Panasonic
INDUSTRY

PAN131x/132x

Bluetooth® Basic Data Rate and Low Energy HCI Module

Product Specification

Rev. 4.2

Wireless Connectivity

Overview

The PAN131x/132x is a Host Controlled Interface (HCI) Bluetooth Low Energy (LE) module that brings Texas Instruments™ seventh generation Bluetooth core integrated circuit, theCC256x, to an easy-to-use module format.

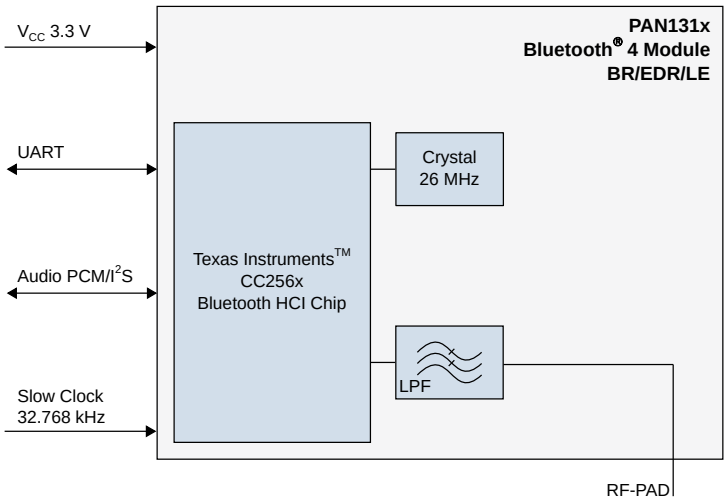
Features

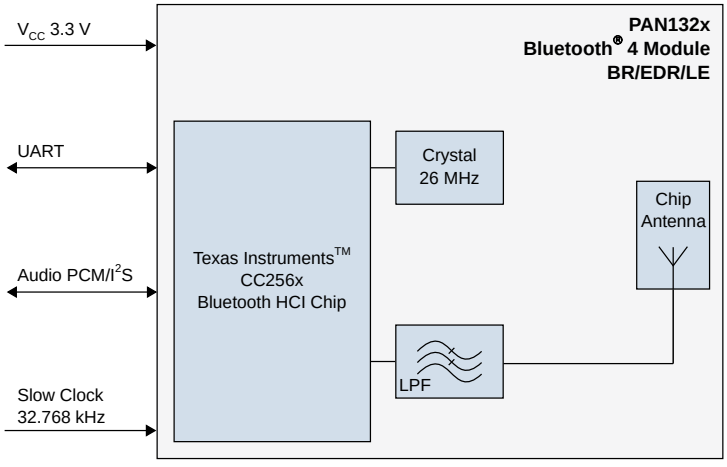
- Small surface mount type dimensions: 9 m × 9.5 mm × 1.8 mm
- Best-in-class Bluetooth RF performance (Tx, Rx sensitivity, blocking)
- Based upon Texas Instruments CC256x
- Interfaces: UART, I²S, PCM

Bluetooth

- Bluetooth 4
- Receiver sensitivity: -93 dBm
- Output power: 10 dBm
- Power supply: 1.7 V to 4.8 V
- Power consumption: Tx 40 mA
- Power consumption: Rx 20 mA
- Sleep mode: 135 µA
- Operating temperature range: -45 ºC to +85 ºC

Block Diagram





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Information on Software

The PAN131x/132x module does not contain any software ex works, i.e. software is provided by 3rd party suppliers only. The essential software resources can be found on the partner website of the software supplier.

PIDEU provides a factory software programming service for your customized firmware; for further information please reach out to your local sales contact this regarding ⇨ 7.2.1 Contact Us.

Table of Contents

1 About This Document

1.1 Purpose and Audience

This Product Specification provides details on the functional, operational, and electrical characteristics of the Panasonic PAN131x/132x module. It is intended for hardware design, application, and Original Equipment Manufacturer (OEM) engineers.

Module Versions

This Product Specification considers the following modules:

- PAN1315(A/B)
- PAN1325(A/B)
- PAN1316(B)
- PAN1326(B)
- PAN1317
- PAN1327
- PAN1323

The product is referred to as “the PAN131x/132x” or “the module” within this document.

Non-antenna versions will be referred to as PAN131x and versions with antenna will be referred to as PAN132x in this document.

1.2 Revision History

Revision	Date	Modifications/Remarks
1.0	2010-11-04	First preliminary version
1.1	2010-12-03	Included reference to “PAN1325 Application Note”
1.2	2011-01-10	Changed wording in chapter “Industry Canada Certification”
1.3	2011-05-23	Included DoC for PAN1315 series. Included reference to “PAN13xx ANT and Bluetooth LE Addendum Rev1.x.pdf”. Included note for IO voltage and MLD_OUT pin.
1.4	2011-07-02	Corrected wording in chapter “European Conformity”
1.5	2011-10-28	Included “CC2560A silicon PAN1315A HW40”. Deleted “ES label“.
1.6	2011-11-15	Added overview for the core specification and their addendums. Updated front page. Updated chapter “Related Documents“.
1.7	2012-01-11	Merged PAN13xx documents into this specification. Updated formatting.
1.8	2012-01-16	Fixed minor mistakes
1.9	2012-05-29	Replaced DoC with revised version
2.0	2012-06-11	Added triple mode stack module PAN1323. Added PAN1323 to ordering and software information overview. Added software Block Diagram. Added Bluetooth Inter IC-Sound information. Added layout recommendations with antenna. Added Application Note LGA.

Revision	Date	Modifications/Remarks
2.1	2012-06-27	Added design information to use low pass filter (chapter 11.1 and 11.9) for better noise suppression when using PCM interface
2.2	2012-07-18	Restructured chapter “Regulatory Information”. Added two chapters.
2.3	2012-10-31	Changed the overview in chapter “Ordering Information”. Included “-40°C to 85°C” version ENW898xxA2KF (K-Version).
2.4	2013-05-17	Changed FCC-ID for models ENW89823xxx and ENW89827xxx
2.5	2013-05-31	Replaced DoC with revised version. Updated links
2.6	2013-08-15	Added component values for low pass filter on PCM interface
2.7	2013-11-11	Changed “CC2567” to “CC2564” in chapter “Ordering Information”
2.8	2013-12-03	Included “CC2560/4B PAN1325/6B” in chapter 2
2.9	2013-12-19	Updated chapter “European Conformity“
3.0	2014-01-10	Added chapter “Radiation Pattern“
3.1	2014-02-28	Changed chapter “Key Features” according to EN regulations
3.2	2014-09-24	Added chapter 27
3.3	2014-11-06	Added DoC
3.4	2015-04-29	Removed chapter 27. Updated chapter “Block Diagram”.
3.5	2015-05-07	Removed chapter “Taiwan Regulatory“
3.6	2015-05-19	Deleted chapter “Software Block Diagram“
3.7	2015-06-11	Changed wording in chapter “Block Diagram”
3.8	2015-09-23	Added Japanese radio law requirements for labeling
3.9	2017-03-09	Added CC2564C in the product description. Added new part number.
4.0	2017-06-14	Editorial changes. Added RED declaration. Added chapter “Korean certification”.
4.1	2017-11-08	Removed PAN13x6C version (moved to separate product specification)
4.2	2021-08-05	New layout, design, and structure. Updated disclaimer. Updated chapters “European Conformity According to RED (2014/53/EU)” and “Bluetooth” (QDID).

1.3 Use of Symbols

Symbol	Description
	**Note** Indicates important information for the proper use of the product. Non-observance can lead to errors.
	**Attention** Indicates important notes that, if not observed, can put the product's functionality at risk.
⇨ [chapter number] [chapter title]	**Cross reference** Indicates cross references within the document. **Example:** Description of the symbols used in this document ⇨ 1.3 Use of Symbols.

1.4 Related Documents

For related documents please refer to the Panasonic website ⇨ 7.2.2 Product Information.

2 Overview

Panasonic's PAN131x/132x is a Host Controlled Interface (HCI) Bluetooth RF module that brings Texas Instruments seventh generation Bluetooth core integrated circuit, the CC256x, to an easy-to-use module format. The PAN131x/132x is Bluetooth 4 compliant and it offers best-in-class RF performance with about twice the range of other Bluetooth LE solutions. Panasonic's tiny footprint technology has produced a module of only 85.5 mm². The module is designed to accommodate PCBs pad pitch of 1.3 mm and as few as two layers for easy implementation and manufacturing.

For related documents please refer to ⇨ 7.2.2 Product Information.

For further information on the variants and versions please refer to ⇨ 7.1 Ordering Information.

2.1 Module Versions

New designs can be completed quickly by mating the PAN131x/132x modules with Texas Instruments “MSP430BT5190” that contains Mindtree’s EtherMind Bluetooth Protocol Stack and serial port profile, additional computing power can be achieved by choosing Texas Instruments Stellaris ARM7 controller that includes StoneStreet One's A2DP profile. Other Bluetooth profiles are available on custom development basis.

2.1.1 PAN13x5B, PAN13x6B

The PAN13x5B and PAN13x6B series are based on Texas Instruments controller “CC2560B” and “CC2564B” respectively. The PAN13x5B and PAN13x6B series modules support assisted mode for the HFP1.6 (WBS) profile or the A2DP profile. The PAN13x6B also supports ten LE connections (instead of six before).

2.1.2 PAN1315, PAN1315A

The PAN1315 and PAN1315A are short-range, Class 1 or 2, HCI modules for implementing Bluetooth functionality into various electronic devices.

Communication between the module and the host controller is carried out via UART.

2.1.3 PAN1317, PAN1327 (ANT)

The PAN1317 and PAN1327 provide wireless, single-chip solution with dual-mode ANT™ and Bluetooth connectivity with inclusion of Texas Instruments “CC2564” device. ANT+ is an interoperability function that can be added to the base ANT protocol (a proprietary wireless sensor network technology). “CC2564” requires 80 percent less board area than a design with two single-mode solutions (one ANT+, one Bluetooth) and increases the wireless transmission range up to two times the distance of a single-mode ANT+ solution.

ANT Current Consumption

Mode	Description	Average Current	Unit
Rx message mode	250 ms interval	380	µA
	500 ms interval	205	
	1 000 ms interval	118	

2.1.4 PAN1323 (Triple Mode)

The PAN1323 has been engineered to give designers the flexibility to implement Bluetooth Classic (BR/EDR), Bluetooth LE or ANT into an application using a single module, reducing cost and footprint area. The module is fully hardware compatible with the PAN1315, PAN1316, PAN1317, PAN1325, PAN1326, and PAN1327. A highly efficient single RF block serves all three protocols. Protocols access the RF block using time division multiplexing. The application layer determines the priority and timing of the RF block. Note that ANT and Bluetooth LE cannot be used simultaneously.

Triple Mode Current Consumption: The current consumption of the PAN1323 is a function of the protocol that the module is running at any point in time.

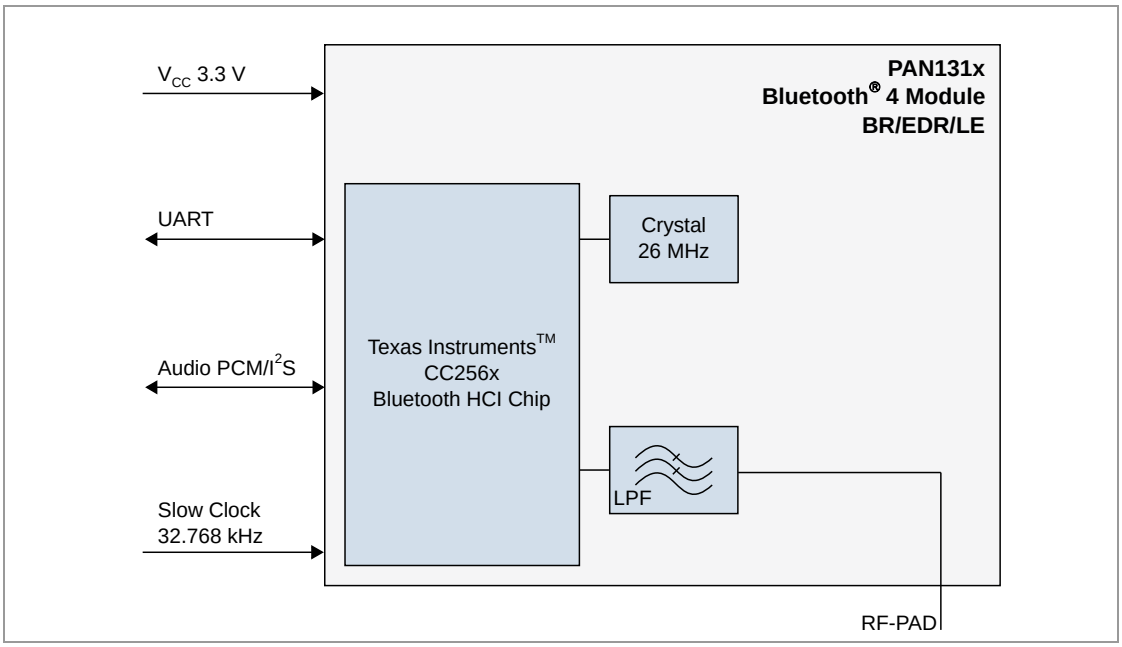
2.2 Block Diagram

The Slow Clock 32.768 kHz is mandatory, otherwise the module does not start up ⇨ 2.5 Clock Inputs.

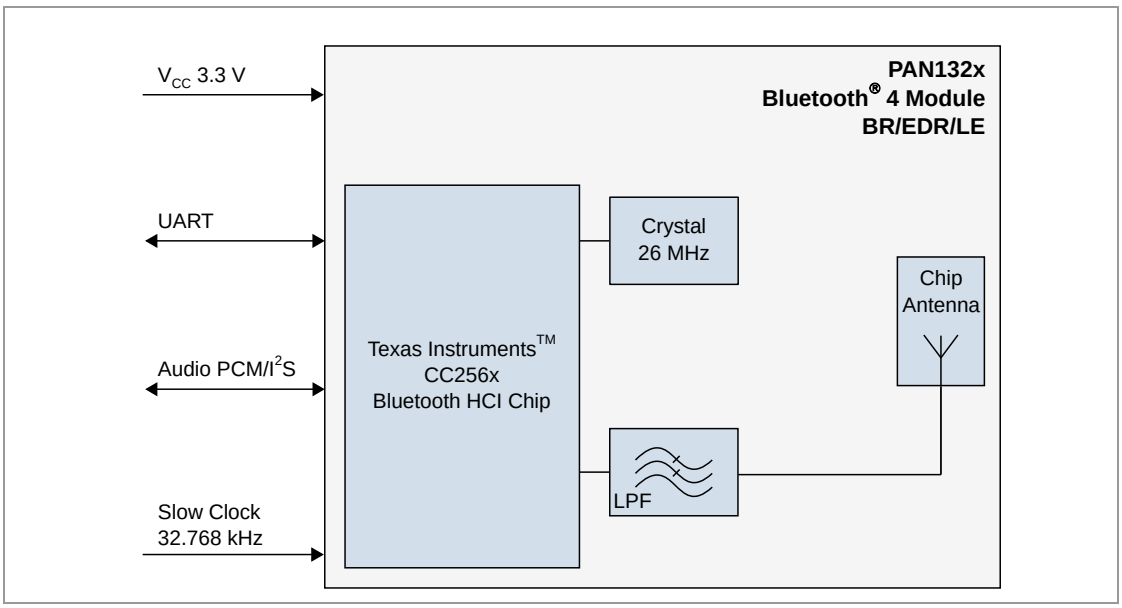
The I/O are 1.8 V driven and might need external level shifter and low-dropout regulator (LDO). The Pin MLDO_OUT cannot be used as reference due to RF internal connection.

