[6].PSEL. Action on pin is to set it low.
TASKS_CLR[7]	0x07C	Task for writing to pin specified in CONFIG[7].PSEL. Action on pin is to set it low.
EVENTS_IN[0]	0x100	Event generated from pin specified in CONFIG[0].PSEL
EVENTS_IN[1]	0x104	Event generated from pin specified in CONFIG[1].PSEL
EVENTS_IN[2]	0x108	Event generated from pin specified in CONFIG[2].PSEL
EVENTS_IN[3]	0x10C	Event generated from pin specified in CONFIG[3].PSEL
EVENTS_IN[4]	0x110	Event generated from pin specified in CONFIG[4].PSEL
EVENTS_IN[5]	0x114	Event generated from pin specified in CONFIG[5].PSEL
EVENTS_IN[6]	0x118	Event generated from pin specified in CONFIG[6].PSEL
EVENTS_IN[7]	0x11C	Event generated from pin specified in CONFIG[7].PSEL
EVENTS_PORT	0x17C	Event generated from multiple input GPIO pins with SENSE mechanism enabled
INTENSET	0x304	Enable interrupt
INTENCLR	0x308	Disable interrupt
CONFIG[0]	0x510	Configuration for OUT[n], SET[n] and CLR[n] tasks and IN[n] event
CONFIG[1]	0x514	Configuration for OUT[n], SET[n] and CLR[n] tasks and IN[n] event
CONFIG[2]	0x518	Configuration for OUT[n], SET[n] and CLR[n] tasks and IN[n] event
CONFIG[3]	0x51C	Configuration for OUT[n], SET[n] and CLR[n] tasks and IN[n] event
CONFIG[4]	0x520	Configuration for OUT[n], SET[n] and CLR[n] tasks and IN[n] event
CONFIG[5]	0x524	Configuration for OUT[n], SET[n] and CLR[n] tasks and IN[n] event
CONFIG[6]	0x528	Configuration for OUT[n], SET[n] and CLR[n] tasks and IN[n] event
CONFIG[7]	0x52C	Configuration for OUT[n], SET[n] and CLR[n] tasks and IN[n] event

Table 41: Register Overview

### 6.9.4.1 INTENSET

Address offset: 0x304

Enable interrupt

Bit number				31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0															
Id				I																							H				G	F	E	D	C	B	A													
Reset 0x00000000				0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0												
Id	RW	Field	Value	Id	Value		Description																																											
A	RW	IN0									Write '1' to Enable interrupt for IN[0] event																																							
											See <a href="#">EVENTS_IN[0]</a>																																							
									Set		1	Enable																																						
									Disabled		0	Read: Disabled																																						
									Enabled		1	Read: Enabled																																						
B	RW	IN1									Write '1' to Enable interrupt for IN[1] event																																							
											See <a href="#">EVENTS_IN[1]</a>																																							
									Set		1	Enable																																						
									Disabled		0	Read: Disabled																																						
									Enabled		1	Read: Enabled																																						
C	RW	IN2									Write '1' to Enable interrupt for IN[2] event																																							
											See <a href="#">EVENTS_IN[2]</a>																																							
									Set		1	Enable																																						

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0																															
Id				I																H G F E D C B A															
Reset 0x00000000				0 0																															
Id	RW	Field	Value	Id	Value	Description																													
			Disabled	0	Read: Disabled																														
			Enabled	1	Read: Enabled																														
			Write '1' to Enable interrupt for IN[3] event																																
			See <a href="#">EVENTS_IN[3]</a>																																
			Set	1	Enable																														
			Disabled	0	Read: Disabled																														
			Enabled	1	Read: Enabled																														
			Write '1' to Enable interrupt for IN[4] event																																
D	RW	IN3	See <a href="#">EVENTS_IN[3]</a>																																
			Set	1	Enable																														
			Disabled	0	Read: Disabled																														
			Enabled	1	Read: Enabled																														
			Write '1' to Enable interrupt for IN[4] event																																
E	RW	IN4	See <a href="#">EVENTS_IN[4]</a>																																
			Set	1	Enable																														
			Disabled	0	Read: Disabled																														
			Enabled	1	Read: Enabled																														
			Write '1' to Enable interrupt for IN[5] event																																
F	RW	IN5	See <a href="#">EVENTS_IN[5]</a>																																
			Set	1	Enable																														
			Disabled	0	Read: Disabled																														
			Enabled	1	Read: Enabled																														
			Write '1' to Enable interrupt for IN[6] event																																
G	RW	IN6	See <a href="#">EVENTS_IN[6]</a>																																
			Set	1	Enable																														
			Disabled	0	Read: Disabled																														
			Enabled	1	Read: Enabled																														
			Write '1' to Enable interrupt for IN[7] event																																
H	RW	IN7	See <a href="#">EVENTS_IN[7]</a>																																
			Set	1	Enable																														
			Disabled	0	Read: Disabled																														
			Enabled	1	Read: Enabled																														
			Write '1' to Enable interrupt for PORT event																																
I	RW	PORT	See <a href="#">EVENTS_PORT</a>																																
			Set	1	Enable																														
			Disabled	0	Read: Disabled																														
			Enabled	1	Read: Enabled																														

### 6.9.4.2 INTENCLR

Address offset: 0x308

Disable interrupt

Bit number					31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0																															
Id					I																								H G F E D C B A							
Reset 0x00000000					0 0																															
Id	RW	Field	Value	Id	Value	Description																														
A	RW	IN0				Write '1' to Disable interrupt for IN[0] event																														
						See <a href="#">EVENTS_IN[0]</a>																														
			Clear		1	Disable																														
			Disabled		0	Read: Disabled																														
			Enabled		1	Read: Enabled																														



Bit number			31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0																															
Id			I H G F E D C B A																															
Reset 0x00000000			0 0																															
Id	RW	Field	Value	Id	Value	Description																												
B	RW	IN1				Write '1' to Disable interrupt for IN[1] event																												
						See <a href="#">EVENTS_IN[1]</a>																												
			Clear	1	Disable																													
			Disabled	0	Read: Disabled																													
			Enabled	1	Read: Enabled																													
C	RW	IN2				Write '1' to Disable interrupt for IN[2] event																												
						See <a href="#">EVENTS_IN[2]</a>																												
			Clear	1	Disable																													
			Disabled	0	Read: Disabled																													
			Enabled	1	Read: Enabled																													
D	RW	IN3				Write '1' to Disable interrupt for IN[3] event																												
						See <a href="#">EVENTS_IN[3]</a>																												
			Clear	1	Disable																													
			Disabled	0	Read: Disabled																													
			Enabled	1	Read: Enabled																													
E	RW	IN4				Write '1' to Disable interrupt for IN[4] event																												
						See <a href="#">EVENTS_IN[4]</a>																												
			Clear	1	Disable																													
			Disabled	0	Read: Disabled																													
			Enabled	1	Read: Enabled																													
F	RW	IN5				Write '1' to Disable interrupt for IN[5] event																												
						See <a href="#">EVENTS_IN[5]</a>																												
			Clear	1	Disable																													
			Disabled	0	Read: Disabled																													
			Enabled	1	Read: Enabled																													
G	RW	IN6				Write '1' to Disable interrupt for IN[6] event																												
						See <a href="#">EVENTS_IN[6]</a>																												
			Clear	1	Disable																													
			Disabled	0	Read: Disabled																													
			Enabled	1	Read: Enabled																													
H	RW	IN7				Write '1' to Disable interrupt for IN[7] event																												
						See <a href="#">EVENTS_IN[7]</a>																												
			Clear	1	Disable																													
			Disabled	0	Read: Disabled																													
			Enabled	1	Read: Enabled																													
I	RW	PORT				Write '1' to Disable interrupt for PORT event																												
						See <a href="#">EVENTS_PORT</a>																												
			Clear	1	Disable																													
			Disabled	0	Read: Disabled																													
			Enabled	1	Read: Enabled																													

### 6.9.4.3 CONFIG[0]

Address offset: 0x510

Configuration for OUT[n], SET[n] and CLR[n] tasks and IN[n] event

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0																																
Id														E	D		D	B				B	B	B											A	A
Reset 0x00000000				0 0																																
Id	RW	Field	Value	Id	Value	Description																														
A	RW	MODE				Mode																														
			Disabled	0	Disabled. Pin specified by PSEL will not be acquired by the GPIOTE module.																															
			Event	1	Event mode																															
			Task	3	The pin specified by PSEL will be configured as an input and the IN[n] event will be generated if operation specified in POLARITY occurs on the pin.  Task mode  The GPIO specified by PSEL will be configured as an output and triggering the SET[n], CLR[n] or OUT[n] task will perform the operation specified by POLARITY on the pin. When enabled as a task the GPIOTE module will acquire the pin and the pin can no longer be written as a regular output pin from the GPIO module.																															
B	RW	PSEL		[0..31]	GPIO number associated with SET[n], CLR[n] and OUT[n] tasks and IN[n] event																															
D	RW	POLARITY				When In task mode: Operation to be performed on output when OUT[n] task is triggered. When In event mode: Operation on input that shall trigger IN[n] event.																														
			None	0	Task mode: No effect on pin from OUT[n] task. Event mode: no IN[n] event generated on pin activity.																															
			LoToHi	1	Task mode: Set pin from OUT[n] task. Event mode: Generate IN[n] event when rising edge on pin.																															
			HiToLo	2	Task mode: Clear pin from OUT[n] task. Event mode: Generate IN[n] event when falling edge on pin.																															
			Toggle	3	Task mode: Toggle pin from OUT[n]. Event mode: Generate IN[n] when any change on pin.																															
E	RW	OUTINIT				When in task mode: Initial value of the output when the GPIOTE channel is configured. When in event mode: No effect.																														
			Low	0	Task mode: Initial value of pin before task triggering is low																															
			High	1	Task mode: Initial value of pin before task triggering is high																															

#### 6.9.4.4 CONFIG[1]

Address offset: 0x514

Configuration for OUT[n], SET[n] and CLR[n] tasks and IN[n] event

Bit number				31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0									
Id														E		D	D											B	B	B	B	B											A	A
Reset 0x00000000				0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0								
Id	RW	Field	Value Id	Value				Description																																				
A	RW	MODE						Mode																																				
			Disabled	0				Disabled. Pin specified by PSEL will not be acquired by the GPIOTE module.																																				

Bit number		31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0																																				
Id												E		D				B		B		B		B										A				
Reset 0x00000000		0 0																																				
Id		RW	Field	Value Id	Value	Description																																
				Event	1	Event mode																																
						The pin specified by PSEL will be configured as an input and the IN[n] event will be generated if operation specified in POLARITY occurs on the pin.																																
				Task	3	Task mode																																
						The GPIO specified by PSEL will be configured as an output and triggering the SET[n], CLR[n] or OUT[n] task will perform the operation specified by POLARITY on the pin. When enabled as a task the GPIOTE module will acquire the pin and the pin can no longer be written as a regular output pin from the GPIO module.																																
B	RW	PSEL			[0..31]	GPIO number associated with SET[n], CLR[n] and OUT[n] tasks and IN[n] event																																
D	RW	POLARITY				When In task mode: Operation to be performed on output when OUT[n] task is triggered. When In event mode: Operation on input that shall trigger IN[n] event.																																
				None	0	Task mode: No effect on pin from OUT[n] task. Event mode: no IN[n] event generated on pin activity.																																
				LoToHi	1	Task mode: Set pin from OUT[n] task. Event mode: Generate IN[n] event when rising edge on pin.																																
				HiToLo	2	Task mode: Clear pin from OUT[n] task. Event mode: Generate IN[n] event when falling edge on pin.																																
				Toggle	3	Task mode: Toggle pin from OUT[n]. Event mode: Generate IN[n] when any change on pin.																																
E	RW	OUTINIT				When in task mode: Initial value of the output when the GPIOTE channel is configured. When in event mode: No effect.																																
				Low	0	Task mode: Initial value of pin before task triggering is low																																
				High	1	Task mode: Initial value of pin before task triggering is high																																

#### 6.9.4.5 CONFIG[2]

Address offset: 0x518

Configuration for OUT[n], SET[n] and CLR[n] tasks and IN[n] event

Bit number		31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0																																				
Id												E		D				B		B		B		B								A						
Reset 0x00000000		0 0																																				
Id		RW	Field	Value Id	Value	Description																																
A	RW	MODE				Mode																																
				Disabled	0	Disabled. Pin specified by PSEL will not be acquired by the GPIOTE module.																																
				Event	1	Event mode																																
						The pin specified by PSEL will be configured as an input and the IN[n] event will be generated if operation specified in POLARITY occurs on the pin.																																

Bit number		31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0					
Id		E D D B B B B B		A A			
Reset 0x00000000		0 0					
Id	RW	Field	Value Id	Value	Description		
			Task	3	Task mode		
						The GPIO specified by PSEL will be configured as an output and triggering the SET[n], CLR[n] or OUT[n] task will perform the operation specified by POLARITY on the pin. When enabled as a task the GPIOTE module will acquire the pin and the pin can no longer be written as a regular output pin from the GPIO module.	
B	RW	PSEL			[0..31]	GPIO number associated with SET[n], CLR[n] and OUT[n] tasks and IN[n] event	
D	RW	POLARITY				When In task mode: Operation to be performed on output when OUT[n] task is triggered. When In event mode: Operation on input that shall trigger IN[n] event.	
			None	0	Task mode: No effect on pin from OUT[n] task. Event mode: no IN[n] event generated on pin activity.		
			LoToHi	1	Task mode: Set pin from OUT[n] task. Event mode: Generate IN[n] event when rising edge on pin.		
			HiToLo	2	Task mode: Clear pin from OUT[n] task. Event mode: Generate IN[n] event when falling edge on pin.		
			Toggle	3	Task mode: Toggle pin from OUT[n]. Event mode: Generate IN[n] when any change on pin.		
E	RW	OUTINIT				When in task mode: Initial value of the output when the GPIOTE channel is configured. When in event mode: No effect.	
			Low	0	Task mode: Initial value of pin before task triggering is low		
			High	1	Task mode: Initial value of pin before task triggering is high		

### 6.9.4.6 CONFIG[3]

Address offset: 0x51C

Configuration for OUT[n], SET[n] and CLR[n] tasks and IN[n] event

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0																																
Id				E D D B B B B B																A A																
Reset 0x00000000				0 0																																
Id	RW	Field	Value Id	Value	Description																															
A	RW	MODE																																		
			Disabled	0	Disabled. Pin specified by PSEL will not be acquired by the GPIOTE module.																															
			Event	1	Event mode																															
					The pin specified by PSEL will be configured as an input and the IN[n] event will be generated if operation specified in POLARITY occurs on the pin.																															

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0																																							
Id																				E	D	D											B	B	B	B	B					A	A
Reset 0x00000000				0 0																																							
Id	RW	Field	Value Id	Value	Description																																						
			Task	3	Task mode  The GPIO specified by PSEL will be configured as an output and triggering the SET[n], CLR[n] or OUT[n] task will perform the operation specified by POLARITY on the pin. When enabled as a task the GPIOTE module will acquire the pin and the pin can no longer be written as a regular output pin from the GPIO module.																																						
B	RW	PSEL		[0..31]	GPIO number associated with SET[n], CLR[n] and OUT[n] tasks and IN[n] event																																						
D	RW	POLARITY			When In task mode: Operation to be performed on output when OUT[n] task is triggered. When In event mode:  Operation on input that shall trigger IN[n] event.																																						
			None	0	Task mode: No effect on pin from OUT[n] task. Event mode: no IN[n] event generated on pin activity.																																						
			LoToHi	1	Task mode: Set pin from OUT[n] task. Event mode: Generate IN[n] event when rising edge on pin.																																						
			HiToLo	2	Task mode: Clear pin from OUT[n] task. Event mode: Generate IN[n] event when falling edge on pin.																																						
			Toggle	3	Task mode: Toggle pin from OUT[n]. Event mode: Generate IN[n] when any change on pin.																																						
E	RW	OUTINIT			When in task mode: Initial value of the output when the GPIOTE channel is configured. When in event mode: No effect.																																						
			Low	0	Task mode: Initial value of pin before task triggering is low																																						
			High	1	Task mode: Initial value of pin before task triggering is high																																						

#### 6.9.4.7 CONFIG[4]

Address offset: 0x520

### Configuration for OUT[n], SET[n] and CLR[n] tasks and IN[n] event

Bit number				31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0					
Id																E	D		D			B	B	B	B	B													A	A
Reset 0x00000000				0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0				
Id	RW	Field	Value Id	Value	Description																																			
A	RW	MODE			Mode																																			
			Disabled	0	Disabled. Pin specified by PSEL will not be acquired by the GPIOTE module.																																			
			Event	1	Event mode																																			
					The pin specified by PSEL will be configured as an input and the IN[n] event will be generated if operation specified in POLARITY occurs on the pin.																																			

Bit number		31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0			
Id		E D D B B B B B A A			
Reset 0x00000000		0 0			
Id	RW	Field	Value Id	Value	Description
			Task	3	Task mode
					The GPIO specified by PSEL will be configured as an output and triggering the SET[n], CLR[n] or OUT[n] task will perform the operation specified by POLARITY on the pin. When enabled as a task the GPIOTE module will acquire the pin and the pin can no longer be written as a regular output pin from the GPIO module.
B	RW	PSEL		[0..31]	GPIO number associated with SET[n], CLR[n] and OUT[n] tasks and IN[n] event
D	RW	POLARITY			When In task mode: Operation to be performed on output when OUT[n] task is triggered. When In event mode: Operation on input that shall trigger IN[n] event.
			None	0	Task mode: No effect on pin from OUT[n] task. Event mode: no IN[n] event generated on pin activity.
			LoToHi	1	Task mode: Set pin from OUT[n] task. Event mode: Generate IN[n] event when rising edge on pin.
			HiToLo	2	Task mode: Clear pin from OUT[n] task. Event mode: Generate IN[n] event when falling edge on pin.
			Toggle	3	Task mode: Toggle pin from OUT[n]. Event mode: Generate IN[n] when any change on pin.
E	RW	OUTINIT			When in task mode: Initial value of the output when the GPIOTE channel is configured. When in event mode: No effect.
			Low	0	Task mode: Initial value of pin before task triggering is low
			High	1	Task mode: Initial value of pin before task triggering is high

### 6.9.4.8 CONFIG[5]

Address offset: 0x524

Configuration for OUT[n], SET[n] and CLR[n] tasks and IN[n] event

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0																															
Id				E D D B B B B B																A A															
Reset 0x00000000				0 0																															
Id	RW	Field	Value Id	Value	Description																														
A	RW	MODE			Mode																														
			Disabled	0	Disabled. Pin specified by PSEL will not be acquired by the GPIOTE module.																														
			Event	1	Event mode																														
					The pin specified by PSEL will be configured as an input and the IN[n] event will be generated if operation specified in POLARITY occurs on the pin.																														

Bit number			31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0																														
Id			E D D B B B B B																A A														
Reset 0x00000000			0 0																														
Id	RW	Field	Value Id	Value	Description																												
			Task	3	Task mode																												
					The GPIO specified by PSEL will be configured as an output and triggering the SET[n], CLR[n] or OUT[n] task will perform the operation specified by POLARITY on the pin. When enabled as a task the GPIOTE module will acquire the pin and the pin can no longer be written as a regular output pin from the GPIO module.																												
B	RW	PSEL		[0..31]	GPIO number associated with SET[n], CLR[n] and OUT[n] tasks and IN[n] event																												
D	RW	POLARITY			When In task mode: Operation to be performed on output when OUT[n] task is triggered. When In event mode: Operation on input that shall trigger IN[n] event.																												
			None	0	Task mode: No effect on pin from OUT[n] task. Event mode: no IN[n] event generated on pin activity.																												
			LoToHi	1	Task mode: Set pin from OUT[n] task. Event mode: Generate IN[n] event when rising edge on pin.																												
			HiToLo	2	Task mode: Clear pin from OUT[n] task. Event mode: Generate IN[n] event when falling edge on pin.																												
			Toggle	3	Task mode: Toggle pin from OUT[n]. Event mode: Generate IN[n] when any change on pin.																												
E	RW	OUTINIT			When in task mode: Initial value of the output when the GPIOTE channel is configured. When in event mode: No effect.																												
			Low	0	Task mode: Initial value of pin before task triggering is low																												
			High	1	Task mode: Initial value of pin before task triggering is high																												

### 6.9.4.9 CONFIG[6]

Address offset: 0x528

Configuration for OUT[n], SET[n] and CLR[n] tasks and IN[n] event

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0																															
Id				E D D B B B B B																A A															
Reset 0x00000000				0 0																															
Id	RW	Field	Value Id	Value	Description																														
A	RW	MODE			Mode																														
			Disabled	0	Disabled. Pin specified by PSEL will not be acquired by the GPIOTE module.																														
			Event	1	Event mode																														
					The pin specified by PSEL will be configured as an input and the IN[n] event will be generated if operation specified in POLARITY occurs on the pin.																														

Bit number		31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0				
Id		E D D B B B B B A A				
Reset 0x00000000		0 0				
Id	RW	Field	Value	Id	Value	Description
Task			3	Task mode		
The GPIO specified by PSEL will be configured as an output and triggering the SET[n], CLR[n] or OUT[n] task will perform the operation specified by POLARITY on the pin. When enabled as a task the GPIOTE module will acquire the pin and the pin can no longer be written as a regular output pin from the GPIO module.						
B	RW	PSEL	[0..31]	GPIO number associated with SET[n], CLR[n] and OUT[n] tasks and IN[n] event		
D	RW	POLARITY		When In task mode: Operation to be performed on output when OUT[n] task is triggered. When In event mode: Operation on input that shall trigger IN[n] event.		
		None	0	Task mode: No effect on pin from OUT[n] task. Event mode: no IN[n] event generated on pin activity.		
		LoToHi	1	Task mode: Set pin from OUT[n] task. Event mode: Generate IN[n] event when rising edge on pin.		
		HiToLo	2	Task mode: Clear pin from OUT[n] task. Event mode: Generate IN[n] event when falling edge on pin.		
		Toggle	3	Task mode: Toggle pin from OUT[n]. Event mode: Generate IN[n] when any change on pin.		
E	RW	OUTINIT		When in task mode: Initial value of the output when the GPIOTE channel is configured. When in event mode: No effect.		
		Low	0	Task mode: Initial value of pin before task triggering is low		
		High	1	Task mode: Initial value of pin before task triggering is high		

#### 6.9.4.10 CONFIG[7]

Address offset: 0x52C

Configuration for OUT[n], SET[n] and CLR[n] tasks and IN[n] event

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0																															
Id				E D D B B B B B																A A															
Reset 0x00000000				0 0																															
Id	RW	Field	Value	Id	Value	Description																													
A	RW	MODE				Mode																													
		Disabled	0			Disabled. Pin specified by PSEL will not be acquired by the GPIOTE module.																													
		Event	1			Event mode																													
						The pin specified by PSEL will be configured as an input and the IN[n] event will be generated if operation specified in POLARITY occurs on the pin.																													



Bit number		31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0						
Id		E D D B B B B B						
Reset 0x00000000		0 0						
Id	RW	Field	Value	Id	Value	Description		
Task						Task mode		
						The GPIO specified by PSEL will be configured as an output and triggering the SET[n], CLR[n] or OUT[n] task will perform the operation specified by POLARITY on the pin. When enabled as a task the GPIOTE module will acquire the pin and the pin can no longer be written as a regular output pin from the GPIO module.		
B	RW	PSEL	[0..31]		GPIO number associated with SET[n], CLR[n] and OUT[n] tasks and IN[n] event			
D	RW	POLARITY			When In task mode: Operation to be performed on output when OUT[n] task is triggered. When In event mode: Operation on input that shall trigger IN[n] event.			
None						Task mode: No effect on pin from OUT[n] task. Event mode: no IN[n] event generated on pin activity.		
LoToHi						Task mode: Set pin from OUT[n] task. Event mode: Generate IN[n] event when rising edge on pin.		
HiToLo						Task mode: Clear pin from OUT[n] task. Event mode: Generate IN[n] event when falling edge on pin.		
Toggle						Task mode: Toggle pin from OUT[n]. Event mode: Generate IN[n] when any change on pin.		
E	RW	OUTINIT			When in task mode: Initial value of the output when the GPIOTE channel is configured. When in event mode: No effect.			
Low						Task mode: Initial value of pin before task triggering is low		
High						Task mode: Initial value of pin before task triggering is high		

### 6.9.5 Electrical specification

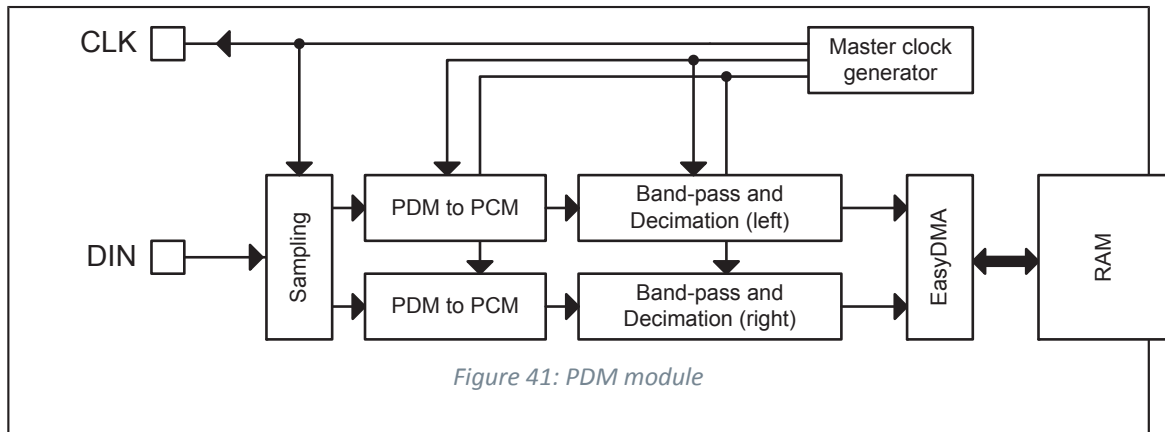
## 6.10 PDM — Pulse density modulation interface

The pulse density modulation (PDM) module enables input of pulse density modulated signals from external audio frontends, for example, digital microphones. The PDM module generates the PDM clock and supports single-channel or dual-channel (Left and Right) data input. Data is transferred directly to RAM buffers using EasyDMA.

Listed here are the main features for PDM:

- Up to two PDM microphones configured as a Left/Right pair using the same data input
- 16 kHz output sample rate, 16-bit samples
- EasyDMA support for sample buffering
- HW decimation filters

The PDM module illustrated in [PDM module](#) on page 202 is interfacing up to two digital microphones with the PDM interface. It implements EasyDMA, which relieves real-time requirements associated with controlling the PDM slave from a low priority CPU execution context. It also includes all the necessary digital filter elements to produce PCM samples. The PDM module allows continuous audio streaming.



### 6.10.1 Master clock generator

The **FREQ** field in the master clock's **PDMCLKCTRL** register allows adjusting the PDM clock's frequency.

The master clock generator does not add any jitter to the **HFCLK** source chosen. It is recommended (but not mandatory) to use the **Xtal** as **HFCLK** source.

### 6.10.2 Module operation

By default, bits from the left PDM microphone are sampled on **PDM\_CLK** falling edge, bits for the right are sampled on the rising edge of **PDM\_CLK**, resulting in two bitstreams. Each bitstream is fed into a digital filter which converts the PDM stream into 16-bit PCM samples, and filters and down-samples them to reach the appropriate sample rate.

The **EDGE** field in the **MODE** register allows swapping Left and Right, so that Left will be sampled on rising edge, and Right on falling.

The PDM module uses EasyDMA to store the samples coming out from the filters into one buffer in RAM.

Depending on the mode chosen in the **OPERATION** field in the **MODE** register, memory either contains alternating left and right 16-bit samples (Stereo), or only left 16-bit samples (Mono).

To ensure continuous PDM sampling, it is up to the application to update the EasyDMA destination address pointer as the previous buffer is filled.

The continuous transfer can be started or stopped by sending the **START** and **STOP** tasks. **STOP** becomes effective after the current frame has finished transferring, which will generate the **STOPPED** event. The **STOPPED** event indicates that all activity in the module are finished, and that the data is available in RAM (EasyDMA has finished transferring as well). Attempting to restart before receiving the **STOPPED** event may result in unpredictable behaviour.

### 6.10.3 Decimation filter

In order to convert the incoming data stream into PCM audio samples, a decimation filter is included in the PDM interface module.

The input of the filter is the two-channel PDM serial stream (with left channel on clock high, right channel on clock low), its output is  $2 \times 16$ -bit PCM samples at a sample rate 64 times lower than the PDM clock rate.

The filter stage of each channel is followed by a digital volume control, to attenuate or amplify the output samples in a range of -20 dB to +20 dB around the default (reset) setting, defined by  $G_{PDM,default}$ . The gain is controlled by the **GAINL** and **GAINR** registers.

As an example, if the goal is to achieve 2500 RMS output samples (16 bit) with a 1 kHz 90 dBA signal into a -26 dBFS sensitivity PDM microphone, the user will have to sum the PDM module's default gain

( $G_{PDM, default}$ ) and the gain introduced by the microphone and acoustic path of his implementation (an attenuation would translate into a negative gain), and adjust GAINL and GAINR by this amount. Assuming that only the PDM module influences the gain, GAINL and GAINR must be set to  $-G_{PDM, default}$  dB to achieve the requirement.

With  $G_{PDM, default}=3.2$  dB, and as GAINL and GAINR are expressed in 0.5 dB steps, the closest value to program would be 3.0 dB, which can be calculated as:

$$GAINL = GAINR = (DefaultGain - (2 * 3))$$

Remember to check that the resulting values programmed into GAINL and GAINR fall within MinGain and MaxGain.

### 6.10.4 EasyDMA

Samples will be written directly to RAM, and EasyDMA must be configured accordingly.

The address pointer for the EasyDMA channel is set in SAMPLE.PTR register. If the destination address set in SAMPLE.PTR is not pointing to the Data RAM region, an EasyDMA transfer may result in a HardFault or RAM corruption. See [Memory](#) on page 15 for more information about the different memory regions.

DMA supports Stereo (Left+Right 16-bit samples) and Mono (Left only) data transfer, depending on setting in the OPERATION field in the MODE register. The samples are stored little endian.

MODE.OPERATION	Bits per sample	Result stored per RAM word	Physical RAM allocated (32 bit words)	Result boundary indexes in RAM	Note
Stereo	32 (2x16)	L+R	$\text{ceil}(\text{SAMPLE.MAXCNT}/2)$	R0=[31:16]; L0=[15:0]	Default
Mono	16	2xL	$\text{ceil}(\text{SAMPLE.MAXCNT}/2)$	L1=[31:16]; L0=[15:0]	

Table 42: DMA sample storage

The destination buffer in RAM consists of one block, the size of which is set in SAMPLE.MAXCNT register. Format is number of 16-bit samples. The physical RAM allocated is always:

$$(\text{RAM allocation, in bytes}) = \text{SAMPLE.MAXCNT} * 2;$$

(but the mapping of the samples depends on MODE.OPERATION.

If OPERATION=Stereo, RAM will contain a succession of Left and Right samples.

If OPERATION=Mono, RAM will contain a succession of mono samples.

For a given value of SAMPLE.MAXCNT, the buffer in RAM can contain half the stereo sampling time as compared to the mono sampling time.

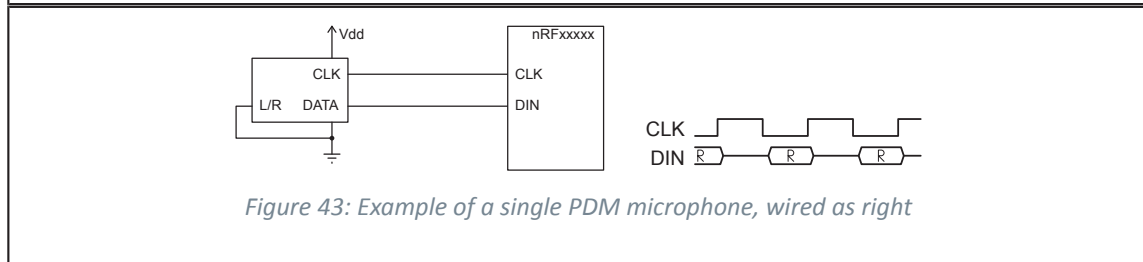
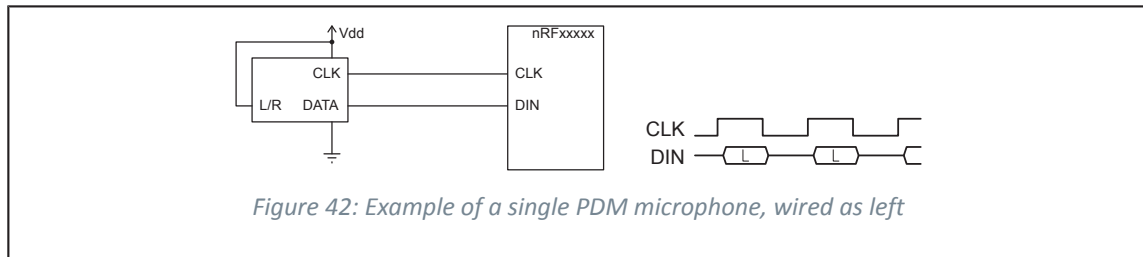
The PDM acquisition can be started by the START task, after the SAMPLE.PTR and SAMPLE.MAXCNT registers have been written. When starting the module, it will take some time for the filters to start outputting valid data. Transients from the PDM microphone itself may also occur. The first few samples (typically around 50) might hence contain invalid values or transients. It is therefore advised to discard the first few samples after a PDM start.

As soon as the STARTED event is received, the firmware can write the next SAMPLE.PTR value (this register is double-buffered), to ensure continuous operation.

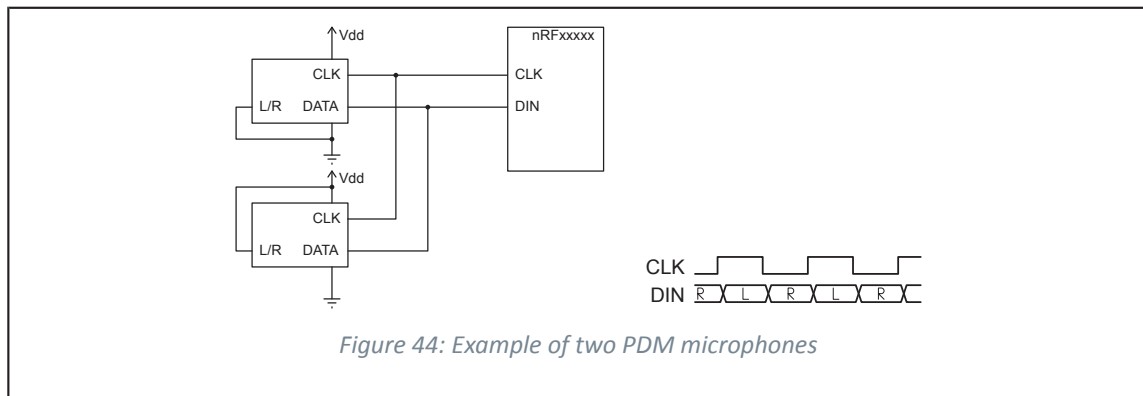
When the buffer in RAM is filled with samples, an END event is triggered. The firmware can start processing the data in the buffer. Meanwhile, the PDM module starts acquiring data into the new buffer pointed to by SAMPLE.PTR, and sends a new STARTED event, so that the firmware can update SAMPLE.PTR to the next buffer address.

### 6.10.5 Hardware example

Connect the microphone clock to CLK, and data to DIN.



Note that in a single-microphone (mono) configuration, depending on the microphone's implementation, either the left or the right channel (sampled at falling or rising CLK edge respectively) will contain reliable data. If two microphones are used, one of them has to be set as left, the other as right (L/R pin tied high or to GND on the respective microphone). It is strongly recommended to use two microphones of exactly the same brand and type so that their timings in left and right operation match.



### 6.10.6 Pin configuration

The CLK and DIN signals associated to the PDM module are mapped to physical pins according to the configuration specified in the PSEL.CLK and PSEL.DIN registers respectively. If the CONNECT field in any PSEL register is set to Disconnected, the associated PDM module signal will not be connected to the required physical pins, and will not operate properly.

The PSEL.CLK and PSEL.DIN registers and their configurations are only used as long as the PDM module is enabled, and retained only as long as the device is in System ON mode. See [POWER — Power supply](#) on page 61 for more information about power modes. When the peripheral is disabled, the pins will behave as regular GPIOs, and use the configuration in their respective OUT bit field and PIN\_CNF[n] register.

To ensure correct behaviour in the PDM module, the pins used by the PDM module must be configured in the GPIO peripheral as described in [GPIO configuration before enabling peripheral](#) on page 205 before enabling the PDM module. This is to ensure that the pins used by the PDM module are driven correctly if the PDM module itself is temporarily disabled or the device temporarily enters System OFF.

This configuration must be retained in the GPIO for the selected I/Os as long as the PDM module is supposed to be connected to an external PDM circuit.

Only one peripheral can be assigned to drive a particular GPIO pin at a time. Failing to do so may result in unpredictable behaviour.

PDM signal	PDM pin	Direction	Output value	Comment
CLK	As specified in PSEL.CLK	Output	0	
DIN	As specified in PSEL.DIN	Input	Not applicable	

Table 43: GPIO configuration before enabling peripheral

## 6.10.7 Registers

Base address	Peripheral	Instance	Description	Configuration
0x4001D000	PDM	PDM	Pulse-density modulation (digital microphone interface)	

Table 44: Instances

Register	Offset	Description
TASKS_START	0x000	Starts continuous PDM transfer
TASKS_STOP	0x004	Stops PDM transfer
EVENTS_STARTED	0x100	PDM transfer has started
EVENTS_STOPPED	0x104	PDM transfer has finished
EVENTS_END	0x108	The PDM has written the last sample specified by SAMPLE.MAXCNT (or the last sample after a STOP task has been received) to Data RAM
INTEN	0x300	Enable or disable interrupt
INTENSET	0x304	Enable interrupt
INTENCLR	0x308	Disable interrupt
ENABLE	0x500	PDM module enable register
PDMCLKCTRL	0x504	PDM clock generator control
MODE	0x508	Defines the routing of the connected PDM microphones' signals
GAINL	0x518	Left output gain adjustment
GAINR	0x51C	Right output gain adjustment
PSEL.CLK	0x540	Pin number configuration for PDM CLK signal
PSEL.DIN	0x544	Pin number configuration for PDM DIN signal
SAMPLE.PTR	0x560	RAM address pointer to write samples to with EasyDMA
SAMPLE.MAXCNT	0x564	Number of samples to allocate memory for in EasyDMA mode

Table 45: Register Overview

### 6.10.7.1 INTEN

Address offset: 0x300

Enable or disable interrupt

Bit number					31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0																														
Id					C B A																														
Reset 0x00000000					0 0																														
Id	RW	Field	Value Id	Value	Description																														
A	RW	STARTED			Enable or disable interrupt for STARTED event																														
					See <a href="#">EVENTS_STARTED</a>																														
			Disabled	0	Disable																														
			Enabled	1	Enable																														
B	RW	STOPPED			Enable or disable interrupt for STOPPED event																														
					See <a href="#">EVENTS_STOPPED</a>																														
			Disabled	0	Disable																														
			Enabled	1	Enable																														
C	RW	END			Enable or disable interrupt for END event																														
					See <a href="#">EVENTS_END</a>																														
			Disabled	0	Disable																														
			Enabled	1	Enable																														

### 6.10.7.2 INTENSET

Address offset: 0x304

Enable interrupt

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0																															
Id				C B A																															
Reset 0x00000000				0 0																															
Id	RW	Field	Value	Id	Value	Description																													
A	RW	STARTED				Write '1' to Enable interrupt for STARTED event																													
						See <a href="#">EVENTS_STARTED</a>																													
			Set		1	Enable																													
			Disabled		0	Read: Disabled																													
			Enabled		1	Read: Enabled																													
B	RW	STOPPED				Write '1' to Enable interrupt for STOPPED event																													
						See <a href="#">EVENTS_STOPPED</a>																													
			Set		1	Enable																													
			Disabled		0	Read: Disabled																													
			Enabled		1	Read: Enabled																													
C	RW	END				Write '1' to Enable interrupt for END event																													
						See <a href="#">EVENTS_END</a>																													
			Set		1	Enable																													
			Disabled		0	Read: Disabled																													
			Enabled		1	Read: Enabled																													

### 6.10.7.3 INTENCLR

Address offset: 0x308

Disable interrupt

Bit number			31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0																																					
Id																																						C	B	A
Reset 0x00000000			0 0																																					
Id	RW	Field	Value Id	Value	Description																																			
A	RW	STARTED			Write '1' to Disable interrupt for STARTED event																																			
					See <a href="#">EVENTS_STARTED</a>																																			
		Clear	1	Disable																																				
		Disabled	0	Read: Disabled																																				
		Enabled	1	Read: Enabled																																				
B	RW	STOPPED			Write '1' to Disable interrupt for STOPPED event																																			
					See <a href="#">EVENTS_STOPPED</a>																																			
		Clear	1	Disable																																				
		Disabled	0	Read: Disabled																																				
		Enabled	1	Read: Enabled																																				
C	RW	END			Write '1' to Disable interrupt for END event																																			
					See <a href="#">EVENTS_END</a>																																			
		Clear	1	Disable																																				
		Disabled	0	Read: Disabled																																				
		Enabled	1	Read: Enabled																																				

#### 6.10.7.4 ENABLE

Address offset: 0x500

PDM module enable register

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0																																
Id																																				A
Reset 0x00000000				0 0																																
Id	RW	Field	Value Id	Value	Description																															
A	RW	ENABLE			Enable or disable PDM module																															
			Disabled	0	Disable																															
			Enabled	1	Enable																															

#### 6.10.7.5 PDMCLKCTRL

Address offset: 0x504

PDM clock generator control

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0																															
Id				A A																															
Reset 0x08400000				0 0 0 0 1 0 0 0 0 1 0																															
Id	RW	Field	Value Id	Value	Description																														
A	RW	FREQ			PDM_CLK frequency																														
			1000K	0x08000000	PDM_CLK = 32 MHz / 32 = 1.000 MHz																														
			Default	0x08400000	PDM_CLK = 32 MHz / 31 = 1.032 MHz																														
			1067K	0x08800000	PDM_CLK = 32 MHz / 30 = 1.067 MHz																														

#### 6.10.7.6 MODE

Address offset: 0x508

Defines the routing of the connected PDM microphones' signals

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0																															
Id				B A																															
Reset 0x00000000				0 0																															
Id	RW	Field	Value Id	Value	Description																														
A	RW	OPERATION			Mono or stereo operation																														
			Stereo	0	Sample and store one pair (Left + Right) of 16bit samples per RAM word R=[31:16]; L=[15:0]																														
			Mono	1	Sample and store two successive Left samples (16 bit each) per RAM word L1=[31:16]; L0=[15:0]																														
B	RW	EDGE			Defines on which PDM_CLK edge Left (or mono) is sampled																														
			LeftFalling	0	Left (or mono) is sampled on falling edge of PDM_CLK																														
			LeftRising	1	Left (or mono) is sampled on rising edge of PDM_CLK																														

### 6.10.7.7 GAINL

Address offset: 0x518

Left output gain adjustment

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0																															
Id				A A																															

### 6.10.7.8 GAINR

Address offset: 0x51C

Right output gain adjustment



Bit number					31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0																															
Id																													A A A A A A A A							
Reset 0x00000028					0 1 0 1 0 0 0																															
Id	RW	Field	Value	Id	Value	Description																														
A	RW	GAINR				Right output gain adjustment, in 0.5 dB steps, around the default module gain (see electrical parameters)																														
		MinGain	0x00			-20dB gain adjustment (minimum)																														
		DefaultGain	0x28			0dB gain adjustment ('2500 RMS' requirement)																														
		MaxGain	0x50			+20dB gain adjustment (maximum)																														

### 6.10.7.9 PSEL.CLK

Address offset: 0x540

Pin number configuration for PDM CLK signal

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0																															
Id				B																												A A A A			
Reset 0xFFFFFFFF				1 1																															
Id	RW	Field	Value	Id	Value	Description																													
A	RW	PIN			[0..31]	Pin number																													
B	RW	CONNECT				Connection																													
		Disconnected	1			Disconnect																													
		Connected	0			Connect																													

### 6.10.7.10 PSEL.DIN

Address offset: 0x544

Pin number configuration for PDM DIN signal

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0																															
Id				B																												A A A A			
Reset 0xFFFFFFFF				1 1																															
Id	RW	Field	Value	Id	Value	Description																													
A	RW	PIN			[0..31]	Pin number																													
B	RW	CONNECT				Connection																													
		Disconnected	1			Disconnect																													
		Connected	0			Connect																													

### 6.10.7.11 SAMPLE.PTR

Address offset: 0x560

RAM address pointer to write samples to with EasyDMA

Bit number					31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0																															
Id					A A																															
Reset 0x00000000					0 0																															
Id		RW	Field		Value	Id	Value	Description																												
A		RW	SAMPLEPTR					Address to write PDM samples to over DMA																												

### 6.10.7.12 SAMPLE.MAXCNT

Address offset: 0x564

Number of samples to allocate memory for in EasyDMA mode

Bit number					31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0		
Id																					A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A
Reset 0x00000000					0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
Id	RW	Field	Value	Id	Value		Description																															
A	RW	BUFFSIZE			[0..32767]		Length of DMA RAM allocation in number of samples																															

## 6.10.8 Electrical specification

### 6.10.8.1 PDM Electrical Specification

Symbol	Description	Min.	Typ.	Max.	Units
$f_{\text{PDM,CLK}}$	PDM clock speed		1.032		MHz
$t_{\text{PDM,JITTER}}$	Jitter in PDM clock output			20	ns
$T_{\text{dPDM,CLK}}$	PDM clock duty cycle	40	50	60	%
$t_{\text{PDM,DATA}}$	Decimation filter delay			5	ms
$t_{\text{PDM,cv}}$	Allowed clock edge to data valid			125	ns
$t_{\text{PDM,ci}}$	Allowed (other) clock edge to data invalid	0			ns
$t_{\text{PDM,s}}$	Data setup time at $f_{\text{PDM,CLK}}=1.024$ MHz	65			ns
$t_{\text{PDM,h}}$	Data hold time at $f_{\text{PDM,CLK}}=1.024$ MHz	0			ns
$G_{\text{PDM,default}}$	Default (reset) absolute gain of the PDM module		3.2		dB

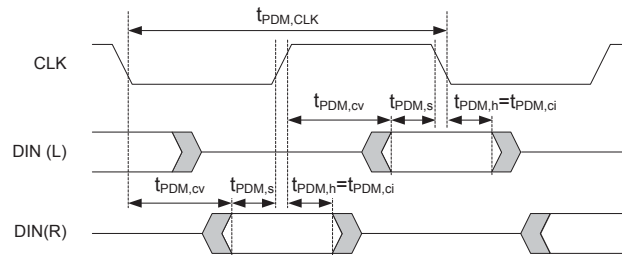


Figure 45: PDM timing diagram

## 6.11 PPI — Programmable peripheral interconnect

The programmable peripheral interconnect (PPI) enables peripherals to interact autonomously with each other using tasks and events independent of the CPU. The PPI allows precise synchronization between peripherals when real-time application constraints exist and eliminates the need for CPU activity to implement behavior which can be predefined using PPI.

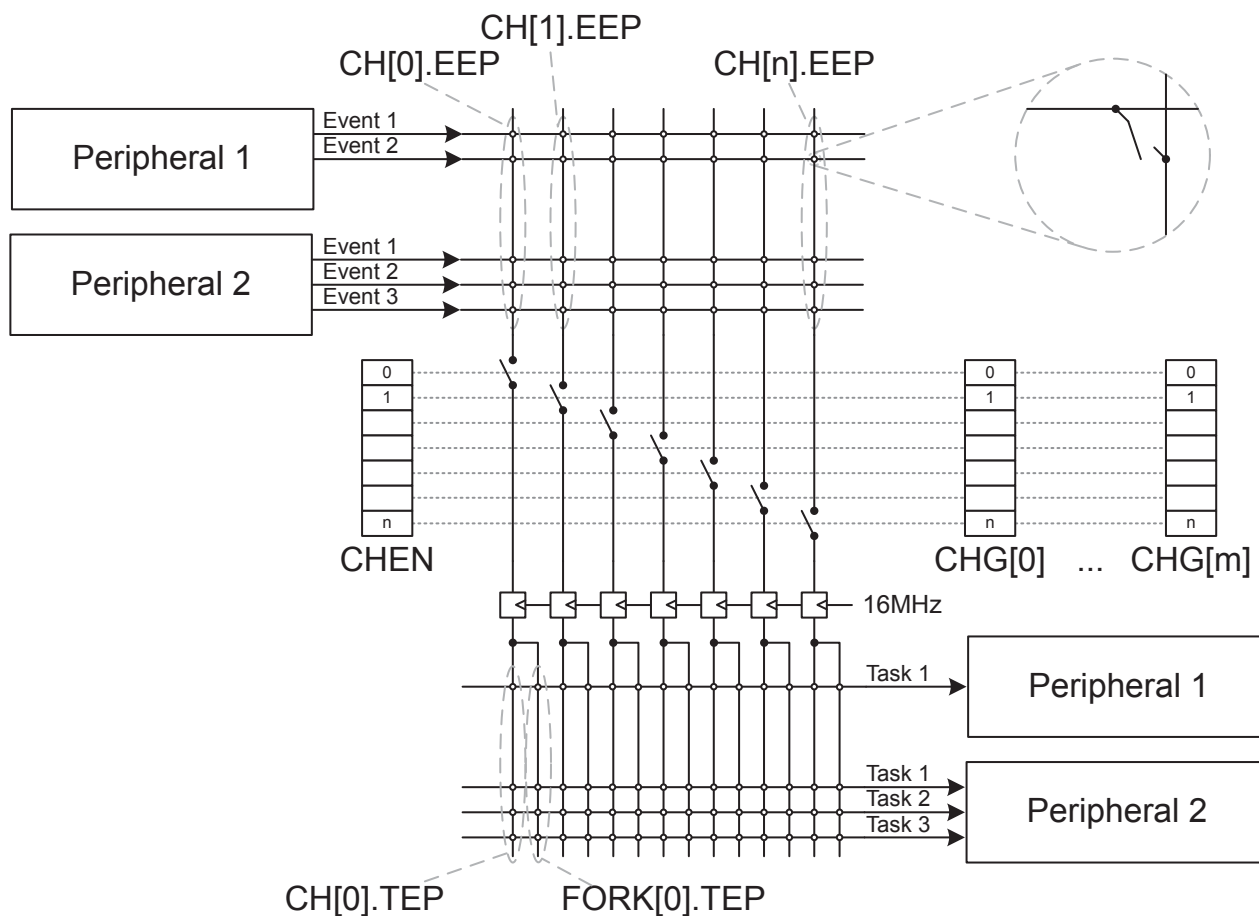


Figure 46: PPI block diagram

The PPI system has, in addition to the fully programmable peripheral interconnections, a set of channels where the event end point (EEP) and task end points (TEP) are fixed in hardware. These fixed channels can be individually enabled, disabled, or added to PPI channel groups (see CHG[n] registers), in the same way as ordinary PPI channels.

Instance	Channel	Number of channels
PPI	0-19	20
PPI (fixed)	20-31	12

Table 46: Configurable and fixed PPI channels

The PPI provides a mechanism to automatically trigger a task in one peripheral as a result of an event occurring in another peripheral. A task is connected to an event through a PPI channel. The PPI channel is composed of three end point registers, one EEP and two TEPs. A peripheral task is connected to a TEP using the address of the task register associated with the task. Similarly, a peripheral event is connected to an EEP using the address of the event register associated with the event.

On each PPI channel, the signals are synchronized to the 16 MHz clock, to avoid any internal violation of setup and hold timings. As a consequence, events that are synchronous to the 16 MHz clock will be delayed by one clock period, while other asynchronous events will be delayed by up to one 16 MHz clock period.

Note that shortcuts (as defined in the SHORTS register in each peripheral) are not affected by this 16 MHz synchronization, and are therefore not delayed.

Each TEP implements a fork mechanism that enables a second task to be triggered at the same time as the task specified in the TEP is triggered. This second task is configured in the task end point register in the FORK registers groups, e.g. FORK.TEP[0] is associated with PPI channel CH[0].

There are two ways of enabling and disabling PPI channels:

- Enable or disable PPI channels individually using the CHEN, CHENSET, and CHENCLR registers.
- Enable or disable PPI channels in PPI channel groups through the groups' ENABLE and DISABLE tasks. Prior to these tasks being triggered, the PPI channel group must be configured to define which PPI channels belong to which groups.

Note that when a channel belongs to two groups m and n, and the tasks CHG[m].EN and CHG[n].DIS occur simultaneously (m and n can be equal or different), the CHG[m].EN on that channel has priority.

PPI tasks (for example, CHG[0].EN) can be triggered through the PPI like any other task, which means they can be hooked to a PPI channel as a TEP. One event can trigger multiple tasks by using multiple channels and one task can be triggered by multiple events in the same way.

### 6.11.1 Pre-programmed channels

Some of the PPI channels are pre-programmed. These channels cannot be configured by the CPU, but can be added to groups and enabled and disabled like the general purpose PPI channels. The FORK TEP for these channels are still programmable and can be used by the application.

For a list of pre-programmed PPI channels, see the table below.

Channel	EEP	TEP
20	TIMER0->EVENTS_COMPARE[0]	RADIO->TASKS_TXEN
21	TIMER0->EVENTS_COMPARE[0]	RADIO->TASKS_RXEN
22	TIMER0->EVENTS_COMPARE[1]	RADIO->TASKS_DISABLE
23	RADIO->EVENTS_BCMATCH	AAR->TASKS_START
24	RADIO->EVENTS_READY	CCM->TASKS_KSGEN
25	RADIO->EVENTS_ADDRESS	CCM->TASKS_CRYPT
26	RADIO->EVENTS_ADDRESS	TIMER0->TASKS_CAPTURE[1]
27	RADIO->EVENTS_END	TIMER0->TASKS_CAPTURE[2]
28	RTC0->EVENTS_COMPARE[0]	RADIO->TASKS_TXEN
29	RTC0->EVENTS_COMPARE[0]	RADIO->TASKS_RXEN
30	RTC0->EVENTS_COMPARE[0]	TIMER0->TASKS_CLEAR
31	RTC0->EVENTS_COMPARE[0]	TIMER0->TASKS_START

Table 47: Pre-programmed channels

### 6.11.2 Registers

Base address	Peripheral	Instance	Description	Configuration
0x4001F000	PPI	PPI	Programmable peripheral interconnect	

Table 48: Instances

Register	Offset	Description
TASKS_CHG[0].EN	0x000	Enable channel group 0
TASKS_CHG[0].DIS	0x004	Disable channel group 0
TASKS_CHG[1].EN	0x008	Enable channel group 1
TASKS_CHG[1].DIS	0x00C	Disable channel group 1
TASKS_CHG[2].EN	0x010	Enable channel group 2
TASKS_CHG[2].DIS	0x014	Disable channel group 2

Register	Offset	Description
TASKS_CHG[3].EN	0x018	Enable channel group 3
TASKS_CHG[3].DIS	0x01C	Disable channel group 3
TASKS_CHG[4].EN	0x020	Enable channel group 4
TASKS_CHG[4].DIS	0x024	Disable channel group 4
TASKS_CHG[5].EN	0x028	Enable channel group 5
TASKS_CHG[5].DIS	0x02C	Disable channel group 5
CHEN	0x500	Channel enable register
CHENSET	0x504	Channel enable set register
CHENCLR	0x508	Channel enable clear register
CH[0].EEP	0x510	Channel 0 event end-point
CH[0].TEP	0x514	Channel 0 task end-point
CH[1].EEP	0x518	Channel 1 event end-point
CH[1].TEP	0x51C	Channel 1 task end-point
CH[2].EEP	0x520	Channel 2 event end-point
CH[2].TEP	0x524	Channel 2 task end-point
CH[3].EEP	0x528	Channel 3 event end-point
CH[3].TEP	0x52C	Channel 3 task end-point
CH[4].EEP	0x530	Channel 4 event end-point
CH[4].TEP	0x534	Channel 4 task end-point
CH[5].EEP	0x538	Channel 5 event end-point
CH[5].TEP	0x53C	Channel 5 task end-point
CH[6].EEP	0x540	Channel 6 event end-point
CH[6].TEP	0x544	Channel 6 task end-point
CH[7].EEP	0x548	Channel 7 event end-point
CH[7].TEP	0x54C	Channel 7 task end-point
CH[8].EEP	0x550	Channel 8 event end-point
CH[8].TEP	0x554	Channel 8 task end-point
CH[9].EEP	0x558	Channel 9 event end-point
CH[9].TEP	0x55C	Channel 9 task end-point
CH[10].EEP	0x560	Channel 10 event end-point
CH[10].TEP	0x564	Channel 10 task end-point
CH[11].EEP	0x568	Channel 11 event end-point
CH[11].TEP	0x56C	Channel 11 task end-point
CH[12].EEP	0x570	Channel 12 event end-point
CH[12].TEP	0x574	Channel 12 task end-point
CH[13].EEP	0x578	Channel 13 event end-point
CH[13].TEP	0x57C	Channel 13 task end-point
CH[14].EEP	0x580	Channel 14 event end-point
CH[14].TEP	0x584	Channel 14 task end-point
CH[15].EEP	0x588	Channel 15 event end-point
CH[15].TEP	0x58C	Channel 15 task end-point
CH[16].EEP	0x590	Channel 16 event end-point
CH[16].TEP	0x594	Channel 16 task end-point
CH[17].EEP	0x598	Channel 17 event end-point
CH[17].TEP	0x59C	Channel 17 task end-point
CH[18].EEP	0x5A0	Channel 18 event end-point
CH[18].TEP	0x5A4	Channel 18 task end-point
CH[19].EEP	0x5A8	Channel 19 event end-point
CH[19].TEP	0x5AC	Channel 19 task end-point
CHG[0]	0x800	Channel group 0
CHG[1]	0x804	Channel group 1
CHG[2]	0x808	Channel group 2
CHG[3]	0x80C	Channel group 3

Register	Offset	Description
CHG[4]	0x810	Channel group 4
CHG[5]	0x814	Channel group 5
FORK[0].TEP	0x910	Channel 0 task end-point
FORK[1].TEP	0x914	Channel 1 task end-point
FORK[2].TEP	0x918	Channel 2 task end-point
FORK[3].TEP	0x91C	Channel 3 task end-point
FORK[4].TEP	0x920	Channel 4 task end-point
FORK[5].TEP	0x924	Channel 5 task end-point
FORK[6].TEP	0x928	Channel 6 task end-point
FORK[7].TEP	0x92C	Channel 7 task end-point
FORK[8].TEP	0x930	Channel 8 task end-point
FORK[9].TEP	0x934	Channel 9 task end-point
FORK[10].TEP	0x938	Channel 10 task end-point
FORK[11].TEP	0x93C	Channel 11 task end-point
FORK[12].TEP	0x940	Channel 12 task end-point
FORK[13].TEP	0x944	Channel 13 task end-point
FORK[14].TEP	0x948	Channel 14 task end-point
FORK[15].TEP	0x94C	Channel 15 task end-point
FORK[16].TEP	0x950	Channel 16 task end-point
FORK[17].TEP	0x954	Channel 17 task end-point
FORK[18].TEP	0x958	Channel 18 task end-point
FORK[19].TEP	0x95C	Channel 19 task end-point
FORK[20].TEP	0x960	Channel 20 task end-point
FORK[21].TEP	0x964	Channel 21 task end-point
FORK[22].TEP	0x968	Channel 22 task end-point
FORK[23].TEP	0x96C	Channel 23 task end-point
FORK[24].TEP	0x970	Channel 24 task end-point
FORK[25].TEP	0x974	Channel 25 task end-point
FORK[26].TEP	0x978	Channel 26 task end-point
FORK[27].TEP	0x97C	Channel 27 task end-point
FORK[28].TEP	0x980	Channel 28 task end-point
FORK[29].TEP	0x984	Channel 29 task end-point
FORK[30].TEP	0x988	Channel 30 task end-point
FORK[31].TEP	0x98C	Channel 31 task end-point

Table 49: Register Overview

### 6.11.2.1 CHEN

Address offset: 0x500

Channel enable register

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0																															
Id				f e d c b a Z Y X W V U T S R Q P O N M L K J I H G F E D C B A																															
Reset 0x00000000				0 0																															
Id	RW	Field	Value	Id	Value	Description																													
A	RW	CH0				Enable or disable channel 0																													
			Disabled	0	Disable channel																														
			Enabled	1	Enable channel																														
B	RW	CH1				Enable or disable channel 1																													
			Disabled	0	Disable channel																														
			Enabled	1	Enable channel																														
C	RW	CH2				Enable or disable channel 2																													

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0																															
Id				f e d c b a Z Y X W V U T S R Q P O N M L K J I H G F E D C B A																															
Reset 0x00000000				0 0																															
Id	RW	Field	Value Id	Value	Description																														
			Disabled	0	Disable channel																														
			Enabled	1	Enable channel																														
			Enable or disable channel 3																																
D	RW	CH3	Disabled	0	Disable channel																														
			Enabled	1	Enable channel																														
			Enable or disable channel 4																																
E	RW	CH4	Disabled	0	Disable channel																														
			Enabled	1	Enable channel																														
			Enable or disable channel 5																																
F	RW	CH5	Disabled	0	Disable channel																														
			Enabled	1	Enable channel																														
			Enable or disable channel 6																																
G	RW	CH6	Disabled	0	Disable channel																														
			Enabled	1	Enable channel																														
			Enable or disable channel 7																																
H	RW	CH7	Disabled	0	Disable channel																														
			Enabled	1	Enable channel																														
			Enable or disable channel 8																																
I	RW	CH8	Disabled	0	Disable channel																														
			Enabled	1	Enable channel																														
			Enable or disable channel 9																																
J	RW	CH9	Disabled	0	Disable channel																														
			Enabled	1	Enable channel																														
			Enable or disable channel 10																																
K	RW	CH10	Disabled	0	Disable channel																														
			Enabled	1	Enable channel																														
			Enable or disable channel 11																																
L	RW	CH11	Disabled	0	Disable channel																														
			Enabled	1	Enable channel																														
			Enable or disable channel 12																																
M	RW	CH12	Disabled	0	Disable channel																														
			Enabled	1	Enable channel																														
			Enable or disable channel 13																																
N	RW	CH13	Disabled	0	Disable channel																														
			Enabled	1	Enable channel																														
			Enable or disable channel 14																																
O	RW	CH14	Disabled	0	Disable channel																														
			Enabled	1	Enable channel																														
			Enable or disable channel 15																																
P	RW	CH15	Disabled	0	Disable channel																														
			Enabled	1	Enable channel																														
			Enable or disable channel 16																																
Q	RW	CH16	Disabled	0	Disable channel																														
			Enabled	1	Enable channel																														
			Enable or disable channel 17																																
R	RW	CH17	Disabled	0	Disable channel																														
			Enabled	1	Enable channel																														
			Enable or disable channel 18																																
S	RW	CH18	Disabled	0	Disable channel																														
			Enabled	1	Enable channel																														

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0																															
Id				f e d c b a Z Y X W V U T S R Q P O N M L K J I H G F E D C B A																															
Reset 0x00000000				0 0																															
Id	RW	Field	Value Id	Value	Description																														
T	RW	CH19			Enable or disable channel 19																														
			Disabled	0	Disable channel																														
			Enabled	1	Enable channel																														
U	RW	CH20			Enable or disable channel 20																														
			Disabled	0	Disable channel																														
			Enabled	1	Enable channel																														
V	RW	CH21			Enable or disable channel 21																														
			Disabled	0	Disable channel																														
			Enabled	1	Enable channel																														
W	RW	CH22			Enable or disable channel 22																														
			Disabled	0	Disable channel																														
			Enabled	1	Enable channel																														
X	RW	CH23			Enable or disable channel 23																														
			Disabled	0	Disable channel																														
			Enabled	1	Enable channel																														
Y	RW	CH24			Enable or disable channel 24																														
			Disabled	0	Disable channel																														
			Enabled	1	Enable channel																														
Z	RW	CH25			Enable or disable channel 25																														
			Disabled	0	Disable channel																														
			Enabled	1	Enable channel																														
a	RW	CH26			Enable or disable channel 26																														
			Disabled	0	Disable channel																														
			Enabled	1	Enable channel																														
b	RW	CH27			Enable or disable channel 27																														
			Disabled	0	Disable channel																														
			Enabled	1	Enable channel																														
c	RW	CH28			Enable or disable channel 28																														
			Disabled	0	Disable channel																														
			Enabled	1	Enable channel																														
d	RW	CH29			Enable or disable channel 29																														
			Disabled	0	Disable channel																														
			Enabled	1	Enable channel																														
e	RW	CH30			Enable or disable channel 30																														
			Disabled	0	Disable channel																														
			Enabled	1	Enable channel																														
f	RW	CH31			Enable or disable channel 31																														
			Disabled	0	Disable channel																														
			Enabled	1	Enable channel																														

### 6.11.2.2 CHENSET

Address offset: 0x504

Channel enable set register

Read: reads value of CH{i} field in CHEN register.



Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0																															
Id				f e d c b a Z Y X W V U T S R Q P O N M L K J I H G F E D C B A																															
Reset 0x00000000				0 0																															
Id	RW	Field	Value Id	Value	Description																														
A	RW	CH0			Channel 0 enable set register. Writing '0' has no effect																														
			Disabled	0	Read: channel disabled																														
			Enabled	1	Read: channel enabled																														
			Set	1	Write: Enable channel																														
B	RW	CH1			Channel 1 enable set register. Writing '0' has no effect																														
			Disabled	0	Read: channel disabled																														
			Enabled	1	Read: channel enabled																														
			Set	1	Write: Enable channel																														
C	RW	CH2			Channel 2 enable set register. Writing '0' has no effect																														
			Disabled	0	Read: channel disabled																														
			Enabled	1	Read: channel enabled																														
			Set	1	Write: Enable channel																														
D	RW	CH3			Channel 3 enable set register. Writing '0' has no effect																														
			Disabled	0	Read: channel disabled																														
			Enabled	1	Read: channel enabled																														
			Set	1	Write: Enable channel																														
E	RW	CH4			Channel 4 enable set register. Writing '0' has no effect																														
			Disabled	0	Read: channel disabled																														
			Enabled	1	Read: channel enabled																														
			Set	1	Write: Enable channel																														
F	RW	CH5			Channel 5 enable set register. Writing '0' has no effect																														
			Disabled	0	Read: channel disabled																														
			Enabled	1	Read: channel enabled																														
			Set	1	Write: Enable channel																														
G	RW	CH6			Channel 6 enable set register. Writing '0' has no effect																														
			Disabled	0	Read: channel disabled																														
			Enabled	1	Read: channel enabled																														
			Set	1	Write: Enable channel																														
H	RW	CH7			Channel 7 enable set register. Writing '0' has no effect																														
			Disabled	0	Read: channel disabled																														
			Enabled	1	Read: channel enabled																														
			Set	1	Write: Enable channel																														
I	RW	CH8			Channel 8 enable set register. Writing '0' has no effect																														
			Disabled	0	Read: channel disabled																														
			Enabled	1	Read: channel enabled																														
			Set	1	Write: Enable channel																														
J	RW	CH9			Channel 9 enable set register. Writing '0' has no effect																														
			Disabled	0	Read: channel disabled																														
			Enabled	1	Read: channel enabled																														
			Set	1	Write: Enable channel																														
K	RW	CH10			Channel 10 enable set register. Writing '0' has no effect																														
			Disabled	0	Read: channel disabled																														
			Enabled	1	Read: channel enabled																														
			Set	1	Write: Enable channel																														
L	RW	CH11			Channel 11 enable set register. Writing '0' has no effect																														
			Disabled	0	Read: channel disabled																														
			Enabled	1	Read: channel enabled																														
			Set	1	Write: Enable channel																														
M	RW	CH12			Channel 12 enable set register. Writing '0' has no effect																														
			Disabled	0	Read: channel disabled																														

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0																														
Id				f e d c b a Z Y X W V U T S R Q P O N M L K J I H G F E D C B A																														
Reset 0x00000000				0 0																														
Id	RW	Field	Value Id	Value	Description																													
			Enabled	1	Read: channel enabled																													
			Set	1	Write: Enable channel																													
			Channel 13 enable set register. Writing '0' has no effect																															
			Disabled	0	Read: channel disabled																													
			Enabled	1	Read: channel enabled																													
N	RW	CH13	Set	1	Write: Enable channel																													
			Disabled	0	Read: channel disabled																													
			Enabled	1	Read: channel enabled																													
			Channel 14 enable set register. Writing '0' has no effect																															
			Set	1	Write: Enable channel																													
			Disabled	0	Read: channel disabled																													
O	RW	CH14	Enabled	1	Read: channel enabled																													
			Set	1	Write: Enable channel																													
			Disabled	0	Read: channel disabled																													
			Enabled	1	Read: channel enabled																													
			Channel 15 enable set register. Writing '0' has no effect																															
			Disabled	0	Read: channel disabled																													
P	RW	CH15	Enabled	1	Read: channel enabled																													
			Set	1	Write: Enable channel																													
			Disabled	0	Read: channel disabled																													
			Enabled	1	Read: channel enabled																													
			Channel 16 enable set register. Writing '0' has no effect																															
			Disabled	0	Read: channel disabled																													
Q	RW	CH16	Enabled	1	Read: channel enabled																													
			Set	1	Write: Enable channel																													
			Disabled	0	Read: channel disabled																													
			Enabled	1	Read: channel enabled																													
			Channel 17 enable set register. Writing '0' has no effect																															
			Disabled	0	Read: channel disabled																													
R	RW	CH17	Enabled	1	Read: channel enabled																													
			Set	1	Write: Enable channel																													
			Disabled	0	Read: channel disabled																													
			Enabled	1	Read: channel enabled																													
			Channel 18 enable set register. Writing '0' has no effect																															
			Disabled	0	Read: channel disabled																													
S	RW	CH18	Enabled	1	Read: channel enabled																													
			Set	1	Write: Enable channel																													
			Disabled	0	Read: channel disabled																													
			Enabled	1	Read: channel enabled																													
			Channel 19 enable set register. Writing '0' has no effect																															
			Disabled	0	Read: channel disabled																													
T	RW	CH19	Enabled	1	Read: channel enabled																													
			Set	1	Write: Enable channel																													
			Disabled	0	Read: channel disabled																													
			Enabled	1	Read: channel enabled																													
			Channel 20 enable set register. Writing '0' has no effect																															
			Disabled	0	Read: channel disabled																													
U	RW	CH20	Enabled	1	Read: channel enabled																													
			Set	1	Write: Enable channel																													
			Disabled	0	Read: channel disabled																													
			Enabled	1	Read: channel enabled																													
			Channel 21 enable set register. Writing '0' has no effect																															
			Disabled	0	Read: channel disabled																													
V	RW	CH21	Enabled	1	Read: channel enabled																													
			Set	1	Write: Enable channel																													
			Disabled	0	Read: channel disabled																													
			Enabled	1	Read: channel enabled																													
			Channel 22 enable set register. Writing '0' has no effect																															
			Disabled	0	Read: channel disabled																													
W	RW	CH22	Enabled	1	Read: channel enabled																													
			Set	1	Write: Enable channel																													
			Disabled	0	Read: channel disabled																													
			Enabled	1	Read: channel enabled																													
			Channel 23 enable set register. Writing '0' has no effect																															
			Disabled	0	Read: channel disabled																													
X	RW	CH23	Enabled	1	Read: channel enabled																													
			Set	1	Write: Enable channel																													
			Disabled	0	Read: channel disabled																													
			Enabled	1	Read: channel enabled																													
			Channel 24 enable set register. Writing '0' has no effect																															
			Disabled	0	Read: channel disabled																													
Y	RW	CH24	Enabled	1	Read: channel enabled																													
			Set	1	Write: Enable channel																													
			Disabled	0	Read: channel disabled																													
			Enabled	1	Read: channel enabled																													
			Channel 24 enable set register. Writing '0' has no effect																															
			Disabled	0	Read: channel disabled																													

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0																															
Id				f e d c b a Z Y X W V U T S R Q P O N M L K J I H G F E D C B A																															
Reset 0x00000000				0 0																															
Id	RW	Field	Value Id	Value	Description																														
Z	RW	CH25			Channel 25 enable set register. Writing '0' has no effect																														
			Disabled	0	Read: channel disabled																														
			Enabled	1	Read: channel enabled																														
			Set	1	Write: Enable channel																														
a	RW	CH26			Channel 26 enable set register. Writing '0' has no effect																														
			Disabled	0	Read: channel disabled																														
			Enabled	1	Read: channel enabled																														
			Set	1	Write: Enable channel																														
b	RW	CH27			Channel 27 enable set register. Writing '0' has no effect																														
			Disabled	0	Read: channel disabled																														
			Enabled	1	Read: channel enabled																														
			Set	1	Write: Enable channel																														
c	RW	CH28			Channel 28 enable set register. Writing '0' has no effect																														
			Disabled	0	Read: channel disabled																														
			Enabled	1	Read: channel enabled																														
			Set	1	Write: Enable channel																														
d	RW	CH29			Channel 29 enable set register. Writing '0' has no effect																														
			Disabled	0	Read: channel disabled																														
			Enabled	1	Read: channel enabled																														
			Set	1	Write: Enable channel																														
e	RW	CH30			Channel 30 enable set register. Writing '0' has no effect																														
			Disabled	0	Read: channel disabled																														
			Enabled	1	Read: channel enabled																														
			Set	1	Write: Enable channel																														
f	RW	CH31			Channel 31 enable set register. Writing '0' has no effect																														
			Disabled	0	Read: channel disabled																														
			Enabled	1	Read: channel enabled																														
			Set	1	Write: Enable channel																														

### 6.11.2.3 CHENCLR

Address offset: 0x508

Channel enable clear register

Read: reads value of CH{i} field in CHEN register.

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0																															
Id				f e d c b a Z Y X W V U T S R Q P O N M L K J I H G F E D C B A																															
Reset 0x00000000				0 0																															
Id	RW	Field	Value Id	Value	Description																														
A	RW	CH0			Channel 0 enable clear register. Writing '0' has no effect																														
			Disabled	0	Read: channel disabled																														
			Enabled	1	Read: channel enabled																														
			Clear	1	Write: disable channel																														
B	RW	CH1			Channel 1 enable clear register. Writing '0' has no effect																														
			Disabled	0	Read: channel disabled																														
			Enabled	1	Read: channel enabled																														
			Clear	1	Write: disable channel																														
C	RW	CH2			Channel 2 enable clear register. Writing '0' has no effect																														
			Disabled	0	Read: channel disabled																														

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0																															
Id				f e d c b a Z Y X W V U T S R Q P O N M L K J I H G F E D C B A																															
Reset 0x00000000				0 0																															
Id	RW	Field	Value Id	Value	Description																														
			Enabled	1	Read: channel enabled																														
			Clear	1	Write: disable channel																														
			Channel 3 enable clear register. Writing '0' has no effect																																
			Disabled	0	Read: channel disabled																														
			Enabled	1	Read: channel enabled																														
D	RW	CH3	Clear	1	Write: disable channel																														
			Channel 3 enable clear register. Writing '0' has no effect																																
			Disabled	0	Read: channel disabled																														
			Enabled	1	Read: channel enabled																														
E	RW	CH4	Clear	1	Write: disable channel																														
			Channel 4 enable clear register. Writing '0' has no effect																																
			Disabled	0	Read: channel disabled																														
			Enabled	1	Read: channel enabled																														
F	RW	CH5	Clear	1	Write: disable channel																														
			Channel 5 enable clear register. Writing '0' has no effect																																
			Disabled	0	Read: channel disabled																														
			Enabled	1	Read: channel enabled																														
G	RW	CH6	Clear	1	Write: disable channel																														
			Channel 6 enable clear register. Writing '0' has no effect																																
			Disabled	0	Read: channel disabled																														
			Enabled	1	Read: channel enabled																														
H	RW	CH7	Clear	1	Write: disable channel																														
			Channel 7 enable clear register. Writing '0' has no effect																																
			Disabled	0	Read: channel disabled																														
			Enabled	1	Read: channel enabled																														
I	RW	CH8	Clear	1	Write: disable channel																														
			Channel 8 enable clear register. Writing '0' has no effect																																
			Disabled	0	Read: channel disabled																														
			Enabled	1	Read: channel enabled																														
J	RW	CH9	Clear	1	Write: disable channel																														
			Channel 9 enable clear register. Writing '0' has no effect																																
			Disabled	0	Read: channel disabled																														
			Enabled	1	Read: channel enabled																														
K	RW	CH10	Clear	1	Write: disable channel																														
			Channel 10 enable clear register. Writing '0' has no effect																																
			Disabled	0	Read: channel disabled																														
			Enabled	1	Read: channel enabled																														
L	RW	CH11	Clear	1	Write: disable channel																														
			Channel 11 enable clear register. Writing '0' has no effect																																
			Disabled	0	Read: channel disabled																														
			Enabled	1	Read: channel enabled																														
M	RW	CH12	Clear	1	Write: disable channel																														
			Channel 12 enable clear register. Writing '0' has no effect																																
			Disabled	0	Read: channel disabled																														
			Enabled	1	Read: channel enabled																														
N	RW	CH13	Clear	1	Write: disable channel																														
			Channel 13 enable clear register. Writing '0' has no effect																																
			Disabled	0	Read: channel disabled																														
			Enabled	1	Read: channel enabled																														
O	RW	CH14	Clear	1	Write: disable channel																														
			Channel 14 enable clear register. Writing '0' has no effect																																
			Disabled	0	Read: channel disabled																														
			Enabled	1	Read: channel enabled																														

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0																															
Id				f e d c b a Z Y X W V U T S R Q P O N M L K J I H G F E D C B A																															
Reset 0x00000000				0 0																															
Id	RW	Field	Value Id	Value	Description																														
P	RW	CH15			Channel 15 enable clear register. Writing '0' has no effect																														
			Disabled	0	Read: channel disabled																														
			Enabled	1	Read: channel enabled																														
			Clear	1	Write: disable channel																														
Q	RW	CH16			Channel 16 enable clear register. Writing '0' has no effect																														
			Disabled	0	Read: channel disabled																														
			Enabled	1	Read: channel enabled																														
			Clear	1	Write: disable channel																														
R	RW	CH17			Channel 17 enable clear register. Writing '0' has no effect																														
			Disabled	0	Read: channel disabled																														
			Enabled	1	Read: channel enabled																														
			Clear	1	Write: disable channel																														
S	RW	CH18			Channel 18 enable clear register. Writing '0' has no effect																														
			Disabled	0	Read: channel disabled																														
			Enabled	1	Read: channel enabled																														
			Clear	1	Write: disable channel																														
T	RW	CH19			Channel 19 enable clear register. Writing '0' has no effect																														
			Disabled	0	Read: channel disabled																														
			Enabled	1	Read: channel enabled																														
			Clear	1	Write: disable channel																														
U	RW	CH20			Channel 20 enable clear register. Writing '0' has no effect																														
			Disabled	0	Read: channel disabled																														
			Enabled	1	Read: channel enabled																														
			Clear	1	Write: disable channel																														
V	RW	CH21			Channel 21 enable clear register. Writing '0' has no effect																														
			Disabled	0	Read: channel disabled																														
			Enabled	1	Read: channel enabled																														
			Clear	1	Write: disable channel																														
W	RW	CH22			Channel 22 enable clear register. Writing '0' has no effect																														
			Disabled	0	Read: channel disabled																														
			Enabled	1	Read: channel enabled																														
			Clear	1	Write: disable channel																														
X	RW	CH23			Channel 23 enable clear register. Writing '0' has no effect																														
			Disabled	0	Read: channel disabled																														
			Enabled	1	Read: channel enabled																														
			Clear	1	Write: disable channel																														
Y	RW	CH24			Channel 24 enable clear register. Writing '0' has no effect																														
			Disabled	0	Read: channel disabled																														
			Enabled	1	Read: channel enabled																														
			Clear	1	Write: disable channel																														
Z	RW	CH25			Channel 25 enable clear register. Writing '0' has no effect																														
			Disabled	0	Read: channel disabled																														
			Enabled	1	Read: channel enabled																														
			Clear	1	Write: disable channel																														
a	RW	CH26			Channel 26 enable clear register. Writing '0' has no effect																														
			Disabled	0	Read: channel disabled																														
			Enabled	1	Read: channel enabled																														
			Clear	1	Write: disable channel																														
b	RW	CH27			Channel 27 enable clear register. Writing '0' has no effect																														
			Disabled	0	Read: channel disabled																														

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0																															
Id				f e d c b a Z Y X W V U T S R Q P O N M L K J I H G F E D C B A																															
Reset 0x00000000				0 0																															
Id	RW	Field	Value Id	Value	Description																														
c	RW	CH28	Enabled	1	Read: channel enabled																														
			Clear	1	Write: disable channel																														
			Channel 28 enable clear register. Writing '0' has no effect																																
			Disabled	0	Read: channel disabled																														
			Enabled	1	Read: channel enabled																														
d	RW	CH29	Clear	1	Write: disable channel																														
			Channel 29 enable clear register. Writing '0' has no effect																																
			Disabled	0	Read: channel disabled																														
			Enabled	1	Read: channel enabled																														
			Clear	1	Write: disable channel																														
e	RW	CH30	Channel 30 enable clear register. Writing '0' has no effect																																
			Disabled	0	Read: channel disabled																														
			Enabled	1	Read: channel enabled																														
			Clear	1	Write: disable channel																														
			f	RW	CH31	Channel 31 enable clear register. Writing '0' has no effect																													
Disabled	0	Read: channel disabled																																	
Enabled	1	Read: channel enabled																																	
Clear	1	Write: disable channel																																	

#### 6.11.2.4 CH[0].EEP

Address offset: 0x510

Channel 0 event end-point

Bit number					31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0																															
Id					A A																															
Reset 0x00000000					0 0																															
Id		RW	Field	Value	Id	Value	Description																													
A		RW	EEP				Pointer to event register. Accepts only addresses to registers from the Event group.																													

