

LockitModule ACN-LM

Integrators Manual

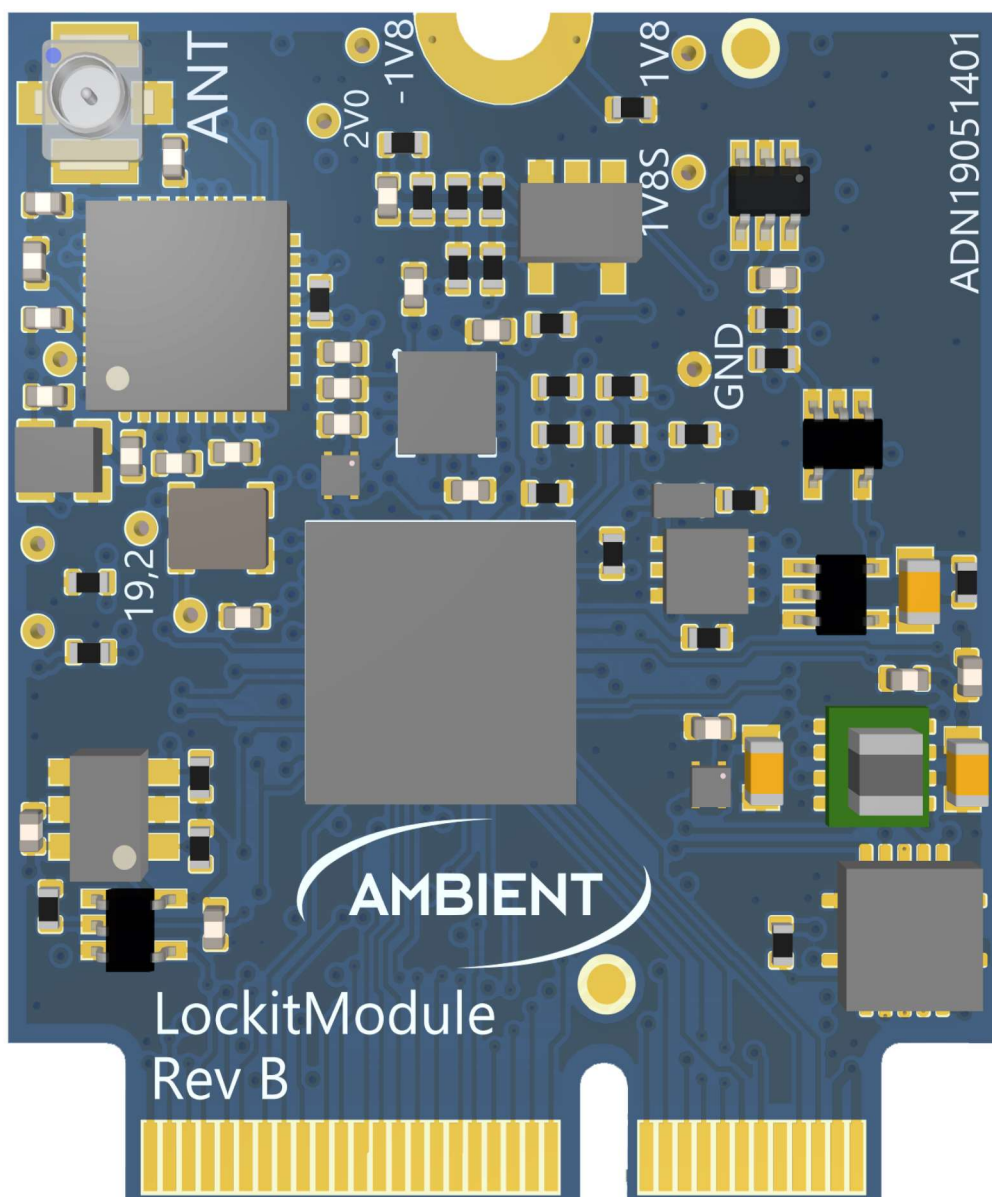


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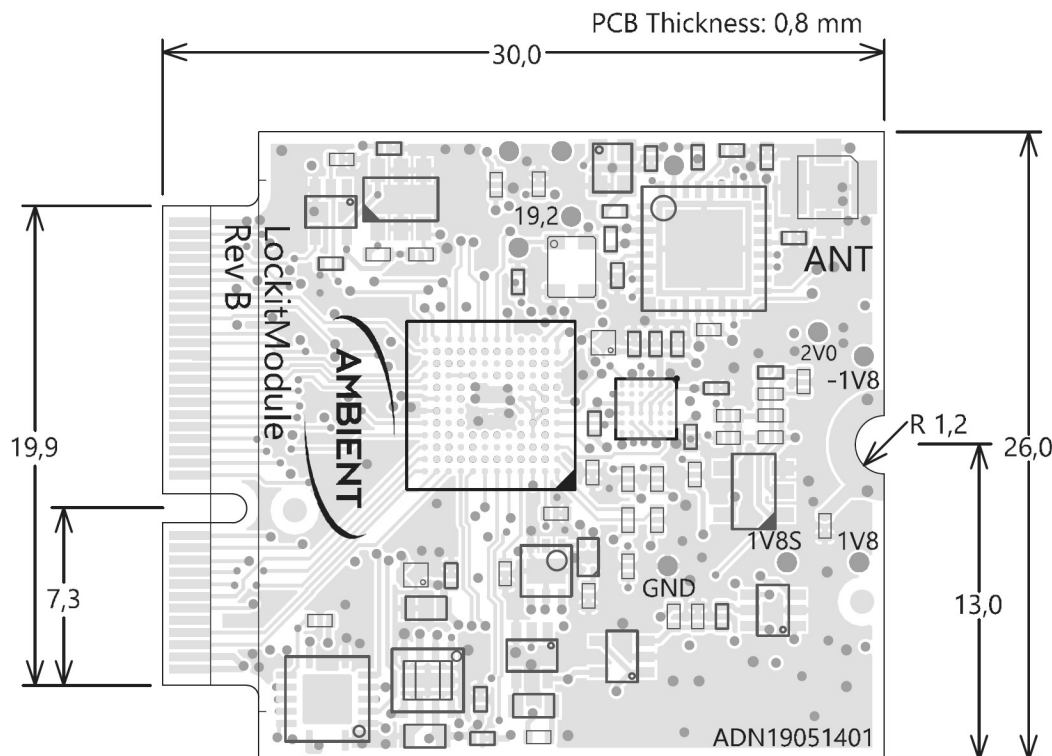
1 Introduction

The LockitModule ACN-LM offers to implement timecode and sync capabilities plus metadata processing based on a modular NVMe form factor plug in card. It features industry standards such as SMPTE 12M, MIDI timecode, ITU/REC tri-level video sync, audio wordclock and multiple pulse per frame camera shutter sync. The module also seamlessly integrates Ambients ACN, an IEEE802.15.4 based, wireless sync and metadata network.