The total capacity will not exceed 2.8 µF. The total inductance will not exceed 0 nH. There are no voltage multiplying or voltage boosting circuits.

PAN131x without Antenna



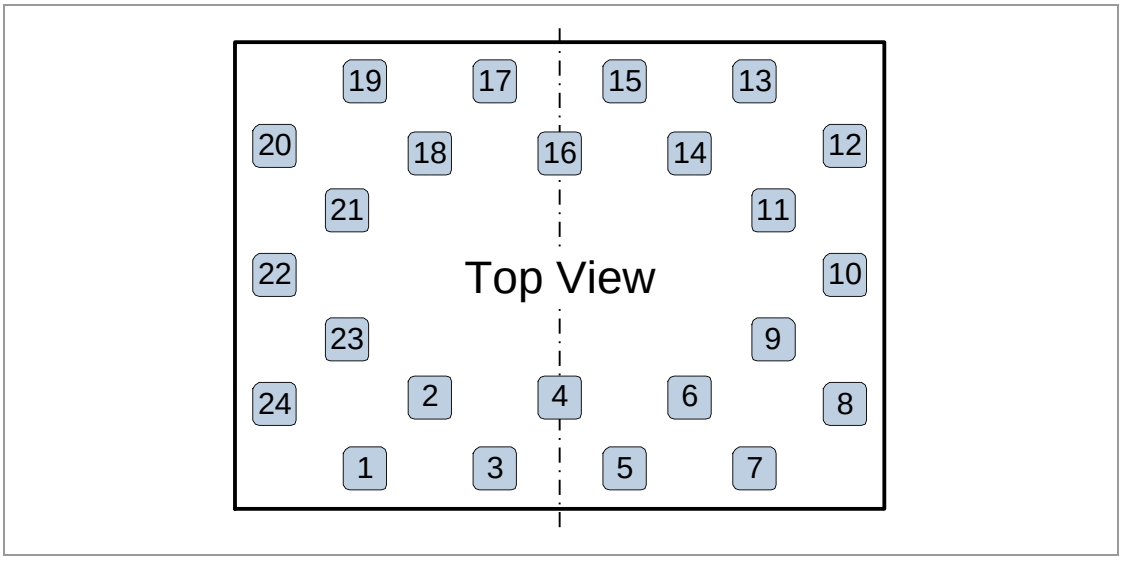
PAN132x with Antenna



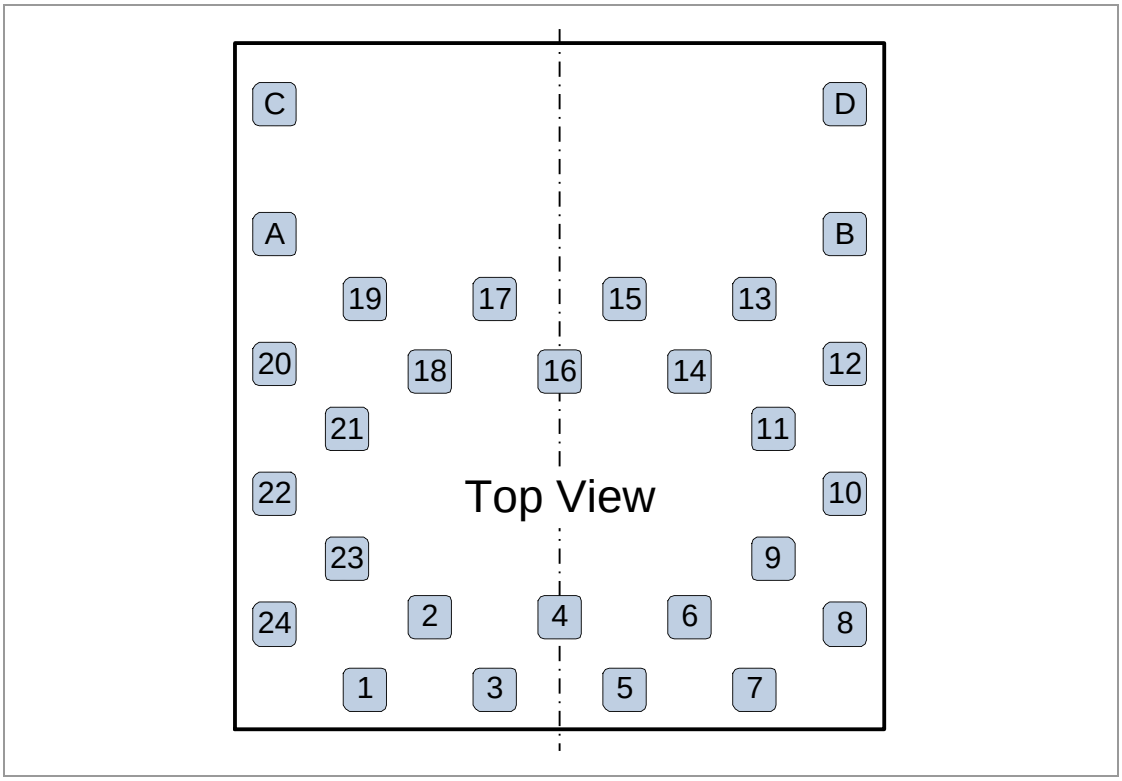
2.3 Pin Configuration

Pin Assignment

PAN131x without Antenna



PAN132x with Antenna



Pin Functions

No.	Pin Name	Pull at Reset	Def. Dir. [1]	I/O Type[2]	ESD	Description
1	GND					Connect to ground
2	TX_DBG	PU	O	2 mA	1 000 V	Logger output
						OPTION: nTX_DBG – logger out (low=1)
3	HCI_CTS	PU	I	8 mA	750 V	HCI UART clear-to-send
4	HCI_RTS	PU	O	8 mA	750 V	HCI UART request-to-send
5	HCI_RX	PU	I	8 mA	750 V	HCI UART data receive
6	HCI_TX	PU	O	8 mA	750 V	HCI UART data transmit
7	AUD_FYSNC	PD	I/O	4 mA	500 V	PCM frame synch (NC if not used)
						Fail-safe[3]
8	SLOW_CLK_IN		I		1 000 V	32.768-kHz clock in
						Fail-safe

[1] I=input, O=output, I/O=bidirectional, P=power, PU=pulled up, PD=pulled down

[2] I/O Type: Digital I/O cells. HY=input hysteresis, current=typ. output current

[3] No signals are allowed on the I/O pins if no V_{DD_IO} (Pin 22) power supplied, except pin 7, 8, 17, 18, 19.

No.	Pin Name	Pull at Reset	Def. Dir. [1]	I/O Type[2]	ESD	Description
9	NC		I/O			
10	MLDO_OUT		O		1 000 V	Main LDO output (1.8 V nominal)
						Cannot be used as 1.8V supply due to internal connection to the RF part.
11	CL1.5_LDO_IN		I		1 000 V	PA LDO input
						Connect directly to battery or to a pre-regulated 1.8-V supply
12	GND					Connect to ground
13	RF		I/O		1 000 V	Bluetooth RF I/O (not connected with antenna)
14	GND					Connect to ground
15	MLDO_IN		I		1 000 V	Main LDO input
						Connect directly to battery or to a pre-regulated 1.8 V supply
16	nSHUTD	PD	I		1 000 V	Shutdown input (active low).
17	AUD_OUT	PD	O	4 mA	500 V	PCM data output (NC if not used)
						Fail-safe
18	AUD_IN	PD	I	4 mA	500 V	PCM data input (NC if not used)
						Fail-safe
19	AUD_CLK	PD	I/O	HY, 4 mA	500 V	PCM clock (NC if not used)
						Fail safe
20	GND					Connect to ground
21	NC				1 000 V	EEPROM I²C IRQ (Internal)
22	VDD_IO		PI		1 000 V	I/O power supply 1.8 V nominal
23	NC				1 000 V	EEPROM I²C SCL (Internal)
24	NC		I/O			Not connected
A	GND					Connect to ground
B	GND					Connect to ground
C	GND					Connect to ground
D	GND					Connect to ground

2.4 Device Power Supply

The PAN131x/132x Bluetooth radio solution is intended to work in devices with a limited power budget such as cellular phones, headsets, Handheld PC's, and other battery-operated devices. One of the main differentiators of the PAN131x/132x is its power management. It is ability to draw as little current as possible.

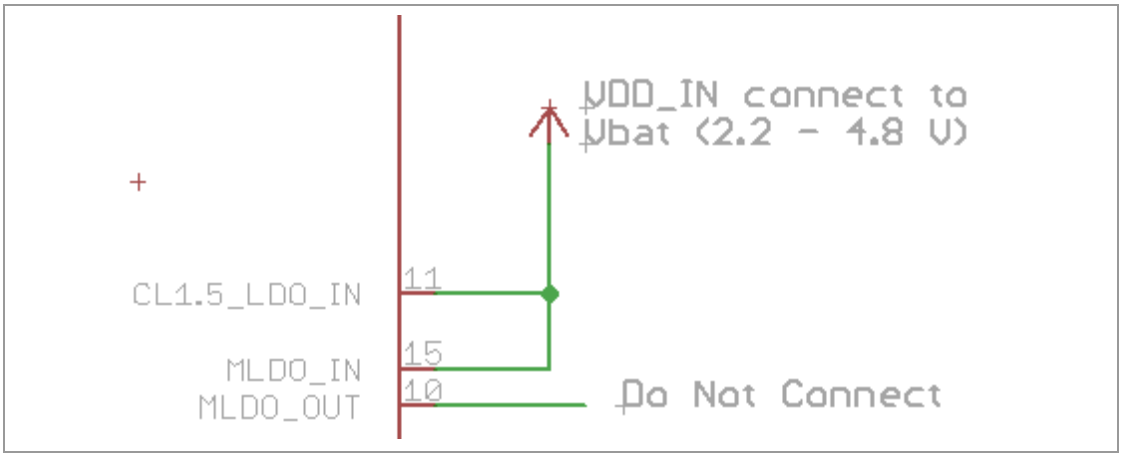
The PAN131x/132x device requires two kinds of power sources:

- Main power supply for the Bluetooth (V_{DD_IN}=V_{BAT})
- Power source for the 1.8 V I/O ring (V_{DD_IO})

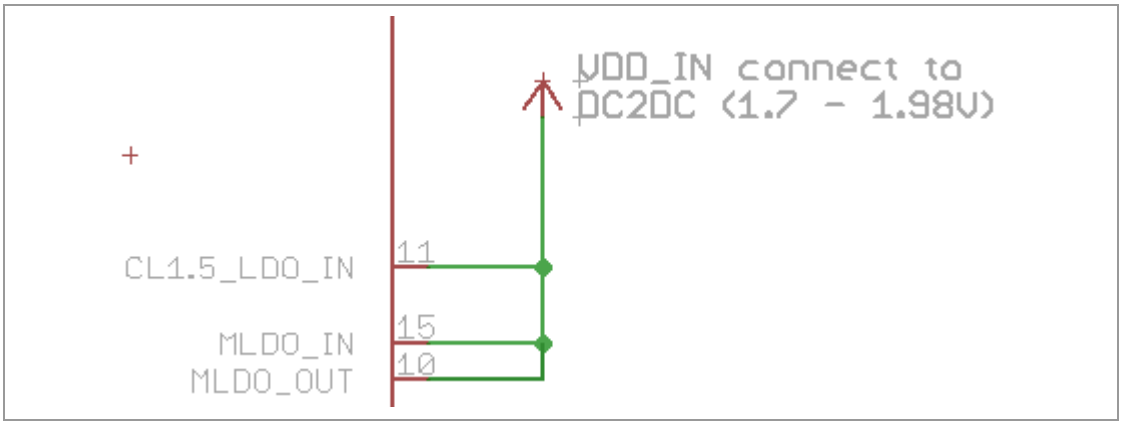
The PAN131x/132x includes several on-chip voltage regulators for increased noise immunity. The PAN131x/132x can be connected either directly to the battery or to an external 1.8 V DC to DC converter.

Three ways to supply power

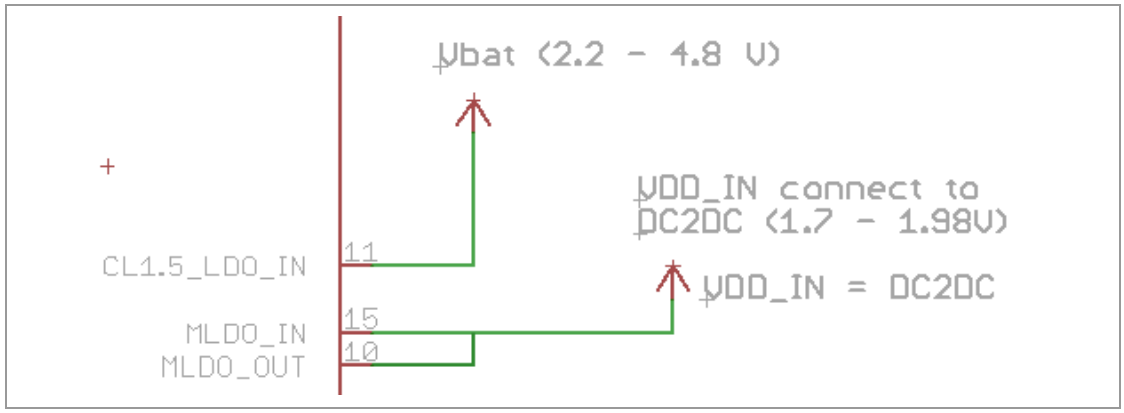
Full V_{BAT} system (Maximum RF output power, but not optimum system power):



Full-DC2DC system (Lower RF output power, but optimum system power):



Mixed DC2DC-V_{BAT} system (Maximum RF output power and optimum system power, but requires routing of $V_{BAT)}$:



2.5 Clock Inputs

The Slow Clock is always supplied from an external source. It is connected to the SLOW_CLK_IN pin number 8 and can be a digital signal with peak to peak of 0 V to 1.8 V.

The Slow Clock's frequency accuracy must be 32.768 kHz 250 ppm for Bluetooth usage (according to the Bluetooth specification).

The Slow Clock 32.768 kHz is mandatory to start the internal controller, otherwise the module does not start up.

2.6 Bluetooth Features

- Support of Bluetooth 2.1+EDR (Lisbon Release) up to HCI level
- Very fast AFH algorithm for both ACL and eSCO
- Supports typically 4 dBm Class 2 Tx power w/o external PA, improving Bluetooth link robustness. Adjusting the host settings, the Tx power can be increased to 10 dBm. It is important, that the national regulations and Bluetooth specification are met.
- Digital Radio Processor (DRP) single-ended 50 ohm
- Internal temperature detection and compensation ensures minimal variation in the RF performance over temperature
- Flexible PCM and Inter-IC Sound (I^2S) digital audio/voice interfaces: Full flexibility of data-format (Linear, a-Law, µ-Law), data-width, data order, sampling and slot positioning, master/slave modes, high clock rates up to 15 MHz for slave mode (or 4.096 MHz for master mode). Lost packet concealment for improved audio.
- Proprietary low-power scan method for page and inquiry scans, achieves page and inquiry scans at 1/3rd normal power.