#### 6.11.2.5 CH[0].TEP

Address offset: 0x514

Channel 0 task end-point

Bit number					31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0																															
Id					A A																															
Reset 0x00000000					0 0																															
Id		RW		Field		Value		Id		Value		Description																								
A		RW		TEP						Pointer to task register. Accepts only addresses to registers from the Task group.																										

#### 6.11.2.6 CH[1].EEP

Address offset: 0x518

Channel 1 event end-point

Bit number	31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0																													
Id	A A																													
Reset 0x00000000	0 0																													
Id	RW	Field	Value Id		Value		Description																							
A	RW	EEP					Pointer to event register. Accepts only addresses to registers from the Event group.																							

### 6.11.2.7 CH[1].TEP

Address offset: 0x51C

Channel 1 task end-point

Bit number					31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0																															
Id					A A																															
Reset 0x00000000					0 0																															
Id		RW	Field	Value Id	Value	Description																														
A		RW	TEP			Pointer to task register. Accepts only addresses to registers from the Task group.																														

### 6.11.2.8 CH[2].EEP

Address offset: 0x520

Channel 2 event end-point

Bit number					31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0																															
Id					A A																															
Reset 0x00000000					0 0																															
Id		RW	Field	Value Id	Value	Description																														
A		RW	EEP			Pointer to event register. Accepts only addresses to registers from the Event group.																														

### 6.11.2.9 CH[2].TEP

Address offset: 0x524

Channel 2 task end-point

Bit number					31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0																															
Id					A A																															
Reset 0x00000000					0 0																															
Id		RW	Field	Value Id	Value	Description																														
A		RW	TEP			Pointer to task register. Accepts only addresses to registers from the Task group.																														

### 6.11.2.10 CH[3].EEP

Address offset: 0x528

Channel 3 event end-point

### Channel 3 task end-point

### Channel 4 event end-point

### Channel 4 task end-point

### Channel 5 event end-point



### Channel 5 task end-point

### Channel 6 event end-point

## Channel 6 task end-point

### Channel 7 event end-point



Bit number					31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0																															
Id					A A																															
Reset 0x00000000					0 0																															
Id		RW	Field	Value Id	Value	Description																														
A		RW	EEP			Pointer to event register. Accepts only addresses to registers from the Event group.																														

### 6.11.2.23 CH[9].TEP

Address offset: 0x55C

Channel 9 task end-point

Bit number					31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0																															
Id					A A																															
Reset 0x00000000					0 0																															
Id		RW	Field	Value Id	Value	Description																														
A		RW	TEP			Pointer to task register. Accepts only addresses to registers from the Task group.																														

### 6.11.2.24 CH[10].EEP

Address offset: 0x560

Channel 10 event end-point

Bit number					31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0																															
Id					A A																															
Reset 0x00000000					0 0																															
Id		RW	Field	Value Id	Value																Description															
A		RW	EEP																		Pointer to event register. Accepts only addresses to registers from the Event group.															

### 6.11.2.25 CH[10].TEP

Address offset: 0x564

Channel 10 task end-point

Bit number					31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0																															
Id					A A																															
Reset 0x00000000					0 0																															
Id		RW	Field	Value Id	Value	Description																														
A		RW	TEP			Pointer to task register. Accepts only addresses to registers from the Task group.																														

### 6.11.2.26 CH[11].EEP

Address offset: 0x568

Channel 11 event end-point

Bit number	31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0																													
Id	A A																													
Reset 0x00000000	0 0																													
Id	RW	Field	Value Id		Value		Description																							
A	RW	EEP					Pointer to event register. Accepts only addresses to registers from the Event group.																							

### 6.11.2.27 CH[11].TEP

Address offset: 0x56C

Channel 11 task end-point

Bit number					31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0																															
Id					A A																															
Reset 0x00000000					0 0																															
Id	RW	Field	Value Id		Value		Description																													
A	RW	TEP					Pointer to task register. Accepts only addresses to registers from the Task group.																													

### 6.11.2.28 CH[12].EEP

Address offset: 0x570

Channel 12 event end-point

Bit number					31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0																															
Id					A A																															
Reset 0x00000000					0 0																															
Id		RW	Field	Value	Id	Value	Description																													
A		RW	EEP				Pointer to event register. Accepts only addresses to registers from the Event group.																													

### 6.11.2.29 CH[12].TEP

Address offset: 0x574

Channel 12 task end-point

Bit number					31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0																															
Id					A A																															
Reset 0x00000000					0 0																															
Id	RW	Field	Value Id		Value		Description																													
A	RW	TEP					Pointer to task register. Accepts only addresses to registers from the Task group.																													

### 6.11.2.30 CH[13].EEP

Address offset: 0x578

Channel 13 event end-point

Bit number					31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
Id					A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A
Reset 0x00000000					0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Id		RW	Field	Value Id	Value		Description																													
A		RW	EEP				Pointer to event register. Accepts only addresses to registers from the Event group.																													

#### 6.11.2.31 CH[13].TEP

Address offset: 0x57C

### Channel 13 task end-point

Bit number	31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0																															
Id	A A																															
Reset 0x00000000	0 0																															
Id	RW	Field	Value	Id	Value	Description																										
A	RW	TEP				Pointer to task register. Accepts only addresses to registers from the Task group.																										

### 6.11.2.32 CH[14].EEP

Address offset: 0x580

### Channel 14 event end-point

Bit number					31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
Id					A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A
Reset 0x00000000					0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Id	RW	Field	Value Id	Value	Description																															
A	RW	EEP			Pointer to event register. Accepts only addresses to registers from the Event group.																															

### 6.11.2.33 CH[14].TEP

Address offset: 0x584

### Channel 14 task end-point

Bit number				31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
Id				A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A
Reset 0x00000000				0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Id	RW	Field	Value	Id		Value		Description																											
A	RW	TEP					Pointer to task register. Accepts only addresses to registers from the Task group.																												

### 6.11.2.34 CH[15].EEP

Address offset: 0x588

### Channel 15 event end-point

Bit number					31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0																															
Id					A A																															
Reset 0x00000000					0 0																															
Id	RW	Field	Value Id		Value		Description																													
A	RW	EEP					Pointer to event register. Accepts only addresses to registers from the Event group.																													

### 6.11.2.35 CH[15].TEP

Address offset: 0x58C

Channel 15 task end-point

Bit number					31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0																															
Id					A A																															
Reset 0x00000000					0 0																															
Id	RW	Field	Value Id		Value		Description																													
A	RW	TEP					Pointer to task register. Accepts only addresses to registers from the Task group.																													

### 6.11.2.36 CH[16].EEP

Address offset: 0x590

Channel 16 event end-point

Bit number					31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0																															
Id					A A																															
Reset 0x00000000					0 0																															
Id		RW		Field		Value Id		Value		Description																										
A		RW		EEP						Pointer to event register. Accepts only addresses to registers from the Event group.																										

### 6.11.2.37 CH[16].TEP

Address offset: 0x594

Channel 16 task end-point

Bit number					31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0																															
Id					A A																															
Reset 0x00000000					0 0																															
Id	RW	Field	Value Id		Value		Description																													
A	RW	TEP					Pointer to task register. Accepts only addresses to registers from the Task group.																													

### 6.11.2.38 CH[17].EEP

Address offset: 0x598

Channel 17 event end-point

Bit number	31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0																																	
Id	A A																																	
Reset 0x00000000	0 0																																	
Id	RW	Field	Value Id		Value		Description																											
A	RW	EEP					Pointer to event register. Accepts only addresses to registers from the Event group.																											

### 6.11.2.39 CH[17].TEP

Address offset: 0x59C

Channel 17 task end-point

Bit number					31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0																															
Id					A A																															
Reset 0x00000000					0 0																															
Id		RW	Field	Value Id	Value	Description																														
A		RW	TEP			Pointer to task register. Accepts only addresses to registers from the Task group.																														

### 6.11.2.40 CH[18].EEP

Address offset: 0x5A0

Channel 18 event end-point

Bit number					31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0																															
Id					A A																															
Reset 0x00000000					0 0																															
Id		RW	Field	Value Id	Value	Description																														
A		RW	EEP			Pointer to event register. Accepts only addresses to registers from the Event group.																														

### 6.11.2.41 CH[18].TEP

Address offset: 0x5A4

Channel 18 task end-point

Bit number					31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0																															
Id					A A																															
Reset 0x00000000					0 0																															
Id		RW	Field	Value Id	Value	Description																														
A		RW	TEP			Pointer to task register. Accepts only addresses to registers from the Task group.																														

### 6.11.2.42 CH[19].EEP

Address offset: 0x5A8

Channel 19 event end-point

Bit number	31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0																														
Id	A A																														
Reset 0x00000000	0 0																														
Id	RW	Field	Value Id	Value	Description																										
A	RW	EEP			Pointer to event register. Accepts only addresses to registers from the Event group.																										

### 6.11.2.43 CH[19].TEP

Address offset: 0x5AC

Channel 19 task end-point

Bit number	31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0																														
Id	A A																														
Reset 0x00000000	0 0																														
Id	RW	Field	Value Id	Value	Description																										
A	RW	TEP			Pointer to task register. Accepts only addresses to registers from the Task group.																										

### 6.11.2.44 CHG[0]

Address offset: 0x800

Channel group 0

Bit number						31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
Id						f	e	d	c	b	a	Z	Y	X	W	V	U	T	S	R	Q	P	O	N	M	L	K	J	I	H	G	F	E	D	C	B	A
Reset 0x00000000						0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Id	RW	Field	Value Id	Value	Description																																
A	RW	CH0			Include or exclude channel 0																																
			Excluded	0	Exclude																																
			Included	1	Include																																
B	RW	CH1			Include or exclude channel 1																																
			Excluded	0	Exclude																																
			Included	1	Include																																
C	RW	CH2			Include or exclude channel 2																																
			Excluded	0	Exclude																																
			Included	1	Include																																
D	RW	CH3			Include or exclude channel 3																																
			Excluded	0	Exclude																																
			Included	1	Include																																
E	RW	CH4			Include or exclude channel 4																																
			Excluded	0	Exclude																																
			Included	1	Include																																
F	RW	CH5			Include or exclude channel 5																																
			Excluded	0	Exclude																																
			Included	1	Include																																
G	RW	CH6			Include or exclude channel 6																																
			Excluded	0	Exclude																																
			Included	1	Include																																
H	RW	CH7			Include or exclude channel 7																																
			Excluded	0	Exclude																																
			Included	1	Include																																
I	RW	CH8			Include or exclude channel 8																																



Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0																														
Id				f e d c b a Z Y X W V U T S R Q P O N M L K J I H G F E D C B A																														
Reset 0x00000000				0 0																														
Id	RW	Field	Value Id	Value	Description																													
			Excluded	0	Exclude																													
			Included	1	Include																													
			Include or exclude channel 9																															
J	RW	CH9	Excluded	0	Exclude																													
			Included	1	Include																													
			Include or exclude channel 10																															
K	RW	CH10	Excluded	0	Exclude																													
			Included	1	Include																													
			Include or exclude channel 11																															
L	RW	CH11	Excluded	0	Exclude																													
			Included	1	Include																													
			Include or exclude channel 12																															
M	RW	CH12	Excluded	0	Exclude																													
			Included	1	Include																													
			Include or exclude channel 13																															
N	RW	CH13	Excluded	0	Exclude																													
			Included	1	Include																													
			Include or exclude channel 14																															
O	RW	CH14	Excluded	0	Exclude																													
			Included	1	Include																													
			Include or exclude channel 15																															
P	RW	CH15	Excluded	0	Exclude																													
			Included	1	Include																													
			Include or exclude channel 16																															
Q	RW	CH16	Excluded	0	Exclude																													
			Included	1	Include																													
			Include or exclude channel 17																															
R	RW	CH17	Excluded	0	Exclude																													
			Included	1	Include																													
			Include or exclude channel 18																															
S	RW	CH18	Excluded	0	Exclude																													
			Included	1	Include																													
			Include or exclude channel 19																															
T	RW	CH19	Excluded	0	Exclude																													
			Included	1	Include																													
			Include or exclude channel 20																															
U	RW	CH20	Excluded	0	Exclude																													
			Included	1	Include																													
			Include or exclude channel 21																															
V	RW	CH21	Excluded	0	Exclude																													
			Included	1	Include																													
			Include or exclude channel 22																															
W	RW	CH22	Excluded	0	Exclude																													
			Included	1	Include																													
			Include or exclude channel 23																															
X	RW	CH23	Excluded	0	Exclude																													
			Included	1	Include																													
			Include or exclude channel 24																															
Y	RW	CH24	Excluded	0	Exclude																													
			Included	1	Include																													

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0																															
Id				f e d c b a z Y X W V U T S R Q P O N M L K J I H G F E D C B A																															
Reset 0x00000000				0 0																															
Id	RW	Field	Value	Id	Value	Description																													
Z	RW	CH25				Include or exclude channel 25																													
			Excluded	0	Exclude																														
			Included	1	Include																														
a	RW	CH26				Include or exclude channel 26																													
			Excluded	0	Exclude																														
			Included	1	Include																														
b	RW	CH27				Include or exclude channel 27																													
			Excluded	0	Exclude																														
			Included	1	Include																														
c	RW	CH28				Include or exclude channel 28																													
			Excluded	0	Exclude																														
			Included	1	Include																														
d	RW	CH29				Include or exclude channel 29																													
			Excluded	0	Exclude																														
			Included	1	Include																														
e	RW	CH30				Include or exclude channel 30																													
			Excluded	0	Exclude																														
			Included	1	Include																														
f	RW	CH31				Include or exclude channel 31																													
			Excluded	0	Exclude																														
			Included	1	Include																														

### 6.11.2.45 CHG[1]

Address offset: 0x804

Channel group 1

Bit number					31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0																															
Id					f e d c b a z Y X W V U T S R Q P O N M L K J I H G F E D C B A																															
Reset 0x00000000					0 0																															
Id	RW	Field	Value	Id	Value	Description																														
A	RW	CH0				Include or exclude channel 0																														
			Excluded	0	Exclude																															
			Included	1	Include																															
B	RW	CH1				Include or exclude channel 1																														
			Excluded	0	Exclude																															
			Included	1	Include																															
C	RW	CH2				Include or exclude channel 2																														
			Excluded	0	Exclude																															
			Included	1	Include																															
D	RW	CH3				Include or exclude channel 3																														
			Excluded	0	Exclude																															
			Included	1	Include																															
E	RW	CH4				Include or exclude channel 4																														
			Excluded	0	Exclude																															
			Included	1	Include																															
F	RW	CH5				Include or exclude channel 5																														
			Excluded	0	Exclude																															
			Included	1	Include																															

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0																															
Id				f e d c b a Z Y X W V U T S R Q P O N M L K J I H G F E D C B A																															
Reset 0x00000000				0 0																															
Id	RW	Field	Value Id	Value	Description																														
G	RW	CH6			Include or exclude channel 6																														
			Excluded	0	Exclude																														
			Included	1	Include																														
H	RW	CH7			Include or exclude channel 7																														
			Excluded	0	Exclude																														
			Included	1	Include																														
I	RW	CH8			Include or exclude channel 8																														
			Excluded	0	Exclude																														
			Included	1	Include																														
J	RW	CH9			Include or exclude channel 9																														
			Excluded	0	Exclude																														
			Included	1	Include																														
K	RW	CH10			Include or exclude channel 10																														
			Excluded	0	Exclude																														
			Included	1	Include																														
L	RW	CH11			Include or exclude channel 11																														
			Excluded	0	Exclude																														
			Included	1	Include																														
M	RW	CH12			Include or exclude channel 12																														
			Excluded	0	Exclude																														
			Included	1	Include																														
N	RW	CH13			Include or exclude channel 13																														
			Excluded	0	Exclude																														
			Included	1	Include																														
O	RW	CH14			Include or exclude channel 14																														
			Excluded	0	Exclude																														
			Included	1	Include																														
P	RW	CH15			Include or exclude channel 15																														
			Excluded	0	Exclude																														
			Included	1	Include																														
Q	RW	CH16			Include or exclude channel 16																														
			Excluded	0	Exclude																														
			Included	1	Include																														
R	RW	CH17			Include or exclude channel 17																														
			Excluded	0	Exclude																														
			Included	1	Include																														
S	RW	CH18			Include or exclude channel 18																														
			Excluded	0	Exclude																														
			Included	1	Include																														
T	RW	CH19			Include or exclude channel 19																														
			Excluded	0	Exclude																														
			Included	1	Include																														
U	RW	CH20			Include or exclude channel 20																														
			Excluded	0	Exclude																														
			Included	1	Include																														
V	RW	CH21			Include or exclude channel 21																														
			Excluded	0	Exclude																														
			Included	1	Include																														
W	RW	CH22			Include or exclude channel 22																														
			Excluded	0	Exclude																														

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0																															
Id				f e d c b a Z Y X W V U T S R Q P O N M L K J I H G F E D C B A																															
Reset 0x00000000				0 0																															
Id	RW	Field	Value Id	Value	Description																														
X	RW	CH23	Included	1	Include																														
			Excluded	0	Exclude																														
			Included	1	Include																														
Y	RW	CH24	Included	1	Include or exclude channel 24																														
			Excluded	0	Exclude																														
			Included	1	Include																														
Z	RW	CH25	Included	1	Include or exclude channel 25																														
			Excluded	0	Exclude																														
			Included	1	Include																														
a	RW	CH26	Included	1	Include or exclude channel 26																														
			Excluded	0	Exclude																														
			Included	1	Include																														
b	RW	CH27	Included	1	Include or exclude channel 27																														
			Excluded	0	Exclude																														
			Included	1	Include																														
c	RW	CH28	Included	1	Include or exclude channel 28																														
			Excluded	0	Exclude																														
			Included	1	Include																														
d	RW	CH29	Included	1	Include or exclude channel 29																														
			Excluded	0	Exclude																														
			Included	1	Include																														
e	RW	CH30	Included	1	Include or exclude channel 30																														
			Excluded	0	Exclude																														
			Included	1	Include																														
f	RW	CH31	Included	1	Include or exclude channel 31																														
			Excluded	0	Exclude																														
			Included	1	Include																														

### 6.11.2.46 CHG[2]

Address offset: 0x808

Channel group 2

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0																															
Id				f e d c b a Z Y X W V U T S R Q P O N M L K J I H G F E D C B A																															
Reset 0x00000000				0 0																															
Id	RW	Field	Value Id	Value	Description																														
A	RW	CH0			Include or exclude channel 0																														
			Excluded	0	Exclude																														
			Included	1	Include																														
B	RW	CH1			Include or exclude channel 1																														
			Excluded	0	Exclude																														
			Included	1	Include																														
C	RW	CH2			Include or exclude channel 2																														
			Excluded	0	Exclude																														
			Included	1	Include																														
D	RW	CH3			Include or exclude channel 3																														
			Excluded	0	Exclude																														

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0																														
Id				f e d c b a z y x w v u t s r q p o n m l k j i h g f e d c b a																														
Reset 0x00000000				0 0																														
Id	RW	Field	Value Id	Value															Description															
				Included	1															Include														
E	RW	CH4																Include or exclude channel 4																
			Excluded	0															Exclude															
			Included	1															Include															
F	RW	CH5																Include or exclude channel 5																
			Excluded	0															Exclude															
			Included	1															Include															
G	RW	CH6																Include or exclude channel 6																
			Excluded	0															Exclude															
			Included	1															Include															
H	RW	CH7																Include or exclude channel 7																
			Excluded	0															Exclude															
			Included	1															Include															
I	RW	CH8																Include or exclude channel 8																
			Excluded	0															Exclude															
			Included	1															Include															
J	RW	CH9																Include or exclude channel 9																
			Excluded	0															Exclude															
			Included	1															Include															
K	RW	CH10																Include or exclude channel 10																
			Excluded	0															Exclude															
			Included	1															Include															
L	RW	CH11																Include or exclude channel 11																
			Excluded	0															Exclude															
			Included	1															Include															
M	RW	CH12																Include or exclude channel 12																
			Excluded	0															Exclude															
			Included	1															Include															
N	RW	CH13																Include or exclude channel 13																
			Excluded	0															Exclude															
			Included	1															Include															
O	RW	CH14																Include or exclude channel 14																
			Excluded	0															Exclude															
			Included	1															Include															
P	RW	CH15																Include or exclude channel 15																
			Excluded	0															Exclude															
			Included	1															Include															
Q	RW	CH16																Include or exclude channel 16																
			Excluded	0															Exclude															
			Included	1															Include															
R	RW	CH17																Include or exclude channel 17																
			Excluded	0															Exclude															
			Included	1															Include															
S	RW	CH18																Include or exclude channel 18																
			Excluded	0															Exclude															
			Included	1															Include															
T	RW	CH19																Include or exclude channel 19																
			Excluded	0															Exclude															
			Included	1															Include															
U	RW	CH20																Include or exclude channel 20																

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0																															
Id				f e d c b a Z Y X W V U T S R Q P O N M L K J I H G F E D C B A																															
Reset 0x00000000				0 0																															
Id	RW	Field	Value Id	Value	Description																														
V	RW	CH21	Excluded	0	Exclude																														
			Included	1	Include																														
			Include or exclude channel 21																																
			Excluded	0	Exclude																														
W	RW	CH22	Included	1	Include																														
			Include or exclude channel 22																																
			Excluded	0	Exclude																														
			Included	1	Include																														
X	RW	CH23	Include or exclude channel 23																																
			Excluded	0	Exclude																														
			Included	1	Include																														
			Y	RW	CH24	Include or exclude channel 24																													
Excluded	0	Exclude																																	
Included	1	Include																																	
Z	RW	CH25				Include or exclude channel 25																													
			Excluded	0	Exclude																														
			Included	1	Include																														
			a	RW	CH26	Include or exclude channel 26																													
Excluded	0	Exclude																																	
Included	1	Include																																	
b	RW	CH27				Include or exclude channel 27																													
			Excluded	0	Exclude																														
			Included	1	Include																														
			c	RW	CH28	Include or exclude channel 28																													
Excluded	0	Exclude																																	
Included	1	Include																																	
d	RW	CH29				Include or exclude channel 29																													
			Excluded	0	Exclude																														
			Included	1	Include																														
			e	RW	CH30	Include or exclude channel 30																													
Excluded	0	Exclude																																	
Included	1	Include																																	
f	RW	CH31				Include or exclude channel 31																													
			Excluded	0	Exclude																														
			Included	1	Include																														

### 6.11.2.47 CHG[3]

Address offset: 0x80C

Channel group 3

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0																															
Id				f e d c b a z Y X W V U T S R Q P O N M L K J I H G F E D C B A																															
Reset 0x00000000				0 0																															
Id	RW	Field	Value Id	Value			Description																												
A	RW	CH0					Include or exclude channel 0																												
			Excluded	0			Exclude																												
			Included	1			Include																												
B	RW	CH1					Include or exclude channel 1																												

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0																															
Id				f e d c b a Z Y X W V U T S R Q P O N M L K J I H G F E D C B A																															
Reset 0x00000000				0 0																															
Id	RW	Field	Value Id	Value	Description																														
			Excluded	0	Exclude																														
			Included	1	Include																														
C	RW	CH2			Include or exclude channel 2																														
		Excluded			0	Exclude																													
				Included	1	Include																													
D	RW			CH3			Include or exclude channel 3																												
		Excluded	0	Exclude																															
				Included	1	Include																													
E	RW			CH4			Include or exclude channel 4																												
		Excluded	0	Exclude																															
				Included	1	Include																													
F	RW			CH5			Include or exclude channel 5																												
		Excluded	0	Exclude																															
				Included	1	Include																													
G	RW			CH6			Include or exclude channel 6																												
		Excluded	0	Exclude																															
				Included	1	Include																													
H	RW			CH7			Include or exclude channel 7																												
		Excluded	0	Exclude																															
				Included	1	Include																													
I	RW			CH8			Include or exclude channel 8																												
		Excluded	0	Exclude																															
				Included	1	Include																													
J	RW			CH9			Include or exclude channel 9																												
		Excluded	0	Exclude																															
				Included	1	Include																													
K	RW			CH10			Include or exclude channel 10																												
		Excluded	0	Exclude																															
				Included	1	Include																													
L	RW			CH11			Include or exclude channel 11																												
		Excluded	0	Exclude																															
				Included	1	Include																													
M	RW			CH12			Include or exclude channel 12																												
		Excluded	0	Exclude																															
				Included	1	Include																													
N	RW			CH13			Include or exclude channel 13																												
		Excluded	0	Exclude																															
				Included	1	Include																													
O	RW			CH14			Include or exclude channel 14																												
		Excluded	0	Exclude																															
				Included	1	Include																													
P	RW			CH15			Include or exclude channel 15																												
		Excluded	0	Exclude																															
				Included	1	Include																													
Q	RW			CH16			Include or exclude channel 16																												
		Excluded	0	Exclude																															
				Included	1	Include																													
R	RW			CH17			Include or exclude channel 17																												
		Excluded	0	Exclude																															
				Included	1	Include																													

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0																															
Id				f e d c b a Z Y X W V U T S R Q P O N M L K J I H G F E D C B A																															
Reset 0x00000000				0 0																															
Id	RW	Field	Value Id	Value	Description																														
S	RW	CH18			Include or exclude channel 18																														
			Excluded	0	Exclude																														
			Included	1	Include																														
T	RW	CH19			Include or exclude channel 19																														
			Excluded	0	Exclude																														
			Included	1	Include																														
U	RW	CH20			Include or exclude channel 20																														
			Excluded	0	Exclude																														
			Included	1	Include																														
V	RW	CH21			Include or exclude channel 21																														
			Excluded	0	Exclude																														
			Included	1	Include																														
W	RW	CH22			Include or exclude channel 22																														
			Excluded	0	Exclude																														
			Included	1	Include																														
X	RW	CH23			Include or exclude channel 23																														
			Excluded	0	Exclude																														
			Included	1	Include																														
Y	RW	CH24			Include or exclude channel 24																														
			Excluded	0	Exclude																														
			Included	1	Include																														
Z	RW	CH25			Include or exclude channel 25																														
			Excluded	0	Exclude																														
			Included	1	Include																														
a	RW	CH26			Include or exclude channel 26																														
			Excluded	0	Exclude																														
			Included	1	Include																														
b	RW	CH27			Include or exclude channel 27																														
			Excluded	0	Exclude																														
			Included	1	Include																														
c	RW	CH28			Include or exclude channel 28																														
			Excluded	0	Exclude																														
			Included	1	Include																														
d	RW	CH29			Include or exclude channel 29																														
			Excluded	0	Exclude																														
			Included	1	Include																														
e	RW	CH30			Include or exclude channel 30																														
			Excluded	0	Exclude																														
			Included	1	Include																														
f	RW	CH31			Include or exclude channel 31																														
			Excluded	0	Exclude																														
			Included	1	Include																														

### 6.11.2.48 CHG[4]

Address offset: 0x810

Channel group 4



Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0																															
Id				f e d c b a Z Y X W V U T S R Q P O N M L K J I H G F E D C B A																															
Reset 0x00000000				0 0																															
Id	RW	Field	Value Id	Value	Description																														
A	RW	CH0			Include or exclude channel 0																														
			Excluded	0	Exclude																														
			Included	1	Include																														
B	RW	CH1			Include or exclude channel 1																														
			Excluded	0	Exclude																														
			Included	1	Include																														
C	RW	CH2			Include or exclude channel 2																														
			Excluded	0	Exclude																														
			Included	1	Include																														
D	RW	CH3			Include or exclude channel 3																														
			Excluded	0	Exclude																														
			Included	1	Include																														
E	RW	CH4			Include or exclude channel 4																														
			Excluded	0	Exclude																														
			Included	1	Include																														
F	RW	CH5			Include or exclude channel 5																														
			Excluded	0	Exclude																														
			Included	1	Include																														
G	RW	CH6			Include or exclude channel 6																														
			Excluded	0	Exclude																														
			Included	1	Include																														
H	RW	CH7			Include or exclude channel 7																														
			Excluded	0	Exclude																														
			Included	1	Include																														
I	RW	CH8			Include or exclude channel 8																														
			Excluded	0	Exclude																														
			Included	1	Include																														
J	RW	CH9			Include or exclude channel 9																														
			Excluded	0	Exclude																														
			Included	1	Include																														
K	RW	CH10			Include or exclude channel 10																														
			Excluded	0	Exclude																														
			Included	1	Include																														
L	RW	CH11			Include or exclude channel 11																														
			Excluded	0	Exclude																														
			Included	1	Include																														
M	RW	CH12			Include or exclude channel 12																														
			Excluded	0	Exclude																														
			Included	1	Include																														
N	RW	CH13			Include or exclude channel 13																														
			Excluded	0	Exclude																														
			Included	1	Include																														
O	RW	CH14			Include or exclude channel 14																														
			Excluded	0	Exclude																														
			Included	1	Include																														
P	RW	CH15			Include or exclude channel 15																														
			Excluded	0	Exclude																														
			Included	1	Include																														
Q	RW	CH16			Include or exclude channel 16																														
			Excluded	0	Exclude																														

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0																															
Id				f e d c b a Z Y X W V U T S R Q P O N M L K J I H G F E D C B A																															
Reset 0x00000000				0 0																															
Id	RW	Field	Value Id	Value	Description																														
			Included	1	Include																														
R	RW	CH17			Include or exclude channel 17																														
			Excluded	0	Exclude																														
			Included	1	Include																														
S	RW	CH18			Include or exclude channel 18																														
			Excluded	0	Exclude																														
			Included	1	Include																														
T	RW	CH19			Include or exclude channel 19																														
			Excluded	0	Exclude																														
			Included	1	Include																														
U	RW	CH20			Include or exclude channel 20																														
			Excluded	0	Exclude																														
			Included	1	Include																														
V	RW	CH21			Include or exclude channel 21																														
			Excluded	0	Exclude																														
			Included	1	Include																														
W	RW	CH22			Include or exclude channel 22																														
			Excluded	0	Exclude																														
			Included	1	Include																														
X	RW	CH23			Include or exclude channel 23																														
			Excluded	0	Exclude																														
			Included	1	Include																														
Y	RW	CH24			Include or exclude channel 24																														
			Excluded	0	Exclude																														
			Included	1	Include																														
Z	RW	CH25			Include or exclude channel 25																														
			Excluded	0	Exclude																														
			Included	1	Include																														
a	RW	CH26			Include or exclude channel 26																														
			Excluded	0	Exclude																														
			Included	1	Include																														
b	RW	CH27			Include or exclude channel 27																														
			Excluded	0	Exclude																														
			Included	1	Include																														
c	RW	CH28			Include or exclude channel 28																														
			Excluded	0	Exclude																														
			Included	1	Include																														
d	RW	CH29			Include or exclude channel 29																														
			Excluded	0	Exclude																														
			Included	1	Include																														
e	RW	CH30			Include or exclude channel 30																														
			Excluded	0	Exclude																														
			Included	1	Include																														
f	RW	CH31			Include or exclude channel 31																														
			Excluded	0	Exclude																														
			Included	1	Include																														

### 6.11.2.49 CHG[5]

Address offset: 0x814

## Channel group 5

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0																															
Id				f e d c b a Z Y X W V U T S R Q P O N M L K J I H G F E D C B A																															
Reset 0x00000000				0 0																															
Id	RW	Field	Value Id	Value	Description																														
A	RW	CH0			Include or exclude channel 0																														
			Excluded	0	Exclude																														
			Included	1	Include																														
B	RW	CH1			Include or exclude channel 1																														
			Excluded	0	Exclude																														
			Included	1	Include																														
C	RW	CH2			Include or exclude channel 2																														
			Excluded	0	Exclude																														
			Included	1	Include																														
D	RW	CH3			Include or exclude channel 3																														
			Excluded	0	Exclude																														
			Included	1	Include																														
E	RW	CH4			Include or exclude channel 4																														
			Excluded	0	Exclude																														
			Included	1	Include																														
F	RW	CH5			Include or exclude channel 5																														
			Excluded	0	Exclude																														
			Included	1	Include																														
G	RW	CH6			Include or exclude channel 6																														
			Excluded	0	Exclude																														
			Included	1	Include																														
H	RW	CH7			Include or exclude channel 7																														
			Excluded	0	Exclude																														
			Included	1	Include																														
I	RW	CH8			Include or exclude channel 8																														
			Excluded	0	Exclude																														
			Included	1	Include																														
J	RW	CH9			Include or exclude channel 9																														
			Excluded	0	Exclude																														
			Included	1	Include																														
K	RW	CH10			Include or exclude channel 10																														
			Excluded	0	Exclude																														
			Included	1	Include																														
L	RW	CH11			Include or exclude channel 11																														
			Excluded	0	Exclude																														
			Included	1	Include																														
M	RW	CH12			Include or exclude channel 12																														
			Excluded	0	Exclude																														
			Included	1	Include																														
N	RW	CH13			Include or exclude channel 13																														
			Excluded	0	Exclude																														
			Included	1	Include																														
O	RW	CH14			Include or exclude channel 14																														
			Excluded	0	Exclude																														
			Included	1	Include																														
P	RW	CH15			Include or exclude channel 15																														
			Excluded	0	Exclude																														
			Included	1	Include																														

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0																																
Id				f e d c b a Z Y X W V U T S R Q P O N M L K J I H G F E D C B A																																
Reset 0x00000000				0 0																																
Id	RW	Field	Value Id	Value				Description																												
Q	RW	CH16						Include or exclude channel 16																												
				Excluded	0				Exclude																											
				Included	1				Include																											
R	RW	CH17						Include or exclude channel 17																												
				Excluded	0				Exclude																											
				Included	1				Include																											
S	RW	CH18						Include or exclude channel 18																												
				Excluded	0				Exclude																											
				Included	1				Include																											
T	RW	CH19						Include or exclude channel 19																												
				Excluded	0				Exclude																											
				Included	1				Include																											
U	RW	CH20						Include or exclude channel 20																												
				Excluded	0				Exclude																											
				Included	1				Include																											
V	RW	CH21						Include or exclude channel 21																												
				Excluded	0				Exclude																											
				Included	1				Include																											
W	RW	CH22						Include or exclude channel 22																												
				Excluded	0				Exclude																											
				Included	1				Include																											
X	RW	CH23						Include or exclude channel 23																												
				Excluded	0				Exclude																											
				Included	1				Include																											
Y	RW	CH24						Include or exclude channel 24																												
				Excluded	0				Exclude																											
				Included	1				Include																											
Z	RW	CH25						Include or exclude channel 25																												
				Excluded	0				Exclude																											
				Included	1				Include																											
a	RW	CH26						Include or exclude channel 26																												
				Excluded	0				Exclude																											
				Included	1				Include																											
b	RW	CH27						Include or exclude channel 27																												
				Excluded	0				Exclude																											
				Included	1				Include																											
c	RW	CH28						Include or exclude channel 28																												
				Excluded	0				Exclude																											
				Included	1				Include																											
d	RW	CH29						Include or exclude channel 29																												
				Excluded	0				Exclude																											
				Included	1				Include																											
e	RW	CH30						Include or exclude channel 30																												
				Excluded	0				Exclude																											
				Included	1				Include																											
f	RW	CH31						Include or exclude channel 31																												
				Excluded	0				Exclude																											
				Included	1				Include																											

### 6.11.2.50 FORK[0].TEP

Address offset: 0x910

Channel 0 task end-point

Bit number	31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0																													
Id	A A																													
Reset 0x00000000	0 0																													
Id	RW	Field	Value Id		Value		Description																							
A	RW	TEP					Pointer to task register																							

### 6.11.2.51 FORK[1].TEP

Address offset: 0x914

Channel 1 task end-point

Bit number					31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0																															
Id					A A																															
Reset 0x00000000					0 0																															
Id		RW		Field		Value Id		Value		Description																										
A		RW		TEP						Pointer to task register																										

### 6.11.2.52 FORK[2].TEP

Address offset: 0x918

Channel 2 task end-point

Bit number					31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0																															
Id					A A																															
Reset 0x00000000					0 0																															
Id	RW	Field	Value Id		Value		Description																													
A	RW	TEP					Pointer to task register																													

### 6.11.2.53 FORK[3].TEP

Address offset: 0x91C

Channel 3 task end-point

Bit number					31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0																															
Id					A A																															
Reset 0x00000000					0 0																															
Id	RW	Field	Value Id		Value		Description																													
A	RW	TEP					Pointer to task register																													

### 6.11.2.54 FORK[4].TEP

Address offset: 0x920

Channel 4 task end-point

### Channel 5 task end-point

### Channel 6 task end-point

### Channel 7 task end-point

### Channel 8 task end-point



**NORDIC**  
SEMICONDUCTOR

### 6.11.2.59 FORK[9].TEP

Address offset: 0x934

Channel 9 task end-point

Bit number	31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0																													
Id	A A																													
Reset 0x00000000	0 0																													
Id	RW	Field	Value Id		Value		Description																							
A	RW	TEP					Pointer to task register																							

### 6.11.2.60 FORK[10].TEP

Address offset: 0x938

Channel 10 task end-point

Bit number					31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0																															
Id					A A																															
Reset 0x00000000					0 0																															
Id	RW	Field	Value Id		Value		Description																													
A	RW	TEP					Pointer to task register																													

### 6.11.2.61 FORK[11].TEP

Address offset: 0x93C

Channel 11 task end-point

Bit number					31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0																															
Id					A A																															
Reset 0x00000000					0 0																															
Id	RW	Field	Value Id		Value		Description																													
A	RW	TEP					Pointer to task register																													

### 6.11.2.62 FORK[12].TEP

Address offset: 0x940

Channel 12 task end-point

Bit number					31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0																															
Id					A A																															
Reset 0x00000000					0 0																															
Id	RW	Field	Value Id		Value		Description																													
A	RW	TEP					Pointer to task register																													

### 6.11.2.63 FORK[13].TEP

Address offset: 0x944

Channel 13 task end-point

### Channel 14 task end-point

Bit number				31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
Id				A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A
Reset 0x00000000				0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Id	RW	Field	Value Id	Value				Description																											
A	RW	TEP						Pointer to task register																											

### Channel 15 task end-point

Bit number					31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
Id					A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A
Reset 0x00000000					0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Id	RW	Field	Value	Id	Value				Description																											
A	RW	TEP							Pointer to task register																											

## Channel 16 task end-point

Bit number				31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
Id				A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A
Reset 0x00000000				0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Id	RW	Field	Value	Id	Value				Description																										
A	RW	TEP							Pointer to task register																										

### Channel 17 task end-point

Bit number					31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
Id					A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A
Reset 0x00000000					0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Id	RW	Field	Value	Id	Value				Description																											
A	RW	TEP							Pointer to task register																											



### 6.11.2.68 FORK[18].TEP

Address offset: 0x958

Channel 18 task end-point

Bit number	31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0																													
Id	A A																													
Reset 0x00000000	0 0																													
Id	RW	Field	Value Id		Value		Description																							
A	RW	TEP					Pointer to task register																							

### 6.11.2.69 FORK[19].TEP

Address offset: 0x95C

Channel 19 task end-point

Bit number					31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0																															
Id					A A																															
Reset 0x00000000					0 0																															
Id	RW	Field	Value Id		Value		Description																													
A	RW	TEP					Pointer to task register																													

### 6.11.2.70 FORK[20].TEP

Address offset: 0x960

Channel 20 task end-point

Bit number					31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0																															
Id					A A																															
Reset 0x00000000					0 0																															
Id	RW	Field	Value Id		Value		Description																													
A	RW	TEP					Pointer to task register																													

### 6.11.2.71 FORK[21].TEP

Address offset: 0x964

Channel 21 task end-point

Bit number					31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0																															
Id					A A																															
Reset 0x00000000					0 0																															
Id	RW	Field	Value Id		Value		Description																													
A	RW	TEP					Pointer to task register																													

### 6.11.2.72 FORK[22].TEP

Address offset: 0x968

Channel 22 task end-point

Bit number	31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0																													
Id	A A																													
Reset 0x00000000	0 0																													
Id	RW	Field	Value Id		Value		Description																							
A	RW	TEP					Pointer to task register																							

### 6.11.2.73 FORK[23].TEP

Address offset: 0x96C

Channel 23 task end-point

Bit number					31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0																															
Id					A A																															
Reset 0x00000000					0 0																															
Id		RW	Field		Value Id	Value	Description																													
A		RW	TEP				Pointer to task register																													

### 6.11.2.74 FORK[24].TEP

Address offset: 0x970

Channel 24 task end-point

Bit number					31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0																															
Id					A A																															
Reset 0x00000000					0 0																															
Id		RW	Field		Value Id	Value	Description																													
A		RW	TEP				Pointer to task register																													

### 6.11.2.75 FORK[25].TEP

Address offset: 0x974

Channel 25 task end-point

Bit number					31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0																															
Id					A A																															
Reset 0x00000000					0 0																															
Id		RW	Field		Value Id		Value		Description																											
A		RW	TEP						Pointer to task register																											

### 6.11.2.76 FORK[26].TEP

Address offset: 0x978

Channel 26 task end-point

Bit number					31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0																															
Id					A A																															
Reset 0x00000000					0 0																															
Id	RW	Field	Value Id		Value				Description																											
A	RW	TEP							Pointer to task register																											

Address offset: 0x97C

A	RW	TEP	Pointer to task register
---	----	-----	--------------------------

Address offset: 0x980

A	RW	TEP	Pointer to task register
---	----	-----	--------------------------

Address offset: 0x984

A	RW	TEP	Pointer to task register
---	----	-----	--------------------------

Address offset: 0x988

A	RW	TEP	Pointer to task register
---	----	-----	--------------------------

Address offset: 0x98C

Bit number				31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
Id				A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A
Reset 0x00000000				0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Id	RW	Field	Value Id	Value				Description																											
A	RW	TEP						Pointer to task register																											

## 6.12 PWM — Pulse width modulation

The PWM module enables the generation of pulse width modulated signals on GPIO. The module implements an up or up-and-down counter with four PWM channels that drive assigned GPIOs.

Three PWM modules can provide up to 12 PWM channels with individual frequency control in groups of up to four channels. Furthermore, a built-in decoder and EasyDMA capabilities make it possible to manipulate the PWM duty cycles without CPU intervention. Arbitrary duty-cycle sequences are read from Data RAM and can be chained to implement ping-pong buffering or repeated into complex loops.

Listed here are the main features of one PWM module:

- Fixed PWM base frequency with programmable clock divider
- Up to four PWM channels with individual polarity and duty-cycle values
- Edge or center-aligned pulses across PWM channels
- Multiple duty-cycle arrays (sequences) defined in Data RAM
- Autonomous and glitch-free update of duty cycle values directly from memory through EasyDMA
- Change of polarity, duty-cycle, and base frequency possibly on every PWM period
- Data RAM sequences can be repeated or connected into loops

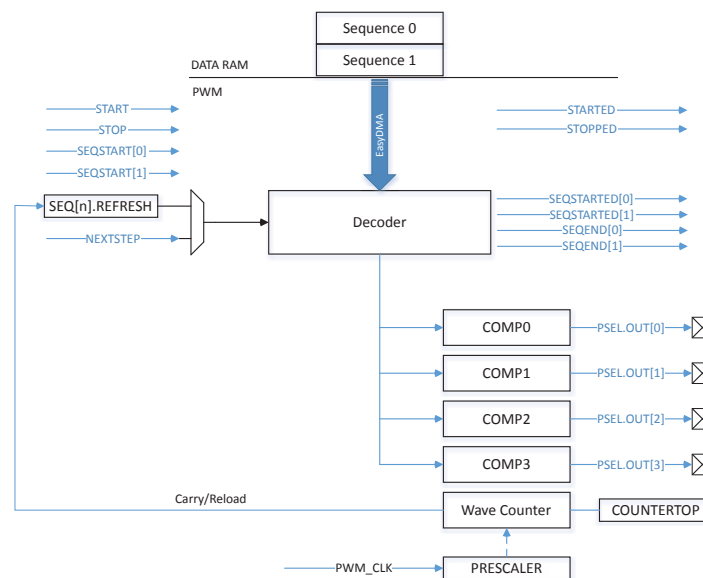


Figure 47: PWM module

### 6.12.1 Wave counter

The wave counter is responsible for generating the pulses at a duty-cycle that depends on the compare values, and at a frequency that depends on COUNTERTOP.

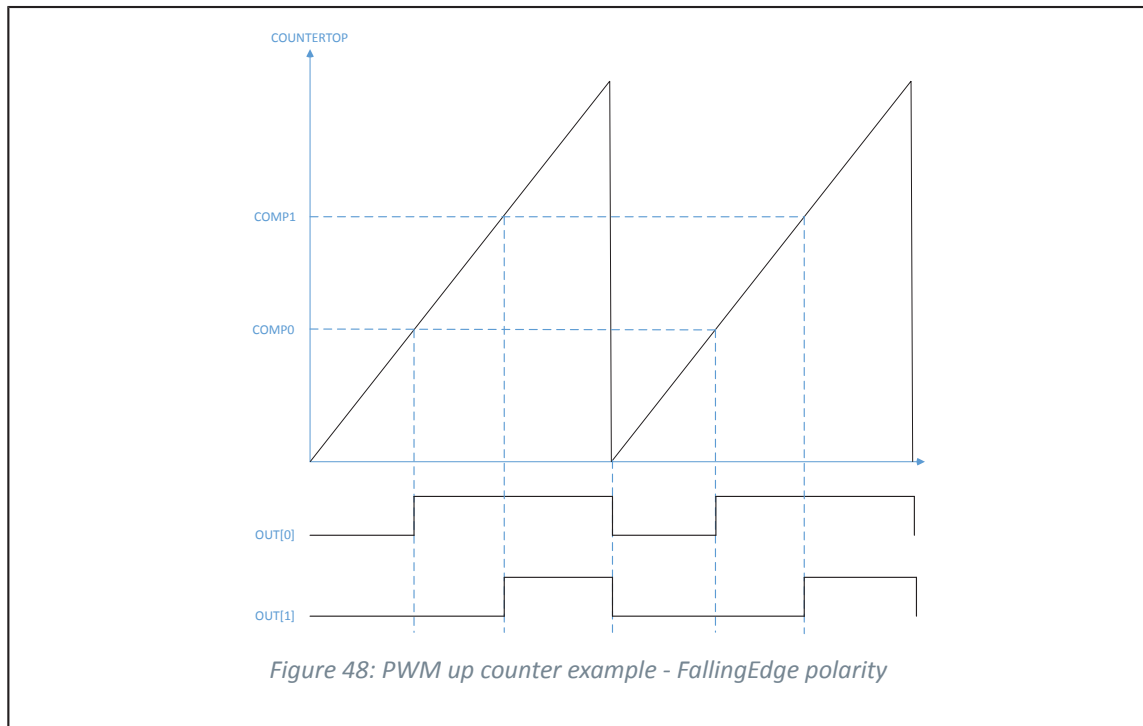
There is one common 15-bit counter with four compare channels. Thus, all four channels will share the same period (PWM frequency), but can have individual duty-cycle and polarity. The polarity is set by the value read from RAM (see [Decoder memory access modes](#) on page 257), while the MODE register controls if the counter counts up, or up and down. The timer top value is controlled by the COUNTERTOP

register. This register value in conjunction with the selected PRESCALER of the PWM\_CLK will result in a given PWM period. A COUNTERTOP value smaller than the compare setting will result in a state where no PWM edges are generated. Respectively, OUT[n] is held high, given that the polarity is set to FallingEdge. All the compare registers are internal and can only be configured through the decoder presented later.

COUNTERTOP can be safely written at any time. It will get sampled following a START task. If DECODER.LOAD is anything else than WaveForm, it will also get sampled following a STARTSEQ[n] task, and when loading a new value from RAM during a sequence playback. If DECODER.LOAD=WaveForm, the register value is ignored, and taken from RAM instead (see [Decoder with EasyDMA](#) on page 256 below).

[PWM up counter example - FallingEdge polarity](#) on page 254 shows the counter operating in up (MODE=PWM\_MODE\_Up) mode with three PWM channels with the same frequency but different duty cycle. The counter is automatically reset to zero when COUNTERTOP is reached and OUT[n] will invert. OUT[n] is held low if the compare value is 0 and held high respectively if set to COUNTERTOP given that the polarity is set to FallingEdge. Running in up counter mode will result in pulse widths that are edge-aligned. See the code example below:

```
uint16_t pwm_seq[4] = {PWM_CH0_DUTY, PWM_CH1_DUTY, PWM_CH2_DUTY, PWM_CH3_DUTY};
NRF_PWM0->PSEL.OUT[0] = (first_pin << PWM_PSEL_OUT_PIN_Pos) |
                        (PWM_PSEL_OUT_CONNECT_Connected <<
                         PWM_PSEL_OUT_CONNECT_Pos);
NRF_PWM0->PSEL.OUT[1] = (second_pin << PWM_PSEL_OUT_PIN_Pos) |
                        (PWM_PSEL_OUT_CONNECT_Connected <<
                         PWM_PSEL_OUT_CONNECT_Pos);
NRF_PWM0->ENABLE      = (PWM_ENABLE_ENABLE_Enabled << PWM_ENABLE_ENABLE_Pos);
NRF_PWM0->MODE        = (PWM_MODE_UPDOWN_Up << PWM_MODE_UPDOWN_Pos);
NRF_PWM0->PRESCALER   = (PWM_PRESCALER_PRESCALER_DIV_1 <<
                         PWM_PRESCALER_PRESCALER_Pos);
NRF_PWM0->COUNTERTOP = (16000 << PWM_COUNTERTOP_COUNTERTOP_Pos); //1 msec
NRF_PWM0->LOOP        = (PWM_LOOP_CNT_Disabled << PWM_LOOP_CNT_Pos);
NRF_PWM0->DECODER     = (PWM_DECODER_LOAD_Individual << PWM_DECODER_LOAD_Pos) |
                        (PWM_DECODER_MODE_RefreshCount << PWM_DECODER_MODE_Pos);
NRF_PWM0->SEQ[0].PTR  = ((uint32_t) (pwm_seq) << PWM_SEQ_PTR_PTR_Pos);
NRF_PWM0->SEQ[0].CNT  = ((sizeof(pwm_seq) / sizeof(uint16_t)) <<
                         PWM_SEQ_CNT_CNT_Pos);
NRF_PWM0->SEQ[0].REFRESH = 0;
NRF_PWM0->SEQ[0].ENDDELAY = 0;
NRF_PWM0->TASKS_SEQSTART[0] = 1;
```



In up counting mode, the following formula can be used to compute PWM period and step size:

PWM period:  $T_{PWM(Up)} = T_{PWM\_CLK} * COUNTERTOP$

Step width/Resolution:  $T_{steps} = T_{PWM\_CLK}$

[PWM up-and-down counter example](#) on page 255 shows the counter operating in up and down mode with (MODE=PWM\_MODE\_UpAndDown) two PWM channels with the same frequency but different duty cycle and output polarity. The counter starts decrementing to zero when COUNTERTOP is reached and will

invert the OUT[n] when compare value is hit for the second time. This results in a set of pulses that are center- aligned.

```
uint16_t pwm_seq[4] = {PWM_CH0_DUTY, PWM_CH1_DUTY, PWM_CH2_DUTY, PWM_CH3_DUTY};
NRF_PWM0->PSEL.OUT[0] = (first_pin << PWM_PSEL_OUT_PIN_Pos) |
    (PWM_PSEL_OUT_CONNECT_Connected <<
        PWM_PSEL_OUT_CONNECT_Pos);
NRF_PWM0->PSEL.OUT[1] = (second_pin << PWM_PSEL_OUT_PIN_Pos) |
    (PWM_PSEL_OUT_CONNECT_Connected <<
        PWM_PSEL_OUT_CONNECT_Pos);
NRF_PWM0->ENABLE = (PWM_ENABLE_ENABLE_Enabled << PWM_ENABLE_ENABLE_Pos);
NRF_PWM0->MODE = (PWM_MODE_UPDOWN_UpAndDown << PWM_MODE_UPDOWN_Pos);
NRF_PWM0->PRESCALER = (PWM_PRESCALER_PRESCALER_DIV_1 <<
    PWM_PRESCALER_PRESCALER_Pos);
NRF_PWM0->COUNTERTOP = (16000 << PWM_COUNTERTOP_COUNTERTOP_Pos); //1 msec
NRF_PWM0->LOOP = (PWM_LOOP_CNT_Disabled << PWM_LOOP_CNT_Pos);
NRF_PWM0->DECODER = (PWM_DECODER_LOAD_Individual << PWM_DECODER_LOAD_Pos) |
    (PWM_DECODER_MODE_RefreshCount << PWM_DECODER_MODE_Pos);
NRF_PWM0->SEQ[0].PTR = ((uint32_t)(pwm_seq) << PWM_SEQ_PTR_PTR_Pos);
NRF_PWM0->SEQ[0].CNT = ((sizeof(pwm_seq) / sizeof(uint16_t)) <<
    PWM_SEQ_CNT_CNT_Pos);
NRF_PWM0->SEQ[0].REFRESH = 0;
NRF_PWM0->SEQ[0].ENDDelay = 0;
NRF_PWM0->TASKS_SEQSTART[0] = 1;
```

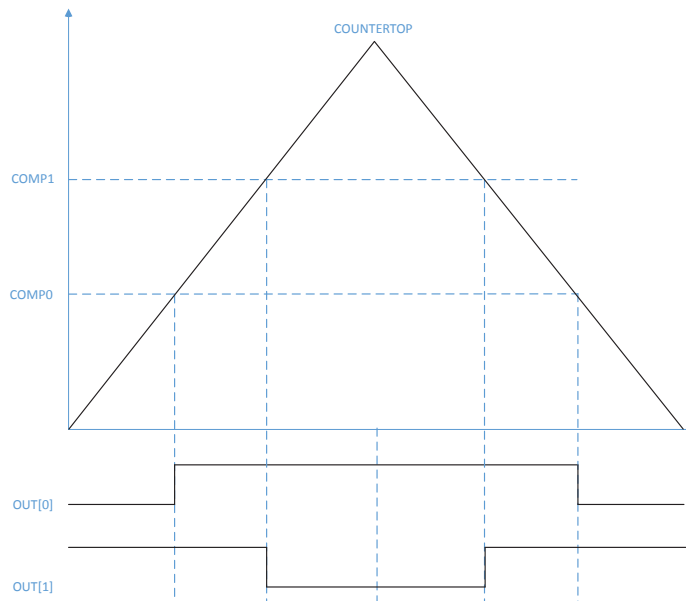


Figure 49: PWM up-and-down counter example

In up-and-down counting modes, the following formula can be used to compute PWM period and step size:  $T_{\text{PWM(Up And Down)}} = T_{\text{PWM\_CLK}} * 2 * \text{COUNTERTOP}$

Step width/Resolution:  $T_{\text{steps}} = T_{\text{PWM\_CLK}} * 2$

## 6.12.2 Decoder with EasyDMA

The decoder uses EasyDMA to take PWM parameters stored in Data RAM by ways of EasyDMA and updates the internal compare registers of the wave counter based on the mode of operation.

The mentioned PWM parameters are organized into a sequence containing at least one half word (16 bit). Its most significant bit[15] denotes the polarity of the OUT[n] while bit[14:0] is the 15-bit compare value. See below for further details of these RAM defined registers.

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0																															
Id																				B A A A A A A A A A A A A A A A															
Reset 0x00000000				0 0																															
Id	RW	Field	Value Id	Value	Description																														
A	RW	COMPARE			Duty cycle setting - value loaded to internal compare register																														
B	RW	POLARITY			Edge polarity of GPIO.																														
			RisingEdge	0	First edge within the PWM period is rising																														
			FallingEdge	1	First edge within the PWM period is falling																														

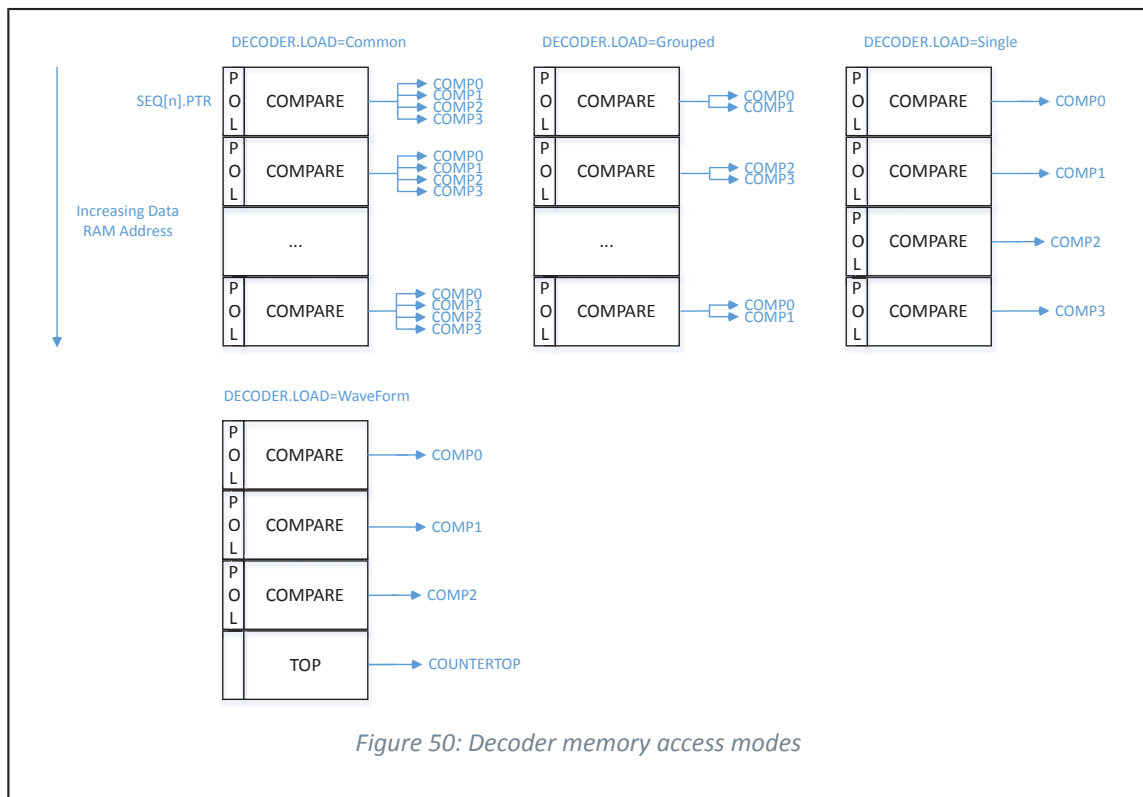
The DECODER register controls how the RAM content is interpreted and loaded to the internal compare registers. The LOAD field can be used to control if the RAM values are loaded to all compare channels - or alternatively to update a group or all channels with individual values. [Decoder memory access modes](#) on page 257 illustrates how the parameters stored in RAM are organized and routed to the various compare channels in the different modes.

A special mode of operation is available when DECODER.LOAD is set to WaveForm. In this mode, up to three PWM channels can be enabled - OUT[0] to OUT[2]. In RAM, four values are loaded at a time: the first, second and third location are used to load the values, and the fourth RAM location is used to load the COUNTERTOP register. This way one can have up to three PWM channels with a frequency base that changes on a per PWM period basis. This mode of operation is useful for arbitrary wave form generation in applications such as LED lighting.

The register SEQ[n].REFRESH=N (one per sequence n=0 or 1) will instruct a new RAM stored pulse width value on every (N+1)<sup>th</sup> PWM period. Setting the register to zero will result in a new duty cycle update every PWM period as long as the minimum PWM period is observed.

Note that registers SEQ[n].REFRESH and SEQ[n].ENDDELAY are ignored when DECODER.MODE=NextStep . The next value is loaded upon receiving every NEXTSTEP task.





SEQ[n].PTR is the pointer used to fetch COMPARE values from RAM. If the SEQ[n].PTR is not pointing to the Data RAM region, an EasyDMA transfer may result in a HardFault or RAM corruption. See [Memory](#) on page 15 for more information about the different memory regions.

After the SEQ[n].PTR is set to the desired RAM location, the SEQ[n].CNT register must be set to the number of 16-bit half words in the sequence. It is important to observe that the Grouped and Single modes require one half word per group or one half word per channel respectively, and thus increases RAM size occupation. If PWM generation was not running yet at that point, sending the SEQSTART[n] task will load the first value from RAM, then start the PWM generation. A SEQSTARTED[n] event is generated as soon as the EasyDMA has read the first PWM parameter from RAM and the wave counter has started executing it. When LOOP.CNT=0, sequence n=0 or 1 is played back once. After the last value in the sequence has been loaded and started executing, a SEQEND[n] event is generated. The PWM generation will then continue with the last loaded value. See [Simple sequence example](#) on page 259 for an example of such simple playback.

To completely stop the PWM generation and force the associated pins to a defined state, a STOP task can be fired at any time. A STOPPED event is generated when the PWM generation has stopped at the end of currently running PWM period, and the pins go into their idle state as defined in GPIO->OUT. PWM generation can then only be restarted through a SEQSTART[n] task. SEQSTART[n] will resume PWM generation after having loaded the first value from the RAM buffer defined in the SEQ[n].PTR register.

The table below provides indication of when specific registers get sampled by the hardware. Care should be taken when updating these registers to avoid values to be applied earlier than expected.

Register	Taken into account by hardware	Recommended (safe) update
SEQ[n].PTR	When sending the SEQSTART[n] task	After having received the SEQSTARTED[n] event
SEQ[n].CNT	When sending the SEQSTART[n] task	After having received the SEQSTARTED[n] event
SEQ[0].ENDDELAY	When sending the SEQSTART[0] task	Before starting sequence [0] through a SEQSTART[0] task
	Every time a new value from sequence [0] has been loaded from RAM and gets applied to the Wave Counter (indicated by the PWMPERIODEND event)	When no more value from sequence [0] gets loaded from RAM (indicated by the SEQEND[0] event)  At any time during sequence [1] (which starts when the SEQSTARTED[1] event is fired)
SEQ[1].ENDDELAY	When sending the SEQSTART[1] task	Before starting sequence [1] through a SEQSTART[1] task
	Every time a new value from sequence [1] has been loaded from RAM and gets applied to the Wave Counter (indicated by the PWMPERIODEND event)	When no more value from sequence [1] gets loaded from RAM (indicated by the SEQEND[1] event)  At any time during sequence [0] (which starts when the SEQSTARTED[0] event is fired)
SEQ[0].REFRESH	When sending the SEQSTART[0] task	Before starting sequence [0] through a SEQSTART[0] task
	Every time a new value from sequence [0] has been loaded from RAM and gets applied to the Wave Counter (indicated by the PWMPERIODEND event)	At any time during sequence [1] (which starts when the SEQSTARTED[1] event is fired)
SEQ[1].REFRESH	When sending the SEQSTART[1] task	Before starting sequence [1] through a SEQSTART[1] task
	Every time a new value from sequence [1] has been loaded from RAM and gets applied to the Wave Counter (indicated by the PWMPERIODEND event)	At any time during sequence [0] (which starts when the SEQSTARTED[0] event is fired)
COUNTERTOP	In DECODER.LOAD=WaveForm: this register is ignored.	Before starting PWM generation through a SEQSTART[n] task
	In all other LOAD modes: at the end of current PWM period (indicated by the PWMPERIODEND event)	After a STOP task has been issued, and the STOPPED event has been received.
MODE	Immediately	Before starting PWM generation through a SEQSTART[n] task
		After a STOP task has been issued, and the STOPPED event has been received.
DECODER	Immediately	Before starting PWM generation through a SEQSTART[n] task
		After a STOP task has been issued, and the STOPPED event has been received.
PRESCALER	Immediately	Before starting PWM generation through a SEQSTART[n] task
		After a STOP task has been issued, and the STOPPED event has been received.
LOOP	Immediately	Before starting PWM generation through a SEQSTART[n] task
		After a STOP task has been issued, and the STOPPED event has been received.
PSEL.OUT[n]	Immediately	Before enabling the PWM instance through the ENABLE register

Table 50: When to safely update PWM registers

**Important:** SEQ[n].REFRESH and SEQ[n].ENDDELAY are ignored at the end of a complex sequence, indicated by a LOOPSDONE event. The reason for this is that the last value loaded from RAM is maintained until further action from software (restarting a new sequence, or stopping PWM generation).

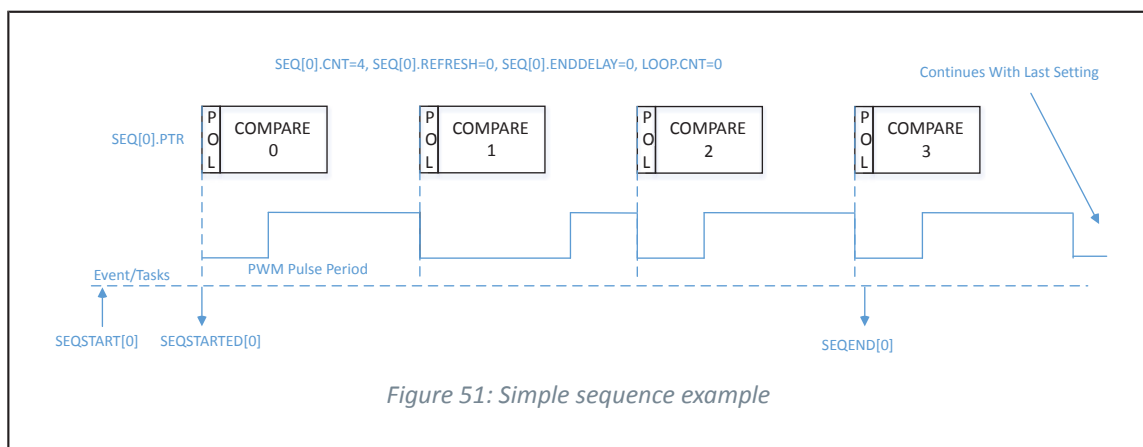
[Simple sequence example](#) on page 259 depicts the source code used for configuration and timing details in a sequence where only sequence 0 is used and only run once with a new PWM duty cycle for each period.

```

NRF_PWM0->PSEL.OUT[0] = (first_pin << PWM_PSEL_OUT_PIN_Pos) |
                          (PWM_PSEL_OUT_CONNECT_Connected <<
                           PWM_PSEL_OUT_CONNECT_Pos);
NRF_PWM0->ENABLE        = (PWM_ENABLE_ENABLE_Enabled << PWM_ENABLE_ENABLE_Pos);
NRF_PWM0->MODE          = (PWM_MODE_UPDOWN_Up << PWM_MODE_UPDOWN_Pos);
NRF_PWM0->PRESCALER     = (PWM_PRESCALER_PRESCALER_DIV_1 <<
                           PWM_PRESCALER_PRESCALER_Pos);
NRF_PWM0->COUNTERTOP    = (16000 << PWM_COUNTERTOP_COUNTERTOP_Pos); //1 msec
NRF_PWM0->LOOP          = (PWM_LOOP_CNT_Disabled << PWM_LOOP_CNT_Pos);
NRF_PWM0->DECODER       = (PWM_DECODER_LOAD_Common << PWM_DECODER_LOAD_Pos) |
                          (PWM_DECODER_MODE_RefreshCount << PWM_DECODER_MODE_Pos);
NRF_PWM0->SEQ[0].PTR    = ((uint32_t)(seq0_ram) << PWM_SEQ_PTR_PTR_Pos);
NRF_PWM0->SEQ[0].CNT    = ((sizeof(seq0_ram) / sizeof(uint16_t)) <<
                           PWM_SEQ_CNT_CNT_Pos);

NRF_PWM0->SEQ[0].REFRESH = 0;
NRF_PWM0->SEQ[0].ENDDELAY = 0;
NRF_PWM0->TASKS_SEQSTART[0] = 1;

```



A more complex example is shown in [Example using two sequences](#) on page 260, where `LOOP.CNT > 0`. In this case, an automated playback takes place, consisting of `SEQ[0]`, delay 0, `SEQ[1]`, delay 1, then again `SEQ[0]`, etc. The user can choose to start a complex playback with `SEQ[0]` or `SEQ[1]` through sending the `SEQSTART[0]` or `SEQSTART[1]` task.

The complex playback always ends with delay 1.

The two sequences 0 and 1 are defined with address of values tables in Data RAM (pointed by `SEQ[n].PTR`) and respective buffer size (`SEQ[n].CNT`). The rate at which a new value is loaded is defined individually for each sequence by `SEQ[n].REFRESH`. The chaining of sequence 1 following sequence 0 is implicit, the `LOOP.CNT` register allows the chaining of sequence 1 to sequence 0 for a determined number of times. In other words, it allows to repeat a complex sequence a number of times in a fully automated way.

In the example below, sequence 0 is defined with `SEQ[0].REFRESH` set to one - that means that a new PWM duty cycle is pushed every second PWM period. This complex sequence is started with the `SEQSTART[0]` task, so `SEQ[0]` is played first. Since `SEQ[0].ENDDELAY=1` there will be one PWM period delay

between last period on sequence 0 and the first period on sequence 1. Since SEQ[1].ENDDELAY=0 there is no delay 1, so SEQ[0] would be started immediately after the end of SEQ[1]. However, as LOOP.CNT is one, the playback stops after having played only once SEQ[1], and both SEQEND[1] and LOOPSDONE are generated (their order is not guaranteed in this case).

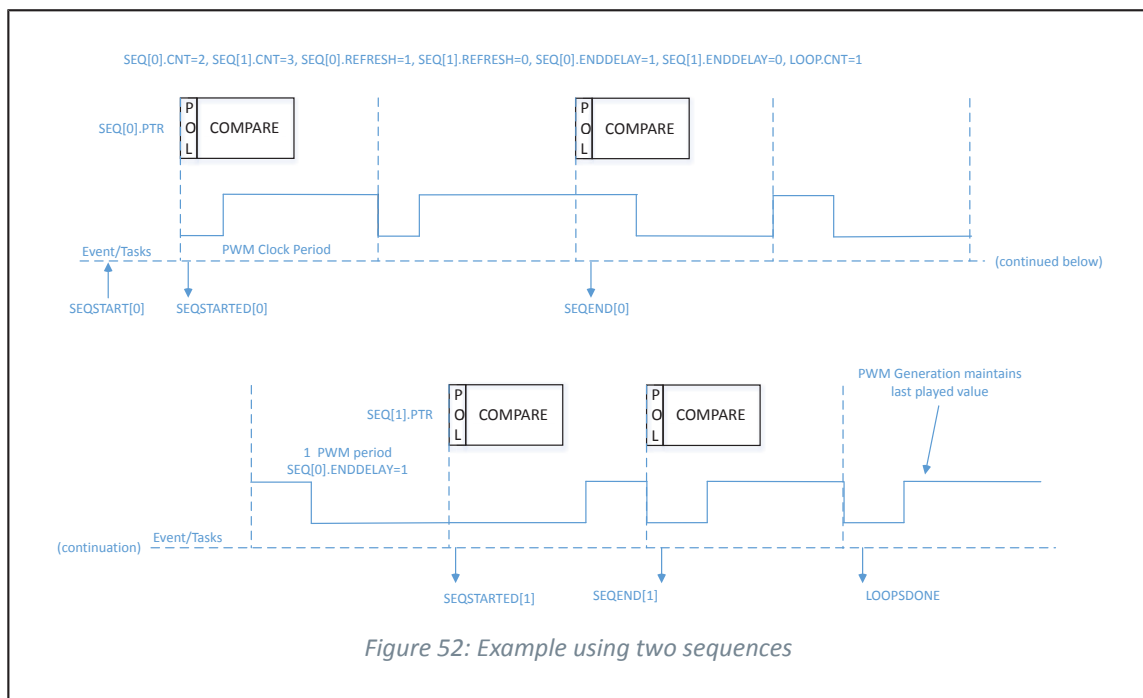
```

NRF_PWM0->PSEL.OUT[0] = (first_pin << PWM_PSEL_OUT_PIN_Pos) |
                        (PWM_PSEL_OUT_CONNECT_Connected <<
                        PWM_PSEL_OUT_CONNECT_Pos);
NRF_PWM0->ENABLE      = (PWM_ENABLE_ENABLE_Enabled << PWM_ENABLE_ENABLE_Pos);
NRF_PWM0->MODE        = (PWM_MODE_UPDOWN_Up << PWM_MODE_UPDOWN_Pos);
NRF_PWM0->PRESCALER    = (PWM_PRESCALER_PRESCALER_DIV_1 <<
                        PWM_PRESCALER_PRESCALER_Pos);
NRF_PWM0->COUNTERTOP   = (16000 << PWM_COUNTERTOP_COUNTERTOP_Pos); //1 msec
NRF_PWM0->LOOP         = (1 << PWM_LOOP_CNT_Pos);
NRF_PWM0->DECODER      = (PWM_DECODER_LOAD_Common << PWM_DECODER_LOAD_Pos) |
                        (PWM_DECODER_MODE_RefreshCount << PWM_DECODER_MODE_Pos);
NRF_PWM0->SEQ[0].PTR   = ((uint32_t)(seq0_ram) << PWM_SEQ_PTR_PTR_Pos);
NRF_PWM0->SEQ[0].CNT   = ((sizeof(seq0_ram) / sizeof(uint16_t)) <<
                        PWM_SEQ_CNT_CNT_Pos);

NRF_PWM0->SEQ[0].REFRESH = 1;
NRF_PWM0->SEQ[0].ENDDELAY = 1;
NRF_PWM0->SEQ[1].PTR   = ((uint32_t)(seq1_ram) << PWM_SEQ_PTR_PTR_Pos);
NRF_PWM0->SEQ[1].CNT   = ((sizeof(seq1_ram) / sizeof(uint16_t)) <<
                        PWM_SEQ_CNT_CNT_Pos);

NRF_PWM0->SEQ[1].REFRESH = 0;
NRF_PWM0->SEQ[1].ENDDELAY = 0;
NRF_PWM0->TASKS_SEQSTART[0] = 1;

```



The decoder can also be configured to asynchronously load a new PWM duty cycle. If the DECODER.MODE register is set to NextStep - then the NEXTSTEP task will cause an update of the internal compare registers on the next PWM period.

The figures below provide an overview of each part of an arbitrary sequence, in various modes (LOOP.CNT=0 and LOOP.CNT>0). In particular are represented:

- Initial and final duty cycle on the PWM output(s)
- Chaining of SEQ[0] and SEQ[1] if LOOP.CNT>0
- Influence of registers on the sequence
- Events fired during a sequence
- DMA activity (loading of next value and applying it to the output(s))

Note that the single-shot example applies also to SEQ[1], only SEQ[0] is represented for simplicity.

