Monarch Platform - GM01Q Module

Datasheet

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Preface

Legal Notices

Document Revision History

Revision	Date	Product Application
05	August 2018	Fifth edition of the document.
06	September 2018	Sixth edition of the document.
07	November 2018	Seventh edition of the document. See list of changes in Section Changes in this Document on page iii.

About this Datasheet

Purpose and Scope

The GM01Q is a complete certified LTE Category M1 module including base-band, RF and memory, for the design of connected machine-to-machine devices, and other Internet-of-Things devices with embedded LTE connectivity. This document provides technical information about GM01Q LGA module. GM01Q is based on Sequans' Monarch platform.

Who Should Read this Datasheet

This document is intended for engineers who are developing User Equipment (UE) for LTE systems.

Changes in this Document

The changes since the previous edition of the document are as follows:

- Updated FCC statement in Section Regulatory Approval on page 4.
- Updated Section 3.1 ECCN and Part Number on page 7 and updated part numbers in the document.
- Added module weight in Section 3.9 Package Description on page 17.
- Added MSL3 compliancy is Section 3.11 Storage Conditions on page 21.

References

[1] Core technology specifications:

- 3GPP E-UTRA 21 series Release 13 (EPS)
- 3GPP E-UTRA 22 series Release 13 (IMEI)
- 3GPP E-UTRA 23 series Release 13 (NAS, SMS)
- 3GPP E-UTRA 24 series Release 13 (NAS)
- 3GPP E-UTRA 31 series Release 13 (UICC)
- 3GPP E-UTRA 33 series Release 13 (security)
- 3GPP E-UTRA 36 series Release 13 (RAN)
- 3GPP2 C.S0015-A v1.0 (SMS)
- IETF, RFC 3261, 4861, 4862, 6434

For more information, see

- ftp://ftp.3gpp.org/Specs/archive/
- http://www.3gpp2.org/public_html/specs/CS0015-0.pdf
- https://tools.ietf.org/html/

[2] Test specifications:
3GPP E-UTRA 36 series Release 13 (RAN)
ftp://ftp.3gpp.org/Specs/archive/

[3] Vocabulary reference:

- 3GPP TR 21.905: "Vocabulary for 3GPP Specifications"

For more information, see http://www.3gpp.org/ftp/specs/archive/21_series/21.905/

Documentation Conventions

This section illustrates the conventions that are used in this document.

General Conventions	
Note	Important information requiring the user's attention.
Caution 	A condition or circumstance that may cause damage to the equipment or loss of data.
Warning 	A condition or circumstance that may cause personal injury.
Italics	Italic font style denotes • emphasis of an important word; • first use of a new term; • title of a document.
Screen Name	Sans serif, bold font denotes • on-screen name of a window, dialog box or field; • keys on a keyboard; • labels printed on the equipment.

Software Conventions	
`Code`	Regular Courier font denotes code or text displayed on-screen.
Code	Bold Courier font denotes commands and parameters that you enter exactly as shown. Multiple parameters are grouped in brackets [ ]. If you are to choose only one among grouped parameters, the choices are separated with a pipe: [parm1 | parm2 | parm3] If there is no pipe separator, you must enter each parameter: [parm1 parm2 parm3]
`Code`	Italic Courier font denotes parameters that require you to enter a value or variable. Multiple parameters are grouped in brackets [ ]. If you are to choose only one among grouped parameters, the choices are separated with a pipe: [parm1 | parm2 | parm3] If there is no pipe separator, you must enter a value for each parameter: [parm1 parm2 parm3]

Table of Contents

1 Product Features

1.1 Features Description

Sequans GM01Q module includes Monarch SQN3330 Cat-M1 baseband, a complete dual band RF front end, memory and required circuitry to meet 3GPP E-UTRA (Long Term Evolution - LTE, Release 13) Cat-M1 UE specifications.

For more information on the core technology specifications see the section References on page iv. The term GM01Q module refers to the hardware and the associated embedded software.

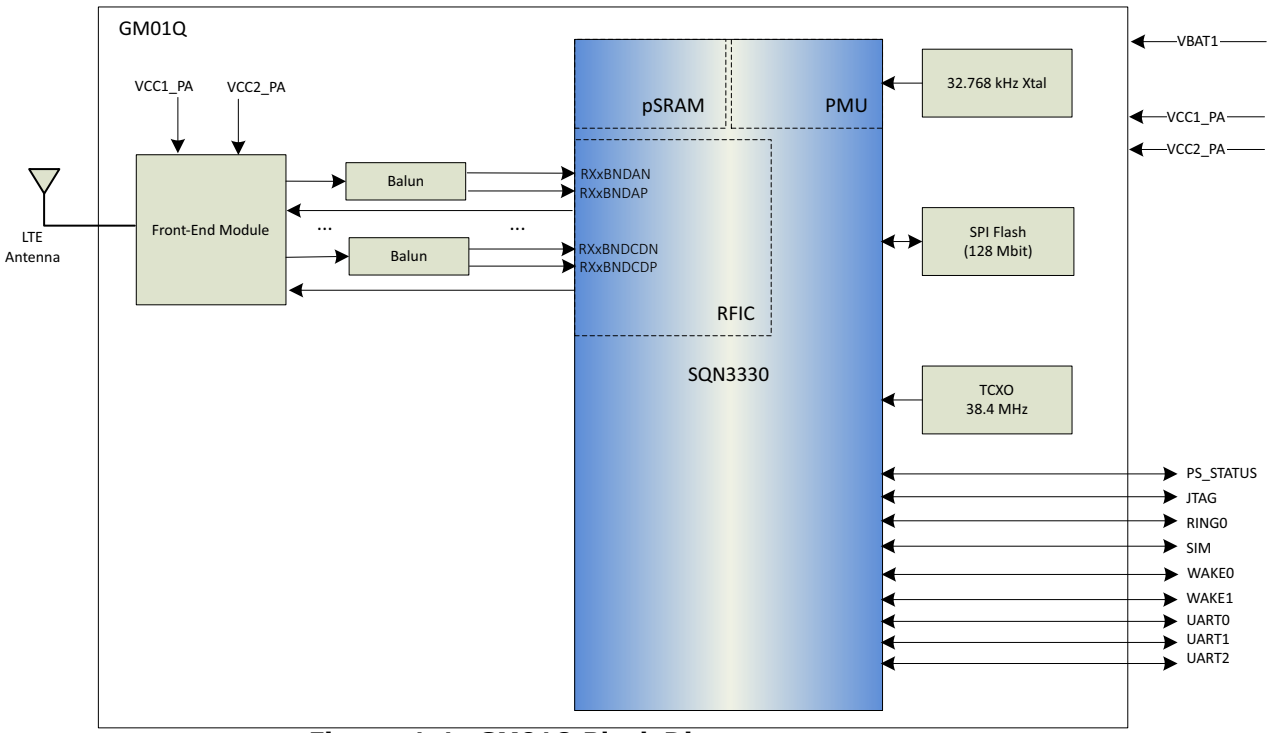

Figure 1-1: GM01Q Block Diagram

Table 1-1 on page 2 provides detail on general features of the GM01Q.

Table 1-2 on page 2 provides detail for the LTE-related features of the GM01Q.

GM01Q's ECCN and part number are detailed in the Section 3.1 ECCN and Part Number on page 7.