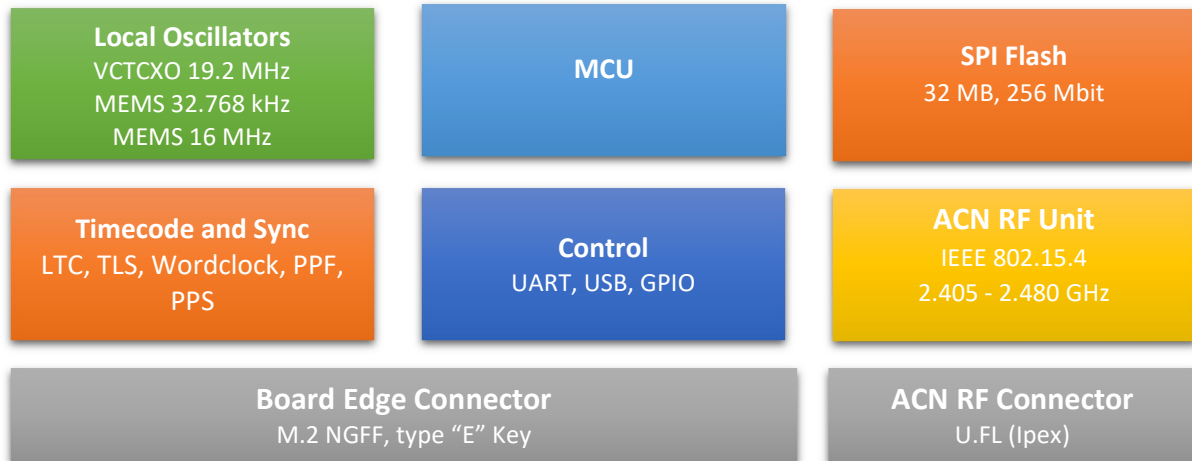
2 Specifications

Name	LockitModule ACN-LM
Module dimension	26 mm (W) x 30 mm (L)
Temperature range	0 °C to 70 °C
Weight	~3g
Power supply voltage range	3.15 to 3.45 V (3.3 V +/- 5%)
Board edge connector	M.2 (NGFF) key E
Host interfaces	USB 1.1, UART
ACN RF	Frequency band: 2400MHz-2483,5MHz, ch. bandwidth 2MHz, ch. spacing 5MHz, ch. 11 through 26 of IEEE802.15.4 2.4. Declared output power: 8.3 dBm

2.1 Physical Dimensions



2.2 Block Diagram



2.2.1 Local Oscillators

The circuitry is driven by 3 frequencies, , the reference oscillator, a tunable VCTCXO @ 19.2 MHz with .1 ppm frequency stability in the temperature range from -30 °C to +70 °C and auxiliary frequencies @ 32.768 KHz and 16 MHz.

2.2.2 MCU

STM32L4R5xx microcontroller.

2.2.3 SPI Flash

For various tasks like firmware update, parameter storing and event logging.

2.2.4 Timecode and Sync

Main signal in-and outputs to sync with external equipment

2.2.5 Control

Access to the units parameters, configuration and status indication.

2.2.6 ACN RF

The ACN sync and metadata network builds on the IEEE802.15.4 LR-WPAN standard in the 2.4GHz, approved for on globally license free use. Channels are fixed and can be selected using the API. If desired, the RF part can also be completely disabled.

ACN Channel	Off	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26
Freq. (MHz)	RF Muted	2405	2410	2415	2420	2425	2430	2435	2440	2445	2450	2455	2460	2465	2470	2475	2480

2.2.7 Board Edge Connector

All signal and control lines to operate the LockitModule are through a single type "E" NGFF M.2 connection. Note that the pinout is proprietary and not compatible with other interfaces using the same keying.

2.2.8 ACN RF Connector

“ANT” carries the ACN IEEE802.15.4 RF signal via a standard U.FL socket. If RF output is not disabled permanently with no option of alteration through the user this connection must be properly terminated with a compliant 50 Ohms IPEX lead and suited antenna with max 2dBi in the according range.