2.7 Interfaces

2.7.1 Host Controller Interface (HCI)

The CC256x incorporates one UART module dedicated to the HCI transport layer. The HCI interface transports commands, events, ACL, and synchronous data between the Bluetooth device and it is host using HCI data packets.

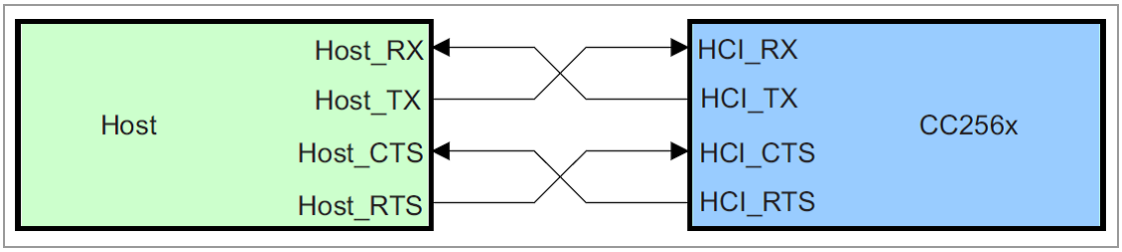
The UART module supports H4 (4-wires) protocol with maximum baud rate of 4 Mbps for all fast clock frequencies.

After power up the baud rate is set for 115.2 kbps, irrespective of fast clock frequency. The baud rate can thereafter be changed with a vendor specific command. The CC256x responds with a Command Complete Event (still at 115.2 kbps), after which the baud rate change takes place. HCI hardware includes the following features:

- Receiver detection of break, idle, framing, FIFO overflow, and parity error conditions
- Transmitter underflow detection
- CTS/RTS hardware flow control

The interface includes four signals: TXD, RXD, CTS, and RTS. Flow control between the host and the CC256x is bytewise by hardware.

Flow control is obtained by the following:



When the UART Rx buffer of the CC256x passes the “flow control” threshold, it will set the UART_RTS signal high to stop transmission from the host.

When the UART_CTS signal is set high, the CC256x will stop it is transmission on the interface. In case HCI_CTS is set high in the middle of transmitting a byte, the CC256x will finish transmitting the byte and stop the transmission.

2.7.2 Audio/Voice CODEC Interface

The codec interface is a fully-dedicated programmable serial port that provides the logic to interface to several kinds of PCM or I²S codecs. PAN131x/132x supports all voice coding schemes required by Bluetooth specification – Log PCM (A-Law or µ-Law) and Linear (CVSD). In addition, module also supports transparent scheme:

- Two voice channels
- Master/slave modes
- µ-Law, A-Law, Linear, Transparent coding schemes
- Long and short frames
- Different data sizes, order, and positions
- High rate PCM interface for EDR
- Enlarged interface options to support a wider variety of codecs
- PCM bus sharing

2.7.2.1 PCM Hardware Interface

The PCM interface is one implementation of the codec interface. It contains the following lines:

- Clock: configurable direction (input or output)
- Frame synchronization: configurable direction (input or output)
- Data In: Input
- Data Out: Output/3-state

The Bluetooth device can be either the master of the interface where it generates the clock and the frame synchronization signals, or slave where it receives these two signals. The PCM interface is fully configured by a vendor specific command.

For slave mode, clock input frequencies of up to 16 MHz are supported. At clock rates above 12 MHz, the maximum data burst size is 32 bits. For master mode, the CC256x can generate any clock frequency between 64 kHz and 6 MHz.

When the I²S bus is used in an application, it is recommended adding a low pass filter (series resistor and capacitor to GND) to the bus for better noise suppression. Connecting the host microcontroller/DSP directly with the module's I²S interface is not recommended.

The suggested low pass filter component values are:

- 470 pF
- 120 Ω

2.7.2.2 Data Format

The data format is fully configurable:

- The data length can be from 8 bits to 320 bits, in 1 bit increments, when working with two channels, or up to 640 bits when using one channel. The data length can be set independently for each channel.
- The data position within a frame is also configurable in with 1 clock (bit) resolution and can be set independently (relative to the edge of the frame synchronization signal) for each channel.
- The Data_In and Data_Out bit order can be configured independently. For example; Data_In can start with the MSB while Data_Out starts with LSB. Each channel is separately configurable. The inverse bit order (that is LSB first) is supported only for sample sizes up to 24 bits.
- It is not necessary for the data in and data out size to be the same length.
- The Data_Out line is configured to “high-Z” output between data words. Data_Out can also be set for permanent high-Z, irrespective of data out. This allows the CC256x to be a bus slave in a multi-slave PCM environment. At power up, Data_Out is configured as “high-Z”.

2.7.2.3 Frame Idle Period

The codec interface has the capability for frame idle periods, where the PCM clock can “take a break” and become “0” at the end of the PCM frame, after all data has been transferred.

The CC256x supports frame idle periods both as master and slave of the PCM bus.

When CC256x is the master of the interface, the frame idle period is configurable. There are two configurable parameters:

Clk_Idle_Start:

Indicates the number of PCM clock cycles from the beginning of the frame until the beginning of the idle period. After Clk_Idle_Start clock cycles, the clock will become “0”.

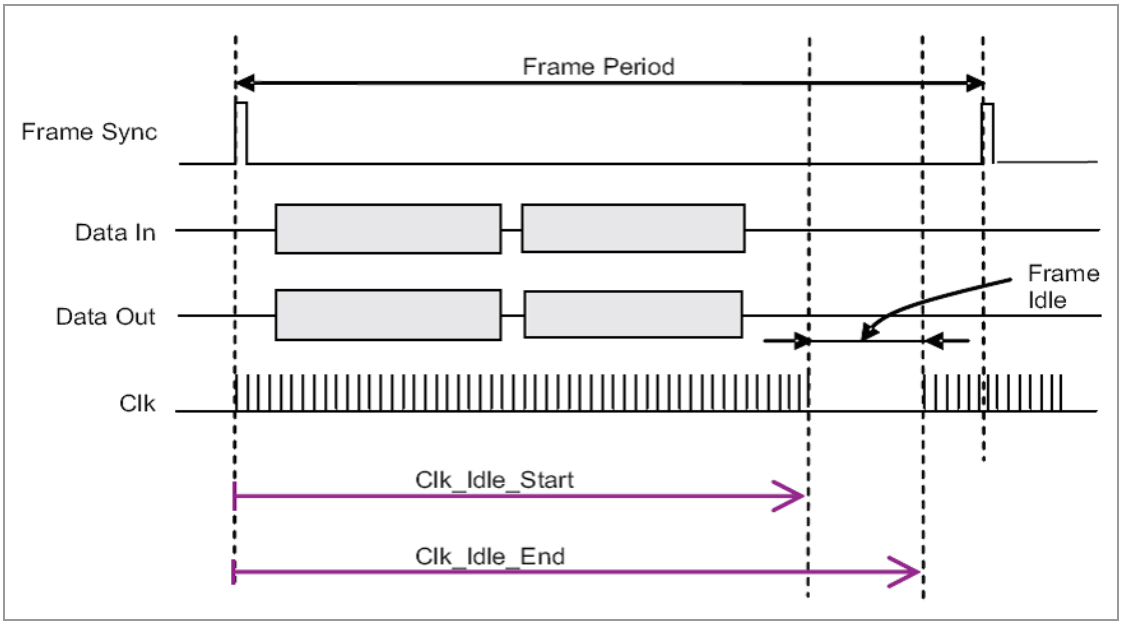
Clk_Idle_End:

Indicates the time from the beginning of the frame till the end of the idle period. This time is given in multiples of PCM clock periods.

The delta between Clk_Idle_Start and Clk_Idle_End is the clock idle period.

For example, for PCM clock rate=1 MHz, frame synchronization period=10 kHz, Clk_Idle_Start=60, Clk_Idle_End=90.

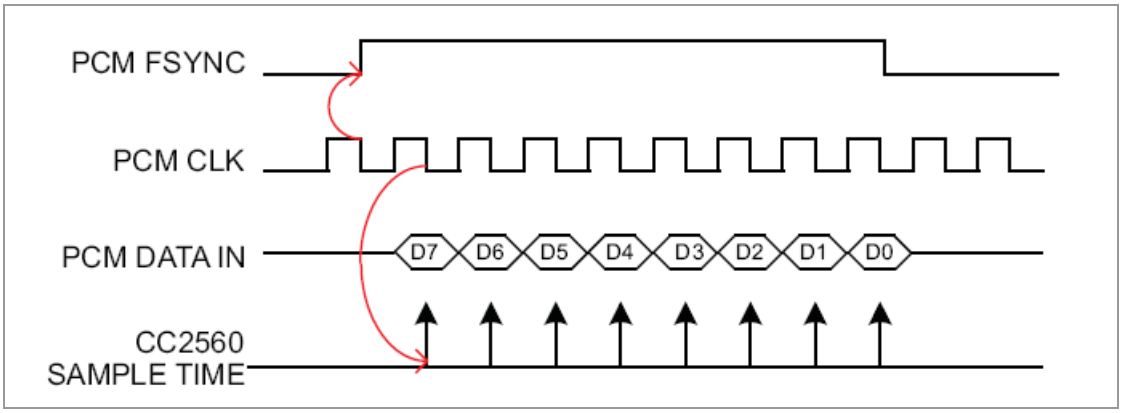
Between each two frame synchronisations there are 70 clock cycles (instead of 100). The clock idle period starts 60 clock cycles after the beginning of the frame, and lasts 90-60=30 clock cycles. This means that the idle period ends 100-90=10 clock cycles before the end of the frame. The data transmission must end prior to the beginning of the idle period.



2.7.2.4 Clock-Edge Operation

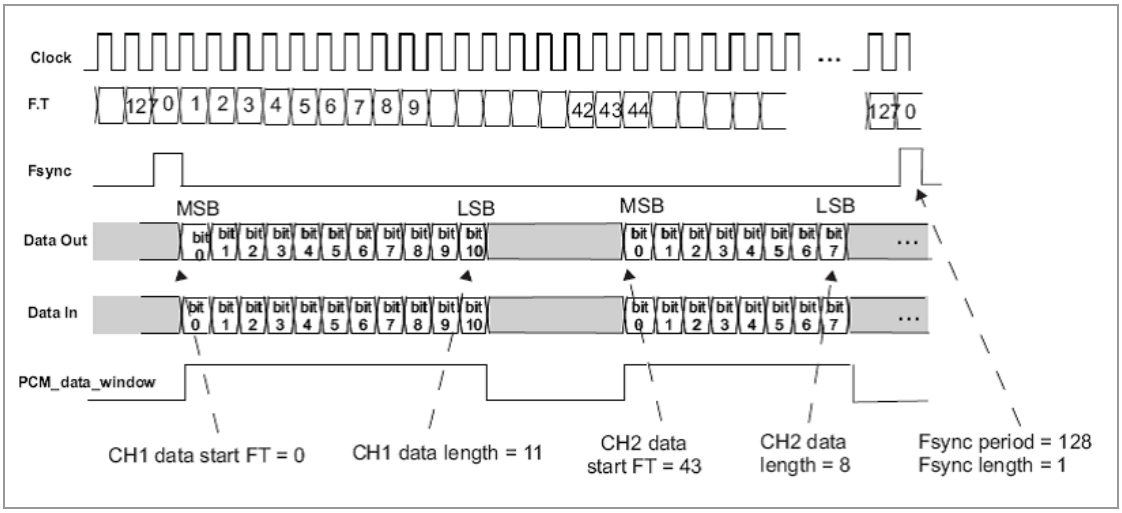
The codec interface of the CC256x can work on the rising or the falling edge of the clock. It also has the ability to sample the frame synchronization and the data at inversed polarity.

This is the operation of a falling-edge-clock type of codec. The codec is the master of the PCM bus. The frame synchronization signal is updated (by the codec) on the falling clock edge and therefore shall be sampled (by the CC256x) on the next rising clock. The data from the codec is sampled (by the CC256x) on the clock falling edge.



2.7.2.5 Two-Channel PCM Bus Example

In below figure, a two-channel PCM bus is shown where the two channels have different word sizes and arbitrary positions in the bus frame. (FT=Frame Timer).



2.7.2.6 Audio Encoding

The CC2564 codec interface can use one of four audio-coding patterns:

- A-Law (8 bit)
- µ-Law (8 bit)
- Linear (8 bit or 16 bit)

2.7.2.7 Improved Algorithm for Lost Packets

The CC256x features an improved algorithm for improving voice quality when received voice data packets are lost. There are two options:

- Repeat the last sample (possible only for sample sizes up to 24 bits). For sample sizes >24 bits, the last byte is repeated.
- Repeat a configurable sample of 8 bits to 24 bits (depends on the real sample size), to simulate silence (or anything else) in the PCM bus. The configured sample will be written in a specific register for each channel.

The choice between those two options is configurable separately for each channel.

2.7.2.8 Bluetooth/PCM Clock Mismatch Handling

In Bluetooth Rx, the CC256x receives RF voice packets and writes these to the codec I/F. If the CC256x receives data faster than the codec I/F output allows, an overflow will occur. In this case, the Bluetooth has two possible behavior modes: “allow overflow” and “don’t allow overflow”.

- “allow overflow”: The Bluetooth will continue receiving data and will overwrite any data not yet sent to the codec.
- “don’t’ allow overflow”: RF voice packets received when buffer is full will be discarded.

2.7.2.9 Bluetooth Inter-IC Sound (I^2S)

The CC256x can be configured as an I^2S serial interface to an I^2S codec device. In this mode, the CC256x audio codec interface is configured as a bi-directional, full-duplex interface, with two time slots per frame: Time slot 0 is used for the left channel audio data and time slot 1 for the right channel audio data. Each time slot is configurable up to 40 serial clock cycles in length and the frame is configurable up to 80 serial clock cycles in length.

Do not connect the microcontroller/DSP directly to the module’s PCM interface.