Table 1-1: General Features

General interfaces	• JTAG • I2C (reserved) • USIM • SPI (reserved) • GPIO • UART (x3, including one reserved)
Supported Frequency Bands	One of the following LTE Bands sets: • GM01R63QR5 : LTE bands B2, B4, B12 • GM01R63QR6 : LTE bands B3, B28 • GM01R63QR7 : LTE bands B1, B2, B3, B4, B5, B8, B12, B13, B14, B17, B18, B19, B20, B25, B26, B28, B66
Operation voltages	• V_{bat1} (range from 3.1 V to 4.5 V)
Packaging	• LGA module • 108 pads (21.35 x 20.25 x 1.79 mm) • RoHS compliant, halogen-free
Operating temperature	• RF compliant -30°C to +60°C (ambient) • Operational: -40°C to +85°C (board) See also Section 3.3 Environmental Operating Conditions on page 10.
Humidity	• 10% to 85% See also Section 3.3 Environmental Operating Conditions on page 10.

Table 1-2: LTE Features

Standard compliance	• 3GPP E-UTRA Release 13 compliant

Table 1-2: LTE Features (Continued)

PHY	• One UL and one DL transceiver • Support of HD-FDD Duplexing • Channel 1.4 MHz bandwidth • Normal and extended cyclic prefix • Support of MPDCCH • Modulation - DL: QPSK, 16QAM - UL: QPSK, 16QAM • All coding schemes corresponding to modulations • All channel coding (turbo-coding with interleaver, tail biting convolutional coding, block and repetition coding) and CRC lengths • Sounding (including in special subframes) • Control and data in special subframes • All power control schemes and DL power allocation schemes • HARQ Incremental Redundancy and Chase Combining, with bundling or multi-plexing • Measurements and computations related to CQI (Channel Quality Indicator), PMI (Pre-coding Matrix Indicator) and RI (Rank Indicator), RSRP, and RSRQ • UEPCOP (from 3GPP Release 12) Power Saving Mode
MAC	• Random Access procedure in normal and special subframes • Scheduling Request, Buffer Status Reporting, and Power Headroom Reporting • Discontinuous reception (DRX, eDRX) with long and short cycles • Fast scanning • Hosted configuration • IPv4, IPv6 • RoHC • Location based services • Advanced QoS features
RLC	• ARQ modes: UM, AM, and TM
PDCP	• Ciphering and deciphering: NULL, AES, SNOW 3G • Integrity and protection: AES, SNOW 3G
RRC	• MIB and new SIB1bis • Intra and inter-frequency measurements and handover • Up to 8 Data Radio Bearers supported • Support of CE (Coverage Extension) Mode
NAS and above	• NAS • SMS over SG • LWM2M Client

2 Regulatory Approval

Note: This section applies to GM01R63QR5 and GM01R63QR7 part numbers.

Attention

GM01R63QR5 `FCC-ID: 2AAGMGM01Q` (single modular approval)

GM01R63QR7 `FCC-ID: 2AAGMGM01QA` (single modular approval)

This above identified LTE radio module is not intended to be provided to end-users but is for installation by OEM integrators only.

Installation/Integration

OEM integrators must follow Sequans installation instructions to provide for and benefit from FCC compliant module integrations and must abide especially by the following:

The only FCC-compliant LTE bands are : band 2, band 4, band 12 and band 13.

The maximum antenna gain values (accounting for cable attenuation) to comply with the FCC maximum ERP/EIRP limits and with RF Exposure rules:

- LTE band 2 (1800 MHz): 2.1 dBi
- LTE band 4 (1700 MHz): 2 dBi
- LTE band 12 (700 MHz): -2 dBi
- LTE band 13 (780 MHz): -2.4 dBi

The Sequans' module integration guidelines must be closely followed.

Compliance of host integrations of the module is limited to hosts adaptation designs which are identical to Sequans' reference design.

Host integrations with adaption designs deviating from Sequans' reference design require either class 2 permissive change to this modular approval or a separate host approval with different FCC-ID;

Host integrations with co-located (simultaneously operating) radio transmitters must be evaluated in accordance with FCC multi-transmitter rules and may require either class 2 permissive change to this modular approval or a separate host approval with different FCC-ID, dependent on the result of the evaluation; Inquiry at FCC or a TCB is urgently recommended.

Integrations of the module into host products which are intended for portable use, i.e. less than 20cm distance between its radiating structures (antenna) and the body of nearby persons, or which otherwise put additional technical requirements like Hearing Aid compatibility require either class 2 permissive change to this modular approval or a separate host approval with different FCC-ID;

Compliance with Unwanted Emission Limits for Digital Device

If the OEM host integration fully complies with the above described reference design and can completely inherit and rest on compliance of the existing modular approval the OEM remains still responsible to show compliance of the overall end-product with the FCC limits for unwanted conducted and radiated emissions from the digital device (unintentional radio) portion of such end-product (commonly addressed as part 15B compliance or similar).

End-product Labelling

- FCC-ID

  The module's FCC-ID must either be visible from the exterior of the host product (e.g. per window) or per electronic display, or shall be displayed on an additional exterior label per the following or similar string:
  `contains FCC-ID: 2AAGMGM01Q`

- Digital Device - Unwanted Emissions Notice

  If the end-product falls under part 15 of the FCC rules (it shall display the following user notice on its exterior acc. to part 15.19 (the notice may be printed in the manual in case the host is too small):

  ```
  This device complies with Part 15 of the FCC Rules.Operation is
  subject to the following two conditions:
  (1) This device may not cause harmful interference,
  and
  (2) This device must accept any interference received, including
  interference that may cause undesired operation.
  ```

- Further Labelling Requirements may apply dependent on the FCC rule parts relevant to the host product.

- End-product User Instructions / Notices in the Manual

  At a minimum, end-product users must be provided with the following notices at a prominent location of the product literature furnished with the product:

  ```
  * Product Modifications
  Modifications not expressly approved by the party responsible for
  compliance could void the user's authority to operate this
  equipment.
  * RF Exposure Compliance
  This equipment complies with FCC radio frequency radiation exposure
  rules and limits set forth for an uncontrolled environment, when
  installed and operated with minimum distance of 20cm between its
  radiating structures (antenna) and the body of nearby persons and
  when not operated simultaneously with other nearby
  radio-transmitters.
  ```

- Maximum Antenna Gain

  The user instructions of end-products equipped with standard external antenna connectors for the modular radio transmitter providing the option to connect other antennae than those which may or may not be bundled with the end-product must list the maximum allowed antenna gain values as derived from those given above, accounting for the cable attenuations of the actual installation.

- Digital Device - Unwanted Emissions Notice

  If the end-product is or contains a digital device (unintentional radio portions) and is not exempted by its use case (like vehicular use) the following part 15.105 (b) user notice shall be provided at prominent location of the product literature:

  ```
  This equipment has been tested and found to comply with the limits
  for a Class B digital device, pursuant to part 15 of the FCC rules.
  These limits are designed to provide reasonable protection against
  harmful interference in a residential installation.
  This equipment generates uses and can radiate radio frequency
  energy and, if not installed and used in accordance with the
  instructions, may cause harmful interference to radio
  communications. However, there is no guarantee that interference
  will not occur in a particular installation. If this equipment does
  cause harmful interference to radio or television reception, which
  can be determined by turning the equipment off and on, the user is
  encouraged to try to correct the interference by one or more of the
  following measures:
  o Reorient or relocate the receiving antenna.
  o Increase the separation between the equipment and receiver.
  o Connect the equipment into an outlet on a circuit different from
  that to which the receiver is connected.
  o Consult the dealer or an experienced radio/TV technician for help
  ```

- Further User Notices

  May be required dependent on the FCC rule parts relevant to the host product.