3 Board Edge Connector Pinout

Signal	Type	Pin	Pin	Type	Signal
VCC	PWR	1	2	Ground	GND
VCC	PWR	3	4	Ground	GND
SWCLK	* Int.	5	6	O	LED_Red
SWDIO	* Int.	7	8	O	LED_Green
TRACESWO	* Int.	9	10	I	TC_In
N_Reset	* Int.	11	12	NC	Reserved
N_StandBy	* Int.	13	14	O	Wordclock
USB Data+	I/O	15	16	O	TC_Out_1 (buffered)
USB Data-	I/O	17	18	I	UART2_RX (RCP)
USB VBUS	PWR	19	20	O	UART2_TX (RCP)
UART1_RX (ACN)	I	21	22	NC	Reserved
UART1_TX (ACN)	O	23		NC	
	Key	25	24	Key	
	Key	27	26	Key	
	Key	29	28	Key	
	Key	31	30	Key	
GPIO0	I/O	33	32	O	Clock
PPF	O	35	34	I/O	GPIO1
Genlock (TLS)	O	37	36	I/O	GPIO3
TC_Out2 (unbuffered)	O	39	38	I	Button_Green
GPS_PPS	* Int.	41	40	I	Button_Red
SPI_CLK	* Int.	43	42	I	Button_PWR
SPI_MOSI	* Int.	45	44	O	LED Blue
SPI_MISO	* Int.	47	46	* Int.	DisableChg
SPI_NSS!	* Int.	49	48	* Int.	Charging
I ² C_1_SCL	* Int.	51	50	* Int.	PwrGood
I ² C_1_SDA	* Int.	53	52	* Int.	OLED
I ² C_2_SCL	* Int.	55	54	* Int.	OLED_RST
I ² C_2_SDA	* Int.	57	56	* Int.	GPIO10
UART3_TX	O	59	58	* Int.	GPIO11
UART3_RX	I	61	60	* Int.	GPIO12
UART3_RTS		63	62	* Int.	GPIO13
UART3_CTS		65	64	Aux DC Out	1V8
UART4_TX	O	67	66	* Int.	Reserved
UART4_RX	I	69	68	* Int.	Reserved
UART5_TX	O	71	70	* Int.	Reserved
UART5_RX	I	73	72	* Int.	Reserved
VBAT	PWR	75	74	Ground	GND

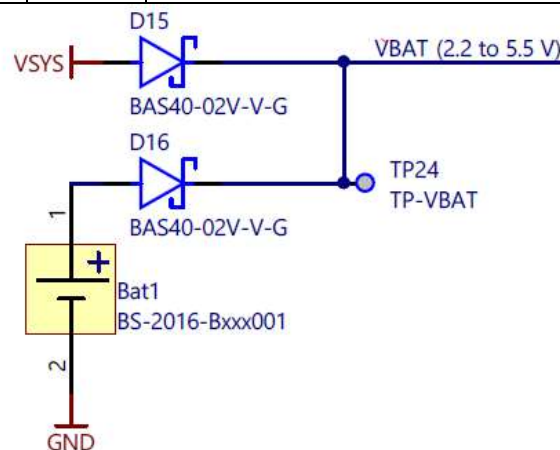
Int. *: exclusive for internal use

3.1 Power

The module requires only one single power supply voltage with 3.3 V.

An optional extra input (VBAT) can be used to supply the internal RTC of the microcontroller

Pin	Name	Type	Description
1, 3	VCC	PWR	Power input, 3.3V DC stabilized, rated 250mA min.
2, 4, 74	GND	Ground	Signal and power ground
64	1V8	PWR	Regulated DC output. Max. load 50 mA
74	VBAT	PWR	Power input for internal RTC 2.2 -5.5V DC, max. 5µA.



Exemplary implementation of a RTC backup battery

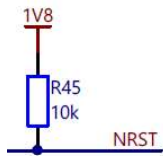
3.2 Aux DC Out

Pin	Name	Type	Description
64	1V8	Power	Output for external Pull-Up resistors. Max. load 50 mA

3.3 System debug signals

Pin	Name	Type	Description
5	SWCLK	* Int.	Serial Wire Clock
7	SWDIO	* Int.	Serial Wire Data In-/Output
9	TRACESWO	* Int.	Serial Wire Trace Output
11	NRST	* Int.	Reset, low active, connect to pin 64 via ext. 10K resistor
13	NSTB	* Int.	Standby, low active

NRST may be used for a hard reset of the microcontroller by momentary pulling to ground. If not connected to other logic tie to 1.8V (available on pin 64) with a 10K resistor to prevent accidental reset.