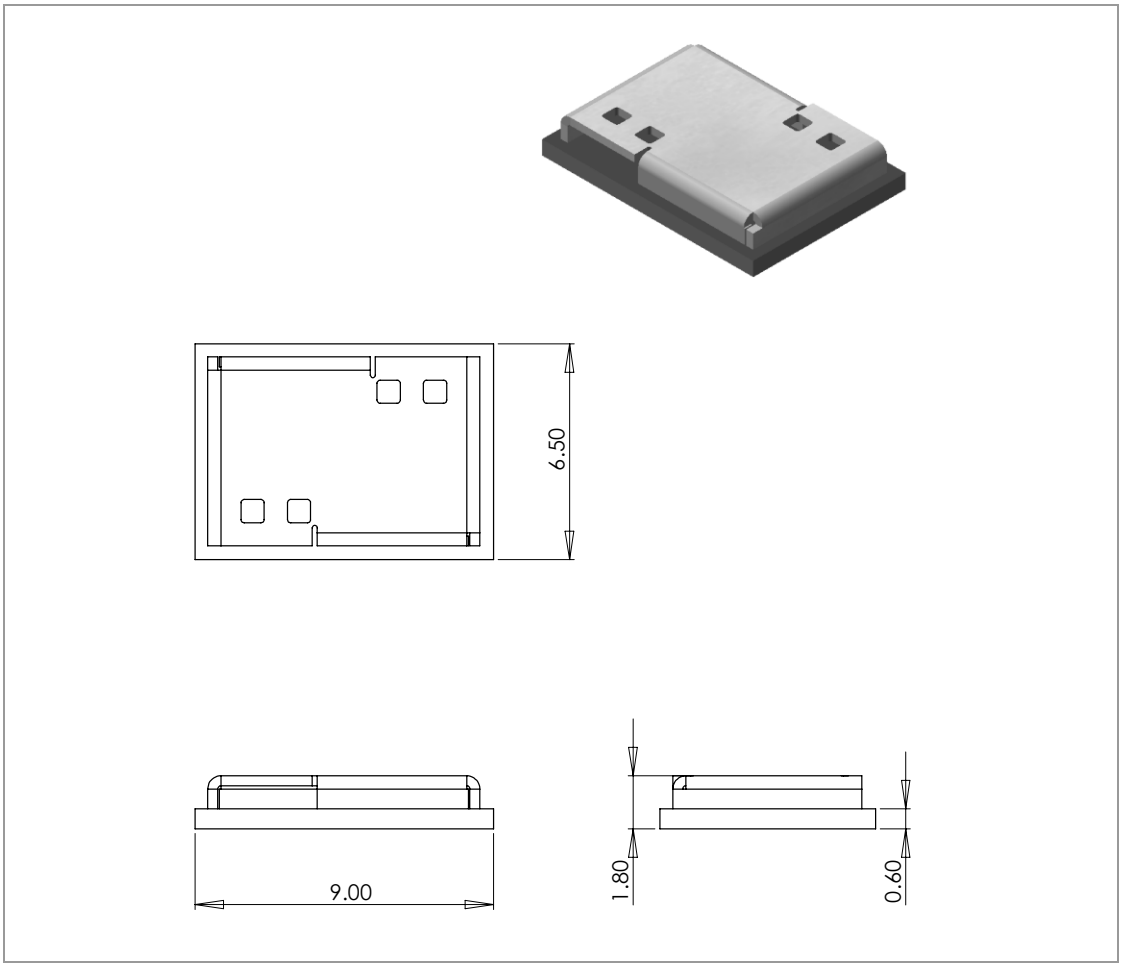
It is recommended to use a simple RC low pass filter to improve noise suppression.

3 Detailed Description

3.1 Dimensions

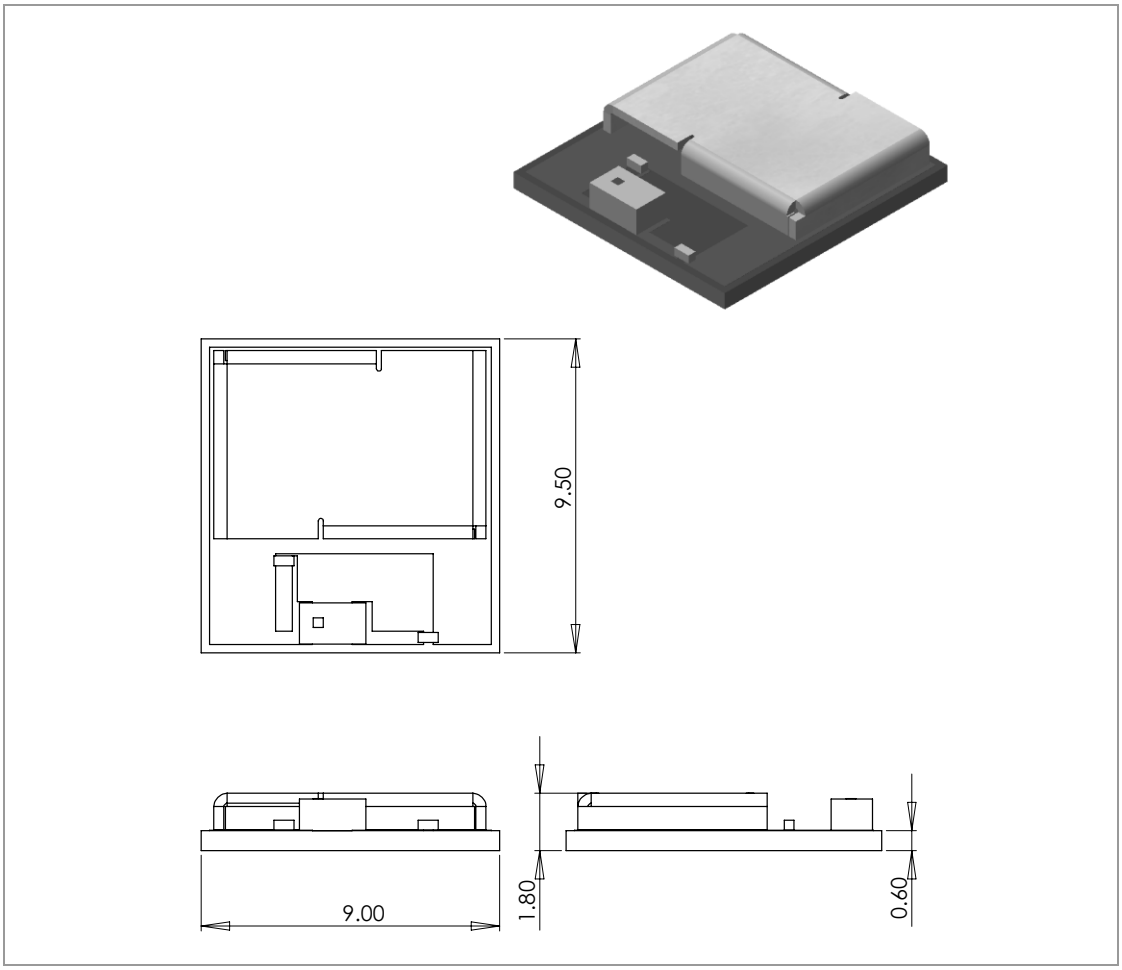
All dimensions are in millimeters.

PAN131x without Antenna



No.	Item	Dimension	Tolerance	Remark
1	Width	6.50	±0.30	
2	Length	9.00	±0.30	
3	Height	1.80	±0.20	With case

PAN132x with Antenna



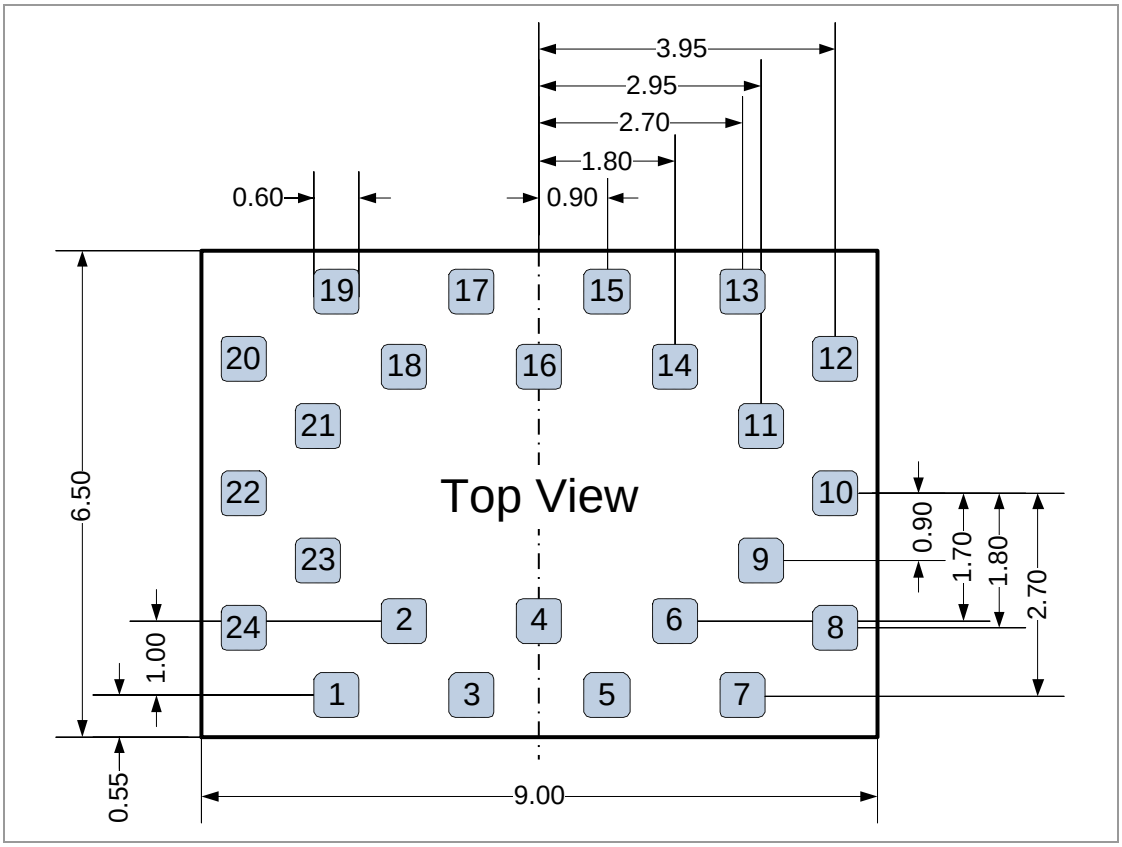
No.	Item	Dimension	Tolerance	Remark
1	Width	9.50	±0.30	
2	Length	9.00	±0.30	
3	Height	1.80	±0.20	With case

3.2 Footprint

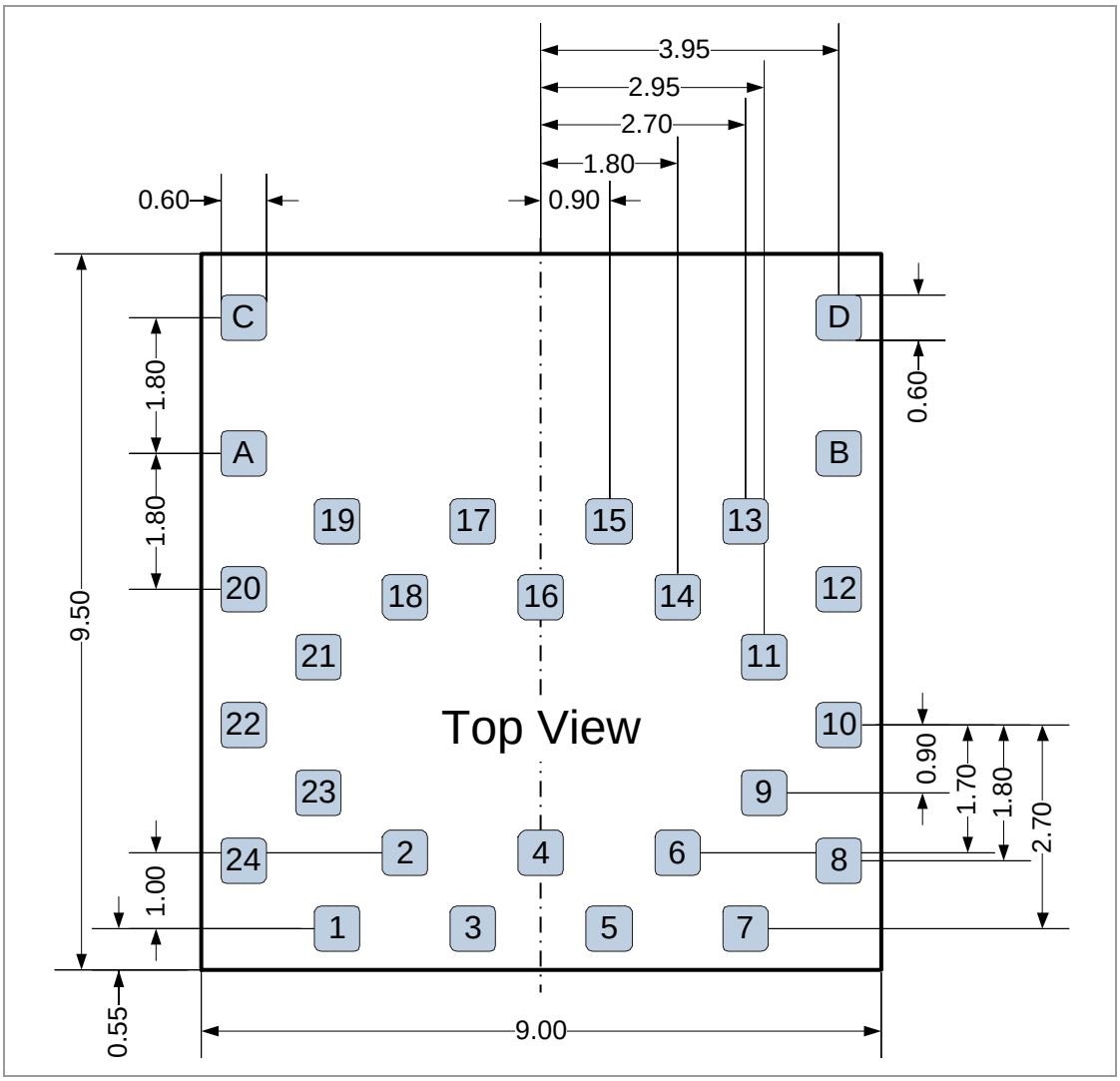
All dimensions are in millimeters.

The inner pins (2, 4, 6, 9, 11, 14, 16, 18, 21, and 23) are shifted to the center by 1 mm.

PAN131x without Antenna



PAN132x with Antenna

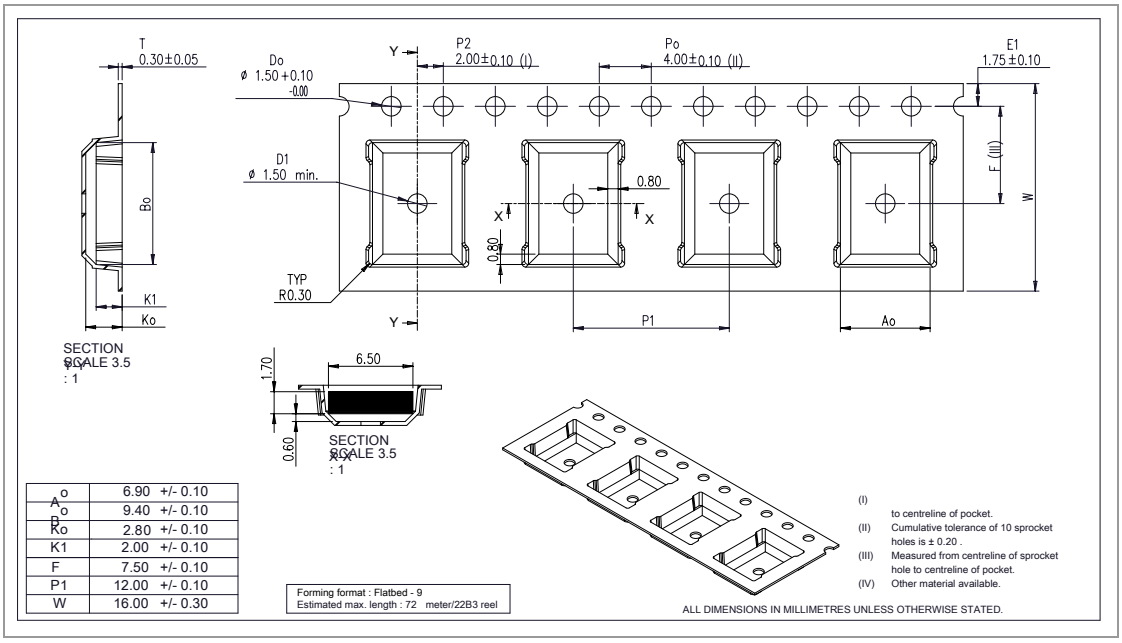


3.3 Packaging

The module is a mass production status product and will be delivered in the package described below.