- Non-allowed User Instructions

  The end-product user guidance may NOT include instructions about how to install or de-install the module.

3 Physical Characteristics

3.1 ECCN and Part Number

The orderable part numbers of the GM01Q module are as follows, according to the supported LTE bands.

- `GM01R63QR5` for mass production modules: LTE Bands 2, 4, 12
- `GM01R63QR6` for mass production modules: LTE Bands 3, 28
- `GM01R63QR7` for engineering samples: LTE Bands 1, 2, 3, 4, 5, 8, 12, 13, 14, 17, 18, 19, 20, 25, 26, 28, 66

Table 3-1 lists the FEM implemented in the module circuitry for each orderable part number.

Table 3-1: Front-End Module Type per Orderable Part Number

Orderable Part Number	PA implemented in the Module
GM01R63QR5	Skyworks® SKY68001
GM01R63QR6	Skyworks® SKY68001
GM01R63QR7	Skyworks® SKY68020

The ECCN of the GM01Q module is `5A992.c`. CCATS number is `G175554`.

The following comment from licensing officer is reported on the license information:

- This encryption item is described in paragraph B to note 3 (mass market note) of category 5 part 2. It is authorized for export and reexport under section 740.17(B)(3) of the export administration regulations (EAR).

3.2 Electrical Operating Conditions

3.2.1 Detailed Information

Table 3-2 describes the electrical operating conditions for GM01Q.

Table 3-2: Electrical Operating Conditions

	Direction	Minimum	Typical	Maximum
VBAT1	In	3.1 V		4.5 V
SIM_VCC (1.8 V or 3.0 V)	Out	1.62 V	1.8 V	1.98 V
		2.7 V	3.0 V	3.3 V
1V8 See notes below.	Out	1.71 V	1.8 V	1.89 V
3V0 See note 2 below.	Out	2.85 V	3.0 V	3.15 V
VCC1_PA	In	2.85 V	3.0 V	3.3 V
VCC2_PA	In	2.85 V	3.0 V	3.3 V

Note:

1. The maximum current consumption allowed from the 1V8 reference pin is 100 mA.
2. Each output reference voltage (1V8, 3V0) can be either running or powered off depending on the internal software configuration. They should not be used to power external IC or parts that require permanent supply.

3.2.2 GM01Q Power Tree

Figure 3-1 provides a representation of the power tree of the GM01Q. All current values are maximum RMS current.

Note: SKY68001 is the Front-End module for GM01R63QR5 and GM01R63QR6. SKY68020 is the Front-End module for GM01R63QR7.

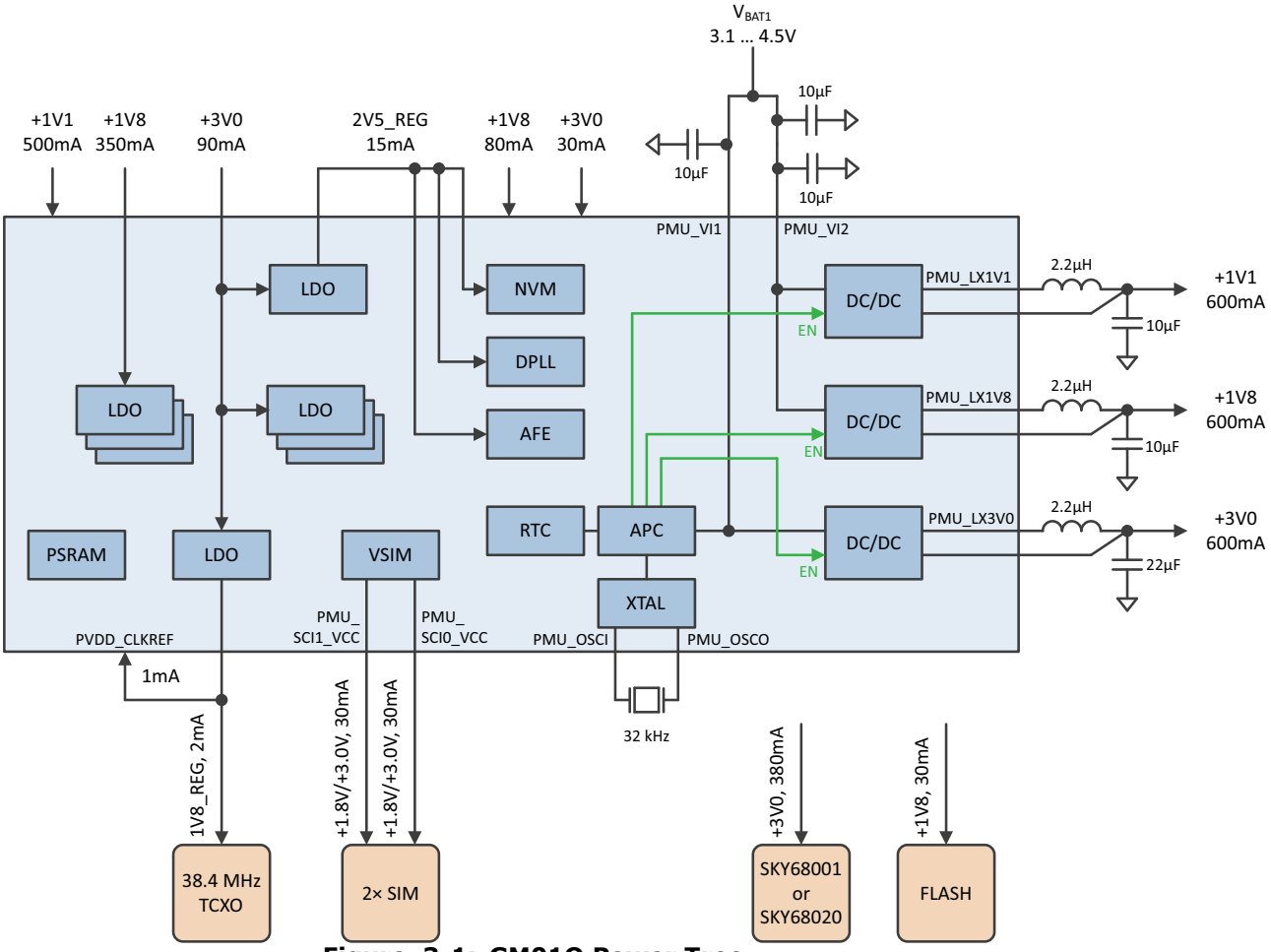

Figure 3-1: GM01Q Power Tree

3.2.3 Power Supplies Environment

Figure 3-2 illustrates the connections between the RF front-end power supplies of the GM01Q.