Exemplary implementation of pull-up resistor

3.4 Communication Interfaces

2 physical host interfaces, UART and USB HID, are available to control and inquire status of the module. The API documentation is available as separate document.

UART

Pin	Name	Type	Description
21	UART_RX	D	3.3V TTL, 5V tolerant
23	UART_TX	D	3.3V TTL

The serial 3V TTL UART1 interface is the most preferable interface for low level connection. A level shifter will be required for communicating over RS232.

USB

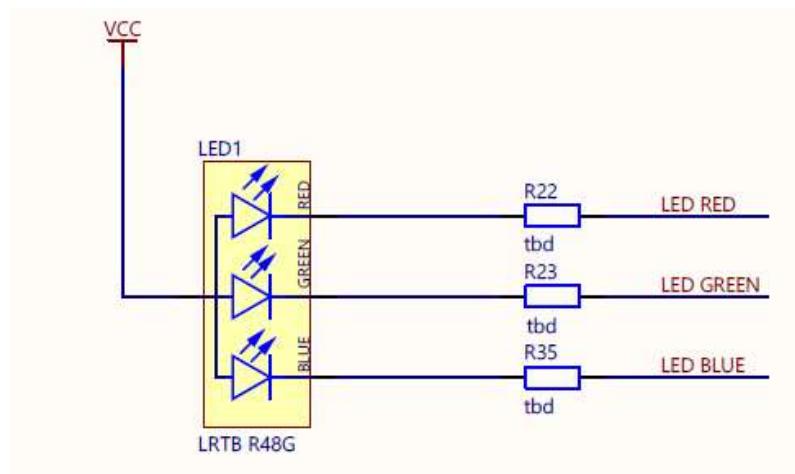
Pin	Name	Type	Description
15	USB_D_P	D	USB data line, full speed
17	USB_D_N	D	USB data line, full speed
19	USB_VBUS	PWR	5V +/-5%, source to be in compliance with BC 1.2

For host systems with USB HID support this interface offers higher data rates and additionally makes the timecode available as MIDI device. Controlling the device is possible via a terminal program using the same API as over UART. Having the USB connection accessible when not in use for configuration offers easy updating of the firmware using the readily available LockitToolbox utility.

3.5 LEDs

Pin	Name	Type	Description
6	LED Red	O	Status indicator, 3.3V, active low
8	LED Green	O	Status indicator, 3.3V, active low
44	LED Blue	O	Status indicator, 3.3V, active low

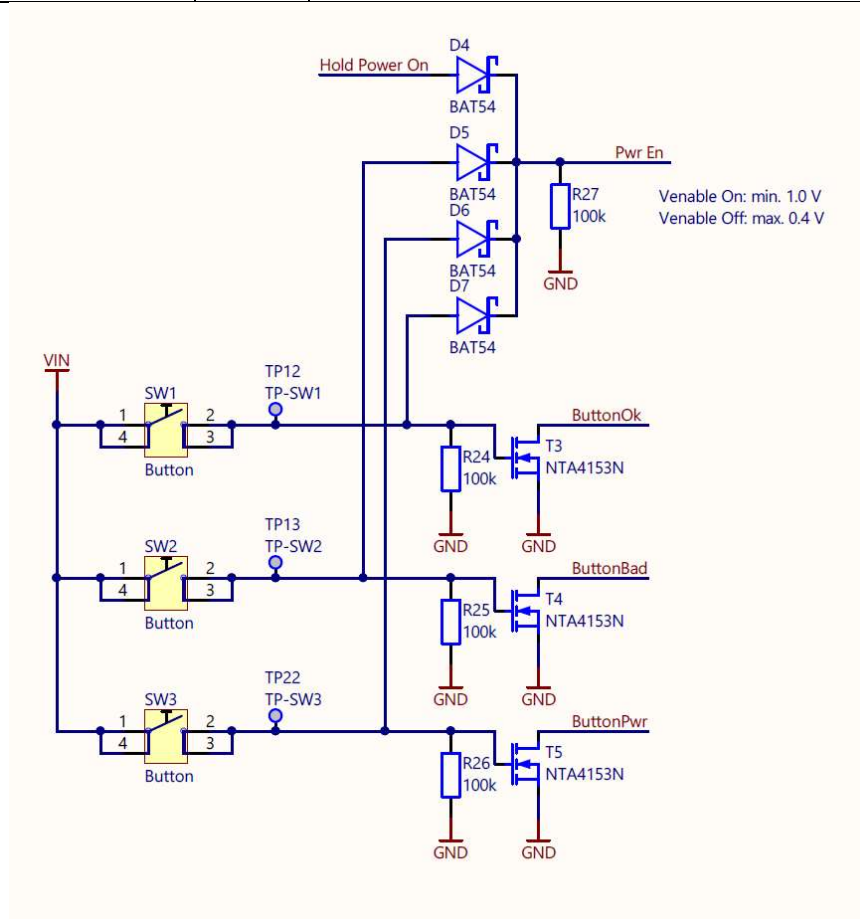
RGB LED outputs allow to visualize the status of generator and ACN activity. It is strongly recommended to connect LEDs for debugging and optimum user experience.