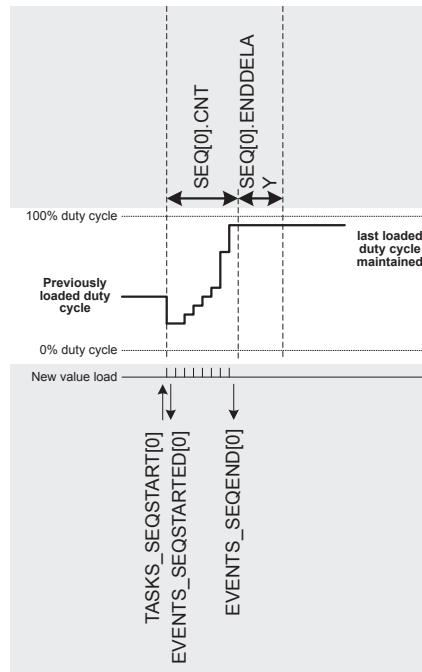
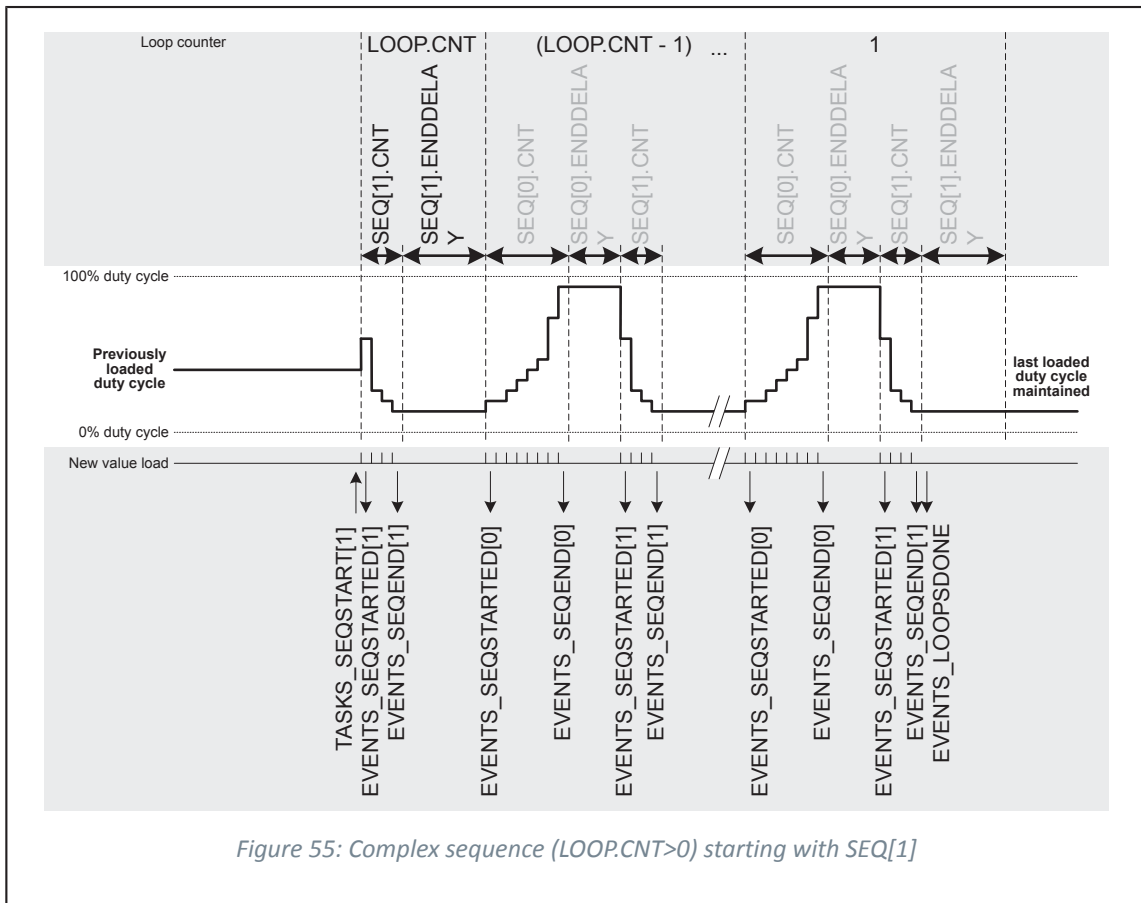


Figure 53: Single shot (LOOP.CNT=0)





Note that if a sequence is in use in a simple or complex sequence, it must have a length of  $SEQ[n].CNT > 0$ .

### 6.12.3 Limitations

The previous compare value will be repeated if the PWM period is selected to be shorter than the time it takes for the EasyDMA to fetch from RAM and update the internal compare registers.

This is to ensure a glitch-free operation even if very short PWM periods are chosen.

### 6.12.4 Pin configuration

The  $OUT[n]$  ( $n=0..3$ ) signals associated to each channel of the PWM module are mapped to physical pins according to the configuration specified in the respective  $PSEL.OUT[n]$  registers. If a  $PSEL.OUT[n].CONNECT$  is set to Disconnected, the associated PWM module signal will not be connected to any physical pins.

The  $PSEL.OUT[n]$  registers and their configurations are only used as long as the PWM module is enabled and PWM generation is active (wave counter started), and retained only as long as the device is in System ON mode, see [POWER](#) chapter for more information about power modes.

To ensure correct behaviour in the PWM module, the pins used by the PWM module must be configured in the GPIO peripheral as described in [Recommended GPIO configuration before starting PWM generation](#) on page 264 before enabling the PWM module. The pins' idle state is defined by the  $OUT$  registers in the GPIO module. This is to ensure that the pins used by the PWM module are driven correctly, if PWM generation is stopped through a STOP task, the PWM module itself is temporarily disabled, or the device temporarily enters System OFF. This configuration must be retained in the GPIO for the selected IOs as long as the PWM module is supposed to be connected to an external PWM circuit.

Only one peripheral can be assigned to drive a particular GPIO pin at a time. Failing to do so may result in unpredictable behaviour.

PWM signal	PWM pin	Direction	Output value	Comment
OUT[n]	As specified in PSEL.OUT[n] (n=0..3)	Output	0	Idle state defined in GPIO->OUT

Table 51: Recommended GPIO configuration before starting PWM generation

## 6.12.5 Registers

Base address	Peripheral	Instance	Description	Configuration
0x4001C000	PWM	PWM0	Pulse-width modulation unit 0	

Table 52: Instances

Register	Offset	Description
TASKS_STOP	0x004	Stops PWM pulse generation on all channels at the end of current PWM period, and stops sequence playback
TASKS_SEQSTART[0]	0x008	Loads the first PWM value on all enabled channels from sequence 0, and starts playing that sequence at the rate defined in SEQ[0]REFRESH and/or DECODER.MODE. Causes PWM generation to start if it was not running.
TASKS_SEQSTART[1]	0x00C	Loads the first PWM value on all enabled channels from sequence 1, and starts playing that sequence at the rate defined in SEQ[1]REFRESH and/or DECODER.MODE. Causes PWM generation to start if it was not running.
TASKS_NEXTSTEP	0x010	Steps by one value in the current sequence on all enabled channels if DECODER.MODE=NextStep. Does not cause PWM generation to start if it was not running.
EVENTS_STOPPED	0x104	Response to STOP task, emitted when PWM pulses are no longer generated
EVENTS_SEQSTARTED[0]	0x108	First PWM period started on sequence 0
EVENTS_SEQSTARTED[1]	0x10C	First PWM period started on sequence 1
EVENTS_SEQEND[0]	0x110	Emitted at end of every sequence 0, when last value from RAM has been applied to wave counter
EVENTS_SEQEND[1]	0x114	Emitted at end of every sequence 1, when last value from RAM has been applied to wave counter
EVENTS_PWMPERIOD	0x118	Emitted at the end of each PWM period
EVENTS_LOOPSDONE	0x11C	Concatenated sequences have been played the amount of times defined in LOOP.CNT
SHORTS	0x200	Shortcut register
INTEN	0x300	Enable or disable interrupt
INTENSET	0x304	Enable interrupt
INTENCLR	0x308	Disable interrupt
ENABLE	0x500	PWM module enable register
MODE	0x504	Selects operating mode of the wave counter
COUNTERTOP	0x508	Value up to which the pulse generator counter counts
PRESCALER	0x50C	Configuration for PWM_CLK
DECODER	0x510	Configuration of the decoder
LOOP	0x514	Amount of playback of a loop
SEQ[0].PTR	0x520	Beginning address in Data RAM of this sequence
SEQ[0].CNT	0x524	Amount of values (duty cycles) in this sequence
SEQ[0].REFRESH	0x528	Amount of additional PWM periods between samples loaded into compare register
SEQ[0].ENDDelay	0x52C	Time added after the sequence
SEQ[1].PTR	0x540	Beginning address in Data RAM of this sequence
SEQ[1].CNT	0x544	Amount of values (duty cycles) in this sequence
SEQ[1].REFRESH	0x548	Amount of additional PWM periods between samples loaded into compare register



Register	Offset	Description
SEQ[1].ENDELAY	0x54C	Time added after the sequence
PSEL.OUT[0]	0x560	Output pin select for PWM channel 0
PSEL.OUT[1]	0x564	Output pin select for PWM channel 1
PSEL.OUT[2]	0x568	Output pin select for PWM channel 2
PSEL.OUT[3]	0x56C	Output pin select for PWM channel 3

Table 53: Register Overview

### 6.12.5.1 SHORTS

Address offset: 0x200

Shortcut register

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0																																			
Id				E D C B A																																			
Reset 0x00000000				0 0																																			
Id	RW	Field	Value	Id	Value	Description																																	
A	RW	SEQEND0_STOP				Shortcut between SEQEND[0] event and STOP task																																	
						See <a href="#">EVENTS_SEQEND[0]</a> and <a href="#">TASKS_STOP</a>																																	
			Disabled	0		Disable shortcut																																	
			Enabled	1		Enable shortcut																																	
B	RW	SEQEND1_STOP				Shortcut between SEQEND[1] event and STOP task																																	
						See <a href="#">EVENTS_SEQEND[1]</a> and <a href="#">TASKS_STOP</a>																																	
			Disabled	0		Disable shortcut																																	
			Enabled	1		Enable shortcut																																	
C	RW	LOOPSDONE_SEQSTART0				Shortcut between LOOPSDONE event and SEQSTART[0] task																																	
						See <a href="#">EVENTS_LOOPSDONE</a> and <a href="#">TASKS_SEQSTART[0]</a>																																	
			Disabled	0		Disable shortcut																																	
			Enabled	1		Enable shortcut																																	
D	RW	LOOPSDONE_SEQSTART1				Shortcut between LOOPSDONE event and SEQSTART[1] task																																	
						See <a href="#">EVENTS_LOOPSDONE</a> and <a href="#">TASKS_SEQSTART[1]</a>																																	
			Disabled	0		Disable shortcut																																	
			Enabled	1		Enable shortcut																																	
E	RW	LOOPSDONE_STOP				Shortcut between LOOPSDONE event and STOP task																																	
						See <a href="#">EVENTS_LOOPSDONE</a> and <a href="#">TASKS_STOP</a>																																	
			Disabled	0		Disable shortcut																																	
			Enabled	1		Enable shortcut																																	

### 6.12.5.2 INTEN

Address offset: 0x300

Enable or disable interrupt

Bit number					31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0																															
Id					H G F E D C B																															
Reset 0x00000000					0 0																															
Id	RW	Field	Value	Id	Value	Description																														
B	RW	STOPPED				Enable or disable interrupt for STOPPED event																														
						See <a href="#">EVENTS_STOPPED</a>																														
			Disabled	0		Disable																														

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0																															
Id				H G F E D C B																															
Reset 0x00000000				0 0																															
Id	RW	Field	Value Id	Value	Description																														
C	RW	SEQSTARTED0	Enabled	1	Enable																														
			Enable or disable interrupt for SEQSTARTED[0] event																																
			See <a href="#">EVENTS_SEQSTARTED[0]</a>																																
			Disabled	0	Disable																														
D	RW	SEQSTARTED1	Enabled	1	Enable																														
			Enable or disable interrupt for SEQSTARTED[1] event																																
			See <a href="#">EVENTS_SEQSTARTED[1]</a>																																
			Disabled	0	Disable																														
E	RW	SEQEND0	Enabled	1	Enable																														
			Enable or disable interrupt for SEQEND[0] event																																
			See <a href="#">EVENTS_SEQEND[0]</a>																																
			Disabled	0	Disable																														
F	RW	SEQEND1	Enabled	1	Enable																														
			Enable or disable interrupt for SEQEND[1] event																																
			See <a href="#">EVENTS_SEQEND[1]</a>																																
			Disabled	0	Disable																														
G	RW	PWMPERIODEND	Enabled	1	Enable																														
			Enable or disable interrupt for PWMPERIODEND event																																
			See <a href="#">EVENTS_PWMPERIODEND</a>																																
			Disabled	0	Disable																														
H	RW	LOOPSDONE	Enabled	1	Enable																														
			Enable or disable interrupt for LOOPSDONE event																																
			See <a href="#">EVENTS_LOOPSDONE</a>																																
			Disabled	0	Disable																														

### 6.12.5.3 INTENSET

Address offset: 0x304

Enable interrupt

Bit number					31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0																															
Id					H G F E D C B																															
Reset 0x00000000					0 0																															
Id	RW	Field	Value Id	Value	Description																															
B	RW	STOPPED			Write '1' to Enable interrupt for STOPPED event																															
					See <a href="#">EVENTS_STOPPED</a>																															
			Set	1	Enable																															
			Disabled	0	Read: Disabled																															
			Enabled	1	Read: Enabled																															
C	RW	SEQSTARTED0			Write '1' to Enable interrupt for SEQSTARTED[0] event																															
					See <a href="#">EVENTS_SEQSTARTED[0]</a>																															
			Set	1	Enable																															
			Disabled	0	Read: Disabled																															
			Enabled	1	Read: Enabled																															

Bit number					31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0																															
Id					H G F E D C B																															
Reset 0x00000000					0 0																															
Id	RW	Field	Value Id	Value	Description																															
D	RW	SEQSTARTED1			Write '1' to Enable interrupt for SEQSTARTED[1] event																															
					See <a href="#">EVENTS_SEQSTARTED[1]</a>																															
			Set	1	Enable																															
			Disabled	0	Read: Disabled																															
			Enabled	1	Read: Enabled																															
E	RW	SEQEND0			Write '1' to Enable interrupt for SEQEND[0] event																															
					See <a href="#">EVENTS_SEQEND[0]</a>																															
			Set	1	Enable																															
			Disabled	0	Read: Disabled																															
			Enabled	1	Read: Enabled																															
F	RW	SEQEND1			Write '1' to Enable interrupt for SEQEND[1] event																															
					See <a href="#">EVENTS_SEQEND[1]</a>																															
			Set	1	Enable																															
			Disabled	0	Read: Disabled																															
			Enabled	1	Read: Enabled																															
G	RW	PWMPERIODEND			Write '1' to Enable interrupt for PWMPERIODEND event																															
					See <a href="#">EVENTS_PWMPERIODEND</a>																															
			Set	1	Enable																															
			Disabled	0	Read: Disabled																															
			Enabled	1	Read: Enabled																															
H	RW	LOOPSDONE			Write '1' to Enable interrupt for LOOPSDONE event																															
					See <a href="#">EVENTS_LOOPSDONE</a>																															
			Set	1	Enable																															
			Disabled	0	Read: Disabled																															
			Enabled	1	Read: Enabled																															

#### 6.12.5.4 INTENCLR

Address offset: 0x308

Disable interrupt

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0																															
Id				H G F E D C B																															
Reset 0x00000000				0 0																															
Id	RW	Field	Value Id	Value	Description																														
B	RW	STOPPED			Write '1' to Disable interrupt for STOPPED event																														
					See <a href="#">EVENTS_STOPPED</a>																														
			Clear	1	Disable																														
			Disabled	0	Read: Disabled																														
			Enabled	1	Read: Enabled																														
C	RW	SEQSTARTED0			Write '1' to Disable interrupt for SEQSTARTED[0] event																														
					See <a href="#">EVENTS_SEQSTARTED[0]</a>																														
			Clear	1	Disable																														
			Disabled	0	Read: Disabled																														
			Enabled	1	Read: Enabled																														
D	RW	SEQSTARTED1			Write '1' to Disable interrupt for SEQSTARTED[1] event																														
					See <a href="#">EVENTS_SEQSTARTED[1]</a>																														

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0																															
Id				H G F E D C B																															
Reset 0x00000000				0 0																															
Id	RW	Field	Value Id	Value	Description																														
			Clear	1	Disable																														
			Disabled	0	Read: Disabled																														
			Enabled	1	Read: Enabled																														
E	RW	SEQEND0			Write '1' to Disable interrupt for SEQEND[0] event																														
					See <a href="#">EVENTS_SEQEND[0]</a>																														
			Clear	1	Disable																														
			Disabled	0	Read: Disabled																														
			Enabled	1	Read: Enabled																														
F	RW	SEQEND1			Write '1' to Disable interrupt for SEQEND[1] event																														
					See <a href="#">EVENTS_SEQEND[1]</a>																														
			Clear	1	Disable																														
			Disabled	0	Read: Disabled																														
			Enabled	1	Read: Enabled																														
G	RW	PWMPERIODEND			Write '1' to Disable interrupt for PWMPERIODEND event																														
					See <a href="#">EVENTS_PWMPERIODEND</a>																														
			Clear	1	Disable																														
			Disabled	0	Read: Disabled																														
			Enabled	1	Read: Enabled																														
H	RW	LOOPSDONE			Write '1' to Disable interrupt for LOOPSDONE event																														
					See <a href="#">EVENTS_LOOPSDONE</a>																														
			Clear	1	Disable																														
			Disabled	0	Read: Disabled																														
			Enabled	1	Read: Enabled																														

### 6.12.5.5 ENABLE

Address offset: 0x500

PWM module enable register

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0																															
Id				A																															
Reset 0x00000000				0 0																															
Id	RW	Field	Value Id	Value	Description																														
A	RW	ENABLE			Enable or disable PWM module																														
			Disabled	0	Disabled																														
			Enabled	1	Enable																														

### 6.12.5.6 MODE

Address offset: 0x504

Selects operating mode of the wave counter

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0																																
Id				A																																
Reset 0x00000000				0 0																																
Id	RW	Field	Value Id	Value	Description																															
A	RW	UPDOWN			Selects up or up and down as wave counter mode																															
			Up	0	Up counter - edge aligned PWM duty-cycle																															
			UpAndDown	1	Up and down counter - center aligned PWM duty cycle																															

### 6.12.5.7 COUNTERTOP

Address offset: 0x508

Value up to which the pulse generator counter counts

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0																															
Id				A A																															
Reset 0x000003FF				0 0																															
Id	RW	Field	Value Id	Value				Description																											
A	RW	COUNTERTOP		[3..32767]				Value up to which the pulse generator counter counts. This register is ignored when DECODER.MODE=WaveForm and only values from RAM will be used.																											

### 6.12.5.8 PRESCALER

Address offset: 0x50C

Configuration for PWM\_CLK

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0																															
Id				A A A																															
Reset 0x00000000				0 0																															
Id	RW	Field	Value Id	Value	Description																														
A	RW	PRESCALER			Pre-scaler of PWM_CLK																														
			DIV_1	0	Divide by 1 (16MHz)																														
			DIV_2	1	Divide by 2 ( 8MHz)																														
			DIV_4	2	Divide by 4 ( 4MHz)																														
			DIV_8	3	Divide by 8 ( 2MHz)																														
			DIV_16	4	Divide by 16 ( 1MHz)																														
			DIV_32	5	Divide by 32 ( 500kHz)																														
			DIV_64	6	Divide by 64 ( 250kHz)																														
			DIV_128	7	Divide by 128 ( 125kHz)																														

### 6.12.5.9 DECODER

Address offset: 0x510

Configuration of the decoder



### 6.12.5.13 SEQ[0].REFRESH

Address offset: 0x528

Amount of additional PWM periods between samples loaded into compare register

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0																															
Id				A A																															
Reset 0x00000001				0 1																															
Id	RW	Field	Value Id	Value	Description																														
A	RW	CNT			Amount of additional PWM periods between samples loaded into compare register (load every REFRESH.CNT+1 PWM periods)																														
			Continuous	0	Update every PWM period																														

### 6.12.5.14 SEQ[0].ENDDDELAY

Address offset: 0x52C

Time added after the sequence

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0																															
Id				A A																															
Reset 0x00000000				0 0																															
Id		RW		Field		Value Id		Value		Description																									
A		RW		CNT						Time added after the sequence in PWM periods																									

### 6.12.5.15 SEQ[1].PTR

Address offset: 0x540

Beginning address in Data RAM of this sequence

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0																															
Id				A A																															
Reset 0x00000000				0 0																															
Id	RW	Field	Value Id	ValueDescription																															
A	RW	PTR		Beginning address in Data RAM of this sequence																															

### 6.12.5.16 SEQ[1].CNT

Address offset: 0x544

Amount of values (duty cycles) in this sequence

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0																															
Id				A A																															
Reset 0x00000000				0 0																															
Id		RW		Field		Value Id		Value		Description																									
A		RW		CNT						Amount of values (duty cycles) in this sequence																									
						Disabled		0		Sequence is disabled, and shall not be started as it is empty																									

### 6.12.5.17 SEQ[1].REFRESH

Address offset: 0x548





### 6.12.5.21 PSEL.OUT[2]

Address offset: 0x568

Output pin select for PWM channel 2

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0																															
Id				C																															
Reset 0xFFFFFFFF				1 1																															
Id	RW	Field	Value Id	Value				Description																											
A	RW	PIN		[0..31]				Pin number																											
C	RW	CONNECT						Connection																											
			Disconnected	1				Disconnect																											
			Connected	0				Connect																											

### 6.12.5.22 PSEL.OUT[3]

Address offset: 0x56C

Output pin select for PWM channel 3

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0																															
Id				C																															
Reset 0xFFFFFFFF				1 1																															
Id	RW	Field	Value	Id	Value	Description																													
A	RW	PIN			[0..31]	Pin number																													
C	RW	CONNECT				Connection																													
			Disconnected		1	Disconnect																													
			Connected		0	Connect																													

## 6.12.6 Electrical specification

## 6.13 QDEC — Quadrature decoder

The Quadrature decoder (QDEC) provides buffered decoding of quadrature-encoded sensor signals. It is suitable for mechanical and optical sensors.

The sample period and accumulation are configurable to match application requirements. The QDEC provides the following:

- Decoding of digital waveform from off-chip quadrature encoder.
- Sample accumulation eliminating hard real-time requirements to be enforced on application.
- Optional input de-bounce filters.
- Optional LED output signal for optical encoders.

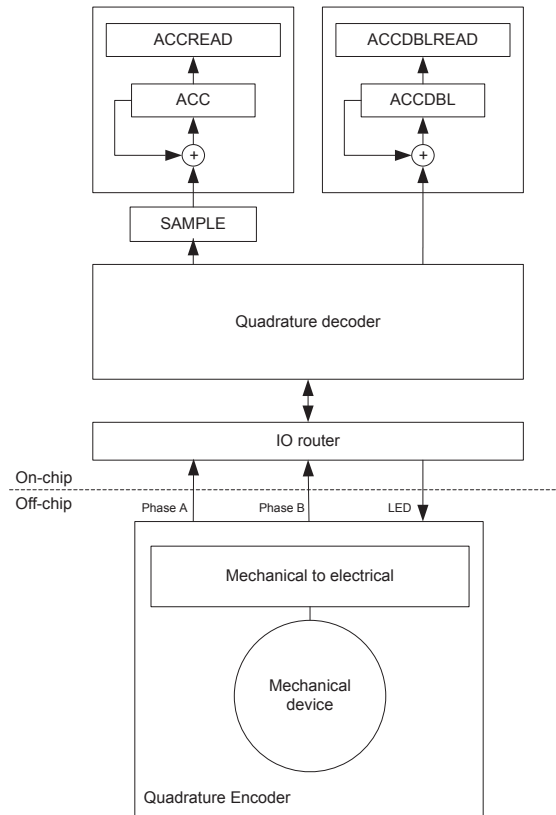


Figure 56: Quadrature decoder configuration

### 6.13.1 Sampling and decoding

The QDEC decodes the output from an incremental motion encoder by sampling the QDEC phase input pins (A and B).

The off-chip quadrature encoder is an incremental motion encoder outputting two waveforms, phase A and phase B. The two output waveforms are always 90 degrees out of phase, meaning that one always changes level before the other. The direction of movement is indicated by which of these two waveforms that changes level first. Invalid transitions may occur, that is when the two waveforms switch simultaneously. This may occur if the wheel rotates too fast relative to the sample rate set for the decoder.

The QDEC decodes the output from the off-chip encoder by sampling the QDEC phase input pins (A and B) at a fixed rate as specified in the SAMPLEPER register.

If the SAMPLEPER value needs to be changed, the QDEC shall be stopped using the STOP task. SAMPLEPER can be then changed upon receiving the STOPPED event, and QDEC can be restarted using the START task. Failing to do so may result in unpredictable behaviour.

It is good practice to change other registers (LEDPOL, REPORTPER, DBFEN and LEDPRE) only when the QDEC is stopped.

When started, the decoder continuously samples the two input waveforms and decodes these by comparing the current sample pair (n) with the previous sample pair (n-1).

The decoding of the sample pairs is described in the table below.

Previous sample pair(n-1)		Current samples pair(n)		SAMPLE register	ACC operation	ACCDBL operation	Description
A	B	A	B				
0	0	0	0	0	No change	No change	No movement
0	0	0	1	1	Increment	No change	Movement in positive direction
0	0	1	0	-1	Decrement	No change	Movement in negative direction
0	0	1	1	2	No change	Increment	Error: Double transition
0	1	0	0	-1	Decrement	No change	Movement in negative direction
0	1	0	1	0	No change	No change	No movement
0	1	1	0	2	No change	Increment	Error: Double transition
0	1	1	1	1	Increment	No change	Movement in positive direction
1	0	0	0	1	Increment	No change	Movement in positive direction
1	0	0	1	2	No change	Increment	Error: Double transition
1	0	1	0	0	No change	No change	No movement
1	0	1	1	-1	Decrement	No change	Movement in negative direction
1	1	0	0	2	No change	Increment	Error: Double transition
1	1	0	1	-1	Decrement	No change	Movement in negative direction
1	1	1	0	1	Increment	No change	Movement in positive direction
1	1	1	1	0	No change	No change	No movement

Table 54: Sampled value encoding

### 6.13.2 LED output

The LED output follows the sample period, and the LED is switched on a given period before sampling and switched off immediately after the inputs are sampled. The period the LED is switched on before sampling is given in the LEDPRE register.

The LED output pin polarity is specified in the LEDPOL register.

For using off-chip mechanical encoders not requiring a LED, the LED output can be disabled by writing value 'Disconnected' to the CONNECT field of the PSEL.LED register. In this case the QDEC will not acquire access to a LED output pin and the pin can be used for other purposes by the CPU.

### 6.13.3 Debounce filters

Each of the two-phase inputs have digital debounce filters.

When enabled through the DBFEN register, the filter inputs are sampled at a fixed 1 MHz frequency during the entire sample period (which is specified in the SAMPLEPER register), and the filters require all of the samples within this sample period to equal before the input signal is accepted and transferred to the output of the filter.

As a result, only input signal with a steady state longer than twice the period specified in SAMPLEPER are guaranteed to pass through the filter, and any signal with a steady state shorter than SAMPLEPER will always be suppressed by the filter. (This is assumed that the frequency during the debounce period never exceeds 500 kHz (as required by the Nyquist theorem when using a 1 MHz sample frequency).

The LED will always be ON when the debounce filters are enabled, as the inputs in this case will be sampled continuously.

Note that when the debounce filters are enabled, displacements reported by the QDEC peripheral are delayed by one SAMPLEPER period.

### 6.13.4 Accumulators

The quadrature decoder contains two accumulator registers, ACC and ACCDBL, that accumulate respectively valid motion sample values and the number of detected invalid samples (double transitions).

The ACC register will accumulate all valid values (1/-1) written to the SAMPLE register. This can be useful for preventing hard real-time requirements from being enforced on the application. When using the ACC register the application does not need to read every single sample from the SAMPLE register, but can instead fetch the ACC register whenever it fits the application. The ACC register will always hold the relative movement of the external mechanical device since the previous clearing of the ACC register. Sample values indicating a double transition (2) will not be accumulated in the ACC register.

An ACCOF event will be generated if the ACC receives a SAMPLE value that would cause the register to overflow or underflow. Any SAMPLE value that would cause an ACC overflow or underflow will be discarded, but any samples not causing the ACC to overflow or underflow will still be accepted.

The accumulator ACCDBL accumulates the number of detected double transitions since the previous clearing of the ACCDBL register.

The ACC and ACCDBL registers can be cleared by the READCLRACC and subsequently read using the ACCREAD and ACCDBLREAD registers.

The ACC register can be separately cleared by the RDCLRACC and subsequently read using the ACCREAD registers.

The ACCDBL register can be separately cleared by the RDCLRDBL and subsequently read using the ACCDBLREAD registers.

The REPORTPER register allows automating the capture of several samples before it can send out a REPORTRDY event in case a non-null displacement has been captured and accumulated, and a DBLRDY event in case one or more double-displacements have been captured and accumulated. The REPORTPER field in this register selects after how many samples the accumulators contents are evaluated to send (or not) REPORTRDY and DBLRDY events.

Using the RDCLRACC task (manually sent upon receiving the event, or using the DBLRDY\_RDCLRACC shortcut), ACCREAD can then be read.

In case at least one double transition has been captured and accumulated, a DBLRDY event is sent. Using the RDCLRDBL task (manually sent upon receiving the event, or using the DBLRDY\_RDCLRDBL shortcut), ACCDBLREAD can then be read.

### 6.13.5 Output/input pins

The QDEC uses a three-pin interface to the off-chip quadrature encoder.

These pins will be acquired when the QDEC is enabled in the ENABLE register. The pins acquired by the QDEC cannot be written by the CPU, but they can still be read by the CPU.

The pin numbers to be used for the QDEC are selected using the PSEL.n registers.

### 6.13.6 Pin configuration

The Phase A, Phase B, and LED signals are mapped to physical pins according to the configuration specified in the PSEL.A, PSEL.B, and PSEL.LED registers respectively.

If the CONNECT field value 'Disconnected' is specified in any of these registers, the associated signal will not be connected to any physical pin. The PSEL.A, PSEL.B, and PSEL.LED registers and their configurations are only used as long as the QDEC is enabled, and retained only as long as the device is in ON mode. When the peripheral is disabled, the pins will behave as regular GPIOs, and use the configuration in their respective OUT bit field and PIN\_CNF[n] register.

To secure correct behavior in the QDEC, the pins used by the QDEC must be configured in the GPIO peripheral as described in [GPIO configuration before enabling peripheral](#) on page 277 before enabling the QDEC. This configuration must be retained in the GPIO for the selected IOs as long as the QDEC is enabled.

Only one peripheral can be assigned to drive a particular GPIO pin at a time. Failing to do so may result in unpredictable behavior.

QDEC signal	QDEC pin	Direction	Output value	Comment
Phase A	As specified in PSEL.A	Input	Not applicable	
Phase B	As specified in PSEL.B	Input	Not applicable	
LED	As specified in PSEL.LED	Input	Not applicable	

Table 55: GPIO configuration before enabling peripheral

## 6.13.7 Registers

Base address	Peripheral	Instance	Description	Configuration
0x40012000	QDEC	QDEC	Quadrature decoder	

Table 56: Instances

Register	Offset	Description
TASKS_START	0x000	Task starting the quadrature decoder
TASKS_STOP	0x004	Task stopping the quadrature decoder
TASKS_READCLRACC	0x008	Read and clear ACC and ACCDBL
TASKS_RDCLRACC	0x00C	Read and clear ACC
TASKS_RDCLRDBL	0x010	Read and clear ACCDBL
EVENTS_SAMPLRDY	0x100	Event being generated for every new sample value written to the SAMPLE register
EVENTS_REPORTRDY	0x104	Non-null report ready
EVENTS_ACCOF	0x108	ACC or ACCDBL register overflow
EVENTS_DBLRDY	0x10C	Double displacement(s) detected
EVENTS_STOPPED	0x110	QDEC has been stopped
SHORTS	0x200	Shortcut register
INTENSET	0x304	Enable interrupt
INTENCLR	0x308	Disable interrupt
ENABLE	0x500	Enable the quadrature decoder
LEDPOL	0x504	LED output pin polarity
SAMPLEPER	0x508	Sample period
SAMPLE	0x50C	Motion sample value
REPORTPER	0x510	Number of samples to be taken before REPORTRDY and DBLRDY events can be generated
ACC	0x514	Register accumulating the valid transitions
ACCREAD	0x518	Snapshot of the ACC register, updated by the READCLRACC or RDCLRACC task
PSEL.LED	0x51C	Pin select for LED signal
PSEL.A	0x520	Pin select for A signal
PSEL.B	0x524	Pin select for B signal
DBFEN	0x528	Enable input debounce filters
LEDPRE	0x540	Time period the LED is switched ON prior to sampling
ACCDBL	0x544	Register accumulating the number of detected double transitions
ACCDBLREAD	0x548	Snapshot of the ACCDBL, updated by the READCLRACC or RDCLRDBL task

Table 57: Register Overview

### 6.13.7.1 SHORTS

Address offset: 0x200

Shortcut register

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0																																			
Id				G F E D C B A																																			
Reset 0x00000000				0 0																																			
Id	RW	Field	Value Id	Value	Description																																		
A	RW	REPORTRDY_READCLRACC			Shortcut between REPORTRDY event and READCLRACC task																																		
					See <a href="#">EVENTS_REPORTRDY</a> and <a href="#">TASKS_READCLRACC</a>																																		
			Disabled	0	Disable shortcut																																		
		Enabled	1	Enable shortcut																																			
B	RW	SAMPLERDY_STOP			Shortcut between SAMPLERDY event and STOP task																																		
					See <a href="#">EVENTS_SAMPLERDY</a> and <a href="#">TASKS_STOP</a>																																		
			Disabled	0	Disable shortcut																																		
		Enabled	1	Enable shortcut																																			
C	RW	REPORTRDY_RDCLRACC			Shortcut between REPORTRDY event and RDCLRACC task																																		
					See <a href="#">EVENTS_REPORTRDY</a> and <a href="#">TASKS_RDCLRACC</a>																																		
			Disabled	0	Disable shortcut																																		
		Enabled	1	Enable shortcut																																			
D	RW	REPORTRDY_STOP			Shortcut between REPORTRDY event and STOP task																																		
					See <a href="#">EVENTS_REPORTRDY</a> and <a href="#">TASKS_STOP</a>																																		
			Disabled	0	Disable shortcut																																		
		Enabled	1	Enable shortcut																																			
E	RW	DBLRDY_RDCLRDBL			Shortcut between DBLRDY event and RDCLRDBL task																																		
					See <a href="#">EVENTS_DBLRDY</a> and <a href="#">TASKS_RDCLRDBL</a>																																		
			Disabled	0	Disable shortcut																																		
		Enabled	1	Enable shortcut																																			
F	RW	DBLRDY_STOP			Shortcut between DBLRDY event and STOP task																																		
					See <a href="#">EVENTS_DBLRDY</a> and <a href="#">TASKS_STOP</a>																																		
			Disabled	0	Disable shortcut																																		
		Enabled	1	Enable shortcut																																			
G	RW	SAMPLERDY_READCLRACC			Shortcut between SAMPLERDY event and READCLRACC task																																		
					See <a href="#">EVENTS_SAMPLERDY</a> and <a href="#">TASKS_READCLRACC</a>																																		
			Disabled	0	Disable shortcut																																		
		Enabled	1	Enable shortcut																																			

### 6.13.7.2 INTENSET

Address offset: 0x304

Enable interrupt

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0																															
Id				E D C B A																															
Reset 0x00000000				0 0																															
Id	RW	Field	Value Id	Value	Description																														
A	RW	SAMPLERDY			Write '1' to Enable interrupt for SAMPLERDY event																														
					See <a href="#">EVENTS_SAMPLERDY</a>																														
			Set	1	Enable																														
			Disabled	0	Read: Disabled																														
			Enabled	1	Read: Enabled																														
B	RW	REPORTRDY			Write '1' to Enable interrupt for REPORTRDY event																														
					See <a href="#">EVENTS_REPORTRDY</a>																														
			Set	1	Enable																														

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0																															
Id				E D C B A																															
Reset 0x00000000				0 0																															
Id	RW	Field	Value Id	Value	Description																														
C	RW	ACCOF	Disabled	0	Read: Disabled																														
			Enabled	1	Read: Enabled																														
			Write '1' to Enable interrupt for ACCOF event																																
			See <a href="#">EVENTS_ACCOF</a>																																
			Set	1	Enable																														
D	RW	DBLRDY	Disabled	0	Read: Disabled																														
			Enabled	1	Read: Enabled																														
			Write '1' to Enable interrupt for DBLRDY event																																
			See <a href="#">EVENTS_DBLRDY</a>																																
			Set	1	Enable																														
E	RW	STOPPED	Disabled	0	Read: Disabled																														
			Enabled	1	Read: Enabled																														
			Write '1' to Enable interrupt for STOPPED event																																
			See <a href="#">EVENTS_STOPPED</a>																																
			Set	1	Enable																														

### 6.13.7.3 INTENCLR

Address offset: 0x308

Disable interrupt

Bit number			31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0																																
Id			E D C B A																																
Reset 0x00000000			0 0																																
Id	RW	Field	Value Id	Value	Description																														
A	RW	SAMPLERDY			Write '1' to Disable interrupt for SAMPLERDY event																														
					See <a href="#">EVENTS_SAMPLERDY</a>																														
			Clear	1	Disable																														
			Disabled	0	Read: Disabled																														
			Enabled	1	Read: Enabled																														
B	RW	REPORTRDY			Write '1' to Disable interrupt for REPORTRDY event																														
					See <a href="#">EVENTS_REPORTRDY</a>																														
			Clear	1	Disable																														
			Disabled	0	Read: Disabled																														
			Enabled	1	Read: Enabled																														
C	RW	ACCOF			Write '1' to Disable interrupt for ACCOF event																														
					See <a href="#">EVENTS_ACCOF</a>																														
			Clear	1	Disable																														
			Disabled	0	Read: Disabled																														
			Enabled	1	Read: Enabled																														
D	RW	DBLRDY			Write '1' to Disable interrupt for DBLRDY event																														
					See <a href="#">EVENTS_DBLRDY</a>																														
			Clear	1	Disable																														
			Disabled	0	Read: Disabled																														
			Enabled	1	Read: Enabled																														





Bit number				31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0			
Id				A A A A																																		
Reset 0x00000000				0 0																																		
Id	RW	Field	Value Id	Value	Description																																	
			256us	1	256 us																																	
			512us	2	512 us																																	
			1024us	3	1024 us																																	
			2048us	4	2048 us																																	
			4096us	5	4096 us																																	
			8192us	6	8192 us																																	
			16384us	7	16384 us																																	
			32ms	8	32768 us																																	
			65ms	9	65536 us																																	
			131ms	10	131072 us																																	

### 6.13.7.7 SAMPLE

Address offset: 0x50C

Motion sample value

Bit number				31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
Id				A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A
Reset 0x00000000				0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Id	RW	Field	Value Id	Value				Description																											
A	R	SAMPLE		[-1..2]				Last motion sample																											

The value is a 2's complement value, and the sign gives the direction of the motion. The value '2' indicates a double transition.

### 6.13.7.8 REPORTPER

Address offset: 0x510

Number of samples to be taken before REPORTRDY and DBLRDY events can be generated

Bit number				31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0			
Id				A																																A	A	A
Reset 0x00000000				0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0			
Id	RW	Field	Value Id	Value				Description																														

A RW REPORTPER Specifies the number of samples to be accumulated in the ACC register before the REPORTRDY and DBLRDY events can be generated

The report period in [us] is given as:  $RPUS = SP * RP$  Where RPUS is the report period in [us/report], SP is the sample period in [us/sample] specified in SAMPLEPER, and RP is the report period in [samples/report] specified in REPORTPER .

10Smpl	0	10 samples / report
40Smpl	1	40 samples / report
80Smpl	2	80 samples / report
120Smpl	3	120 samples / report
160Smpl	4	160 samples / report
200Smpl	5	200 samples / report
240Smpl	6	240 samples / report

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0																															
Id				A A A A																															
Reset 0x00000000				0 0																															
Id	RW	Field	Value Id	Value	Description																														
			280Smpl	7	280 samples / report																														
			1Smpl	8	1 sample / report																														

### 6.13.7.9 ACC

Address offset: 0x514

Register accumulating the valid transitions

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0																															
Id				A A																															
Reset 0x00000000				0 0																															
Id		RW	Field	Value Id	Value	Description																													
A		R	ACC		[-1024..1023]	Register accumulating all valid samples (not double transition) read from the SAMPLE register  Double transitions ( SAMPLE = 2 ) will not be accumulated in this register. The value is a 32 bit 2's complement value.  If a sample that would cause this register to overflow or underflow is received, the sample will be ignored and an overflow event ( ACCOF ) will be generated. The ACC register is cleared by triggering the READCLRACC or the RDCLRACC task.																													

### 6.13.7.10 ACCREAD

Address offset: 0x518

Snapshot of the ACC register, updated by the READCLRACC or RDCLRACC task

Bit number					31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0			
Id					A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A		
Reset 0x00000000					0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0		
Id		RW	Field	Value Id	Value	Description																																	
A		R	ACCREAD		[-1024..1023]	Snapshot of the ACC register.																																	
						The ACCREAD register is updated when the READCLRACC or RDCLRACC task is triggered																																	

### 6.13.7.11 PSEL.LED

Address offset: 0x51C

Pin select for LED signal

Bit number	31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0																													
Id	C																													
Reset 0xFFFFFFFF	1 1																													
Id	RW	Field	Value	Id	Value	Description																								
A	RW	PIN			[0..31]	Pin number																								
C	RW	CONNECT				Connection																								
			Disconnected		1	Disconnect																								
			Connected		0	Connect																								

### 6.13.7.12 PSEL.A

Address offset: 0x520

Pin select for A signal

Bit number					31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0																															
Id					C																															
Reset 0xFFFFFFFF					1 1																															
Id		RW		Field		Value		Id		Value		Description																								
A		RW		PIN						[0..31]		Pin number																								
C		RW		CONNECT								Connection																								
						Disconnected				1		Disconnect																								
						Connected				0		Connect																								

### 6.13.7.13 PSEL.B

Address offset: 0x524

Pin select for B signal

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0																															
Id				C																															
Reset 0xFFFFFFFF				1 1																															
Id	RW	Field	Value	Id	Value	Description																													
A	RW	PIN			[0..31]	Pin number																													
C	RW	CONNECT				Connection																													
			Disconnected	1	Disconnect																														
			Connected	0	Connect																														

### 6.13.7.14 DBFEN

Address offset: 0x528

Enable input debounce filters

Bit number					31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0																															
Id					A																															
Reset 0x00000000					0 0																															
Id	RW	Field	Value	Id	Value	Description																														
A	RW	DBFEN				Enable input debounce filters																														
			Disabled	0	Debounce input filters disabled																															
			Enabled	1	Debounce input filters enabled																															

### 6.13.7.15 LEDPRE

Address offset: 0x540

Time period the LED is switched ON prior to sampling

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0																															
Id				A A A A A A A A																															
Reset 0x00000010				0 0																															
Id		RW		Field		Value Id		Value								Description																			
A		RW		LEDPRE				[1..511]								Period in us the LED is switched on prior to sampling																			

### 6.13.7.16 ACCDBL

Address offset: 0x544

Register accumulating the number of detected double transitions

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0																															
Id				A A A A																															
Reset 0x00000000				0 0																															
Id	RW	Field	Value Id	Value	Description																														
A	R	ACCDBL		[0..15]	Register accumulating the number of detected double or illegal transitions. ( SAMPLE = 2 ).																														
When this register has reached its maximum value the accumulation of double / illegal transitions will stop. An overflow event ( ACCOF ) will be generated if any double or illegal transitions are detected after the maximum value was reached. This field is cleared by triggering the READCLRACC or RDCLRDBL task.																																			

### 6.13.7.17 ACCDBLREAD

Address offset: 0x548

Snapshot of the ACCDBL, updated by the READCLRACC or RDCLRDBL task

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0																															
Id				A A A A																															
Reset 0x00000000				0 0																															
Id	RW	Field	Value Id	Value	Description																														
A	R	ACCDBLREAD		[0..15]	Snapshot of the ACCDBL register. This field is updated when the READCLRACC or RDCLRDBL task is triggered.																														

## 6.13.8 Electrical specification

### 6.13.8.1 QDEC Electrical Specification

Symbol	Description	Min.	Typ.	Max.	Units
t <sub>SAMPLE</sub>	Time between sampling signals from quadrature decoder	128		131072	µs
t <sub>LED</sub>	Time from LED is turned on to signals are sampled	0		511	µs

## 6.14 RADIO — 2.4 GHz radio

The 2.4 GHz radio transceiver is compatible with multiple radio standards, such as 1 Mbps and 2 Mbps *Bluetooth*<sup>®</sup> low energy, as well as Nordic's proprietary 1 Mbps and 2 Mbps modes of operation.

EasyDMA in combination with an automated packet assembler and packet disassembler, and an automated CRC generator and CRC checker, makes it very easy to configure and use the RADIO. See [RADIO block diagram](#) on page 285 for details.

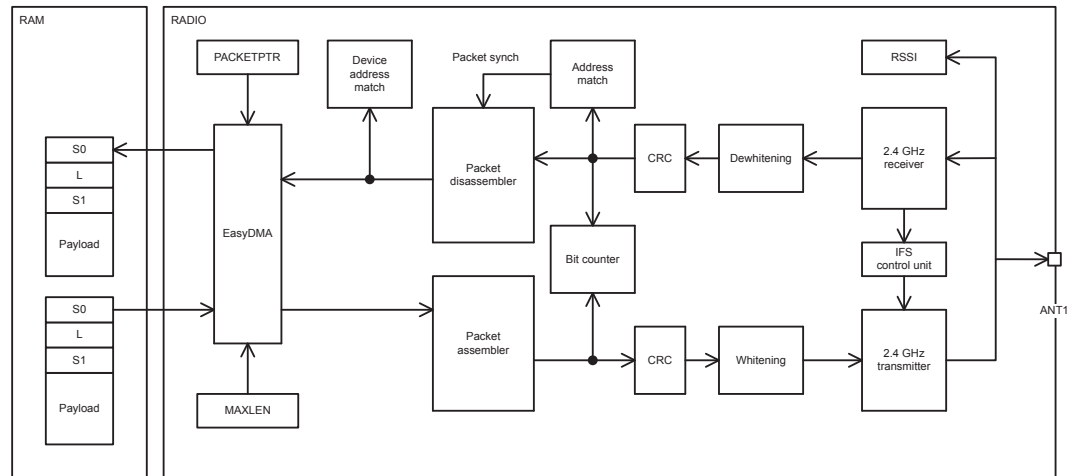


Figure 57: RADIO block diagram

The RADIO includes a device address match unit and an interframe spacing control unit that can be utilized to simplify address white listing and interframe spacing respectively, in *Bluetooth*<sup>®</sup> Smart and similar applications.

The RADIO also includes a received signal strength indicator (RSSI) and a bit counter. The bit counter generates events when a preconfigured number of bits have been sent or received by the RADIO.

### 6.14.1 EasyDMA

The RADIO peripheral uses EasyDMA for reading of data packets from and writing to RAM, without CPU involvement.

As illustrated in [RADIO block diagram](#) on page 285, the RADIO's EasyDMA utilizes the same [PACKETPTR](#) on page 300 for receiving and transmitting packets, and this pointer can only point to the Data RAM region. See [Memory](#) on page 15 for more information about the different memory regions.

The DISABLED event indicates that the EasyDMA has finished accessing the RAM.

The structure of a radio packet is described in detail in [Packet configuration](#) on page 286. The data that is stored in Data RAM and transported by EasyDMA consists of the following fields:

- S0
- LENGTH
- S1
- PAYLOAD

In addition, a static add-on is sent immediately after the payload.

The size of each of the above fields in the frame is configurable, and the space occupied in RAM depends on these settings. A size of zero is possible for any of the fields, it is up to the user to make sure that the resulting frame complies with the RF protocol chosen. For the field sizes defined in bits, the occupation

in RAM will always be rounded up to the next full byte size (for instance 3 bit length will allocate 1 byte in RAM, 9 bit length will allocate 2 bytes, etc.).

The sizes of the fields S0, LENGTH and S1 can be individually configured by the SOLEN, LFLEN and S1LEN fields of the PCNF0 register respectively. The size of the payload is configured through the value in RAM corresponding to the LENGTH field. The size of the static add-on to the payload is configured through the STATLEN field in PCNF1 register.

The MAXLEN field in the PCNF1 register configures the maximum packet payload plus add-on size in number of bytes that can be transmitted or received by the RADIO. This feature can be used to ensure that the RADIO does not overwrite, or read beyond, the RAM assigned to the packet payload. This means that if the packet payload length defined by the PCNF1.STATLEN and the LENGTH field in the packet specify a packet larger than MAXLEN, the payload will be truncated at MAXLEN. The packet's LENGTH field will not be altered when the payload is truncated. The RADIO will calculate CRC as if the packet length is equal to MAXLEN.

**Important:** Note that MAXLEN includes the size of the payload and the add-on, but excludes the size occupied by the fields S0, LENGTH and S1. This has to be taken into account when allocating RAM.

### 6.14.2 Packet configuration

RADIO packet contains the following fields: PREAMBLE, ADDRESS, S0, LENGTH, S1, PAYLOAD and CRC.

The content of a RADIO packet is illustrated in [On-air packet layout](#) on page 286. The RADIO sends the different fields in the packet in the order they are illustrated below, from left to right:

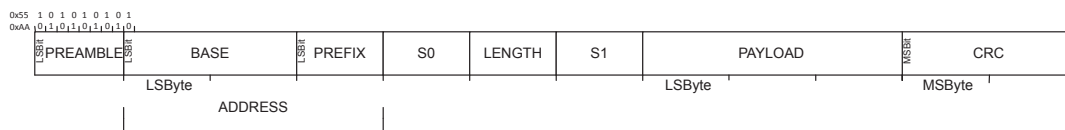


Figure 58: On-air packet layout

PREAMBLE is sent with least significant bit first on-air. For all modes that can be specified in the MODE register, the PREAMBLE is one byte long. If the first bit of the ADDRESS is 0, the PREAMBLE is set to 0xAA. Otherwise the PREAMBLE is set to 0x55.

Not shown in the figure above is the static payload add-on (the length of which is defined in PCNF1.STATLEN, and which is 0 bytes long in a standard BLE packet). The static payload add-on is sent between the PAYLOAD and CRC fields.

The RADIO packets are stored in memory, inside instances of a radio packet data structure as illustrated in [In-RAM representation of radio packet - S0, LENGTH and S1 are optional](#) on page 286. The PREAMBLE, ADDRESS and CRC fields are omitted in this data structure.



Figure 59: In-RAM representation of radio packet - S0, LENGTH and S1 are optional

The byte ordering on the air is always:

- Least significant byte first for the fields ADDRESS and PAYLOAD. The ADDRESS fields are also always transmitted and received least significant bit first on-air.
- Most significant byte first for the CRC field. The CRC field is also always transmitted and received most significant bit first.

The bit endianness, i.e. the order in which the bits are sent and received, is configured in PCNF1.ENDIAN for the fields S0, LENGTH, S1 and PAYLOAD.

The sizes of the fields S0, LENGTH and S1 can be individually configured in the SOLEN, LFLEN and S1LEN fields of the PCNF0 register respectively. If any of these fields are configured to be less than 8 bit long, the least significant bits of the fields are used, as seen from the RAM representation.

If S0, LENGTH or S1 are specified with zero length, their fields will be omitted in memory. Otherwise each field will be represented as a separate byte, regardless of the number of bits in their on-air counterpart.

### 6.14.3 Maximum packet length

Independent of the configuration of MAXLEN, the combined length of S0, LENGTH, S1 and PAYLOAD cannot exceed 258 bytes.

### 6.14.4 Address configuration

The on-air radio ADDRESS field is composed of two parts, the base address field and the address prefix field.

The size of the base address field is configurable via BALEN in PCNF1. The base address is truncated from LSByte if the BALEN is less than 4. See [Definition of logical addresses](#) on page 287.

The on-air addresses are defined in the BASEn and PREFIXn registers, and it is only when writing these registers the user will have to relate to actual on-air addresses. For other radio address registers such as the TXADDRESS, RXADDRESSES and RXMATCH registers, logical radio addresses ranging from 0 to 7 are being used. The relationship between the on-air radio addresses and the logical addresses is described in [Definition of logical addresses](#) on page 287.

Logical address	Base address	Prefix byte
0	BASE0	PREFIX0.AP0
1	BASE1	PREFIX0.AP1
2	BASE1	PREFIX0.AP2
3	BASE1	PREFIX0.AP3
4	BASE1	PREFIX1.AP4
5	BASE1	PREFIX1.AP5
6	BASE1	PREFIX1.AP6
7	BASE1	PREFIX1.AP7

Table 58: Definition of logical addresses

### 6.14.5 Data whitening

The RADIO is able to do packet whitening and de-whitening.

See WHITEEN in PCNF1 register for how to enable whitening. When enabled, whitening and de-whitening will be handled by the RADIO automatically as packets are sent and received.

The whitening word is generated using polynomial  $g(D) = D^7 + D^4 + 1$ , which then is XORed with the data packet that is to be whitened, or de-whitened. See the figure below.

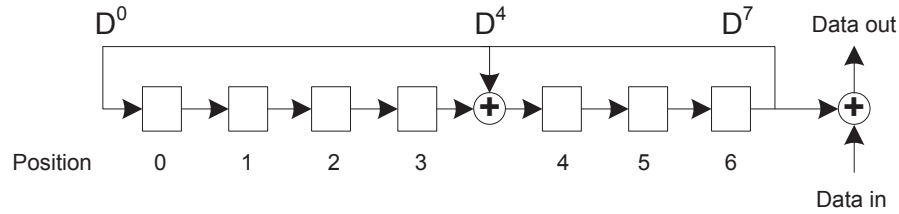


Figure 60: Data whitening and de-whitening

Whitening and de-whitening will be performed over the whole packet (except for the preamble and the address field).

The linear feedback shift register, illustrated in [Data whitening and de-whitening](#) on page 288 can be initialised via the DATAWHITEIV register.

#### 6.14.6 CRC

The CRC generator in the RADIO calculates the CRC over the whole packet excluding the preamble. If desirable, the address field can be excluded from the CRC calculation as well

See CRCCNF register for more information.

The CRC polynomial is configurable as illustrated in [CRC generation of an n bit CRC](#) on page 288 where bit 0 in the CRCPOLY register corresponds to  $X^0$  and bit 1 corresponds to  $X^1$  etc. See CRCPOLY for more information.

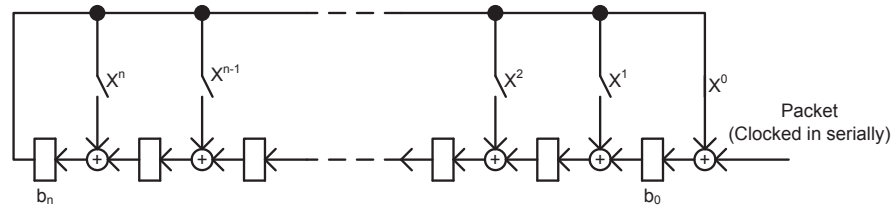


Figure 61: CRC generation of an n bit CRC

As illustrated in [CRC generation of an n bit CRC](#) on page 288, the CRC is calculated by feeding the packet serially through the CRC generator. Before the packet is clocked through the CRC generator, the CRC generator's latches  $b_0$  through  $b_n$  will be initialized with a predefined value specified in the CRCINIT register. When the whole packet is clocked through the CRC generator, latches  $b_0$  through  $b_n$  will hold the resulting CRC. This value will be used by the RADIO during both transmission and reception but it is not available to be read by the CPU at any time. A received CRC can however be read by the CPU via the RXCRC register independent of whether or not it has passed the CRC check.

The length (n) of the CRC is configurable, see CRCCNF for more information.

After the whole packet including the CRC has been received, the RADIO will generate a CRCOK event if no CRC errors were detected, or alternatively generate a CRCERROR event if CRC errors were detected.



The status of the CRC check can be read from the CRCSTATUS register after a packet has been received.

### 6.14.7 Radio states

The RADIO can enter a number of states.

The RADIO can enter the states described the table below. An overview state diagram for the RADIO is illustrated in [Radio states](#) on page 289. This figure shows how the tasks and events relate to the RADIO's operation. The RADIO does not prevent a task from being triggered from the wrong state. If a task is triggered from the wrong state, for example if the RXEN task is triggered from the RXDISABLE state, this may lead to incorrect behaviour. As illustrated in [Radio states](#) on page 289, the PAYLOAD event is always generated even if the payload is zero.

State	Description
DISABLED	No operations are going on inside the radio and the power consumption is at a minimum
RXRU	The radio is ramping up and preparing for reception
RXIDLE	The radio is ready for reception to start
RX	Reception has been started and the addresses enabled in the RXADDRESSES register are being monitored
TXRU	The radio is ramping up and preparing for transmission
TXIDLE	The radio is ready for transmission to start
TX	The radio is transmitting a packet
RXDISABLE	The radio is disabling the receiver
TXDISABLE	The radio is disabling the transmitter

Table 59: RADIO state diagram

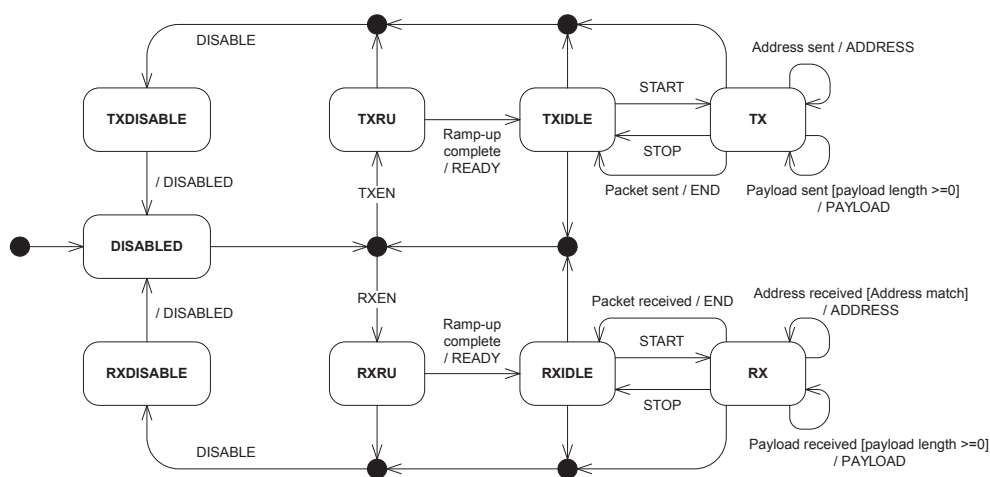


Figure 62: Radio states

### 6.14.8 Transmit sequence

Before the RADIO is able to transmit a packet, it must first ramp-up in TX mode.

See TXRU in [Radio states](#) on page 289 and [Transmit sequence](#) on page 290. A TXRU ramp-up sequence is initiated when the TXEN task is triggered. After the radio has successfully ramped up it will generate the READY event indicating that a packet transmission can be initiate. A packet transmission is initiated by triggering the START task. As illustrated in [Radio states](#) on page 289 the START task can first be triggered after the RADIO has entered into the TXIDLE state.

[Transmit sequence](#) on page 290 illustrates a single packet transmission where the CPU manually triggers the different tasks needed to control the flow of the RADIO, i.e. no shortcuts are used. If shortcuts are not used, a certain amount of delay caused by CPU execution is expected between READY and START, and between END and DISABLE. As illustrated in [Transmit sequence](#) on page 290 the RADIO will by default transmit '1's between READY and START, and between END and DISABLE. What is transmitted can be programmed through the DTX field in the MODECNF0 register.

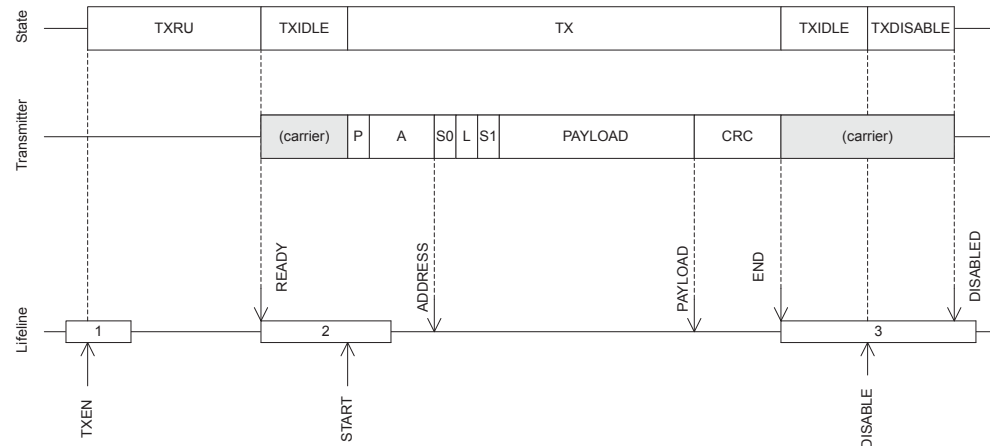


Figure 63: Transmit sequence

A slightly modified version of the transmit sequence from [Transmit sequence](#) on page 290 is illustrated in [Transmit sequence using shortcuts to avoid delays](#) on page 290 where the RADIO is configured to use shortcuts between READY and START, and between END and DISABLE, which means that no delay is introduced.

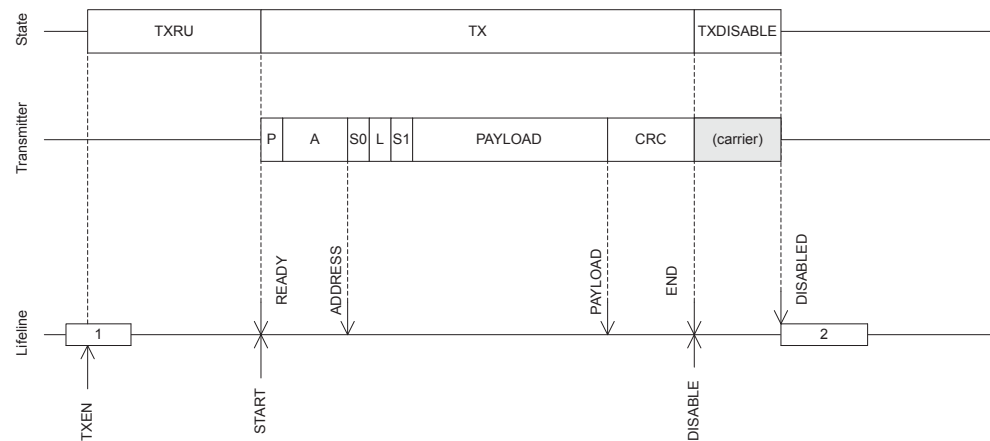


Figure 64: Transmit sequence using shortcuts to avoid delays

The RADIO is able to send multiple packets one after the other without having to disable and re-enable the RADIO between packets, this is illustrated in [Transmission of multiple packets](#) on page 291.

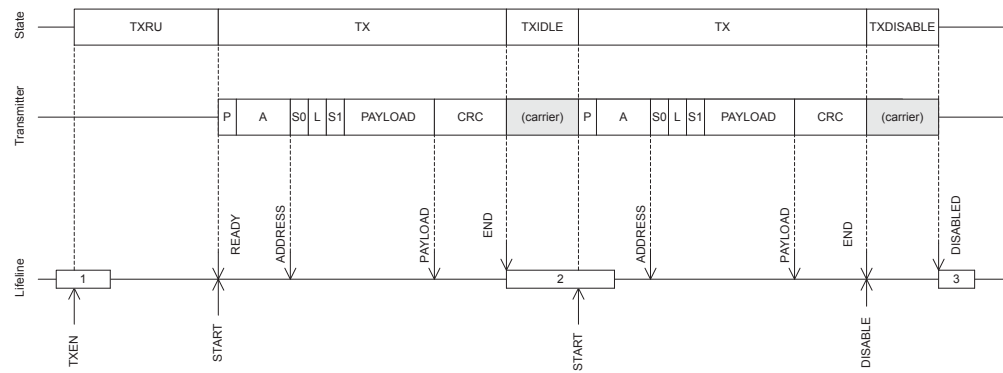


Figure 65: Transmission of multiple packets

### 6.14.9 Receive sequence

Before the RADIO is able to receive a packet, it must first ramp up in RX mode

See RXRU in [Radio states](#) on page 289 and [Receive sequence](#) on page 291. An RXRU ramp-up sequence is initiated when the RXEN task is triggered. After the radio has successfully ramped up it will generate the READY event indicating that a packet reception can be initiated. A packet reception is initiated by triggering the START task. As illustrated in [Radio states](#) on page 289 the START task can, first be triggered after the RADIO has entered into the RXIDLE state.

[Receive sequence](#) on page 291 illustrates a single packet reception where the CPU manually triggers the different tasks needed to control the flow of the RADIO, i.e. no shortcuts are used. If shortcuts are not used, a certain amount of delay, caused by CPU execution, is expected between READY and START, and between END and DISABLE. As illustrated [Receive sequence](#) on page 291 the RADIO will be listening and possibly receiving undefined data, illustrated with an 'X', from START and until a packet with valid preamble (P) is received.

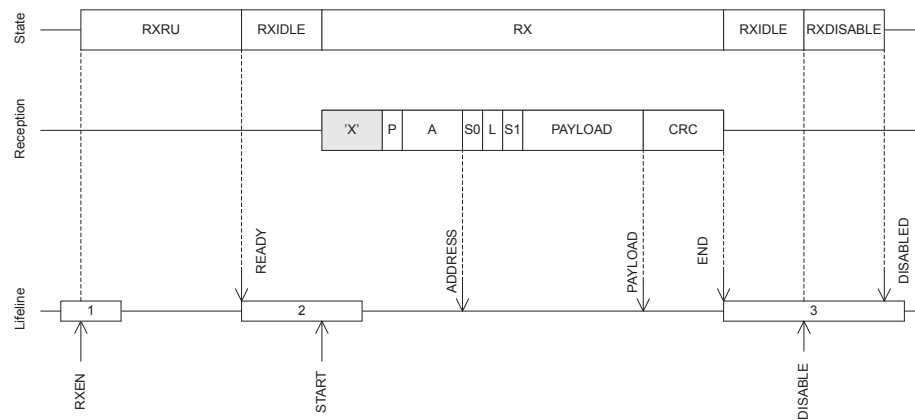


Figure 66: Receive sequence

A slightly modified version of the receive sequence from [Receive sequence](#) on page 291 is illustrated in [Receive sequence using shortcuts to avoid delays](#) on page 292 where the the RADIO is configured to use shortcuts between READY and START, and between END and DISABLE, which means that no delay is introduced.

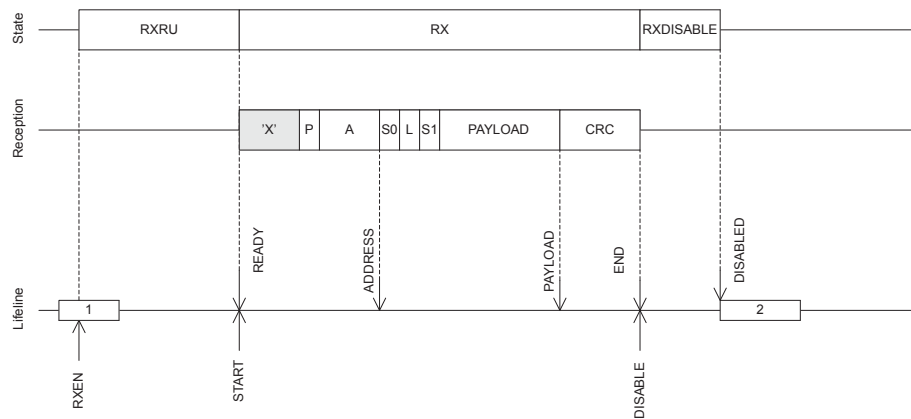


Figure 67: Receive sequence using shortcuts to avoid delays

The RADIO is able to receive multiple packets one after the other without having to disable and re-enable the RADIO between packets, this is illustrated [Reception of multiple packets](#) on page 292.

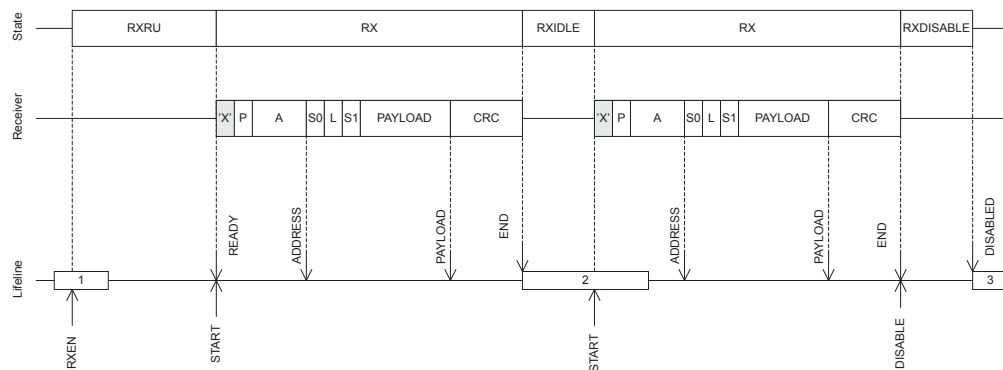


Figure 68: Reception of multiple packets

#### 6.14.10 Received signal strength indicator (RSSI)

A mechanism for measuring the power in the received radio signal is implemented. This feature is called received signal strength indicator (RSSI).

Sampling of the received signal strength is started by using the RSSISTART task. The sample can be read from the RSSISAMPLE register.

The sample period of the RSSI is defined by  $RSSI_{PERIOD}$ , see the device product specification for details. The RSSI sample will hold the average received signal strength during this sample period.

For the RSSI sample to be valid, the radio has to be enabled in the receive mode (RXEN task) and the reception has to be started (READY event followed by START task).

#### 6.14.11 Interframe spacing

Interframe spacing is the time interval between two consecutive packets.

It is defined as the time (in microseconds) from the end of the last bit of the previous packet received and to the start of the first bit of the subsequent packet that is transmitted. The radio is able to enforce this interval as specified in the TIFS register as long as TIFS is not specified to be shorter than the radio's turn-around time, i.e. the time needed to switch off the receiver, and switch back on the transmitter.

TIFS is only enforced if END\_DISABLE and DISABLED\_TXEN or END\_DISABLE and DISABLED\_RXEN shortcuts are enabled. TIFS is only qualified for use in BLE\_1MBIT mode, and default ramp-up mode. The use of shortcuts and timing is illustrated in [Ramp up and TIFS Timing Details](#) on page 293.

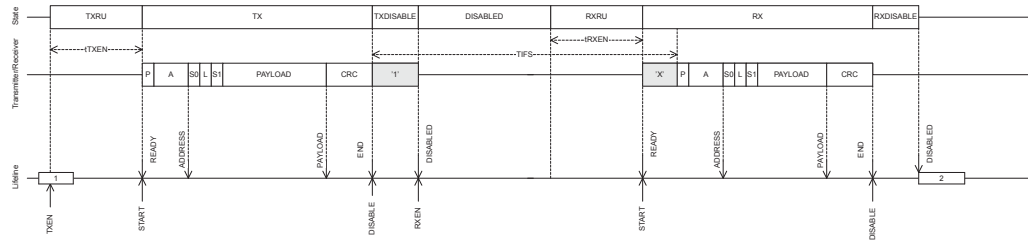


Figure 69: Ramp up and TIFS Timing Details

### 6.14.12 Device address match

The device address match feature is tailored for address white listing in a *Bluetooth*® Smart and similar implementations.

This feature enables on-the-fly device address matching while receiving a packet on air. This feature only works in receive mode and as long as the radio is configured for little endian, see PCNF1.ENDIAN.

The device address match unit assumes that the 48 first bits of the payload is the device address and that bit number 6 in S0 is the TxAdd bit. See the *Bluetooth*® Core Specification for more information about device addresses, TxAdd and whitelisting.

The radio is able to listen for eight different device addresses at the same time. These addresses are specified in a DAB/DAP register pair, one pair per address, in addition to a TxAdd bit configured in the DACNF register. The DAB register specifies the 32 least significant bits of the device address, while the DAP register specifies the 16 most significant bits of the device address.

Each of the device addresses can be individually included or excluded from the matching mechanism. This is configured in the DACNF register.

### 6.14.13 Bit counter

Radio implements a simple counter that can be configured to generate an event after a specific number of bits have been transmitted or received.

By using shortcuts, this counter can be started from different events generated by the radio and hence count relative to these.

The bit counter is started by triggering the BCSTART task, and stopped by triggering the BCSTOP task. A BCMATCH event will be generated when the bit counter has counted the number of bits specified in the BCC register. The bit counter will continue to count bits until the DISABLED event is generated or until the BCSTOP task is triggered. The CPU can therefore, after a BCMATCH event, reconfigure the BCC value for new BCMATCH events within the same packet.

The bit counter can only be started after the radio has received the ADDRESS event.

The bit counter will stop and reset on BCSTOP, STOP, END and DISABLE tasks.

The figure below illustrates how the bit counter can be used to generate a BCMATCH event in the beginning of the packet payload, and again generate a second BCMATCH event after sending 2 bytes (16 bits) of the payload.