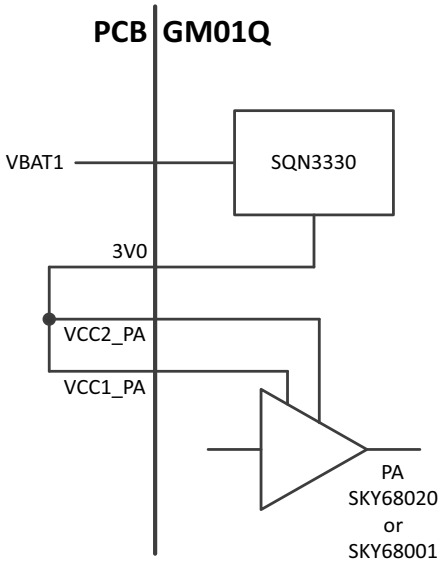

Figure 3-2: GM01Q LTE RF Front-End Power Supplies Diagram

3.3 Environmental Operating Conditions

3.3.1 Temperature

- RF compliant: -30°C to +60°C (ambient)
- Operational, with additional software to limit TxPower: -40°C to +85°C (measured on board)
- Storage: -40°C to +85°C

3.3.2 Humidity

- Operating: 10% to 85% (non condensing)
- Storage: 5% to 85% (non condensing)

3.4 Power Supply Dimensioning

Important: - Information provided here is ***estimated peak current consumption*** for the GM01Q Module in various LTE Tx/Rx configurations, with and without the DC/DC losses. It represents the maximum RMS current.

- The power consumption depends on LTE band of operation. The figures in Table 3-1 are provided for LTE Band 13 only. Please contact your Sequans' representative for other LTE Bands figures.

- Average and detailed power consumption figures are provided in Sequans' Software Release Notes.

Table 3-3: Measured Peak Current and Peak Power Consumption (LTE Band 13)

	Measured Peak Power Consumption	Measured Battery Peak Current (for V_{BAT1}=4.2 V)
RRC Connected, 0dBm Tx, with UL and DL traffic	0.9 W	210 mA
RRC Connected, 10dBm Tx, with UL and DL traffic	1.1 W	250 mA
RRC Connected, 23dBm Tx, with UL and DL traffic	2.0 W	485 mA

3.5 I/O Characteristics

The voltage and current characteristics of the various IO pads of the GM01Q versus IO bank supply voltage are illustrated in the tables below.

Caution: Note that the V_{oh} values in the tables below do not apply to GPIOs configured in open drain mode. GPIOs can be individually configured in open drain mode. When in open drain mode they either drive the line to V_{ol}, or leave it floating, to be pulled up by an external pullup resistance. The PCB designer must ensure that the voltage on these pads never exceeds V_{ih} of the IO group to which they belong.

Refer to GM01Q Pin List to know the type of IO pad used on every termination.

- The Minimum values for I_{ol} and I_{oh} should not be exceeded to guarantee that the logical level are not spoiled for each pad type.
- The Nominal values for I_{ol} and I_{oh} represent the nominal values for the pad type. They are provided for information only.
- The Maximum values for I_{ol} and I_{oh} represent the maximal values for the pad type. They are provided for information only.
- By default, during boot time:
  - The pad defined as GPIO as default function, with BIDIR or BIDIR_WAKE types, are configured as input, output disabled, with no internal pull-up and no internal pull-down.
  - The pads defined as RFDATA as alternate function are configured as input, output disabled, with no internal pull-up and no internal pull-down.

  Contact Sequans's Support Team for detail on persistent AT Commands availability to change these default behaviors.

Table 3-4: DC Characteristics for Digital IOs, Voltage 1.8 V - BIDIR and IN Types

Parameter	Drive Strength	Min.	Nom.	Max.	Unit
V_{IL} Input Low Voltage		0		0.54	V
V_{IH} Input High Voltage		1.26		3.6	V
V_{OL} Output Low Voltage		0		0.45	V
V_{OH} Output High Voltage		1.35		1.8	V

Table 3-4: DC Characteristics for Digital IOs, Voltage 1.8 V - BIDIR and IN Types

Parameter	Drive Strength	Min.	Nom.	Max.	Unit
V_T Threshold Point		0.79	0.87	0.94	V
V_{T+} Schmitt Trigger Low to High Threshold Point		1	1.12	1.22	V
V_{T-} Schmitt Trigger High to Low Threshold Point		0.61	0.71	0.8	V
$V_{T\ PU}$ Threshold Point with Pull-up Resistor Enabled		0.79	0.86	0.93	V
$V_{T\ PD}$ Threshold Point with Pull-down Resistor Enabled		0.8	0.87	0.95	V
$V_{T+\ PU}$ Schmitt Trigger Low to High Threshold Point with Pull-up Resistor Enabled		1	1.12	1.21	V
$V_{T-\ PU}$ Schmitt Trigger High to Low Threshold Point with Pull-up Resistor Enabled		0.61	0.7	0.8	V
$V_{T+\ PD}$ Schmitt Trigger Low to High Threshold Point with Pull-down Resistor Enabled		1.01	1.13	1.23	V
$V_{T-\ PD}$ Schmitt Trigger High to Low Threshold Point with Pull-down Resistor Enabled		0.62	0.72	0.81	V
I_I Input Leakage Current @ VI=1.8V or 0V				±10	µA
I_{OZ} Tri-state Output Leakage Current @ VO=1.8V or 0V				±10	µA
Input Capacitance			3		pF
R_{PU} Pull-up Resistor		56	89	148	kOhm
R_{PD} Pull-down Resistor		52	90	167	kOhm
I_{OL} Low Level Output Current at V_{OL}(max)	2 mA	1.2	2.2	3.6	mA
	4 mA	2.3	4.3	7.1	mA
	8 mA	4.6	8.6	14.3	mA

Table 3-4: DC Characteristics for Digital IOs, Voltage 1.8 V - BIDIR and IN Types

Parameter	Drive Strength	Min.	Nom.	Max.	Unit
I_{OH} High Level Output Current at V_{OH}(max)	2 mA	1.0	2.4	4.6	mA
	4 mA	2.0	4.7	9.2	mA
	8 mA	4.0	9.4	18.4	mA

Table 3-5: DC Characteristics - IN_PMU Type

Parameter	Drive Strength	Min.	Nom.	Max.	Unit
V_{IL} Input Low Voltage		0		0.27	V
V_{IH} Input High Voltage		1.56		3.6	V

Table 3-6: DC Characteristics - BIDIR_WAKE Type

Parameter	Min.	Nom.	Max.	Unit
V_{IL} Input Low Voltage	0		0.27	V
V_{IH} Input High Voltage. See note below related to maximum value.	1.56		3.6	V
V_{OL} Output Low Voltage	0		0.2	V
V_{OH} Output High Voltage	1.63		1.98	V

3.6 Auxiliary ADC

ADC specification is described in Table 3-7.

Table 3-7: ADC Specification

Performance Specification	Description	Value			Unit
		Min.	Typical	Max.	
ADC voltage range		0.1		1.8	V
ADC tolerance	After calibration. The tolerance considered is the highest value between the percentage and the absolute voltage mentioned.	Highest of -2% or -5 mV		Highest of +2% or +5 mV	% or mV
ADC resolution	Nominal resolution		10		bit
ADC input capacitance	ADC input capacitance. See the note below to prevent current leakage in low-power mode.			2	pF
ADC input resistance	ADC input resistance. See the note below to prevent current leakage in low-power mode.	1			MOhm

Important: If the ADC input is interfacing with an external device which doesn't drive 0V when the GM01Q is in Sleeping Mode, then an external analog switch (such as FET) must be connected to ADC input pin to prevent any current leakage in PMU sleeping state.

3.7 Performance

Table 3-8 and Table 3-9 present the GM01Q module's performance in the supported LTE Bands.