Exemplary implementation of an RGB LED for status display

3.6 Buttons

Pin	Name	Type	Description
38	Button Green	I	Momentary input
40	Button Red	I	Momentary input
42	Button Pwr	I	Momentary input



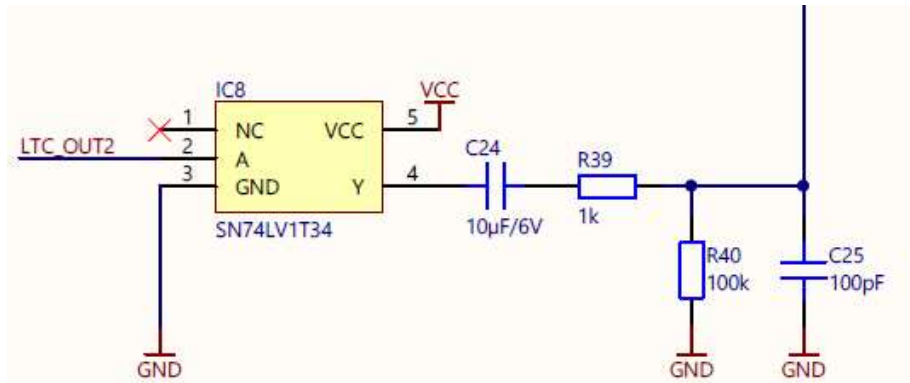
Exemplary implementation using momentary switches

3.7 Timecode

Pin	Name	Type	Description
10	LTC In	I	1.8 – 5V
14	Wordclock	O	3.3V TTL
16	LTC Out	O	Buffered output, variable from mic level to 3.3V TTL max.
39	LTC Out 2	O	1.8V TTL

Timecode is available on 2 pins of the module. Pin 39 supplies 1.8V logic signal for internal use. Pin 16 gives the option to gradually reduce the level from 3V TTL down to mic level to adapt the signal to different requirements. This signal can directly be used to jam sync with external equipment without additional circuitry.

LTC_OUT2 on pin 39 is a direct connection to the processor and optimized for direct internal connection. When made available for external access we recommend a current limiting in line resistor, DC decoupling and tie to GND for defined DC state.



Exemplary circuit for external use of LTC_OUT2

3.8 Sync

Pin	Name	Type	Description
14	Wordclock	O	Wordclock audio, 48/96/192KHz selectable, 3.3V TTL
35	PPF	O	Pulse-Per-Frame output, 1-4 x Proj. FPS selectable, 3.3V TTL
37	TLS		Tri-level sync output, 1080p, i/Psf @ project frame rate selectable, dynamic load impedance signal matching

Pin37 delivers an ITU/REC tri level video sync signal at project frame rate selectable in either 1080i/PsF or 1080P that can be matched in level to drive one or two 75 Ohm targets. For one sync connection adding an inline resistor of 75 Ohms is required, to drive two in parallel 37.5 Ohms.