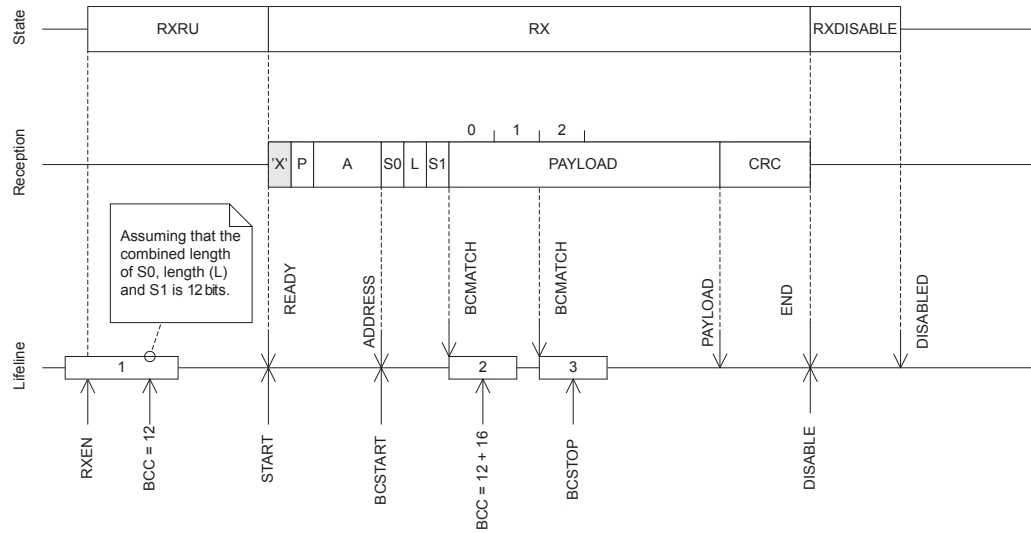


Figure 70: Bit counter example

## 6.14.14 Registers

Base address	Peripheral	Instance	Description	Configuration
0x40001000	RADIO	RADIO	2.4 GHz radio	

Table 60: Instances

Register	Offset	Description
TASKS_TXEN	0x000	Enable RADIO in TX mode
TASKS_RXEN	0x004	Enable RADIO in RX mode
TASKS_START	0x008	Start RADIO
TASKS_STOP	0x00C	Stop RADIO
TASKS_DISABLE	0x010	Disable RADIO
TASKS_RSSISTART	0x014	Start the RSSI and take one single sample of the receive signal strength.
TASKS_RSSISTOP	0x018	Stop the RSSI measurement
TASKS_BCSTART	0x01C	Start the bit counter
TASKS_BCSTOP	0x020	Stop the bit counter
EVENTS_READY	0x100	RADIO has ramped up and is ready to be started
EVENTS_ADDRESS	0x104	Address sent or received
EVENTS_PAYLOAD	0x108	Packet payload sent or received
EVENTS_END	0x10C	Packet sent or received
EVENTS_DISABLED	0x110	RADIO has been disabled
EVENTS_DEVMATCH	0x114	A device address match occurred on the last received packet
EVENTS_DEVMISS	0x118	No device address match occurred on the last received packet
EVENTS_RSSIEND	0x11C	Sampling of receive signal strength complete.
EVENTS_BCMATCH	0x128	Bit counter reached bit count value.
EVENTS_CRCOK	0x130	Packet received with CRC ok
EVENTS_CRCERROR	0x134	Packet received with CRC error
SHORTS	0x200	Shortcut register
INTENSET	0x304	Enable interrupt
INTENCLR	0x308	Disable interrupt
CRCSTATUS	0x400	CRC status
RXMATCH	0x408	Received address
RXCRC	0x40C	CRC field of previously received packet

Register	Offset	Description
DAI	0x410	Device address match index
PACKETPTR	0x504	Packet pointer
FREQUENCY	0x508	Frequency
TXPOWER	0x50C	Output power
MODE	0x510	Data rate and modulation
PCNF0	0x514	Packet configuration register 0
PCNF1	0x518	Packet configuration register 1
BASE0	0x51C	Base address 0
BASE1	0x520	Base address 1
PREFIX0	0x524	Prefixes bytes for logical addresses 0-3
PREFIX1	0x528	Prefixes bytes for logical addresses 4-7
TXADDRESS	0x52C	Transmit address select
RXADDRESSES	0x530	Receive address select
CRCCNF	0x534	CRC configuration
CRCPOLY	0x538	CRC polynomial
CRCINIT	0x53C	CRC initial value
	0x540	Reserved
TIFS	0x544	Inter Frame Spacing in us
RSSISAMPLE	0x548	RSSI sample
STATE	0x550	Current radio state
DATAWHITEIV	0x554	Data whitening initial value
BCC	0x560	Bit counter compare
DAB[0]	0x600	Device address base segment 0
DAB[1]	0x604	Device address base segment 1
DAB[2]	0x608	Device address base segment 2
DAB[3]	0x60C	Device address base segment 3
DAB[4]	0x610	Device address base segment 4
DAB[5]	0x614	Device address base segment 5
DAB[6]	0x618	Device address base segment 6
DAB[7]	0x61C	Device address base segment 7
DAP[0]	0x620	Device address prefix 0
DAP[1]	0x624	Device address prefix 1
DAP[2]	0x628	Device address prefix 2
DAP[3]	0x62C	Device address prefix 3
DAP[4]	0x630	Device address prefix 4
DAP[5]	0x634	Device address prefix 5
DAP[6]	0x638	Device address prefix 6
DAP[7]	0x63C	Device address prefix 7
DACNF	0x640	Device address match configuration
MODECNF0	0x650	Radio mode configuration register 0
POWER	0xFFC	Peripheral power control

Table 61: Register Overview

### 6.14.14.1 SHORTS

Address offset: 0x200

Shortcut register

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0																															
Id				H G F E D C B A																															
Reset 0x00000000				0 0																															
Id	RW	Field	Value	Id	Value	Description																													
A	RW	READY_START				Shortcut between READY event and START task																													
						See <a href="#">EVENTS_READY</a> and <a href="#">TASKS_START</a>																													
			Disabled		0	Disable shortcut																													
			Enabled		1	Enable shortcut																													
B	RW	END_DISABLE				Shortcut between END event and DISABLE task																													
						See <a href="#">EVENTS_END</a> and <a href="#">TASKS_DISABLE</a>																													
			Disabled		0	Disable shortcut																													
			Enabled		1	Enable shortcut																													
C	RW	DISABLED_TXEN				Shortcut between DISABLED event and TXEN task																													
						See <a href="#">EVENTS_DISABLED</a> and <a href="#">TASKS_TXEN</a>																													
			Disabled		0	Disable shortcut																													
			Enabled		1	Enable shortcut																													
D	RW	DISABLED_RXEN				Shortcut between DISABLED event and RXEN task																													
						See <a href="#">EVENTS_DISABLED</a> and <a href="#">TASKS_RXEN</a>																													
			Disabled		0	Disable shortcut																													
			Enabled		1	Enable shortcut																													
E	RW	ADDRESS_RSSISTART				Shortcut between ADDRESS event and RSSISTART task																													
						See <a href="#">EVENTS_ADDRESS</a> and <a href="#">TASKS_RSSISTART</a>																													
			Disabled		0	Disable shortcut																													
			Enabled		1	Enable shortcut																													
F	RW	END_START				Shortcut between END event and START task																													
						See <a href="#">EVENTS_END</a> and <a href="#">TASKS_START</a>																													
			Disabled		0	Disable shortcut																													
			Enabled		1	Enable shortcut																													
G	RW	ADDRESS_BCSTART				Shortcut between ADDRESS event and BCSTART task																													
						See <a href="#">EVENTS_ADDRESS</a> and <a href="#">TASKS_BCSTART</a>																													
			Disabled		0	Disable shortcut																													
			Enabled		1	Enable shortcut																													
H	RW	DISABLED_RSSISTOP				Shortcut between DISABLED event and RSSISTOP task																													
						See <a href="#">EVENTS_DISABLED</a> and <a href="#">TASKS_RSSISTOP</a>																													
			Disabled		0	Disable shortcut																													
			Enabled		1	Enable shortcut																													

### 6.14.14.2 INTENSET

Address offset: 0x304

Enable interrupt

Bit number					31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0																																
Id																					K	J				I				H	G	F	E	D	C	B	A
Reset 0x00000000					0 0																																
Id	RW	Field	Value	Id	Value	Description																															
A	RW	READY				Write '1' to Enable interrupt for READY event																															
						See <a href="#">EVENTS_READY</a>																															
			Set		1	Enable																															
			Disabled		0	Read: Disabled																															



Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0																																
Id				K J I H G F E D C B A																																
Reset 0x00000000				0 0																																
Id	RW	Field	Value Id	Value	Description																															
			Enabled	1	Read: Enabled																															
B	RW	ADDRESS	Write '1' to Enable interrupt for ADDRESS event																																	
			See <a href="#">EVENTS_ADDRESS</a>																																	
			Set	1	Enable																															
			Disabled	0	Read: Disabled																															
			Enabled	1	Read: Enabled																															
C	RW	PAYLOAD	Write '1' to Enable interrupt for PAYLOAD event																																	
			See <a href="#">EVENTS_PAYLOAD</a>																																	
			Set	1	Enable																															
			Disabled	0	Read: Disabled																															
			Enabled	1	Read: Enabled																															
D	RW	END	Write '1' to Enable interrupt for END event																																	
			See <a href="#">EVENTS_END</a>																																	
			Set	1	Enable																															
			Disabled	0	Read: Disabled																															
			Enabled	1	Read: Enabled																															
E	RW	DISABLED	Write '1' to Enable interrupt for DISABLED event																																	
			See <a href="#">EVENTS_DISABLED</a>																																	
			Set	1	Enable																															
			Disabled	0	Read: Disabled																															
			Enabled	1	Read: Enabled																															
F	RW	DEVMATCH	Write '1' to Enable interrupt for DEVMATCH event																																	
			See <a href="#">EVENTS_DEVMATCH</a>																																	
			Set	1	Enable																															
			Disabled	0	Read: Disabled																															
			Enabled	1	Read: Enabled																															
G	RW	DEVMISS	Write '1' to Enable interrupt for DEVMISS event																																	
			See <a href="#">EVENTS_DEVMISS</a>																																	
			Set	1	Enable																															
			Disabled	0	Read: Disabled																															
			Enabled	1	Read: Enabled																															
H	RW	RSSIEND	Write '1' to Enable interrupt for RSSIEND event																																	
			See <a href="#">EVENTS_RSSIEND</a>																																	
			Set	1	Enable																															
			Disabled	0	Read: Disabled																															
			Enabled	1	Read: Enabled																															
I	RW	BCMATCH	Write '1' to Enable interrupt for BCMATCH event																																	
			See <a href="#">EVENTS_BCMATCH</a>																																	
			Set	1	Enable																															
			Disabled	0	Read: Disabled																															
			Enabled	1	Read: Enabled																															
J	RW	CRCOK	Write '1' to Enable interrupt for CRCOK event																																	
			See <a href="#">EVENTS_CRCOK</a>																																	
			Set	1	Enable																															
			Disabled	0	Read: Disabled																															
			Enabled	1	Read: Enabled																															

Bit number				31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0			
Id																				K	J			I			H	G	F	E	D	C	B	A				
Reset 0x00000000				0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0			
Id	RW	Field	Value Id	Value	Description																																	
K	RW	CRCERROR			Write '1' to Enable interrupt for CRCERROR event																																	
					See <a href="#">EVENTS_CRCERROR</a>																																	
		Set		1	Enable																																	
		Disabled		0	Read: Disabled																																	
		Enabled		1	Read: Enabled																																	

### 6.14.14.3 INTENCLR

Address offset: 0x308

### Disable interrupt

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0																															
Id				K J I H G F E D C B A																															
Reset 0x00000000				0 0																															
Id	RW	Field	Value	Id	Value	Description																													
A	RW	READY				Write '1' to Disable interrupt for READY event																													
						See <a href="#">EVENTS_READY</a>																													
			Clear	1		Disable																													
			Disabled	0		Read: Disabled																													
			Enabled	1		Read: Enabled																													
B	RW	ADDRESS				Write '1' to Disable interrupt for ADDRESS event																													
						See <a href="#">EVENTS_ADDRESS</a>																													
			Clear	1		Disable																													
			Disabled	0		Read: Disabled																													
			Enabled	1		Read: Enabled																													
C	RW	PAYLOAD				Write '1' to Disable interrupt for PAYLOAD event																													
						See <a href="#">EVENTS_PAYLOAD</a>																													
			Clear	1		Disable																													
			Disabled	0		Read: Disabled																													
			Enabled	1		Read: Enabled																													
D	RW	END				Write '1' to Disable interrupt for END event																													
						See <a href="#">EVENTS_END</a>																													
			Clear	1		Disable																													
			Disabled	0		Read: Disabled																													
			Enabled	1		Read: Enabled																													
E	RW	DISABLED				Write '1' to Disable interrupt for DISABLED event																													
						See <a href="#">EVENTS_DISABLED</a>																													
			Clear	1		Disable																													
			Disabled	0		Read: Disabled																													
			Enabled	1		Read: Enabled																													
F	RW	DEVMATCH				Write '1' to Disable interrupt for DEVMATCH event																													
						See <a href="#">EVENTS_DEVMATCH</a>																													
			Clear	1		Disable																													
			Disabled	0		Read: Disabled																													
			Enabled	1		Read: Enabled																													
G	RW	DEVMISS				Write '1' to Disable interrupt for DEVMISS event																													
						See <a href="#">EVENTS_DEVMISS</a>																													

Address offset: 0x400

CRC status

#### 6.14.14.5 RXMATCH

Address offset: 0x408

Received address

Bit number					31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0																																		
Id																																					A	A	A
Reset 0x00000000					0 0																																		
Id	RW	Field	Value	Id	Value	Description																																	
A	R	RXMATCH				Received address																																	
Logical address of which previous packet was received																																							

### 6.14.14.6 RXCRC

Address offset: 0x40C

CRC field of previously received packet

Bit number					31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0																															
Id					A A																															
Reset 0x00000000					0 0																															
Id		RW	Field		Value		Id	Value		Description																										
A		R	RXCRC						CRC field of previously received packet																											
									CRC field of previously received packet																											

### 6.14.14.7 DAI

Address offset: 0x410

Device address match index

Bit number					31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0																															
Id					A A A																															
Reset 0x00000000					0 0																															
Id	RW	Field	Value	Id	Value	Description																														
A	R	DAI				Device address match index																														
Index (n) of device address, see DAB[n] and DAP[n], that got an address match.																																				

### 6.14.14.8 PACKETPTR

Address offset: 0x504

Packet pointer

Bit number					31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0																															
Id					A A																															
Reset 0x00000000					0 0																															
Id		RW	Field	Value	Id	Value	Description																													
A		RW	PACKETPTR				Packet pointer  Packet address to be used for the next transmission or reception. When transmitting, the packet pointed to by this address will be transmitted and when receiving, the received packet will be written to this address. This address is a byte aligned ram address.																													

### 6.14.14.9 FREQUENCY

Address offset: 0x508

## Frequency

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0																															
Id				B A A A A A A A																															
Reset 0x00000002				0 1 0																															
Id	RW	Field	Value	Id	Value	Description																													
A	RW	FREQUENCY			[0..100]	Radio channel frequency																													
						Frequency = 2400 + FREQUENCY (MHz).																													
B	RW	MAP				Channel map selection.																													
			Default		0	Channel map between 2400 MHz .. 2500 MHz																													
						Frequency = 2400 + FREQUENCY (MHz)																													
			Low		1	Channel map between 2360 MHz .. 2460 MHz																													
						Frequency = 2360 + FREQUENCY (MHz)																													

## 6.14.14.10 TXPOWER

Address offset: 0x50C

Output power

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0																															
Id				A A A A A A A A																															
Reset 0x00000000				0 0																															
Id	RW	Field	Value Id	Value	Description																														
A	RW	TXPOWER			RADIO output power.																														
					Output power in number of dBm, i.e. if the value -20 is specified the output power will be set to -20dBm.																														
			Pos4dBm	0x04	+4 dBm																														
			Pos3dBm	0x03	+3 dBm																														
			0dBm	0x00	0 dBm																														
			Neg4dBm	0xFC	-4 dBm																														
			Neg8dBm	0xF8	-8 dBm																														
			Neg12dBm	0xF4	-12 dBm																														
			Neg16dBm	0xF0	-16 dBm																														
			Neg20dBm	0xEC	-20 dBm																														
			Neg30dBm	0xD8	-40 dBm																														
			Neg40dBm	0xD8	-40 dBm																														

Deprecated

## 6.14.14.11 MODE

Address offset: 0x510

Data rate and modulation

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0																															
Id				A A A A																															
Reset 0x00000000				0 0																															
Id	RW	Field	Value	Id	Value	Description																													
A	RW	MODE				Radio data rate and modulation setting. The radio supports Frequency-shift Keying (FSK) modulation.																													
			Nrf_1Mbit	0		1 Mbit/s Nordic proprietary radio mode																													
			Nrf_2Mbit	1		2 Mbit/s Nordic proprietary radio mode																													
			Ble_1Mbit	3		1 Mbit/s Bluetooth Low Energy																													
			Ble_2Mbit	4		2 Mbit/s Bluetooth Low Energy																													

#### 6.14.14.12 PCNF0

Address offset: 0x514

Packet configuration register 0

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0																																
Id				G								F E E E E								C								A A A A								
Reset 0x00000000				0 0																																
Id	RW	Field	Value Id	Value	Description																															
A	RW	LFLEN			Length on air of LENGTH field in number of bits.																															
C	RW	SOLEN			Length on air of S0 field in number of bytes.																															
E	RW	S1LEN			Length on air of S1 field in number of bits.																															
F	RW	S1INCL			Include or exclude S1 field in RAM																															
			Automatic	0	Include S1 field in RAM only if S1LEN > 0																															
			Include	1	Always include S1 field in RAM independent of S1LEN																															
G	RW	PLEN			Length of preamble on air. Decision point: TASKS_START task																															
			8bit	0	8-bit preamble																															
			16bit	1	16-bit preamble																															

#### 6.14.14.13 PCNF1

Address offset: 0x518

Packet configuration register 1

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0																																			
Id				E D C C C B B B B B B B A A A A A A A																																			
Reset 0x00000000				0 0																																			
Id	RW	Field	Value Id	Value	Description																																		
A	RW	MAXLEN		[0..255]	Maximum length of packet payload. If the packet payload is larger than MAXLEN, the radio will truncate the payload to MAXLEN.																																		
B	RW	STATLEN		[0..255]	Static length in number of bytes  The static length parameter is added to the total length of the payload when sending and receiving packets, e.g. if the static length is set to N the radio will receive or send N bytes more than what is defined in the LENGTH field of the packet.																																		
C	RW	BALEN		[2..4]	Base address length in number of bytes  The address field is composed of the base address and the one byte long address prefix, e.g. set BALEN=2 to get a total address of 3 bytes.																																		
D	RW	ENDIAN			On air endianness of packet, this applies to the S0, LENGTH, S1 and the PAYLOAD fields.																																		
			Little	0	Least Significant bit on air first																																		
			Big	1	Most significant bit on air first																																		
E	RW	WHITEEN			Enable or disable packet whitening																																		
			Disabled	0	Disable																																		
			Enabled	1	Enable																																		

#### 6.14.14.14 BASE0

Address offset: 0x51C

Base address 0

Bit number					31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0																															
Id					A A																															
Reset 0x00000000					0 0																															
Id	RW	Field	Value Id	Value	Description																															
A	RW	BASE0			Base address 0																															
					Radio base address 0.																															

#### 6.14.14.15 BASE1

Address offset: 0x520

Base address 1

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0																															
Id				A A																															
Reset 0x00000000				0 0																															
Id	RW	Field	Value Id	Value				Description																											
A	RW	BASE1						Base address 1																											
								Radio base address 1.																											

#### 6.14.14.16 PREFIX0

Address offset: 0x524

## Prefixes bytes for logical addresses 0-3

Bit number					31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0																															
Id					D D D D D D D D C C C C C C C C B B B B B B B B A A A A A A A A																															
Reset 0x00000000					0 0																															
Id	RW	Field	Value	Id	Value				Description																											
A	RW	AP0							Address prefix 0.																											
B	RW	AP1							Address prefix 1.																											
C	RW	AP2							Address prefix 2.																											
D	RW	AP3							Address prefix 3.																											

## 6.14.14.17 PREFIX1

Address offset: 0x528

## Prefixes bytes for logical addresses 4-7

Bit number					31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0																															
Id					D D D D D D D D C C C C C C C C B B B B B B B B A A A A A A A A																															
Reset 0x00000000					0 0																															
Id	RW	Field	Value	Id	Value		Description																													
A	RW	AP4					Address prefix 4.																													
B	RW	AP5					Address prefix 5.																													
C	RW	AP6					Address prefix 6.																													
D	RW	AP7					Address prefix 7.																													

## 6.14.14.18 TXADDRESS

Address offset: 0x52C

## Transmit address select

Bit number	31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0																														
Id	A A A																														
Reset 0x00000000	0 0																														
Id	RW	Field	Value	Id	Value	Description																									
A	RW	TXADDRESS				Transmit address select																									
						Logical address to be used when transmitting a packet.																									

## 6.14.14.19 RXADDRESSES

Address offset: 0x530

## Receive address select

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0																															
Id				H G F E D C B A																															
Reset 0x00000000				0 0																															
Id	RW	Field	Value	Id	Value	Description																													
A	RW	ADDR0				Enable or disable reception on logical address 0.																													
			Disabled	0	Disable																														
			Enabled	1	Enable																														
B	RW	ADDR1				Enable or disable reception on logical address 1.																													
			Disabled	0	Disable																														



Bit number				31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
Id																																			
Reset 0x00000000				0 0																															
Id	RW	Field	Value	Id	Value	Description																													
			Enabled	1	Enable																														
C	RW	ADDR2	Enable or disable reception on logical address 2.																																
			Disabled	0	Disable																														
			Enabled	1	Enable																														
D	RW	ADDR3	Enable or disable reception on logical address 3.																																
			Disabled	0	Disable																														
			Enabled	1	Enable																														
E	RW	ADDR4	Enable or disable reception on logical address 4.																																
			Disabled	0	Disable																														
			Enabled	1	Enable																														
F	RW	ADDR5	Enable or disable reception on logical address 5.																																
			Disabled	0	Disable																														
			Enabled	1	Enable																														
G	RW	ADDR6	Enable or disable reception on logical address 6.																																
			Disabled	0	Disable																														
			Enabled	1	Enable																														
H	RW	ADDR7	Enable or disable reception on logical address 7.																																
			Disabled	0	Disable																														
			Enabled	1	Enable																														

#### 6.14.14.20 CRCCNF

Address offset: 0x534

## CRC configuration

Bit number				31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
Id				B																												A		A	
Reset 0x00000000				0																												0		0	
Id	RW	Field	Value	Id	Value		Description																												
A	RW	LEN			[1..3]		CRC length in number of bytes.																												
			Disabled	0	CRC length is zero and CRC calculation is disabled																														
			One	1	CRC length is one byte and CRC calculation is enabled																														
			Two	2	CRC length is two bytes and CRC calculation is enabled																														
			Three	3	CRC length is three bytes and CRC calculation is enabled																														
B	RW	SKIPADDR					Include or exclude packet address field out of CRC calculation.																												
			Include	0	CRC calculation includes address field																														
			Skip	1	CRC calculation does not include address field. The CRC calculation will start at the first byte after the address.																														

#### 6.14.14.21 CRCPOLY

Address offset: 0x538

CRC polynomial

Bit number	31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0																													
Id	A A																													A
Reset 0x00000000	0 0																													0
Id	RW	Field	Value Id	Value	Description																									

A RW CRCPOLY

CRC polynomial

Each term in the CRC polynomial is mapped to a bit in this register which index corresponds to the term's exponent. The least significant term/bit is hard-wired internally to 1, and bit number 0 of the register content is ignored by the hardware. The following example is for an 8 bit CRC polynomial:  $x^8 + x^7 + x^3 + x^2 + 1 = 1\ 1000\ 1101$ .

### 6.14.14.22 CRCINIT

Address offset: 0x53C

CRC initial value

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0																																
Id				A A																																
Reset 0x00000000				0 0																																
Id	RW	Field	Value Id	Value	Description																															

A RW CRCINIT

CRC initial value

Initial value for CRC calculation.

### 6.14.14.23 TIFS

Address offset: 0x544

Inter Frame Spacing in us

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0																															
Id				A A																															
Reset 0x00000000				0 0																															
Id	RW	Field	Value Id	Value	Description																														

A RW TIFS

Inter Frame Spacing in us

Inter frame space is the time interval between two consecutive packets. It is defined as the time, in microseconds, from the end of the last bit of the previous packet to the start of the first bit of the subsequent packet.

### 6.14.14.24 RSSISAMPLE

Address offset: 0x548

RSSI sample

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0																															
Id				A A A A A A A A																															
Reset 0x00000000				0 0																															
Id	RW	Field	Value Id	Value	Description																														

Id	RW	Field	Value Id	Value	Description
A	R	RSSISAMPLE		[0..127]	RSSI sample
RSSI sample result. The value of this register is read as a positive value while the actual received signal strength is a negative value. Actual received signal strength is therefore as follows: received signal strength = -A dBm					

### 6.14.14.25 STATE

Address offset: 0x550

Current radio state

Bit number					31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0	
Id																																	A	A	A	A	
Reset 0x00000000					0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Id	RW	Field	Value	Id	Value		Description																														

Id	RW	Field	Value Id	Value	Description
A	R	STATE			Current radio state
			Disabled	0	RADIO is in the Disabled state
			RxRu	1	RADIO is in the RXRU state
			RxIdle	2	RADIO is in the RXIDLE state
			Rx	3	RADIO is in the RX state
			RxDisable	4	RADIO is in the RXDISABLED state
			TxRu	9	RADIO is in the TXRU state
			TxIdle	10	RADIO is in the TXIDLE state
			Tx	11	RADIO is in the TX state
			TxDisable	12	RADIO is in the TXDISABLED state

### 6.14.14.26 DATAWHITEIV

Address offset: 0x554

Data whitening initial value

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0																															
Id				A A A A A A A A																															
Reset 0x00000040				0 1 0 0 0 0 0 0 0																															
Id	RW	Field	Value	Id	Value	Description																													

Id	RW	Field	Value Id	Value	Description
A	RW	DATAWHITEIV			Data whitening initial value. Bit 6 is hard-wired to '1', writing '0' to it has no effect, and it will always be read back and used by the device as '1'.
Bit 0 corresponds to Position 6 of the LSFR, Bit 1 to Position 5, etc.					

### 6.14.14.27 BCC

Address offset: 0x560

Bit counter compare



### 6.14.14.32 DAB[4]

Address offset: 0x610

Device address base segment 4

Bit number	31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0																													
Id	A A																													
Reset 0x00000000	0 0																													
Id	RW	Field	Value Id		Value		Description																							
A	RW	DAB					Device address base segment 4																							

### 6.14.14.33 DAB[5]

Address offset: 0x614

Device address base segment 5

Bit number					31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0																															
Id					A A																															
Reset 0x00000000					0 0																															
Id	RW	Field	Value Id		Value		Description																													
A	RW	DAB					Device address base segment 5																													

### 6.14.14.34 DAB[6]

Address offset: 0x618

Device address base segment 6

Bit number					31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0																															
Id					A A																															
Reset 0x00000000					0 0																															
Id	RW	Field	Value Id		Value		Description																													
A	RW	DAB					Device address base segment 6																													

### 6.14.14.35 DAB[7]

Address offset: 0x61C

Device address base segment 7

Bit number					31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0																															
Id					A A																															
Reset 0x00000000					0 0																															
Id	RW	Field	Value Id		Value		Description																													
A	RW	DAB					Device address base segment 7																													

### 6.14.14.36 DAP[0]

Address offset: 0x620

Device address prefix 0

Bit number					31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0																															
Id					A A																															
Reset 0x00000000					0 0																															
Id		RW	Field		Value Id		Value																Description													
A		RW	DAP																				Device address prefix 0													

### 6.14.14.37 DAP[1]

Address offset: 0x624

Device address prefix 1

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0																															
Id				A A																															
Reset 0x00000000				0 0																															
Id		RW	Field	Value Id	Value	Description																													
A		RW	DAP			Device address prefix 1																													

### 6.14.14.38 DAP[2]

Address offset: 0x628

Device address prefix 2

Bit number	31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0																																								
Id																A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A						
Reset 0x00000000																0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0		
Id	RW	Field	Value Id													Value																Description									
A	RW	DAP																														Device address prefix 2									

### 6.14.14.39 DAP[3]

Address offset: 0x62C

Device address prefix 3

Bit number	31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0																																								
Id																A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A					
Reset 0x00000000																0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
Id	RW	Field	Value Id													Value																Description									
A	RW	DAP																														Device address prefix 3									

### 6.14.14.40 DAP[4]

Address offset: 0x630

Device address prefix 4

Bit number	31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0																																								
Id																A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A					
Reset 0x00000000																0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
Id	RW	Field	Value Id													Value																Description									
A	RW	DAP																														Device address prefix 4									

#### 6.14.14.41 DAP[5]

Address offset: 0x634

Device address prefix 5

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0																															
Id				A A																															
Reset 0x00000000				0 0																															
Id	RW	Field	Value Id	ValueDescription																															
A	RW	DAP		Device address prefix 5																															

#### 6.14.14.42 DAP[6]

Address offset: 0x638

Device address prefix 6

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0																															
Id																		A A A A A A A A A A A A A A A A A A																	
Reset 0x00000000				0 0																															
Id	RW	Field	Value Id	Value				Description																											
A	RW	DAP						Device address prefix 6																											

#### 6.14.14.43 DAP[7]

Address offset: 0x63C

Device address prefix 7

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0																															
Id																				A A A A A A A A A A A A A A A A															
Reset 0x00000000				0 0																															
Id	RW	Field	Value Id	Value				Description																											
A	RW	DAP						Device address prefix 7																											

#### 6.14.14.44 DACNF

Address offset: 0x640

Device address match configuration

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0																															
Id				P O N M L K J I H G F E D C B A																															
Reset 0x00000000				0 0																															
Id	RW	Field	Value Id	Value	Description																														
A	RW	ENAO			Enable or disable device address matching using device address 0																														
			Disabled	0	Disabled																														
			Enabled	1	Enabled																														
B	RW	ENA1			Enable or disable device address matching using device address 1																														
			Disabled	0	Disabled																														
			Enabled	1	Enabled																														

Address offset: 0x650

Bit number				31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0	
Id																												C	C					A		
Reset 0x00000200				0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0
Id	RW	Field	Value Id	Value				Description																												
A	RW	RU						Radio ramp-up time																												
			Default	0				Default ramp-up time (tRXEN), compatible with firmware written for nRF51																												
			Fast	1				Fast ramp-up (tRXEN,FAST), see electrical specification for more information																												



Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0																															
Id				C C A																															
Reset 0x00000200				0 0																															
Id	RW	Field	Value Id	Value	Description																														
C	RW	DTX			Default TX value																														
					Specifies what the RADIO will transmit when it is not started, i.e. between:																														
					RADIO.EVENTS_READY and RADIO.TASKS_START																														
					RADIO.EVENTS_END and RADIO.TASKS_START																														
					RADIO.EVENTS_END and RADIO.EVENTS_DISABLED																														
			B1	0	Transmit '1'																														
			B0	1	Transmit '0'																														
			Center	2	Transmit center frequency																														
					When tuning the crystal for centre frequency, the RADIO must be set in DTX = Center mode to be able to achieve the expected accuracy.																														

#### 6.14.14.46 POWER

Address offset: 0xFFC

Peripheral power control

Bit number					31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0		
Id					A																																	
Reset 0x00000001					0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1		
Id	RW	Field	Value Id	Value	Description																																	
A	RW	POWER			Peripheral power control. The peripheral and its registers will be reset to its initial state by switching the peripheral off and then back on again.																																	
			Disabled	0	Peripheral is powered off																																	
			Enabled	1	Peripheral is powered on																																	

### 6.14.15 Electrical specification

#### 6.14.15.1 General radio characteristics

Symbol	Description	Min.	Typ.	Max.	Units
$f_{OP}$	Operating frequencies	2360		2500	MHz
$f_{PLL,PROG,RES}$	PLL programming resolution		2		kHz
$f_{PLL,CH,SP}$	PLL channel spacing		1		MHz
$f_{\Delta,1M}$	Frequency deviation @ 1 Mbps		±170		kHz
$f_{\Delta,BLE,1M}$	Frequency deviation @ BLE 1 Mbps		±250		kHz
$f_{\Delta,2M}$	Frequency deviation @ 2 Mbps		±320		kHz
$f_{\Delta,BLE,2M}$	Frequency deviation @ BLE 2 Mbps		±500		kHz
$f_{SK,SPS}$	On-the-air data rate	1		2	Mbps

#### 6.14.15.2 Radio current consumption (transmitter)

Symbol	Description	Min.	Typ.	Max.	Units
$I_{TX,PLU54dBm,DCDC}$	TX only run current (DCDC, 3V) $P_{RF} = +4$ dBm		7.0		mA

Symbol	Description	Min.	Typ.	Max.	Units
$I_{TX,PLUS4dBm}$	TX only run current $P_{RF} = +4$ dBm		15.4		mA
$I_{TX,0dBm,DCDC}$	TX only run current (DCDC, 3V) $P_{RF} = 0$ dBm		4.6		mA
$I_{TX,0dBm}$	TX only run current $P_{RF} = 0$ dBm		10.1		mA
$I_{TX,MINUS4dBm,DCDC}$	TX only run current DCDC, 3V $P_{RF} = -4$ dBm		3.6		mA
$I_{TX,MINUS4dBm}$	TX only run current $P_{RF} = -4$ dBm		7.8		mA
$I_{TX,MINUS8dBm,DCDC}$	TX only run current DCDC, 3V $P_{RF} = -8$ dBm		3.2		mA
$I_{TX,MINUS8dBm}$	TX only run current $P_{RF} = -8$ dBm		6.8		mA
$I_{TX,MINUS12dBm,DCDC}$	TX only run current DCDC, 3V $P_{RF} = -12$ dBm		2.9		mA
$I_{TX,MINUS12dBm}$	TX only run current $P_{RF} = -12$ dBm		6.2		mA
$I_{TX,MINUS16dBm,DCDC}$	TX only run current DCDC, 3V $P_{RF} = -16$ dBm		2.7		mA
$I_{TX,MINUS16dBm}$	TX only run current $P_{RF} = -16$ dBm		5.7		mA
$I_{TX,MINUS20dBm,DCDC}$	TX only run current DCDC, 3V $P_{RF} = -20$ dBm		2.5		mA
$I_{TX,MINUS20dBm}$	TX only run current $P_{RF} = -20$ dBm		5.4		mA
$I_{TX,MINUS40dBm,DCDC}$	TX only run current DCDC, 3V $P_{RF} = -40$ dBm		2.1		mA
$I_{TX,MINUS40dBm}$	TX only run current $P_{RF} = -40$ dBm		4.3		mA

### 6.14.15.3 Radio current consumption (receiver)

Symbol	Description	Min.	Typ.	Max.	Units
$I_{RX,1M,DCDC}$	RX only run current (DCDC, 3V) 1 Mbps / 1 Mbps BLE		4.6		mA
$I_{RX,1M}$	RX only run current 1 Mbps / 1 Mbps BLE		10.0		mA
$I_{RX,2M,DCDC}$	RX only run current (DCDC, 3V) 2 Mbps / 2 Mbps BLE		5.2		mA
$I_{RX,2M}$	RX only run current 2 Mbps / 2 Mbps BLE		11.2		mA
$I_{START,RX,1M,DCDC}$	RX start-up current (DCDC, 3 V) 1 Mbps / 1 Mbps BLE		3.5		mA
$I_{START,RX,1M}$	RX start-up current 1 Mbps / 1 Mbps BLE		6.7		mA

### 6.14.15.4 Transmitter specification

Symbol	Description	Min.	Typ.	Max.	Units
$P_{RF}$	Maximum output power		4	8	dBm
$P_{RFC}$	RF power control range		24		dB
$P_{RFCR}$	RF power accuracy			$\pm 4$	dB
$P_{RF1,1}$	1st Adjacent Channel Transmit Power 1 MHz (1 Mbps)		-25		dBc
$P_{RF2,1}$	2nd Adjacent Channel Transmit Power 2 MHz (1 Mbps)		-50		dBc
$P_{RF1,2}$	1st Adjacent Channel Transmit Power 2 MHz (2 Mbps)		-25		dBc
$P_{RF2,2}$	2nd Adjacent Channel Transmit Power 4 MHz (2 Mbps)		-50		dBc

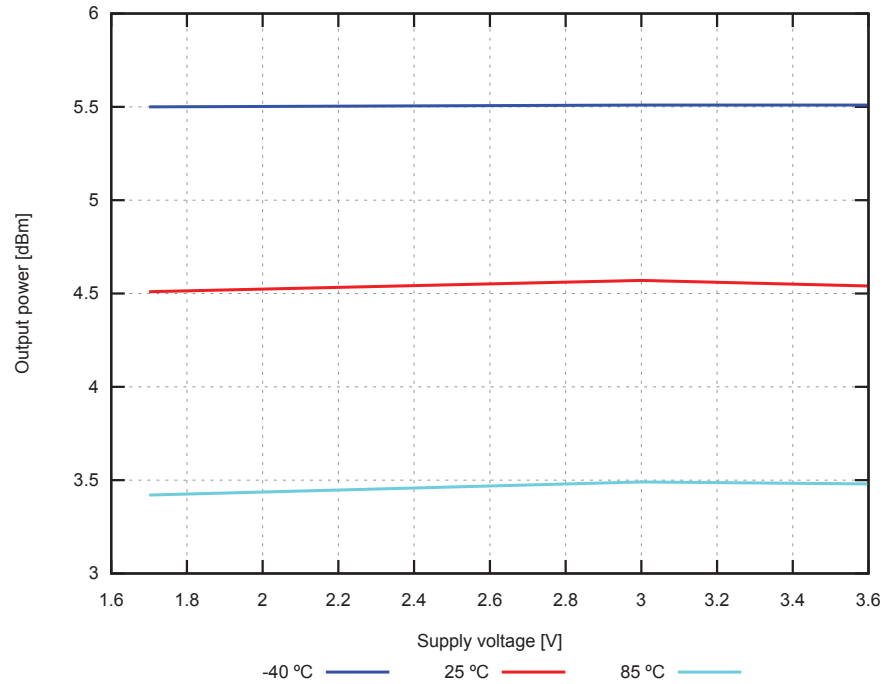


Figure 71: Output power, 1 Mbps Bluetooth low energy mode, 4 dBm TXPOWER setting (typical values)

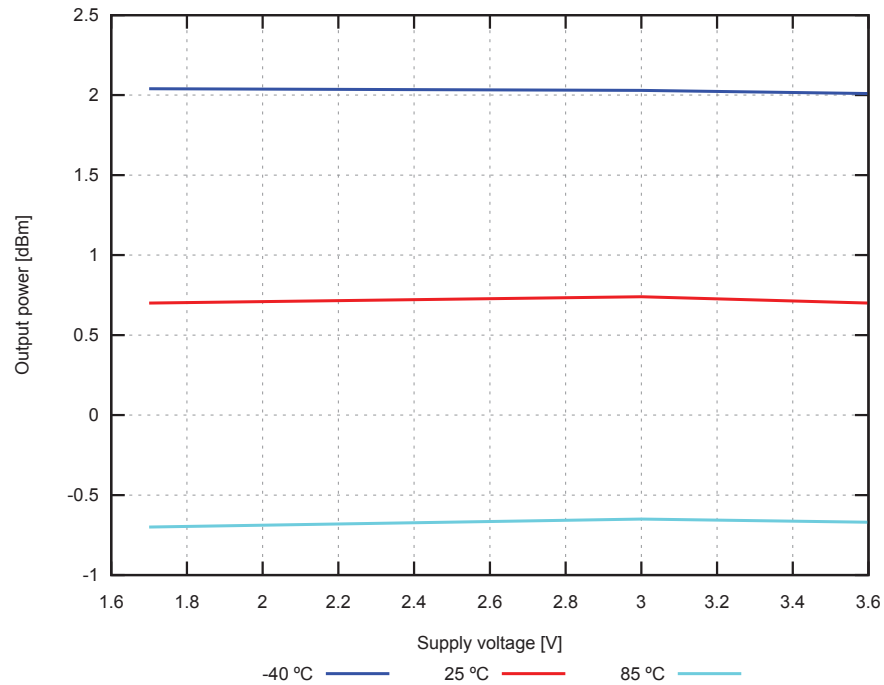


Figure 72: Output power, 1 Mbps Bluetooth low energy mode, 0 dBm TXPOWER setting (typical values)

### 6.14.15.5 Receiver operation

Symbol	Description	Min.	Typ.	Max.	Units
P <sub>RX,MAX</sub>	Maximum received signal strength at < 0.1% BER		0		dBm

Symbol	Description	Min.	Typ.	Max.	Units
P <sub>SENS,IT,1M</sub>	Sensitivity, 1 Mbps nRF mode <sup>15</sup>		-93		dBm
P <sub>SENS,IT,SP,1M,BLE</sub>	Sensitivity, 1 Mbps BLE ideal transmitter, <=37 bytes BER=1E-3 <sup>16</sup>		-96		dBm
P <sub>SENS,IT,LP,1M,BLE</sub>	Sensitivity, 1 Mbps BLE ideal transmitter >=128 bytes BER=1E-4 <sup>17</sup>		-95		dBm
P <sub>SENS,IT,2M</sub>	Sensitivity, 2 Mbps nRF mode <sup>18</sup>		-89		dBm
P <sub>SENS,IT,SP,2M,BLE</sub>	Sensitivity, 2 Mbps BLE ideal transmitter, Packet length <=37bytes		-93		dBm

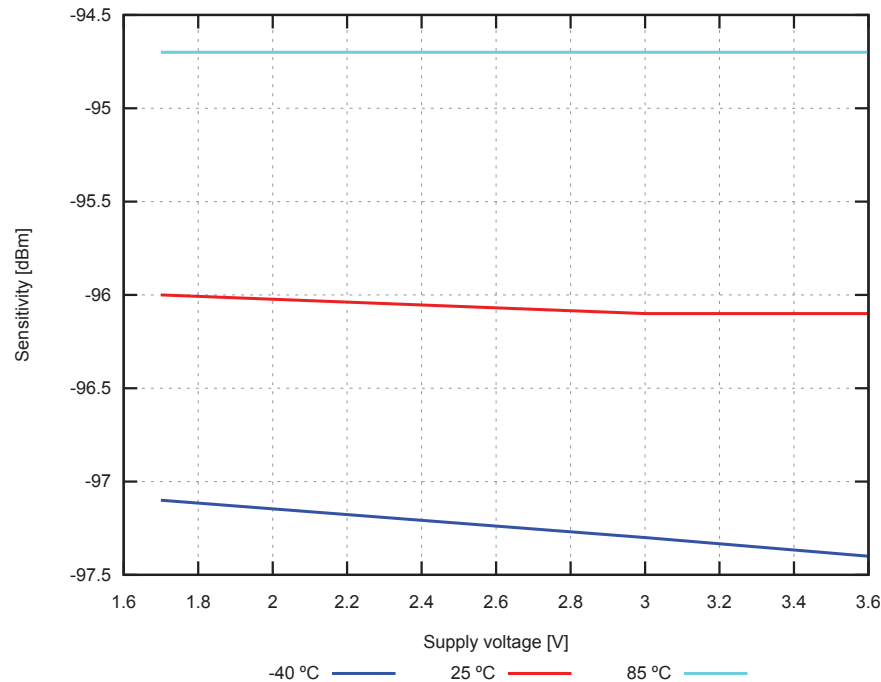


Figure 73: Sensitivity, 1 Mbps Bluetooth low energy mode, Regulator = LDO (typical values)

#### 6.14.15.6 RX selectivity

RX selectivity with equal modulation on interfering signal<sup>19</sup>

Symbol	Description	Min.	Typ.	Max.	Units
C/I <sub>1M,co-channel</sub>	1 Mbps mode, Co-Channel interference		9		dB
C/I <sub>1M,-1MHz</sub>	1 Mbps mode, Adjacent (-1 MHz) interference		-2		dB
C/I <sub>1M,+1MHz</sub>	1 Mbps mode, Adjacent (+1 MHz) interference		-10		dB
C/I <sub>1M,-2MHz</sub>	1 Mbps mode, Adjacent (-2 MHz) interference		-19		dB

<sup>15</sup> Typical sensitivity applies when ADDR0 is used for receiver address correlation. When ADDR[1...7] are used for receiver address correlation, the typical sensitivity for this mode is degraded by 3dB.

<sup>16</sup> As defined in the Bluetooth Core Specification v4.0 Volume 6: Core System Package (Low Energy Controller Volume)

<sup>17</sup> Equivalent BER limit < 10E-04

<sup>18</sup> Typical sensitivity applies when ADDR0 is used for receiver address correlation. When ADDR[1...7] are used for receiver address correlation, the typical sensitivity for this mode is degraded by 3dB.

<sup>19</sup> Wanted signal level at PIN = -67 dBm. One interferer is used, having equal modulation as the wanted signal. The input power of the interferer where the sensitivity equals BER = 0.1% is presented

Symbol	Description	Min.	Typ.	Max.	Units
$C/I_{1M,+2MHz}$	1 Mbps mode, Adjacent (+2 MHz) interference		-42		dB
$C/I_{1M,-3MHz}$	1 Mbps mode, Adjacent (-3 MHz) interference		-38		dB
$C/I_{1M,+3MHz}$	1 Mbps mode, Adjacent (+3 MHz) interference		-48		dB
$C/I_{1M,\pm 6MHz}$	1 Mbps mode, Adjacent ( $\geq 6$ MHz) interference		-50		dB
$C/I_{1MBLE,co-channel}$	1 Mbps BLE mode, Co-Channel interference		6		dB
$C/I_{1MBLE,-1MHz}$	1 Mbps BLE mode, Adjacent (-1 MHz) interference		-2		dB
$C/I_{1MBLE,+1MHz}$	1 Mbps BLE mode, Adjacent (+1 MHz) interference		-9		dB
$C/I_{1MBLE,-2MHz}$	1 Mbps BLE mode, Adjacent (-2 MHz) interference		-22		dB
$C/I_{1MBLE,+2MHz}$	1 Mbps BLE mode, Adjacent (+2 MHz) interference		-46		dB
$C/I_{1MBLE,>3MHz}$	1 Mbps BLE mode, Adjacent ( $\geq 3$ MHz) interference		-50		dB
$C/I_{1MBLE,image}$	Image frequency Interference		-22		dB
$C/I_{1MBLE,image,1MHz}$	Adjacent (1 MHz) interference to in-band image frequency		-35		dB
$C/I_{2M,co-channel}$	2 Mbps mode, Co-Channel interference		2-C0		dB
$C/I_{2M,-2MHz}$	2 Mbps mode, Adjacent (-2 MHz) interference		6		dB
$C/I_{2M,+2MHz}$	2 Mbps mode, Adjacent (+2 MHz) interference		-14		dB
$C/I_{2M,-4MHz}$	2 Mbps mode, Adjacent (-4 MHz) interference		-20		dB
$C/I_{2M,+4MHz}$	2 Mbps mode, Adjacent (+4 MHz) interference		-44		dB
$C/I_{2M,-6MHz}$	2 Mbps mode, Adjacent (-6 MHz) interference		-42		dB
$C/I_{2M,+6MHz}$	2 Mbps mode, Adjacent (+6 MHz) interference		-47		dB
$C/I_{2M,\geq 12MHz}$	2 Mbps mode, Adjacent ( $\geq 12$ MHz) interference		-52		dB

### 6.14.15.7 RX intermodulation

RX intermodulation<sup>20</sup>

Symbol	Description	Min.	Typ.	Max.	Units
$P_{IMD,5TH,1M}$	IMD performance, 1 Msps, 5th offset channel, Packet length $\leq 37$ bytes		-33		dBm
$P_{IMD,5TH,1M,BLE}$	IMD performance, BLE 1 Msps, 5th offset channel, Packet length $\leq 37$ bytes		-30		dBm
$P_{IMD,5TH,2M}$	IMD performance, 2 Msps, 5th offset channel, Packet length $\leq 37$ bytes		-33		dBm
$P_{IMD,5TH,2M,BLE}$	IMD performance, BLE 2 Msps, 5th offset channel, Packet length $\leq 37$ bytes		-31		dBm

### 6.14.15.8 Radio timing

Symbol	Description	Min.	Typ.	Max.	Units
$t_{TXEN}$	Time between TXEN task and READY event after channel FREQUENCY configured. Compatible with old devices.		140		$\mu s$
$t_{TXEN,FAST}$	Time between TXEN task and READY event after channel FREQUENCY configured (Fast Mode)		40		$\mu s$
$t_{TXDISABLE,1M}$	Time between DISABLE task and DISABLED event when the radio was in TX for MODE = Nrf_1Mbit and MODE = Ble_1Mbit		6		$\mu s$
$t_{TXDISABLE,2M}$	Time between DISABLE task and DISABLED event when the radio was in TX and mode is set to 2 Mbps		4		$\mu s$

<sup>20</sup> Wanted signal level at PIN = -64 dBm. Two interferers with equal input power are used. The interferer closest in frequency is not modulated, the other interferer is modulated equal with the wanted signal. The input power of the interferers where the sensitivity equals BER = 0.1% is presented.

Symbol	Description	Min.	Typ.	Max.	Units
$t_{RXEN}$	Time between the RXEN task and READY event after channel FREQUENCY configured in default mode. Compatible with old devices.		140		$\mu s$
$t_{RXEN,FAST}$	Time between the RXEN task and READY event after channel FREQUENCY configured in fast mode		40		$\mu s$
$t_{SWITCH}$	The minimum time taken to switch from RX to TX or TX to RX when channel FREQUENCY unchanged		20		$\mu s$
$t_{RXDISABLE}$	Time between DISABLE task and DISABLED event when the radio was in RX		0		$\mu s$
$t_{TXCHAIN}$	Digital propagation delay (in radio only) when transmitting. Does not include EasyDMA access time.		0.6		$\mu s$
$t_{RXCHAIN}$	Digital propagation delay (in radio only) when receiving. Does not include EasyDMA access time.		9.4		$\mu s$
$t_{RXCHAIN,2M}$	Digital propagation delay in 2 Mbps mode (radio only) when receiving. Does not include EasyDMA access time.		5		$\mu s$

### 6.14.15.9 Received Signal Strength Indicator (RSSI) specifications

Symbol	Description	Min.	Typ.	Max.	Units
RSSI <sub>ACC</sub>	RSSI Accuracy Valid range -90 to -20 dBm		$\pm 2$		dB
RSSI <sub>RESOLUTION</sub>	RSSI resolution		1		dB
RSSI <sub>PERIOD</sub>	Sample period		0.25		$\mu s$

### 6.14.15.10 Jitter

Symbol	Description	Min.	Typ.	Max.	Units
$t_{DISABLEDJITTER}$	Jitter on DISABLED event relative to END event when shortcut between END and DISABLE is enabled.		0.25		$\mu s$
$t_{READYJITTER}$	Jitter on READY event relative to TXEN and RXEN task.		0.25		$\mu s$

## 6.15 RNG — Random number generator

The Random number generator (RNG) generates true non-deterministic random numbers based on internal thermal noise that are suitable for cryptographic purposes. The RNG does not require a seed value.

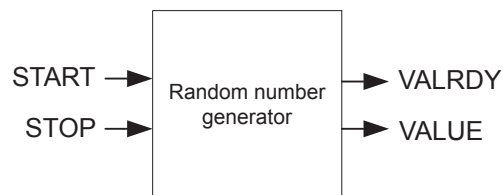


Figure 74: Random number generator

The RNG is started by triggering the START task and stopped by triggering the STOP task. When started, new random numbers are generated continuously and written to the VALUE register when ready. A VALRDY event is generated for every new random number that is written to the VALUE register. This means that after a VALRDY event is generated the CPU has the time until the next VALRDY event to read out the random number from the VALUE register before it is overwritten by a new random number.

### 6.15.1 Bias correction

A bias correction algorithm is employed on the internal bit stream to remove any bias toward '1' or '0'. The bits are then queued into an eight-bit register for parallel readout from the VALUE register.

It is possible to enable bias correction in the CONFIG register. This will result in slower value generation, but will ensure a statistically uniform distribution of the random values.

### 6.15.2 Speed

The time needed to generate one random byte of data is unpredictable, and may vary from one byte to the next. This is especially true when bias correction is enabled.

### 6.15.3 Registers

Base address	Peripheral	Instance	Description	Configuration
0x4000D000	RNG	RNG	Random number generator	

Table 62: Instances

Register	Offset	Description
TASKS_START	0x000	Task starting the random number generator
TASKS_STOP	0x004	Task stopping the random number generator
EVENTS_VALRDY	0x100	Event being generated for every new random number written to the VALUE register
SHORTS	0x200	Shortcut register
INTENSET	0x304	Enable interrupt
INTENCLR	0x308	Disable interrupt
CONFIG	0x504	Configuration register
VALUE	0x508	Output random number

Table 63: Register Overview

#### 6.15.3.1 SHORTS

Address offset: 0x200

Shortcut register

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0																															
Id				A																															
Reset 0x00000000				0 0																															
Id	RW	Field	Value Id	Value	Description																														
A	RW	VALRDY_STOP			Shortcut between VALRDY event and STOP task																														
					See <a href="#">EVENTS_VALRDY</a> and <a href="#">TASKS_STOP</a>																														
			Disabled	0	Disable shortcut																														
			Enabled	1	Enable shortcut																														

#### 6.15.3.2 INTENSET

Address offset: 0x304

Enable interrupt

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0																															
Id				A																															
Reset 0x00000000				0 0																															
Id	RW	Field	Value Id	Value	Description																														
A	RW	VALRDY			Write '1' to Enable interrupt for VALRDY event																														
					See <a href="#">EVENTS_VALRDY</a>																														
			Set	1	Enable																														
			Disabled	0	Read: Disabled																														
			Enabled	1	Read: Enabled																														

### 6.15.3.3 INTENCLR

Address offset: 0x308

Disable interrupt

Bit number					31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0		
Id					A																																	
Reset 0x00000000					0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0		
Id	RW	Field	Value Id	Value	Description																																	
A	RW	VALRDY			Write '1' to Disable interrupt for VALRDY event																																	
					See <a href="#">EVENTS_VALRDY</a>																																	
			Clear	1	Disable																																	
			Disabled	0	Read: Disabled																																	
			Enabled	1	Read: Enabled																																	

### 6.15.3.4 CONFIG

Address offset: 0x504

Configuration register

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0																															
Id				A																															
Reset 0x00000000				0 0																															
Id	RW	Field	Value Id	Value	Description																														
A	RW	DERCEN			Bias correction																														
			Disabled	0	Disabled																														
			Enabled	1	Enabled																														

### 6.15.3.5 VALUE

Address offset: 0x508

Output random number

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0																															
Id				A A A A A A A A																															
Reset 0x00000000				0 0																															
Id	RW	Field	Value Id	Value	Description																														
A	R	VALUE		[0..255]	Generated random number																														



## 6.15.4 Electrical specification

### 6.15.4.1 RNG Electrical Specification

Symbol	Description	Min.	Typ.	Max.	Units
$t_{\text{RNG\_START}}$	Time from setting the START task to generation begins. This is a one-time delay on START signal and does not apply between samples.		128		$\mu\text{s}$
$t_{\text{RNG\_RAW}}$	Run time per byte without bias correction. Uniform distribution of 0 and 1 is not guaranteed.		30		$\mu\text{s}$
$t_{\text{RNG\_BC}}$	Run time per byte with bias correction. Uniform distribution of 0 and 1 is guaranteed. Time to generate a byte cannot be guaranteed.		120		$\mu\text{s}$

## 6.16 RTC — Real-time counter

The Real-time counter (RTC) module provides a generic, low power timer on the low-frequency clock source (LFCLK).

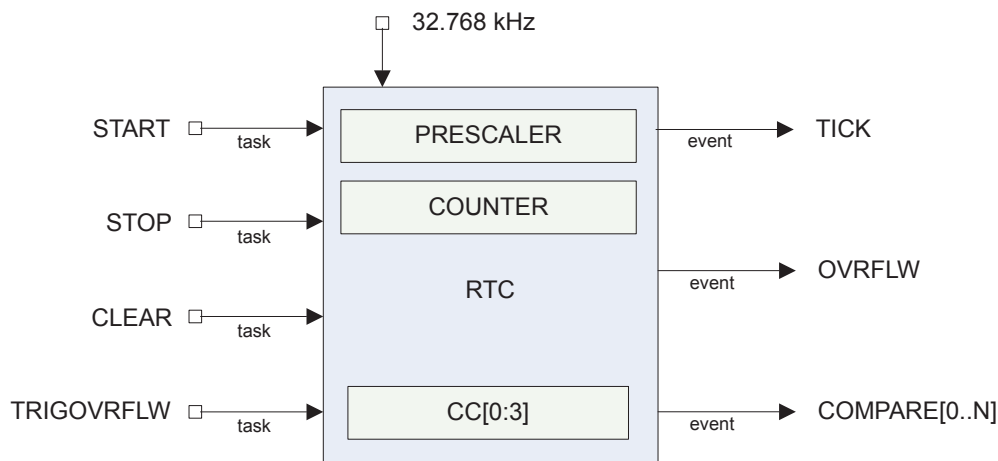


Figure 75: RTC block schematic

The RTC module features a 24-bit COUNTER, a 12-bit (1/X) prescaler, capture/compare registers, and a tick event generator for low power, tickless RTOS implementation.

### 6.16.1 Clock source

The RTC will run off the LFCLK.

The COUNTER resolution will therefore be 30.517  $\mu\text{s}$ . Depending on the source, the RTC is able to run while the HFCLK is OFF and PCLK16M is not available.

The software has to explicitly start LFCLK before using the RTC.

See [CLOCK — Clock control](#) on page 83 for more information about clock sources.

### 6.16.2 Resolution versus overflow and the PRESCALER

Counter increment frequency:

$$f_{\text{RTC}} [\text{kHz}] = 32.768 / (\text{PRESCALER} + 1)$$

The PRESCALER register is read/write when the RTC is stopped. The PRESCALER register is read-only once the RTC is STARTed. Writing to the PRESCALER register when the RTC is started has no effect.

The PRESCALER is restarted on START, CLEAR and TRIGOVFLW, that is, the prescaler value is latched to an internal register (<<PRESC>>) on these tasks.

Examples:

1. Desired COUNTER frequency 100 Hz (10 ms counter period)

$$\text{PRESCALER} = \text{round}(32.768 \text{ kHz} / 100 \text{ Hz}) - 1 = 327$$

$$f_{\text{RTC}} = 99.9 \text{ Hz}$$

$$10009.576 \mu\text{s} \text{ counter period}$$

2. Desired COUNTER frequency 8 Hz (125 ms counter period)

$$\text{PRESCALER} = \text{round}(32.768 \text{ kHz} / 8 \text{ Hz}) - 1 = 4095$$

$$f_{\text{RTC}} = 8 \text{ Hz}$$

$$125 \text{ ms counter period}$$

Prescaler	Counter resolution	Overflow
0	30.517 $\mu\text{s}$	512 seconds
$2^8 - 1$	7812.5 $\mu\text{s}$	131072 seconds
$2^{12} - 1$	125 ms	582.542 hours

Table 64: RTC resolution versus overflow

### 6.16.3 COUNTER register

The COUNTER increments on LFCLK when the internal PRESCALER register (<<PRESC>>) is 0x00. <<PRESC>> is reloaded from the PRESCALER register. If enabled, the TICK event occurs on each increment of the COUNTER. The TICK event is disabled by default.

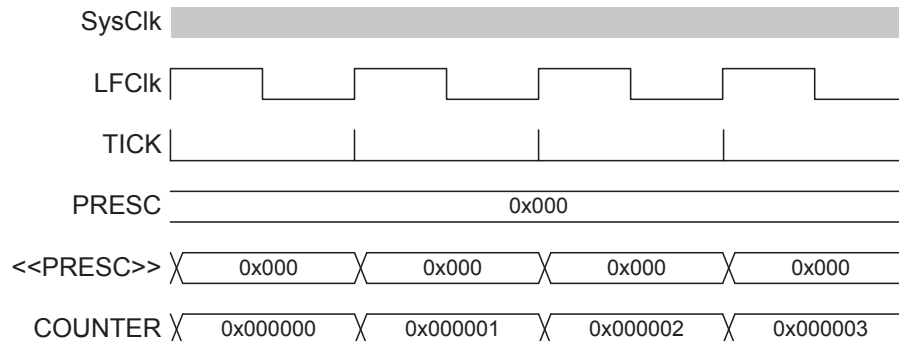


Figure 76: Timing diagram - COUNTER\_PRESCALER\_0

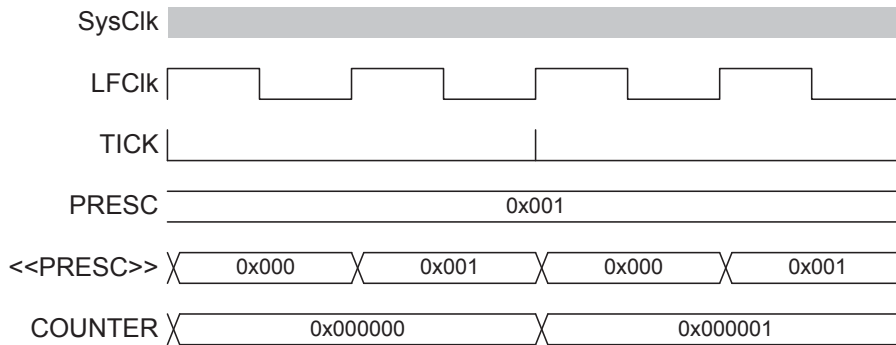


Figure 77: Timing diagram - COUNTER\_PRESCALER\_1

#### 6.16.4 Overflow features

The TRIGOVFLW task sets the COUNTER value to 0xFFFFF0 to allow SW test of the overflow condition.

OVRFLW occurs when COUNTER overflows from 0xFFFFF to 0.

**Important:** The OVRFLW event is disabled by default.

#### 6.16.5 TICK event

The TICK event enables low power "tick-less" RTOS implementation as it optionally provides a regular interrupt source for a RTOS without the need to use the ARM® SysTick feature.

Using the RTC TICK event rather than the SysTick allows the CPU to be powered down while still keeping RTOS scheduling active.

**Important:** The TICK event is disabled by default.

#### 6.16.6 Event control feature

To optimize RTC power consumption, events in the RTC can be individually disabled to prevent PCLK16M and HFCLK being requested when those events are triggered. This is managed using the EVTEN register.

For example, if the TICK event is not required for an application, this event should be disabled as it is frequently occurring and may increase power consumption if HFCLK otherwise could be powered down for long durations.

This means that the RTC implements a slightly different task and event system compared to the standard system described in [Peripheral interface](#) on page 94. The RTC task and event system is illustrated in [Tasks, events and interrupts in the RTC](#) on page 324.

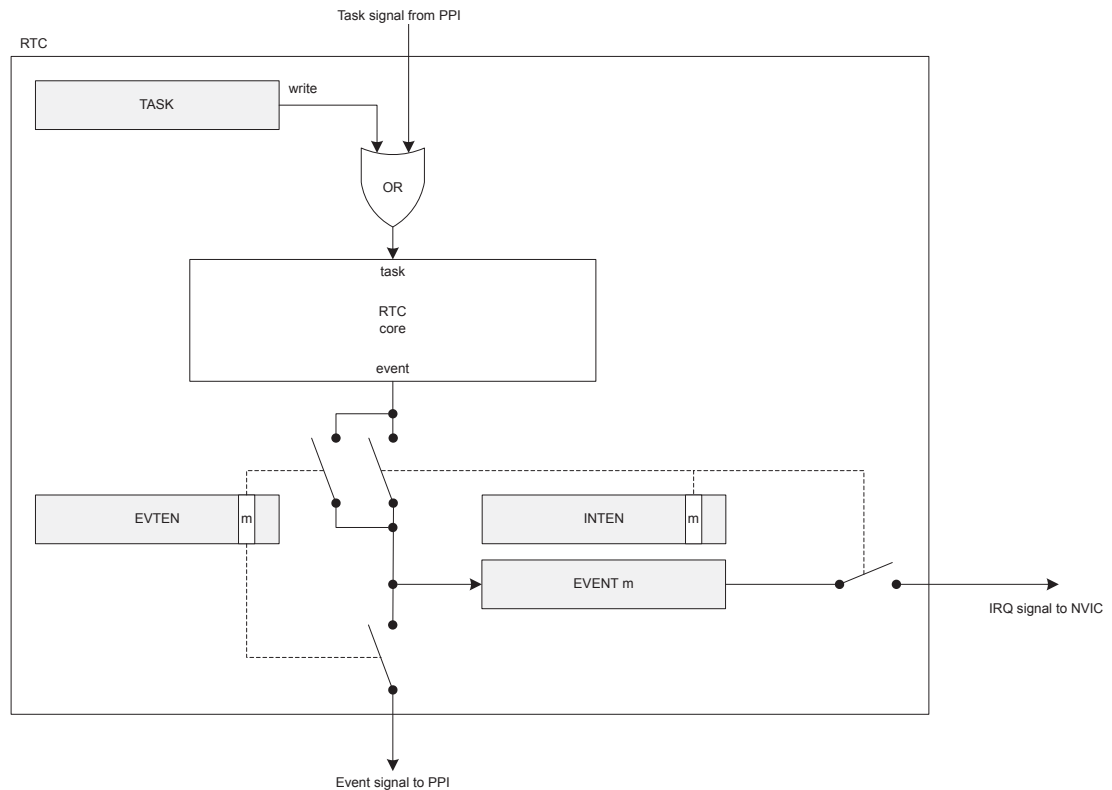


Figure 78: Tasks, events and interrupts in the RTC

### 6.16.7 Compare feature

There are a number of Compare registers.

For more information, see [Registers](#) on page 329.

When setting a compare register, the following behavior of the RTC compare event should be noted:

- If a CC register value is 0 when a CLEAR task is set, this will not trigger a COMPARE event.

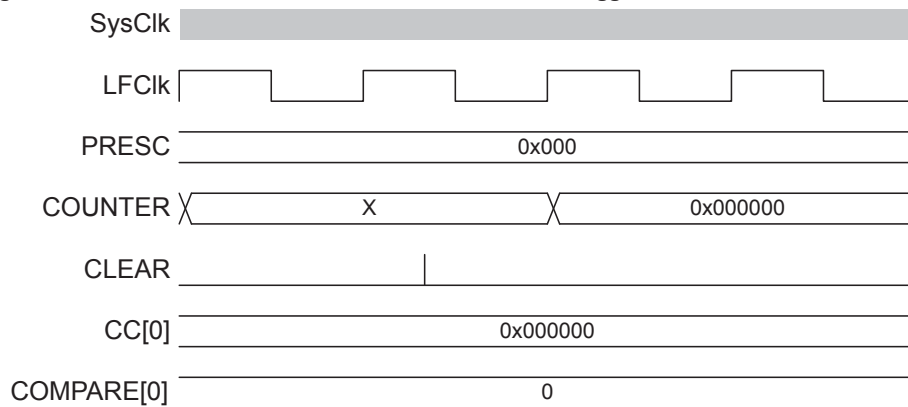


Figure 79: Timing diagram - COMPARE\_CLEAR

- If a CC register is N and the COUNTER value is N when the START task is set, this will not trigger a COMPARE event.

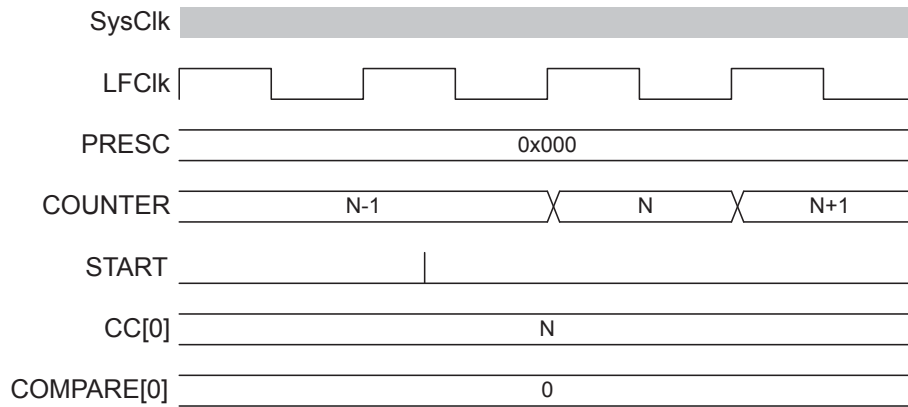


Figure 80: Timing diagram - COMPARE\_START

- COMPARE occurs when a CC register is N and the COUNTER value transitions from N-1 to N.

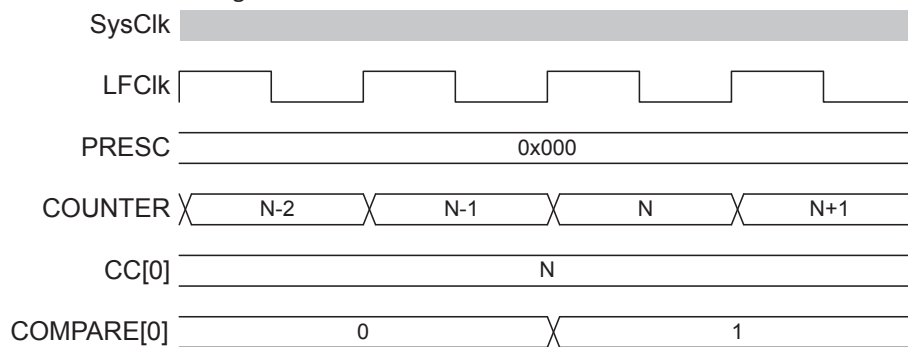


Figure 81: Timing diagram - COMPARE

- If the COUNTER is N, writing N+2 to a CC register is guaranteed to trigger a COMPARE event at N+2.

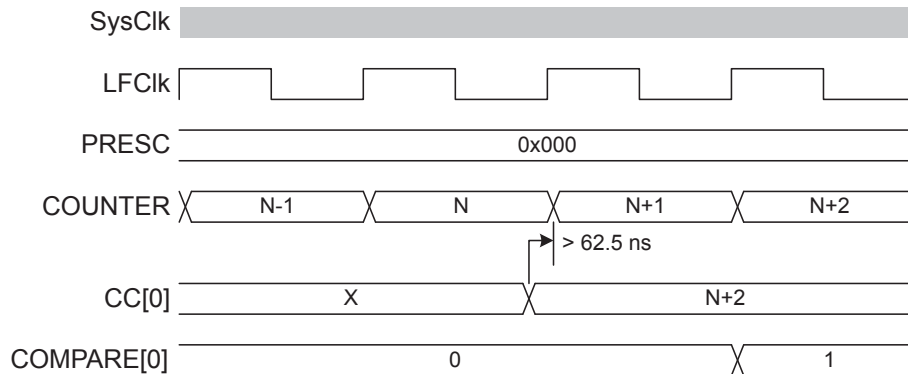


Figure 82: Timing diagram - COMPARE\_N+2

- If the COUNTER is N, writing N or N+1 to a CC register may not trigger a COMPARE event.

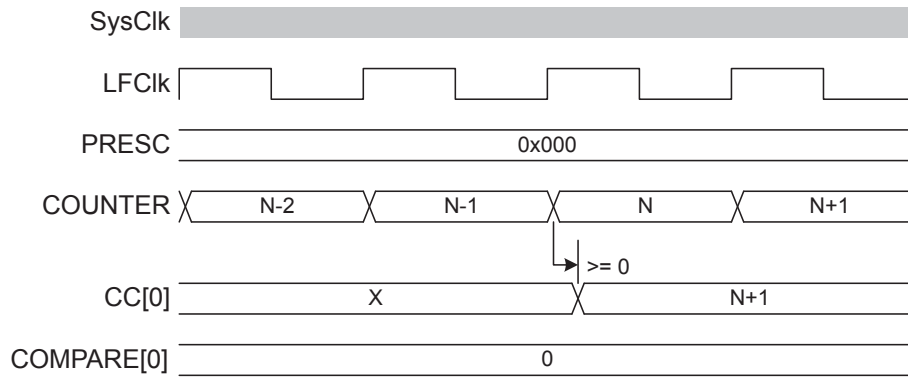


Figure 83: Timing diagram - COMPARE\_N+1

- If the COUNTER is N and the current CC register value is N+1 or N+2 when a new CC value is written, a match may trigger on the previous CC value before the new value takes effect. If the current CC value greater than N+2 when the new value is written, there will be no event due to the old value.

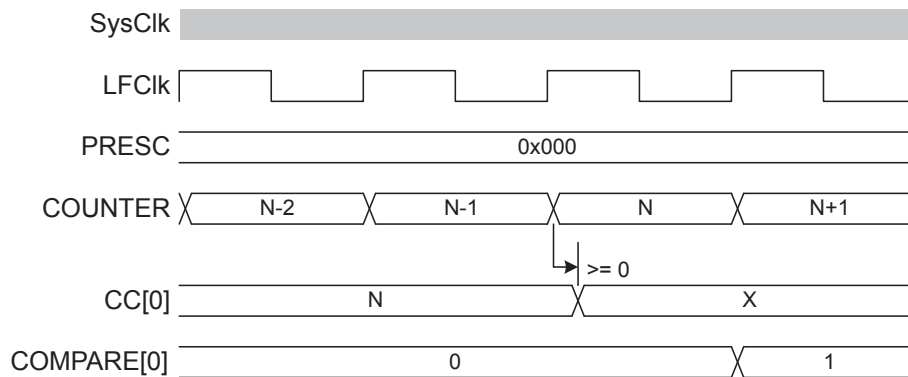


Figure 84: Timing diagram - COMPARE\_N-1

### 6.16.8 TASK and EVENT jitter/delay

Jitter or delay in the RTC is due to the peripheral clock being a low frequency clock (LFCLK) which is not synchronous to the faster PCLK16M.

Registers in the peripheral interface, part of the PCLK16M domain, have a set of mirrored registers in the LFCLK domain. For example, the COUNTER value accessible from the CPU is in the PCLK16M domain and is latched on read from an internal register called COUNTER in the LFCLK domain. COUNTER is the register which is actually modified each time the RTC ticks. These registers must be synchronised between clock domains (PCLK16M and LFCLK).

The following is a summary of the jitter introduced on tasks and events. Figures illustrating jitter follow.

Task	Delay
CLEAR, STOP, START, TRIGOVFLOW	+15 to 46 $\mu$ s

Table 65: RTC jitter magnitudes on tasks

Operation/Function	Jitter
START to COUNTER increment	+/- 15 $\mu$ s
COMPARE to COMPARE <sup>21</sup>	+/- 62.5 ns

Table 66: RTC jitter magnitudes on events

1. CLEAR and STOP (and TRIGOVFLW; not shown) will be delayed as long as it takes for the peripheral to clock a falling edge and rising of the LFCLK. This is between 15.2585  $\mu$ s and 45.7755  $\mu$ s – rounded to 15  $\mu$ s and 46  $\mu$ s for the remainder of the section.

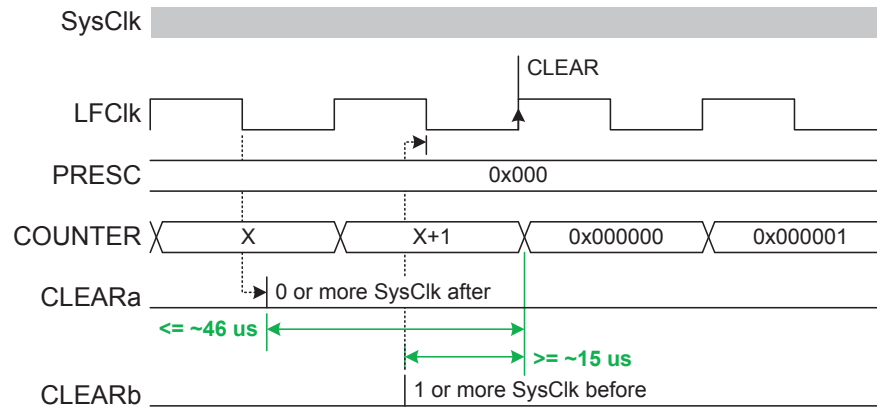


Figure 85: Timing diagram - DELAY\_CLEAR

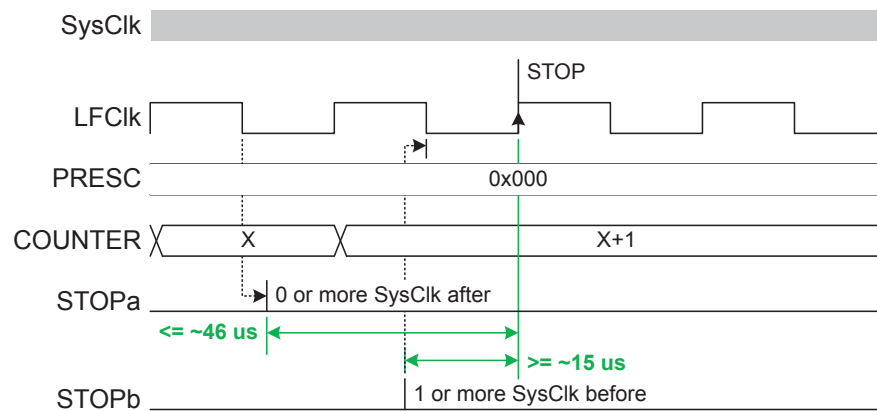


Figure 86: Timing diagram - DELAY\_STOP

2. The START task will start the RTC. Assuming that the LFCLK was previously running and stable, the first increment of COUNTER (and instance of TICK event) will be typically after 30.5  $\mu$ s +/- 15  $\mu$ s. In some cases, in particular if the RTC is STARTed before the LFCLK is running, that timing can be up to ~250  $\mu$ s. The software should therefore wait for the first TICK if it has to make sure the RTC is running. Sending a TRIGOVFLW task sets the COUNTER to a value close to overflow. However, since the update of COUNTER relies on a stable LFCLK, sending this task while LFCLK is not running will start LFCLK, but the update will then be delayed by the same amount of time of up to ~250  $\mu$ s. The figures show the smallest and largest delays to on the START task which appears as a +/- 15  $\mu$ s jitter on the first COUNTER increment.

<sup>21</sup> Assumes RTC runs continuously between these events.

**Note:** 32.768 kHz clock jitter is additional to the numbers provided above.

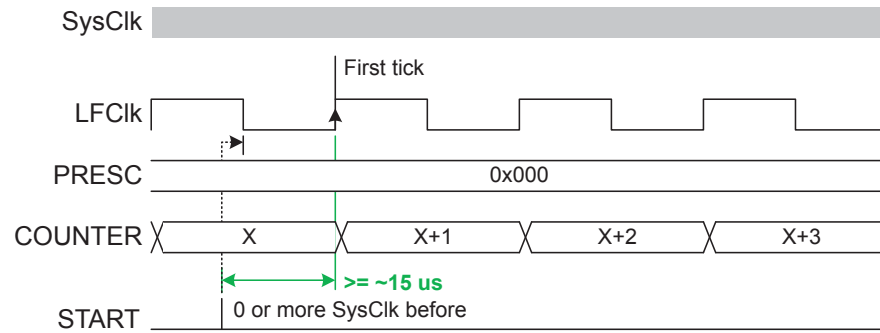


Figure 87: Timing diagram - JITTER\_START-

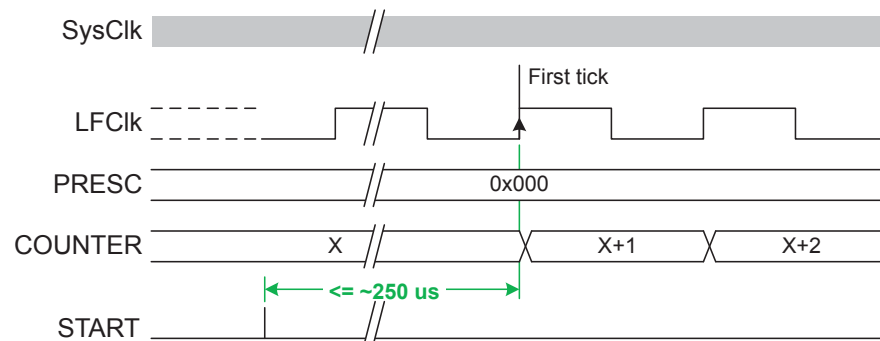


Figure 88: Timing diagram - JITTER\_START+

### 6.16.9 Reading the COUNTER register

To read the COUNTER register, the internal <<COUNTER>> value is sampled.

To ensure that the <<COUNTER>> is safely sampled (considering an LFCCLK transition may occur during a read), the CPU and core memory bus are halted for three cycles by lowering the core PREADY signal. The Read takes the CPU 2 cycles in addition resulting in the COUNTER register read taking a fixed five PCLK16M clock cycles.