Table 3-8: Output Power

GM01Q Module Version	LTE Bands	Conducted Power (dBm) Bandwidth 1.4 MHz, 6 RB
GM01R63QR5	B2, B4, B12	23 +1/-1.7
GM01R63QR6	B3, B28	23 +1/-1.7
GM01R63QR7	B1, B2, B3, B4, B5, B8, B12, B13, B14, B17, B18, B19, B20, B25, B26, B28, B66	23 +1/-1.7

Table 3-9: RF Sensitivity

GM01Q Module Version	LTE Bands	Typ. Sensitivity level (dBm) Bandwidth 1.4 MHz, 6 RB, MCS-5, BLER <5%
GM01R63QR5	B2, B4, B12	-104
GM01R63QR6	B3, B28	-104
GM01R63QR7	B1, B2, B3, B4, B5, B8, B12, B13, B14, B17, B18, B19, B20, B25, B26, B28, B66	-104

3.8 Component Reliability

Note: Information related to component reliability will be provided in a future edition of this document.

3.9 Package Description

3.9.1 Module Footprint

The module weight is 1.6 g.

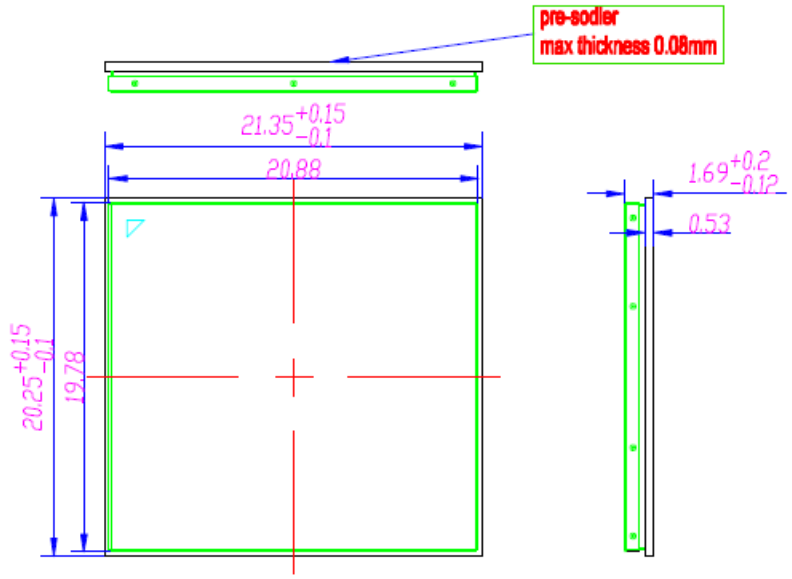

Figure 3-3: Module Top and Side View and Dimensions

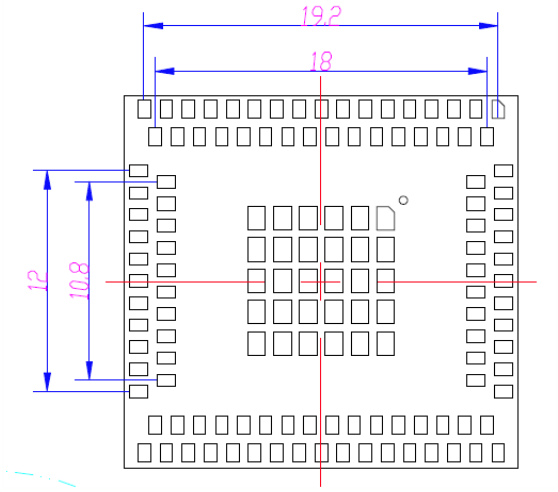

Figure 3-4: Module General Bottom View and Dimensions

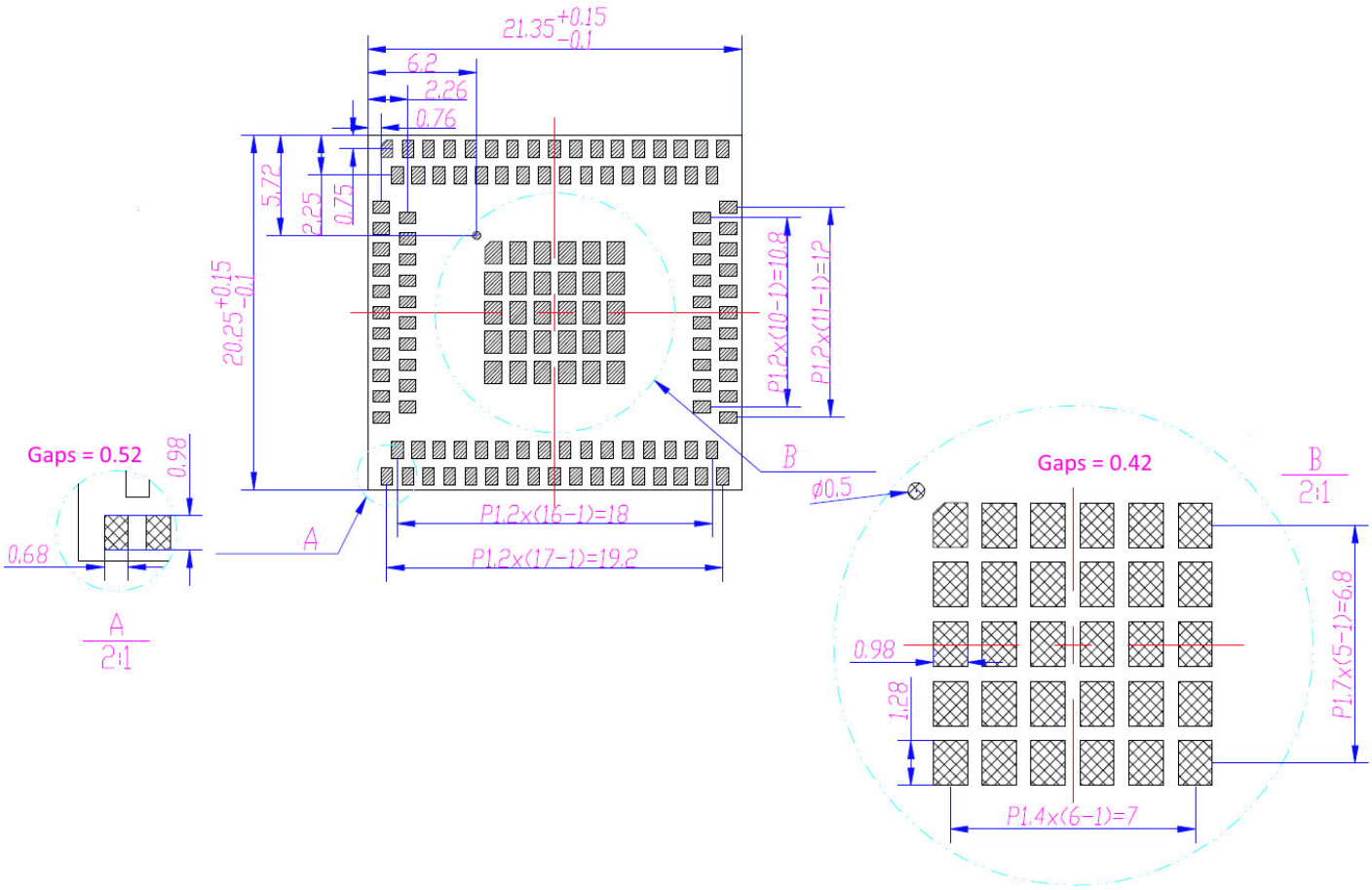

Figure 3-5: Module Detailed Bottom View and Dimensions

3.9.2 Marking Information

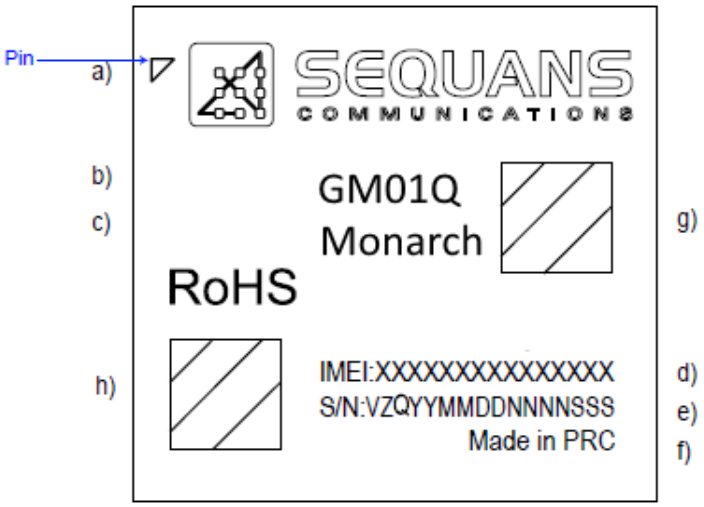

Figure 3-6: GM01Q Marking Description (to be updated)

Table 3-10: Marking Details

Symbol	Description
a	Sequans' Logo
b	GM01Q Product Name
c	Monarch / RoHS logo
d	IMEI: XXXXXXXXXXXXXXX (15 digits)
e	S/N: VZQYYMMDDNNNNSSS (16 digits) VZQ: is immovable (3digits) YYMMDD: Manufacturing Date(YY: Year, MM: Month, DD: Date) NNNN: Panel Counter(4 digits 0001~9999); SSS: Piece counter(001~020)
f	Made in PRC
g	IMEI Barcode
h	S/N Barcode

3.10 Packing Information