3.9 GPS PPS

Pin	Name	Type	Description
41	GPS PPS	Int	Optional GPS PPS input, reserved for internal use

3.10 Clock

Pin	Name	Type	Description
32	Clock Out	O	19.2 MHz, 1.8V TTL

3.11 GPIOs

Pin	Name	Type	Description
33	GPIO0	I/O	
34	GPIO1	I/O	
35	GPO2	O	
36	GPIO3	I/O	
44	GPIO4	I/O	

46	GPIO5	I/O	
48	GPIO6	I/O	
50	GPIO7	I/O	
52	GPIO8	I/O	
54	GPIO9	I/O	
56	GPIO10	I/O	
58	GPIO11	I/O	
60	GPIO12	I/O	
62	GPIO13	I/O	

Reserved for internal use

3.12 Analog inputs

4 general purpose analog inputs, with firmware dependent functionality:

Pin	Name	Type	Description	Note
66	AI1	Analog	Analog input 1. Input range: 0 to 1.8 V	reserved for internal use
68	AI2	Analog	Analog input 2. Input range: 0 to 1.8 V	reserved for internal use
70	AI3	Analog	Analog input 3. Input range: 0 to 1.8 V	reserved for internal use
72	AI4	Analog	Analog input 4. Input range: 0 to 1.8 V	reserved for internal use

reserved for internal use

3.13 UART lines

Pin	Name	Type	Description
18	UART2 RX	I	Receiver input, 3.3 V logic ,1.8 V logic, 5V tolerant
20	UART2 TX	O	Transmitter output , 3.3 V logic

UART2 is permanently assigned for native support of RED Digital Cinemas® RCP for control and metadata.

Pin	Name	Type	Description
59	UART3 TX	O	Transmitter output ,1.8 V logic
61	UART3 RX	I	Receiver input ,1.8 V logic, 5V tolerant
63	UART3 RTS	O	RTS output ,1.8 V logic
65	UART3 CTS	I	CTS input ,1.8 V logic, 5V tolerant

Reserved for internal use

Pin	Name	Type	Description
67	UART4 TX	O	Transmitter output ,1.8 V logic
69	UART4 RX	I	Receiver input ,1.8 V logic, 5V tolerant

Pipelines a serial signal from UART or USB host control. Please contact Ambient for more information.

Pin	Name	Type	Description
71	UART5 TX	O	Transmitter output ,1.8 V logic
73	UART5 RX	I	Receiver input ,1.8 V logic, 5V tolerant

Reserved for internal use

3.14 SPI lines

Pin	Name	Type	Description
43	SPI CLK	O	SPI clock ,1.8 V logic
45	SPI MOSI	O	SPI master output ,1.8 V logic
47	SPI MISO	I	SPI master input ,1.8 V logic, 5V tolerant
49	SPI NSS1	O	SPI slave select ,1.8 V logic

Reserved for internal use

3.15 I²C Interface

Pin	Name	Type	Description
51	I ² C 1 SCL		1.8V TTL
53	I ² C 1 SDA		1.8V TTL
55	I ² C 2 SCL		1.8V TTL
57	I ² C 2 SDA		1.8V TTL

Reserved for internal use/OLED display.

4 Regulatory Requirements

4.1 EU (ETSI)

The Ambient LockitModule ACN-LM is conform for use in European Union countries. If the module is incorporated into a product, the manufacturer must ensure the compliance of the final product to the European harmonized EMC and low-voltage/safety standards. A Declaration of Conformity must be issued for each of these standards and kept on file as described in Annex II of the R&TTE Directive. The manufacturer must maintain a copy of the module documentation and ensure the final product does not exceed the specified power ratings, antenna specifications, and/or installation requirements as specified in the user manual. If any of these specifications are exceeded in the final product, a submission must be made to a notified body for compliance testing to all required standards. The CE marking must be affixed to a visible location at the OEM product. The CE mark shall consist of the initials "CE" taking the following form:

- If the CE marking is reduced or enlarged, the proportions must be respected.
- The CE marking must have a height of at least 5 mm except where this is not possible on account of the nature of the apparatus.
- The CE marking must be affixed visibly, legibly, and indelibly.