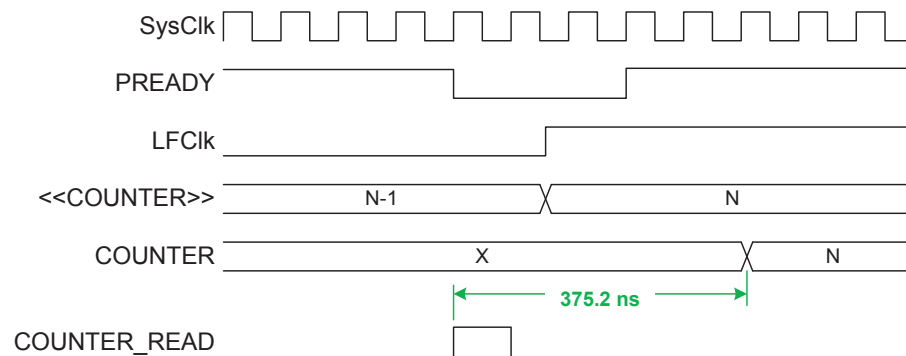


Figure 89: Timing diagram - COUNTER\_READ



## 6.16.10 Registers

Base address	Peripheral	Instance	Description	Configuration
0x4000B000	RTC	RTC0	Real-time counter 0	CC[0..2] implemented, CC[3] not implemented
0x40011000	RTC	RTC1	Real-time counter 1	CC[0..3] implemented

Table 67: Instances

Register	Offset	Description
TASKS_START	0x000	Start RTC COUNTER
TASKS_STOP	0x004	Stop RTC COUNTER
TASKS_CLEAR	0x008	Clear RTC COUNTER
TASKS_TRIGOVFLW	0x00C	Set COUNTER to 0xFFFFF0
EVENTS_TICK	0x100	Event on COUNTER increment
EVENTS_OVRFLW	0x104	Event on COUNTER overflow
EVENTS_COMPARE[0]	0x140	Compare event on CC[0] match
EVENTS_COMPARE[1]	0x144	Compare event on CC[1] match
EVENTS_COMPARE[2]	0x148	Compare event on CC[2] match
EVENTS_COMPARE[3]	0x14C	Compare event on CC[3] match
INTENSET	0x304	Enable interrupt
INTENCLR	0x308	Disable interrupt
EVTEN	0x340	Enable or disable event routing
EVTENSET	0x344	Enable event routing
EVTENCLR	0x348	Disable event routing
COUNTER	0x504	Current COUNTER value
PRESCALER	0x508	12 bit prescaler for COUNTER frequency (32768/(PRESCALER+1)). Must be written when RTC is stopped
CC[0]	0x540	Compare register 0
CC[1]	0x544	Compare register 1
CC[2]	0x548	Compare register 2
CC[3]	0x54C	Compare register 3

Table 68: Register Overview

### 6.16.10.1 INTENSET

Address offset: 0x304

Enable interrupt

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0																															
Id				F E D C B A																															
Reset 0x00000000				0 0																															
Id	RW	Field	Value Id	Value	Description																														
A	RW	TICK			Write '1' to Enable interrupt for TICK event																														
					See <a href="#">EVENTS_TICK</a>																														
		Set		1	Enable																														
		Disabled		0	Read: Disabled																														
		Enabled		1	Read: Enabled																														
B	RW	OVRFLW			Write '1' to Enable interrupt for OVRFLW event																														
					See <a href="#">EVENTS_OVRFLW</a>																														
		Set		1	Enable																														

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0																																	
Id				F E D C																																B A	
Reset 0x00000000				0 0																																	
Id	RW	Field	Value Id	Value	Description																																
C	RW	COMPARE0	Disabled	0	Read: Disabled																																
			Enabled	1	Read: Enabled																																
			Write '1' to Enable interrupt for COMPARE[0] event																																		
			See <a href="#">EVENTS_COMPARE[0]</a>																																		
			Set	1	Enable																																
D	RW	COMPARE1	Disabled	0	Read: Disabled																																
			Enabled	1	Read: Enabled																																
			Write '1' to Enable interrupt for COMPARE[1] event																																		
			See <a href="#">EVENTS_COMPARE[1]</a>																																		
			Set	1	Enable																																
E	RW	COMPARE2	Disabled	0	Read: Disabled																																
			Enabled	1	Read: Enabled																																
			Write '1' to Enable interrupt for COMPARE[2] event																																		
			See <a href="#">EVENTS_COMPARE[2]</a>																																		
			Set	1	Enable																																
F	RW	COMPARE3	Disabled	0	Read: Disabled																																
			Enabled	1	Read: Enabled																																
			Write '1' to Enable interrupt for COMPARE[3] event																																		
			See <a href="#">EVENTS_COMPARE[3]</a>																																		
			Set	1	Enable																																

### 6.16.10.2 INTENCLR

Address offset: 0x308

Disable interrupt

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0																																			
Id				F E D C																																B A			
Reset 0x00000000				0 0																																			
Id	RW	Field	Value Id	Value	Description																																		
A	RW	TICK			Write '1' to Disable interrupt for TICK event																																		
					See <a href="#">EVENTS_TICK</a>																																		
			Clear	1	Disable																																		
			Disabled	0	Read: Disabled																																		
			Enabled	1	Read: Enabled																																		
B	RW	OVRFLW			Write '1' to Disable interrupt for OVRFLW event																																		
					See <a href="#">EVENTS_OVRFLW</a>																																		
			Clear	1	Disable																																		
			Disabled	0	Read: Disabled																																		
			Enabled	1	Read: Enabled																																		
C	RW	COMPARE0			Write '1' to Disable interrupt for COMPARE[0] event																																		
					See <a href="#">EVENTS_COMPARE[0]</a>																																		
			Clear	1	Disable																																		
			Disabled	0	Read: Disabled																																		
			Enabled	1	Read: Enabled																																		

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0																															
Id				F E D C B A																															
Reset 0x00000000				0 0																															
Id	RW	Field	Value Id	Value	Description																														
D	RW	COMPARE1			Write '1' to Disable interrupt for COMPARE[1] event																														
					See <a href="#">EVENTS_COMPARE[1]</a>																														
			Clear	1	Disable																														
			Disabled	0	Read: Disabled																														
			Enabled	1	Read: Enabled																														
E	RW	COMPARE2			Write '1' to Disable interrupt for COMPARE[2] event																														
					See <a href="#">EVENTS_COMPARE[2]</a>																														
			Clear	1	Disable																														
			Disabled	0	Read: Disabled																														
			Enabled	1	Read: Enabled																														
F	RW	COMPARE3			Write '1' to Disable interrupt for COMPARE[3] event																														
					See <a href="#">EVENTS_COMPARE[3]</a>																														
			Clear	1	Disable																														
			Disabled	0	Read: Disabled																														
			Enabled	1	Read: Enabled																														

### 6.16.10.3 EVTEN

Address offset: 0x340

Enable or disable event routing

Bit number					31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0																															
Id					F E D C B A																															
Reset 0x00000000					0 0																															
Id	RW	Field	Value Id	Value	Description																															
A	RW	TICK			Enable or disable event routing for TICK event																															
					See <a href="#">EVENTS_TICK</a>																															
			Disabled	0	Disable																															
			Enabled	1	Enable																															
B	RW	OVRFLW			Enable or disable event routing for OVRFLW event																															
					See <a href="#">EVENTS_OVRFLW</a>																															
			Disabled	0	Disable																															
			Enabled	1	Enable																															
C	RW	COMPARE0			Enable or disable event routing for COMPARE[0] event																															
					See <a href="#">EVENTS_COMPARE[0]</a>																															
			Disabled	0	Disable																															
			Enabled	1	Enable																															
D	RW	COMPARE1			Enable or disable event routing for COMPARE[1] event																															
					See <a href="#">EVENTS_COMPARE[1]</a>																															
			Disabled	0	Disable																															
			Enabled	1	Enable																															
E	RW	COMPARE2			Enable or disable event routing for COMPARE[2] event																															
					See <a href="#">EVENTS_COMPARE[2]</a>																															
			Disabled	0	Disable																															
			Enabled	1	Enable																															

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0																																	
Id				F E D C																																B A	
Reset 0x00000000				0 0																																	
Id	RW	Field	Value Id	Value	Description																																
F	RW	COMPARE3			Enable or disable event routing for COMPARE[3] event																																
					See <a href="#">EVENTS_COMPARE[3]</a>																																
			Disabled	0	Disable																																
			Enabled	1	Enable																																

#### 6.16.10.4 EVTENSET

Address offset: 0x344

Enable event routing

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0																															
Id				F E D C B A																															
Reset 0x00000000				0 0																															
Id	RW	Field	Value Id	Value	Description																														
A	RW	TICK			Write '1' to Enable event routing for TICK event																														
					See <a href="#">EVENTS_TICK</a>																														
			Set	1	Enable																														
			Disabled	0	Read: Disabled																														
			Enabled	1	Read: Enabled																														
B	RW	OVRFLW			Write '1' to Enable event routing for OVRFLW event																														
					See <a href="#">EVENTS_OVRFLW</a>																														
			Set	1	Enable																														
			Disabled	0	Read: Disabled																														
			Enabled	1	Read: Enabled																														
C	RW	COMPARE0			Write '1' to Enable event routing for COMPARE[0] event																														
					See <a href="#">EVENTS_COMPARE[0]</a>																														
			Set	1	Enable																														
			Disabled	0	Read: Disabled																														
			Enabled	1	Read: Enabled																														
D	RW	COMPARE1			Write '1' to Enable event routing for COMPARE[1] event																														
					See <a href="#">EVENTS_COMPARE[1]</a>																														
			Set	1	Enable																														
			Disabled	0	Read: Disabled																														
			Enabled	1	Read: Enabled																														
E	RW	COMPARE2			Write '1' to Enable event routing for COMPARE[2] event																														
					See <a href="#">EVENTS_COMPARE[2]</a>																														
			Set	1	Enable																														
			Disabled	0	Read: Disabled																														
			Enabled	1	Read: Enabled																														
F	RW	COMPARE3			Write '1' to Enable event routing for COMPARE[3] event																														
					See <a href="#">EVENTS_COMPARE[3]</a>																														
			Set	1	Enable																														
			Disabled	0	Read: Disabled																														
			Enabled	1	Read: Enabled																														

#### 6.16.10.5 EVTENCLR

Address offset: 0x348



12 bit prescaler for COUNTER frequency ( $32768/(PRESCALER+1)$ ). Must be written when RTC is stopped

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0																															
Id				A A A A A A A A A A A A A A A A																															
Reset 0x00000000				0 0																															
Id	RW	Field	Value Id	Value				Description																											
A	RW	PRESCALER						Prescaler value																											

#### 6.16.10.8 CC[0]

Address offset: 0x540

Compare register 0

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0																															
Id				A A																															
Reset 0x00000000				0 0																															
Id	RW	Field	Value Id	Value				Description																											
A	RW	COMPARE						Compare value																											

#### 6.16.10.9 CC[1]

Address offset: 0x544

Compare register 1

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0																															
Id				A A																															
Reset 0x00000000				0 0																															
Id	RW	Field	Value Id	Value				Description																											
A	RW	COMPARE						Compare value																											

#### 6.16.10.10 CC[2]

Address offset: 0x548

Compare register 2

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0																																			
Id																				A A																			
Reset 0x00000000				0 0																																			
Id		RW		Field		Value Id		Value								Description																							
A		RW		COMPARE												Compare value																							

#### 6.16.10.11 CC[3]

Address offset: 0x54C

Compare register 3

Bit number	31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0																													
Id	A A																													
Reset 0x00000000	0 0																													
Id	RW	Field	Value Id		Value		Description																							
A	RW	COMPARE					Compare value																							

### 6.16.11 Electrical specification

## 6.17 SAADC — Successive approximation analog-to-digital converter

The ADC is a differential successive approximation register (SAR) analog-to-digital converter.

Listed here are the main features of SAADC:

- 8/10/12-bit resolution, 14-bit resolution with oversampling
- Up to eight input channels
  - One channel per single-ended input and two channels per differential input
  - Scan mode can be configured with both single-ended channels and differential channels.
- Full scale input range (0 to VDD)
- Sampling triggered via a task from software or a PPI channel for full flexibility on sample frequency source from low power 32.768kHz RTC or more accurate 1/16MHz Timers
- One-shot conversion mode to sample a single channel
- Scan mode to sample a series of channels in sequence. Sample delay between channels is  $t_{\text{ack}} + t_{\text{conv}}$  which may vary between channels according to user configuration of  $t_{\text{ack}}$ .
- Support for direct sample transfer to RAM using EasyDMA
- Interrupts on single sample and full buffer events
- Samples stored as 16-bit 2's complement values for differential and single-ended sampling
- Continuous sampling without the need of an external timer
- Internal resistor string
- Limit checking on the fly

### 6.17.1 Shared resources

The ADC can coexist with COMP and other peripherals using one of AIN0–AIN7, provided these are assigned to different pins.

It is not recommended to select the same analog input pin for both modules.

### 6.17.2 Overview

The ADC supports up to eight external analog input channels, depending on package variant. It can be operated in a one-shot mode with sampling under software control, or a continuous conversion mode with a programmable sampling rate.

The analog inputs can be configured as eight single-ended inputs, four differential inputs or a combination of these. Each channel can be configured to select AIN0 to AIN7 pins, or the VDD pin. Channels can be sampled individually in one-shot or continuous sampling modes, or, using scan mode, multiple channels can be sampled in sequence. Channels can also be oversampled to improve noise performance.

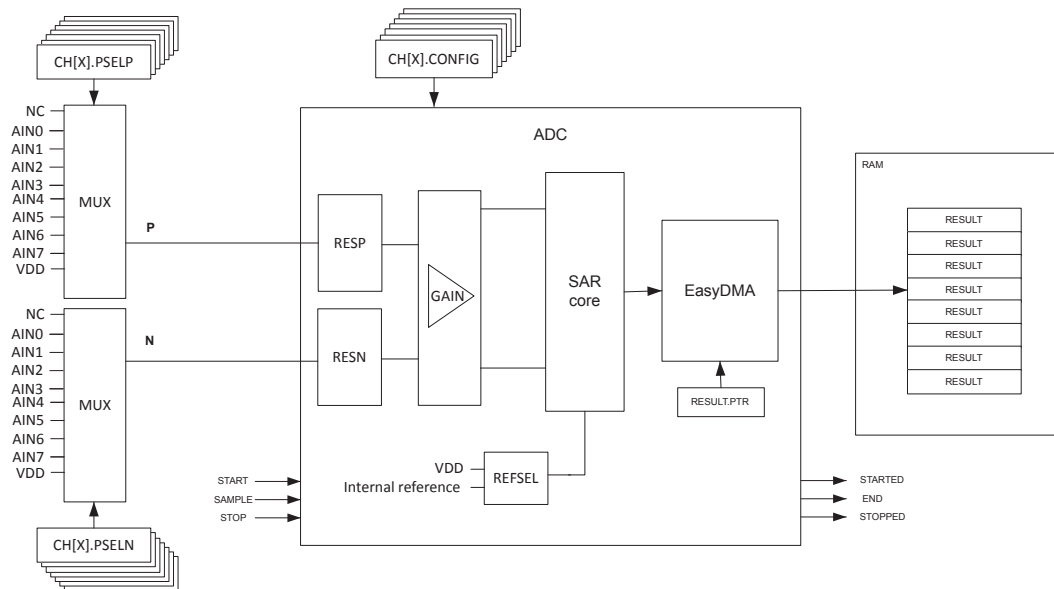


Figure 90: Simplified ADC block diagram

Internally, the ADC is always a differential analog-to-digital converter, but by default it is configured with single-ended input in the MODE field of the CH[n].CONFIG register. In single-ended mode, the negative input will be shorted to ground internally.

The assumption in single-ended mode is that the internal ground of the ADC is the same as the external ground that the measured voltage is referred to. The ADC is thus sensitive to ground bounce on the PCB in single-ended mode. If this is a concern we recommend using differential measurement.

### 6.17.3 Digital output

The output result of the ADC depends on the settings in the CH[n].CONFIG and RESOLUTION registers as follows:

$$\text{RESULT} = [V(P) - V(N)] * \text{GAIN/REFERENCE} * 2^{(\text{RESOLUTION} - m)}$$

where

**V(P)**

is the voltage at input P

**V(N)**

is the voltage at input N

**GAIN**

is the selected gain setting

**REFERENCE**

is the selected reference voltage

and  $m=0$  if CONFIG.MODE=SE, or  $m=1$  if CONFIG.MODE=Diff.

The result generated by the ADC will deviate from the expected due to DC errors like offset, gain, differential non-linearity (DNL), and integral non-linearity (INL). See [Electrical specification](#) for details on these parameters. The result can also vary due to AC errors like non-linearities in the GAIN block, settling errors due to high source impedance and sampling jitter. For battery measurement the DC errors are most noticeable.



The ADC has a wide selection of gains controlled in the GAIN field of the CH[n].CONFIG register. If CH[n].CONFIG.REFSEL=0, the input range of the ADC core is nominally  $\pm 0.6$  V differential and the input must be scaled accordingly.

The ADC has a temperature dependent offset. If the ADC is to operate over a large temperature range, we recommend running CALIBRATEOFFSET at regular intervals, a CALIBRATEDONE event will be fired when the calibration is complete

### 6.17.4 Analog inputs and channels

Up to eight analog input channels, CH[n](n=0..7), can be configured.

See [Shared resources](#) on page 335 for shared input with comparators.

Any one of the available channels can be enabled for the ADC to operate in one-shot mode. If more than one CH[n] is configured, the ADC enters scan mode.

An analog input is selected as a positive converter input if CH[n].PSELN is set, setting CH[n].PSELN also enables the particular channel.

An analog input is selected as a negative converter input if CH[n].PSELN is set. The CH[n].PSELN register will have no effect unless differential mode is enabled, see MODE field in CH[n].CONFIG register.

If more than one of the CH[n].PSELN registers is set, the device enters scan mode. Input selections in scan mode are controlled by the CH[n].PSELN and CH[n].PSELN registers, where CH[n].PSELN is only used if the particular scan channel is specified as differential, see MODE field in CH[n].CONFIG register.

**Important:** Channels selected for COMP cannot be used at the same time for ADC sampling, though channels not selected for use by these blocks can be used by the ADC.

Channel input	Source	Connectivity
CH[n].PSELN	AIN0...AIN7	Yes(any)
CH[n].PSELN	VDD	Yes
CH[n].PSELN	AIN0...AIN7	Yes(any)
CH[n].PSELN	VDD	Yes

Table 69: Legal connectivity CH[n] vs. analog input

### 6.17.5 Operation modes

The ADC input configuration supports one-shot mode, continuous mode and scan mode.

Scan mode and oversampling cannot be combined.

#### 6.17.5.1 One-shot mode

One-shot operation is configured by enabling only one of the available channels defined by CH[n].PSELN, CH[n].PSELN, and CH[n].CONFIG registers.

Upon a SAMPLE task, the ADC starts to sample the input voltage. The CH[n].CONFIG.TACQ controls the acquisition time.

A DONE event signals that one sample has been taken.

In this mode, the RESULTDONE event has the same meaning as DONE when no oversampling takes place. Note that both events may occur before the actual value has been transferred into RAM by EasyDMA. For more information, see [EasyDMA](#) on page 339.

### 6.17.5.2 Continuous mode

Continuous sampling can be achieved by using the internal timer in the ADC, or triggering the SAMPLE task from one of the general purpose timers through the PPI.

Care shall be taken to ensure that the sample rate fulfils the following criteria, depending on how many channels are active:

$$f_{\text{SAMPLE}} < 1 / [t_{\text{ACQ}} + t_{\text{conv}}]$$

The SAMPLERATE register can be used as a local timer instead of triggering individual SAMPLE tasks. When SAMPLERATE.MODE is set to Timers, it is sufficient to trigger SAMPLE task only once in order to start the SAADC and triggering the STOP task will stop sampling. The SAMPLERATE.CC field controls the sample rate.

The SAMPLERATE timer mode cannot be combined with SCAN mode, and only one channel can be enabled in this mode.

A DONE event signals that one sample has been taken.

In this mode, the RESULTDONE event has the same meaning as DONE when no oversampling takes place. Note that both events may occur before the actual value has been transferred into RAM by EasyDMA.

### 6.17.5.3 Oversampling

An accumulator in the ADC can be used to average noise on the analog input. In general, oversampling improves the signal-to-noise ratio (SNR). Oversampling, however, does not improve the integral non-linearity (INL), or differential non-linearity (DNL).

Oversampling and scan should not be combined, since oversampling and scan will average over input channels.

The accumulator is controlled in the OVERSAMPLE register. The SAMPLE task must be set  $2^{\text{OVERSAMPLE}}$  number of times before the result is written to RAM. This can be achieved by:

- Configuring a fixed sampling rate using the local timer or a general purpose timer and PPI to trigger a SAMPLE task
- Triggering SAMPLE  $2^{\text{OVERSAMPLE}}$  times from software
- Enabling BURST mode

CH[n].CONFIG.BURST can be enabled to avoid setting SAMPLE task  $2^{\text{OVERSAMPLE}}$  times. With BURST = 1 the ADC will sample the input  $2^{\text{OVERSAMPLE}}$  times as fast as it can (actual timing:  $<(t_{\text{ACQ}}+t_{\text{CONV}}) \times 2^{\text{OVERSAMPLE}})$ ). Thus, for the user it will just appear like the conversion took a bit longer time, but other than that, it is similar to one-shot mode. Scan mode can be combined with BURST=1, if burst is enabled on all channels.

A DONE event signals that one sample has been taken.

In this mode, the RESULTDONE event signals that enough conversions have taken place for an oversampled result to get transferred into RAM. Note that both events may occur before the actual value has been transferred into RAM by EasyDMA.

### 6.17.5.4 Scan mode

A channel is considered enabled if CH[n].PSEL is set. If more than one channel, CH[n], is enabled, the ADC enters scan mode.

In scan mode, one SAMPLE task will trigger one conversion per enabled channel. The time it takes to sample all channels is:

$$\text{Total time} < \text{Sum}(\text{CH}[x].t_{\text{ACQ}}+t_{\text{CONV}}), \quad x=0..\text{enabled channels}$$

A DONE event signals that one sample has been taken.

In this mode, the RESULTDONE event signals has the same meaning as DONE when no oversampling takes place. Note that both events may occur before the actual values have been transferred into RAM by EasyDMA.

**Example of RAM placement (even RESULT.MAXCNT), channels 1, 2 and 5 enabled** on page 339 provides an example of results placement in Data RAM, with an even RESULT.MAXCNT. In this example, channels 1, 2 and 5 are enabled, all others are disabled.

	31	16	15	0
RESULT.PTR	CH[2] 1 <sup>st</sup> result		CH[1] 1 <sup>st</sup> result	
RESULT.PTR + 4	CH[1] 2 <sup>nd</sup> result		CH[5] 1 <sup>st</sup> result	
RESULT.PTR + 8	CH[5] 2 <sup>nd</sup> result		CH[2] 2 <sup>nd</sup> result	
	(…)			
RESULT.PTR + 2*(RESULT.MAXCNT – 2)	CH[5] last result		CH[2] last result	

Figure 91: Example of RAM placement (even RESULT.MAXCNT), channels 1, 2 and 5 enabled

**Example of RAM placement (odd RESULT.MAXCNT), channels 1, 2 and 5 enabled** on page 339 provides an example of results placement in Data RAM, with an odd RESULT.MAXCNT. In this example, channels 1, 2 and 5 are enabled, all others are disabled. The last 32-bit word is populated only with one 16-bit result.

	31	16	15	0
RESULT.PTR	CH[2] 1 <sup>st</sup> result		CH[1] 1 <sup>st</sup> result	
RESULT.PTR + 4	CH[1] 2 <sup>nd</sup> result		CH[5] 1 <sup>st</sup> result	
RESULT.PTR + 8	CH[5] 2 <sup>nd</sup> result		CH[2] 2 <sup>nd</sup> result	
	( ... )			
RESULT.PTR + 2*(RESULT.MAXCNT – 1)			CH[5] last result	

Figure 92: Example of RAM placement (odd RESULT.MAXCNT), channels 1, 2 and 5 enabled

### 6.17.6 EasyDMA

After configuring RESULT.PTR and RESULT.MAXCNT, the ADC resources are started by triggering the START task. The ADC is using EasyDMA to store results in a Result buffer in RAM.

The Result buffer is located at the address specified in the RESULT.PTR register. The RESULT.PTR register is double-buffered and it can be updated and prepared for the next START task immediately after the STARTED event is generated. The size of the Result buffer is specified in the RESULT.MAXCNT register and the ADC will generate an END event when it has filled up the Result buffer, see [ADC](#) on page 340. Results are stored in little-endian byte order in Data RAM. Every sample will be sign extended to 16 bit before stored in the Result buffer.

The ADC is stopped by triggering the STOP task. The STOP task will terminate an ongoing sampling. The ADC will generate a STOPPED event when it has stopped. If the ADC is already stopped when the STOP task is triggered, the STOPPED event will still be generated.

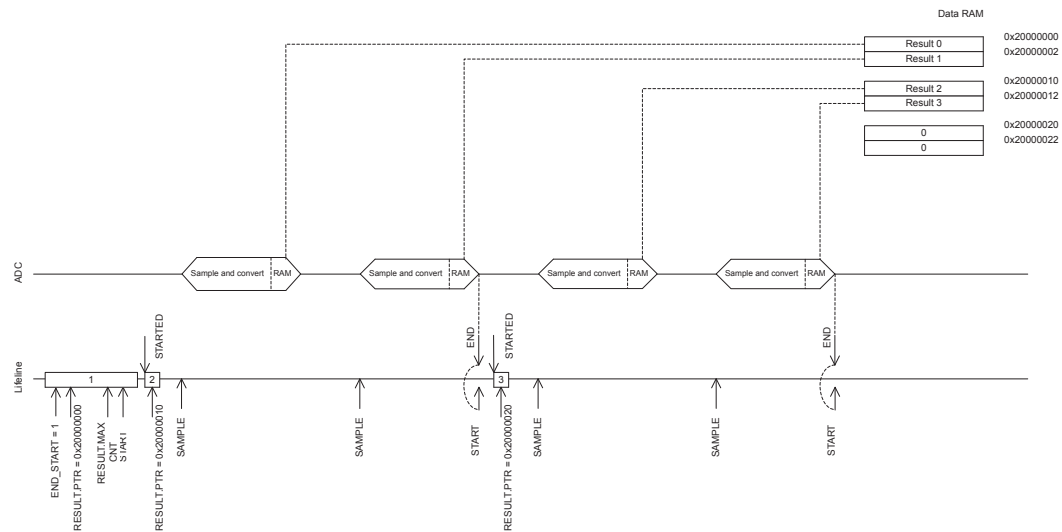


Figure 93: ADC

If the RESULT.PTR is not pointing to the Data RAM region, an EasyDMA transfer may result in a HardFault or RAM corruption. See [Memory](#) on page 15 for more information about the different memory regions.

The EasyDMA will have finished accessing the RAM when the END or STOPPED event has been generated.

The RESULT.AMOUNT register can be read following an END event or a STOPPED event to see how many results have been transferred to the Result buffer in RAM since the START task was triggered.

In scan mode, SAMPLE tasks can be triggered once the START task is triggered. The END event is generated when the number of samples transferred to memory reaches the value specified by RESULT.MAXCNT. After an END event, the START task needs to be triggered again before new samples can be taken. Also make sure that the size of the Result buffer is large enough to have space for minimum one result from each of the enabled channels, by specifying RESULT.MAXCNT >= number of channels enabled. For more information about the scan mode, see [Scan mode](#) on page 338.

### 6.17.7 Resistor ladder

The ADC has an internal resistor string for positive and negative input.

See [Resistor ladder for positive input \(negative input is equivalent, using RESN instead of RESP\)](#) on page 341. The resistors are controlled in the CH[n].CONFIG.RESP and CH[n].CONFIG.RESN registers.

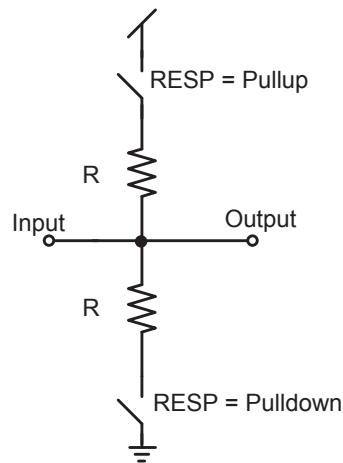


Figure 94: Resistor ladder for positive input (negative input is equivalent, using RESN instead of RESP)

### 6.17.8 Reference

The ADC can use two different references, controlled in the REFSEL field of the CH[n].CONFIG register.

These are:

- Internal reference
- VDD as reference

The internal reference results in an input range of  $\pm 0.6$  V on the ADC core. VDD as reference results in an input range of  $\pm VDD/4$  on the ADC core. The gain block can be used to change the effective input range of the ADC.

$$\text{Input range} = (\pm 0.6 \text{ V or } \pm VDD/4) / \text{Gain}$$

For example, choosing VDD as reference, single ended input (grounded negative input), and a gain of 1/4 the input range will be:

$$\text{Input range} = (VDD/4) / (1/4) = VDD$$

With internal reference, single ended input (grounded negative input), and a gain of 1/6 the input range will be:

$$\text{Input range} = (0.6 \text{ V}) / (1/6) = 3.6 \text{ V}$$

The AIN0-AIN7 inputs cannot exceed VDD, or be lower than VSS.

### 6.17.9 Acquisition time

To sample the input voltage, the ADC connects a capacitor to the input.

For illustration, see [Simplified ADC sample network](#) on page 342. The acquisition time indicates how long the capacitor is connected, see TACQ field in CH[n].CONFIG register. The required acquisition time depends on the source ( $R_{\text{source}}$ ) resistance. For high source resistance the acquisition time should be increased, see [Acquisition time](#) on page 342.

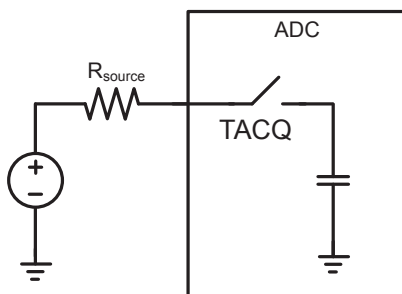


Figure 95: Simplified ADC sample network

TACQ [ $\mu$ s]	Maximum source resistance [kOhm]
3	10
5	40
10	100
15	200
20	400
40	800

Table 70: Acquisition time

### 6.17.10 Limits event monitoring

A channel can be event monitored by configuring limit register CH[n].LIMIT.

If the conversion result is higher than the defined high limit, or lower than the defined low limit, the appropriate event will get fired.

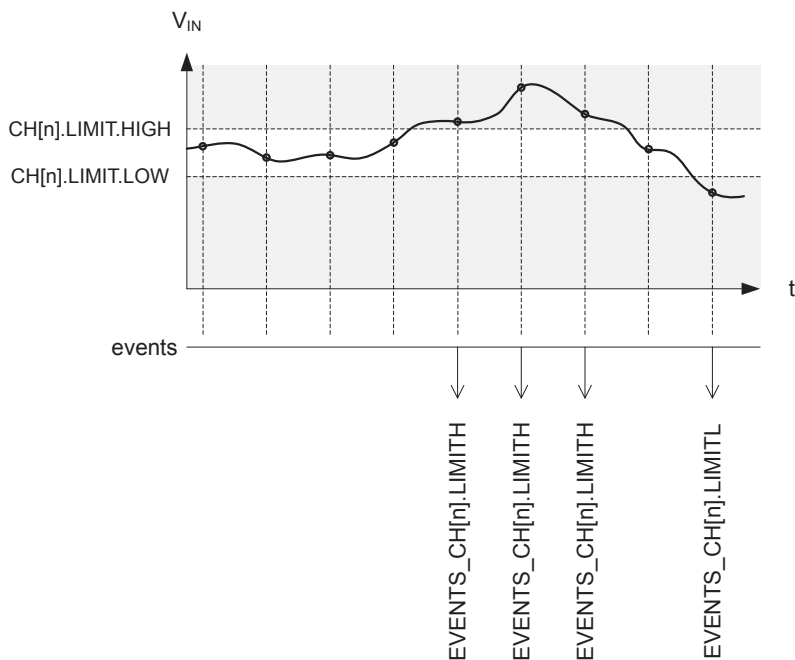


Figure 96: Example of limits monitoring on channel 'n'

Note that when setting the limits, CH[n].LIMIT.HIGH shall always be higher than or equal to CH[n].LIMIT.LOW. In other words, an event can be fired only when the input signal has been sampled outside of the defined limits. It is not possible to fire an event when the input signal is inside a defined range by swapping high and low limits.

The comparison to limits always takes place, there is no need to enable it. If comparison is not required on a channel, the software shall simply ignore the related events. In that situation, the value of the limits registers is irrelevant, so it does not matter if CH[n].LIMIT.LOW is lower than CH[n].LIMIT.HIGH or not.

### 6.17.11 Registers

Base address	Peripheral	Instance	Description	Configuration
0x40007000	SAADC	SAADC	Analog-to-digital converter	

Table 71: Instances

Register	Offset	Description
TASKS_START	0x000	Start the ADC and prepare the result buffer in RAM
TASKS_SAMPLE	0x004	Take one ADC sample, if scan is enabled all channels are sampled
TASKS_STOP	0x008	Stop the ADC and terminate any on-going conversion
TASKS_CALIBRATEOFFS	0x00C	Starts offset auto-calibration
EVENTS_STARTED	0x100	The ADC has started
EVENTS_END	0x104	The ADC has filled up the Result buffer
EVENTS_DONE	0x108	A conversion task has been completed. Depending on the mode, multiple conversions might be needed for a result to be transferred to RAM.
EVENTS_RESULTDONE	0x10C	A result is ready to get transferred to RAM.
EVENTS_CALIBRATEDONE	0x110	Calibration is complete
EVENTS_STOPPED	0x114	The ADC has stopped
EVENTS_CH[0].LIMITH	0x118	Last results is equal or above CH[0].LIMIT.HIGH
EVENTS_CH[0].LIMITL	0x11C	Last results is equal or below CH[0].LIMIT.LOW
EVENTS_CH[1].LIMITH	0x120	Last results is equal or above CH[1].LIMIT.HIGH
EVENTS_CH[1].LIMITL	0x124	Last results is equal or below CH[1].LIMIT.LOW
EVENTS_CH[2].LIMITH	0x128	Last results is equal or above CH[2].LIMIT.HIGH
EVENTS_CH[2].LIMITL	0x12C	Last results is equal or below CH[2].LIMIT.LOW
EVENTS_CH[3].LIMITH	0x130	Last results is equal or above CH[3].LIMIT.HIGH
EVENTS_CH[3].LIMITL	0x134	Last results is equal or below CH[3].LIMIT.LOW
EVENTS_CH[4].LIMITH	0x138	Last results is equal or above CH[4].LIMIT.HIGH
EVENTS_CH[4].LIMITL	0x13C	Last results is equal or below CH[4].LIMIT.LOW
EVENTS_CH[5].LIMITH	0x140	Last results is equal or above CH[5].LIMIT.HIGH
EVENTS_CH[5].LIMITL	0x144	Last results is equal or below CH[5].LIMIT.LOW
EVENTS_CH[6].LIMITH	0x148	Last results is equal or above CH[6].LIMIT.HIGH
EVENTS_CH[6].LIMITL	0x14C	Last results is equal or below CH[6].LIMIT.LOW
EVENTS_CH[7].LIMITH	0x150	Last results is equal or above CH[7].LIMIT.HIGH
EVENTS_CH[7].LIMITL	0x154	Last results is equal or below CH[7].LIMIT.LOW
INTEN	0x300	Enable or disable interrupt
INTENSET	0x304	Enable interrupt
INTENCLR	0x308	Disable interrupt
STATUS	0x400	Status
ENABLE	0x500	Enable or disable ADC
CH[0].PSEL	0x510	Input positive pin selection for CH[0]
CH[0].PSELN	0x514	Input negative pin selection for CH[0]
CH[0].CONFIG	0x518	Input configuration for CH[0]
CH[0].LIMIT	0x51C	High/low limits for event monitoring a channel
CH[1].PSEL	0x520	Input positive pin selection for CH[1]

Register	Offset	Description
CH[1].PSELN	0x524	Input negative pin selection for CH[1]
CH[1].CONFIG	0x528	Input configuration for CH[1]
CH[1].LIMIT	0x52C	High/low limits for event monitoring a channel
CH[2].PSELP	0x530	Input positive pin selection for CH[2]
CH[2].PSELN	0x534	Input negative pin selection for CH[2]
CH[2].CONFIG	0x538	Input configuration for CH[2]
CH[2].LIMIT	0x53C	High/low limits for event monitoring a channel
CH[3].PSELP	0x540	Input positive pin selection for CH[3]
CH[3].PSELN	0x544	Input negative pin selection for CH[3]
CH[3].CONFIG	0x548	Input configuration for CH[3]
CH[3].LIMIT	0x54C	High/low limits for event monitoring a channel
CH[4].PSELP	0x550	Input positive pin selection for CH[4]
CH[4].PSELN	0x554	Input negative pin selection for CH[4]
CH[4].CONFIG	0x558	Input configuration for CH[4]
CH[4].LIMIT	0x55C	High/low limits for event monitoring a channel
CH[5].PSELP	0x560	Input positive pin selection for CH[5]
CH[5].PSELN	0x564	Input negative pin selection for CH[5]
CH[5].CONFIG	0x568	Input configuration for CH[5]
CH[5].LIMIT	0x56C	High/low limits for event monitoring a channel
CH[6].PSELP	0x570	Input positive pin selection for CH[6]
CH[6].PSELN	0x574	Input negative pin selection for CH[6]
CH[6].CONFIG	0x578	Input configuration for CH[6]
CH[6].LIMIT	0x57C	High/low limits for event monitoring a channel
CH[7].PSELP	0x580	Input positive pin selection for CH[7]
CH[7].PSELN	0x584	Input negative pin selection for CH[7]
CH[7].CONFIG	0x588	Input configuration for CH[7]
CH[7].LIMIT	0x58C	High/low limits for event monitoring a channel
RESOLUTION	0x5F0	Resolution configuration
OVERSAMPLE	0x5F4	Oversampling configuration. OVERSAMPLE should not be combined with SCAN. The RESOLUTION is applied before averaging, thus for high OVERSAMPLE a higher RESOLUTION should be used.
SAMPLERATE	0x5F8	Controls normal or continuous sample rate
RESULT.PTR	0x62C	Data pointer
RESULT.MAXCNT	0x630	Maximum number of buffer words to transfer
RESULT.AMOUNT	0x634	Number of buffer words transferred since last START

Table 72: Register Overview

### 6.17.11.1 INTEN

Address offset: 0x300

Enable or disable interrupt

Bit number	31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0																												
Id	V U T S R Q P O N M L K J I H G F E D C B A																												
Reset 0x00000000	0 0																												
Id	RW	Field	Value	Id	Value	Description																							
A	RW	STARTED				Enable or disable interrupt for STARTED event																							
						See <a href="#">EVENTS_STARTED</a>																							
			Disabled		0	Disable																							
			Enabled		1	Enable																							



Bit number			31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0																															
Id			V U T S R Q P O N M L K J I H G F E D C B A																															
Reset 0x00000000			0 0																															
Id	RW	Field	Value Id	Value	Description																													
B	RW	END			Enable or disable interrupt for END event																													
					See <a href="#">EVENTS_END</a>																													
			Disabled	0	Disable																													
		Enabled	1	Enable																														
C	RW	DONE			Enable or disable interrupt for DONE event																													
					See <a href="#">EVENTS_DONE</a>																													
			Disabled	0	Disable																													
		Enabled	1	Enable																														
D	RW	RESULTDONE			Enable or disable interrupt for RESULTDONE event																													
					See <a href="#">EVENTS_RESULTDONE</a>																													
			Disabled	0	Disable																													
		Enabled	1	Enable																														
E	RW	CALIBRATEDONE			Enable or disable interrupt for CALIBRATEDONE event																													
					See <a href="#">EVENTS_CALIBRATEDONE</a>																													
			Disabled	0	Disable																													
		Enabled	1	Enable																														
F	RW	STOPPED			Enable or disable interrupt for STOPPED event																													
					See <a href="#">EVENTS_STOPPED</a>																													
			Disabled	0	Disable																													
		Enabled	1	Enable																														
G	RW	CH0LIMITH			Enable or disable interrupt for CH[0].LIMITH event																													
					See <a href="#">EVENTS_CH[0].LIMITH</a>																													
			Disabled	0	Disable																													
		Enabled	1	Enable																														
H	RW	CH0LIMITL			Enable or disable interrupt for CH[0].LIMITL event																													
					See <a href="#">EVENTS_CH[0].LIMITL</a>																													
			Disabled	0	Disable																													
		Enabled	1	Enable																														
I	RW	CH1LIMITH			Enable or disable interrupt for CH[1].LIMITH event																													
					See <a href="#">EVENTS_CH[1].LIMITH</a>																													
			Disabled	0	Disable																													
		Enabled	1	Enable																														
J	RW	CH1LIMITL			Enable or disable interrupt for CH[1].LIMITL event																													
					See <a href="#">EVENTS_CH[1].LIMITL</a>																													
			Disabled	0	Disable																													
		Enabled	1	Enable																														
K	RW	CH2LIMITH			Enable or disable interrupt for CH[2].LIMITH event																													
					See <a href="#">EVENTS_CH[2].LIMITH</a>																													
			Disabled	0	Disable																													
		Enabled	1	Enable																														
L	RW	CH2LIMITL			Enable or disable interrupt for CH[2].LIMITL event																													
					See <a href="#">EVENTS_CH[2].LIMITL</a>																													
			Disabled	0	Disable																													
		Enabled	1	Enable																														
M	RW	CH3LIMITH			Enable or disable interrupt for CH[3].LIMITH event																													
					See <a href="#">EVENTS_CH[3].LIMITH</a>																													

Bit number			31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0																															
Id			V U T S R Q P O N M L K J I H G F E D C B A																															
Reset 0x00000000			0 0																															
Id	RW	Field	Value Id	Value	Description																													
			Disabled	0	Disable																													
			Enabled	1	Enable																													
N	RW	CH3LIMITL			Enable or disable interrupt for CH[3].LIMITL event																													
					See <a href="#">EVENTS_CH[3].LIMITL</a>																													
			Disabled	0	Disable																													
			Enabled	1	Enable																													
O	RW	CH4LIMITH			Enable or disable interrupt for CH[4].LIMITH event																													
					See <a href="#">EVENTS_CH[4].LIMITH</a>																													
			Disabled	0	Disable																													
			Enabled	1	Enable																													
P	RW	CH4LIMITL			Enable or disable interrupt for CH[4].LIMITL event																													
					See <a href="#">EVENTS_CH[4].LIMITL</a>																													
			Disabled	0	Disable																													
			Enabled	1	Enable																													
Q	RW	CH5LIMITH			Enable or disable interrupt for CH[5].LIMITH event																													
					See <a href="#">EVENTS_CH[5].LIMITH</a>																													
			Disabled	0	Disable																													
			Enabled	1	Enable																													
R	RW	CH5LIMITL			Enable or disable interrupt for CH[5].LIMITL event																													
					See <a href="#">EVENTS_CH[5].LIMITL</a>																													
			Disabled	0	Disable																													
			Enabled	1	Enable																													
S	RW	CH6LIMITH			Enable or disable interrupt for CH[6].LIMITH event																													
					See <a href="#">EVENTS_CH[6].LIMITH</a>																													
			Disabled	0	Disable																													
			Enabled	1	Enable																													
T	RW	CH6LIMITL			Enable or disable interrupt for CH[6].LIMITL event																													
					See <a href="#">EVENTS_CH[6].LIMITL</a>																													
			Disabled	0	Disable																													
			Enabled	1	Enable																													
U	RW	CH7LIMITH			Enable or disable interrupt for CH[7].LIMITH event																													
					See <a href="#">EVENTS_CH[7].LIMITH</a>																													
			Disabled	0	Disable																													
			Enabled	1	Enable																													
V	RW	CH7LIMITL			Enable or disable interrupt for CH[7].LIMITL event																													
					See <a href="#">EVENTS_CH[7].LIMITL</a>																													
			Disabled	0	Disable																													
			Enabled	1	Enable																													

### 6.17.11.2 INTENSET

Address offset: 0x304

Enable interrupt

Bit number			31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0																																			
Id			V U T S R Q P O N M L K J I H G F E D C B A																																			
Reset 0x00000000			0 0																																			
Id	RW	Field	Value	Id	Value	Description																																
A	RW	STARTED				Write '1' to Enable interrupt for STARTED event																																
						See <a href="#">EVENTS_STARTED</a>																																
		Set	1			Enable																																
		Disabled	0			Read: Disabled																																
		Enabled	1			Read: Enabled																																
B	RW	END				Write '1' to Enable interrupt for END event																																
						See <a href="#">EVENTS_END</a>																																
		Set	1			Enable																																
		Disabled	0			Read: Disabled																																
		Enabled	1			Read: Enabled																																
C	RW	DONE				Write '1' to Enable interrupt for DONE event																																
						See <a href="#">EVENTS_DONE</a>																																
		Set	1			Enable																																
		Disabled	0			Read: Disabled																																
		Enabled	1			Read: Enabled																																
D	RW	RESULTDONE				Write '1' to Enable interrupt for RESULTDONE event																																
						See <a href="#">EVENTS_RESULTDONE</a>																																
		Set	1			Enable																																
		Disabled	0			Read: Disabled																																
		Enabled	1			Read: Enabled																																
E	RW	CALIBRATEDONE				Write '1' to Enable interrupt for CALIBRATEDONE event																																
						See <a href="#">EVENTS_CALIBRATEDONE</a>																																
		Set	1			Enable																																
		Disabled	0			Read: Disabled																																
		Enabled	1			Read: Enabled																																
F	RW	STOPPED				Write '1' to Enable interrupt for STOPPED event																																
						See <a href="#">EVENTS_STOPPED</a>																																
		Set	1			Enable																																
		Disabled	0			Read: Disabled																																
		Enabled	1			Read: Enabled																																
G	RW	CH0LIMITH				Write '1' to Enable interrupt for CH[0].LIMITH event																																
						See <a href="#">EVENTS_CH[0].LIMITH</a>																																
		Set	1			Enable																																
		Disabled	0			Read: Disabled																																
		Enabled	1			Read: Enabled																																
H	RW	CH0LIMITL				Write '1' to Enable interrupt for CH[0].LIMITL event																																
						See <a href="#">EVENTS_CH[0].LIMITL</a>																																
		Set	1			Enable																																
		Disabled	0			Read: Disabled																																
		Enabled	1			Read: Enabled																																
I	RW	CH1LIMITH				Write '1' to Enable interrupt for CH[1].LIMITH event																																
						See <a href="#">EVENTS_CH[1].LIMITH</a>																																
		Set	1			Enable																																
		Disabled	0			Read: Disabled																																
		Enabled	1			Read: Enabled																																
J	RW	CH1LIMITL				Write '1' to Enable interrupt for CH[1].LIMITL event																																
						See <a href="#">EVENTS_CH[1].LIMITL</a>																																

Bit number			31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0																															
Id			V U T S R Q P O N M L K J I H G F E D C B A																															
Reset 0x00000000			0 0																															
Id	RW	Field	Value Id	Value	Description																													
			Set	1	Enable																													
			Disabled	0	Read: Disabled																													
			Enabled	1	Read: Enabled																													
K	RW	CH2LIMITH			Write '1' to Enable interrupt for CH[2].LIMITH event																													
					See <a href="#">EVENTS_CH[2].LIMITH</a>																													
			Set	1	Enable																													
			Disabled	0	Read: Disabled																													
			Enabled	1	Read: Enabled																													
L	RW	CH2LIMITL			Write '1' to Enable interrupt for CH[2].LIMITL event																													
					See <a href="#">EVENTS_CH[2].LIMITL</a>																													
			Set	1	Enable																													
			Disabled	0	Read: Disabled																													
			Enabled	1	Read: Enabled																													
M	RW	CH3LIMITH			Write '1' to Enable interrupt for CH[3].LIMITH event																													
					See <a href="#">EVENTS_CH[3].LIMITH</a>																													
			Set	1	Enable																													
			Disabled	0	Read: Disabled																													
			Enabled	1	Read: Enabled																													
N	RW	CH3LIMITL			Write '1' to Enable interrupt for CH[3].LIMITL event																													
					See <a href="#">EVENTS_CH[3].LIMITL</a>																													
			Set	1	Enable																													
			Disabled	0	Read: Disabled																													
			Enabled	1	Read: Enabled																													
O	RW	CH4LIMITH			Write '1' to Enable interrupt for CH[4].LIMITH event																													
					See <a href="#">EVENTS_CH[4].LIMITH</a>																													
			Set	1	Enable																													
			Disabled	0	Read: Disabled																													
			Enabled	1	Read: Enabled																													
P	RW	CH4LIMITL			Write '1' to Enable interrupt for CH[4].LIMITL event																													
					See <a href="#">EVENTS_CH[4].LIMITL</a>																													
			Set	1	Enable																													
			Disabled	0	Read: Disabled																													
			Enabled	1	Read: Enabled																													
Q	RW	CH5LIMITH			Write '1' to Enable interrupt for CH[5].LIMITH event																													
					See <a href="#">EVENTS_CH[5].LIMITH</a>																													
			Set	1	Enable																													
			Disabled	0	Read: Disabled																													
			Enabled	1	Read: Enabled																													
R	RW	CH5LIMITL			Write '1' to Enable interrupt for CH[5].LIMITL event																													
					See <a href="#">EVENTS_CH[5].LIMITL</a>																													
			Set	1	Enable																													
			Disabled	0	Read: Disabled																													
			Enabled	1	Read: Enabled																													
S	RW	CH6LIMITH			Write '1' to Enable interrupt for CH[6].LIMITH event																													
					See <a href="#">EVENTS_CH[6].LIMITH</a>																													
			Set	1	Enable																													
			Disabled	0	Read: Disabled																													

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0																															
Id				V U T S R Q P O N M L K J I H G F E D C B A																															
Reset 0x00000000				0 0																															
Id	RW	Field	Value Id	Value	Description																														
T	RW	CH6LIMITL	Enabled	1	Read: Enabled																														
			Write '1' to Enable interrupt for CH[6].LIMITL event																																
			See <a href="#">EVENTS_CH[6].LIMITL</a>																																
			Set	1	Enable																														
			Disabled	0	Read: Disabled																														
U	RW	CH7LIMITH	Enabled	1	Read: Enabled																														
			Write '1' to Enable interrupt for CH[7].LIMITH event																																
			See <a href="#">EVENTS_CH[7].LIMITH</a>																																
			Set	1	Enable																														
			Disabled	0	Read: Disabled																														
V	RW	CH7LIMITL	Enabled	1	Read: Enabled																														
			Write '1' to Enable interrupt for CH[7].LIMITL event																																
			See <a href="#">EVENTS_CH[7].LIMITL</a>																																
			Set	1	Enable																														
			Disabled	0	Read: Disabled																														
			Enabled	1	Read: Enabled																														

### 6.17.11.3 INTENCLR

Address offset: 0x308

Disable interrupt

Bit number			31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0																															
Id			V U T S R Q P O N M L K J I H G F E D C B A																															
Reset 0x00000000			0 0																															
Id	RW	Field	Value Id	Value	Description																													
A	RW	STARTED			Write '1' to Disable interrupt for STARTED event																													
					See <a href="#">EVENTS_STARTED</a>																													
			Clear	1	Disable																													
			Disabled	0	Read: Disabled																													
			Enabled	1	Read: Enabled																													
B	RW	END			Write '1' to Disable interrupt for END event																													
					See <a href="#">EVENTS_END</a>																													
			Clear	1	Disable																													
			Disabled	0	Read: Disabled																													
			Enabled	1	Read: Enabled																													
C	RW	DONE			Write '1' to Disable interrupt for DONE event																													
					See <a href="#">EVENTS_DONE</a>																													
			Clear	1	Disable																													
			Disabled	0	Read: Disabled																													
			Enabled	1	Read: Enabled																													
D	RW	RESULTDONE			Write '1' to Disable interrupt for RESULTDONE event																													
					See <a href="#">EVENTS_RESULTDONE</a>																													
			Clear	1	Disable																													
			Disabled	0	Read: Disabled																													
			Enabled	1	Read: Enabled																													

Bit number			31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0																															
Id			V U T S R Q P O N M L K J I H G F E D C B A																															
Reset 0x00000000			0 0																															
Id	RW	Field	Value Id	Value	Description																													
E	RW	CALIBRATEDONE			Write '1' to Disable interrupt for CALIBRATEDONE event																													
					See <a href="#">EVENTS_CALIBRATEDONE</a>																													
			Clear	1	Disable																													
			Disabled	0	Read: Disabled																													
			Enabled	1	Read: Enabled																													
F	RW	STOPPED			Write '1' to Disable interrupt for STOPPED event																													
					See <a href="#">EVENTS_STOPPED</a>																													
			Clear	1	Disable																													
			Disabled	0	Read: Disabled																													
			Enabled	1	Read: Enabled																													
G	RW	CH0LIMITH			Write '1' to Disable interrupt for CH[0].LIMITH event																													
					See <a href="#">EVENTS_CH[0].LIMITH</a>																													
			Clear	1	Disable																													
			Disabled	0	Read: Disabled																													
			Enabled	1	Read: Enabled																													
H	RW	CH0LIMITL			Write '1' to Disable interrupt for CH[0].LIMITL event																													
					See <a href="#">EVENTS_CH[0].LIMITL</a>																													
			Clear	1	Disable																													
			Disabled	0	Read: Disabled																													
			Enabled	1	Read: Enabled																													
I	RW	CH1LIMITH			Write '1' to Disable interrupt for CH[1].LIMITH event																													
					See <a href="#">EVENTS_CH[1].LIMITH</a>																													
			Clear	1	Disable																													
			Disabled	0	Read: Disabled																													
			Enabled	1	Read: Enabled																													
J	RW	CH1LIMITL			Write '1' to Disable interrupt for CH[1].LIMITL event																													
					See <a href="#">EVENTS_CH[1].LIMITL</a>																													
			Clear	1	Disable																													
			Disabled	0	Read: Disabled																													
			Enabled	1	Read: Enabled																													
K	RW	CH2LIMITH			Write '1' to Disable interrupt for CH[2].LIMITH event																													
					See <a href="#">EVENTS_CH[2].LIMITH</a>																													
			Clear	1	Disable																													
			Disabled	0	Read: Disabled																													
			Enabled	1	Read: Enabled																													
L	RW	CH2LIMITL			Write '1' to Disable interrupt for CH[2].LIMITL event																													
					See <a href="#">EVENTS_CH[2].LIMITL</a>																													
			Clear	1	Disable																													
			Disabled	0	Read: Disabled																													
			Enabled	1	Read: Enabled																													
M	RW	CH3LIMITH			Write '1' to Disable interrupt for CH[3].LIMITH event																													
					See <a href="#">EVENTS_CH[3].LIMITH</a>																													
			Clear	1	Disable																													
			Disabled	0	Read: Disabled																													
			Enabled	1	Read: Enabled																													
N	RW	CH3LIMITL			Write '1' to Disable interrupt for CH[3].LIMITL event																													
					See <a href="#">EVENTS_CH[3].LIMITL</a>																													

Bit number					31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0																															
Id					V U T S R Q P O N M L K J I H G F E D C B A																															
Reset 0x00000000					0 0																															
Id	RW	Field	Value Id	Value	Description																															
			Clear	1	Disable																															
			Disabled	0	Read: Disabled																															
			Enabled	1	Read: Enabled																															
O	RW	CH4LIMITH			Write '1' to Disable interrupt for CH[4].LIMITH event																															
					See <a href="#">EVENTS_CH[4].LIMITH</a>																															
			Clear	1	Disable																															
			Disabled	0	Read: Disabled																															
			Enabled	1	Read: Enabled																															
P	RW	CH4LIMITL			Write '1' to Disable interrupt for CH[4].LIMITL event																															
					See <a href="#">EVENTS_CH[4].LIMITL</a>																															
			Clear	1	Disable																															
			Disabled	0	Read: Disabled																															
			Enabled	1	Read: Enabled																															
Q	RW	CH5LIMITH			Write '1' to Disable interrupt for CH[5].LIMITH event																															
					See <a href="#">EVENTS_CH[5].LIMITH</a>																															
			Clear	1	Disable																															
			Disabled	0	Read: Disabled																															
			Enabled	1	Read: Enabled																															
R	RW	CH5LIMITL			Write '1' to Disable interrupt for CH[5].LIMITL event																															
					See <a href="#">EVENTS_CH[5].LIMITL</a>																															
			Clear	1	Disable																															
			Disabled	0	Read: Disabled																															
			Enabled	1	Read: Enabled																															
S	RW	CH6LIMITH			Write '1' to Disable interrupt for CH[6].LIMITH event																															
					See <a href="#">EVENTS_CH[6].LIMITH</a>																															
			Clear	1	Disable																															
			Disabled	0	Read: Disabled																															
			Enabled	1	Read: Enabled																															
T	RW	CH6LIMITL			Write '1' to Disable interrupt for CH[6].LIMITL event																															
					See <a href="#">EVENTS_CH[6].LIMITL</a>																															
			Clear	1	Disable																															
			Disabled	0	Read: Disabled																															
			Enabled	1	Read: Enabled																															
U	RW	CH7LIMITH			Write '1' to Disable interrupt for CH[7].LIMITH event																															
					See <a href="#">EVENTS_CH[7].LIMITH</a>																															
			Clear	1	Disable																															
			Disabled	0	Read: Disabled																															
			Enabled	1	Read: Enabled																															
V	RW	CH7LIMITL			Write '1' to Disable interrupt for CH[7].LIMITL event																															
					See <a href="#">EVENTS_CH[7].LIMITL</a>																															
			Clear	1	Disable																															
			Disabled	0	Read: Disabled																															
			Enabled	1	Read: Enabled																															

#### 6.17.11.4 STATUS

Address offset: 0x400

Status

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0																																
Id				A																																
Reset 0x00000000				0 0																																
Id	RW	Field	Value Id	Value	Description																															
A	R	STATUS			Status																															
			Ready	0	ADC is ready. No on-going conversion.																															
			Busy	1	ADC is busy. Conversion in progress.																															

### 6.17.11.5 ENABLE

Address offset: 0x500

Enable or disable ADC

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0																															
Id				A																															
Reset 0x00000000				0 0																															
Id	RW	Field	Value Id	Value	Description																														
A	RW	ENABLE			Enable or disable ADC																														
			Disabled	0	Disable ADC																														
			Enabled	1	Enable ADC																														
					When enabled, the ADC will acquire access to the analog input pins specified in the CH[n].PSEL0 and CH[n].PSELN registers.																														

### 6.17.11.6 CH[0].PSEL0

Address offset: 0x510

Input positive pin selection for CH[0]

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0																															
Id				A A																															
Reset 0x00000000				0 0																															
Id	RW	Field	Value Id	Value	Description																														
A	RW	PSEL0			Analog positive input channel																														
			NC	0	Not connected																														
			AnalogInput0	1	AIN0																														
			AnalogInput1	2	AIN1																														
			AnalogInput2	3	AIN2																														
			AnalogInput3	4	AIN3																														
			AnalogInput4	5	AIN4																														
			AnalogInput5	6	AIN5																														
			AnalogInput6	7	AIN6																														
			AnalogInput7	8	AIN7																														
			VDD	9	VDD																														

### 6.17.11.7 CH[0].PSELN

Address offset: 0x514

Input negative pin selection for CH[0]



Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0																															
Id				A A																															

### 6.17.11.8 CH[0].CONFIG

Address offset: 0x518

Input configuration for CH[0]

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0																																	
Id				G																F			E E E			D				C C C			B B			A A	
Reset 0x00020000				0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 1 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0																																	
Id	RW	Field	Value Id	Value	Description																																
A	RW	RESP			Positive channel resistor control																																
			Bypass	0	Bypass resistor ladder																																
			Pulldown	1	Pull-down to GND																																
			Pullup	2	Pull-up to VDD																																
			VDD1_2	3	Set input at VDD/2																																
B	RW	RESN			Negative channel resistor control																																
			Bypass	0	Bypass resistor ladder																																
			Pulldown	1	Pull-down to GND																																
			Pullup	2	Pull-up to VDD																																
			VDD1_2	3	Set input at VDD/2																																
C	RW	GAIN			Gain control																																
			Gain1_6	0	1/6																																
			Gain1_5	1	1/5																																
			Gain1_4	2	1/4																																
			Gain1_3	3	1/3																																
			Gain1_2	4	1/2																																
			Gain1	5	1																																
			Gain2	6	2																																
Gain4	7	4																																			
D	RW	REFSEL			Reference control																																
			Internal	0	Internal reference (0.6 V)																																
			VDD1_4	1	VDD/4 as reference																																
E	RW	TACQ			Acquisition time, the time the ADC uses to sample the input voltage																																
			3us	0	3 us																																
			5us	1	5 us																																
			10us	2	10 us																																
			15us	3	15 us																																

Bit number		31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
Id		G										F			E			D			C			B			A						
Reset 0x00020000		0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 1 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0																															
Id	RW	Field	Value Id	Value	Description																												
			20us	4	20 us																												
			40us	5	40 us																												
F	RW	MODE			Enable differential mode																												
			SE	0	Single ended, PSELN will be ignored, negative input to ADC shorted to GND																												
			Diff	1	Differential																												
G	RW	BURST			Enable burst mode																												
			Disabled	0	Burst mode is disabled (normal operation)																												
			Enabled	1	Burst mode is enabled. SAADC takes 2 <sup>OVERSAMPLE</sup> number of samples as fast as it can, and sends the average to Data RAM.																												

### 6.17.11.9 CH[0].LIMIT

Address offset: 0x51C

High/low limits for event monitoring a channel

Bit number				31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0	
Id				B	B	B	B	B	B	B	B	B	B	B	B	B	B	B	B	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A
Reset 0x7FFF8000				0	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Id	RW	Field	Value Id	Value				Description																												
A	RW	LOW		[-32768 to +32767]				Low level limit																												
B	RW	HIGH		[-32768 to +32767]				High level limit																												

### 6.17.11.10 CH[1].PSELP

Address offset: 0x520

Input positive pin selection for CH[1]

Bit number				31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
Id				A A																															

### 6.17.11.11 CH[1].PSELN

Address offset: 0x524

Input negative pin selection for CH[1]

Input configuration for CH[1]

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Bit number				31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0								
Id				G										F			E			E			D			C			C			B			B			A			A		
Reset 0x00020000				0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0						
Id	RW	Field	Value Id	Value	Description																																						
			20us	4	20 us																																						
			40us	5	40 us																																						
F	RW	MODE			Enable differential mode																																						
			SE	0	Single ended, PSELN will be ignored, negative input to ADC shorted to GND																																						
			Diff	1	Differential																																						
G	RW	BURST			Enable burst mode																																						
			Disabled	0	Burst mode is disabled (normal operation)																																						
			Enabled	1	Burst mode is enabled. SAADC takes 2^OVERSAMPLE number of samples as fast as it can, and sends the average to Data RAM.																																						

### 6.17.11.13 CH[1].LIMIT

Address offset: 0x52C

High/low limits for event monitoring a channel

Bit number				31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0	
Id				B	B	B	B	B	B	B	B	B	B	B	B	B	B	B	B	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A
Reset 0x7FFF8000				0	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Id	RW	Field	Value Id	Value				Description																												
A	RW	LOW		[-32768 to +32767]				Low level limit																												
B	RW	HIGH		[-32768 to +32767]				High level limit																												

### 6.17.11.14 CH[2].PSELP

Address offset: 0x530

Input positive pin selection for CH[2]

Bit number				31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0				
Id				A																																A	A	A	A
Reset 0x00000000				0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0			
Id	RW	Field	Value Id	Value	Description																																		
A	RW	PSELP			Analog positive input channel																																		
			NC	0	Not connected																																		
			AnalogInput0	1	AIN0																																		
			AnalogInput1	2	AIN1																																		
			AnalogInput2	3	AIN2																																		
			AnalogInput3	4	AIN3																																		
			AnalogInput4	5	AIN4																																		
			AnalogInput5	6	AIN5																																		
			AnalogInput6	7	AIN6																																		
			AnalogInput7	8	AIN7																																		
			VDD	9	VDD																																		

### 6.17.11.15 CH[2].PSELN

Address offset: 0x534

Input negative pin selection for CH[2]

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0																															
Id				A A A A A																															
Reset 0x00000000				0 0																															
Id	RW	Field	Value Id	Value	Description																														
A	RW	PSELN			Analog negative input, enables differential channel																														
			NC	0	Not connected																														
			AnalogInput0	1	AIN0																														
			AnalogInput1	2	AIN1																														
			AnalogInput2	3	AIN2																														
			AnalogInput3	4	AIN3																														
			AnalogInput4	5	AIN4																														
			AnalogInput5	6	AIN5																														
			AnalogInput6	7	AIN6																														
			AnalogInput7	8	AIN7																														
			VDD	9	VDD																														

### 6.17.11.16 CH[2].CONFIG

Address offset: 0x538

Input configuration for CH[2]

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0																																			
Id																			G			F			E E E			D			C C C			B B			A A		
Reset 0x00020000				0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 1 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0																																			
Id	RW	Field	Value Id	Value	Description																																		
A	RW	RESP			Positive channel resistor control																																		
			Bypass	0	Bypass resistor ladder																																		
			Pulldown	1	Pull-down to GND																																		
			Pullup	2	Pull-up to VDD																																		
			VDD1_2	3	Set input at VDD/2																																		
B	RW	RESN			Negative channel resistor control																																		
			Bypass	0	Bypass resistor ladder																																		
			Pulldown	1	Pull-down to GND																																		
			Pullup	2	Pull-up to VDD																																		
			VDD1_2	3	Set input at VDD/2																																		
C	RW	GAIN			Gain control																																		
			Gain1_6	0	1/6																																		
			Gain1_5	1	1/5																																		
			Gain1_4	2	1/4																																		
			Gain1_3	3	1/3																																		
			Gain1_2	4	1/2																																		
			Gain1	5	1																																		
			Gain2	6	2																																		
			Gain4	7	4																																		
D	RW	REFSEL			Reference control																																		
			Internal	0	Internal reference (0.6 V)																																		
			VDD1_4	1	VDD/4 as reference																																		
E	RW	TACQ			Acquisition time, the time the ADC uses to sample the input voltage																																		
			3us	0	3 us																																		
			5us	1	5 us																																		
			10us	2	10 us																																		
			15us	3	15 us																																		

Bit number		31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
Id		G										F			E			D			C			B			A						
Reset 0x00020000		0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 1 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0																															
Id	RW	Field	Value Id	Value	Description																												
			20us	4	20 us																												
			40us	5	40 us																												
F	RW	MODE			Enable differential mode																												
			SE	0	Single ended, PSELN will be ignored, negative input to ADC shorted to GND																												
			Diff	1	Differential																												
G	RW	BURST			Enable burst mode																												
			Disabled	0	Burst mode is disabled (normal operation)																												
			Enabled	1	Burst mode is enabled. SAADC takes 2 <sup>OVERSAMPLE</sup> number of samples as fast as it can, and sends the average to Data RAM.																												

### 6.17.11.17 CH[2].LIMIT

Address offset: 0x53C

High/low limits for event monitoring a channel

Bit number				31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
Id				B	B	B	B	B	B	B	B	B	B	B	B	B	B	B	B	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A
Reset 0x7FFF8000				0	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Id	RW	Field	Value Id	Value				Description																											
A	RW	LOW		[-32768 to +32767]				Low level limit																											
B	RW	HIGH		[-32768 to +32767]				High level limit																											

### 6.17.11.18 CH[3].PSELP

Address offset: 0x540

Input positive pin selection for CH[3]

Bit number				31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
Id				A A																															

### 6.17.11.19 CH[3].PSELN

Address offset: 0x544

Input negative pin selection for CH[3]

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0																															
Id				A A A A A																															
Reset 0x00000000				0 0																															
Id	RW	Field	Value Id	Value	Description																														
A	RW	PSELN			Analog negative input, enables differential channel																														
			NC	0	Not connected																														
			AnalogInput0	1	AIN0																														
			AnalogInput1	2	AIN1																														
			AnalogInput2	3	AIN2																														
			AnalogInput3	4	AIN3																														
			AnalogInput4	5	AIN4																														
			AnalogInput5	6	AIN5																														
			AnalogInput6	7	AIN6																														
			AnalogInput7	8	AIN7																														
			VDD	9	VDD																														

### 6.17.11.20 CH[3].CONFIG

Address offset: 0x548

Input configuration for CH[3]

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0																																								
Id														G				F				E	E	E				D				C	C	C				B	B				A	A
Reset 0x00020000				0 0																																								
Id	RW	Field	Value Id	Value	Description																																							
A	RW	RESP			Positive channel resistor control																																							
			Bypass	0	Bypass resistor ladder																																							
			Pulldown	1	Pull-down to GND																																							
			Pullup	2	Pull-up to VDD																																							
			VDD1_2	3	Set input at VDD/2																																							
B	RW	RESN			Negative channel resistor control																																							
			Bypass	0	Bypass resistor ladder																																							
			Pulldown	1	Pull-down to GND																																							
			Pullup	2	Pull-up to VDD																																							
			VDD1_2	3	Set input at VDD/2																																							
C	RW	GAIN			Gain control																																							
			Gain1_6	0	1/6																																							
			Gain1_5	1	1/5																																							
			Gain1_4	2	1/4																																							
			Gain1_3	3	1/3																																							
			Gain1_2	4	1/2																																							
			Gain1	5	1																																							
			Gain2	6	2																																							
			Gain4	7	4																																							
D	RW	REFSEL			Reference control																																							
			Internal	0	Internal reference (0.6 V)																																							
			VDD1_4	1	VDD/4 as reference																																							
E	RW	TACQ			Acquisition time, the time the ADC uses to sample the input voltage																																							
			3us	0	3 us																																							
			5us	1	5 us																																							
			10us	2	10 us																																							
			15us	3	15 us																																							

Bit number				31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0								
Id				G										F			E			E			D			C			C			B			B			A			A		
Reset 0x00020000				0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0						
Id	RW	Field	Value Id	Value	Description																																						
			20us	4	20 us																																						
			40us	5	40 us																																						
F	RW	MODE			Enable differential mode																																						
			SE	0	Single ended, PSELN will be ignored, negative input to ADC shorted to GND																																						
			Diff	1	Differential																																						
G	RW	BURST			Enable burst mode																																						
			Disabled	0	Burst mode is disabled (normal operation)																																						
			Enabled	1	Burst mode is enabled. SAADC takes 2^OVERSAMPLE number of samples as fast as it can, and sends the average to Data RAM.																																						

### 6.17.11.21 CH[3].LIMIT

Address offset: 0x54C

High/low limits for event monitoring a channel

Bit number				31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
Id				B	B	B	B	B	B	B	B	B	B	B	B	B	B	B	B	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A
Reset 0x7FFF8000				0	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Id	RW	Field	Value Id	Value				Description																											
A	RW	LOW		[-32768 to +32767]				Low level limit																											
B	RW	HIGH		[-32768 to +32767]				High level limit																											

### 6.17.11.22 CH[4].PSELP

Address offset: 0x550

Input positive pin selection for CH[4]

Bit number				31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
Id				A A																															

### 6.17.11.23 CH[4].PSELN

Address offset: 0x554

Input negative pin selection for CH[4]



Input configuration for CH[4]



**NORDIC**<sup>®</sup>  
SEMICONDUCTOR

Bit number		31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
Id		G										F			E			D			C			B			A						
Reset 0x00020000		0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 1 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0																															
Id	RW	Field	Value Id	Value	Description																												
			20us	4	20 us																												
			40us	5	40 us																												
F	RW	MODE			Enable differential mode																												
			SE	0	Single ended, PSELN will be ignored, negative input to ADC shorted to GND																												
			Diff	1	Differential																												
G	RW	BURST			Enable burst mode																												
			Disabled	0	Burst mode is disabled (normal operation)																												
			Enabled	1	Burst mode is enabled. SAADC takes 2 <sup>OVERSAMPLE</sup> number of samples as fast as it can, and sends the average to Data RAM.																												

### 6.17.11.25 CH[4].LIMIT

Address offset: 0x55C

High/low limits for event monitoring a channel

Bit number				31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
Id				B	B	B	B	B	B	B	B	B	B	B	B	B	B	B	B	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A
Reset 0x7FFF8000				0	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Id	RW	Field	Value Id	Value				Description																											
A	RW	LOW		[-32768 to +32767]				Low level limit																											
B	RW	HIGH		[-32768 to +32767]				High level limit																											

### 6.17.11.26 CH[5].PSELP

Address offset: 0x560

Input positive pin selection for CH[5]

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0																															
Id				A A																															

### 6.17.11.27 CH[5].PSELN

Address offset: 0x564

Input negative pin selection for CH[5]

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0																																
Id				A A A A A																																
Reset 0x00000000				0 0																																
Id	RW	Field	Value Id	Value	Description																															
A	RW	PSELN			Analog negative input, enables differential channel																															
			NC	0	Not connected																															
			AnalogInput0	1	AIN0																															
			AnalogInput1	2	AIN1																															
			AnalogInput2	3	AIN2																															
			AnalogInput3	4	AIN3																															
			AnalogInput4	5	AIN4																															
			AnalogInput5	6	AIN5																															
			AnalogInput6	7	AIN6																															
			AnalogInput7	8	AIN7																															
		VDD	9	VDD																																

### 6.17.11.28 CH[5].CONFIG

Address offset: 0x568

Input configuration for CH[5]

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0																																							
Id				G																F		E		E		D				C		C		C		B		B		A		A	
Reset 0x00020000				0 0																																							
Id	RW	Field	Value Id	Value	Description																																						
A	RW	RESP			Positive channel resistor control																																						
			Bypass	0	Bypass resistor ladder																																						
			Pulldown	1	Pull-down to GND																																						
			Pullup	2	Pull-up to VDD																																						
			VDD1_2	3	Set input at VDD/2																																						
B	RW	RESN			Negative channel resistor control																																						
			Bypass	0	Bypass resistor ladder																																						
			Pulldown	1	Pull-down to GND																																						
			Pullup	2	Pull-up to VDD																																						
			VDD1_2	3	Set input at VDD/2																																						
C	RW	GAIN			Gain control																																						
			Gain1_6	0	1/6																																						
			Gain1_5	1	1/5																																						
			Gain1_4	2	1/4																																						
			Gain1_3	3	1/3																																						
			Gain1_2	4	1/2																																						
			Gain1	5	1																																						
			Gain2	6	2																																						
D	RW	REFSEL			Reference control																																						
			Internal	0	Internal reference (0.6 V)																																						
			VDD1_4	1	VDD/4 as reference																																						
E	RW	TACQ			Acquisition time, the time the ADC uses to sample the input voltage																																						
			3us	0	3 us																																						
			5us	1	5 us																																						
			10us	2	10 us																																						
			15us	3	15 us																																						

Bit number		31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
Id		G										F			E			D			C			B			A						
Reset 0x00020000		0 0																															
Id	RW	Field	Value Id	Value	Description																												
			20us	4	20 us																												
			40us	5	40 us																												
F	RW	MODE			Enable differential mode																												
			SE	0	Single ended, PSELN will be ignored, negative input to ADC shorted to GND																												
			Diff	1	Differential																												
G	RW	BURST			Enable burst mode																												
			Disabled	0	Burst mode is disabled (normal operation)																												
			Enabled	1	Burst mode is enabled. SAADC takes 2 <sup>OVERSAMPLE</sup> number of samples as fast as it can, and sends the average to Data RAM.																												

### 6.17.11.29 CH[5].LIMIT

Address offset: 0x56C

High/low limits for event monitoring a channel

Bit number				31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
Id				B	B	B	B	B	B	B	B	B	B	B	B	B	B	B	B	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A
Reset 0x7FFF8000				0	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Id	RW	Field	Value Id	Value				Description																											
A	RW	LOW		[-32768 to +32767]				Low level limit																											
B	RW	HIGH		[-32768 to +32767]				High level limit																											

### 6.17.11.30 CH[6].PSELP

Address offset: 0x570

Input positive pin selection for CH[6]

Bit number				31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0				
Id																																				A	A	A	A
Reset 0x00000000				0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0				
Id	RW	Field	Value Id	Value	Description																																		
A	RW	PSELP			Analog positive input channel																																		
			NC	0	Not connected																																		
			AnalogInput0	1	AIN0																																		
			AnalogInput1	2	AIN1																																		
			AnalogInput2	3	AIN2																																		
			AnalogInput3	4	AIN3																																		
			AnalogInput4	5	AIN4																																		
			AnalogInput5	6	AIN5																																		
			AnalogInput6	7	AIN6																																		
			AnalogInput7	8	AIN7																																		
			VDD	9	VDD																																		

### 6.17.11.31 CH[6].PSELN

Address offset: 0x574

Input negative pin selection for CH[6]

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0																															
Id				A A A A A																															
Reset 0x00000000				0 0																															
Id	RW	Field	Value Id	Value	Description																														
A	RW	PSELN			Analog negative input, enables differential channel																														
			NC	0	Not connected																														
			AnalogInput0	1	AIN0																														
			AnalogInput1	2	AIN1																														
			AnalogInput2	3	AIN2																														
			AnalogInput3	4	AIN3																														
			AnalogInput4	5	AIN4																														
			AnalogInput5	6	AIN5																														
			AnalogInput6	7	AIN6																														
			AnalogInput7	8	AIN7																														
			VDD	9	VDD																														

### 6.17.11.32 CH[6].CONFIG

Address offset: 0x578

Input configuration for CH[6]

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0																																													
Id														G		F			E			E						D		C		C		C					B		B					A		A	
Reset 0x00020000				0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 1 0																																													
Id	RW	Field	Value Id	Value	Description																																												
A	RW	RESP			Positive channel resistor control																																												
			Bypass	0	Bypass resistor ladder																																												
			Pulldown	1	Pull-down to GND																																												
			Pullup	2	Pull-up to VDD																																												
			VDD1_2	3	Set input at VDD/2																																												
B	RW	RESN			Negative channel resistor control																																												
			Bypass	0	Bypass resistor ladder																																												
			Pulldown	1	Pull-down to GND																																												
			Pullup	2	Pull-up to VDD																																												
			VDD1_2	3	Set input at VDD/2																																												
C	RW	GAIN			Gain control																																												
			Gain1_6	0	1/6																																												
			Gain1_5	1	1/5																																												
			Gain1_4	2	1/4																																												
			Gain1_3	3	1/3																																												
			Gain1_2	4	1/2																																												
			Gain1	5	1																																												
			Gain2	6	2																																												
			Gain4	7	4																																												
D	RW	REFSEL			Reference control																																												
			Internal	0	Internal reference (0.6 V)																																												
			VDD1_4	1	VDD/4 as reference																																												
E	RW	TACQ			Acquisition time, the time the ADC uses to sample the input voltage																																												
			3us	0	3 us																																												
			5us	1	5 us																																												
			10us	2	10 us																																												
			15us	3	15 us																																												

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0																																
Id				G								F				E E E				D				C C C				B B				A A				
Reset 0x00020000				0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 1 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0																																
Id	RW	Field	Value Id	Value	Description																															
F	RW	MODE	20us	4	20 us																															
			40us	5	40 us																															
			SE	0	Enable differential mode Single ended, PSELN will be ignored, negative input to ADC shorted to GND																															
			Diff	1	Differential																															
G	RW	BURST			Enable burst mode																															
			Disabled	0	Burst mode is disabled (normal operation)																															
			Enabled	1	Burst mode is enabled. SAADC takes 2^OVERSAMPLE number of samples as fast as it can, and sends the average to Data RAM.																															

### 6.17.11.33 CH[6].LIMIT

Address offset: 0x57C

High/low limits for event monitoring a channel

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0																															
Id				B B B B B B B B B B B B B B B A A A A A A A A A A A A A A A A																															
Reset 0x7FFF8000				0 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 0 0 0 0 0 0 0 0 0 0 0 0 0 0																															
Id	RW	Field	Value Id	Value																Description															
A	RW	LOW		[-32768 to +32767]																Low level limit															
B	RW	HIGH		[-32768 to +32767]																High level limit															

### 6.17.11.34 CH[7].PSELP

Address offset: 0x580

Input positive pin selection for CH[7]

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0																																	
Id				A A A A A																																	
Reset 0x00000000				0 0																																	
Id	RW	Field	Value	Id	Value	Description																															
A	RW	PSELP				Analog positive input channel																															
			NC	0		Not connected																															
			AnalogInput0	1		AIN0																															
			AnalogInput1	2		AIN1																															
			AnalogInput2	3		AIN2																															
			AnalogInput3	4		AIN3																															
			AnalogInput4	5		AIN4																															
			AnalogInput5	6		AIN5																															
			AnalogInput6	7		AIN6																															
			AnalogInput7	8		AIN7																															
			VDD	9		VDD																															

### 6.17.11.35 CH[7].PSELN

Address offset: 0x584

Input negative pin selection for CH[7]

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0																															
Id				A A																															

### 6.17.11.36 CH[7].CONFIG

Address offset: 0x588

Input configuration for CH[7]

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0																																													
Id														G		F			E			E						D		C		C		C					B		B					A		A	
Reset 0x00020000				0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 1 0																																													
Id	RW	Field	Value Id	Value	Description																																												
A	RW	RESP			Positive channel resistor control																																												
			Bypass	0	Bypass resistor ladder																																												
			Pulldown	1	Pull-down to GND																																												
			Pullup	2	Pull-up to VDD																																												
			VDD1_2	3	Set input at VDD/2																																												
B	RW	RESN			Negative channel resistor control																																												
			Bypass	0	Bypass resistor ladder																																												
			Pulldown	1	Pull-down to GND																																												
			Pullup	2	Pull-up to VDD																																												
			VDD1_2	3	Set input at VDD/2																																												
C	RW	GAIN			Gain control																																												
			Gain1_6	0	1/6																																												
			Gain1_5	1	1/5																																												
			Gain1_4	2	1/4																																												
			Gain1_3	3	1/3																																												
			Gain1_2	4	1/2																																												
			Gain1	5	1																																												
			Gain2	6	2																																												
			Gain4	7	4																																												
D	RW	REFSEL			Reference control																																												
			Internal	0	Internal reference (0.6 V)																																												
			VDD1_4	1	VDD/4 as reference																																												
E	RW	TACQ			Acquisition time, the time the ADC uses to sample the input voltage																																												
			3us	0	3 us																																												
			5us	1	5 us																																												
			10us	2	10 us																																												
			15us	3	15 us																																												

Bit number				31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0								
Id				G										F			E			E			D			C			C			B			B			A			A		
Reset 0x00020000				0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0						
Id	RW	Field	Value Id	Value	Description																																						
			20us	4	20 us																																						
			40us	5	40 us																																						
F	RW	MODE			Enable differential mode																																						
			SE	0	Single ended, PSELN will be ignored, negative input to ADC shorted to GND																																						
			Diff	1	Differential																																						
G	RW	BURST			Enable burst mode																																						
			Disabled	0	Burst mode is disabled (normal operation)																																						
			Enabled	1	Burst mode is enabled. SAADC takes 2^OVERSAMPLE number of samples as fast as it can, and sends the average to Data RAM.																																						

### 6.17.11.37 CH[7].LIMIT

Address offset: 0x58C

High/low limits for event monitoring a channel

Bit number				31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
Id				B	B	B	B	B	B	B	B	B	B	B	B	B	B	B	B	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A
Reset 0x7FFF8000				0	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Id	RW	Field	Value Id	Value				Description																											
A	RW	LOW		[-32768 to +32767]				Low level limit																											
B	RW	HIGH		[-32768 to +32767]				High level limit																											

### 6.17.11.38 RESOLUTION

Address offset: 0x5F0

Resolution configuration

Bit number										31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0				
Id																																						A	A	A					
Reset 0x00000001										0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
Id	RW	Field	Value Id		Value		Description																																						
A	RW	VAL					Set the resolution																																						
			8bit		0		8 bit																																						
			10bit		1		10 bit																																						
			12bit		2		12 bit																																						
			14bit		3		14 bit																																						

### 6.17.11.39 OVERSAMPLE

Address offset: 0x5F4

Oversampling configuration. OVERSAMPLE should not be combined with SCAN. The RESOLUTION is applied before averaging, thus for high OVERSAMPLE a higher RESOLUTION should be used.



Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0																															
Id				A A A A																															
Reset 0x00000000				0 0																															
Id	RW	Field	Value	Id	Value	Description																													
A	RW	OVERSAMPLE				Oversample control																													
			Bypass	0		Bypass oversampling																													
			Over2x	1		Oversample 2x																													
			Over4x	2		Oversample 4x																													
			Over8x	3		Oversample 8x																													
			Over16x	4		Oversample 16x																													
			Over32x	5		Oversample 32x																													
			Over64x	6		Oversample 64x																													
			Over128x	7		Oversample 128x																													
			Over256x	8		Oversample 256x																													

#### 6.17.11.40 SAMPLERATE

Address offset: 0x5F8

Controls normal or continuous sample rate

Bit number		31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0			
Id		B A			
Reset 0x00000000		0 0			
Id	RW	Field	Value Id	Value	Description
A	RW	CC		[80..2047]	Capture and compare value. Sample rate is 16 MHz/CC
B	RW	MODE			Select mode for sample rate control
			Task	0	Rate is controlled from SAMPLE task
			Timers	1	Rate is controlled from local timer (use CC to control the rate)

#### 6.17.11.41 RESULT.PTR

Address offset: 0x62C

Data pointer

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0																															
Id				A A																															
Reset 0x00000000				0 0																															
Id	RW	Field	Value Id	Value				Description																											
A	RW	PTR						Data pointer																											

#### 6.17.11.42 RESULT.MAXCNT

Address offset: 0x630

Maximum number of buffer words to transfer

Bit number					31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0		
Id																					A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A
Reset 0x00000000					0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
Id	RW	Field	Value	Id	Value		Description																															
A	RW	MAXCNT					Maximum number of buffer words to transfer																															

### 6.17.11.43 RESULT.AMOUNT

Address offset: 0x634

Number of buffer words transferred since last START

Bit number					31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0																															
Id					A A																															
Reset 0x00000000					0 0																															
Id	RW	Field	Value Id	Value	Description																															
A	R	AMOUNT			Number of buffer words transferred since last START. This register can be read after an END or STOPPED event.																															

## 6.17.12 Electrical specification

### 6.17.12.1 SAADC Electrical Specification

Symbol	Description	Min.	Typ.	Max.	Units
DNL <sub>10</sub>	Differential non-linearity, 10-bit resolution	-0.95	<1		LSB10b
INL <sub>10</sub>	Integral non-linearity, 10-bit resolution		1		LSB10b
V <sub>OS</sub>	Differential offset error (calibrated), 10-bit resolution <sup>a</sup>		+2		LSB10b
DNL <sub>12</sub>	Differential non-linearity, 12-bit resolution	-0.95	1.3		LSB12b
INL <sub>12</sub>	Integral non-linearity, 12-bit resolution		4.7		LSB12b
C <sub>EG</sub>	Gain error temperature coefficient		0.02		%/°C
f <sub>SAMPLE</sub>	Maximum sampling rate			200	kHz
t <sub>ACQ,10k</sub>	Acquisition time (configurable), source Resistance <= 10kOhm		3		μs
t <sub>ACQ,40k</sub>	Acquisition time (configurable), source Resistance <= 40kOhm		5		μs
t <sub>ACQ,100k</sub>	Acquisition time (configurable), source Resistance <= 100kOhm		10		μs
t <sub>ACQ,200k</sub>	Acquisition time (configurable), source Resistance <= 200kOhm		15		μs
t <sub>ACQ,400k</sub>	Acquisition time (configurable), source Resistance <= 400kOhm		20		μs
t <sub>ACQ,800k</sub>	Acquisition time (configurable), source Resistance <= 800kOhm		40		μs
t <sub>CONV</sub>	Conversion time		<2		μs
E <sub>G1/6</sub>	Error <sup>b</sup> for Gain = 1/6	-3		3	%
E <sub>G1/4</sub>	Error <sup>b</sup> for Gain = 1/4	-3		3	%
E <sub>G1/2</sub>	Error <sup>b</sup> for Gain = 1/2	-3		4	%
E <sub>G1</sub>	Error <sup>b</sup> for Gain = 1	-3		4	%
C <sub>SAMPLE</sub>	Sample and hold capacitance at maximum gain <sup>22</sup>		2.5		pF
R <sub>INPUT</sub>	Input resistance		>1		MΩ
E <sub>NOB</sub>	Effective number of bits, differential mode, 12-bit resolution, 1/1 gain, 3 μs acquisition time, crystal HFCLK, 200 ksp/s		9		Bit

<sup>a</sup> Digital output code at zero volt differential input.

<sup>b</sup> Does not include temperature drift

<sup>22</sup> Maximum gain corresponds to highest capacitance.

Symbol	Description	Min.	Typ.	Max.	Units
$S_{NDR}$	Peak signal to noise and distortion ratio, differential mode, 12-bit resolution, 1/1 gain, 3 $\mu$ s acquisition time, crystal HFCLK, 200 kps		56		dB
$S_{FDR}$	Spurious free dynamic range, differential mode, 12-bit resolution, 1/1 gain, 3 $\mu$ s acquisition time, crystal HFCLK, 200 kps		70		dBc
$R_{LADDER}$	Ladder resistance		160		k $\Omega$

### 6.17.13 Performance factors

Clock jitter, affecting sample timing accuracy, and circuit noise can affect ADC performance.

Jitter can be between START tasks or from START task to acquisition. START timer accuracy and startup times of regulators and references will contribute to variability. Sources of circuit noise may include CPU activity and the DC/DC regulator. Best ADC performance is achieved using START timing based on the TIMER module, HFXO clock source, and Constant Latency mode.

## 6.18 SPIM — Serial peripheral interface master with EasyDMA

The SPI master can communicate with multiple slaves using individual chip select signals for each of the slave devices attached to a bus.

Listed here are the main features for the SPIM

- SPI mode 0-3
- EasyDMA direct transfer to/from RAM for both SPI Slave and SPI Master
- Individual selection of IO pin for each SPI signal

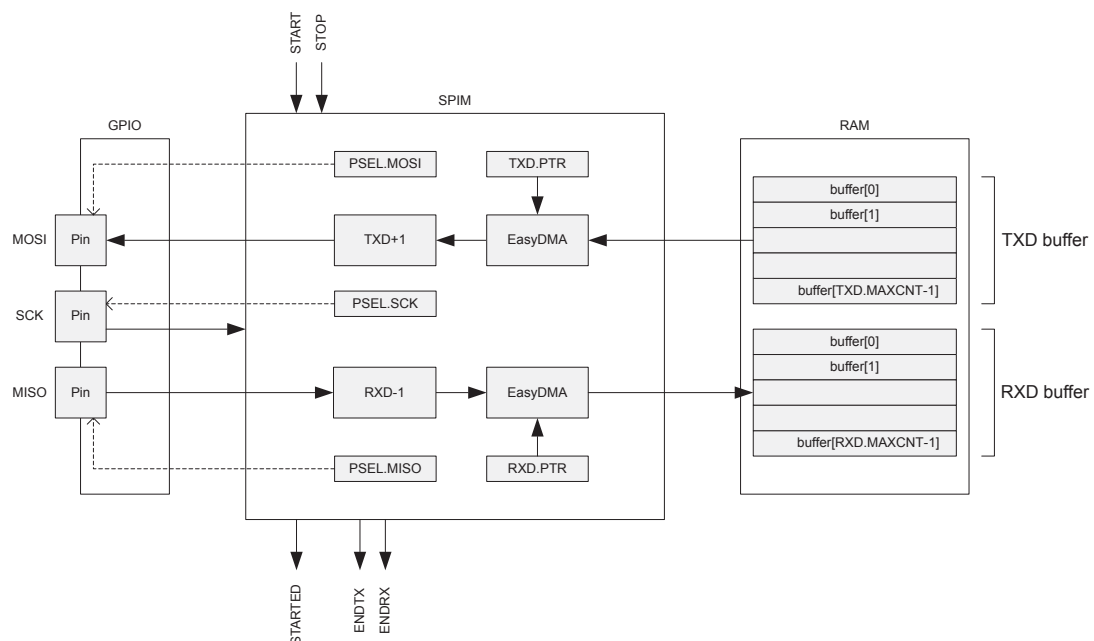


Figure 97: SPIM — SPI master with EasyDMA

The SPIM does not implement support for chip select directly. Therefore, the CPU must use available GPIOs to select the correct slave and control this independently of the SPI master. The SPIM supports SPI modes 0 through 3. The CONFIG register allows setting CPOL and CPHA appropriately.

Mode	Clock polarity	Clock phase
	CPOL	CPHA
SPI_MODE0	0 (Active High)	0 (Leading)
SPI_MODE1	0 (Active High)	1 (Trailing)
SPI_MODE2	1 (Active Low)	0 (Leading)
SPI_MODE3	1 (Active Low)	1 (Trailing)

Table 73: SPI modes

### 6.18.1 SPI master transaction sequence

An SPI master transaction consists of a sequence started by the START task followed by a number of events, and finally the STOP task.

An SPI master transaction is started by triggering the START task. The ENDTX event will be generated when the transmitter has transmitted all bytes in the TXD buffer as specified in the TXD.MAXCNT register. The ENDRX event will be generated when the receiver has filled the RXD buffer, i.e. received the last possible byte as specified in the RXD.MAXCNT register.

Following a START task, the SPI master will generate an END event when both ENDRX and ENDTX have been generated.

The SPI master is stopped by triggering the STOP task. A STOPPED event is generated when the SPI master has stopped.

If the ENDRX event has not already been generated when the SPI master has come to a stop, the SPI master will generate the ENDRX event explicitly even though the RX buffer is not full.

If the ENDTX event has not already been generated when the SPI master has come to a stop, the SPI master will generate the ENDTX event explicitly even though all bytes in the TXD buffer, as specified in the TXD.MAXCNT register, have not been transmitted.

The SPI master is a synchronous interface, and for every byte that is sent, a different byte will be received at the same time; this is illustrated in [SPI master transaction](#) on page 373.

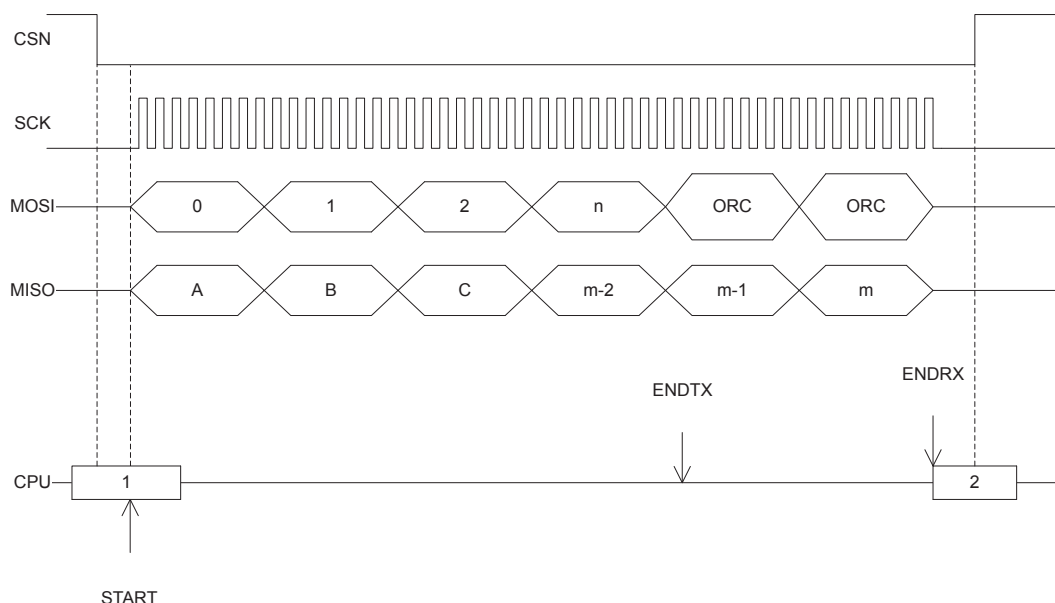


Figure 98: SPI master transaction

### 6.18.2 Master mode pin configuration

The SCK, MOSI, and MISO signals associated with the SPI master are mapped to physical pins according to the configuration specified in the PSEL.SCK, PSEL.MOSI, and PSEL.MISO registers respectively.

The PSEL.SCK, PSEL.MOSI, and PSEL.MISO registers and their configurations are only used as long as the SPI master is enabled, and retained only as long as the device is in ON mode. PSEL.SCK, PSEL.MOSI and PSEL.MISO must only be configured when the SPI master is disabled.

To secure correct behavior in the SPI, the pins used by the SPI must be configured in the GPIO peripheral as described in [GPIO configuration](#) on page 373 prior to enabling the SPI. This configuration must be retained in the GPIO for the selected IOs as long as the SPI is enabled.

Only one peripheral can be assigned to drive a particular GPIO pin at a time. Failing to do so may result in unpredictable behavior.

SPI master signal	SPI master pin	Direction	Output value
SCK	As specified in PSEL.SCK	Output	Same as CONFIG.CPOL
MOSI	As specified in PSEL.MOSI	Output	0
MISO	As specified in PSEL.MISO	Input	Not applicable

Table 74: GPIO configuration

### 6.18.3 EasyDMA

The SPI master implements EasyDMA for reading and writing of data packets from and to the DATA RAM without CPU involvement.

RXD.PTR and TXD.PTR point to the RXD buffer (receive buffer) and TXD buffer (transmit buffer) respectively, see [SPIM — SPI master with EasyDMA](#) on page 371. RXD.MAXCNT and TXD.MAXCNT specify the maximum number of bytes allocated to the buffers. The SPI master will automatically stop transmitting after TXD.MAXCNT bytes have been transmitted and RXD.MAXCNT bytes have been

received. If TXD.MAXCNT is larger than RXD.MAXCNT, the superfluous received bytes will be ignored. If RXD.MAXCNT is larger than TXD.MAXCNT, the remaining transmitted bytes will contain the value defined in the ORC register.

If RXD.PTR and TXD.PTR are not pointing to Data RAM region, an EasyDMA transfer may result in a HardFault or RAM corruption. See [Memory](#) on page 15 for more information about the different memory regions.

The .PTR and .MAXCNT registers are double-buffered. They can be updated and prepared for the next transmission immediately after having received the STARTED event.

The ENDRX/ENDTX events indicate that EasyDMA has finished accessing the RX/TX buffer in RAM respectively. The END events are generated when both RX and TX are finished accessing the buffers in RAM.

EasyDMA supports the following list types:

- Array list

### 6.18.3.1 EasyDMA array list

The EasyDMA array list can be represented by the data structure `ArrayList_type`.

For illustration, see the code example below. This data structure includes only a buffer with size equal to `Channel.MAXCNT`. EasyDMA will use the `Channel.MAXCNT` register to determine when the buffer is full. Replace 'Channel' by the specific data channel you want to use, for instance 'NRF\_SPIM->RXD', 'NRF\_SPIM->TXD', 'NRF\_TWIM->RXD', etc.

The `Channel.MAXCNT` register cannot be specified larger than the actual size of the buffer. If `Channel.MAXCNT` is specified larger than the size of the buffer, the EasyDMA channel may overflow the buffer.

This array list does not provide a mechanism to explicitly specify where the next item in the list is located. Instead, it assumes that the list is organized as a linear array where items are located one after the other in RAM.

```
#define BUFFER_SIZE 4

typedef struct ArrayList
{
    uint8_t buffer[BUFFER_SIZE];
} ArrayList_type;

ArrayList_type MyArrayList[3];

//replace 'Channel' below by the specific data channel you want to use,
//      for instance 'NRF_SPIM->RXD', 'NRF_TWIM->RXD', etc.
Channel.MAXCNT = BUFFER_SIZE;
Channel.PTR = &MyArrayList;
```

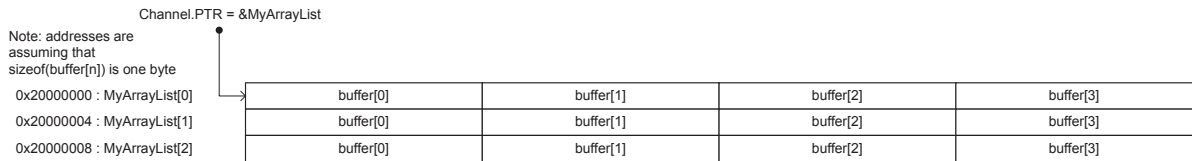


Figure 99: EasyDMA array list

### 6.18.4 Low power

When putting the system in low power and the peripheral is not needed, lowest possible power consumption is achieved by stopping, and then disabling the peripheral.

The STOP task may not be always needed (the peripheral might already be stopped), but if it is sent, software shall wait until the STOPPED event was received as a response before disabling the peripheral through the ENABLE register.

### 6.18.5 Registers

Base address	Peripheral	Instance	Description	Configuration
0x40004000	SPIM	SPIM0	SPI master	

Table 75: Instances

Register	Offset	Description
TASKS_START	0x010	Start SPI transaction
TASKS_STOP	0x014	Stop SPI transaction
TASKS_SUSPEND	0x01C	Suspend SPI transaction
TASKS_RESUME	0x020	Resume SPI transaction
EVENTS_STOPPED	0x104	SPI transaction has stopped
EVENTS_ENDRX	0x110	End of RXD buffer reached
EVENTS_END	0x118	End of RXD buffer and TXD buffer reached
EVENTS_ENDTX	0x120	End of TXD buffer reached
EVENTS_STARTED	0x14C	Transaction started
SHORTS	0x200	Shortcut register
INTENSET	0x304	Enable interrupt
INTENCLR	0x308	Disable interrupt
ENABLE	0x500	Enable SPIM
PSEL_SCK	0x508	Pin select for SCK
PSEL_MOSI	0x50C	Pin select for MOSI signal
PSEL_MISO	0x510	Pin select for MISO signal
FREQUENCY	0x524	SPI frequency. Accuracy depends on the HFCLK source selected.
RXD_PTR	0x534	Data pointer
RXD_MAXCNT	0x538	Maximum number of bytes in receive buffer
RXD_AMOUNT	0x53C	Number of bytes transferred in the last transaction
RXD_LIST	0x540	EasyDMA list type
TXD_PTR	0x544	Data pointer
TXD_MAXCNT	0x548	Maximum number of bytes in transmit buffer
TXD_AMOUNT	0x54C	Number of bytes transferred in the last transaction
TXD_LIST	0x550	EasyDMA list type
CONFIG	0x554	Configuration register
ORC	0x5C0	Over-read character. Character clocked out in case and over-read of the TXD buffer.

Table 76: Register Overview

### 6.18.5.1 SHORTS

Address offset: 0x200

Shortcut register

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0																															
Id				A																															
Reset 0x00000000				0 0																															
Id	RW	Field	Value Id	Value	Description																														
A	RW	END_START			Shortcut between END event and START task																														
					See <a href="#">EVENTS_END</a> and <a href="#">TASKS_START</a>																														
			Disabled	0	Disable shortcut																														
			Enabled	1	Enable shortcut																														

### 6.18.5.2 INTENSET

Address offset: 0x304

Enable interrupt

Bit number		31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0																																			
Id		E D C B A																																			
Reset 0x00000000		0 0																																			
Id	RW	Field	Value Id	Value	Description																																
A	RW	STOPPED			Write '1' to Enable interrupt for STOPPED event																																
					See <a href="#">EVENTS_STOPPED</a>																																
			Set	1	Enable																																
			Disabled	0	Read: Disabled																																
			Enabled	1	Read: Enabled																																
B	RW	ENDRX			Write '1' to Enable interrupt for ENDRX event																																
					See <a href="#">EVENTS_ENDRX</a>																																
			Set	1	Enable																																
			Disabled	0	Read: Disabled																																
			Enabled	1	Read: Enabled																																
C	RW	END			Write '1' to Enable interrupt for END event																																
					See <a href="#">EVENTS_END</a>																																
			Set	1	Enable																																
			Disabled	0	Read: Disabled																																
			Enabled	1	Read: Enabled																																
D	RW	ENDTX			Write '1' to Enable interrupt for ENDTX event																																
					See <a href="#">EVENTS_ENDTX</a>																																
			Set	1	Enable																																
			Disabled	0	Read: Disabled																																
			Enabled	1	Read: Enabled																																
E	RW	STARTED			Write '1' to Enable interrupt for STARTED event																																
					See <a href="#">EVENTS_STARTED</a>																																
			Set	1	Enable																																
			Disabled	0	Read: Disabled																																
			Enabled	1	Read: Enabled																																



### 6.18.5.3 INTENCLR

Address offset: 0x308

Disable interrupt

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0																															
Id				E																D				C		B		A							
Reset 0x00000000				0 0																															
Id	RW	Field	Value Id	Value	Description																														
A	RW	STOPPED			Write '1' to Disable interrupt for STOPPED event																														
					See <a href="#">EVENTS_STOPPED</a>																														
			Clear	1	Disable																														
			Disabled	0	Read: Disabled																														
			Enabled	1	Read: Enabled																														
B	RW	ENDRX			Write '1' to Disable interrupt for ENDRX event																														
					See <a href="#">EVENTS_ENDRX</a>																														
			Clear	1	Disable																														
			Disabled	0	Read: Disabled																														
			Enabled	1	Read: Enabled																														
C	RW	END			Write '1' to Disable interrupt for END event																														
					See <a href="#">EVENTS_END</a>																														
			Clear	1	Disable																														
			Disabled	0	Read: Disabled																														
			Enabled	1	Read: Enabled																														
D	RW	ENDTX			Write '1' to Disable interrupt for ENDTX event																														
					See <a href="#">EVENTS_ENDTX</a>																														
			Clear	1	Disable																														
			Disabled	0	Read: Disabled																														
			Enabled	1	Read: Enabled																														
E	RW	STARTED			Write '1' to Disable interrupt for STARTED event																														
					See <a href="#">EVENTS_STARTED</a>																														
			Clear	1	Disable																														
			Disabled	0	Read: Disabled																														
			Enabled	1	Read: Enabled																														

### 6.18.5.4 ENABLE

Address offset: 0x500

Enable SPIM

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0																															
Id																																			
Reset 0x00000000				0 0																															
Id	RW	Field	Value	Id	Value	Description																													
A	RW	ENABLE				Enable or disable SPIM																													
			Disabled	0	Disable SPIM																														
			Enabled	7	Enable SPIM																														

### 6.18.5.5 PSEL.SCK

Address offset: 0x508

## Pin select for SCK

Bit number	31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0																													
Id	C																													
Reset 0xFFFFFFFF	1 1																													
Id	RW	Field	Value	Id	Value	Description																								
A	RW	PIN			[0..31]	Pin number																								
C	RW	CONNECT																												
			Disconnected		1	Disconnect																								
			Connected		0	Connect																								

## 6.18.5.6 PSEL.MOSI

Address offset: 0x50C

Pin select for MOSI signal

Bit number					31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0																																			
Id					C																																A A A A			
Reset 0xFFFFFFFF					1 1																																			
Id		RW		Field		Value Id		Value		Description																														
A		RW		PIN				[0..31]		Pin number																														
C		RW		CONNECT																																				
						Disconnected		1		Disconnect																														
						Connected		0		Connect																														

## 6.18.5.7 PSEL.MISO

Address offset: 0x510

Pin select for MISO signal

Bit number					31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0																																			
Id					C																																A A A A			
Reset 0xFFFFFFFF					1 1																																			
Id		RW		Field		Value Id		Value		Description																														
A		RW		PIN				[0..31]		Pin number																														
C		RW		CONNECT																																				
						Disconnected		1		Disconnect																														
						Connected		0		Connect																														

## 6.18.5.8 FREQUENCY

Address offset: 0x524

SPI frequency. Accuracy depends on the HFCLK source selected.

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0																															
Id				A A																															
Reset 0x04000000				0 0 0 0 0 1 0																															
Id	RW	Field	Value Id	Value								Description																							
A	RW	FREQUENCY										SPI master data rate																							
			K125	0x02000000								125 kbps																							
			K250	0x04000000								250 kbps																							
			K500	0x08000000								500 kbps																							
			M1	0x10000000								1 Mbps																							
			M2	0x20000000								2 Mbps																							
			M4	0x40000000								4 Mbps																							
			M8	0x80000000								8 Mbps																							

### 6.18.5.9 RXD.PTR

Address offset: 0x534

Data pointer

Bit number					31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0																															
Id					A A																															
Reset 0x00000000					0 0																															
Id		RW		Field		Value Id		Value		Description																										
A		RW		PTR						Data pointer																										

### 6.18.5.10 RXD.MAXCNT

Address offset: 0x538

Maximum number of bytes in receive buffer

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0																															
Id				A A																															
Reset 0x00000000				0 0																															
Id		RW	Field	Value Id		Value		Description																											
A		RW	MAXCNT			[1..0x3FF]		Maximum number of bytes in receive buffer																											

### 6.18.5.11 RXD.AMOUNT

Address offset: 0x53C

Number of bytes transferred in the last transaction

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0																															
Id				A A																															
Reset 0x00000000				0 0																															
Id	RW	Field	Value Id	Value								Description																							
A	R	AMOUNT		[1..0x3FF]								Number of bytes transferred in the last transaction																							

### 6.18.5.12 RXD.LIST

Address offset: 0x540

EasyDMA list type

Bit number										31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																		
Id																																						A	A	A																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																			
Reset										0x00000000										0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

### 6.18.5.13 TXD.PTR

Address offset: 0x544

Data pointer

[illegible]

#### 6.18.5.14 TXD.MAXCNT

Address offset: 0x548

Maximum number of bytes in transmit buffer

Bit number	31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0																														
Id	A A																														
Reset	0x00000000 0																														
Id	RW	Field	Value Id		Value				Description																						
A	RW	MAXCNT			[1..0x3FF]				Maximum number of bytes in transmit buffer																						

#### 6.18.5.15 TXD.AMOUNT

Address offset: 0x54C

Number of bytes transferred in the last transaction

Bit number	31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0																														
Id	A A																														
Reset	0x00000000 0																														
Id	RW	Field	Value Id		Value				Description																						
A	R	AMOUNT			[1..0x3FF]				Number of bytes transferred in the last transaction																						

#### 6.18.5.16 TXD.LIST

Address offset: 0x550

## EasyDMA list type

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0																																		
Id																																				A	A	A
Reset 0x00000000				0 0																																		
Id	RW	Field	Value Id	Value	Description																																	
A	RW	LIST			List type																																	
			Disabled	0	Disable EasyDMA list																																	
			ArrayList	1	Use array list																																	

### 6.18.5.17 CONFIG

Address offset: 0x554

Configuration register

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0																																		
Id																																				C	B	A
Reset 0x00000000				0 0																																		
Id	RW	Field	Value Id	Value	Description																																	
A	RW	ORDER			Bit order																																	
			MsbFirst	0	Most significant bit shifted out first																																	
			LsbFirst	1	Least significant bit shifted out first																																	
B	RW	CPHA			Serial clock (SCK) phase																																	
			Leading	0	Sample on leading edge of clock, shift serial data on trailing edge																																	
			Trailing	1	Sample on trailing edge of clock, shift serial data on leading edge																																	
C	RW	CPOL			Serial clock (SCK) polarity																																	
			ActiveHigh	0	Active high																																	
			ActiveLow	1	Active low																																	

### 6.18.5.18 ORC

Address offset: 0x5C0

Over-read character. Character clocked out in case and over-read of the TXD buffer.

Bit number		31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0																																			
Id																																					A A A A A A A A
Reset 0x00000000		0 0																																			
Id	RW	Field	Value Id	Value	Description																																
A	RW	ORC			Over-read character. Character clocked out in case and over-read of the TXD buffer.																																

## 6.18.6 Electrical specification

### 6.18.6.1 SPIM master interface electrical specifications

Symbol	Description	Min.	Typ.	Max.	Units
$f_{\text{SPIM}}$	Bit rates for SPIM <sup>23</sup>			$g^{24}$	Mbps
$t_{\text{SPIM\_START}}$	Time from START task to transmission started	..	..	..	$\mu\text{s}$

<sup>23</sup> High bit rates may require GPIOs to be set as High Drive, see GPIO chapter for more details.

<sup>24</sup> The actual maximum data rate depends on the slave's CLK to MISO and MOSI setup and hold timings.

### 6.18.6.2 Serial Peripheral Interface Master (SPIM) timing specifications

Symbol	Description	Min.	Typ.	Max.	Units
$t_{SPIM,CCLK}$	SCK period	..	..	..	ns
$t_{SPIM,RSCK,LD}$	SCK rise time, standard drive <sup>a</sup>			$t_{RF,25pF}$	
$t_{SPIM,RSCK,HD}$	SCK rise time, high drive <sup>a</sup>			$t_{HRF,25pF}$	
$t_{SPIM,FSCK,LD}$	SCK fall time, standard drive <sup>a</sup>			$t_{RF,25pF}$	
$t_{SPIM,FSCK,HD}$	SCK fall time, high drive <sup>a</sup>			$t_{HRF,25pF}$	
$t_{SPIM,WHSCCK}$	SCK high time <sup>a</sup>	$(0.5 \cdot t_{CCLK} - t_{RSCK})$			
$t_{SPIM,WLSCCK}$	SCK low time <sup>a</sup>	$(0.5 \cdot t_{CCLK} - t_{FSCK})$			
$t_{SPIM,SUMI}$	MISO to CLK edge setup time	19			ns
$t_{SPIM,HMI}$	CLK edge to MISO hold time	18			ns
$t_{SPIM,VMO}$	CLK edge to MOSI valid			59	ns
$t_{SPIM,HMO}$	MOSI hold time after CLK edge	20			ns

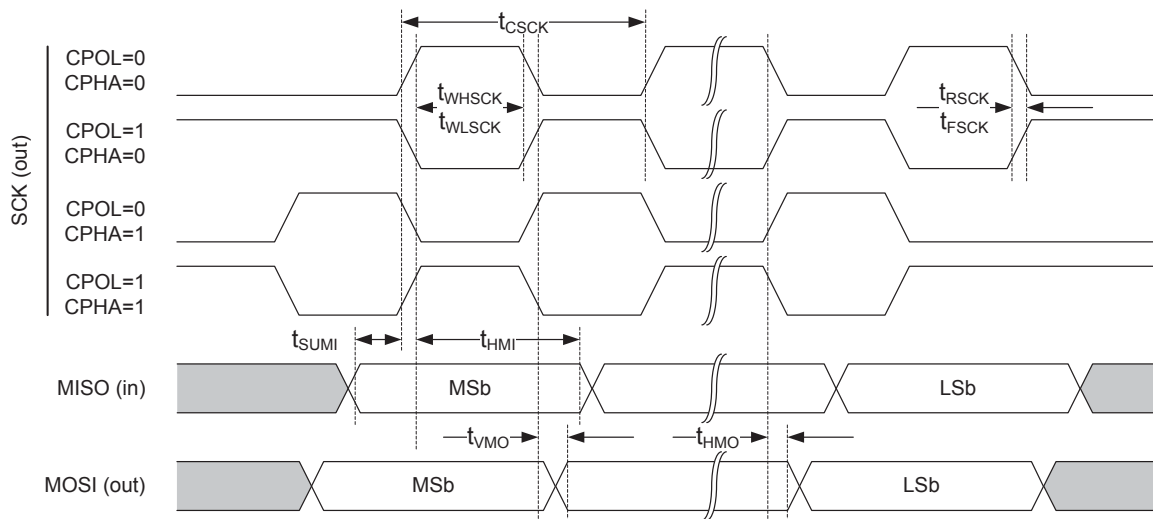


Figure 100: SPIM timing diagram

## 6.19 SPIS — Serial peripheral interface slave with EasyDMA

SPI slave (SPIS) is implemented with EasyDMA support for ultra low power serial communication from an external SPI master. EasyDMA in conjunction with hardware-based semaphore mechanisms removes all real-time requirements associated with controlling the SPI slave from a low priority CPU execution context.

<sup>a</sup> At 25pF load, including GPIO pin capacitance, see GPIO spec.

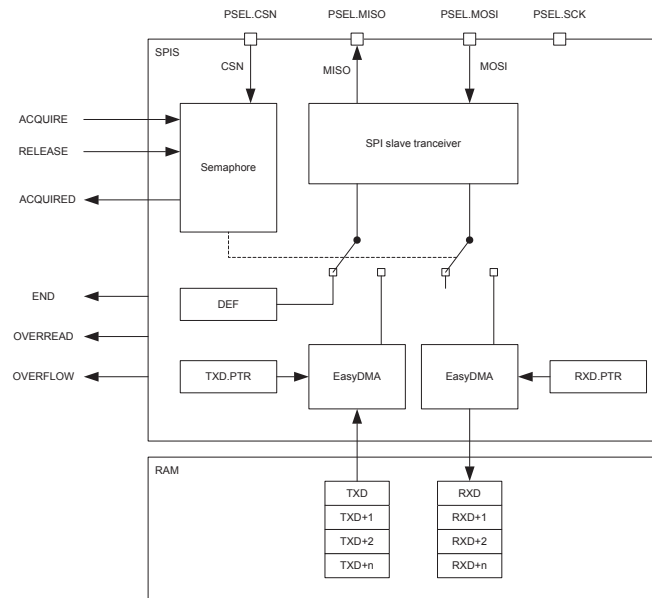


Figure 101: SPI slave

The SPIS supports SPI modes 0 through 3. The CONFIG register allows setting CPOL and CPHA appropriately.

Mode	Clock polarity	Clock phase
	CPOL	CPHA
SPI_MODE0	0 (Leading)	0 (Active High)
SPI_MODE1	0 (Leading)	1 (Active Low)
SPI_MODE2	1 (Trailing)	0 (Active High)
SPI_MODE3	1 (Trailing)	1 (Active Low)

Table 77: SPI modes

### 6.19.1 Shared resources

The SPI slave shares registers and other resources with other peripherals that have the same ID as the SPI slave. Therefore, you must disable all peripherals that have the same ID as the SPI slave before the SPI slave can be configured and used.

Disabling a peripheral that has the same ID as the SPI slave will not reset any of the registers that are shared with the SPI slave. It is important to configure all relevant SPI slave registers explicitly to secure that it operates correctly.

The Instantiation table in [Instantiation](#) on page 17 shows which peripherals have the same ID as the SPI slave.

### 6.19.2 EasyDMA

The SPI slave implements EasyDMA for reading and writing to and from the RAM. The END event indicates that EasyDMA has finished accessing the buffer in RAM.

If the TXD.PTR and the RXD.PTR are not pointing to the Data RAM region, an EasyDMA transfer may result in a HardFault or RAM corruption. See [Memory](#) on page 15 for more information about the different memory regions.

### 6.19.3 SPI slave operation

SPI slave uses two memory pointers, RXD.PTR and TXD.PTR, that point to the RXD buffer (receive buffer) and TXD buffer (transmit buffer) respectively. Since these buffers are located in RAM, which can be accessed by both the SPI slave and the CPU, a hardware based semaphore mechanism is implemented to enable safe sharing.

See [SPI transaction when shortcut between END and ACQUIRE is enabled](#) on page 385.

Before the CPU can safely update the RXD.PTR and TXD.PTR pointers it must first acquire the SPI semaphore. The CPU can acquire the semaphore by triggering the ACQUIRE task and then receiving the ACQUIRED event. When the CPU has updated the RXD.PTR and TXD.PTR pointers the CPU must release the semaphore before the SPI slave will be able to acquire it. The CPU releases the semaphore by triggering the RELEASE task. This is illustrated in [SPI transaction when shortcut between END and ACQUIRE is enabled](#) on page 385. Triggering the RELEASE task when the semaphore is not granted to the CPU will have no effect.

The semaphore mechanism does not, at any time, prevent the CPU from performing read or write access to the RXD.PTR register, the TXD.PTR registers, or the RAM that these pointers are pointing to. The semaphore is only telling when these can be updated by the CPU so that safe sharing is achieved.

The semaphore is by default assigned to the CPU after the SPI slave is enabled. No ACQUIRED event will be generated for this initial semaphore handover. An ACQUIRED event will be generated immediately if the ACQUIRE task is triggered while the semaphore is assigned to the CPU.

The SPI slave will try to acquire the semaphore when CSN goes low. If the SPI slave does not manage to acquire the semaphore at this point, the transaction will be ignored. This means that all incoming data on MOSI will be discarded, and the DEF (default) character will be clocked out on the MISO line throughout the whole transaction. This will also be the case even if the semaphore is released by the CPU during the transaction. In case of a race condition where the CPU and the SPI slave try to acquire the semaphore at the same time, as illustrated in lifeline item 2 in [SPI transaction when shortcut between END and ACQUIRE is enabled](#) on page 385, the semaphore will be granted to the CPU.

If the SPI slave acquires the semaphore, the transaction will be granted. The incoming data on MOSI will be stored in the RXD buffer and the data in the TXD buffer will be clocked out on MISO.

When a granted transaction is completed and CSN goes high, the SPI slave will automatically release the semaphore and generate the END event.

As long as the semaphore is available the SPI slave can be granted multiple transactions one after the other. If the CPU is not able to reconfigure the TXD.PTR and RXD.PTR between granted transactions, the same TX data will be clocked out and the RX buffers will be overwritten. To prevent this from happening, the END\_ACQUIRE shortcut can be used. With this shortcut enabled the semaphore will be handed over to the CPU automatically after the granted transaction has completed, giving the CPU the ability to update the TXPTR and RXPTR between every granted transaction.

If the CPU tries to acquire the semaphore while it is assigned to the SPI slave, an immediate handover will not be granted. However, the semaphore will be handed over to the CPU as soon as the SPI slave has released the semaphore after the granted transaction is completed. If the END\_ACQUIRE shortcut is enabled and the CPU has triggered the ACQUIRE task during a granted transaction, only one ACQUIRE request will be served following the END event.

The MAXRX register specifies the maximum number of bytes the SPI slave can receive in one granted transaction. If the SPI slave receives more than MAXRX number of bytes, an OVERFLOW will be indicated in the STATUS register and the incoming bytes will be discarded.

The MAXTX parameter specifies the maximum number of bytes the SPI slave can transmit in one granted transaction. If the SPI slave is forced to transmit more than MAXTX number of bytes, an OVERREAD will be indicated in the STATUS register and the ORC character will be clocked out.



The RXD.AMOUNT and TXD.AMOUNT registers are updated when a granted transaction is completed. The TXD.AMOUNT register indicates how many bytes were read from the TX buffer in the last transaction, that is, ORC (over-read) characters are not included in this number. Similarly, the RXD.AMOUNT register indicates how many bytes were written into the RX buffer in the last transaction.

The ENDRX event is generated when the RX buffer has been filled.

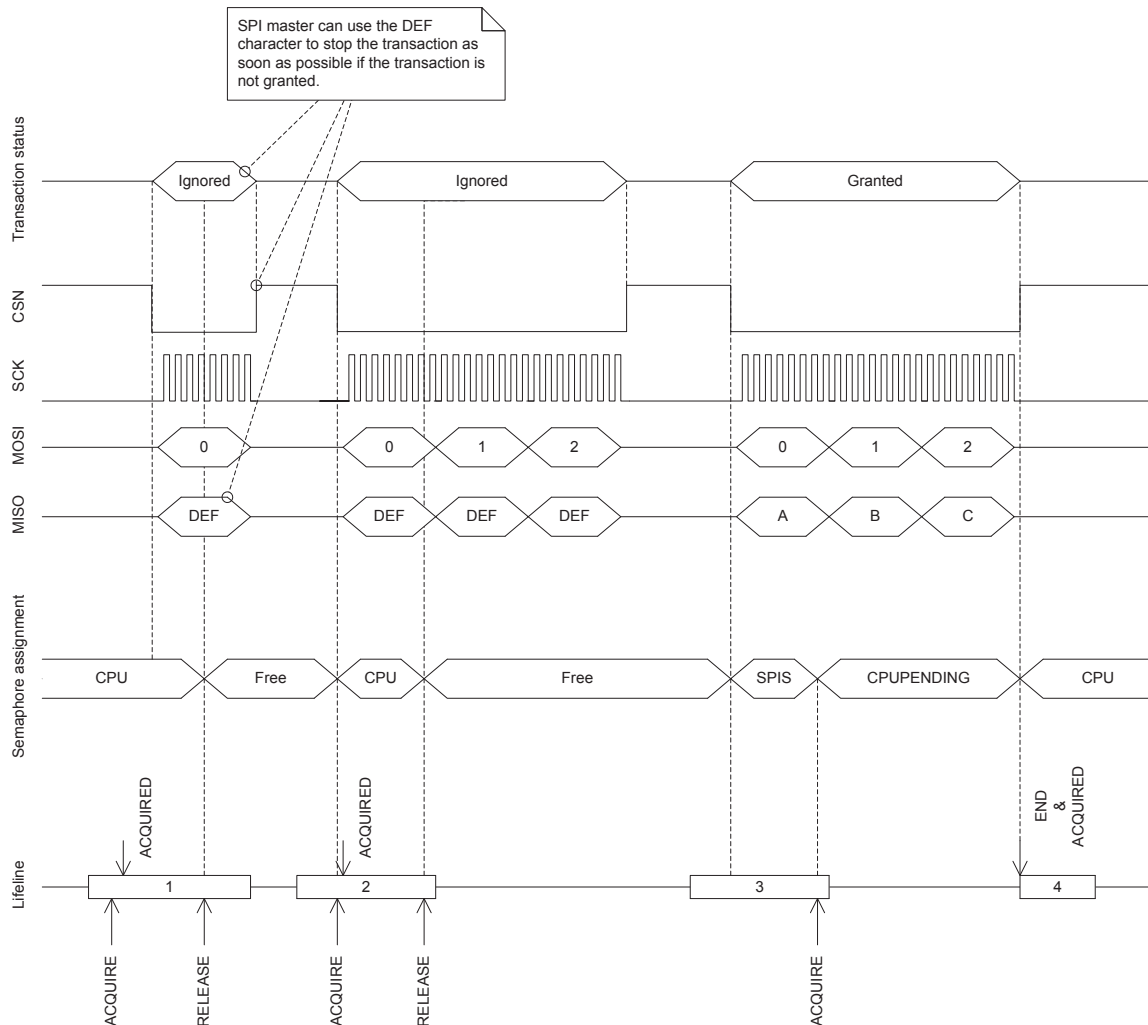


Figure 102: SPI transaction when shortcut between END and ACQUIRE is enabled

#### 6.19.4 Pin configuration

The CSN, SCK, MOSI, and MISO signals associated with the SPI slave are mapped to physical pins according to the configuration specified in the PSEL.CSN, PSEL.SCK, PSEL.MOSI, and PSEL.MISO registers respectively. If the CONNECT field of any of these registers is set to Disconnected, the associated SPI slave signal will not be connected to any physical pins.

The PSEL.CSN, PSEL.SCK, PSEL.MOSI, and PSEL.MISO registers and their configurations are only used as long as the SPI slave is enabled, and retained only as long as the device is in System ON mode, see [POWER — Power supply](#) on page 61 chapter for more information about power modes. When the peripheral is disabled, the pins will behave as regular GPIOs, and use the configuration in their respective OUT bit field and PIN\_CNF[n] register. PSEL.CSN, PSEL.SCK, PSEL.MOSI, and PSEL.MISO must only be configured when the SPI slave is disabled.

To secure correct behavior in the SPI slave, the pins used by the SPI slave must be configured in the GPIO peripheral as described in [GPIO configuration before enabling peripheral](#) on page 386 before enabling the SPI slave. This is to secure that the pins used by the SPI slave are driven correctly if the SPI slave itself is temporarily disabled, or if the device temporarily enters System OFF. This configuration must be retained in the GPIO for the selected I/Os as long as the SPI slave is to be recognized by an external SPI master.

The MISO line is set in high impedance as long as the SPI slave is not selected with CSN.

Only one peripheral can be assigned to drive a particular GPIO pin at a time. Failing to do so may result in unpredictable behavior.

SPI signal	SPI pin	Direction	Output value	Comment
CSN	As specified in PSEL.CSN	Input	Not applicable	
SCK	As specified in PSEL.SCK	Input	Not applicable	
MOSI	As specified in PSEL.MOSI	Input	Not applicable	
MISO	As specified in PSEL.MISO	Input	Not applicable	Emulates that the SPI slave is not selected.

Table 78: GPIO configuration before enabling peripheral

## 6.19.5 Registers

Base address	Peripheral	Instance	Description	Configuration
0x40004000	SPIS	SPIS0	SPI slave	

Table 79: Instances

Register	Offset	Description	
TASKS_ACQUIRE	0x024	Acquire SPI semaphore	
TASKS_RELEASE	0x028	Release SPI semaphore, enabling the SPI slave to acquire it	
EVENTS_END	0x104	Granted transaction completed	
EVENTS_ENDRX	0x110	End of RXD buffer reached	
EVENTS_ACQUIRED	0x128	Semaphore acquired	
SHORTS	0x200	Shortcut register	
INTENSET	0x304	Enable interrupt	
INTENCLR	0x308	Disable interrupt	
SEMSTAT	0x400	Semaphore status register	
STATUS	0x440	Status from last transaction	
ENABLE	0x500	Enable SPI slave	
PSELSCK	0x508	Pin select for SCK	Deprecated
PSELMISO	0x50C	Pin select for MISO	Deprecated
PSELMOSI	0x510	Pin select for MOSI	Deprecated
PSELCSN	0x514	Pin select for CSN	Deprecated
PSEL.SCK	0x508	Pin select for SCK	
PSEL.MISO	0x50C	Pin select for MISO signal	
PSEL.MOSI	0x510	Pin select for MOSI signal	
PSEL.CSN	0x514	Pin select for CSN signal	
RXDPTR	0x534	RXD data pointer	Deprecated
MAXRX	0x538	Maximum number of bytes in receive buffer	Deprecated
AMOUNTRX	0x53C	Number of bytes received in last granted transaction	Deprecated
RXD.PTR	0x534	RXD data pointer	
RXD.MAXCNT	0x538	Maximum number of bytes in receive buffer	
RXD.AMOUNT	0x53C	Number of bytes received in last granted transaction	
TXDPTR	0x544	TXD data pointer	Deprecated
MAXTX	0x548	Maximum number of bytes in transmit buffer	Deprecated

Register	Offset	Description	
AMOUNTTX	0x54C	Number of bytes transmitted in last granted transaction	Deprecated
TXD.PTR	0x544	TXD data pointer	
TXD.MAXCNT	0x548	Maximum number of bytes in transmit buffer	
TXD.AMOUNT	0x54C	Number of bytes transmitted in last granted transaction	
CONFIG	0x554	Configuration register	
DEF	0x55C	Default character. Character clocked out in case of an ignored transaction.	
ORC	0x5C0	Over-read character	

Table 80: Register Overview

### 6.19.5.1 SHORTS

Address offset: 0x200

Shortcut register

Bit number					31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0																															
Id					A																															
Reset 0x00000000					0 0																															
Id	RW	Field	Value Id	Value	Description																															
A	RW	END_ACQUIRE			Shortcut between END event and ACQUIRE task																															
					See <a href="#">EVENTS_END</a> and <a href="#">TASKS_ACQUIRE</a>																															
			Disabled	0	Disable shortcut																															
			Enabled	1	Enable shortcut																															

### 6.19.5.2 INTENSET

Address offset: 0x304

Enable interrupt

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0																															
Id				C																B					A										
Reset 0x00000000				0 0																															
Id	RW	Field	Value	Id	Value	Description																													
A	RW	END				Write '1' to Enable interrupt for END event																													
						See <a href="#">EVENTS_END</a>																													
			Set	1		Enable																													
			Disabled	0		Read: Disabled																													
			Enabled	1		Read: Enabled																													
B	RW	ENDRX				Write '1' to Enable interrupt for ENDRX event																													
						See <a href="#">EVENTS_ENDRX</a>																													
			Set	1		Enable																													
			Disabled	0		Read: Disabled																													
			Enabled	1		Read: Enabled																													
C	RW	ACQUIRED				Write '1' to Enable interrupt for ACQUIRED event																													
						See <a href="#">EVENTS_ACQUIRED</a>																													
			Set	1		Enable																													
			Disabled	0		Read: Disabled																													
			Enabled	1		Read: Enabled																													

### 6.19.5.3 INTENCLR

Address offset: 0x308

Disable interrupt

Bit number			31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0																															
Id			C																B								A							
Reset 0x00000000			0 0																															
Id	RW	Field	Value Id	Value	Description																													
A	RW	END			Write '1' to Disable interrupt for END event																													
					See <a href="#">EVENTS_END</a>																													
			Clear	1	Disable																													
			Disabled	0	Read: Disabled																													
			Enabled	1	Read: Enabled																													
B	RW	ENDRX			Write '1' to Disable interrupt for ENDRX event																													
					See <a href="#">EVENTS_ENDRX</a>																													
			Clear	1	Disable																													
			Disabled	0	Read: Disabled																													
			Enabled	1	Read: Enabled																													
C	RW	ACQUIRED			Write '1' to Disable interrupt for ACQUIRED event																													
					See <a href="#">EVENTS_ACQUIRED</a>																													
			Clear	1	Disable																													
			Disabled	0	Read: Disabled																													
			Enabled	1	Read: Enabled																													

### 6.19.5.4 SEMSTAT

Address offset: 0x400

Semaphore status register

Bit number		31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0																																				
Id																																					A	A
Reset 0x00000001		0 0																																			1	
Id	RW	Field	Value Id	Value	Description																																	
A	R	SEMSTAT			Semaphore status																																	
			Free	0	Semaphore is free																																	
			CPU	1	Semaphore is assigned to CPU																																	
			SPIS	2	Semaphore is assigned to SPI slave																																	
			CPUPending	3	Semaphore is assigned to SPI but a handover to the CPU is pending																																	

### 6.19.5.5 STATUS

Address offset: 0x440

Status from last transaction

Individual bits are cleared by writing a '1' to the bits that shall be cleared



### 6.19.5.9 PSELMOSI ( Deprecated )

Address offset: 0x510

Pin select for MOSI

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0																															
Id				A A																															
Reset 0xFFFFFFFF				1 1																															
Id	RW	Field	Value Id	Value	Description																														
A	RW	PSELMOSI		[0..31]	Pin number configuration for SPI MOSI signal																														
			Disconnected	0xFFFFFFFF	Disconnect																														

### 6.19.5.10 PSELCSN ( Deprecated )

Address offset: 0x514

Pin select for CSN

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0																															
Id				A A																															
Reset 0xFFFFFFFF				1 1																															
Id	RW	Field	Value Id	Value				Description																											
A	RW	PSELCSN		[0..31]				Pin number configuration for SPI CSN signal																											
			Disconnected	0xFFFFFFFF				Disconnect																											

### 6.19.5.11 PSEL.SCK

Address offset: 0x508

Pin select for SCK

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0																															
Id				C A																															
Reset 0xFFFFFFFF				1 1																															
Id	RW	Field	Value Id	Value		Description																													
A	RW	PIN		[0..31]		Pin number																													
C	RW	CONNECT				Connection																													
			Disconnected	1		Disconnect																													
			Connected	0		Connect																													

### 6.19.5.12 PSEL.MISO

Address offset: 0x50C

Pin select for MISO signal

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0																															
Id				C A																															
Reset 0xFFFFFFFF				1 1																															
Id	RW	Field	Value Id	Value				Description																											
A	RW	PIN		[0..31]				Pin number																											
C	RW	CONNECT						Connection																											
			Disconnected	1				Disconnect																											
			Connected	0				Connect																											

### 6.19.5.13 PSEL.MOSI

Address offset: 0x510

Pin select for MOSI signal

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0																															
Id				C																															
Reset 0xFFFFFFFF				1 1																															
Id	RW	Field	Value Id	Value				Description																											
A	RW	PIN		[0..31]				Pin number																											
C	RW	CONNECT						Connection																											
			Disconnected	1				Disconnect																											
			Connected	0				Connect																											

### 6.19.5.14 PSEL.CSN

Address offset: 0x514

Pin select for CSN signal

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0																															
Id				C																															
Reset 0xFFFFFFFF				1 1																															
Id	RW	Field	Value Id	Value		Description																													
A	RW	PIN		[0..31]		Pin number																													
C	RW	CONNECT				Connection																													
			Disconnected	1		Disconnect																													
			Connected	0		Connect																													

### 6.19.5.15 RXDPTR ( Deprecated )

Address offset: 0x534

RXD data pointer

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0																															
Id				A A																															
Reset 0x00000000				0 0																															
Id	RW	Field	Value Id	Value		Description																													
A	RW	RXDPTR				RXD data pointer																													

### 6.19.5.16 MAXRX ( Deprecated )

Address offset: 0x538

Maximum number of bytes in receive buffer

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0																															
Id				A A																															
Reset 0x00000000				0 0																															
Id	RW	Field	Value Id	Value				Description																											
A	RW	MAXRX		[1..0x3FF]				Maximum number of bytes in receive buffer																											





[illegible]

#### 6.19.5.22 MAXTX ( Deprecated )

Address offset: 0x548

Maximum number of bytes in transmit buffer

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0																															
Id				A A																															
Reset 0x00000000				0 0																															

### 6.19.5.23 AMOUNTTX ( Deprecated )

Address offset: 0x54C

Number of bytes transmitted in last granted transaction

Bit number	31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0																														
Id	A A																														
Reset	0x00000000 0																														
Id	RW	Field	Value Id		Value		Description																								
A	R	AMOUNTTX			[1..0x3FF]		Number of bytes transmitted in last granted transaction																								

#### 6.19.5.24 TXD.PTR

Address offset: 0x544

TXD data pointer

[illegible]

#### 6.19.5.25 TXD.MAXCNT

Address offset: 0x548

Maximum number of bytes in transmit buffer

Bit number	31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0																														
Id	A A																														
Reset	0x00000000 0																														
Id	RW	Field	Value Id		Value		Description																								
A	RW	MAXCNT			[1..0x3FF]		Maximum number of bytes in transmit buffer																								

### 6.19.5.26 TXD.AMOUNT

Address offset: 0x54C

Number of bytes transmitted in last granted transaction

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0																															
Id				A A																															

### 6.19.5.27 CONFIG

Address offset: 0x554

Configuration register

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0																															
Id				C B A																															
Reset 0x00000000				0 0																															
Id	RW	Field	Value Id	Value	Description																														
A	RW	ORDER			Bit order																														
			MsbFirst	0	Most significant bit shifted out first																														
			LsbFirst	1	Least significant bit shifted out first																														
B	RW	CPHA			Serial clock (SCK) phase																														
			Leading	0	Sample on leading edge of clock, shift serial data on trailing edge																														
			Trailing	1	Sample on trailing edge of clock, shift serial data on leading edge																														
C	RW	CPOL			Serial clock (SCK) polarity																														
			ActiveHigh	0	Active high																														
			ActiveLow	1	Active low																														

### 6.19.5.28 DEF

Address offset: 0x55C

Default character. Character clocked out in case of an ignored transaction.

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0																															
Id				A A A A A A A A																															
Reset 0x00000000				0 0																															
Id	RW	Field	Value Id	Value			Description																												
A	RW	DEF					Default character. Character clocked out in case of an ignored transaction.																												

### 6.19.5.29 ORC

Address offset: 0x5C0

Over-read character

Bit number	31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0																														
Id	A A A A A A A A A A																														
Reset 0x00000000	0 0																														
Id	RW	Field	Value		Id	Value		Description																							
A	RW	ORC						Over-read character. Character clocked out after an over-read of the transmit buffer.																							

## 6.19.6 Electrical specification

### 6.19.6.1 SPIS slave interface electrical specifications

Symbol	Description	Min.	Typ.	Max.	Units
$f_{SPIS}$	Bit rates for SPIS <sup>25</sup>			$8^{26}$	Mbps
$t_{SPIS,START}$	Time from RELEASE task to receive/transmit (CSN active)	..	..	..	$\mu$ s

### 6.19.6.2 Serial Peripheral Interface Slave (SPIS) timing specifications

Symbol	Description	Min.	Typ.	Max.	Units
$t_{SPIS,CCKIN}$	SCK input period	..	..	..	ns
$t_{SPIS,RFCKIN}$	SCK input rise/fall time			30	ns
$t_{SPIS,WHCKIN}$	SCK input high time	30			ns
$t_{SPIS,WLCKIN}$	SCK input low time	30			ns
$t_{SPIS,SUCSN}$	CSN to CLK setup time	..	..	..	ns
$t_{SPIS,HCSN}$	CLK to CSN hold time	2000			ns
$t_{SPIS,ASA}$	CSN to MISO driven	..	..	..	ns
$t_{SPIS,ASO}$	CSN to MISO valid <sup>a</sup>			1000	ns
$t_{SPIS,DISSO}$	CSN to MISO disabled <sup>a</sup>			68	ns
$t_{SPIS,CWH}$	CSN inactive time	300			ns
$t_{SPIS,VSO}$	CLK edge to MISO valid			19	ns
$t_{SPIS,HSO}$	MISO hold time after CLK edge	18 <sup>27</sup>			ns
$t_{SPIS,SUSI}$	MOSI to CLK edge setup time	59			ns
$t_{SPIS,HSI}$	CLK edge to MOSI hold time	20			ns

<sup>25</sup> High bit rates may require GPIOs to be set as High Drive, see GPIO chapter for more details.

<sup>26</sup> The actual maximum data rate depends on the master's CLK to MISO and MOSI setup and hold timings.

<sup>a</sup> At 25pF load, including GPIO capacitance, see GPIO spec.

<sup>27</sup> This is to ensure compatibility to SPI masters sampling MISO on the same edge as MOSI is output

Timing diagram for SPI Master/Slave communication. The diagram shows signals CSN, SCK, MISO, and MOSI. CSN is active-low. SCK is the serial clock. MISO and MOSI are bidirectional data lines. The diagram illustrates four data transfer scenarios: CPOL=0, CPHA=0; CPOL=1, CPHA=0; CPOL=0, CPHA=1; and CPOL=1, CPHA=1. Various timing parameters are labeled:  $t_{SUCSN,CPHA0}$ ,  $t_{CSCK}$ ,  $t_{HCSN}$ ,  $t_{WHSCK}$ ,  $t_{WLSCK}$ ,  $t_{RSCK}$ ,  $t_{FSCK}$ ,  $t_{SUMI}$ ,  $t_{HMI}$ ,  $t_{VSO}$ ,  $t_{HSD}$ ,  $t_{HSD}$ ,  $t_{DISO}$ ,  $t_{ASA}$ ,  $t_{ASO}$ ,  $t_{SUSI}$ ,  $t_{VMO}$ ,  $t_{HSI}$ ,  $t_{HMO}$ . The diagram is divided into Master and Slave sections by a vertical dashed line.



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## 6.20 SWI — Software interrupts

A set of interrupts have been reserved for use as software interrupts.

### 6.20.1 Registers

Base address	Peripheral	Instance	Description	Configuration
0x40014000	SWI	SWI0	Software interrupt 0	
0x40015000	SWI	SWI1	Software interrupt 1	
0x40016000	SWI	SWI2	Software interrupt 2	
0x40017000	SWI	SWI3	Software interrupt 3	
0x40018000	SWI	SWI4	Software interrupt 4	
0x40019000	SWI	SWI5	Software interrupt 5	

Table 81: Instances

## 6.21 TEMP — Temperature sensor

The temperature sensor measures die temperature over the temperature range of the device. Linearity compensation can be implemented if required by the application.

Listed here are the main features for TEMP:

- Temperature range is greater than or equal to operating temperature of the device
- Resolution is 0.25 degrees

TEMP is started by triggering the START task.

When the temperature measurement is completed, a DATARDY event will be generated and the result of the measurement can be read from the TEMP register.

To achieve the measurement accuracy stated in the electrical specification, the crystal oscillator must be selected as the HFCLK source, see [CLOCK — Clock control](#) on page 83 for more information.

When the temperature measurement is completed, TEMP analog electronics power down to save power.

TEMP only supports one-shot operation, meaning that every TEMP measurement has to be explicitly started using the START task.

### 6.21.1 Registers

Base address	Peripheral	Instance	Description	Configuration
0x4000C000	TEMP	TEMP	Temperature sensor	

Table 82: Instances

Register	Offset	Description
TASKS_START	0x000	Start temperature measurement
TASKS_STOP	0x004	Stop temperature measurement
EVENTS_DATARDY	0x100	Temperature measurement complete, data ready
INTENSET	0x304	Enable interrupt
INTENCLR	0x308	Disable interrupt
TEMP	0x508	Temperature in °C (0.25° steps)
AO	0x520	Slope of 1st piece wise linear function

Register	Offset	Description
A1	0x524	Slope of 2nd piece wise linear function
A2	0x528	Slope of 3rd piece wise linear function
A3	0x52C	Slope of 4th piece wise linear function
A4	0x530	Slope of 5th piece wise linear function
A5	0x534	Slope of 6th piece wise linear function
B0	0x540	y-intercept of 1st piece wise linear function
B1	0x544	y-intercept of 2nd piece wise linear function
B2	0x548	y-intercept of 3rd piece wise linear function
B3	0x54C	y-intercept of 4th piece wise linear function
B4	0x550	y-intercept of 5th piece wise linear function
B5	0x554	y-intercept of 6th piece wise linear function
T0	0x560	End point of 1st piece wise linear function
T1	0x564	End point of 2nd piece wise linear function
T2	0x568	End point of 3rd piece wise linear function
T3	0x56C	End point of 4th piece wise linear function
T4	0x570	End point of 5th piece wise linear function

Table 83: Register Overview

### 6.21.1.1 INTENSET

Address offset: 0x304

Enable interrupt

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0																															
Id				A																															
Reset 0x00000000				0 0																															
Id	RW	Field	Value Id	Value	Description																														
A	RW	DATARDY			Write '1' to Enable interrupt for DATARDY event																														
					See <a href="#">EVENTS_DATARDY</a>																														
			Set	1	Enable																														
			Disabled	0	Read: Disabled																														
			Enabled	1	Read: Enabled																														

### 6.21.1.2 INTENCLR

Address offset: 0x308

Disable interrupt

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0																															
Id				A																															
Reset 0x00000000				0 0																															
Id	RW	Field	Value Id	Value	Description																														
A	RW	DATARDY			Write '1' to Disable interrupt for DATARDY event																														
					See <a href="#">EVENTS_DATARDY</a>																														
			Clear	1	Disable																														
			Disabled	0	Read: Disabled																														
			Enabled	1	Read: Enabled																														

### 6.21.1.3 TEMP

Address offset: 0x508

## Temperature in °C (0.25° steps)

Bit number	31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0																													
Id	A A																													
Reset 0x00000000	0 0																													
Id	RW	Field	Value Id	Value	Description																									
A	R	TEMP			Temperature in °C (0.25° steps)																									
					Result of temperature measurement. The temperature in °C, 2's complement format, 0.25 °C steps																									
					Decision point: DATARDY																									

## 6.21.1.4 A0

Address offset: 0x520

Slope of 1st piece wise linear function

Bit number	31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0																													
Id																							A	A	A	A	A	A	A	A
Reset 0x00000326	0 1 1 0 0 1 0 0 1 1 0																													
Id	RW	Field	Value Id	Value	Description																									
A	RW	A0			Slope of 1st piece wise linear function																									

## 6.21.1.5 A1

Address offset: 0x524

Slope of 2nd piece wise linear function

Bit number	31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0																													
Id																							A	A	A	A	A	A	A	A
Reset 0x00000348	0 1 1 0 1 0 0 1 0 0 0																													
Id	RW	Field	Value Id	Value	Description																									
A	RW	A1			Slope of 2nd piece wise linear function																									

## 6.21.1.6 A2

Address offset: 0x528

Slope of 3rd piece wise linear function

Bit number	31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0																													
Id																							A	A	A	A	A	A	A	A
Reset 0x000003AA	0 1 1 1 0 1 0 1 0 1 0																													
Id	RW	Field	Value Id	Value	Description																									
A	RW	A2			Slope of 3rd piece wise linear function																									

## 6.21.1.7 A3

Address offset: 0x52C

Slope of 4th piece wise linear function

### Slope of 5th piece wise linear function

Bit number				31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0											
Id																												A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A
Reset 0x000004BD				0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	1	0	1	1	1	1	0	1									
Id	RW	Field	Value Id	Value				Description																																						
A	RW	A4						Slope of 5th piece wise linear function																																						

Slope of 6th piece wise linear function

Bit number				31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0											
Id																												A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A
Reset 0x000005A3				0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1	1	0	1	0	0	0	1	1									
Id	RW	Field	Value	Id	Value	Description																																								
A	RW	A5				Slope of 6th piece wise linear function																																								

y-intercept of 1st piece wise linear function

Bit number			31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0																														
Id			A A																														

y-intercept of 2nd piece wise linear function

Bit number				31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0								
Id																								A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A
Reset 0x00003FBE				0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	0	1	1	1	1	1	1	0							
Id	RW	Field	Value	Id	Value		Description																																				
A	RW	B1				y-intercept of 2nd piece wise linear function																																					





Bit number					31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0																															
Id					A A A A A A A A																															
Reset 0x000000E2					0 0																															

### 6.21.1.17 T1

Address offset: 0x564

End point of 2nd piece wise linear function

Bit number					31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0																															
Id					A A A A A A A A																															
Reset 0x00000000					0 0																															
Id	RW	Field	Value Id		Value		Description																													
A	RW	T1					End point of 2nd piece wise linear function																													

### 6.21.1.18 T2

Address offset: 0x568

End point of 3rd piece wise linear function

Bit number					31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0																															
Id					A A A A A A A A																															
Reset					0x00000019																															
Id					RW	Field	Value Id	Value	Description																											
A					RW	T2			End point of 3rd piece wise linear function																											

### 6.21.1.19 T3

Address offset: 0x56C

End point of 4th piece wise linear function

Bit number					31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0																															
Id					A A A A A A A A																															
Reset 0x0000003C					0 1 1 1 1 0 0																															
Id	RW	Field	Value Id		Value		Description																													
A	RW	T3					End point of 4th piece wise linear function																													

### 6.21.1.20 T4

Address offset: 0x570

End point of 5th piece wise linear function

Bit number					31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0																															
Id					A A A A A A A A																															
Reset 0x00000050					0 0																															

## 6.21.2 Electrical specification

### 6.21.2.1 Temperature Sensor Electrical Specification

Symbol	Description	Min.	Typ.	Max.	Units
$t_{TEMP}$	Time required for temperature measurement		36		$\mu s$
$T_{TEMP,RANGE}$	Temperature sensor range	-40		85	$^{\circ}C$
$T_{TEMP,ACC}$	Temperature sensor accuracy	-5		5	$^{\circ}C$
$T_{TEMP,RES}$	Temperature sensor resolution		0.25		$^{\circ}C$
$T_{TEMP,STB}$	Sample to sample stability at constant device temperature		+/-0.25		$^{\circ}C$
$T_{TEMP,OFFST}$	Sample offset at 25 $^{\circ}C$	-2.5		2.5	$^{\circ}C$

## 6.22 TIMER — Timer/counter

The TIMER can operate in two modes: timer and counter.

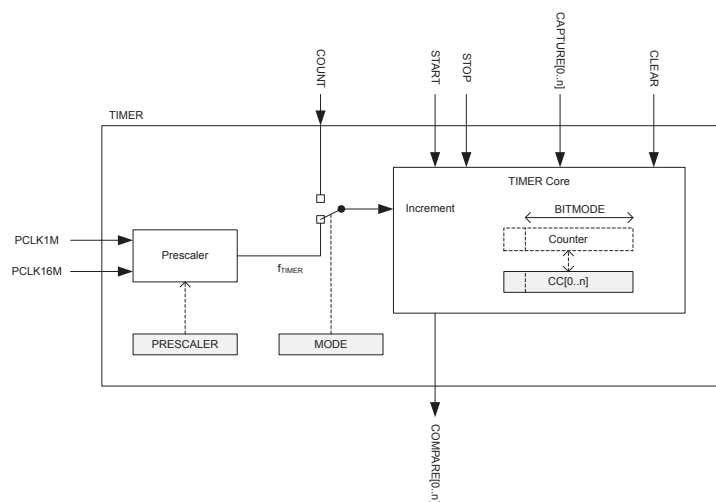


Figure 105: Block schematic for timer/counter

The timer/counter runs on the high-frequency clock source (HFCLK) and includes a four-bit (1/2X) prescaler that can divide the timer input clock from the HFCLK controller. Clock source selection between PCLK16M and PCLK1M is automatic according to TIMER base frequency set by the prescaler. The TIMER base frequency is always given as 16 MHz divided by the prescaler value.

The PPI system allows a TIMER event to trigger a task of any other system peripheral of the device. The PPI system also enables the TIMER task/event features to generate periodic output and PWM signals to any GPIO. The number of input/outputs used at the same time is limited by the number of GPIOTE channels.

The TIMER can operate in two modes, Timer mode and Counter mode. In both modes, the TIMER is started by triggering the START task, and stopped by triggering the STOP task. After the timer is stopped the timer can resume timing/counting by triggering the START task again. When timing/counting is resumed, the timer will continue from the value it had prior to being stopped.

In Timer mode, the TIMER's internal Counter register is incremented by one for every tick of the timer frequency  $f_{\text{TIMER}}$  as illustrated in [Block schematic for timer/counter](#) on page 403. The timer frequency is derived from PCLK16M as shown below, using the values specified in the PRESCALER register:

$$f_{\text{TIMER}} = 16 \text{ MHz} / (2^{\text{PRESCALER}})$$

When  $f_{\text{TIMER}} \leq 1 \text{ MHz}$  the TIMER will use PCLK1M instead of PCLK16M for reduced power consumption.

In counter mode, the TIMER's internal Counter register is incremented by one each time the COUNT task is triggered, that is, the timer frequency and the prescaler are not utilized in counter mode. Similarly, the COUNT task has no effect in Timer mode.

The TIMER's maximum value is configured by changing the bit-width of the timer in the [BITMODE](#) on page 408 register.

[PRESCALER](#) on page 409 and the [BITMODE](#) on page 408 must only be updated when the timer is stopped. If these registers are updated while the TIMER is started then this may result in unpredictable behavior.

When the timer is incremented beyond its maximum value the Counter register will overflow and the TIMER will automatically start over from zero.

The Counter register can be cleared, that is, its internal value set to zero explicitly, by triggering the CLEAR task.

The TIMER implements multiple capture/compare registers.

Independent of prescaler setting the accuracy of the TIMER is equivalent to one tick of the timer frequency  $f_{\text{TIMER}}$  as illustrated in [Block schematic for timer/counter](#) on page 403.

### 6.22.1 Capture

The TIMER implements one capture task for every available capture/compare register.

Every time the CAPTURE[n] task is triggered, the Counter value is copied to the CC[n] register.

### 6.22.2 Compare

The TIMER implements one COMPARE event for every available capture/compare register.

A COMPARE event is generated when the Counter is incremented and then becomes equal to the value specified in one of the capture compare registers. When the Counter value becomes equal to the value specified in a capture compare register CC[n], the corresponding compare event COMPARE[n] is generated.

[BITMODE](#) on page 408 specifies how many bits of the Counter register and the capture/compare register that are used when the comparison is performed. Other bits will be ignored.

### 6.22.3 Task delays

After the TIMER is started, the CLEAR task, COUNT task and the STOP task will guarantee to take effect within one clock cycle of the PCLK16M.

### 6.22.4 Task priority

If the START task and the STOP task are triggered at the same time, that is, within the same period of PCLK16M, the STOP task will be prioritized.

## 6.22.5 Registers

Base address	Peripheral	Instance	Description	Configuration
0x40008000	TIMER	TIMER0	Timer 0	This timer instance has 4 CC registers (CC[0..3])
0x40009000	TIMER	TIMER1	Timer 1	This timer instance has 4 CC registers (CC[0..3])
0x4000A000	TIMER	TIMER2	Timer 2	This timer instance has 4 CC registers (CC[0..3])

Table 84: Instances

Register	Offset	Description
TASKS_START	0x000	Start Timer
TASKS_STOP	0x004	Stop Timer
TASKS_COUNT	0x008	Increment Timer (Counter mode only)
TASKS_CLEAR	0x00C	Clear time
TASKS_SHUTDOWN	0x010	Shut down timer <span>Deprecated</span>
TASKS_CAPTURE[0]	0x040	Capture Timer value to CC[0] register
TASKS_CAPTURE[1]	0x044	Capture Timer value to CC[1] register
TASKS_CAPTURE[2]	0x048	Capture Timer value to CC[2] register
TASKS_CAPTURE[3]	0x04C	Capture Timer value to CC[3] register
TASKS_CAPTURE[4]	0x050	Capture Timer value to CC[4] register
TASKS_CAPTURE[5]	0x054	Capture Timer value to CC[5] register
EVENTS_COMPARE[0]	0x140	Compare event on CC[0] match
EVENTS_COMPARE[1]	0x144	Compare event on CC[1] match
EVENTS_COMPARE[2]	0x148	Compare event on CC[2] match
EVENTS_COMPARE[3]	0x14C	Compare event on CC[3] match
EVENTS_COMPARE[4]	0x150	Compare event on CC[4] match
EVENTS_COMPARE[5]	0x154	Compare event on CC[5] match
SHORTS	0x200	Shortcut register
INTENSET	0x304	Enable interrupt
INTENCLR	0x308	Disable interrupt
MODE	0x504	Timer mode selection
BITMODE	0x508	Configure the number of bits used by the TIMER
PRESCALER	0x510	Timer prescaler register
CC[0]	0x540	Capture/Compare register 0
CC[1]	0x544	Capture/Compare register 1
CC[2]	0x548	Capture/Compare register 2
CC[3]	0x54C	Capture/Compare register 3
CC[4]	0x550	Capture/Compare register 4
CC[5]	0x554	Capture/Compare register 5

Table 85: Register Overview

### 6.22.5.1 SHORTS

Address offset: 0x200

Shortcut register

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0																															
Id				L K J I H G																F E D C B A															
Reset 0x00000000				0 0																															
Id	RW	Field	Value	Id	Value	Description																													
A	RW	COMPARE0_CLEAR				Shortcut between COMPARE[0] event and CLEAR task																													
						See <a href="#">EVENTS_COMPARE[0]</a> and <a href="#">TASKS_CLEAR</a>																													
			Disabled		0	Disable shortcut																													
			Enabled		1	Enable shortcut																													
B	RW	COMPARE1_CLEAR				Shortcut between COMPARE[1] event and CLEAR task																													
						See <a href="#">EVENTS_COMPARE[1]</a> and <a href="#">TASKS_CLEAR</a>																													
			Disabled		0	Disable shortcut																													
			Enabled		1	Enable shortcut																													
C	RW	COMPARE2_CLEAR				Shortcut between COMPARE[2] event and CLEAR task																													
						See <a href="#">EVENTS_COMPARE[2]</a> and <a href="#">TASKS_CLEAR</a>																													
			Disabled		0	Disable shortcut																													
			Enabled		1	Enable shortcut																													
D	RW	COMPARE3_CLEAR				Shortcut between COMPARE[3] event and CLEAR task																													
						See <a href="#">EVENTS_COMPARE[3]</a> and <a href="#">TASKS_CLEAR</a>																													
			Disabled		0	Disable shortcut																													
			Enabled		1	Enable shortcut																													
E	RW	COMPARE4_CLEAR				Shortcut between COMPARE[4] event and CLEAR task																													
						See <a href="#">EVENTS_COMPARE[4]</a> and <a href="#">TASKS_CLEAR</a>																													
			Disabled		0	Disable shortcut																													
			Enabled		1	Enable shortcut																													
F	RW	COMPARE5_CLEAR				Shortcut between COMPARE[5] event and CLEAR task																													
						See <a href="#">EVENTS_COMPARE[5]</a> and <a href="#">TASKS_CLEAR</a>																													
			Disabled		0	Disable shortcut																													
			Enabled		1	Enable shortcut																													
G	RW	COMPARE0_STOP				Shortcut between COMPARE[0] event and STOP task																													
						See <a href="#">EVENTS_COMPARE[0]</a> and <a href="#">TASKS_STOP</a>																													
			Disabled		0	Disable shortcut																													
			Enabled		1	Enable shortcut																													
H	RW	COMPARE1_STOP				Shortcut between COMPARE[1] event and STOP task																													
						See <a href="#">EVENTS_COMPARE[1]</a> and <a href="#">TASKS_STOP</a>																													
			Disabled		0	Disable shortcut																													
			Enabled		1	Enable shortcut																													
I	RW	COMPARE2_STOP				Shortcut between COMPARE[2] event and STOP task																													
						See <a href="#">EVENTS_COMPARE[2]</a> and <a href="#">TASKS_STOP</a>																													
			Disabled		0	Disable shortcut																													
			Enabled		1	Enable shortcut																													
J	RW	COMPARE3_STOP				Shortcut between COMPARE[3] event and STOP task																													
						See <a href="#">EVENTS_COMPARE[3]</a> and <a href="#">TASKS_STOP</a>																													
			Disabled		0	Disable shortcut																													
			Enabled		1	Enable shortcut																													
K	RW	COMPARE4_STOP				Shortcut between COMPARE[4] event and STOP task																													
						See <a href="#">EVENTS_COMPARE[4]</a> and <a href="#">TASKS_STOP</a>																													
			Disabled		0	Disable shortcut																													
			Enabled		1	Enable shortcut																													
L	RW	COMPARE5_STOP				Shortcut between COMPARE[5] event and STOP task																													
						See <a href="#">EVENTS_COMPARE[5]</a> and <a href="#">TASKS_STOP</a>																													

Bit number					31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0										
Id																									L	K	J	I	H	G											F	E	D	C	B	A
Reset 0x00000000					0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0								
Id	RW	Field	Value	Id	Value		Description																																							
			Disabled		0		Disable shortcut																																							
			Enabled		1		Enable shortcut																																							

### 6.22.5.2 INTENSET

Address offset: 0x304

Enable interrupt

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0																															
Id				F E D C B A																															
Reset 0x00000000				0 0																															
Id	RW	Field	Value Id	Value	Description																														
A	RW	COMPARE0			Write '1' to Enable interrupt for COMPARE[0] event																														
					See <a href="#">EVENTS_COMPARE[0]</a>																														
			Set	1	Enable																														
			Disabled	0	Read: Disabled																														
			Enabled	1	Read: Enabled																														
B	RW	COMPARE1			Write '1' to Enable interrupt for COMPARE[1] event																														
					See <a href="#">EVENTS_COMPARE[1]</a>																														
			Set	1	Enable																														
			Disabled	0	Read: Disabled																														
			Enabled	1	Read: Enabled																														
C	RW	COMPARE2			Write '1' to Enable interrupt for COMPARE[2] event																														
					See <a href="#">EVENTS_COMPARE[2]</a>																														
			Set	1	Enable																														
			Disabled	0	Read: Disabled																														
			Enabled	1	Read: Enabled																														
D	RW	COMPARE3			Write '1' to Enable interrupt for COMPARE[3] event																														
					See <a href="#">EVENTS_COMPARE[3]</a>																														
			Set	1	Enable																														
			Disabled	0	Read: Disabled																														
			Enabled	1	Read: Enabled																														
E	RW	COMPARE4			Write '1' to Enable interrupt for COMPARE[4] event																														
					See <a href="#">EVENTS_COMPARE[4]</a>																														
			Set	1	Enable																														
			Disabled	0	Read: Disabled																														
			Enabled	1	Read: Enabled																														
F	RW	COMPARE5			Write '1' to Enable interrupt for COMPARE[5] event																														
					See <a href="#">EVENTS_COMPARE[5]</a>																														
			Set	1	Enable																														
			Disabled	0	Read: Disabled																														
			Enabled	1	Read: Enabled																														

### 6.22.5.3 INTENCLR

Address offset: 0x308

Disable interrupt

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0																															
Id				F E D C B A																															
Reset 0x00000000				0 0																															
Id	RW	Field	Value	Id	Value	Description																													
A	RW	COMPARE0				Write '1' to Disable interrupt for COMPARE[0] event																													
						See <a href="#">EVENTS_COMPARE[0]</a>																													
			Clear	1		Disable																													
			Disabled	0		Read: Disabled																													
			Enabled	1		Read: Enabled																													
B	RW	COMPARE1				Write '1' to Disable interrupt for COMPARE[1] event																													
						See <a href="#">EVENTS_COMPARE[1]</a>																													
			Clear	1		Disable																													
			Disabled	0		Read: Disabled																													
			Enabled	1		Read: Enabled																													
C	RW	COMPARE2				Write '1' to Disable interrupt for COMPARE[2] event																													
						See <a href="#">EVENTS_COMPARE[2]</a>																													
			Clear	1		Disable																													
			Disabled	0		Read: Disabled																													
			Enabled	1		Read: Enabled																													
D	RW	COMPARE3				Write '1' to Disable interrupt for COMPARE[3] event																													
						See <a href="#">EVENTS_COMPARE[3]</a>																													
			Clear	1		Disable																													
			Disabled	0		Read: Disabled																													
			Enabled	1		Read: Enabled																													
E	RW	COMPARE4				Write '1' to Disable interrupt for COMPARE[4] event																													
						See <a href="#">EVENTS_COMPARE[4]</a>																													
			Clear	1		Disable																													
			Disabled	0		Read: Disabled																													
			Enabled	1		Read: Enabled																													
F	RW	COMPARE5				Write '1' to Disable interrupt for COMPARE[5] event																													
						See <a href="#">EVENTS_COMPARE[5]</a>																													
			Clear	1		Disable																													
			Disabled	0		Read: Disabled																													
			Enabled	1		Read: Enabled																													

### 6.22.5.4 MODE

Address offset: 0x504

Timer mode selection

Bit number					31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0																															
Id					A A																															
Reset 0x00000000					0 0																															
Id	RW	Field	Value	Id	Value	Description																														
A	RW	MODE				Timer mode																														
			Timer	0		Select Timer mode																														
			Counter	1		Select Counter mode																														
			LowPowerCounter	2		Select Low Power Counter mode																														

Deprecated

### 6.22.5.5 BITMODE

Address offset: 0x508



Configure the number of bits used by the TIMER

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0																															
Id				A A																															
Reset 0x00000000				0 0																															
Id	RW	Field	Value Id	Value		Description																													
A	RW	BITMODE				Timer bit width																													
			16Bit	0		16 bit timer bit width																													
			08Bit	1		8 bit timer bit width																													
			24Bit	2		24 bit timer bit width																													
			32Bit	3		32 bit timer bit width																													

### 6.22.5.6 PRESCALER

Address offset: 0x510

Timer prescaler register

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0																															
Id				A A A A																															
Reset 0x00000004				0 1 0 0																															
Id	RW	Field	Value Id	Value	Description																														
A	RW	PRESCALER		[0..9]	Prescaler value																														

### 6.22.5.7 CC[0]

Address offset: 0x540

Capture/Compare register 0

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0																															
Id				A A																															
Reset 0x00000000				0 0																															
Id	RW	Field	Value Id	Value				Description																											
A	RW	CC						Capture/Compare value																											

Only the number of bits indicated by BITMODE will be used by the TIMER.