The module is delivered in Tape-and-Reel as described in Figure 3-7. The sizes indicated are in mm. Please zoom in the figure to read the numbers.

Each reel contains up to 2000 modules. Each carton contains up to 5 reels.

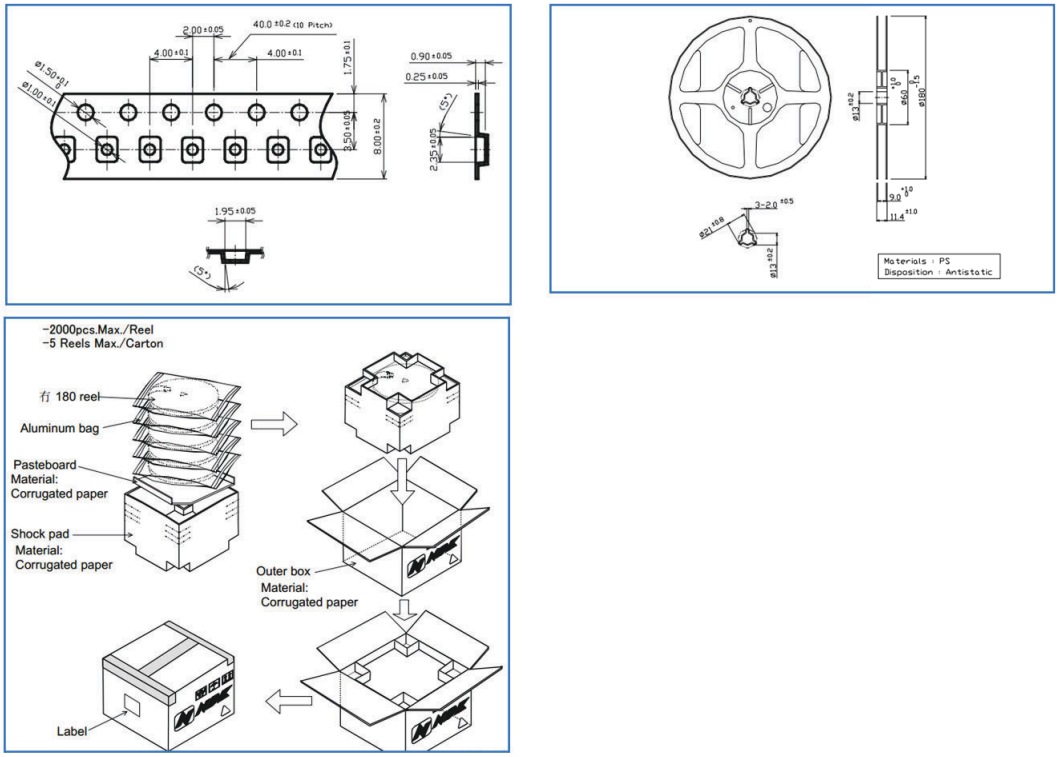

Figure 3-7: Packing Tape and Reel Description

3.11 Storage Conditions

Note: Additional storage conditions impacting the mounting process are provided in Section 3.12 Mounting Considerations on page 22.

The module is MSL3 compliant.

1. Calculated shelf life in sealed bag : 12 months at < 40°C and < 90% RH
2. Peak package body temperature: 250°C
3. After bag is opened, devices that will be subjected to reflow solder or other high temperature process must be:
   a) mounted within 168 hours of factory conditions ≤ 30°C/60%RH, or
   b) Stored as per J-STD-033
4. Devices require bake, before mounting, if
   a) Humidity Indicator Card reads >10% for level 2a-5a devices or >60% for level 2 devices when read at 23±5°C
   b) 3a or 3b above are not met
5. If baking is required, refer to IPC/FEDEC J-STD-033 for bake procedure.

Note: Level and body temperature are defined by IPC/JEDEC J-STD-020.

3.12 Mounting Considerations

The GM01Q can support up to 3 reflows with 250°C maximum.

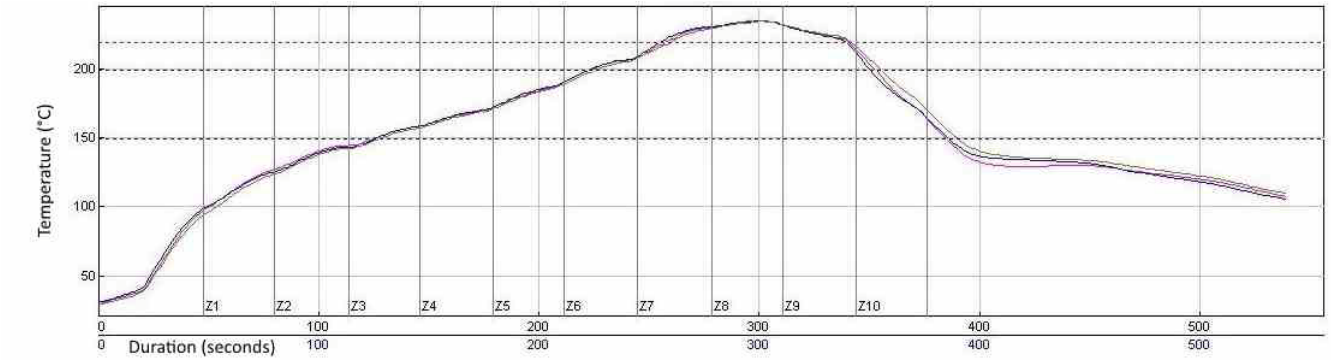

Figure 3-8: Reflow Profile

Table 3-11: Reflow Parameters

Parameter	Setting
Peak package body temperature	To be defined
Liquidous Time	To be defined
Preheat/Soak	To be defined
Ramp-up rate	To be defined
Ramp-down rate	To be defined

4 Signal and Pins

4.1 GM01Q Pinout

The signals and all the related details are listed in the MS-Excel companion file delivered together with the present document in a PDF portfolio.