More detailed information about CE marking requirements can be found at "DIRECTIVE 1999/5/EC OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL" on 9 March 1999 at section 12.

4.2 USA (FCC)

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

FCC §15.105 (b):

Note: 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:

- Reorient or relocate the receiving antenna.
- Increase the separation between the equipment and receiver.
- Connect the equipment into an outlet on a circuit different from that to which the Receiver is connected.
- Consult the dealer or an experienced radio/TV technician for help.

FCC notes for a host subject to certification

The end device must be labeled with:

Contains FCC ID: PDZ-LM

For a host device assembled with the certified module and subject to 47 CFR Part 15 verification of class A digital devices, the following statements have to be included in the user manual and the host device has to be labelled as noted below.

If the host device is subject to other authorization procedures or parts the appropriate requirements of these authorization procedures or parts apply.

Modification of equipment

The instruction manual of the host shall include the following statement:

Changes or modifications made to this equipment not expressly approved by the party responsible for compliance may void the FCC authorization to operate this equipment.

Information to the user

The instruction manual of the host shall include the following statement

4.3 Canada (IC)

This device complies with Industry Canada's license-exempt RSS Standard(s). Operation is subject to the following two conditions:

- (1) This device may not cause interference; and

(2) This device must accept any interference, including interference that may cause undesired operation of the device.

Le présent appareil est conforme aux CNR d'Industrie Canada applicables aux appareils radio exempts de licence. L'exploitation est autorisée aux deux conditions suivantes:

- 1) l'appareil ne doit pas produire de brouillage;
- 2) l'utilisateur de l'appareil doit accepter tout brouillage radioélectrique subi, même si le brouillage est susceptible d'en compromettre le fonctionnement.

The end device must be labeled with:

Contains IC: 27202-LM

4.4 Japan

当該機器には電波法に基づく、技術基準適合証明等を受けた特定無線設備を装着している。

This equipment contains specified radio equipment that has been certified to the Technical Regulation Conformity Certification under the Radio Law.

4.5 Various

Special accessories

Where special accessories such as shielded cables and/or special connectors are required to comply with the emission limits, the instruction manual shall include appropriate instructions on the first page of the text describing the installation of the device.

Simultaneous transmission

When the host product supports simultaneous-transmission operations the host manufacturer needs to check if there are additional RF exposure filing requirements due to the simultaneous transmissions. When additional application filing for RF exposure compliance demonstration is not required (e. g. the RF module in combination with all simultaneously operating transmitters complies with the RF exposure simultaneous transmission SAR test exclusion requirements), the host manufacturer may do his own evaluation without any filing, using reasonable engineering judgment and testing for confirming compliance with out-of-band, restricted band, and spurious emission requirements in the simultaneous-transmission operating modes.

If additional filing is required please contact the person at Ambient Recording GmbH responsible for certification of the RF module.

RF exposure statement (mobile and fixed devices)

The instruction manual of the host shall include the following statement:

This device complies with the RF exposure requirements for mobile and fixed devices. However, the device shall be used in such a manner that the potential for human contact during normal operation is minimized.

RF exposure statement (portable devices)

The instruction manual of the host shall include the following statement:

This device complies with the RF exposure SAR test exclusion requirements for portable devices, if a minimum separation distance of 15mm is kept. However, the device shall be used in such a manner that the potential for human contact during normal operation is minimized

5 Contact Information, Support

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Further documentation, firmware updates, and more: ambient.de/downloads/