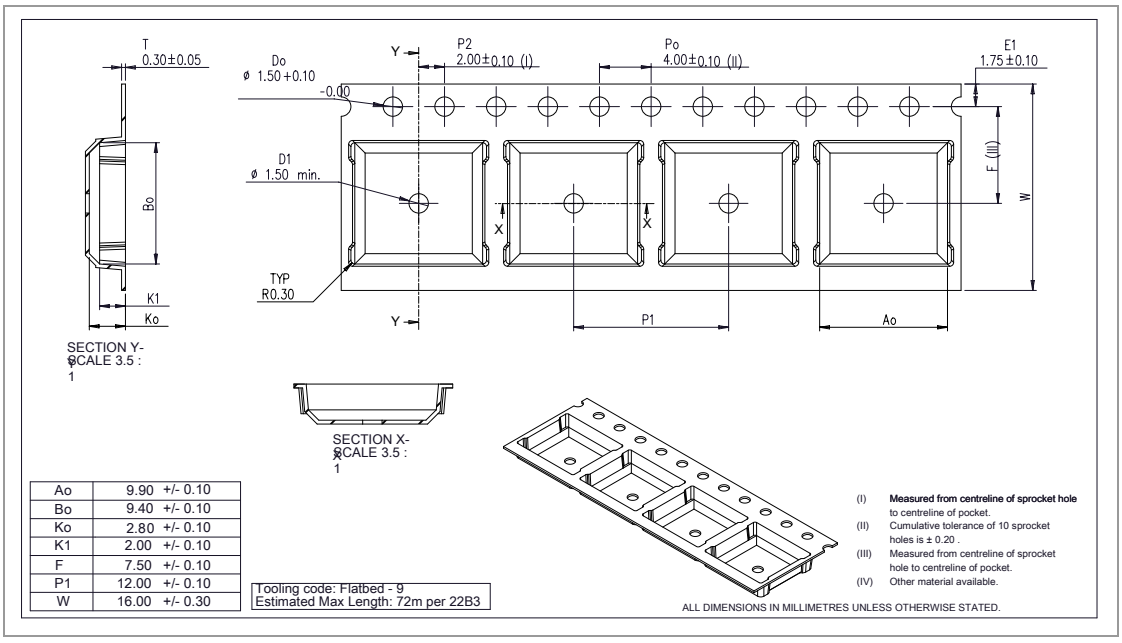
3.3.1 Tape Dimensions

PAN131x without Antenna



Ao	6.90 +/- 0.10
Bo	9.40 +/- 0.10
Ko	2.80 +/- 0.10
K1	2.00 +/- 0.10
F	7.50 +/- 0.10
P1	12.00 +/- 0.10
W	16.00 +/- 0.30

PAN132x with Antenna



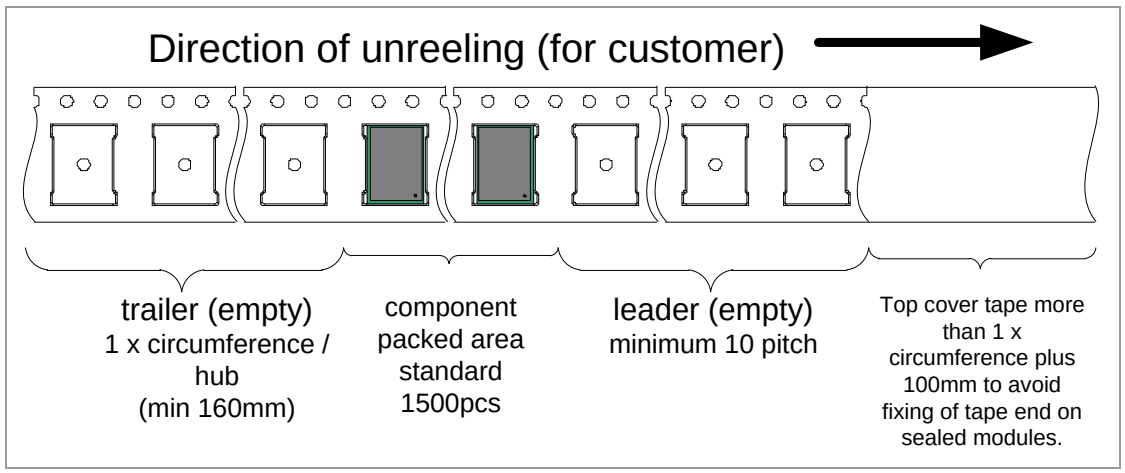
Ao	9.90 +/- 0.10
Bo	9.40 +/- 0.10
Ko	2.80 +/- 0.10
K1	2.00 +/- 0.10
F	7.50 +/- 0.10
P1	12.00 +/- 0.10
W	16.00 +/- 0.30

3.3.2 Packing in Tape

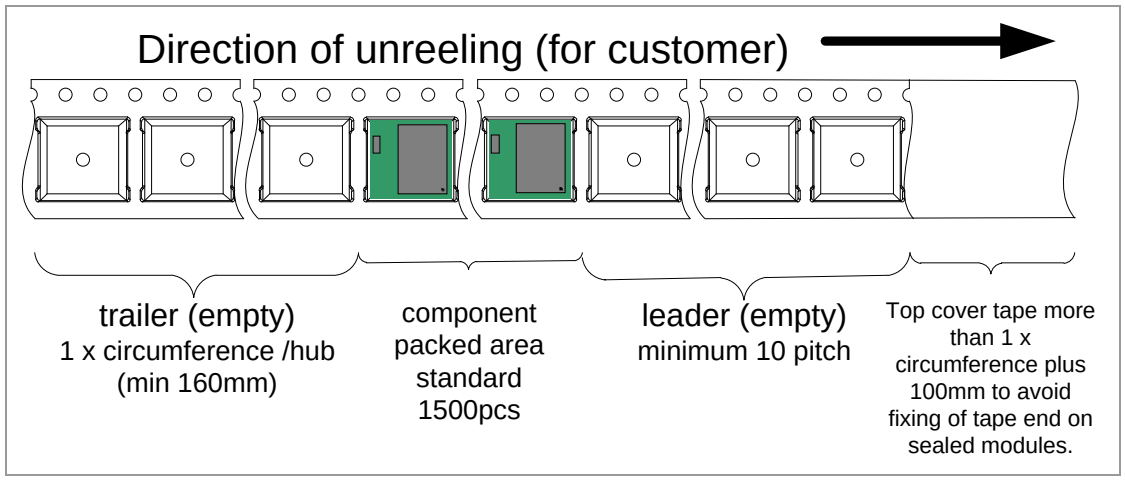
Empty spaces in the component packed area shall be less than two per reel and those spaces shall not be consecutive.

The top cover tape shall not be found on reel holes and it shall not stick out from the reel.