The pads listed in Table 4-1 are connected to ground.

Table 4-1: Ground and Thermal Pads

Pad #	Pad Name	Comment
1 20 22 24 26 28 30 31 32 33 34 42 43 45 46 53 55 62 63 64 65 66 68 69 70 71 72 73 74 86 87	GND	All GND pads shall be connected to the same copper.
T1 T2 T3 T4 T5 T6 T7 T8 T9 T10 T11 T12 T13 T14 T15 T16 T17 T18 T19 T20 T21 T22 T23 T24 T25 T26 T27 T28 T29 T30	GND	T1 to T30 pads are used as both GND and thermal drops.

4.2 UART Interfaces

Figure 4-1 represents the typical implementation for the hardware flow control for UART0, UART1 and UART2. TXD and RXD signals are mandatory. RTS and CTS are strongly recommended. The other signals are optional.

GM01Q is designed for use as DCE (Data Communication Equipment).

Based on the conventions for DCE-DTE connections, the DCE device will communicate with the customer application (DTE) using the following signals:

- Port TXD on Application sends data to the module's TXD signal line.
- Port RXD on Application receives data from the module's RXD signal line.

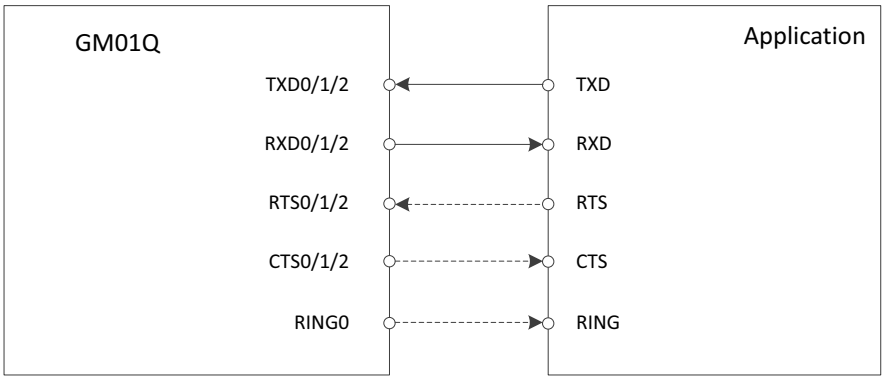

Figure 4-1: UART0, UART1 and UART2 Signals Convention and Flow Control

4.3 Power-up Sequence

The following timing requirement applies to the signals VBAT1, POWER_EN and RESET_N. It must be respected for proper GM01Q's behavior.

Note: The POWER_EN signal has no function for Monarch platform modules. It is mentioned here for compatibility reasons with Calliope platform modules.

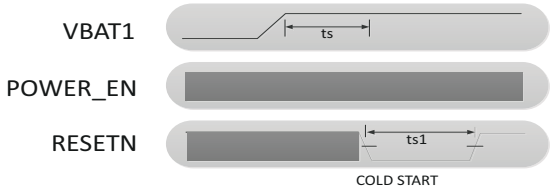

Figure 4-2: VBAT1, POWER_EN and RESET_N Signals Timing Requirement for Cold Start

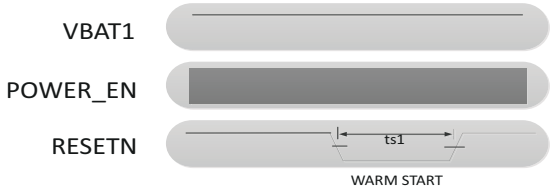

Figure 4-3: VBAT1, POWER_EN and RESET_N Signals Timing Requirement for Warm Start

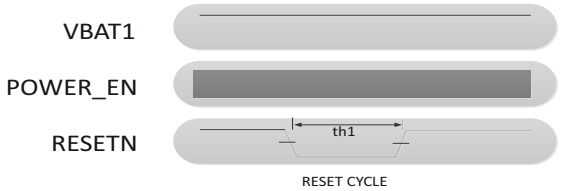

Figure 4-4: VBAT1, POWER_EN and RESET_N Signals Timing Requirement for Reset Cycle

The timing minimum values are listed in Table 4-2.

Note: For cold start: `ts+ts1`=10 s maximum.

Table 4-2: VBAT1 and RESET_N Signal Timing Values

Symbol	Description	Minimum Duration	Maximum Duration
th1	RESET_N hold time	1 µs	-
ts	VBAT1 setup time	1 ms	-
ts1	RESET_N setup time	1 ms	-

4.4 LTE Low Power Mode

4.4.1 General Information

Important: The GM01Q module is provided with an internal RTC whose supply is VBAT1. As a consequence, VBAT1 should not be removed, in order to keep RTC active.

The GM01Q will automatically enter in low-power mode. GM01Q can be woken from low power mode by external sources through:

- SIM_DETECT input signal to cope with SIM card insertion or removal into a SIM card connector with built-in hardware detection.
- The RTS0 input signal whenever data traffic is initiated by the host connected to the module UART0 with hardware flow control; The default configuration to wake-up the module is low level.
- Two dedicated input signal WAKE0 and WAKE1. They are not configured by default as wake-up source but a persistent AT command can enable them. For instance, WAKE0 or WAKE1 can be used to detect an alarm from an external IC such as a sensor.

4.4.2 Detailed Behavior of IO Pads of BIDIR Type

- Behavior in PS-P or Active Mode

  Figure 4-5 shows a simplified diagram of the Digital bi-directional IOs in PS-P or active mode.

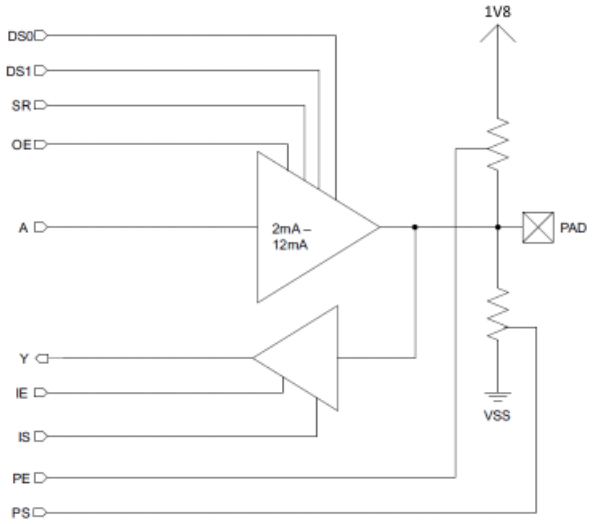

Figure 4-5: Digital Bi-Directional IOs in PS-P or Active Mode

- Behavior in PS-PM

  In PS-PM the Digital bi-directional IOs are completly powered Off.

  In PS-PM the Digital bi-directional IOs can be seen as high-impedance from the outside.

  Table 4-3 shows the Digital bi-directional IOs expected impedance value as seen from the ouside in PS-PM.