### 6.22.5.8 CC[1]

Address offset: 0x544

Capture/Compare register 1

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0																															
Id				A A																															
Reset 0x00000000				0 0																															
Id	RW	Field	Value Id	Value				Description																											
A	RW	CC						Capture/Compare value																											

Only the number of bits indicated by BITMODE will be used by the TIMER.

### 6.22.5.9 CC[2]

Address offset: 0x548

Capture/Compare register 2

Bit number					31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0	
Id					A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A
Reset 0x00000000					0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Id	RW	Field	Value Id	Value	Description																																
A	RW	CC			Capture/Compare value																																
					Only the number of bits indicated by BITMODE will be used by the TIMER.																																

### 6.22.5.10 CC[3]

Address offset: 0x54C

Capture/Compare register 3

Bit number					31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0																															
Id					A A																															
Reset 0x00000000					0 0																															
Id	RW	Field	Value Id	Value	Description																															
A	RW	CC			Capture/Compare value																															
Only the number of bits indicated by BITMODE will be used by the TIMER.																																				

### 6.22.5.11 CC[4]

Address offset: 0x550

Capture/Compare register 4

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0																															
Id				A A																															
Reset 0x00000000				0 0																															
Id	RW	Field	Value Id	Value				Description																											
A	RW	CC						Capture/Compare value																											
Only the number of bits indicated by BITMODE will be used by the TIMER.																																			

### 6.22.5.12 CC[5]

Address offset: 0x554

Capture/Compare register 5

Bit number					31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
Id					A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A
Reset 0x00000000					0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Id	RW	Field	Value	Id	Value		Description																													

A RW CC

Capture/Compare value

Only the number of bits indicated by BITMODE will be used  
by the TIMER.

## 6.23 TWIM — I<sup>2</sup>C compatible two-wire interface master with EasyDMA

TWI master with EasyDMA (TWIM) is a two-wire half-duplex master which can communicate with multiple slave devices connected to the same bus

Listed here are the main features for TWIM:

- I<sup>2</sup>C compatible
- 100 kbps, 250 kbps, or 400 kbps
- Support for clock stretching (non I<sup>2</sup>C compliant)
- EasyDMA

The two-wire interface can communicate with a bi-directional wired-AND bus with two lines (SCL, SDA). The protocol makes it possible to interconnect up to 127 individually addressable devices. TWIM is not compatible with CBUS.

The GPIOs used for each two-wire interface line can be chosen from any GPIO on the device and are independently configurable. This enables great flexibility in device pinout and efficient use of board space and signal routing.

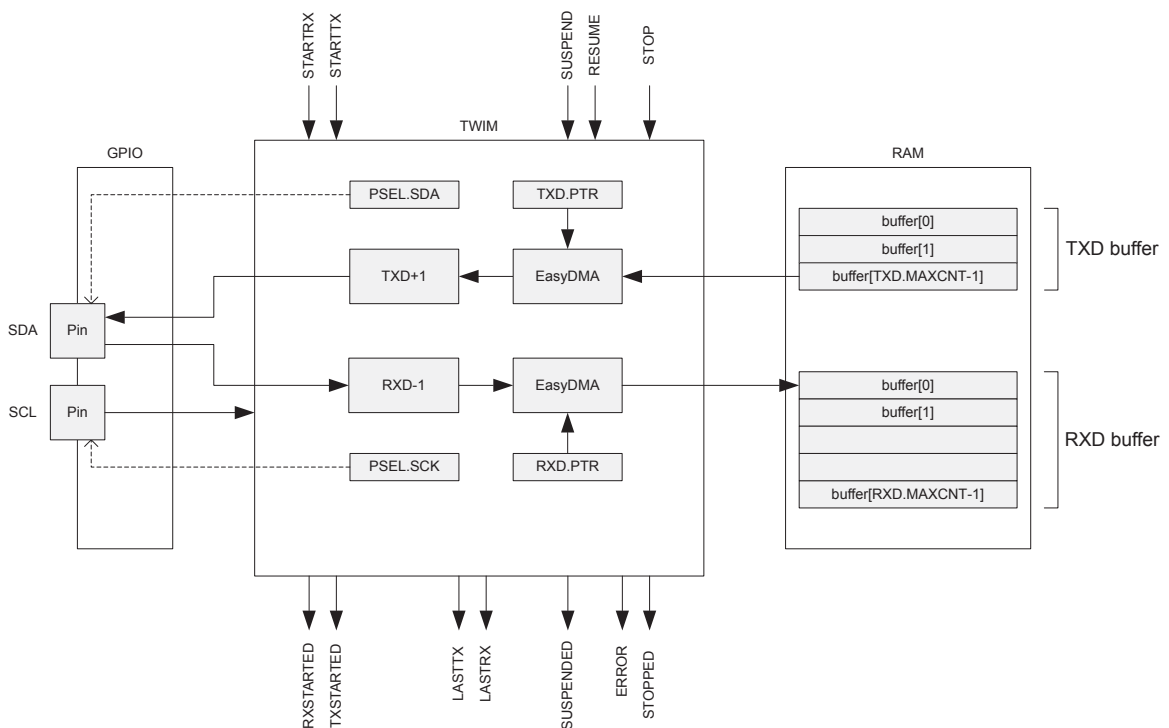


Figure 106: TWI master with EasyDMA

A typical TWI setup consists of one master and one or more slaves. For an example, see [A typical TWI setup comprising one master and three slaves](#) on page 412. This TWIM is only able to operate as a single master on the TWI bus. Multi-master bus configuration is not supported.

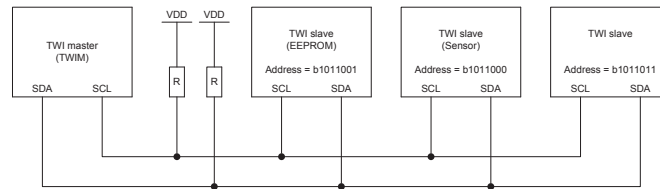


Figure 107: A typical TWI setup comprising one master and three slaves

This TWI master supports clock stretching performed by the slaves. Note that the SCK pulse following a stretched clock cycle may be shorter than specified by the I2C specification.

The TWI master is started by triggering the STARTTX or STARTRX tasks, and stopped by triggering the STOP task. The TWI master will generate a STOPPED event when it has stopped following a STOP task. The TWI master cannot get stopped while it is suspended, so the STOP task has to be issued after the TWI master has been resumed.

After the TWI master is started, the STARTTX task or the STARTRX task should not be triggered again before the TWI master has stopped, i.e. following a LASTRX, LASTTX or STOPPED event.

If a NACK is clocked in from the slave, the TWI master will generate an ERROR event.

### 6.23.1 EasyDMA

The TWI master implements EasyDMA for reading and writing to and from the RAM.

If the TXD.PTR and the RXD.PTR are not pointing to the Data RAM region, an EasyDMA transfer may result in a HardFault or RAM corruption. See [Memory](#) on page 15 for more information about the different memory regions.

The .PTR and .MAXCNT registers are double-buffered. They can be updated and prepared for the next RX/TX transmission immediately after having received the RXSTARTED/TXSTARTED event.

The STOPPED event indicates that EasyDMA has finished accessing the buffer in RAM.

### 6.23.2 Master write sequence

A TWI master write sequence is started by triggering the STARTTX task. After the STARTTX task has been triggered, the TWI master will generate a start condition on the TWI bus, followed by clocking out the address and the READ/WRITE bit set to 0 (WRITE=0, READ=1).

The address must match the address of the slave device that the master wants to write to. The READ/WRITE bit is followed by an ACK/NACK bit (ACK=0 or NACK=1) generated by the slave.

After receiving the ACK bit, the TWI master will clock out the data bytes found in the transmit buffer located in RAM at the address specified in the TXD.PTR register. Each byte clocked out from the master will be followed by an ACK/NACK bit clocked in from the slave.

A typical TWI master write sequence is illustrated in [TWI master writing data to a slave](#) on page 413. Occurrence 2 in the figure illustrates clock stretching performed by the TWI master following a SUSPEND task.

A SUSPENDED event indicates that the SUSPEND task has taken effect; this event can be used to synchronize the software.

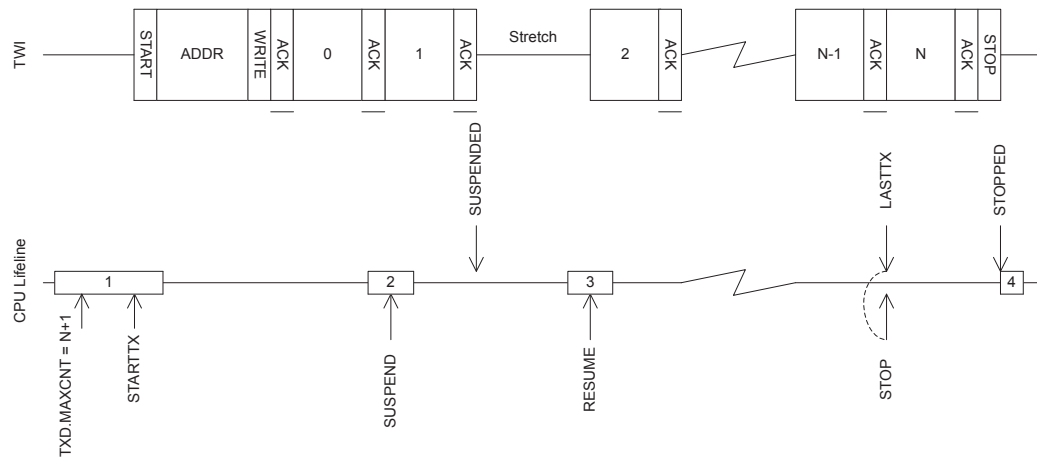


Figure 108: TWI master writing data to a slave

The TWI master will generate a LASTTX event when it starts to transmit the last byte, this is illustrated in [TWI master writing data to a slave](#) on page 413

The TWI master is stopped by triggering the STOP task, this task should be triggered during the transmission of the last byte to secure that the TWI will stop as fast as possible after sending the last byte. It is safe to use the shortcut between LASTTX and STOP to accomplish this.

Note that the TWI master does not stop by itself when the whole RAM buffer has been sent, or when an error occurs. The STOP task must be issued, through the use of a local or PPI shortcut, or in software as part of the error handler.

The TWI master cannot get stopped while it is suspended, so the STOP task has to be issued after the TWI master has been resumed.

### 6.23.3 Master read sequence

A TWI master read sequence is started by triggering the STARTRX task. After the STARTRX task has been triggered the TWI master will generate a start condition on the TWI bus, followed by clocking out the address and the READ/WRITE bit set to 1 (WRITE = 0, READ = 1). The address must match the address of the slave device that the master wants to read from. The READ/WRITE bit is followed by an ACK/NACK bit (ACK=0 or NACK = 1) generated by the slave.

After having sent the ACK bit the TWI slave will send data to the master using the clock generated by the master.

Data received will be stored in RAM at the address specified in the RXD.PTR register. The TWI master will generate an ACK after all but the last byte received from the slave. The TWI master will generate a NACK after the last byte received to indicate that the read sequence shall stop.

A typical TWI master read sequence is illustrated in [The TWI master reading data from a slave](#) on page 414. Occurrence 2 in the figure illustrates clock stretching performed by the TWI master following a SUSPEND task.

A SUSPENDED event indicates that the SUSPEND task has taken effect; this event can be used to synchronize the software.

The TWI master will generate a LASTRX event when it is ready to receive the last byte, this is illustrated in [The TWI master reading data from a slave](#) on page 414. If RXD.MAXCNT > 1 the LASTRX event is generated after sending the ACK of the previously received byte. If RXD.MAXCNT = 1 the LASTRX event is generated after receiving the ACK following the address and READ bit.

The TWI master is stopped by triggering the STOP task, this task must be triggered before the NACK bit is supposed to be transmitted. The STOP task can be triggered at any time during the reception of the last byte. It is safe to use the shortcut between LASTRX and STOP to accomplish this.

Note that the TWI master does not stop by itself when the RAM buffer is full, or when an error occurs. The STOP task must be issued, through the use of a local or PPI shortcut, or in software as part of the error handler.

The TWI master cannot get stopped while it is suspended, so the STOP task has to be issued after the TWI master has been resumed.

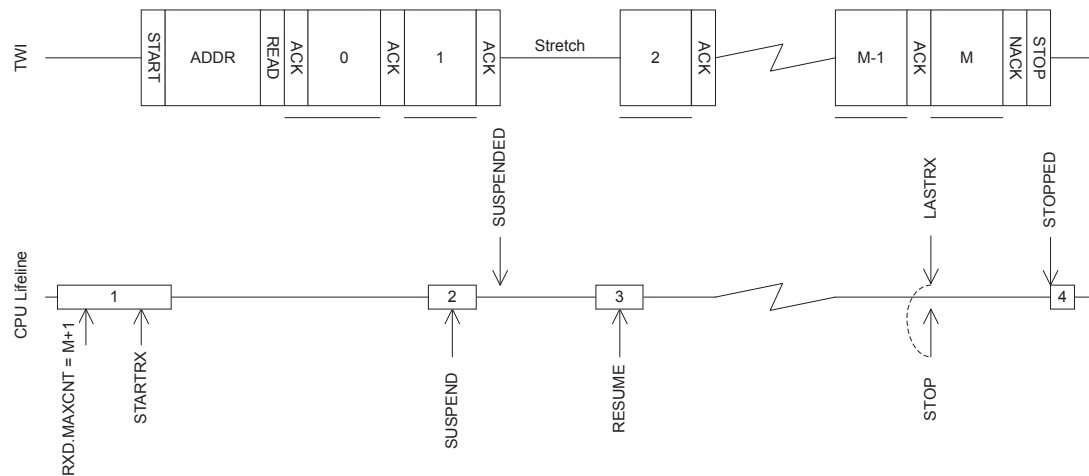


Figure 109: The TWI master reading data from a slave

#### 6.23.4 Master repeated start sequence

A typical repeated start sequence is one in which the TWI master writes two bytes to the slave followed by reading four bytes from the slave. This example uses shortcuts to perform the simplest type of repeated start sequence, i.e. one write followed by one read. The same approach can be used to perform a repeated start sequence where the sequence is read followed by write.

The figure [A repeated start sequence, where the TWI master writes two bytes followed by reading 4 bytes from the slave](#) on page 414 illustrates this:

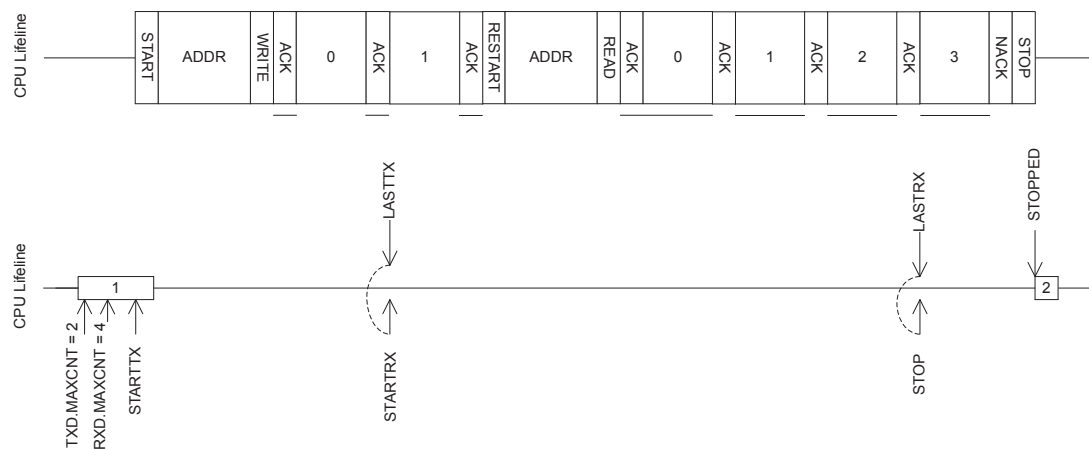


Figure 110: A repeated start sequence, where the TWI master writes two bytes followed by reading 4 bytes from the slave

If a more complex repeated start sequence is needed and the TWI firmware drive is serviced in a low priority interrupt it may be necessary to use the SUSPEND task and SUSPENDED event to guarantee that the correct tasks are generated at the correct time. This is illustrated in [A double repeated start sequence using the SUSPEND task to secure safe operation in low priority interrupts](#) on page 415.

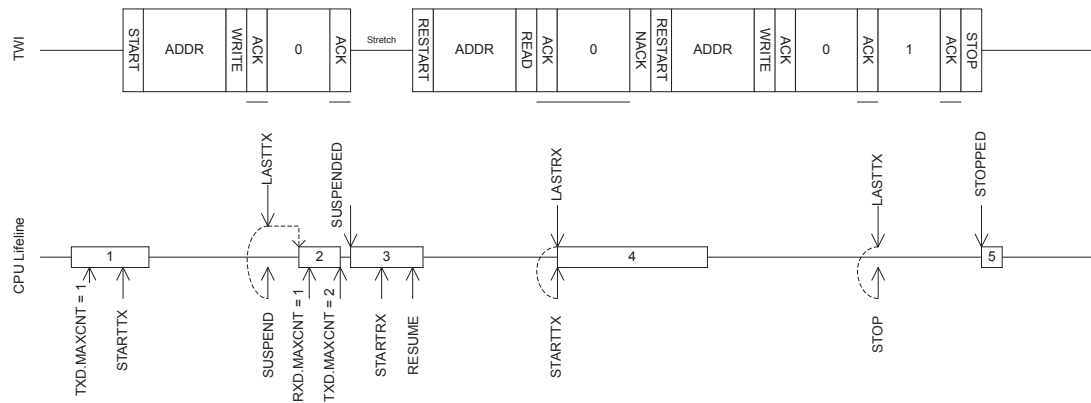


Figure 111: A double repeated start sequence using the SUSPEND task to secure safe operation in low priority interrupts

### 6.23.5 Low power

When putting the system in low power and the peripheral is not needed, lowest possible power consumption is achieved by stopping, and then disabling the peripheral.

The STOP task may not be always needed (the peripheral might already be stopped), but if it is sent, software shall wait until the STOPPED event was received as a response before disabling the peripheral through the ENABLE register.

### 6.23.6 Master mode pin configuration

The SCL and SDA signals associated with the TWI master are mapped to physical pins according to the configuration specified in the PSEL.SCL and PSEL.SDA registers respectively.

The PSEL.SCL and PSEL.SDA registers and their configurations are only used as long as the TWI master is enabled, and retained only as long as the device is in ON mode. When the peripheral is disabled, the pins will behave as regular GPIOs, and use the configuration in their respective OUT bit field and PIN\_CNF[n] register. PSEL.SCL, PSEL.SDA must only be configured when the TWI master is disabled.

To secure correct signal levels on the pins used by the TWI master when the system is in OFF mode, and when the TWI master is disabled, these pins must be configured in the GPIO peripheral as described in [GPIO configuration before enabling peripheral](#) on page 415.

Only one peripheral can be assigned to drive a particular GPIO pin at a time. Failing to do so may result in unpredictable behavior.

TWI master signal	TWI master pin	Direction	Output value	Drive strength
SCL	As specified in PSEL.SCL	Input	Not applicable	S0D1
SDA	As specified in PSEL.SDA	Input	Not applicable	S0D1

Table 86: GPIO configuration before enabling peripheral

## 6.23.7 Registers

Base address	Peripheral	Instance	Description	Configuration
0x40003000	TWIM	TWIM0	Two-wire interface master	

Table 87: Instances

Register	Offset	Description
TASKS_STARTRX	0x000	Start TWI receive sequence
TASKS_STARTTX	0x008	Start TWI transmit sequence
TASKS_STOP	0x014	Stop TWI transaction. Must be issued while the TWI master is not suspended.
TASKS_SUSPEND	0x01C	Suspend TWI transaction
TASKS_RESUME	0x020	Resume TWI transaction
EVENTS_STOPPED	0x104	TWI stopped
EVENTS_ERROR	0x124	TWI error
EVENTS_SUSPENDED	0x148	Last byte has been sent out after the SUSPEND task has been issued, TWI traffic is now suspended.
EVENTS_RXSTARTED	0x14C	Receive sequence started
EVENTS_TXSTARTED	0x150	Transmit sequence started
EVENTS_LASTRX	0x15C	Byte boundary, starting to receive the last byte
EVENTS_LASTTX	0x160	Byte boundary, starting to transmit the last byte
SHORTS	0x200	Shortcut register
INTEN	0x300	Enable or disable interrupt
INTENSET	0x304	Enable interrupt
INTENCLR	0x308	Disable interrupt
ERRORSRC	0x4C4	Error source
ENABLE	0x500	Enable TWIM
PSEL_SCL	0x508	Pin select for SCL signal
PSEL_SDA	0x50C	Pin select for SDA signal
FREQUENCY	0x524	TWI frequency. Accuracy depends on the HFCLK source selected.
RXD_PTR	0x534	Data pointer
RXD_MAXCNT	0x538	Maximum number of bytes in receive buffer
RXD_AMOUNT	0x53C	Number of bytes transferred in the last transaction
RXD_LIST	0x540	EasyDMA list type
TXD_PTR	0x544	Data pointer
TXD_MAXCNT	0x548	Maximum number of bytes in transmit buffer
TXD_AMOUNT	0x54C	Number of bytes transferred in the last transaction
TXD_LIST	0x550	EasyDMA list type
ADDRESS	0x588	Address used in the TWI transfer

Table 88: Register Overview

### 6.23.7.1 SHORTS

Address offset: 0x200

Shortcut register



Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0																															
Id				F																D C B A															
Reset 0x00000000				0 0																															
Id	RW	Field	Value	Id	Value	Description																													
A	RW	LASTTX_STARTRX				Shortcut between LASTTX event and STARTRX task																													
						See <a href="#">EVENTS_LASTTX</a> and <a href="#">TASKS_STARTRX</a>																													
			Disabled		0	Disable shortcut																													
			Enabled		1	Enable shortcut																													
B	RW	LASTTX_SUSPEND				Shortcut between LASTTX event and SUSPEND task																													
						See <a href="#">EVENTS_LASTTX</a> and <a href="#">TASKS_SUSPEND</a>																													
			Disabled		0	Disable shortcut																													
			Enabled		1	Enable shortcut																													
C	RW	LASTTX_STOP				Shortcut between LASTTX event and STOP task																													
						See <a href="#">EVENTS_LASTTX</a> and <a href="#">TASKS_STOP</a>																													
			Disabled		0	Disable shortcut																													
			Enabled		1	Enable shortcut																													
D	RW	LASTRX_STARTTX				Shortcut between LASTRX event and STARTTX task																													
						See <a href="#">EVENTS_LASTRX</a> and <a href="#">TASKS_STARTTX</a>																													
			Disabled		0	Disable shortcut																													
			Enabled		1	Enable shortcut																													
F	RW	LASTRX_STOP				Shortcut between LASTRX event and STOP task																													
						See <a href="#">EVENTS_LASTRX</a> and <a href="#">TASKS_STOP</a>																													
			Disabled		0	Disable shortcut																													
			Enabled		1	Enable shortcut																													

### 6.23.7.2 INTEN

Address offset: 0x300

Enable or disable interrupt

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0																																	
Id				J I H G F																D																A	
Reset 0x00000000				0 0																																	
Id	RW	Field	Value	Id	Value	Description																															
A	RW	STOPPED				Enable or disable interrupt for STOPPED event																															
						See <a href="#">EVENTS_STOPPED</a>																															
			Disabled		0	Disable																															
			Enabled		1	Enable																															
D	RW	ERROR				Enable or disable interrupt for ERROR event																															
						See <a href="#">EVENTS_ERROR</a>																															
			Disabled		0	Disable																															
			Enabled		1	Enable																															
F	RW	SUSPENDED				Enable or disable interrupt for SUSPENDED event																															
						See <a href="#">EVENTS_SUSPENDED</a>																															
			Disabled		0	Disable																															
			Enabled		1	Enable																															
G	RW	RXSTARTED				Enable or disable interrupt for RXSTARTED event																															
						See <a href="#">EVENTS_RXSTARTED</a>																															
			Disabled		0	Disable																															
			Enabled		1	Enable																															

Bit number					31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0	
Id												J	I	H			G	F											D						A		
Reset 0x00000000					0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Id	RW	Field	Value Id	Value	Description																																
H	RW	TXSTARTED			Enable or disable interrupt for TXSTARTED event																																
					See <a href="#">EVENTS_TXSTARTED</a>																																
			Disabled	0	Disable																																
			Enabled	1	Enable																																
I	RW	LASTRX			Enable or disable interrupt for LASTRX event																																
					See <a href="#">EVENTS_LASTRX</a>																																
			Disabled	0	Disable																																
			Enabled	1	Enable																																
J	RW	LASTTX			Enable or disable interrupt for LASTTX event																																
					See <a href="#">EVENTS_LASTTX</a>																																
			Disabled	0	Disable																																
			Enabled	1	Enable																																

### 6.23.7.3 INTENSET

Address offset: 0x304

Enable interrupt

Bit number					31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0																																										
Id															J		I		H		G		F												D												A
Reset 0x00000000					0 0																																										

Bit number					31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0																															
Id					J I H G F D A																															
Reset 0x00000000					0 0																															
Id	RW	Field	Value Id	Value	Description																															
I	RW	LASTRX			Write '1' to Enable interrupt for LASTRX event																															
					See <a href="#">EVENTS_LASTRX</a>																															
			Set	1	Enable																															
			Disabled	0	Read: Disabled																															
			Enabled	1	Read: Enabled																															
J	RW	LASTTX			Write '1' to Enable interrupt for LASTTX event																															
					See <a href="#">EVENTS_LASTTX</a>																															
			Set	1	Enable																															
			Disabled	0	Read: Disabled																															
			Enabled	1	Read: Enabled																															

### 6.23.7.4 INTENCLR

Address offset: 0x308

Disable interrupt

Bit number					31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0																															
Id		J I H G F D A																																		
Reset 0x00000000					0 0																															
Id	RW	Field	Value Id	Value	Description																															
A	RW	STOPPED			Write '1' to Disable interrupt for STOPPED event																															
					See <a href="#">EVENTS_STOPPED</a>																															
			Clear	1	Disable																															
			Disabled	0	Read: Disabled																															
			Enabled	1	Read: Enabled																															
D	RW	ERROR			Write '1' to Disable interrupt for ERROR event																															
					See <a href="#">EVENTS_ERROR</a>																															
			Clear	1	Disable																															
			Disabled	0	Read: Disabled																															
			Enabled	1	Read: Enabled																															
F	RW	SUSPENDED			Write '1' to Disable interrupt for SUSPENDED event																															
					See <a href="#">EVENTS_SUSPENDED</a>																															
			Clear	1	Disable																															
			Disabled	0	Read: Disabled																															
			Enabled	1	Read: Enabled																															
G	RW	RXSTARTED			Write '1' to Disable interrupt for RXSTARTED event																															
					See <a href="#">EVENTS_RXSTARTED</a>																															
			Clear	1	Disable																															
			Disabled	0	Read: Disabled																															
			Enabled	1	Read: Enabled																															
H	RW	TXSTARTED			Write '1' to Disable interrupt for TXSTARTED event																															
					See <a href="#">EVENTS_TXSTARTED</a>																															
			Clear	1	Disable																															
			Disabled	0	Read: Disabled																															
			Enabled	1	Read: Enabled																															
I	RW	LASTRX			Write '1' to Disable interrupt for LASTRX event																															
					See <a href="#">EVENTS_LASTRX</a>																															

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0																															
Id				J I H G F																D A															
Reset 0x00000000				0 0																															
Id	RW	Field	Value Id	Value	Description																														
			Clear	1	Disable																														
			Disabled	0	Read: Disabled																														
			Enabled	1	Read: Enabled																														
J	RW	LASTTX			Write '1' to Disable interrupt for LASTTX event																														
					See <a href="#">EVENTS_LASTTX</a>																														
			Clear	1	Disable																														
			Disabled	0	Read: Disabled																														
			Enabled	1	Read: Enabled																														

### 6.23.7.5 ERRORSRC

Address offset: 0x4C4

Error source

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0																															
Id				C B A																															
Reset 0x00000000				0 0																															
Id	RW	Field	Value Id	Value	Description																														
A	RW	OVERRUN			Overrun error																														
					A new byte was received before previous byte got transferred into RXD buffer. (Previous data is lost)																														
			NotReceived	0	Error did not occur																														
			Received	1	Error occurred																														
B	RW	ANACK			NACK received after sending the address (write '1' to clear)																														
			NotReceived	0	Error did not occur																														
			Received	1	Error occurred																														
C	RW	DNACK			NACK received after sending a data byte (write '1' to clear)																														
			NotReceived	0	Error did not occur																														
			Received	1	Error occurred																														

### 6.23.7.6 ENABLE

Address offset: 0x500

Enable TWIM

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0																															
Id				A A A A																															
Reset 0x00000000				0 0																															
Id	RW	Field	Value Id	Value	Description																														
A	RW	ENABLE			Enable or disable TWIM																														
			Disabled	0	Disable TWIM																														
			Enabled	6	Enable TWIM																														

### 6.23.7.7 PSEL.SCL

Address offset: 0x508

Pin select for SCL signal

Bit number					31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0																																															
Id					C																																A				A				A				A			
Reset 0xFFFFFFFF					1 1																																															

### 6.23.7.8 PSEL.SDA

Address offset: 0x50C

Pin select for SDA signal

Bit number					31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0																															
Id					C																															
Reset 0xFFFFFFFF					1 1																															
Id		RW		Field		Value		Id		Value		Description																								
A		RW		PIN						[0..31]		Pin number																								
C		RW		CONNECT								Connection																								
						Disconnected				1		Disconnect																								
						Connected				0		Connect																								

### 6.23.7.9 FREQUENCY

Address offset: 0x524

TWI frequency. Accuracy depends on the HFCLK source selected.

Bit number					31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0																															
Id					A A																															
Reset 0x04000000					0 0 0 0 0 1 0																															
Id	RW	Field	Value	Id	Value		Description																													
A	RW	FREQUENCY					TWI master clock frequency																													
			K100		0x01980000		100 kbps																													
			K250		0x04000000		250 kbps																													
			K400		0x06400000		400 kbps																													

### 6.23.7.10 RXD.PTR

Address offset: 0x534

Data pointer

Bit number					31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0																															
Id					A A																															
Reset 0x00000000					0 0																															
Id		RW	Field		Value	Id	Value	Description																												
A		RW	PTR					Data pointer																												

### 6.23.7.11 RXD.MAXCNT

Address offset: 0x538

Maximum number of bytes in receive buffer

Bit number					31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0																															
Id					A A																															

### 6.23.7.12 RXD.AMOUNT

Address offset: 0x53C

Number of bytes transferred in the last transaction

Bit number					31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0																															
Id					A A A A A A A A																															
Reset 0x00000000					0 0																															
Id		RW	Field		Value Id		Value		Description																											
A		R	AMOUNT				[1..0x3FF]		Number of bytes transferred in the last transaction. In case of NACK error, includes the NACK'ed byte.																											

### 6.23.7.13 RXD.LIST

Address offset: 0x540

EasyDMA list type

Bit number					31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0																																		
Id																																					A	A	A
Reset 0x00000000					0 0																																		
Id	RW	Field	Value Id		Value		Description																																
A	RW	LIST					List type																																
			Disabled		0		Disable EasyDMA list																																
			ArrayList		1		Use array list																																

### 6.23.7.14 TXD.PTR

Address offset: 0x544

Data pointer

Bit number					31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0																															
Id					A A																															
Reset 0x00000000					0 0																															
Id		RW		Field		Value Id		Value		Description																										
A		RW		PTR						Data pointer																										

### 6.23.7.15 TXD.MAXCNT

Address offset: 0x548

Maximum number of bytes in transmit buffer

Bit number	31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
Id																								A	A	A	A	A	A	A	A	A
Reset 0x00000000	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Id	RW	Field	Value Id	Value	Description																											
A	RW	MAXCNT		[1..0x3FF]	Maximum number of bytes in transmit buffer																											

### 6.23.7.16 TXD.AMOUNT

Address offset: 0x54C

Number of bytes transferred in the last transaction

Bit number	31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
Id																								A	A	A	A	A	A	A	A	A
Reset 0x00000000	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Id	RW	Field	Value Id	Value	Description																											
A	R	AMOUNT		[1..0x3FF]	Number of bytes transferred in the last transaction. In case of NACK error, includes the NACK'ed byte.																											

### 6.23.7.17 TXD.LIST

Address offset: 0x550

EasyDMA list type

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0																															
Id																																			
Reset 0x00000000				0 0																															

### 6.23.7.18 ADDRESS

Address offset: 0x588

Address used in the TWI transfer

Bit number					31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0			
Id																													A					A	A	A	A	A	A
Reset 0x00000000					0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0		
Id	RW	Field	Value Id	Value	Description																																		
A	RW	ADDRESS			Address used in the TWI transfer																																		

## 6.23.8 Electrical specification

### 6.23.8.1 TWIM interface electrical specifications

Symbol	Description	Min.	Typ.	Max.	Units
$f_{TWIM,SCL}$	Bit rates for TWIM <sup>28</sup>	100		400	kbps
$t_{TWIM,START}$	Time from STARTRX/STARTTX task to transmission started	..	..	..	$\mu s$

### 6.23.8.2 Two Wire Interface Master (TWIM) timing specifications

Symbol	Description	Min.	Typ.	Max.	Units
$t_{TWIM,SU\_DAT}$	Data setup time before positive edge on SCL – all modes	300			ns
$t_{TWIM,HD\_DAT}$	Data hold time after negative edge on SCL – all modes	500			ns
$t_{TWIM,HD\_STA,100kbps}$	TWIM master hold time for START and repeated START condition, 100 kbps	10000			ns
$t_{TWIM,HD\_STA,250kbps}$	TWIM master hold time for START and repeated START condition, 250kbps	4000			ns
$t_{TWIM,HD\_STA,400kbps}$	TWIM master hold time for START and repeated START condition, 400 kbps	2500			ns
$t_{TWIM,SU\_STO,100kbps}$	TWIM master setup time from SCL high to STOP condition, 100 kbps	5000			ns
$t_{TWIM,SU\_STO,250kbps}$	TWIM master setup time from SCL high to STOP condition, 250 kbps	2000			ns
$t_{TWIM,SU\_STO,400kbps}$	TWIM master setup time from SCL high to STOP condition, 400 kbps	1250			ns
$t_{TWIM,BUF,100kbps}$	TWIM master bus free time between STOP and START conditions, 100 kbps	5800			ns
$t_{TWIM,BUF,250kbps}$	TWIM master bus free time between STOP and START conditions, 250 kbps	2700			ns
$t_{TWIM,BUF,400kbps}$	TWIM master bus free time between STOP and START conditions, 400 kbps	2100			ns

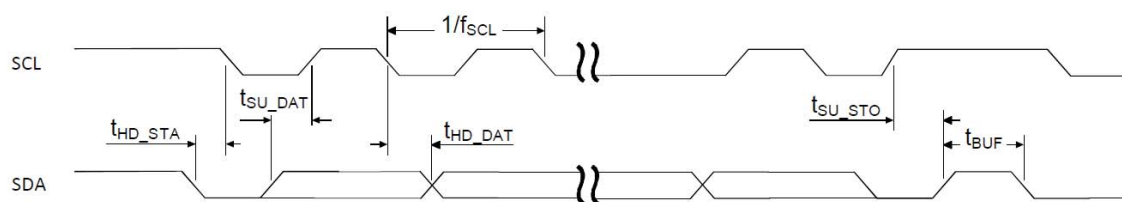


Figure 112: TWIM timing diagram, 1 byte transaction

<sup>28</sup> High bit rates or stronger pull-ups may require GPIOs to be set as High Drive, see GPIO chapter for more details.



### 6.23.9 Pullup resistor

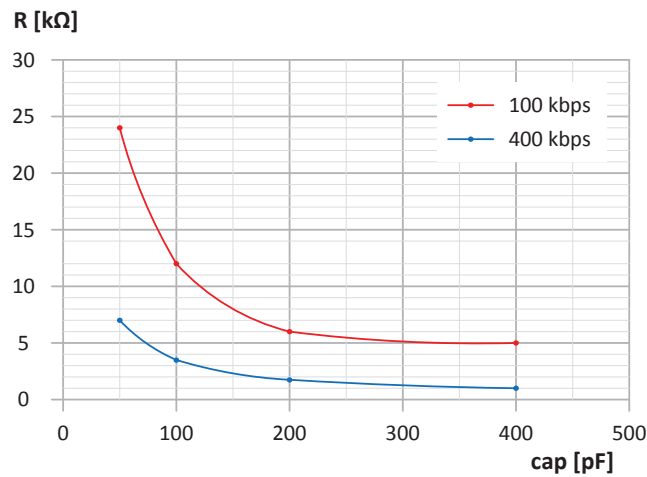


Figure 113: Recommended TWIM pullup value vs. line capacitance

- The I2C specification allows a line capacitance of 400 pF at most.
- The value of internal pullup resistor ( $R_{PU}$ ) for nRF52810 can be found in [GPIO — General purpose input/output](#) on page 137.

## 6.24 TWIS — I<sup>2</sup>C compatible two-wire interface slave with EasyDMA

TWI slave with EasyDMA (TWIS) is compatible with I<sup>2</sup>C operating at 100 kHz and 400 kHz. The TWI transmitter and receiver implement EasyDMA.

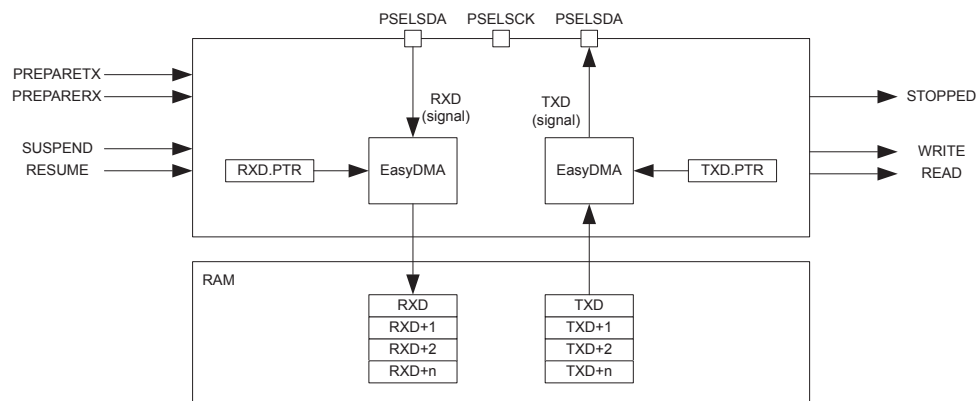


Figure 114: TWI slave with EasyDMA

A typical TWI setup consists of one master and one or more slaves. For an example, see [A typical TWI setup comprising one master and three slaves](#) on page 426. TWIS is only able to operate with a single master on the TWI bus.

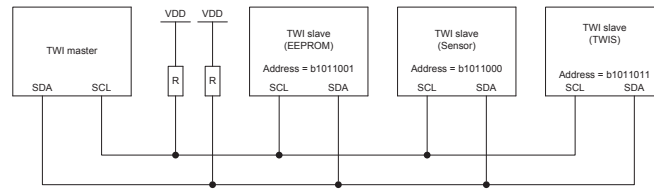


Figure 115: A typical TWI setup comprising one master and three slaves

The TWI slave state machine is illustrated in [TWI slave state machine](#) on page 426 and [TWI slave state machine symbols](#) on page 427 is explaining the different symbols used in the state machine.

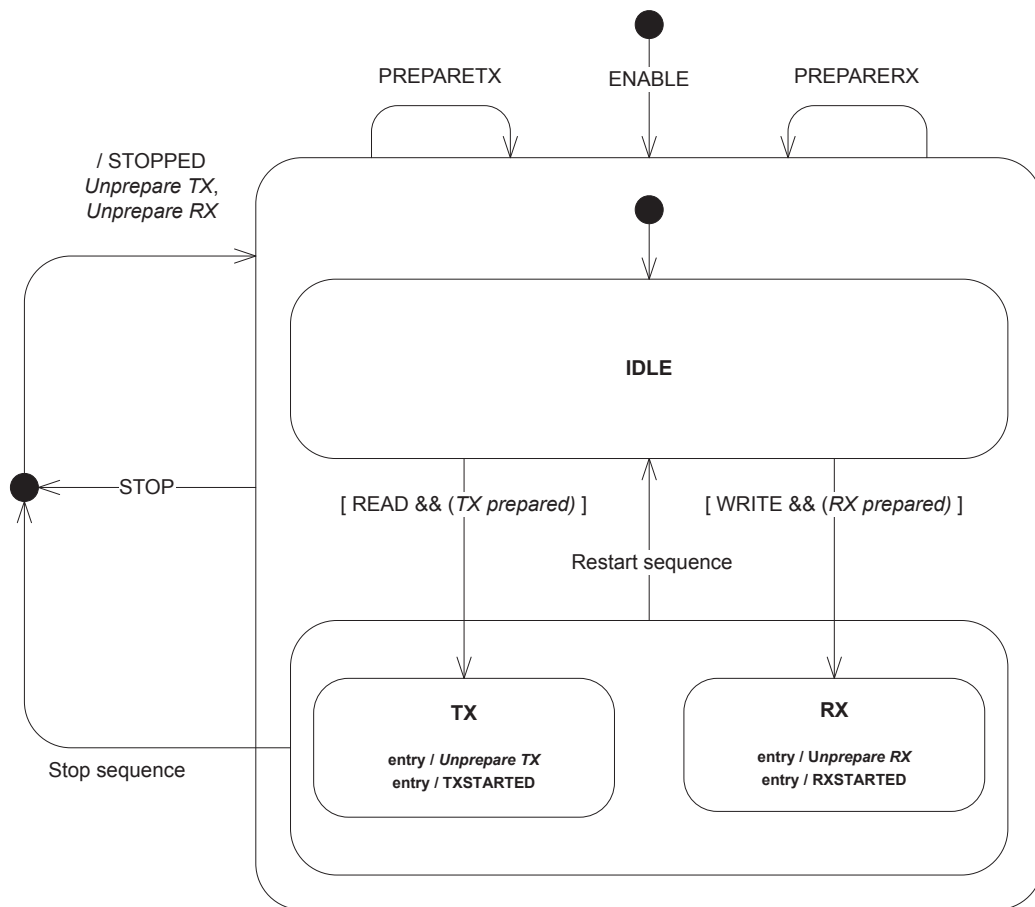


Figure 116: TWI slave state machine

Symbol	Type	Description
ENABLE	Register	The TWI slave has been enabled via the <code>ENABLE</code> register
PREPARETX	Task	The <code>TASKS_PREPARETX</code> task has been triggered
STOP	Task	The <code>TASKS_STOP</code> task has been triggered
PREPARERX	Task	The <code>TASKS_PREPARERX</code> task has been triggered
STOPPED	Event	The <code>EVENTS_STOPPED</code> event was generated
RXSTARTED	Event	The <code>EVENTS_RXSTARTED</code> event was generated
TXSTARTED	Event	The <code>EVENTS_TXSTARTED</code> event was generated
TX prepared	Internal	Internal flag indicating that a <code>TASKS_PREPARETX</code> task has been triggered. This flag is not visible to the user.
RX prepared	Internal	Internal flag indicating that a <code>TASKS_PREPARERX</code> task has been triggered. This flag is not visible to the user.
Unprepare TX	Internal	Clears the internal 'TX prepared' flag until next <code>TASKS_PREPARETX</code> task.
Unprepare RX	Internal	Clears the internal 'RX prepared' flag until next <code>TASKS_PREPARERX</code> task.
Stop sequence	TWI protocol	A TWI stop sequence was detected
Restart sequence	TWI protocol	A TWI restart sequence was detected

Table 89: TWI slave state machine symbols

The TWI slave supports clock stretching performed by the master.

The TWI slave operates in a low power mode while waiting for a TWI master to initiate a transfer. As long as the TWI slave is not addressed, it will remain in this low power mode.

To secure correct behaviour of the TWI slave, `PSEL.SCL`, `PSEL.SDA`, `CONFIG` and the `ADDRESS[n]` registers, must be configured prior to enabling the TWI slave through the `ENABLE` register. Similarly, changing these settings must be performed while the TWI slave is disabled. Failing to do so may result in unpredictable behaviour.

### 6.24.1 EasyDMA

The TWI slave implements EasyDMA for reading and writing to and from the RAM.

The `STOPPED` event indicates that EasyDMA has finished accessing the buffer in RAM.

If the `TXD.PTR` and the `RXD.PTR` are not pointing to the Data RAM region, an EasyDMA transfer may result in a `HardFault` or RAM corruption. See [Memory](#) on page 15 for more information about the different memory regions.

### 6.24.2 TWI slave responding to a read command

Before the TWI slave can respond to a read command the TWI slave must be configured correctly and enabled via the `ENABLE` register. When enabled the TWI slave will be in its `IDLE` state where it will consume `I_IDLE`.

A read command is started when the TWI master generates a start condition on the TWI bus, followed by clocking out the address and the `READ/WRITE` bit set to 1 (`WRITE=0`, `READ=1`). The `READ/WRITE` bit is followed by an `ACK/NACK` bit (`ACK=0` or `NACK=1`) response from the TWI slave.

The TWI slave is able to listen for up to two addresses at the same time. Which addresses to listen for is configured in the `ADDRESS` registers and the `CONFIG` register.

The TWI slave will only acknowledge (`ACK`) the read command if the address presented by the master matches one of the addresses the slave is configured to listen for. The TWI slave will generate a `READ` event when it acknowledges the read command.

The TWI slave is only able to detect a read command from the `IDLE` state.

The TWI slave will set an internal 'TX prepared' flag when the `PREPARETX` task is triggered.

When the read command is received the TWI slave will enter the TX state if the internal 'TX prepared' flag is set.

If the internal 'TX prepared' flag is not set when the read command is received, the TWI slave will stretch the master's clock until the PREPARETX task is triggered and the internal 'TX prepared' flag is set.

The TWI slave will generate the TXSTARTED event and clear the 'TX prepared' flag ('unprepare TX') when it enters the TX state. In this state the TWI slave will send the data bytes found in the transmit buffer to the master using the master's clock. The TWI slave will consume  $I_{TX}$  in this mode.

The TWI slave will go back to the IDLE state if the TWI slave receives a restart command when it is in the TX state.

The TWI slave is stopped when it receives the stop condition from the TWI master. A STOPPED event will be generated when the transaction has stopped. The TWI slave will clear the 'TX prepared' flag ('unprepare TX') and go back to the IDLE state when it has stopped.

The transmit buffer is located in RAM at the address specified in the TXD.PTR register. The TWI slave will only be able to send TXD.MAXCNT bytes from the transmit buffer for each transaction. If the TWI master forces the slave to send more than TXD.MAXCNT bytes, the slave will send the byte specified in the ORC register to the master instead. If this happens, an ERROR event will be generated.

The EasyDMA configuration registers, see TXD.PTR etc., are latched when the TXSTARTED event is generated.

The TWI slave can be forced to stop by triggering the STOP task. A STOPPED event will be generated when the TWI slave has stopped. The TWI slave will clear the 'TX prepared' flag and go back to the IDLE state when it has stopped, see also [Terminating an ongoing TWI transaction](#) on page 430.

Each byte sent from the slave will be followed by an ACK/NACK bit sent from the master. The TWI master will generate a NACK following the last byte that it wants to receive to tell the slave to release the bus so that the TWI master can generate the stop condition. The TXD.AMOUNT register can be queried after a transaction to see how many bytes were sent.

A typical TWI slave read command response is illustrated in [The TWI slave responding to a read command](#) on page 428. Occurrence 2 in the figure illustrates clock stretching performed by the TWI slave following a SUSPEND task.

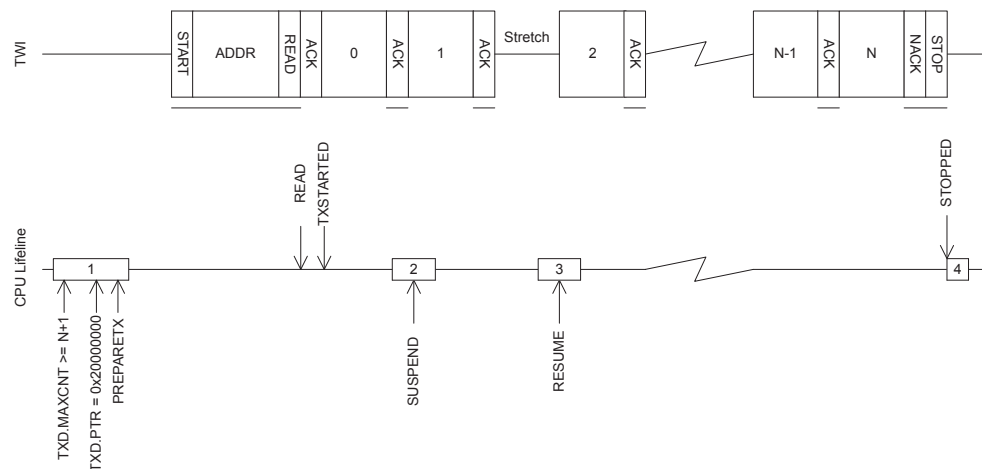


Figure 117: The TWI slave responding to a read command

### 6.24.3 TWI slave responding to a write command

Before the TWI slave can respond to a write command the TWI slave must be configured correctly and enabled via the ENABLE register. When enabled the TWI slave will be in its IDLE state where it will consume  $I_{IDLE}$ .

A write command is started when the TWI master generates a start condition on the TWI bus, followed by clocking out the address and the READ/WRITE bit set to 0 (WRITE=0, READ=1). The READ/WRITE bit is followed by an ACK/NACK bit (ACK=0 or NACK=1) response from the slave.

The TWI slave is able to listen for up to two addresses at the same time. Which addresses to listen for is configured in the ADDRESS registers and the CONFIG register.

The TWI slave will only acknowledge (ACK) the write command if the address presented by the master matches one of the addresses the slave is configured to listen for. The TWI slave will generate a WRITE event if it acknowledges the write command.

The TWI slave is only able to detect a write command from the IDLE state.

The TWI slave will set an internal 'RX prepared' flag when the PREPARERX task is triggered.

When the write command is received the TWI slave will enter the RX state if the internal 'RX prepared' flag is set.

If the internal 'RX prepared' flag is not set when the write command is received, the TWI slave will stretch the master's clock until the PREPARERX task is triggered and the internal 'RX prepared' flag is set.

The TWI slave will generate the RXSTARTED event and clear the internal 'RX prepared' flag ('unprepare RX') when it enters the RX state. In this state the TWI slave will be able to receive the bytes sent by the TWI master. The TWI slave will consume I<sub>RX</sub> in this mode.

The TWI slave will go back to the IDLE state if the TWI slave receives a restart command when it is in the RX state.

The TWI slave is stopped when it receives the stop condition from the TWI master. A STOPPED event will be generated when the transaction has stopped. The TWI slave will clear the internal 'RX prepared' flag ('unprepare RX') and go back to the IDLE state when it has stopped.

The receive buffer is located in RAM at the address specified in the TXD.PTR register. The TWI slave will only be able to receive as many bytes as specified in the RXD.MAXCNT register. If the TWI master tries to send more bytes to the slave than the slave is able to receive, these bytes will be discarded and the bytes will be NACKed by the slave. If this happens, an ERROR event will be generated.

The EasyDMA configuration registers, see RXD.PTR etc., are latched when the RXSTARTED event is generated.

The TWI slave can be forced to stop by triggering the STOP task. A STOPPED event will be generated when the TWI slave has stopped. The TWI slave will clear the internal 'RX prepared' flag and go back to the IDLE state when it has stopped, see also [Terminating an ongoing TWI transaction](#) on page 430.

The TWI slave will generate an ACK after every byte received from the master. The RXD.AMOUNT register can be queried after a transaction to see how many bytes were received.

A typical TWI slave write command response is illustrated in [The TWI slave responding to a write command](#) on page 430. Occurrence 2 in the figure illustrates clock stretching performed by the TWI slave following a SUSPEND task.

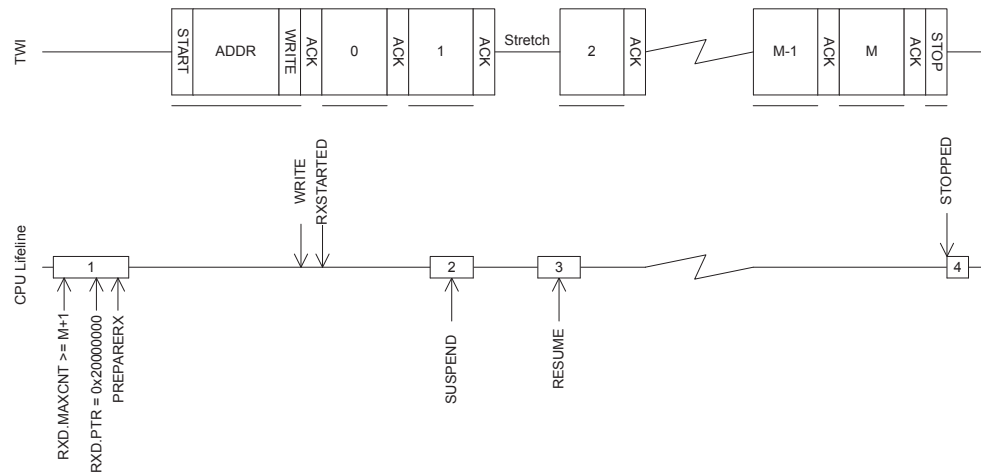


Figure 118: The TWI slave responding to a write command

### 6.24.4 Master repeated start sequence

An example of a repeated start sequence is one in which the TWI master writes two bytes to the slave followed by reading four bytes from the slave.

This is illustrated in [A repeated start sequence, where the TWI master writes two bytes followed by reading four bytes from the slave](#) on page 430.

It is here assumed that the receiver does not know in advance what the master wants to read, and that this information is provided in the first two bytes received in the write part of the repeated start sequence. To guarantee that the CPU is able to process the received data before the TWI slave starts to reply to the read command, the SUSPEND task is triggered via a shortcut from the READ event generated when the read command is received. When the CPU has processed the incoming data and prepared the correct data response, the CPU will resume the transaction by triggering the RESUME task.

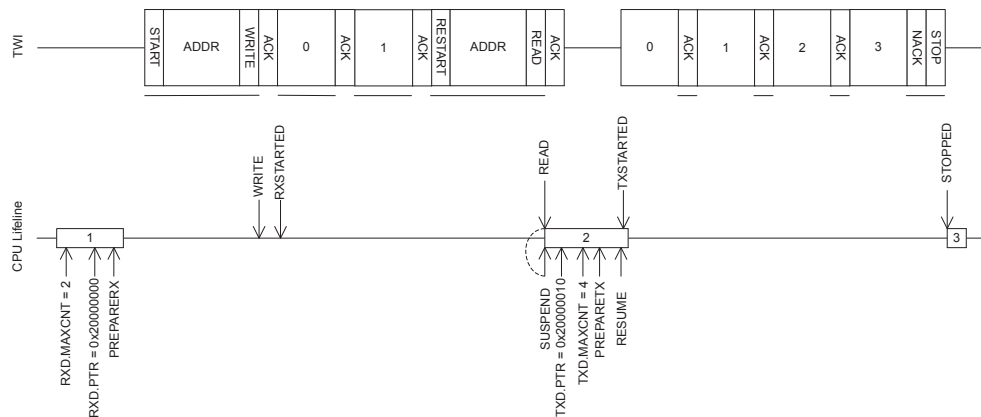


Figure 119: A repeated start sequence, where the TWI master writes two bytes followed by reading four bytes from the slave

### 6.24.5 Terminating an ongoing TWI transaction

In some situations, e.g. if the external TWI master is not responding correctly, it may be required to terminate an ongoing transaction.

This can be achieved by triggering the STOP task. In this situation a STOPPED event will be generated when the TWI has stopped independent of whether or not a STOP condition has been generated on the TWI bus. The TWI slave will release the bus when it has stopped and go back to its IDLE state.

## 6.24.6 Low power

When putting the system in low power and the peripheral is not needed, lowest possible power consumption is achieved by stopping, and then disabling the peripheral.

The STOP task may not be always needed (the peripheral might already be stopped), but if it is sent, software shall wait until the STOPPED event was received as a response before disabling the peripheral through the ENABLE register.

## 6.24.7 Slave mode pin configuration

The SCL and SDA signals associated with the TWI slave are mapped to physical pins according to the configuration specified in the PSEL.SCL and PSEL.SDA registers respectively.

The PSEL.SCL and PSEL.SDA registers and their configurations are only used as long as the TWI slave is enabled, and retained only as long as the device is in ON mode. When the peripheral is disabled, the pins will behave as regular GPIOs, and use the configuration in their respective OUT bit field and PIN\_CNF[n] register. PSEL.SCL and PSEL.SDA must only be configured when the TWI slave is disabled.

To secure correct signal levels on the pins used by the TWI slave when the system is in OFF mode, and when the TWI slave is disabled, these pins must be configured in the GPIO peripheral as described in [GPIO configuration before enabling peripheral](#) on page 431.

Only one peripheral can be assigned to drive a particular GPIO pin at a time. Failing to do so may result in unpredictable behavior.

TWI slave signal	TWI slave pin	Direction	Output value	Drive strength
SCL	As specified in PSEL.SCL	Input	Not applicable	S0D1
SDA	As specified in PSEL.SDA	Input	Not applicable	S0D1

Table 90: GPIO configuration before enabling peripheral

## 6.24.8 Registers

Base address	Peripheral	Instance	Description	Configuration
0x40003000	TWIS	TWIS0	Two-wire interface slave	

Table 91: Instances

Register	Offset	Description
TASKS_STOP	0x014	Stop TWI transaction
TASKS_SUSPEND	0x01C	Suspend TWI transaction
TASKS_RESUME	0x020	Resume TWI transaction
TASKS_PREPARERX	0x030	Prepare the TWI slave to respond to a write command
TASKS_PREPARETX	0x034	Prepare the TWI slave to respond to a read command
EVENTS_STOPPED	0x104	TWI stopped
EVENTS_ERROR	0x124	TWI error
EVENTS_RXSTARTED	0x14C	Receive sequence started
EVENTS_TXSTARTED	0x150	Transmit sequence started
EVENTS_WRITE	0x164	Write command received
EVENTS_READ	0x168	Read command received
SHORTS	0x200	Shortcut register
INTEN	0x300	Enable or disable interrupt
INTENSET	0x304	Enable interrupt
INTENCLR	0x308	Disable interrupt
ERRORSRC	0x4D0	Error source

Register	Offset	Description
MATCH	0x4D4	Status register indicating which address had a match
ENABLE	0x500	Enable TWIS
PSEL.SCL	0x508	Pin select for SCL signal
PSEL.SDA	0x50C	Pin select for SDA signal
RXD.PTR	0x534	RXD Data pointer
RXD.MAXCNT	0x538	Maximum number of bytes in RXD buffer
RXD.AMOUNT	0x53C	Number of bytes transferred in the last RXD transaction
TXD.PTR	0x544	TXD Data pointer
TXD.MAXCNT	0x548	Maximum number of bytes in TXD buffer
TXD.AMOUNT	0x54C	Number of bytes transferred in the last TXD transaction
ADDRESS[0]	0x588	TWI slave address 0
ADDRESS[1]	0x58C	TWI slave address 1
CONFIG	0x594	Configuration register for the address match mechanism
ORC	0x5C0	Over-read character. Character sent out in case of an over-read of the transmit buffer.

Table 92: Register Overview

### 6.24.8.1 SHORTS

Address offset: 0x200

Shortcut register

Bit number					31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0																															
Id																					B		A													
Reset 0x00000000					0 0																															

### 6.24.8.2 INTEN

Address offset: 0x300

Enable or disable interrupt

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0																																			
Id												H		G				F		E						B												A	
Reset 0x00000000				0 0																																			



Address offset: 0x304

Bit number																																			
Id				H G								F E								B								A							
Reset 0x00000000				0 0																															
Id	RW	Field	Value Id	Value	Description																														
A	RW	STOPPED			Write '1' to Enable interrupt for STOPPED event  See <a href="#">EVENTS_STOPPED</a>  Set 1 Enable Disabled 0 Read: Disabled Enabled 1 Read: Enabled																														
B	RW	ERROR			Write '1' to Enable interrupt for ERROR event  See <a href="#">EVENTS_ERROR</a>  Set 1 Enable Disabled 0 Read: Disabled Enabled 1 Read: Enabled																														
E	RW	RXSTARTED			Write '1' to Enable interrupt for RXSTARTED event  See <a href="#">EVENTS_RXSTARTED</a>  Set 1 Enable Disabled 0 Read: Disabled Enabled 1 Read: Enabled																														
F	RW	TXSTARTED			Write '1' to Enable interrupt for TXSTARTED event  See <a href="#">EVENTS_TXSTARTED</a>  Set 1 Enable Disabled 0 Read: Disabled Enabled 1 Read: Enabled																														

Bit number			31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0																															
Id			H G								F E								B								A							
Reset 0x00000000			0 0																															
Id	RW	Field	Value Id	Value	Description																													
G	RW	WRITE			Write '1' to Enable interrupt for WRITE event																													
					See <a href="#">EVENTS_WRITE</a>																													
			Set	1	Enable																													
			Disabled	0	Read: Disabled																													
			Enabled	1	Read: Enabled																													
H	RW	READ			Write '1' to Enable interrupt for READ event																													
					See <a href="#">EVENTS_READ</a>																													
			Set	1	Enable																													
			Disabled	0	Read: Disabled																													
			Enabled	1	Read: Enabled																													

### 6.24.8.4 INTENCLR

Address offset: 0x308

Disable interrupt

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0																															
Id				H G								F E								B								A							
Reset 0x00000000				0 0																															
Id	RW	Field	Value Id	Value	Description																														
A	RW	STOPPED			Write '1' to Disable interrupt for STOPPED event																														
					See <a href="#">EVENTS_STOPPED</a>																														
			Clear	1	Disable																														
			Disabled	0	Read: Disabled																														
			Enabled	1	Read: Enabled																														
B	RW	ERROR			Write '1' to Disable interrupt for ERROR event																														
					See <a href="#">EVENTS_ERROR</a>																														
			Clear	1	Disable																														
			Disabled	0	Read: Disabled																														
			Enabled	1	Read: Enabled																														
E	RW	RXSTARTED			Write '1' to Disable interrupt for RXSTARTED event																														
					See <a href="#">EVENTS_RXSTARTED</a>																														
			Clear	1	Disable																														
			Disabled	0	Read: Disabled																														
			Enabled	1	Read: Enabled																														
F	RW	TXSTARTED			Write '1' to Disable interrupt for TXSTARTED event																														
					See <a href="#">EVENTS_TXSTARTED</a>																														
			Clear	1	Disable																														
			Disabled	0	Read: Disabled																														
			Enabled	1	Read: Enabled																														
G	RW	WRITE			Write '1' to Disable interrupt for WRITE event																														
					See <a href="#">EVENTS_WRITE</a>																														
			Clear	1	Disable																														
			Disabled	0	Read: Disabled																														
			Enabled	1	Read: Enabled																														
H	RW	READ			Write '1' to Disable interrupt for READ event																														
					See <a href="#">EVENTS_READ</a>																														

Bit number				31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0				
Id				H								G				F								E				B								A			
Reset 0x00000000				0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0			
Id	RW	Field	Value Id	Value	Description																																		
			Clear	1	Disable																																		
			Disabled	0	Read: Disabled																																		
			Enabled	1	Read: Enabled																																		

### 6.24.8.5 ERRORSRC

Address offset: 0x4D0

Error source

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0																															
Id				C B A																															
Reset 0x00000000				0 0																															
Id	RW	Field	Value Id	Value	Description																														
A	RW	OVERFLOW			RX buffer overflow detected, and prevented																														
			NotDetected	0	Error did not occur																														
			Detected	1	Error occurred																														
B	RW	DNACK			NACK sent after receiving a data byte																														
			NotReceived	0	Error did not occur																														
			Received	1	Error occurred																														
C	RW	OVERREAD			TX buffer over-read detected, and prevented																														
			NotDetected	0	Error did not occur																														
			Detected	1	Error occurred																														

### 6.24.8.6 MATCH

Address offset: 0x4D4

Status register indicating which address had a match

Bit number				31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0	
Id																																				A
Reset 0x00000000				0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Id	RW	Field	Value Id	Value				Description																												
A	R	MATCH		[0..1]				Which of the addresses in {ADDRESS} matched the incoming address																												

### 6.24.8.7 ENABLE

Address offset: 0x500

Enable TWIS

Bit number				31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0				
Id																																				A	A	A	A
Reset 0x00000000				0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0			
Id	RW	Field	Value Id	Value				Description																															
A	RW	ENABLE						Enable or disable TWIS																															
			Disabled	0				Disable TWIS																															
			Enabled	9				Enable TWIS																															

### 6.24.8.8 PSEL.SCL

Address offset: 0x508

Pin select for SCL signal

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0																															
Id				C																															
Reset 0xFFFFFFFF				1 1																															
Id	RW	Field	Value Id	Value				Description																											
A	RW	PIN		[0..31]				Pin number																											
C	RW	CONNECT						Connection																											
			Disconnected	1				Disconnect																											
			Connected	0				Connect																											

### 6.24.8.9 PSEL.SDA

Address offset: 0x50C

Pin select for SDA signal

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0																															
Id				C																															
Reset 0xFFFFFFFF				1 1																															
Id	RW	Field	Value Id	Value				Description																											
A	RW	PIN		[0..31]				Pin number																											
C	RW	CONNECT						Connection																											
			Disconnected	1				Disconnect																											
			Connected	0				Connect																											

### 6.24.8.10 RXD.PTR

Address offset: 0x534

RXD Data pointer

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0																															
Id				A A																															
Reset 0x00000000				0 0																															
Id	RW	Field	Value Id	Value		Description																													
A	RW	PTR				RXD Data pointer																													

### 6.24.8.11 RXD.MAXCNT

Address offset: 0x538

Maximum number of bytes in RXD buffer

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0																															
Id				A A																															
Reset 0x00000000				0 0																															
Id	RW	Field	Value Id	Value				Description																											
A	RW	MAXCNT		[1..0x3FF]				Maximum number of bytes in RXD buffer																											

### 6.24.8.12 RXD.AMOUNT

Address offset: 0x53C

Number of bytes transferred in the last RXD transaction

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0																															
Id				A A A A A A A A																															
Reset 0x00000000				0 0																															
Id	RW	Field	Value Id	Value	Description																														
A	R	AMOUNT		[1..0x3FF]	Number of bytes transferred in the last RXD transaction																														

### 6.24.8.13 TXD.PTR

Address offset: 0x544

TXD Data pointer

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0																															
Id				A A																															
Reset 0x00000000				0 0																															
Id	RW	Field	Value Id	Value	Description																														
A	RW	PTR			TXD Data pointer																														

### 6.24.8.14 TXD.MAXCNT

Address offset: 0x548

Maximum number of bytes in TXD buffer

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0																															
Id				A A																															
Reset 0x00000000				0 0																															
Id	RW	Field	Value Id	Value	Description																														
A	RW	MAXCNT		[1..0x3FF]	Maximum number of bytes in TXD buffer																														

### 6.24.8.15 TXD.AMOUNT

Address offset: 0x54C

Number of bytes transferred in the last TXD transaction

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																															
Id																																				A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A

### 6.24.8.16 ADDRESS[0]

Address offset: 0x588

TWI slave address 0

Bit number					31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0	
Id																													A	A	A	A	A	A	A	A	A
Reset 0x00000000					0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Id	RW	Field	Value	Id	Value		Description																														
A	RW	ADDRESS					TWI slave address																														

### 6.24.8.17 ADDRESS[1]

Address offset: 0x58C

TWI slave address 1

Bit number					31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0	
Id																													A	A	A	A	A	A	A	A	A
Reset 0x00000000					0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Id	RW	Field	Value	Id	Value		Description																														
A	RW	ADDRESS					TWI slave address																														

### 6.24.8.18 CONFIG

Address offset: 0x594

Configuration register for the address match mechanism

Bit number	31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
Id																															B	A
Reset 0x00000001	0 1																															1
Id	RW	Field	Value	Id	Value	Description																										
A	RW	ADDRESS0				Enable or disable address matching on ADDRESS[0]																										
			Disabled		0	Disabled																										
			Enabled		1	Enabled																										
B	RW	ADDRESS1				Enable or disable address matching on ADDRESS[1]																										
			Disabled		0	Disabled																										
			Enabled		1	Enabled																										

### 6.24.8.19 ORC

Address offset: 0x5C0

Over-read character. Character sent out in case of an over-read of the transmit buffer.

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0																															
Id				A A A A A A A A																															
Reset 0x00000000				0 0																															
Id	RW	Field	Value	Id	Value	Description																													
A	RW	ORC				Over-read character. Character sent out in case of an over-read of the transmit buffer.																													

## 6.24.9 Electrical specification

### 6.24.9.1 TWIS slave timing specifications

Symbol	Description	Min.	Typ.	Max.	Units
$f_{\text{TWIS,SCL}}$	Bit rates for TWIS <sup>29</sup>	100		400	kbps
$t_{\text{TWIS,START}}$	Time from PREPARERX/PREPARETX task to ready to receive/transmit		1.5		$\mu\text{s}$
$t_{\text{TWIS,SU\_DAT}}$	Data setup time before positive edge on SCL – all modes	300			ns
$t_{\text{TWIS,HD\_DAT}}$	Data hold time after negative edge on SCL – all modes	500			ns
$t_{\text{TWIS,HD\_STA,100kbps}}$	TWI slave hold time from for START condition (SDA low to SCL low), 100 kbps	5200			ns
$t_{\text{TWIS,HD\_STA,400kbps}}$	TWI slave hold time from for START condition (SDA low to SCL low), 400 kbps	1300			ns
$t_{\text{TWIS,SU\_STO,100kbps}}$	TWI slave setup time from SCL high to STOP condition, 100 kbps	5200			ns
$t_{\text{TWIS,SU\_STO,400kbps}}$	TWI slave setup time from SCL high to STOP condition, 400 kbps	1300			ns
$t_{\text{TWIS,BUF,100kbps}}$	TWI slave bus free time between STOP and START conditions, 100 kbps		4700		ns
$t_{\text{TWIS,BUF,400kbps}}$	TWI slave bus free time between STOP and START conditions, 400 kbps		1300		ns

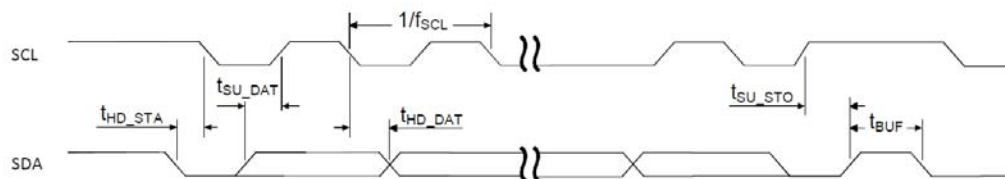


Figure 120: TWIS timing diagram, 1 byte transaction

## 6.25 UARTE — Universal asynchronous receiver/transmitter with EasyDMA

The Universal asynchronous receiver/transmitter with EasyDMA (UARTE) offers fast, full-duplex, asynchronous serial communication with built-in flow control (CTS, RTS) support in hardware at a rate up to 1 Mbps, and EasyDMA data transfer from/to RAM.

Listed here are the main features for UARTE:

- Full-duplex operation
- Automatic hardware flow control
- Optional even parity bit checking and generation
- EasyDMA
- Up to 1 Mbps baudrate
- Return to IDLE between transactions supported (when using HW flow control)
- One or two stop bit

<sup>29</sup> High bit rates or stronger pull-ups may require GPIOs to be set as High Drive, see GPIO chapter for more details.

- Least significant bit (LSB) first

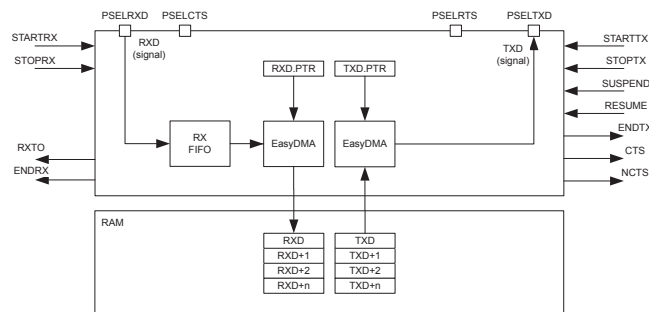


Figure 121: UARTE configuration

The GPIOs used for each UART interface can be chosen from any GPIO on the device and are independently configurable. This enables great flexibility in device pinout and efficient use of board space and signal routing.

### 6.25.1 EasyDMA

The UARTE implements EasyDMA for reading and writing to and from the RAM.

If the TXD.PTR and the RXD.PTR are not pointing to the Data RAM region, an EasyDMA transfer may result in a HardFault or RAM corruption. See [Memory](#) on page 15 for more information about the different memory regions.

The .PTR and .MAXCNT registers are double-buffered. They can be updated and prepared for the next RX/TX transmission immediately after having received the RXSTARTED/TXSTARTED event.

The ENDRX/ENDTX event indicates that EasyDMA has finished accessing respectively the RX/TX buffer in RAM.

### 6.25.2 Transmission

The first step of a DMA transmission is storing bytes in the transmit buffer and configuring EasyDMA. This is achieved by writing the initial address pointer to TXD.PTR, and the number of bytes in the RAM buffer to TXD.MAXCNT. The UARTE transmission is started by triggering the STARTTX task.

After each byte has been sent over the TXD line, a TXDRDY event will be generated.

When all bytes in the TXD buffer, as specified in the TXD.MAXCNT register, have been transmitted, the UARTE transmission will end automatically and an ENDTX event will be generated.

A UARTE transmission sequence is stopped by triggering the STOPTX task, a TXSTOPPED event will be generated when the UARTE transmitter has stopped.

If the ENDTX event has not already been generated when the UARTE transmitter has come to a stop, the UARTE will generate the ENDTX event explicitly even though all bytes in the TXD buffer, as specified in the TXD.MAXCNT register, have not been transmitted.

If flow control is enabled through the HWFC field in the CONFIG register, a transmission will be automatically suspended when CTS is deactivated and resumed when CTS is activated again, as illustrated in [UARTE transmission](#) on page 441. A byte that is in transmission when CTS is deactivated will be fully transmitted before the transmission is suspended.