PAN131x without Antenna

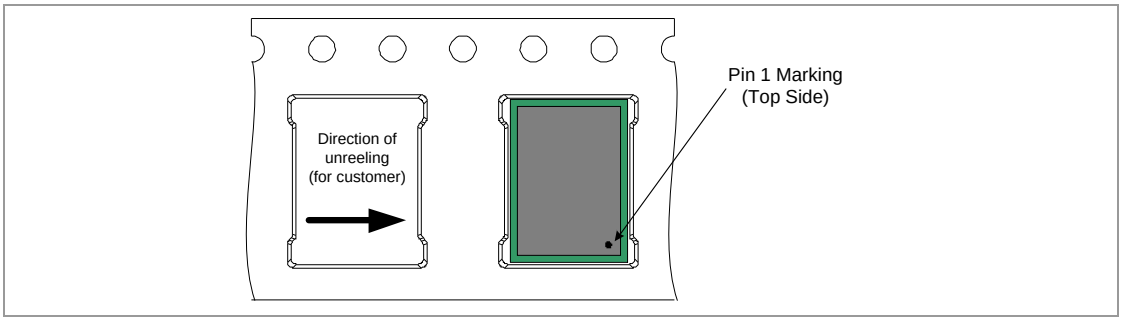


PAN132x with Antenna

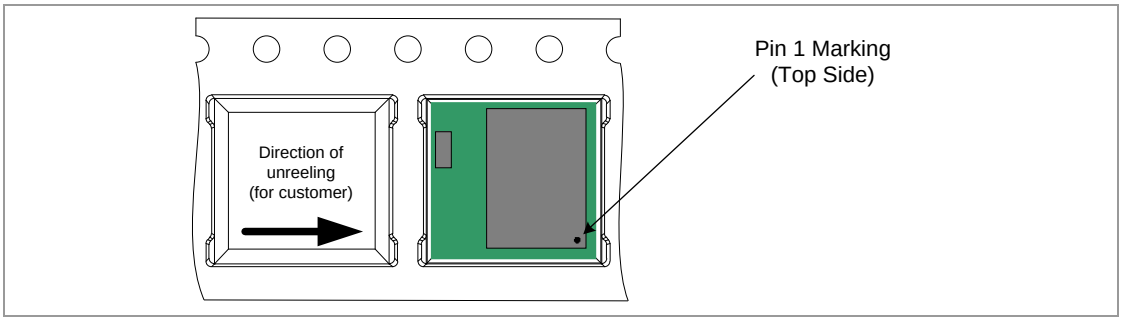


3.3.3 Component Direction

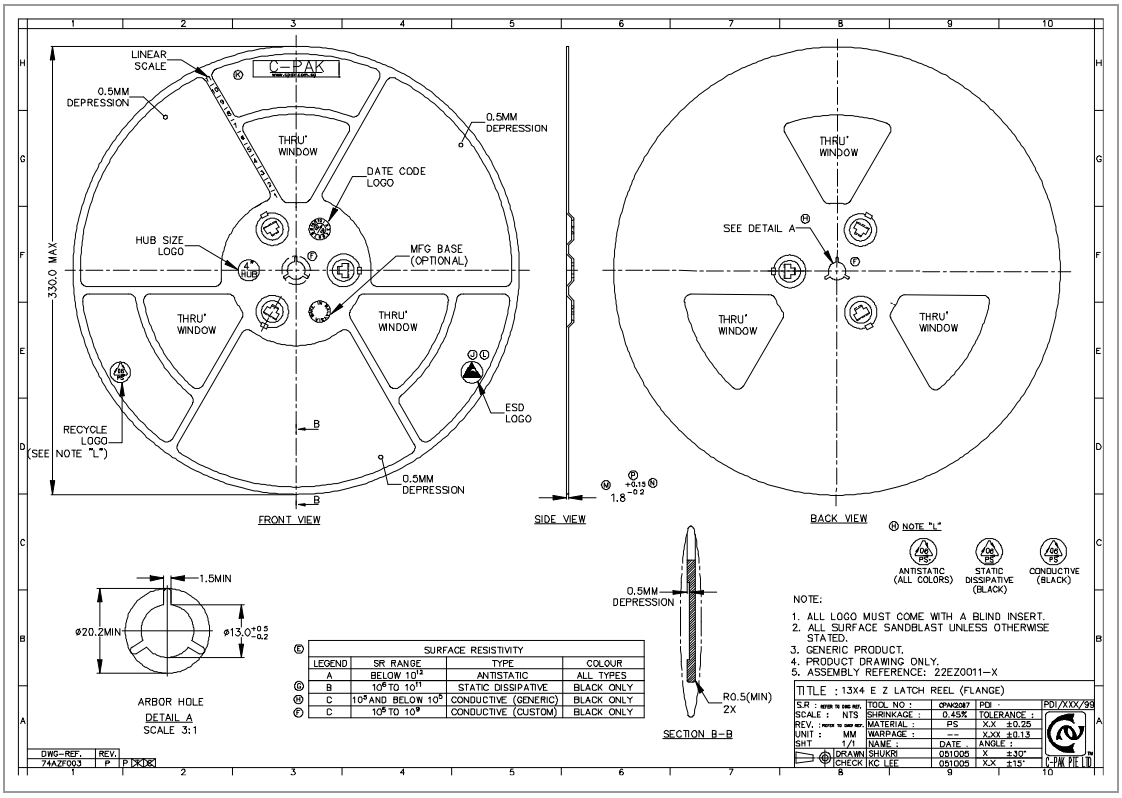
PAN131x without Antenna



PAN132x with Antenna

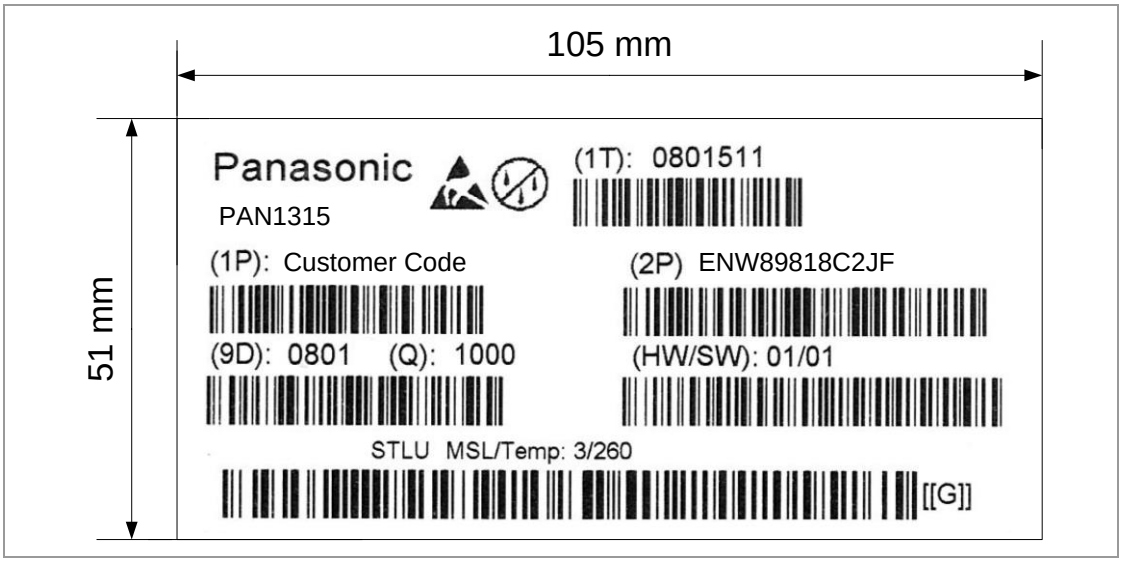


3.3.4 Reel Dimension



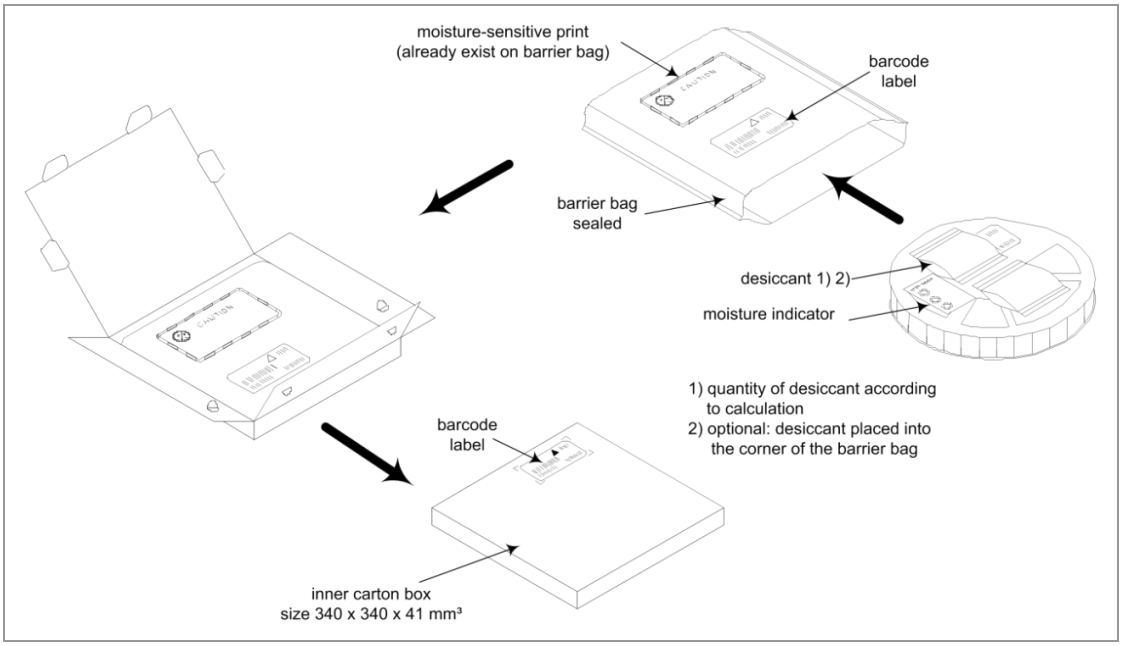
3.3.5 Package Label

Example:



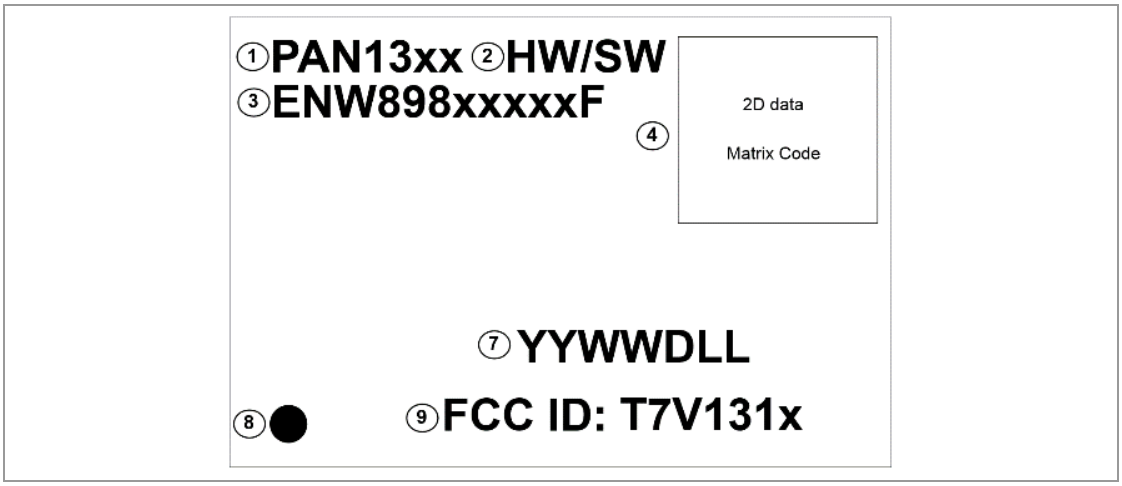
(1T)	Lot code
(1P)	Customer order number, if applicable
(2P)	Order number
(9D)	Date code
(Q)	Quantity
(HW/SW)	Hardware/software version

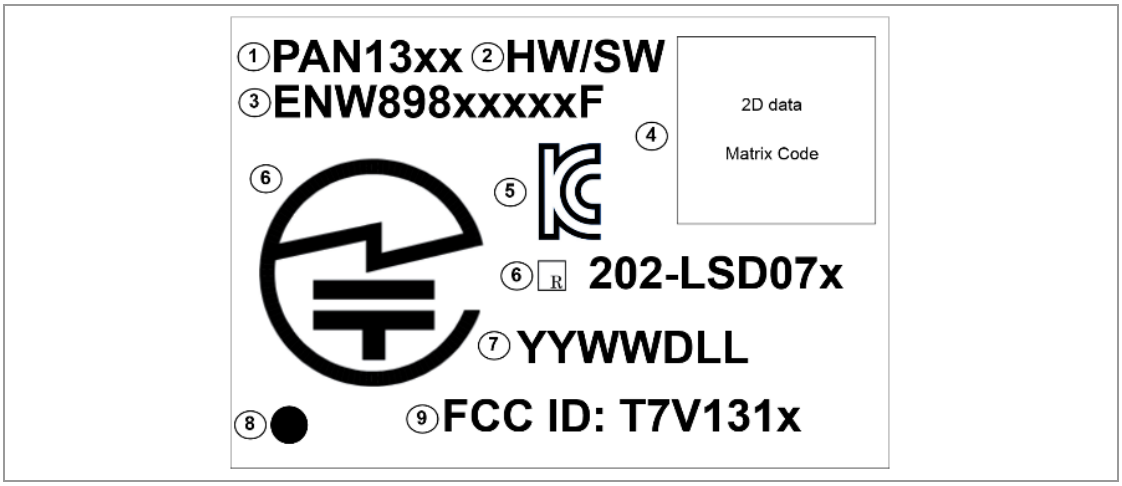
3.3.6 Total Package



3.4 Case Marking

Example:





1	Brand name
2	Hardware/software version
3	Order number
4	2D Data matrix code
5	KCC Logo
6	MIC Logo/ID
7	Lot code
8	Marking for Pin 1
9	FCC ID

4 Specification

All specifications are over temperature and process, unless indicated otherwise.

4.1 Default Test Conditions

Temperature:	25 °C ± 10 °C
Humidity:	40 % to 85 % RH
Supply Voltage:	3.3 V

4.2 Absolute Maximum Ratings

The maximum ratings may not be exceeded under any circumstances, not even momentarily or individually, as permanent damage to the module may result.

All parameters are measured as follows unless stated otherwise: V_{DD_IN}[4]=3.3 V, V_{DD_IO}=1.8 V.

No.	See[5]	Min.	Max.	Unit
Ratings Over Operating Free-Air Temperature Range				
1	V_{DD_IN}	-0.5	5.5	V[6]
2	$V_{DDIO\_1.8V}$	-0.5	2.145	V
3	Input voltage to RF (Pin 13)	-0.5	2.1	V
4	Operating ambient temperature range	-40	85[7]	°C
5	Storage temperature range	-40	125	°C
6	ESD: Human Body Model (HBM). JEDEC 22-A114		500	V

[4] V_{DD_IN} is supplied to MLDO_IN (Pin 15) and CL1.5_LDO_IN (Pin 11); other options are described in ⇨ 2.4 Device Power Supply.

[5] Stresses beyond those listed under “absolute maximum ratings” may cause permanent damage to the device. These are stress ratings only and functional operation of the device at these or any other conditions beyond those indicated under “recommended operating conditions” is not implied. Exposure to absolute maximum rating conditions for extended periods may affect device reliability.

[6] Maximum allowed depends on accumulated time at that voltage: V_{DD_IN} is defined in reference schematics. When DC2DC supply is used, maximum voltage into MLDO_OUT and LDO_IN=2.145 V.

[7] Older generation parts, which are not recommended for new designs, will support a temperature range -20 °C to 70 °C. For details please refer to ⇨ 7.1 Ordering Information.

4.3 Recommended Operating Conditions

The maximum ratings may not be exceeded under any circumstances, not even momentarily or individually, as permanent damage to the module may result.

Symbol	Parameter	Condition	Min.	Max.	Unit
V_{DD_IN}	Power supply voltage[8]		1.7	4.8	V
V_{DD_IO}	I/O power supply voltage		1.62	1.92	V
V_{IH}	High-level input voltage	Default	0.65 × V_{DD_IO}	V_{DD_IO}	V
V_{IL}	Low-level input voltage	Default	0	0.35 × V_{DD_IO}	V
Tr/Tf	IO Input rise/fall times, 10 % to 90 %[9]		1	10	ns
	Maximum ripple on V_{DD_IN} (Sine wave) for 1.8 V (DC2DC) mode	0 MHz to 0.1 MHz		60	mVp-p
		0.1 MHz to 0.5 MHz		50	
		0.5 MHz to 2.5 MHz		30	
		2.5 MHz to 3 MHz		15	
		>3 MHz		5	
	Voltage dips on V_{DD_IN} (V_{BAT}) (duration=577 µs to 2.31 ms, period=4.6 ms)			400	mV
	Maximum ambient operating temperature[10]		-40	85	°C

[8] Excluding 1.98 < V_{DD_IN} < 2.2 V range is not allowed.

[9] Asynchronous mode.

[10] The device can be reliably operated for seven years at $T_{ambient}$ of 85 °C, assuming 25 percent active mode and 75 percent sleep mode (15 400 cumulative active power-on hours). Older generation parts, which are not recommended for new designs, will support a temperature range -20 °C to 70 °C. For details please refer to ⇨ 7.1 Ordering Information.

4.4 Current Consumption

No.	Characteristics	Min. 25 °C	Typ. 25 °C	Max. 25 °C	Min. -40 °C	Typ. -40 °C	Max. -40 °C	Min. +85 °C	Typ. +85 °C	Max. +85 °C	Unit
1	Current consumption in shutdown mode (V_{bat} + V_{io})		1	3						7	µA
2	Current consumption in deep sleep mode (V_{bat} + V_{io} + V_{sd} (shutdown))		40	105						700	µA
3	Total I/O current consumption for active mode			1			1			1	mA
4	Current consumption during transmits DH5 full throughput		40								mA

4.4.1 Current Consumption for different Bluetooth Scenarios

Conditions:

V_{DD_IN}=3.6 V, 25 °C, 26 MHz fast clock, nominal unit, 4 dBm output power

Mode Description	Average Current	Unit
Idle current (ARM off)	2.5	mA
SCO link HV3	12	
eSCO link EV3 64 kbps, no retransmission	11.5	
eSCO link 2-EV3 64 kbps, no retransmission	8.3	
GFSK full troughput: Tx=DH1, Rx=DH5	38.5	
EDR full troughput: Tx=2-DH1, Rx=2-DH5	39.2	
EDR full troughput: Tx=3-DH1, Rx=3-DH5	39.2	
Sniff, 1 attemp, 1.28 s	76/100	µA
Page or inquiry scan 1.28 s, 11.25 ms	300	
Page (1.28 s) and inquiry (2.56 s) scans, 11.25 ms	430	
Low power scan, 1.28 s, quiet envirement	135	

4.4.2 Current Consumption for different Low Energy Scenarios

Conditions:

V_{DD_IN}=3.6 V, 25°C, 26-MHz fast clock, nominal unit, 10 dBm output power

Mode	Description	Average Current	Unit
Advertising, non-connectable	• Advertising in all 3 channels • 1.28 ms advertising interval • 15 bytes advertise Data	104	µA
Advertising, discoverable	• Advertising in all 3 channels • 1.28 ms advertising interval • 15 bytes advertise Data	121	
Scanning	• Listening to a single frequency per window • 1.28 ms scan interval • 11.25 ms scan window	302	
Connected (master role)	• 500 ms connection interval • 0 ms Slave connection latency • Empty Tx/Rx LL packets	169	

4.5 Bluetooth RF Performance

No.	Parameter	Min.	Typ.	Max.	Unit
1	Average Power Hopping DH5	4	7.2	20	dBm
2	Average Power: Ch0	4	7.5	20	
3	Peak Power: Ch0		7.7	23	
4	Average Power: Ch39	4	7	20	
5	Peak Power: Ch39		7.2	23	
6	Average Power: Ch78	4	6.7	20	
7	Peak Power: Ch78		7	23	
8	Max. Frequency Tolerance: Ch0	-75	-2.6	75	kHz
9	Max. Frequency Tolerance: Ch39	-75	-2.2	75	
10	Max. Frequency Tolerance: Ch78	-75	-2.1	75	
11	Max. Drift: Ch0_DH1	-25	3.6	25	
12	Max. Drift: Ch0_DH3	-40	3.7	40	
13	Max. Drift: Ch0_DH5	-40	4	40	
14	Max. Drift Rate: Ch0_DH1	-20	-2.6	20	
15	Max. Drift Rate: Ch0_DH3	-20	-3.2	20	
16	Max. Drift Rate: Ch0_DH5	-20	-3.3	20	

No.	Parameter	Min.	Typ.	Max.	Unit
17	Max. Drift: Ch39_DH1	-25	4	25	
18	Max. Drift: Ch39_DH3	-40	4.3	40	
19	Max. Drift: Ch39_DH5	-40	4.3	40	
20	Max. Drift Rate: Ch39_DH1	-20	-3.1	20	
21	Max. Drift Rate: Ch39_DH3	-20	-3.6	20	
22	Max. Drift Rate: Ch39_DH5	-20	-3.7	20	
23	Max. Drift: Ch78_DH1	-25	4.1	25	
24	Max. Drift: Ch78_DH3	-40	4.5	40	
25	Max. Drift: Ch78_DH5	-40	4.4	40	
26	Max. Drift Rate: Ch78_DH1	-20	-3.4	20	
27	Max. Drift Rate: Ch78_DH3	-20	-3.9	20	
28	Max. Drift Rate: Ch78_DH5	-20	-4.1	20	
29	Delta F1 Avg: Ch0 [kHz]	140	159.5	175	
30	Delta F2 Max.: Ch0	99.9	100		
31	Delta F2 Avg/Delta F1 Avg: Ch0	0.8	0.9		
32	Delta F1 Avg: Ch39	140	159.8	175	kHz
33	Delta F2 Max.: Ch39	99.9	100		%
34	Delta F2 Avg/Delta F1 Avg: Ch39	0.8	0.9		
35	Delta F1 Avg: Ch78	140	159.1	175	kHz
36	Delta F2 Max.: Ch78	99.9	100		%
37	Delta F2 Avg/Delta F1 Avg: Ch78	0.8	0.9		
45	Sensitivity	-81	-93		
46	f(H)-f(L): Ch0		918.4	1 000	kHz
47	f(H)-f(L): Ch39		918.3	1 000	
48	f(H)-f(L): Ch78		918.2	1 000	
49	ACPower -3: Ch3		-51.5	-40	dBm
50	ACPower -2: Ch3		-50.4	-40	
51	ACPower -1: Ch3		-18.5		
52	ACPower Center: Ch3	4	8.1	20	
53	ACPower +1: Ch3		-19.2		
54	ACPower +2: Ch3		-50.7	-40	
55	ACPower +3: Ch3		-53.3	-40	
56	ACPower -3: Ch39		-51.6	-40	
57	ACPower -2: Ch39		-50.7	-40	
58	ACPower -1: Ch39		-19		
59	ACPower Center: Ch39	4	7.7	20	