Table 4-3: Digital Bi-Directional IOs Expected Impedance Value (Seen from the Outside) in PS-PM

Typical
50 MOhm

4.4.3 Detailed Behavior of IO Pads of BIDIR_WAKE Type

- Behavior in PS-P or Active Mode

  PMU bi-directional wake IOs are used as general purposed IO buffers in PS-P or active mode. Figure 4-6 shows a simplified diagram of the PMU bi-directional wake IOs in PS-P or active mode.

Note:	The PMU bi-directional wake IOs output buffer requires the 3.0V power supply to be ON.

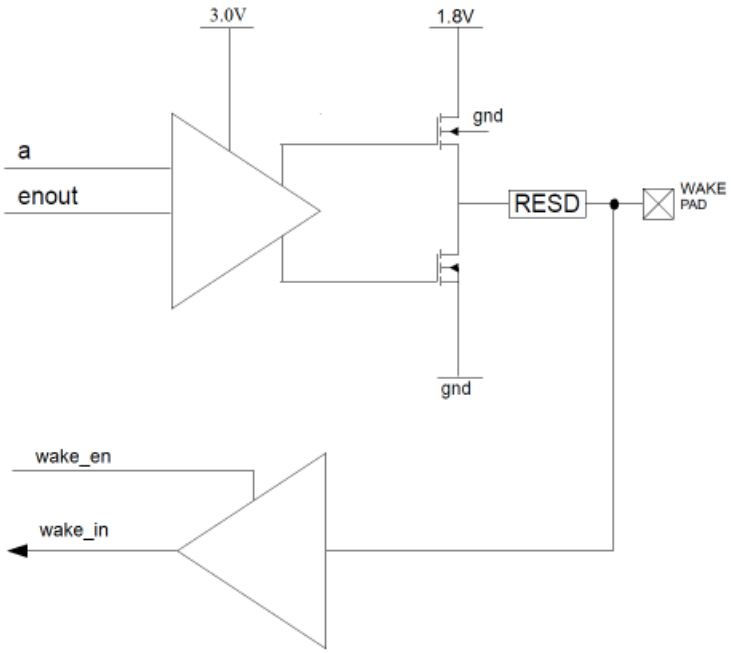

Figure 4-6: PMU Wake IOs in PS-P or Active Mode

- Behavior in PS-PM.

Note:	The PMU bi-directional wake IOs output buffer is disabled in PS-PM.

Figure 4-7 shows a simplified diagram of the PMU bi-directional wake IOs in PS-PM.

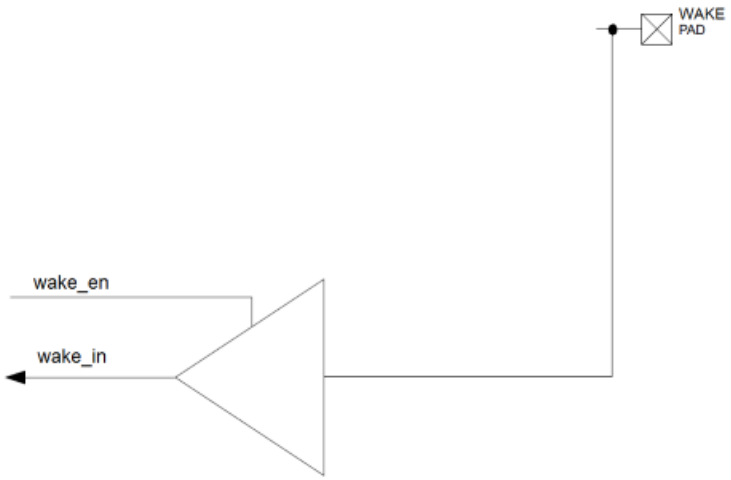

Figure 4-7: PMU Wake IOs in PS-PM Mode

In PS-PM, all PMU bi-directional wake IOs are high impedance with ultra low leakage current. This corresponds to a minimum impedance of 180 MOhm at the maximum input supply voltage of 3.6 V.

If an event is presented on the wake IO pad and this wake IO has been configured to be sensitive on that event, this will take the system back to Active mode.

Table 4-4 shows the values of the measured leakage current (measurements taken on silicon) for the PMU bi-directional wake IOs.

Table 4-4: Measured leakage current for the PMU bi-directional wake IOs.

Minimum	Typical	Maximum
3 nA	4 nA	12 nA

Table 4-5 shows values of the external pull-up/pull-down resistor to be used on the PMU bi-directional wake IOs pads.

Table 4-5: External pull-up/pull-down resistor to be used on the PMU bi-directional wake IOs Pads.

Minimum	Typical	Maximum
1 kOhm	10 kOhm	100 kOhm

Table 4-6 shows details about the PMU bi-directional wake IOs pulses detection mechanism timings.

Table 4-6: Details about the PMU bi-directional wake IOs pulses detection mechanism timings

Maximum pulse width that is guaranteed to be ignored	Minimum pulse width that is guaranteed to be seen
11.1 ns	100 µs

A Acronyms

Acronym	Definition
AFE	Analog Front-End
APC	Automatic Control Power
CE	Coverage Extension
COO	Country of origin
CPU	Central Processing Unit
DC/DC	Direct current converter
DDR	Double Data Rate (SDRAM)
DL	Downlink
DPLL	Digital Phase-Locked Loop
ECCN	Export Control Classification Number
EPS	Evolved Packet System
ESD	Electro-static discharge
ETSI	European Telecommunications Standard Institute
FCC	Federal Communications Commission (USA)
GND	Ground
GPIO	General Purpose Input Output
HBM	Human Body Model (ESD)
I/O	Input/Output
I2C	Inter-integrated circuit (bus)

Acronym	Definition
IETF	Internet Engineering Task Force. See https://www.ietf.org/
IMEI	International Mobile Equipment Identity
IMS	Instant Messaging Service
IP	Internet Protocol
JTAG	Joint Test Action Group. See IEEE 1149.7 specification
LDO	Low Drop-Out regulator
LGA	Large Grid Array
LNA	Low-Noise Amplifier
LTE	Long Term Evolution, or 4G. Standard is developed by the 3GPP www.3gpp.org.
MM	Machine Model (ESD)
NAS	Network Access Server
NVM	Non Volatile Memory
OEM	Original Equipment Manufacturer
OMADM	Open Mobile Alliance Device Management
PCB	Printed Circuit Board
PHY	Physical Layer
PLL	Phase-Locked Loop
PMIC	Power Management Integrated Circuit
pSRAM	Pseudo-Static Random Access Memory
QTY	Quantity
RAM	Random Access Memory
RAN	Radio Access Network
RB	Resource Block
RF	Radio Frequency
RFIC	RF Integrated Circuit

Acronym	Definition
RoHS	Restriction of Hazardous Substances
RTC	Real-Time Clock
Rx	Reception
S/N	or SN: Serial Number
SAW	Surface Acoustic Wave (filters)
SDM	Socketed Device Model (ESD)
SDRAM	Synchronous Dynamic Random Access Memory
SIM	Subscriber Identification Module
SMS	Short Message Service
SPI	Serial Peripheral Interface
TCXO	Temperature-controlled crystal oscillator
Tx	Transmission
UART	Universal asynchronous receiver transmitter.
UE	User Equipment
UICC	Universal integrated circuit card (SIM)
UL	Uplink
XTAL	Crystal