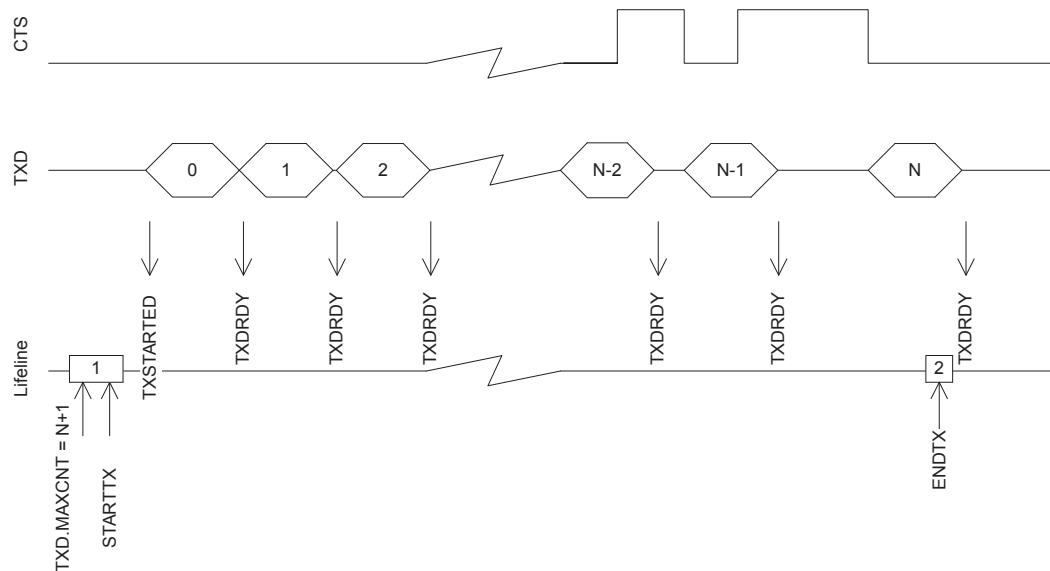


Figure 122: UARTe transmission

The UARTe transmitter will be in its lowest activity level, and consume the least amount of energy, when it is stopped, i.e. before it is started via STARTTX or after it has been stopped via STOPTH and the TXSTOPPED event has been generated. See [POWER — Power supply](#) on page 61 for more information about power modes.

### 6.25.3 Reception

The UARTe receiver is started by triggering the STARTRX task. The UARTe receiver is using EasyDMA to store incoming data in an RX buffer in RAM.

The RX buffer is located at the address specified in the RXD.PTR register. The RXD.PTR register is double-buffered and it can be updated and prepared for the next STARTRX task immediately after the RXSTARTED event is generated. The size of the RX buffer is specified in the RXD.MAXCNT register and the UARTe will generate an ENDRX event when it has filled up the RX buffer, see [UARTe reception](#) on page 442.

For each byte received over the RXD line, an RXDRDY event will be generated. This event is likely to occur before the corresponding data has been transferred to Data RAM.

The RXD.AMOUNT register can be queried following an ENDRX event to see how many new bytes have been transferred to the RX buffer in RAM since the previous ENDRX event.

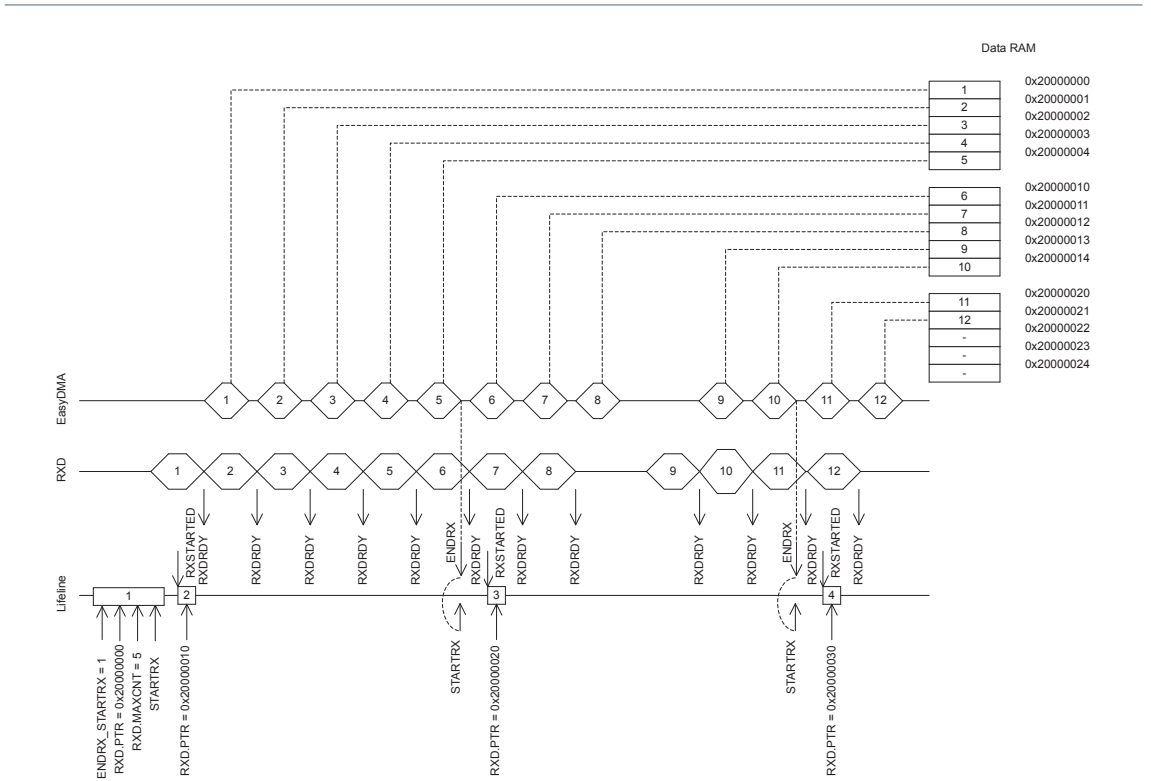


Figure 123: UARTE reception

The UARTE receiver is stopped by triggering the STOPRX task. An RXTO event is generated when the UARTE has stopped. The UARTE will make sure that an impending ENDRX event will be generated before the RXTO event is generated. This means that the UARTE will guarantee that no ENDRX event will be generated after RXTO, unless the UARTE is restarted or a FLUSHRX command is issued after the RXTO event is generated.

**Important:** If the ENDRX event has not already been generated when the UARTE receiver has come to a stop, which implies that all pending content in the RX FIFO has been moved to the RX buffer, the UARTE will generate the ENDRX event explicitly even though the RX buffer is not full. In this scenario the ENDRX event will be generated before the RXTO event is generated.

To be able to know how many bytes have actually been received into the RX buffer, the CPU can read the RXD.AMOUNT register following the ENDRX event or the RXTO event.

The UARTE is able to receive up to four bytes after the STOPRX task has been triggered as long as these are sent in succession immediately after the RTS signal is deactivated. This is possible because after the RTS is deactivated the UARTE is able to receive bytes for an extended period equal to the time it takes to send 4 bytes on the configured baud rate.

After the RXTX event is generated the internal RX FIFO may still contain data, and to move this data to RAM the FLUSHRX task must be triggered. To make sure that this data does not overwrite data in the RX buffer, the RX buffer should be emptied or the RXD.PTR should be updated before the FLUSHRX task is triggered. To make sure that all data in the RX FIFO is moved to the RX buffer, the RXD.MAXCNT register must be set to  $RXD.MAXCNT > 4$ , see [UARTE reception with forced stop via STOPRX](#) on page 443. The UARTE will generate the ENDRX event after completing the FLUSHRX task even if the RX FIFO was empty or if the RX buffer does not get filled up. To be able to know how many bytes have actually been received into the RX buffer in this case, the CPU can read the RXD.AMOUNT register following the ENDRX event.

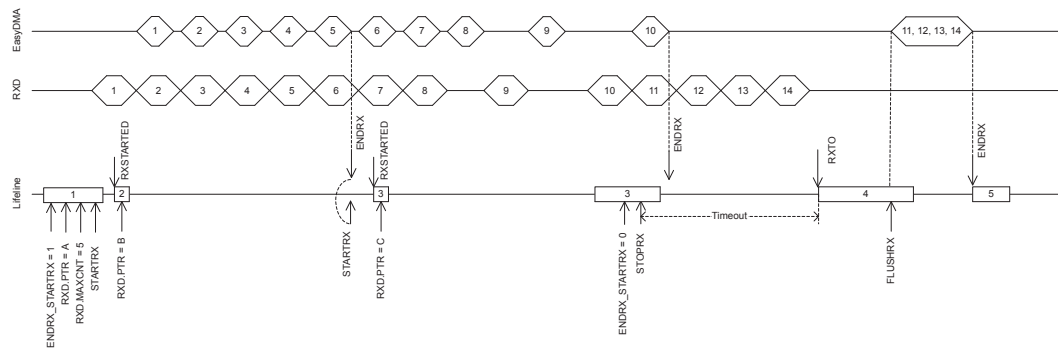


Figure 124: UARTE reception with forced stop via STOPRX

If HW flow control is enabled through the HWFC field in the CONFIG register, the RTS signal will be deactivated when the receiver is stopped via the STOPRX task or when the UARTE is only able to receive four more bytes in its internal RX FIFO.

With flow control disabled, the UARTE will function in the same way as when the flow control is enabled except that the RTS line will not be used. This means that no signal will be generated when the UARTE has reached the point where it is only able to receive four more bytes in its internal RX FIFO. Data received when the internal RX FIFO is filled up, will be lost.

The UARTE receiver will be in its lowest activity level, and consume the least amount of energy, when it is stopped, i.e. before it is started via STARTRX or after it has been stopped via STOPRX and the RXTD event has been generated. See [POWER — Power supply](#) on page 61 for more information about power modes.

### 6.25.4 Error conditions

An ERROR event, in the form of a framing error, will be generated if a valid stop bit is not detected in a frame. Another ERROR event, in the form of a break condition, will be generated if the RXD line is held active low for longer than the length of a data frame. Effectively, a framing error is always generated before a break condition occurs.

An ERROR event will not stop reception. If the error was a parity error, the received byte will still be transferred into Data RAM, and so will following incoming bytes. If there was a framing error (wrong stop bit), that specific byte will NOT be stored into Data RAM, but following incoming bytes will.

### 6.25.5 Using the UARTE without flow control

If flow control is not enabled, the interface will behave as if the CTS and RTS lines are kept active all the time.

### 6.25.6 Parity and stop bit configuration

When parity is enabled through the PARITY field in the CONFIG register, the parity will be generated automatically from the even parity of TXD and RXD for transmission and reception respectively.

The amount of stop bits can be configured through the STOP field in the CONFIG register.

### 6.25.7 Low power

When putting the system in low power and the peripheral is not needed, lowest possible power consumption is achieved by stopping, and then disabling the peripheral.

The STOPTH and STOPRX tasks may not be always needed (the peripheral might already be stopped), but if STOPTH and/or STOPRX is sent, software shall wait until the TXSTOPPED and/or RXTD event is received in response, before disabling the peripheral through the ENABLE register.

## 6.25.8 Pin configuration

The different signals RXD, CTS (Clear To Send, active low), RTS (Request To Send, active low), and TXD associated with the UARTE are mapped to physical pins according to the configuration specified in the PSEL.RXD, PSEL.CTS, PSEL.RTS, and PSEL.TXD registers respectively.

The PSEL.RXD, PSEL.CTS, PSEL.RTS, and PSEL.TXD registers and their configurations are only used as long as the UARTE is enabled, and retained only for the duration the device is in ON mode. PSEL.RXD, PSEL.RTS, PSEL.RTS and PSEL.TXD must only be configured when the UARTE is disabled.

To secure correct signal levels on the pins by the UARTE when the system is in OFF mode, the pins must be configured in the GPIO peripheral as described in [GPIO configuration before enabling peripheral](#) on page 444.

Only one peripheral can be assigned to drive a particular GPIO pin at a time. Failing to do so may result in unpredictable behavior.

UARTE signal	UARTE pin	Direction	Output value
RXD	As specified in PSEL.RXD	Input	Not applicable
CTS	As specified in PSEL.CTS	Input	Not applicable
RTS	As specified in PSEL.RTS	Output	1
TXD	As specified in PSEL.TXD	Output	1

Table 93: GPIO configuration before enabling peripheral

## 6.25.9 Registers

Base address	Peripheral	Instance	Description	Configuration
0x40002000	UARTE	UARTE0	Universal asynchronous receiver/transmitter with EasyDMA	

Table 94: Instances

Register	Offset	Description
TASKS_STARTRX	0x000	Start UART receiver
TASKS_STOPRX	0x004	Stop UART receiver
TASKS_STARTTX	0x008	Start UART transmitter
TASKS_STOPTX	0x00C	Stop UART transmitter
TASKS_FLUSHRX	0x02C	Flush RX FIFO into RX buffer
EVENTS_CTS	0x100	CTS is activated (set low). Clear To Send.
EVENTS_NCTS	0x104	CTS is deactivated (set high). Not Clear To Send.
EVENTS_RXDRDY	0x108	Data received in RXD (but potentially not yet transferred to Data RAM)
EVENTS_ENDRX	0x110	Receive buffer is filled up
EVENTS_TXDRDY	0x11C	Data sent from TXD
EVENTS_ENDTX	0x120	Last TX byte transmitted
EVENTS_ERROR	0x124	Error detected
EVENTS_RXTO	0x144	Receiver timeout
EVENTS_RXSTARTED	0x14C	UART receiver has started
EVENTS_TXSTARTED	0x150	UART transmitter has started
EVENTS_TXSTOPPED	0x158	Transmitter stopped
SHORTS	0x200	Shortcut register
INTEN	0x300	Enable or disable interrupt
INTENSET	0x304	Enable interrupt
INTENCLR	0x308	Disable interrupt

Register	Offset	Description
ERRORSRC	0x480	Error source
Note : this register is read / write one to clear.		
ENABLE	0x500	Enable UART
PSEL.RTS	0x508	Pin select for RTS signal
PSEL.TXD	0x50C	Pin select for TXD signal
PSEL.CTS	0x510	Pin select for CTS signal
PSEL.RXD	0x514	Pin select for RXD signal
BAUDRATE	0x524	Baud rate. Accuracy depends on the HFCLK source selected.
RXD.PTR	0x534	Data pointer
RXD.MAXCNT	0x538	Maximum number of bytes in receive buffer
RXD.AMOUNT	0x53C	Number of bytes transferred in the last transaction
TXD.PTR	0x544	Data pointer
TXD.MAXCNT	0x548	Maximum number of bytes in transmit buffer
TXD.AMOUNT	0x54C	Number of bytes transferred in the last transaction
CONFIG	0x56C	Configuration of parity and hardware flow control

Table 95: Register Overview

### 6.25.9.1 SHORTS

Address offset: 0x200

Shortcut register

Bit number					31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0																															
Id					D C																															
Reset 0x00000000					0 0																															
Id	RW	Field	Value Id	Value	Description																															
C	RW	ENDRX_STARTRX			Shortcut between ENDRX event and STARTRX task																															
					See <a href="#">EVENTS_ENDRX</a> and <a href="#">TASKS_STARTRX</a>																															
			Disabled	0	Disable shortcut																															
			Enabled	1	Enable shortcut																															
D	RW	ENDRX_STOPRX			Shortcut between ENDRX event and STOPRX task																															
					See <a href="#">EVENTS_ENDRX</a> and <a href="#">TASKS_STOPRX</a>																															
			Disabled	0	Disable shortcut																															
			Enabled	1	Enable shortcut																															

### 6.25.9.2 INTEN

Address offset: 0x300

Enable or disable interrupt

Bit number					31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0																															
Id					L J I H																G F E								D C B A							
Reset 0x00000000					0 0																															
Id	RW	Field	Value	Id	Value	Description																														
A	RW	CTS				Enable or disable interrupt for CTS event																														
						See <a href="#">EVENTS_CTS</a>																														
			Disabled	0		Disable																														
			Enabled	1		Enable																														

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0																															
Id				L J I H																G F E D C B A															
Reset 0x00000000				0 0																															
Id	RW	Field	Value Id	Value	Description																														
B	RW	NCTS			Enable or disable interrupt for NCTS event																														
					See <a href="#">EVENTS_NCTS</a>																														
			Disabled	0	Disable																														
			Enabled	1	Enable																														
C	RW	RXDRDY			Enable or disable interrupt for RXDRDY event																														
					See <a href="#">EVENTS_RXDRDY</a>																														
			Disabled	0	Disable																														
			Enabled	1	Enable																														
D	RW	ENDRX			Enable or disable interrupt for ENDRX event																														
					See <a href="#">EVENTS_ENDRX</a>																														
			Disabled	0	Disable																														
			Enabled	1	Enable																														
E	RW	TXDRDY			Enable or disable interrupt for TXDRDY event																														
					See <a href="#">EVENTS_TXDRDY</a>																														
			Disabled	0	Disable																														
			Enabled	1	Enable																														
F	RW	ENDTX			Enable or disable interrupt for ENDTX event																														
					See <a href="#">EVENTS_ENDTX</a>																														
			Disabled	0	Disable																														
			Enabled	1	Enable																														
G	RW	ERROR			Enable or disable interrupt for ERROR event																														
					See <a href="#">EVENTS_ERROR</a>																														
			Disabled	0	Disable																														
			Enabled	1	Enable																														
H	RW	RXTO			Enable or disable interrupt for RXTO event																														
					See <a href="#">EVENTS_RXTO</a>																														
			Disabled	0	Disable																														
			Enabled	1	Enable																														
I	RW	RXSTARTED			Enable or disable interrupt for RXSTARTED event																														
					See <a href="#">EVENTS_RXSTARTED</a>																														
			Disabled	0	Disable																														
			Enabled	1	Enable																														
J	RW	TXSTARTED			Enable or disable interrupt for TXSTARTED event																														
					See <a href="#">EVENTS_TXSTARTED</a>																														
			Disabled	0	Disable																														
			Enabled	1	Enable																														
L	RW	TXSTOPPED			Enable or disable interrupt for TXSTOPPED event																														
					See <a href="#">EVENTS_TXSTOPPED</a>																														
			Disabled	0	Disable																														
			Enabled	1	Enable																														

### 6.25.9.3 INTENSET

Address offset: 0x304

Enable interrupt

Bit number			31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0																															
Id			L J I H														G F E D C B A																	
Reset 0x00000000			0 0																															
Id	RW	Field	Value Id	Value	Description																													
A	RW	CTS			Write '1' to Enable interrupt for CTS event																													
					See <a href="#">EVENTS_CTS</a>																													
			Set	1	Enable																													
			Disabled	0	Read: Disabled																													
		Enabled	1	Read: Enabled																														
B	RW	NCTS			Write '1' to Enable interrupt for NCTS event																													
					See <a href="#">EVENTS_NCTS</a>																													
			Set	1	Enable																													
			Disabled	0	Read: Disabled																													
		Enabled	1	Read: Enabled																														
C	RW	RXDRDY			Write '1' to Enable interrupt for RXDRDY event																													
					See <a href="#">EVENTS_RXDRDY</a>																													
			Set	1	Enable																													
			Disabled	0	Read: Disabled																													
		Enabled	1	Read: Enabled																														
D	RW	ENDRX			Write '1' to Enable interrupt for ENDRX event																													
					See <a href="#">EVENTS_ENDRX</a>																													
			Set	1	Enable																													
			Disabled	0	Read: Disabled																													
		Enabled	1	Read: Enabled																														
E	RW	TXDRDY			Write '1' to Enable interrupt for TXDRDY event																													
					See <a href="#">EVENTS_TXDRDY</a>																													
			Set	1	Enable																													
			Disabled	0	Read: Disabled																													
		Enabled	1	Read: Enabled																														
F	RW	ENDTX			Write '1' to Enable interrupt for ENDTX event																													
					See <a href="#">EVENTS_ENDTX</a>																													
			Set	1	Enable																													
			Disabled	0	Read: Disabled																													
		Enabled	1	Read: Enabled																														
G	RW	ERROR			Write '1' to Enable interrupt for ERROR event																													
					See <a href="#">EVENTS_ERROR</a>																													
			Set	1	Enable																													
			Disabled	0	Read: Disabled																													
		Enabled	1	Read: Enabled																														
H	RW	RXTO			Write '1' to Enable interrupt for RXTO event																													
					See <a href="#">EVENTS_RXTO</a>																													
			Set	1	Enable																													
			Disabled	0	Read: Disabled																													
		Enabled	1	Read: Enabled																														
I	RW	RXSTARTED			Write '1' to Enable interrupt for RXSTARTED event																													
					See <a href="#">EVENTS_RXSTARTED</a>																													
			Set	1	Enable																													
			Disabled	0	Read: Disabled																													
		Enabled	1	Read: Enabled																														
J	RW	TXSTARTED			Write '1' to Enable interrupt for TXSTARTED event																													
					See <a href="#">EVENTS_TXSTARTED</a>																													

Bit number					31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0			
Id															L	J	I	H								G	F	E					D	C				B	A
Reset 0x00000000					0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0		
Id	RW	Field	Value	Id	Value	Description																																	
			Set		1	Enable																																	
			Disabled		0	Read: Disabled																																	
			Enabled		1	Read: Enabled																																	
L	RW	TXSTOPPED						Write '1' to Enable interrupt for TXSTOPPED event																															
							See <a href="#">EVENTS_TXSTOPPED</a>																																
			Set		1	Enable																																	
			Disabled		0	Read: Disabled																																	
			Enabled		1	Read: Enabled																																	

### 6.25.9.4 INTENCLR

Address offset: 0x308

Disable interrupt

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0																															
Id				L J I H																G F E D C B A															
Reset 0x00000000				0 0																															
Id	RW	Field	Value Id	Value	Description																														
A	RW	CTS			Write '1' to Disable interrupt for CTS event																														
					See <a href="#">EVENTS_CTS</a>																														
			Clear	1	Disable																														
			Disabled	0	Read: Disabled																														
			Enabled	1	Read: Enabled																														
B	RW	NCTS			Write '1' to Disable interrupt for NCTS event																														
					See <a href="#">EVENTS_NCTS</a>																														
			Clear	1	Disable																														
			Disabled	0	Read: Disabled																														
			Enabled	1	Read: Enabled																														
C	RW	RXDRDY			Write '1' to Disable interrupt for RXDRDY event																														
					See <a href="#">EVENTS_RXDRDY</a>																														
			Clear	1	Disable																														
			Disabled	0	Read: Disabled																														
			Enabled	1	Read: Enabled																														
D	RW	ENDRX			Write '1' to Disable interrupt for ENDRX event																														
					See <a href="#">EVENTS_ENDRX</a>																														
			Clear	1	Disable																														
			Disabled	0	Read: Disabled																														
			Enabled	1	Read: Enabled																														
E	RW	TXDRDY			Write '1' to Disable interrupt for TXDRDY event																														
					See <a href="#">EVENTS_TXDRDY</a>																														
			Clear	1	Disable																														
			Disabled	0	Read: Disabled																														
			Enabled	1	Read: Enabled																														
F	RW	ENDTX			Write '1' to Disable interrupt for ENDTX event																														
					See <a href="#">EVENTS_ENDTX</a>																														
			Clear	1	Disable																														
			Disabled	0	Read: Disabled																														



Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0																															
Id				L J I H																G F E D C B A															
Reset 0x00000000				0 0																															
Id	RW	Field	Value Id	Value	Description																														
G	RW	ERROR	Enabled	1	Read: Enabled																														
						Write '1' to Disable interrupt for ERROR event																													
						See <a href="#">EVENTS_ERROR</a>																													
			Clear	1	Disable																														
			Disabled	0	Read: Disabled																														
H	RW	RXTO	Enabled	1	Read: Enabled																														
						Write '1' to Disable interrupt for RXTO event																													
						See <a href="#">EVENTS_RXTO</a>																													
			Clear	1	Disable																														
			Disabled	0	Read: Disabled																														
I	RW	RXSTARTED	Enabled	1	Read: Enabled																														
						Write '1' to Disable interrupt for RXSTARTED event																													
						See <a href="#">EVENTS_RXSTARTED</a>																													
			Clear	1	Disable																														
			Disabled	0	Read: Disabled																														
J	RW	TXSTARTED	Enabled	1	Read: Enabled																														
						Write '1' to Disable interrupt for TXSTARTED event																													
						See <a href="#">EVENTS_TXSTARTED</a>																													
			Clear	1	Disable																														
			Disabled	0	Read: Disabled																														
L	RW	TXSTOPPED	Enabled	1	Read: Enabled																														
						Write '1' to Disable interrupt for TXSTOPPED event																													
						See <a href="#">EVENTS_TXSTOPPED</a>																													
			Clear	1	Disable																														
			Disabled	0	Read: Disabled																														
			Enabled	1	Read: Enabled																														

### 6.25.9.5 ERRORSRC

Address offset: 0x480

Error source

Note : this register is read / write one to clear.

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0																															
Id				D C B A																															
Reset 0x00000000				0 0																															
Id	RW	Field	Value Id	Value	Description																														
A	RW	OVERRUN			Overrun error																														
					A start bit is received while the previous data still lies in RXD. (Previous data is lost.)																														
			NotPresent	0	Read: error not present																														
			Present	1	Read: error present																														
B	RW	PARITY			Parity error																														
					A character with bad parity is received, if HW parity check is enabled.																														
			NotPresent	0	Read: error not present																														
			Present	1	Read: error present																														

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0																															
Id				D C B A																															
Reset 0x00000000				0 0																															
Id	RW	Field	Value Id	Value	Description																														
C	RW	FRAMING			Framing error occurred																														
					A valid stop bit is not detected on the serial data input after all bits in a character have been received.																														
			NotPresent	0	Read: error not present																														
			Present	1	Read: error present																														
D	RW	BREAK			Break condition																														
					The serial data input is '0' for longer than the length of a data frame. (The data frame length is 10 bits without parity bit, and 11 bits with parity bit.).																														
			NotPresent	0	Read: error not present																														
			Present	1	Read: error present																														

### 6.25.9.6 ENABLE

Address offset: 0x500

Enable UART

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0																															
Id				A A A A																															
Reset 0x00000000				0 0																															
Id	RW	Field	Value Id	Value	Description																														
A	RW	ENABLE			Enable or disable UARTE																														
			Disabled	0	Disable UARTE																														
			Enabled	8	Enable UARTE																														

### 6.25.9.7 PSEL.RTS

Address offset: 0x508

Pin select for RTS signal

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0																															
Id				C																															
Reset 0xFFFFFFFF				1 1																															
Id	RW	Field	Value Id	Value				Description																											
A	RW	PIN		[0..31]				Pin number																											
C	RW	CONNECT						Connection																											
			Disconnected	1				Disconnect																											
			Connected	0				Connect																											

### 6.25.9.8 PSEL.TXD

Address offset: 0x50C

Pin select for TXD signal

Bit number	31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0																													
Id	C																													
Reset 0xFFFFFFFF	1 1																													
Id	RW	Field	Value	Id	Value	Description																								
A	RW	PIN			[0..31]	Pin number																								
C	RW	CONNECT				Connection																								
					Disconnected	1	Disconnect																							
					Connected	0	Connect																							

### 6.25.9.9 PSEL.CTS

Address offset: 0x510

Pin select for CTS signal

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0																															
Id				C																															
Reset 0xFFFFFFFF				1 1																															
Id	RW	Field	Value	Id	Value	Description																													
A	RW	PIN			[0..31]	Pin number																													
C	RW	CONNECT				Connection																													
			Disconnected	1	Disconnect																														
			Connected	0	Connect																														

### 6.25.9.10 PSEL.RXD

Address offset: 0x514

Pin select for RXD signal

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0																															
Id				C																															
Reset 0xFFFFFFFF				1 1																															
Id	RW	Field	Value	Id	Value	Description																													
A	RW	PIN			[0..31]	Pin number																													
C	RW	CONNECT				Connection																													
			Disconnected	1	Disconnect																														
			Connected	0	Connect																														

### 6.25.9.11 BAUDRATE

Address offset: 0x524

Baud rate. Accuracy depends on the HFCLK source selected.

Bit number					31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0																															
Id					A A																															
Reset 0x04000000					0 0 0 0 0 0 1 0																															
Id	RW	Field	Value	Id	Value	Description																														
A	RW	BAUDRATE				Baud rate																														
			Baud1200	0x0004F000	1200 baud (actual rate: 1205)																															
			Baud2400	0x0009D000	2400 baud (actual rate: 2396)																															
			Baud4800	0x0013B000	4800 baud (actual rate: 4808)																															
			Baud9600	0x00275000	9600 baud (actual rate: 9598)																															
			Baud14400	0x003AF000	14400 baud (actual rate: 14401)																															

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0																															
Id				A A																															
Reset 0x04000000				0 0 0 0 0 1 0																															
Id	RW	Field	Value Id	Value	Description																														
			Baud19200	0x004EA000	19200 baud (actual rate: 19208)																														
			Baud28800	0x0075C000	28800 baud (actual rate: 28777)																														
			Baud31250	0x00800000	31250 baud																														
			Baud38400	0x009D0000	38400 baud (actual rate: 38369)																														
			Baud56000	0x00E50000	56000 baud (actual rate: 55944)																														
			Baud57600	0x00EB0000	57600 baud (actual rate: 57554)																														
			Baud76800	0x013A9000	76800 baud (actual rate: 76923)																														
			Baud115200	0x01D60000	115200 baud (actual rate: 115108)																														
			Baud230400	0x03B00000	230400 baud (actual rate: 231884)																														
			Baud250000	0x04000000	250000 baud																														
			Baud460800	0x07400000	460800 baud (actual rate: 457143)																														
			Baud921600	0x0F000000	921600 baud (actual rate: 941176)																														
			Baud1M	0x10000000	1Mega baud																														

### 6.25.9.12 RXD.PTR

Address offset: 0x534

Data pointer

Bit number	31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0																																					
Id	A A																																					
Reset 0x00000000	0 0																																					
Id	RW	Field	Value Id	Value	Description																																	
A	RW	PTR			Data pointer																																	

### 6.25.9.13 RXD.MAXCNT

Address offset: 0x538

Maximum number of bytes in receive buffer

Bit number	31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0																																					
Id	A A																																					
Reset 0x00000000	0 0																																					
Id	RW	Field	Value Id	Value	Description																																	
A	RW	MAXCNT		[1..0x3FF]	Maximum number of bytes in receive buffer																																	

### 6.25.9.14 RXD.AMOUNT

Address offset: 0x53C

Number of bytes transferred in the last transaction

Bit number	31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0																																					
Id	A A																																					
Reset 0x00000000	0 0																																					
Id	R	Field	Value Id	Value	Description																																	
A	R	AMOUNT		[1..0x3FF]	Number of bytes transferred in the last transaction																																	

### 6.25.9.15 TXD.PTR

Address offset: 0x544

Data pointer

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0																															
Id				A A																															
Reset 0x00000000				0 0																															
Id		RW		Field		Value Id		Value								Description																			
A		RW		PTR												Data pointer																			

### 6.25.9.16 TXD.MAXCNT

Address offset: 0x548

Maximum number of bytes in transmit buffer

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0																															
Id				A A																															

### 6.25.9.17 TXD.AMOUNT

Address offset: 0x54C

Number of bytes transferred in the last transaction

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0																															
Id				A A																															

### 6.25.9.18 CONFIG

Address offset: 0x56C

Configuration of parity and hardware flow control

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0																															
Id				C B B B A																															
Reset 0x00000000				0 0																															
Id	RW	Field	Value Id	Value	Description																														
A	RW	HWFC			Hardware flow control																														
			Disabled	0	Disabled																														
			Enabled	1	Enabled																														
B	RW	PARITY			Parity																														
			Excluded	0x0	Exclude parity bit																														
			Included	0x7	Include even parity bit																														
C	RW	STOP			Stop bits																														
			One	0	One stop bit																														
			Two	1	Two stop bits																														

## 6.25.10 Electrical specification

### 6.25.10.1 UARTE electrical specification

Symbol	Description	Min.	Typ.	Max.	Units
$f_{\text{UARTE}}$	Baud rate for UARTE <sup>30</sup> .			1000	kbps
$t_{\text{UARTE,CTSH}}$	CTS high time	1			$\mu\text{s}$
$t_{\text{UARTE,START}}$	Time from STARTRX/STARTTX task to transmission started	..	..	..	$\mu\text{s}$

## 6.26 WDT — Watchdog timer

A countdown watchdog timer using the low-frequency clock source (LFCLK) offers configurable and robust protection against application lock-up.

The watchdog timer is started by triggering the START task.

The watchdog can be paused during long CPU sleep periods for low power applications and when the debugger has halted the CPU. The watchdog is implemented as a down-counter that generates a TIMEOUT event when it wraps over after counting down to 0. When the watchdog timer is started through the START task, the watchdog counter is loaded with the value specified in the CRV register. This counter is also reloaded with the value specified in the CRV register when a reload request is granted.

The watchdog's timeout period is given by:

$$\text{timeout [s]} = (\text{CRV} + 1) / 32768$$

When started, the watchdog will automatically force the 32.768 kHz RC oscillator on as long as no other 32.768 kHz clock source is running and generating the 32.768 kHz system clock, see chapter [CLOCK — Clock control](#) on page 83.

### 6.26.1 Reload criteria

The watchdog has eight separate reload request registers, which shall be used to request the watchdog to reload its counter with the value specified in the CRV register. To reload the watchdog counter, the special value 0x6E524635 needs to be written to all enabled reload registers.

One or more RR registers can be individually enabled through the RREN register.

### 6.26.2 Temporarily pausing the watchdog

By default, the watchdog will be active counting down the down-counter while the CPU is sleeping and when it is halted by the debugger. It is however possible to configure the watchdog to automatically pause while the CPU is sleeping as well as when it is halted by the debugger.

### 6.26.3 Watchdog reset

A TIMEOUT event will automatically lead to a watchdog reset.

See [Reset](#) on page 65 for more information about reset sources. If the watchdog is configured to generate an interrupt on the TIMEOUT event, the watchdog reset will be postponed with two 32.768 kHz clock cycles after the TIMEOUT event has been generated. Once the TIMEOUT event has been generated, the impending watchdog reset will always be effectuated.

<sup>30</sup> High baud rates may require GPIOs to be set as High Drive, see GPIO chapter for more details.

The watchdog must be configured before it is started. After it is started, the watchdog's configuration registers, which comprise registers CRV, RREN, and CONFIG, will be blocked for further configuration.

The watchdog can be reset from several reset sources, see [Reset behavior](#) on page 66.

When the device starts running again, after a reset, or waking up from OFF mode, the watchdog configuration registers will be available for configuration again.

## 6.26.4 Registers

Base address	Peripheral	Instance	Description	Configuration
0x40010000	WDT	WDT	Watchdog timer	

Table 96: Instances

Register	Offset	Description
TASKS_START	0x000	Start the watchdog
EVENTS_TIMEOUT	0x100	Watchdog timeout
INTENSET	0x304	Enable interrupt
INTENCLR	0x308	Disable interrupt
RUNSTATUS	0x400	Run status
REQSTATUS	0x404	Request status
CRV	0x504	Counter reload value
RREN	0x508	Enable register for reload request registers
CONFIG	0x50C	Configuration register
RR[0]	0x600	Reload request 0
RR[1]	0x604	Reload request 1
RR[2]	0x608	Reload request 2
RR[3]	0x60C	Reload request 3
RR[4]	0x610	Reload request 4
RR[5]	0x614	Reload request 5
RR[6]	0x618	Reload request 6
RR[7]	0x61C	Reload request 7

Table 97: Register Overview

### 6.26.4.1 INTENSET

Address offset: 0x304

Enable interrupt

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0																															
Id				A																															
Reset 0x00000000				0 0																															
Id	RW	Field	Value Id	Value	Description																														
A	RW	TIMEOUT			Write '1' to Enable interrupt for TIMEOUT event																														
					See <a href="#">EVENTS_TIMEOUT</a>																														
			Set	1	Enable																														
			Disabled	0	Read: Disabled																														
			Enabled	1	Read: Enabled																														

### 6.26.4.2 INTENCLR

Address offset: 0x308

## Disable interrupt

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0																															
Id				A																															
Reset 0x00000000				0 0																															
Id	RW	Field	Value Id	Value	Description																														
A	RW	TIMEOUT			Write '1' to Disable interrupt for TIMEOUT event																														
					See <a href="#">EVENTS_TIMEOUT</a>																														
			Clear	1	Disable																														
			Disabled	0	Read: Disabled																														
			Enabled	1	Read: Enabled																														

## 6.26.4.3 RUNSTATUS

Address offset: 0x400

Run status

Bit number			31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0																																
Id																																			A
Reset 0x00000000			0 0																																
Id	RW	Field	Value Id	Value	Description																														
A	R	RUNSTATUS			Indicates whether or not the watchdog is running																														
			NotRunning	0	Watchdog not running																														
			Running	1	Watchdog is running																														

## 6.26.4.4 REQSTATUS

Address offset: 0x404

Request status

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0																															
Id				H G F E D C B A																															
Reset 0x00000001				0 1																															
Id	RW	Field	Value Id	Value	Description																														
A	R	RR0			Request status for RR[0] register																														
			DisabledOrRequested	0	RR[0] register is not enabled, or are already requesting reload																														
			EnabledAndUnrequested	1	RR[0] register is enabled, and are not yet requesting reload																														
B	R	RR1			Request status for RR[1] register																														
			DisabledOrRequested	0	RR[1] register is not enabled, or are already requesting reload																														
			EnabledAndUnrequested	1	RR[1] register is enabled, and are not yet requesting reload																														
C	R	RR2			Request status for RR[2] register																														
			DisabledOrRequested	0	RR[2] register is not enabled, or are already requesting reload																														
			EnabledAndUnrequested	1	RR[2] register is enabled, and are not yet requesting reload																														
D	R	RR3			Request status for RR[3] register																														
			DisabledOrRequested	0	RR[3] register is not enabled, or are already requesting reload																														
			EnabledAndUnrequested	1	RR[3] register is enabled, and are not yet requesting reload																														
E	R	RR4			Request status for RR[4] register																														



Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0																															
Id				H G F E D C B A																															
Reset 0x00000001				0 1																															
Id	RW	Field	Value Id	Value	Description																														
F	R	RR5	DisabledOrRequested	0	RR[4] register is not enabled, or are already requesting reload																														
			EnabledAndUnrequested	1	RR[4] register is enabled, and are not yet requesting reload																														
			Request status for RR[5] register																																
			DisabledOrRequested	0	RR[5] register is not enabled, or are already requesting reload																														
G	R	RR6	EnabledAndUnrequested	1	RR[5] register is enabled, and are not yet requesting reload																														
			Request status for RR[6] register																																
			DisabledOrRequested	0	RR[6] register is not enabled, or are already requesting reload																														
			EnabledAndUnrequested	1	RR[6] register is enabled, and are not yet requesting reload																														
H	R	RR7	Request status for RR[7] register																																
			DisabledOrRequested	0	RR[7] register is not enabled, or are already requesting reload																														
			EnabledAndUnrequested	1	RR[7] register is enabled, and are not yet requesting reload																														

### 6.26.4.5 CRV

Address offset: 0x504

Counter reload value

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0																															
Id				A A																															
Reset 0xFFFFFFFF				1 1																															
Id	RW	Field	Value Id	Value																Description															
A	RW	CRV		[0x0000000F..0xFFFFFFFF]																Counter reload value in number of cycles of the 32.768 kHz clock															

### 6.26.4.6 RREN

Address offset: 0x508

Enable register for reload request registers

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0																																
Id				H G F E D C B A																																
Reset 0x00000001				0 1																																
Id	RW	Field	Value Id	Value	Description																															
A	RW	RR0			Enable or disable RR[0] register																															
			Disabled	0	Disable RR[0] register																															
			Enabled	1	Enable RR[0] register																															
B	RW	RR1			Enable or disable RR[1] register																															
			Disabled	0	Disable RR[1] register																															
			Enabled	1	Enable RR[1] register																															
C	RW	RR2			Enable or disable RR[2] register																															
			Disabled	0	Disable RR[2] register																															
			Enabled	1	Enable RR[2] register																															
D	RW	RR3			Enable or disable RR[3] register																															
			Disabled	0	Disable RR[3] register																															
			Enabled	1	Enable RR[3] register																															

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0																															
Id				H G F E D C B A																															
Reset 0x00000001				0 1																															
Id	RW	Field	Value Id	Value	Description																														
E	RW	RR4			Enable or disable RR[4] register																														
			Disabled	0	Disable RR[4] register																														
			Enabled	1	Enable RR[4] register																														
F	RW	RR5			Enable or disable RR[5] register																														
			Disabled	0	Disable RR[5] register																														
			Enabled	1	Enable RR[5] register																														
G	RW	RR6			Enable or disable RR[6] register																														
			Disabled	0	Disable RR[6] register																														
			Enabled	1	Enable RR[6] register																														
H	RW	RR7			Enable or disable RR[7] register																														
			Disabled	0	Disable RR[7] register																														
			Enabled	1	Enable RR[7] register																														

### 6.26.4.7 CONFIG

Address offset: 0x50C

Configuration register

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0																															
Id				C A																															
Reset 0x00000001				0 1																															
Id	RW	Field	Value Id	Value	Description																														
A	RW	SLEEP			Configure the watchdog to either be paused, or kept running, while the CPU is sleeping																														
			Pause	0	Pause watchdog while the CPU is sleeping																														
			Run	1	Keep the watchdog running while the CPU is sleeping																														
C	RW	HALT			Configure the watchdog to either be paused, or kept running, while the CPU is halted by the debugger																														
			Pause	0	Pause watchdog while the CPU is halted by the debugger																														
			Run	1	Keep the watchdog running while the CPU is halted by the debugger																														

### 6.26.4.8 RR[0]

Address offset: 0x600

Reload request 0

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0																															
Id				A A																															
Reset 0x00000000				0 0																															
Id	RW	Field	Value Id	Value	Description																														
A	W	RR			Reload request register																														
			Reload	0x6E524635	Value to request a reload of the watchdog timer																														

### 6.26.4.9 RR[1]

Address offset: 0x604

Reload request 1

Bit number	31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0																													
Id	A A																													
Reset 0x00000000	0 0																													
Id	RW	Field	Value Id	Value	Description																									
A	W	RR			Reload request register																									
			Reload	0x6E524635	Value to request a reload of the watchdog timer																									

#### 6.26.4.10 RR[2]

Address offset: 0x608

Reload request 2

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0																															
Id				A A																															
Reset 0x00000000				0 0																															
Id	RW	Field	Value Id	Value				Description																											
A	W	RR						Reload request register																											
			Reload	0x6E524635				Value to request a reload of the watchdog timer																											

#### 6.26.4.11 RR[3]

Address offset: 0x60C

Reload request 3

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0																															
Id				A A																															
Reset 0x00000000				0 0																															
Id	RW	Field	Value Id	Value								Description																							
A	W	RR										Reload request register																							
			Reload	0x6E524635								Value to request a reload of the watchdog timer																							

#### 6.26.4.12 RR[4]

Address offset: 0x610

Reload request 4

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0																															
Id				A A																															
Reset 0x00000000				0 0																															
Id	RW	Field	Value Id	Value				Description																											
A	W	RR						Reload request register																											
			Reload	0x6E524635				Value to request a reload of the watchdog timer																											

#### 6.26.4.13 RR[5]

Address offset: 0x614

Reload request 5

Bit number	31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0																													
Id	A A																													
Reset 0x00000000	0 0																													
Id	RW	Field	Value Id	Value	Description																									
A	W	RR			Reload request register																									
			Reload	0x6E524635	Value to request a reload of the watchdog timer																									

#### 6.26.4.14 RR[6]

Address offset: 0x618

Reload request 6

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0																															
Id				A A																															
Reset 0x00000000				0 0																															
Id	RW	Field	Value Id	Value				Description																											
A	W	RR						Reload request register																											
			Reload	0x6E524635				Value to request a reload of the watchdog timer																											

#### 6.26.4.15 RR[7]

Address offset: 0x61C

Reload request 7

Bit number				31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0																															
Id				A A																															
Reset 0x00000000				0 0																															
Id	RW	Field	Value Id	Value				Description																											
A	W	RR						Reload request register																											
			Reload	0x6E524635				Value to request a reload of the watchdog timer																											

### 6.26.5 Electrical specification

#### 6.26.5.1 Watchdog Timer Electrical Specification

Symbol	Description	Min.	Typ.	Max.	Units
t <sub>WDT</sub>	Time out interval	458 μs		36 h	

# 7 Hardware and layout

## 7.1 Pin assignments

The pin assignment figures and tables describe the pinouts for the product variants of the chip. There are also recommendations for how the GPIO pins should be configured, in addition to any usage restrictions.

### 7.1.1 QFN48 pin assignments

The nRF52810 QFN48 pin assignment table and figure describe the pinouts for this variant of the chip.

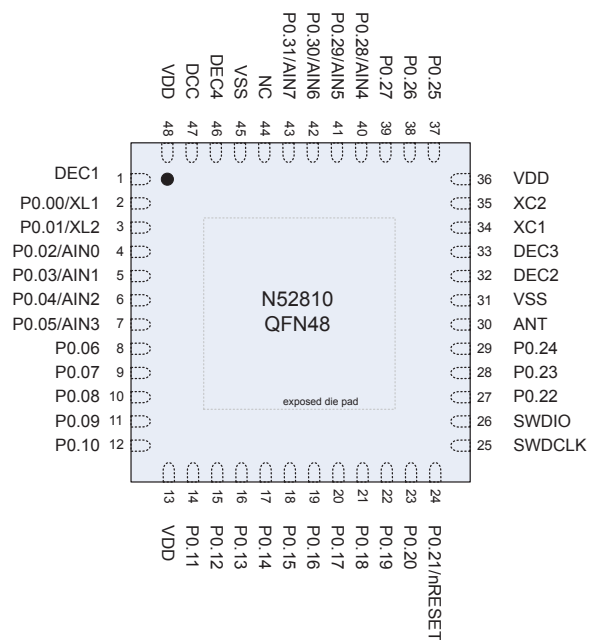


Figure 125: QFN48 pin assignments, top view

Pin	Name	Type	Description
<b>Left side of chip</b>			
1	DEC1	Power	0.9 V regulator digital supply decoupling
2	P0.00	Digital I/O	General purpose I/O
	XL1	Analog input	Connection for 32.768 kHz crystal (LFXO)
3	P0.01	Digital I/O	General purpose I/O
	XL2	Analog input	Connection for 32.768 kHz crystal (LFXO)
4	P0.02	Digital I/O	General purpose I/O
	AIN0	Analog input	COMP input
			SAADC input
5	P0.03	Digital I/O	General purpose I/O
	AIN1	Analog input	COMP input
			SAADC input
6	P0.04	Digital I/O	General purpose I/O
	AIN2	Analog input	COMP input
			SAADC input
7	P0.05	Digital I/O	General purpose I/O
	AIN3	Analog input	COMP input
			SAADC input
8	P0.06	Digital I/O	General purpose I/O
9	P0.07	Digital I/O	General purpose I/O
10	P0.08	Digital I/O	General purpose I/O
11	P0.09	Digital I/O	General purpose I/O
12	P0.10	Digital I/O	General purpose I/O
<b>Lower side of chip</b>			
13	VDD	Power	Power supply
14	P0.11	Digital I/O	General purpose I/O
15	P0.12	Digital I/O	General purpose I/O
16	P0.13	Digital I/O	General purpose I/O
17	P0.14	Digital I/O	General purpose I/O
18	P0.15	Digital I/O	General purpose I/O
19	P0.16	Digital I/O	General purpose I/O
20	P0.17	Digital I/O	General purpose I/O
21	P0.18	Digital I/O	General purpose I/O
22	P0.19	Digital I/O	General purpose I/O
23	P0.20	Digital I/O	General purpose I/O
24	P0.21	Digital I/O	General purpose I/O
	nRESET		Configurable as pin reset
<b>Right side of chip</b>			
25	SWDCLK	Digital input	Serial wire debug clock input for debug and programming
26	SWDIO	Digital I/O	Serial wire debug I/O for debug and programming
27	P0.22	Digital I/O	General purpose I/O
28	P0.23	Digital I/O	General purpose I/O
29	P0.24	Digital I/O	General purpose I/O

Pin	Name	Type	Description
30	ANT	RF	Single-ended radio antenna connection
31	VSS	Power	Ground (radio supply)
32	DEC2	Power	1.3 V regulator supply decoupling (radio supply)
33	DEC3	Power	Power supply decoupling
34	XC1	Analog input	Connection for 32 MHz crystal
35	XC2	Analog input	Connection for 32 MHz crystal
36	VDD	Power	Power supply
<b>Upper side of chip</b>			
37	P0.25	Digital I/O	General purpose I/O
38	P0.26	Digital I/O	General purpose I/O
39	P0.27	Digital I/O	General purpose I/O
40	P0.28	Digital I/O	General purpose I/O
	AIN4	Analog input	COMP input SAADC input
41	P0.29	Digital I/O	General purpose I/O
	AIN5	Analog input	COMP input SAADC input
42	P0.30	Digital I/O	General purpose I/O
	AIN6	Analog input	COMP input SAADC input
43	P0.31	Digital I/O	General purpose I/O pin
	AIN7	Analog input	COMP input SAADC input
44	NC		No connect Leave unconnected
45	VSS	Power	Ground
46	DEC4	Power	1.3 V regulator supply decoupling
			Input from DC/DC regulator
			Output from 1.3 V LDO
47	DCC	Power	DC/DC regulator output
48	VDD	Power	Power supply
<b>Bottom of chip</b>			
Die pad	VSS	Power	Ground pad  Exposed die pad must be connected to ground (VSS) for proper device operation.

Table 98: QFN48 pin assignments

### 7.1.2 QFN32 pin assignments

The nRF52810 QFN32 pin assignment table and figure describe the pinouts for this variant of the chip.

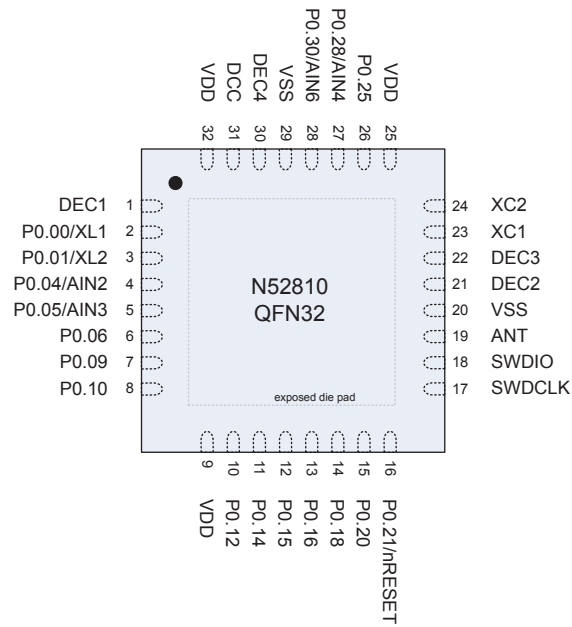


Figure 126: QFN32 pin assignments, top view



Pin	Name	Type	Description
Left side of chip			
1	DEC1	Power	0.9 V regulator digital supply decoupling
2	P0.00	Digital I/O	General purpose I/O
	XL1	Analog input	Connection for 32.768 kHz crystal (LFXO)
3	P0.01	Digital I/O	General purpose I/O
	XL2	Analog input	Connection for 32.768 kHz crystal (LFXO)
4	P0.04	Digital I/O	General purpose I/O
	AIN2	Analog input	COMP input SAADC input
5	P0.05	Digital I/O	General purpose I/O
	AIN3	Analog input	COMP input SAADC input
6	P0.06	Digital I/O	General purpose I/O
7	P0.09	Digital I/O	General purpose I/O
8	P0.10	Digital I/O	General purpose I/O
Lower side of chip			
9	VDD	Power	Power supply
10	P0.12	Digital I/O	General purpose I/O
11	P0.14	Digital I/O	General purpose I/O
12	P0.15	Digital I/O	General purpose I/O
13	P0.16	Digital I/O	General purpose I/O
14	P0.18	Digital I/O	General purpose I/O
			Single wire output
15	P0.20	Digital I/O	General purpose I/O
16	P0.21	Digital I/O	General purpose I/O
	nRESET		Configurable as pin reset
Right side of chip			
17	SWDCLK	Digital input	Serial wire debug clock input for debug and programming
18	SWDIO	Digital I/O	Serial wire debug I/O for debug and programming
19	ANT	RF	Single-ended radio antenna connection
20	VSS	Power	Ground (radio supply)
21	DEC2	Power	1.3 V regulator supply decoupling (radio supply)
22	DEC3	Power	Power supply decoupling
23	XC1	Analog input	Connection for 32 MHz crystal
24	XC2	Analog input	Connection for 32 MHz crystal
Upper side of chip			
25	VDD	Power	Power supply
26	P0.25	Digital I/O	General purpose I/O
27	P0.28	Digital I/O	General purpose I/O
	AIN4	Analog input	COMP input SAADC input
28	P0.30	Digital I/O	General purpose I/O
	AIN6	Analog input	COMP input

Pin	Name	Type	Description
			SAADC input
29	VSS	Power	Ground
30	DEC4	Power	1.3 V regulator supply decoupling Input from DC/DC regulator Output from 1.3 V LDO
31	DCC	Power	DC/DC regulator output
32	VDD	Power	Power supply
<b>Bottom of chip</b>			
Die pad	VSS	Power	Ground pad  Exposed die pad must be connected to ground (VSS) for proper device operation.

Table 99: QFN32 pin assignments

### 7.1.3 GPIO pins located near the radio

Radio performance parameters, such as sensitivity, may be affected by high frequency digital I/O with large sink/source current close to the radio power supply and antenna pins.

[GPIO recommended usage](#) on page 466 identifies some GPIO pins that have recommended usage guidelines for maximizing radio performance in an application.

GPIO	QFN48 pin	QFN32 pin	Recommended usage
P0.25	37	26	Low drive, low frequency I/O only.
P0.26	38		
P0.27	39		
P0.28	40	27	
P0.29	41		

Table 100: GPIO recommended usage

## 7.2 Mechanical specifications

The mechanical specifications for the packages show the dimensions in millimeters.

### 7.2.1 QFN48 6 x 6 mm package

Dimensions in millimeters for the nRF52810 QFN48 6 x 6 mm package.

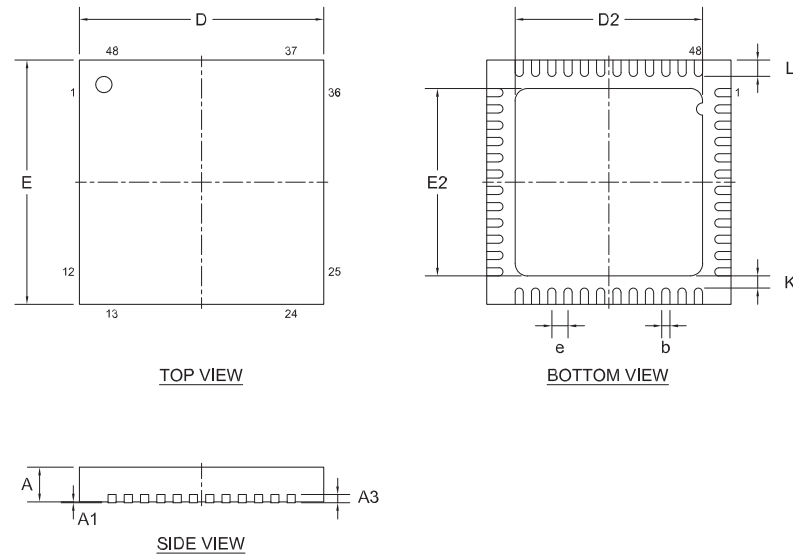


Figure 127: QFN48 6 x 6 mm package

Package	A	A1	A3	b	D, E	D2, E2	e	K	L	
	0.80	0.00		0.15		4.50		0.20	0.35	Min.
QFN48 (6x6)	0.85	0.04	0.20	0.20	6.00	4.60	0.40		0.40	Nom.
	0.90	0.05		0.25		4.70			0.45	Max.

Table 101: QFN48 dimensions in millimeters

## 7.2.2 QFN32 5 x 5 mm package

Dimensions in millimeters for the nRF52810 QFN32 5 x 5 mm package.



Table 102: QFN32 dimensions in millimeters

In addition to the schematic, the bill of material (BOM) is also provided.

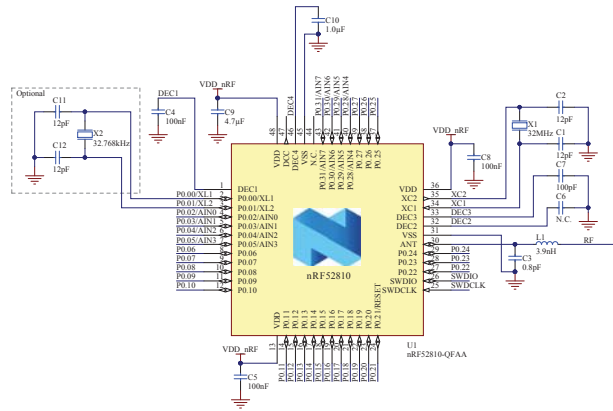


Figure 129: QFAA QFN48 with internal LDO setup

**Important:** For PCB reference layouts, see [Reference layout nRF52 Series](#).

Designator	Value	Description	Footprint
C1, C2, C11, C12	12 pF	Capacitor, NP0, $\pm 2\%$	0402
C3	0.8 pF	Capacitor, NP0, $\pm 5\%$	0402
C4, C5, C8	100 nF	Capacitor, X7R, $\pm 10\%$	0402
C6	N.C.	Not mounted	0402
C7	100 pF	Capacitor, NP0, $\pm 5\%$	0402
C9	4.7 $\mu$ F	Capacitor, X5R, $\pm 10\%$	0603
C10	1.0 $\mu$ F	Capacitor, X7R, $\pm 10\%$	0603
L1	3.9 nH	High frequency chip inductor $\pm 5\%$	0402
U1	nRF52810-QFAA	Multi-protocol Bluetooth <sup>®</sup> low energy, ANT and 2.4 GHz proprietary system on chip	QFN-48
X1	32 MHz	XTAL SMD 2016, 32 MHz, CI = 8 pF, Total Tol: $\pm 40$ ppm	XTAL_2016
X2	32.768 kHz	XTAL SMD 3215, 32.768 kHz, CI = 9 pF, Total Tol: $\pm 20$ ppm	XTAL_3215

Table 103: Bill of material for QFAA QFN48 with internal LDO setup

### 7.3.2 Schematic QFAA QFN48 with DC/DC regulator setup

In addition to the schematic, the bill of material (BOM) is also provided.

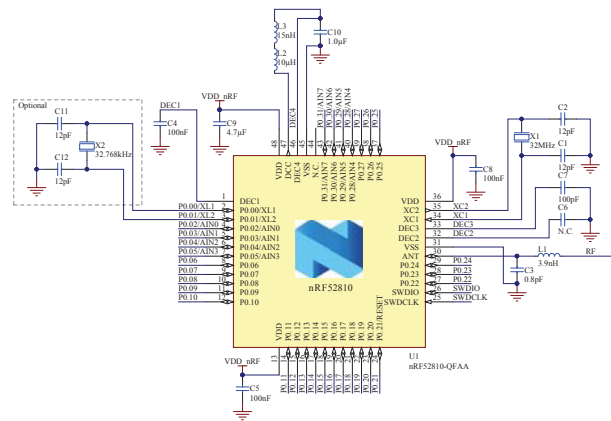


Figure 130: QFAA QFN48 with DC/DC regulator setup

**Important:** For PCB reference layouts, see [Reference layout nRF52 Series](#).

Designator	Value	Description	Footprint
C1, C2, C11, C12	12 pF	Capacitor, NP0, ±2%	0402
C3	0.8 pF	Capacitor, NP0, ±5%	0402
C4, C5, C8	100 nF	Capacitor, X7R, ±10%	0402
C6	N.C.	Not mounted	0402
C7	100 pF	Capacitor, NP0, ±5%	0402
C9	4.7 µF	Capacitor, X5R, ±10%	0603
C10	1.0 µF	Capacitor, X7R, ±10%	0603
L1	3.9 nH	High frequency chip inductor ±5%	0402
L2	10 µH	Chip inductor, IDC,min = 50 mA, ±20%	0603
L3	15 nH	High frequency chip inductor ±10%	0402
U1	nRF52810-QFAA	Multi-protocol Bluetooth® low energy, ANT and 2.4 GHz proprietary system on chip	QFN-48
X1	32 MHz	XTAL SMD 2016, 32 MHz, Cl = 8 pF, Total Tol: ±40 ppm	XTAL_2016
X2	32.768 kHz	XTAL SMD 3215, 32.768 kHz, Cl = 9 pF, Total Tol: ±20 ppm	XTAL_3215

Table 104: Bill of material for QFAA QFN48 with DC/DC regulator setup

### 7.3.3 Schematic QCAA QFN32 with internal LDO setup

In addition to the schematic, the bill of material (BOM) is also provided.

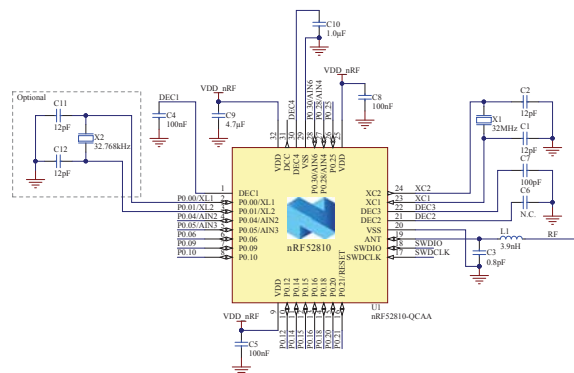


Figure 131: QCAA QFN32 with internal LDO setup

**Important:** For PCB reference layouts, see [Reference layout nRF52 Series](#).

Designator	Value	Description	Footprint
C1, C2, C11, C12	12 pF	Capacitor, NP0, $\pm 2\%$	0402
C3	0.8 pF	Capacitor, NP0, $\pm 5\%$	0402
C4, C5, C8	100 nF	Capacitor, X7R, $\pm 10\%$	0402
C6	N.C.	Not mounted	0402
C7	100 pF	Capacitor, NP0, $\pm 5\%$	0402
C9	4.7 $\mu$ F	Capacitor, X5R, $\pm 10\%$	0603
C10	1.0 $\mu$ F	Capacitor, X7R, $\pm 10\%$	0603
L1	3.9 nH	High frequency chip inductor $\pm 5\%$	0402
U1	nRF52810-QCAA	Multi-protocol Bluetooth <sup>®</sup> low energy, ANT and 2.4 GHz proprietary system on chip	QFN-32
X1	32 MHz	XTAL SMD 2016, 32 MHz, CI = 8 pF, Total Tol: $\pm 40$ ppm	XTAL_2016
X2	32.768 kHz	XTAL SMD 3215, 32.768 kHz, CI = 9 pF, Total Tol: $\pm 20$ ppm	XTAL_3215

Table 105: Bill of material for QCAA QFN32 with internal LDO setup

### 7.3.4 Schematic QCAA QFN32 with DC/DC regulator setup

In addition to the schematic, the bill of material (BOM) is also provided.

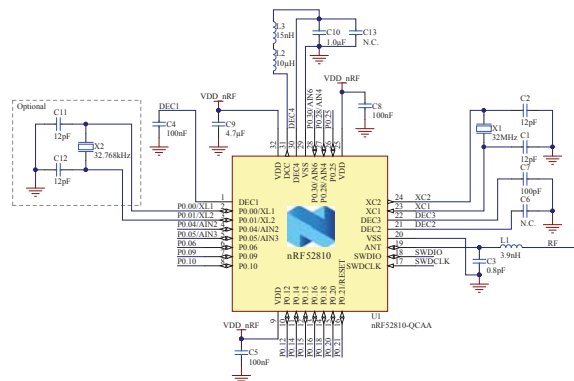


Figure 132: QCAA QFN32 with DC/DC regulator setup



**Important:** For PCB reference layouts, see [Reference layout nRF52 Series](#).

Designator	Value	Description	Footprint
C1, C2, C11, C12	12 pF	Capacitor, NP0, $\pm 2\%$	0402
C3	0.8 pF	Capacitor, NP0, $\pm 5\%$	0402
C4, C5, C8	100 nF	Capacitor, X7R, $\pm 10\%$	0402
C6	N.C.	Not mounted	0402
C7	100 pF	Capacitor, NP0, $\pm 5\%$	0402
C9	4.7 $\mu$ F	Capacitor, X5R, $\pm 10\%$	0603
C10	1.0 $\mu$ F	Capacitor, X7R, $\pm 10\%$	0603
L1	3.9 nH	High frequency chip inductor $\pm 5\%$	0402
L2	10 $\mu$ H	Chip inductor, IDC,min = 50 mA, $\pm 20\%$	0603
L3	15 nH	High frequency chip inductor $\pm 10\%$	0402
U1	nRF52810-QCAA	Multi-protocol Bluetooth <sup>®</sup> low energy, ANT and 2.4 GHz proprietary system on chip	QFN-32
X1	32 MHz	XTAL SMD 2016, 32 MHz, CI = 8 pF, Total Tol: $\pm 40$ ppm	XTAL_2016
X2	32.768 kHz	XTAL SMD 3215, 32.768 kHz, CI = 9 pF, Total Tol: $\pm 20$ ppm	XTAL_3215

Table 106: Bill of material for QCAA QFN32 with DC/DC regulator setup

### 7.3.5 PCB guidelines

A well designed PCB is necessary to achieve good RF performance. Poor layout can lead to loss in performance or functionality.

A qualified RF layout for the IC and its surrounding components, including matching networks, can be downloaded from [Reference layout nRF52 Series](#).

To ensure optimal performance it is essential that you follow the schematics and layout references closely. Especially in the case of the antenna matching circuitry (components between device pin ANT and the antenna), any changes to the layout can change the behavior, resulting in degradation of RF performance or a need to change component values. All reference circuits are designed for use with a 50  $\Omega$  single-ended antenna.

A PCB with a minimum of two layers, including a ground plane, is recommended for optimal performance. On PCBs with more than two layers, put a keep-out area on the inner layers directly below the antenna matching circuitry (components between device pin ANT and the antenna) to reduce the stray capacitances that influence RF performance.

A matching network is needed between the RF pin ANT and the antenna, to match the antenna impedance (normally 50  $\Omega$ ) to the optimum RF load impedance for the chip. For optimum performance, the impedance for the matching network should be set as described in the recommended package reference circuitry in [Reference circuitry](#) on page 468 above.

The DC supply voltage should be decoupled as close as possible to the VDD pins with high performance RF capacitors. See the schematics for recommended decoupling capacitor values. The supply voltage for the chip should be filtered and routed separately from the supply voltages of any digital circuitry.

Long power supply lines on the PCB should be avoided. All device grounds, VDD connections, and VDD bypass capacitors must be connected as close as possible to the IC. For a PCB with a topside RF ground plane, the VSS pins should be connected directly to the ground plane. For a PCB with a bottom ground plane, the best technique is to have via holes as close as possible to the VSS pads. A minimum of one via hole should be used for each VSS pin.

Fast switching digital signals should not be routed close to the crystal or the power supply lines. Capacitive loading of fast switching digital output lines should be minimized in order to avoid radio interference.

### 7.3.6 PCB layout example

The PCB layout shown as the example is a reference layout for the QFN48 package with internal LDO setup.

**Important:** Pay attention to how the capacitor C3 is grounded. It is not directly connected to the ground plane, but grounded via VSS pin 31. This is done to create additional filtering of harmonic components.

For all available reference layouts, see [Reference layout nRF52 Series](#).

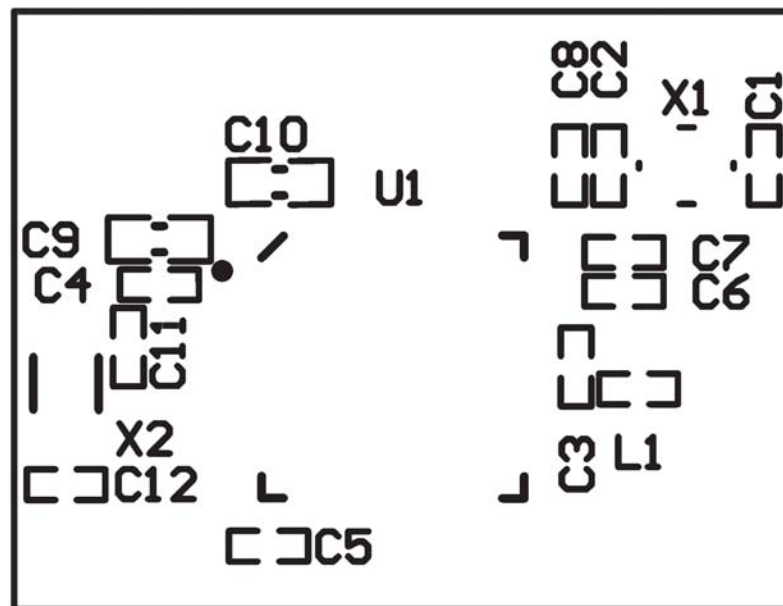


Figure 133: Top silk layer

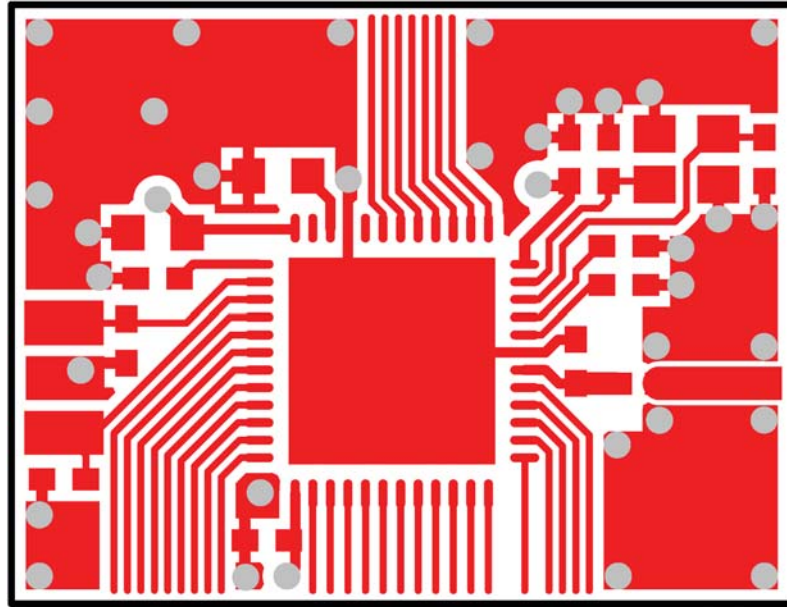


Figure 134: Top layer

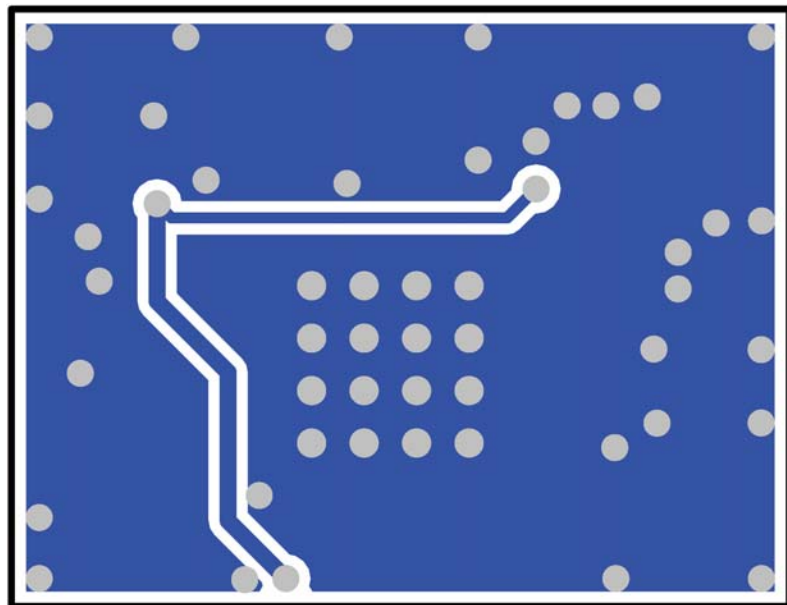


Figure 135: Bottom layer

**Important:** No components in bottom layer.

# 8 Recommended operating conditions

The operating conditions are the physical parameters that the chip can operate within.

Symbol	Parameter	Notes	Min.	Nom.	Max.	Units
VDD	Supply voltage, independent of DCDC enable		1.7	3.0	3.6	V
t <sub>R_VDD</sub>	Supply rise time (0 V to 1.7 V)				60	ms
TA	Operating temperature		-40	25	85	°C

Table 107: Recommended operating conditions

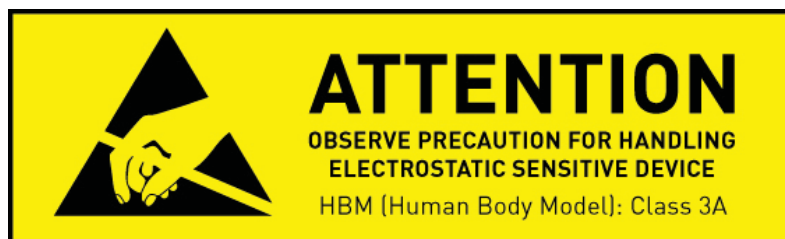
**Important:** The on-chip power-on reset circuitry may not function properly for rise times longer than the specified maximum.

## 9 Absolute maximum ratings

Maximum ratings are the extreme limits to which the chip can be exposed for a limited amount of time without permanently damaging it. Exposure to absolute maximum ratings for prolonged periods of time may affect the reliability of the device.

	Note	Min.	Max.	Unit
Supply voltages				
VDD		-0.3	+3.9	V
VSS			0	V
I/O pin voltage				
V <sub>I/O</sub> , VDD ≤ 3.6 V		-0.3	VDD + 0.3 V	V
V <sub>I/O</sub> , VDD > 3.6 V		-0.3	3.9 V	V
Radio				
RF input level			10	dBm
Environmental (QFN package)				
Storage temperature		-40	+125	°C
MSL	Moisture Sensitivity Level		2	
ESD HBM	Human Body Model		4	kV
ESD CDM	Charged Device Model		1000	V
Flash memory				
Endurance		10 000		Write/erase cycles
Retention		10 years at 40°C		

Table 108: Absolute maximum ratings



# 10 Ordering information

This chapter contains information on IC marking, ordering codes, and container sizes.

## 10.1 IC marking

The IC package is marked like described below.

N	5	2	8	1	0
<P>	P>	<V>	V>	<H>	<P>
<Y>	Y>	<W>	W>	<L>	L>

Figure 136: Package marking

## 10.2 Box labels

Here are the box labels used for the IC.

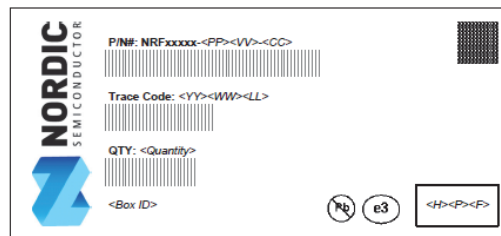


Figure 137: Inner box label

FROM:

TO:

DEVICE: NRFxxxx-<PP>-<VV>-<CC>

S/O No.: <Nordic Sales Order>

CUSTOMER PO No.: <Customer Purchase Order>

WF LOT No.: <Wafer Lot Number>

Trace Code: <YY><WW><LL>

QTY: <Quantity>

PACKAGE COUNT:  
 of

PACKAGE WEIGHT:  
 KGS

COUNTRY OF ORIGIN: <Country>

Figure 138: Outer box label

### 10.3 Order code

Here are the nRF52810 order codes and definitions.

n	R	F	5	2	8	1	0	-	<P	P>	<V	V>	-	<C	C>
---	---	---	---	---	---	---	---	---	----	----	----	----	---	----	----

Figure 139: Order code

Abbreviation	Definition and implemented codes
N52/nRF52	nRF52 Series product
810	Part code
<PP>	Package variant code
<VV>	Function variant code
<H><P><F>	Build code H - Hardware version code P - Production configuration code (production site, etc.) F - Firmware version code (only visible on shipping container label)
<YY><WW><LL>	Tracking code YY - Year code WW - Assembly week number LL - Wafer lot code
<CC>	Container code

Table 109: Abbreviations

## 10.4 Code ranges and values

Defined here are the nRF52810 code ranges and values.

<PP>	Package	Size (mm)	Pin/Ball count	Pitch (mm)
QF	QFN	6 x 6	48	0.4
QC	QFN	5 x 5	32	0.5

Table 110: Package variant codes

<VV>	Flash (kB)	RAM (kB)
AA	192	24

Table 111: Function variant codes

<H>	Description
[A . . Z]	Hardware version/revision identifier (incremental)

Table 112: Hardware version codes



<P>	Description
[0 . . 9]	Production device identifier (incremental)
[A . . Z]	Engineering device identifier (incremental)

Table 113: Production configuration codes

<F>	Description
[A . . N, P . . Z]	Version of preprogrammed firmware
[0]	Delivered without preprogrammed firmware

Table 114: Production version codes

<YY>	Description
[15 . . 99]	Production year: 2015 to 2099

Table 115: Year codes

<WW>	Description
[1 . . 52]	Week of production

Table 116: Week codes

<LL>	Description
[AA . . ZZ]	Wafer production lot identifier

Table 117: Lot codes

<CC>	Description
R7	7" Reel
R	13" Reel
T	Tray

Table 118: Container codes

## 10.5 Product options

Defined here are the nRF52810 product options.

Order code	MOQ (minimum ordering quantity)	Comment
nRF52810-QFAA-R7	1000	Availability to be announced.
nRF52810-QFAA-R	3000	
nRF52810-QFAA-T	490	
nRF52810-QCAA-R7	1500	
nRF52810-QCAA-R	4000	
nRF52810-QCAA-T	490	

Table 119: nRF IC order codes

Order code	Description
nRF52-DK	nRF52832 development kit with tools to support nRF52810 development.

Table 120: Development tools order code

# 11 Liability disclaimer

Nordic Semiconductor ASA reserves the right to make changes without further notice to the product to improve reliability, function or design. Nordic Semiconductor ASA does not assume any liability arising out of the application or use of any product or circuits described herein.

## Life support applications

Nordic Semiconductor's products are not designed for use in life support appliances, devices, or systems where malfunction of these products can reasonably be expected to result in personal injury. Nordic Semiconductor ASA customers using or selling these products for use in such applications do so at their own risk and agree to fully indemnify Nordic Semiconductor ASA for any damages resulting from such improper use or sale.

## RoHS and REACH statement

Nordic Semiconductor's products meet the requirements of Directive 2011/65/EU of the European Parliament and of the Council on the Restriction of Hazardous Substances (RoHS 2) and the requirements of the REACH regulation (EC 1907/2006) on Registration, Evaluation, Authorization and Restriction of Chemicals.

The SVHC (Substances of Very High Concern) candidate list is continually being updated. Complete hazardous substance reports, material composition reports and latest version of Nordic's REACH statement can be found on our website [www.nordicsemi.com](http://www.nordicsemi.com).