No.	Parameter	Min.	Typ.	Max.	Unit
60	ACPower +1: Ch39		-19.7		
61	ACPower +2: Ch39		-50.9	-40	
62	ACPower +3: Ch39		-53.2	-40	
63	ACPower -3: Ch75		-51.7	-40	
64	ACPower -2: Ch75		-50.7	-40	
65	ACPower -1: Ch75		-19.2		
66	ACPower Center: Ch75	4	7.5	20	
67	ACPower +1: Ch75		-20		
68	ACPower +2: Ch75		-51	-40	
69	ACPower +3: Ch75		-53.4	-40	
70	omega i 2-DH5: Ch0	-75	-4.7	75	kHz
71	omega o + omega i 2-DH5: Ch0	-75	-6	75	
72	omega o 2-DH5: Ch0	-10	-1.5	10	
73	DEVM RMS 2-DH5: Ch0		0.0	0.2	%
74	DEVM Peak 2-DH5: Ch0		0.1	0.35	
75	DEVM 99 % 2-DH5: Ch0	99	100		
76	omega i 3-DH5: Ch0	-75	-3.7	75	kHz
77	omega o + omega i 3-DH5: Ch0	-75	-5.8	75	
78	omega o 3-DH5: Ch0	-10	-2.6	10	
79	DEVM RMS 3-DH5: Ch0		0.0	0.13	%
80	DEVM Peak 3-DH5: Ch0		0.1	0.25	
81	DEVM 99 % 3-DH5: Ch0	99	100		
82	omega i 2-DH5: Ch39	-75	-4.8	75	kHz
83	omega o + omega i 2-DH5: Ch39	-75	-6.1	75	
84	omega o 2-DH5: Ch39	-10	-1.4	10	
85	DEVM RMS 2-DH5: Ch39		0.0	0.2	%
86	DEVM Peak 2-DH5: Ch39		0.1	0.35	
87	DEVM 99 % 2-DH5: Ch39	99	100		
88	omega i 3-DH5: Ch39 [kHz]	-75	-3.8	75	kHz
89	omega o + omega i 3-DH5: Ch39	-75	-5.9	75	
90	omega o 3-DH5: Ch39	-10	-2.6	10	
91	DEVM RMS 3-DH5: Ch39		0.0	0.13	%
92	DEVM Peak 3-DH5: Ch39		0.1	0.25	
93	DEVM 99 % 3-DH5: Ch39	99	100		
94	omega i 2-DH5: Ch78	-75	-4.9	75	kHz
95	omega o + omega i 2-DH5: Ch78	-75	-6.2	75	

No.	Parameter	Min.	Typ.	Max.	Unit
96	omega o 2-DH5: Ch78	-10	-1.4	10	
97	DEVM RMS 2-DH5: Ch78		0.0	0.2	%
98	DEVM Peak 2-DH5: Ch78		0.1	0.35	
99	DEVM 99 % 2-DH5: Ch78	99	100		
100	omega i 3-DH5: Ch78	-75	-3.8	75	kHz
101	omega o + omega i 3-DH5: Ch78	-75	-6	75	
102	omega o 3-DH5: Ch78	-10	-2.7	10	
103	DEVM RMS 3-DH5: Ch78		0.0	0.13	%
104	DEVM Peak 3-DH5: Ch78		0.1	0.25	
105	DEVM 99% 3-DH5: Ch78	99	100		

No.	Parameter	Conditions	Bluetooth Specification	Min.	Typ.	Max.	Unit
1	Operation frequency range		2 402		2 480		MHz
2	Channel spacing			1			MHz
3	Input impedance			50			Ω
4	Sensitivity, Dirty Tx on	GFSK, BER=0.1 %		-93		-70	dBm
		Pi/4-DQPSK, BER=0.01 %		-92.5		-70	
		8DPSK, BER=0.01 %		-85.5		-70	

No.	Parameter	Conditions	Typ.	Max.	Unit
1	Tx and Rx out-of-band emissions Output signal=7 dBm	30 kHz to 1 GHz [11, 12, 13]		-30	dBm
		1 GHz to 12.75 GHz [11, 12, 13]		-30	
2	2nd harmonic	At 7 dBm output power [11, 12, 13]		-30	
3	3rd harmonic	At 7 dBm output power [11, 12, 13]		-30	

The values are measured conducted. Better suppression of the spurious emissions with an antenna can be expected as, antenna frequently have band pass filter characteristics.

[11] Includes effects of frequency hopping

[12] Average according FCC, IC, and ETSI requirements. Above +7 dBm output power (refer also to 13) the customer must verify the final product against national regulations.

[13] +7 dBm related to power register value 18, according to Texas Instruments service pack 2.30

4.6 General Electrical Characteristics

No.	Rating			Condition	Min.	Max.	Unit
1	High-level output voltage, V_{OH}			At 2/4/8 mA	0.8 × V_{DD_IO}	V_{DD_IO}	V
				At 0.1 mA	V_{DD_IO} – 0.2	V_{DD_IO}	V
2	Low-level output voltage, V_{OL}			At 2/4/8 mA	0	0.2 × V_{DD_IO}	V
				At 0.1 mA	0	0.2	V
3	I/O input impedance			Resistance	1		MΩ
				Capacitance		5	pF
4	Output rise/fall times,10 % to 90 % (Digital pins)			C_L=20 pF		10	Ns
5	I/O pull currents	TX_DBG, PCM bus	PU	Typ=6.5	3.5	9.7	µA
			PD	Typ=27	9.5	55	µA
		All others	PU	Typ=100	100	300	µA
			PD	Typ=100	100	360	µA

4.7 External Digital Slow Clock Requirements

Symbol	Parameter	Condition	Min.	Typ.	Max.	Unit
	Input Slow Clock frequency			32 768		Hz
	Input Slow Clock accuracy (Initial + temp + aging)	Bluetooth			±250	Ppm
Tr/Tf	Input transition time Tr/Tf : 10 % to 90 %				100	Ns
	Frequency input duty cycle		15	50	85	%
	Phase noise	At 1 kHz			-125	dBc/Hz
	Jitter	Integrated over 300 Hz to 15 000 Hz			1	Hz
V_{IH}	Slow Clock input voltage limits	Square wave, DC coupled	0.65 × V_{DD_IO}		V_{DD_IO}	V peak
V_{IL}	Slow Clock input voltage limits	Square wave, DC coupled	0		0.35 × V_{DD_IO}	V peak
	Input impedance		1			MΩ
	Input capacitance				5	pF

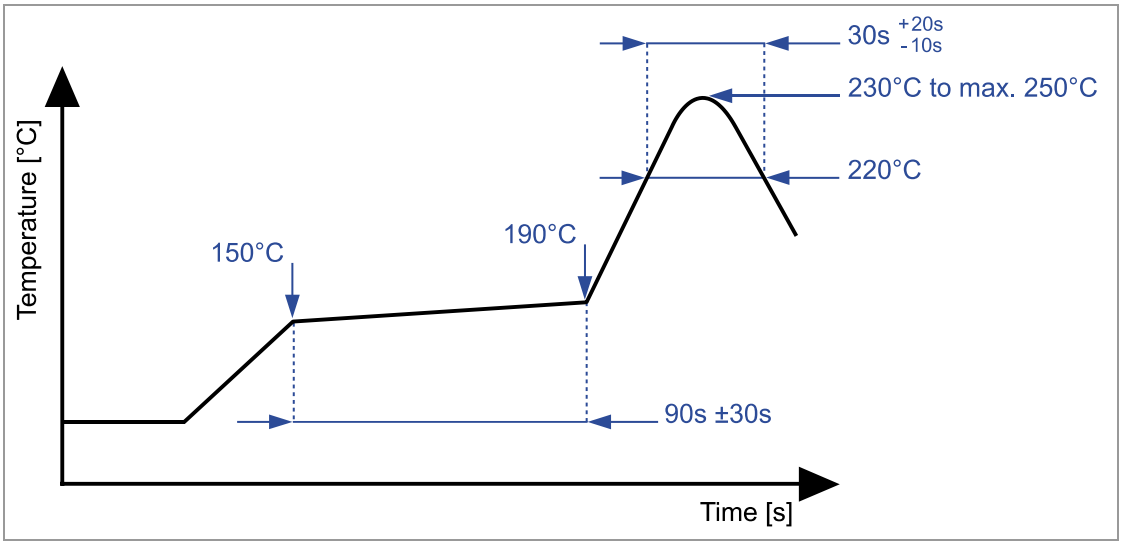
4.8 Reliability Tests

The measurement should be done after the test module has been exposed to room temperature and humidity for one hour.

No.	Item	Limit	Condition
1	Vibration test	Electrical parameter are in specification	• Freq.: 10~50 Hz; Amplitude: 1.5 mm; 20 min./cycle, 1 h. each of XYZ axis • Freq.: 30~100 Hz, 6G; 20 min./cycle, 1 h. each of XYZ axis
2	Shock test		Dropped onto hard wood from a height of 50 cm for 3 times
3	Heat cycle test		-40 °C for 30 min. and 85 °C for 30 min.; each temperature 300 cycles
4	Moisture test		60 °C, 90 % RH, 300 h
5	Low temperature test		-40 °C, 300 h
6	High temperature test		85 °C, 300 h

4.9 Recommended Soldering Profile

- Reflow permissible cycles: 2
- Opposite side reflow is prohibited due to module weight
- More than 75 percent of the soldering area shall be coated by solder
- The soldering profiles should be adhered to in order to prevent electrical or mechanical damage
- Soldering profile assumes lead-free soldering



5 Cautions

Failure to follow the guidelines set forth in this document may result in degrading of the module functions and damage to the module.

5.1 Design Notes

1. Follow the conditions written in this specification, especially the control signals of this module.
2. The supply voltage should abide by the maximum ratings (⇨ 4.2 Absolute Maximum Ratings).
3. The supply voltage must be free of AC ripple voltage (for example from a battery or a low noise regulator output). For noisy supply voltages, provide a decoupling circuit (for example a ferrite in series connection and a bypass capacitor to ground of at least 47 µF directly at the module).
4. This module should not be mechanically stressed when installed.
5. Keep this module away from heat. Heat is the major cause of decreasing the life time of these modules.
6. Avoid assembly and use of the target equipment in conditions where the module temperature may exceed the maximum tolerance.
7. Keep this module away from other high frequency circuits.
8. Refer to the recommended pattern when designing a board.

5.2 Installation Notes

1. Reflow soldering is possible twice based on the conditions set forth in ⇨ 4.9 Recommended Soldering Profile. Set up the temperature at the soldering portion of this module according to this reflow profile.
2. Carefully position the module so that the heat will not burn into printed circuit boards or affect other components that are susceptible to heat.
3. Carefully locate the module, to avoid an increased temperature caused by heat generated by neighboring components.
4. If a vinyl-covered wire comes into contact with the module, the wire cover will melt and generate toxic gas, damaging the insulation. Never allow contact between a vinyl cover and these modules to occur.
5. This module should not be mechanically stressed or vibrated when reflowed.
6. To repair the board by hand soldering, follow the conditions set forth in this chapter.
7. Do not wash this product.
8. Pressing on parts of the metal cover or fastening objects to the metal will cause damage to the module.

5.3 Usage Condition Notes

1. Take measures to protect the module against static electricity.
   If pulses or transient loads (a large load, which is suddenly applied) are applied to the modules, check and evaluate their operation before assembly of the final products.
2. Do not use dropped modules.
3. Do not touch, damage, or soil the pins.
4. Follow the recommended condition ratings about the power supply applied to this module.
5. Electrode peeling strength: Do not apply a force of more than 4.9 N in any direction on the soldered module.
6. Pressing on parts of the metal cover or fastening objects to the metal cover will cause damage.
7. These modules are intended for general purpose and standard use in general electronic equipment, such as home appliances, office equipment, information, and communication equipment.

5.4 Storage Notes

1. The module should not be stressed mechanically during storage.
2. Do not store these modules in the following conditions or the performance characteristics of the module, such as RF performance will be adversely affected:
   - Storage in salty air or in an environment with a high concentration of corrosive gas, such as Cl2, H2S, NH3, SO2, or NOX,
   - Storage in direct sunlight,
   - Storage in an environment where the temperature may be outside the range of 5 °C to 35 °C, or where the humidity may be outside the 45 % to 85 % range,
   - Storage of the modules for more than one year after the date of delivery storage period: Please check the adhesive strength of the embossed tape and soldering after 6 months of storage.
3. Keep this module away from water, poisonous gas, and corrosive gas.
4. This module should not be stressed or shocked when transported.
5. Follow the specification when stacking packed crates (max. 10).

5.5 Safety Cautions

These specifications are intended to preserve the quality assurance of products and individual components.

Before use, check and evaluate the operation when mounted on your products. Abide by these specifications without deviation when using the products. These products may short-circuit. If electrical shocks, smoke, fire, and/or accidents involving human life are anticipated when a short circuit occurs, provide the following failsafe functions as a minimum:

1. Ensure the safety of the whole system by installing a protection circuit and a protection device.
2. Ensure the safety of the whole system by installing a redundant circuit or another system to prevent a single fault causing an unsafe status.

5.6 Other Cautions

1. Do not use the module for other purposes than those listed in ⇨ 5.3 Usage Condition Notes.
2. Be sure to provide an appropriate fail-safe function on your product to prevent any additional damage that may be caused by the abnormal function or the failure of the module.
3. This module has been manufactured without any ozone chemical controlled under the Montreal Protocol.
4. These modules are not intended for use under the special conditions shown below. Before using these modules under such special conditions, carefully check their performance and reliability under the said special conditions to determine whether or not they can be used in such a manner:
   - In liquid, such as water, salt water, oil, alkali, or organic solvent, or in places where liquid may splash,
   - In direct sunlight, outdoors, or in a dusty environment,
   - In an environment where condensation occurs,
   - In an environment with a high concentration of harmful gas (e. g. salty air, HCl, Cl2, SO2, H2S, NH3, and NOX).
5. If an abnormal voltage is applied due to a problem occurring in other components or circuits, replace these modules with new modules, because they may not be able to provide normal performance even if their electronic characteristics and appearances appear satisfactory.

For further information please refer to the Panasonic website ⇨ 7.2.2 Product Information.

5.7 Restricted Use

5.7.1 Life Support Policy

This Panasonic Industrial Devices Europe GmbH product is not designed for use in life support appliances, devices, or systems where malfunction can reasonably be expected to result in a significant personal injury to the user, or as a critical component in any life support device or system whose failure to perform can be reasonably expected to cause the failure of the life support device or system, or to affect its safety or effectiveness.

Panasonic customers using or selling these products for use in such applications do so at their own risk and agree to fully indemnify Panasonic Industrial Devices Europe GmbH for any damages resulting.

5.7.2 Restricted End Use

This Panasonic Industrial Devices Europe GmbH product is not designed for any restricted activity that supports the development, production, handling usage, maintenance, storage, inventory or proliferation of any weapons or military use.

Transfer, export, re-export, usage or reselling of this product to any destination, end user or any end use prohibited by the European Union, United States or any other applicable law is strictly prohibited.

6 Regulatory and Certification Information

6.1 Federal Communications Commission (FCC) for US

6.1.1 FCC Notice

The PAN131x/132x including the antennas, which are listed in ⇨ 6.1.5 Approved Antenna List, complies with Part 15 of the FCC Rules.

The device meets the requirements for modular transmitter approval as detailed in FCC public Notice DA00-1407. The transmitter 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.

6.1.2 Caution

The FCC requires the user to be notified that any changes or modifications made to this device that are not expressly approved by Panasonic Industrial Devices Europe GmbH may void the user's authority to operate the equipment.

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.

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.

6.1.3 Label Requirements

The OEM must ensure that FCC labelling requirements are met. This includes a clearly visible label on the outside of the OEM enclosure specifying the appropriate Panasonic FCC identifier for this product as well as the FCC Notice above.

The FCC identifier are:

FCC ID: T7V1315 (for PAN1315, PAN1325)
FCC ID: T7V1316 (for PAN1316, PAN1317, PAN1326, PAN1327)

This FCC identifier is valid for the PAN131x/132x. The end product must in any case be labelled on the exterior with:

"Contains FCC ID: T7V1315" (for PAN1315, PAN1325) or

"Contains FCC ID: T7V1316" (for PAN1316, PAN1317, PAN1326, PAN1327).

6.1.4 Antenna Warning

This antenna warning refers to the test device with the model number PAN131x/132x ⇨ 7.1 Ordering Information.

The device is tested with a standard SMA connector and with the antenna listed below. When integrated into the OEM's product, these fixed antennas require installation preventing end users from replacing them with non-approved antennas. Any antenna not in the following table must be tested to comply with FCC Section 15.203 for unique antenna connectors and with Section 15.247 for emissions. The FCC identifier for the device with the antenna listed in ⇨ 6.1.5 Approved Antenna List is the same (**FCC ID: T7V1315** or **FCC ID: T7V1316**).

6.1.5 Approved Antenna List

For PAN1315, PAN1325:

Item	Part Number	Manufacturer	Frequency Band	Type	Gain (dBi)
1	2450AT43B100	Johanson Technologies	2.4 GHz	Chip antenna	+1.3
2	LDA212G3110K	Murata	2.4 GHz	Chip antenna	+0.9
3	4788930245	Würth Elektronik	2.4 GHz	Chip antenna	+0.5

For PAN1316, PAN1317, PAN1326, PAN1327:

Item	Part Number	Manufacturer	Frequency Band	Type	Gain (dBi)
1	LDA212G3110K	Murata	2.4 GHz	Chip antenna	+0.9
2	ANT2012	Yageo	2.4 GHz	Chip antenna	+0.9

6.1.6 RF Exposure

To comply with FCC RF Exposure requirements, the OEM must ensure that only antennas from the Approved Antenna List are installed ⇨ 6.1.5 Approved Antenna List.

The preceding statement must be included as a “CAUTION” statement in manuals for products operating with the approved antennas in the previous table to alert users on FCC RF Exposure compliance.

Any notification to the end user of installation or removal instructions about the integrated radio module is not allowed.

The radiated output power of the PAN131x/132x with a mounted ceramic antenna
(**FCC ID: T7V1315** or **FCC ID: T7V1316**) is below the FCC radio frequency exposure limits. The PAN131x/132x shall be used in such a manner that the potential for human contact during normal operation is minimized.

End users may not be provided with the module installation instructions. OEM integrators and end users must be provided with transmitter operating conditions for satisfying RF exposure compliance.

6.2 Innovation, Science, and Economic Development (ISED) for Canada

English

The PAN131x/132x is licensed to meet the regulatory requirements of ISED.

License ID: **IC: 216Q-1315** (for PAN1315, PAN1325)
IC: 216Q-1316 (for PAN1316, PAN1317, PAN1326, PAN1327)

Manufacturers of mobile, fixed or portable devices incorporating this module are advised to clarify any regulatory questions and ensure compliance for SAR and/or RF exposure limits. Users can obtain Canadian information on RF exposure and compliance from www.ic.gc.ca.

This device has been designed to operate with the antennas listed in ⇨ 6.1.5 Approved Antenna List, having a maximum gain of +1.3 dBi (+0.9 dBi for PAN1316, PAN1317, PAN1326, PAN1327). Antennas not included in this list or having a gain greater than +1.3 dBi (+0.9 dBi for PAN1316, PAN1317, PAN1326, PAN1327) are strictly prohibited for use with this device. The required antenna impedance is 50 ohms. The antenna used for this transmitter must not be co-located or operating in conjunction with any other antenna or transmitter.

Due to the model size, the IC identifier is displayed in the installation instruction only and it cannot be displayed on the module’s label due to the limited size.

French

PAN131x/132x est garanti conforme aux dispositions règlementaires d'Industry Canada (ISED).

License: **IC: 216Q-1315** (pour PAN1315, PAN1325)

IC: 216Q-1316 (pour PAN1316, PAN1317, PAN1326, PAN1327)

Il est recommandé aux fabricants d'appareils fixes, mobiles ou portables de consulter la réglementation en vigueur et de vérifier la conformité de leurs produits relativement aux limites d'exposition aux rayonnements radiofréquence ainsi qu'au débit d'absorption spécifique maximum autorisé.

Des informations pour les utilisateurs sur la réglementation Canadienne concernant l'exposition aux rayonnements RF sont disponibles sur le site www.ic.gc.ca.

Ce produit a été développé pour fonctionner spécifiquement avec les antennes listées dans le tableau ⇨ 6.1.5 Approved Antenna List, présentant un gain maximum de +1.3 dBi (+0.9 dBi pour PAN1316, PAN1317, PAN1326, PAN1327). Des antennes autres que celles listées ici, ou présentant un gain supérieur à +1.3 dBi (+0.9 dBi pour PAN1316, PAN1317, PAN1326, PAN1327) ne doivent en aucune circonstance être utilisées en combinaison avec ce produit. L'impédance des antennes compatibles est 50 Ohm. L'antenne utilisée avec ce produit ne doit ni être située à proximité d'une autre antenne ou d'un autre émetteur, ni être utilisée conjointement avec une autre antenne ou un autre émetteur.

En raison de la taille du produit, l'identifiant IC est fourni dans le manuel d'installation.

6.2.1 IC Notice

English

The device PAN131x/132x (⇨ 7.1 Ordering Information), including the antennas (⇨ 6.1.5 Approved Antenna List), complies with Canada RSS-GEN Rules. The device meets the requirements for modular transmitter approval as detailed in RSS-Gen.

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.

French

Le présent appareil PAN131x/132x (⇨ 7.1 Ordering Information), les antennes y compris (⇨ 6.1.5 Approved Antenna List), est conforme aux CNR-Gen 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, et
2. L'utilisateur de l'appareil doit accepter tout brouillage radioélectrique subi, même si le brouillage est susceptible d'en compromettre le fonctionnement.

6.2.2 Labeling Requirements

English

Labeling Requirements

The OEM must ensure that IC labelling requirements are met. This includes a clearly visible label on the outside of the OEM enclosure specifying the appropriate Panasonic IC identifier for this product as well as the IC Notice above.

The IC identifier are:

IC: 216Q 1315 (for PAN1315, PAN1325)
IC: 216Q-1316 (for PAN1316, PAN1317, PAN1326, PAN1327)

This IC identifier is valid for all PAN131x/132x modules ⇨ 7.1 Ordering Information. In any case, the end product must be labelled on the exterior with:

"Contains IC: 216Q-1315” (for PAN1315, PAN1325) or
"Contains IC: 216Q-1316” (for PAN1316, PAN1317, PAN1326, PAN1327).

French

Obligations d’étiquetage

Les fabricants d’équipements d’origine (FEO) – en anglais Original Equipment Manufacturer (OEM) – doivent s’assurer que les obligations d’étiquetage IC du produit final sont remplies. Ces obligations incluent une étiquette clairement visible à l’extérieur de l’emballage externe, comportant l’identifiant IC du module Panasonic inclus, ainsi que la notification ci-dessus.

L’ identifiant IC sont:

IC: 216Q-1315 (pour PAN1315, PAN1325)
IC: 216Q-1316 (pour PAN1316, PAN1317, PAN1326, PAN1327).

Cet identifiant est valide pour tous les modules PAN131x/132x ⇨ 7.1 Ordering Information. Dans tous les cas les produits finaux doivent indiquer sur leur emballage externe la mention suivante:

"Contient IC: 216Q-1315” (pour PAN1315, PAN1325) ou
"Contient IC: 216Q-1316” (pour PAN1316, PAN1317, PAN1326, PAN1327).

6.3 European Conformity According to RED (2014/53/EU)

All modules described in this Product Specification comply with the standards according to the following LVD (2014/35/EU), EMC-D (2014/30/EU) together with RED (2014/53/EU) articles:

3.1a Safety/Health:	EN 62368-1:2014
3.1b EMC:	EN 301 489-1 V2.1.1:2017-02
	EN 301 489-17 V3.1.1:2017-02
3.2 Radio:	EN 300 328 V2.2.2:2019

As a result of the conformity assessment procedure described in 2014/53/EU Directive, the end customer equipment should be labelled as follows:

CE

The end customer has to assure that the device has a distance of more than 20 cm from the human body under all circumstances.

The end customer equipment must meet the actual Safety/Health requirements according to RED.

PAN131x/132x and its model versions in the specified reference design can be used in all countries of the European Economic Area (Member States of the EU, European Free Trade Association States [Iceland, Liechtenstein, Norway]), Monaco, San Marino, Andorra, and Turkey.

6.4 Japanese Radio Law Compliance

This device is granted pursuant to the Japanese Radio Law (電波法).

This device should not be modified (otherwise the granted designation number will become invalid).

The following model are qualified for the Japanese market:

ENW89823A2KF:	MIC ID: [R]202-LSD072
ENW89823A3KF:	MIC ID: [R]202-LSD072
ENW89829A2KF:	MIC ID: [R]202-LSD073
ENW89829A3KF:	MIC ID: [R]202-LSD073

6.5 Korea (Label Requirements)

Since the printable area on the PAN131x/132x is too small to show the KC logo and ID, this information will be placed on the package and in the user information.

The OEM must ensure KC marking requirements. The integrator of the module should refer to the labeling requirements for Korea available on the Korea Communications Commission (KCC) website.

The module is not labeled with its own KC mark. The final product requires the KC mark and MSIP certificate number of the module:

Format of the ID is as follows: "**MSIP-CRM-Pid-ENW89823A3KF**", where

- **MSIP:** Ministry of Science, ICT & Future Planning
- **R:** Indication of Broadcasting Communication Equipment code
- **R:** Indication of Basic Registration Information
- **Pid:** Indication of Application Information
- **ENW89823A3KF:** Indication of Product

End Product Labelling Example:

R-R-Pid- ENW89823A3KF

The label of end product should indicate the RF approved module's certification number as well as the end-device's certification number.

For more details please visit:

Korea Communications Commission (KCC)
http://www.kcc.go.kr

National Radio Research Agency (RRA)
http://rra.go.kr

6.6 Bluetooth

The final Bluetooth end product listing needs to be created by using the following IDs:

Bluetooth 4.0	Declaration ID	QDID
Controller Subsystem (deprecated)	B019784	39329

To enable a new Bluetooth listing for new products, the PAN1326C2 module should be used.

Bluetooth Marks

According to the Bluetooth SIG, the PAN131x/132x fulfills the criteria to label your product as a Bluetooth device:

For further information please refer to the Bluetooth website www.bluetooth.com.

6.7 RoHS and REACH Declaration

The latest declaration of environmental compatibility (Restriction of Hazardous Substances, RoHS and Registration, Evaluation, Authorisation and Restriction of Chemicals, REACH) for supplied products can be found on the Panasonic website in the “Downloads” section of the respective product ⇨ 7.2.2 Product Information.

7 Appendix

7.1 Ordering Information

Variants and Versions

The following modules are recommended for new designs:

- PAN1315B
- PAN1316B
- PAN1325B

Order Number[14]	Brand Name	Temperature	Texas Instruments Device	MOQ[15]
ENW89829C2JF	PAN1315A	-20°C to +70°C	CC2560A	1 500
ENW89829C2KF	PAN1315A	-40°C to +85°C	CC2560A	
ENW89829C3KF	PAN1315B	-40°C to +85°C	CC2560B	
ENW89823C2JF	PAN1316	-20°C to +70°C	CC2564	
ENW89823C2KF	PAN1316	-40°C to +85°C	CC2564	
ENW89823C3KF	PAN1316B	-40°C to +85°C	CC2564B	
ENW89827C2JF	PAN1317	-20°C to +70°C	CC2564	
ENW89827C2KF	PAN1317	-40°C to +85°C	CC2564	
ENW89842A2JF	PAN1323	-20°C to +70°C	CC2564	
ENW89842A2KF	PAN1323	-40°C to +85°C	CC2564	
ENW89829A2JF	PAN1325A	-20°C to +70°C	CC2560A	
ENW89829A2KF	PAN1325A	-40°C to +85°C	CC2560A	
ENW89829A3KF	PAN1325B	-40°C to +85°C	CC2560B	
ENW89823A2JF	PAN1326	-20°C to +70°C	CC2564	
ENW89823A2KF	PAN1326	-40°C to +85°C	CC2564	
ENW89823A3KF	PAN1326B	-40°C to +85°C	CC2564B	
ENW89827A2JF	PAN1327	-20°C to +70°C	CC2564	
ENW89827A2KF	PAN1327	-40°C to +85°C	CC2564	

[14] Samples are available on customer demand.

[15] Abbreviation for Minimum Order Quantity (MOQ). The default MOQ for mass production is 1 500 pieces, fewer only on customer demand. Samples for evaluation can be delivered at any quantity via the distribution channels.

7.2 Contact Details

7.2.1 Contact Us

Please contact your local Panasonic Sales office for details on additional product options and services:

For Panasonic Sales assistance in the **EU**, visit

https://eu.industrial.panasonic.com/about-us/contact-us

Email: wireless@eu.panasonic.com

For Panasonic Sales assistance in **North America**, visit the Panasonic website "Sales & Support" to find assistance near you at

https://na.industrial.panasonic.com/distributors

Please visit the **Panasonic Wireless Technical Forum** to submit a question at

https://forum.na.industrial.panasonic.com

7.2.2 Product Information

Please refer to the Panasonic Wireless Connectivity website for further information on our products and related documents:

For complete Panasonic product details in the **EU**, visit

http://pideu.panasonic.de/products/wireless-modules.html

For complete Panasonic product details in **North America**, visit

http://www.panasonic.com/rfmodules