Specification for Production

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By purchase of any products described in this document the customer accepts the document's validity and declares their agreement and understanding of its contents and recommendations. Panasonic reserves the right to make changes as required without notification.

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1 SCOPE OF THIS DOCUMENT

This product specification describes Panasonic's HCI, Class 1.5 , TI based, Bluetooth®[1] modules, series number 13xx.

For detailed family overview that includes part numbers see Chapter 28, Ordering Information.

Non-antenna versions will be refered to as PAN131x, versions with antenna will be refered to as PAN132x in this document.

Fore information and features on Bluetooth Low Energy 4.0 refer to Chapter 19, for information on ANT refer to Chapter 21.

1.1 NEW PAN1315A, PAN1325A

The PAN1315A/1325A Series is based on Texas Instruments' NEW CC2560A controller. A ROM update from Texas Instruments to the CC2560 IC has allowed Panasonic to improve PAN1315/1325 Series. The NEW PAN1315A/1325A Series Modules has increased power and system efficiency resulting from reduced initialization script size, start-up time and decreased system memory requirements.

Compatibility:

PAN1315, PAN1315A, PAN1316 and PAN1317 are 100% footprint compatible

PAN1325, PAN1325A, PAN1326 and PAN1327 are 100% footprint compatible

As an updated initialization script resident on the application microcontroller is required for modules based on the CC2560A, compatibility between the PAN1315/PAN1325 and PAN1315A/PAN1325A is dependant on the Bluetooth stack. Stacks are available that will operate with all PAN1315/1325 variations.

BT-Stack solutions provided by software development partners are available for most processors, including linux based host systems..

For detailed family overview that includes part numbers see Chapter 28 Ordering Information.

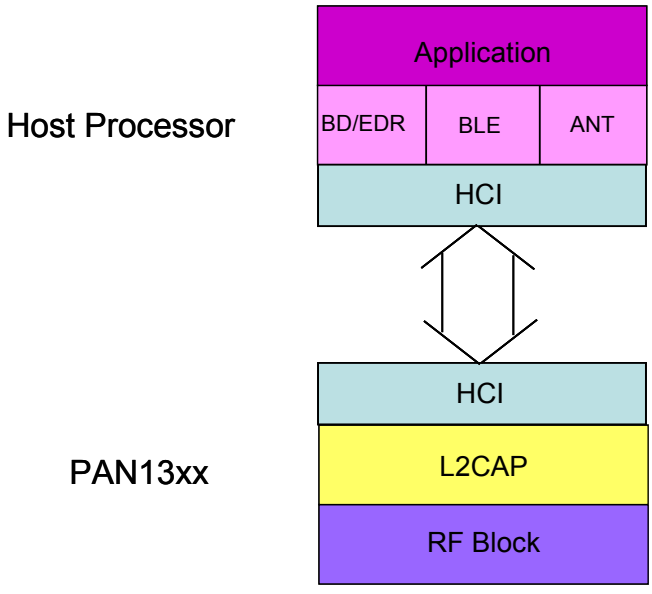
Contact your stack provider or local Panasonic sales company for currently available Bluetooth Profiles.

[1] Bluetooth is a registered trademark of the Bluetooth Special Interest Group.

2 KEY FEATURES

- Bluetooth specification v2.1 + EDR (**E**nhanced **D**ata **R**ate)
- Surface mount type 6.5(9.5 w. Ant.) x 9.0 x 1.8 mm³
- Up to 10.5dBm Tx power (typical) with transmit power control
- High sensitivity (-93 dBm typ.)
- Texas Instrument's CC256X BlueLink 7.0 inside
- Fast Connection Setup
- Extended SCO Link
- Supports convenient direct connection to battery (2.2-4.8 V), or connect to DC/DC (1.7-1.98 V) for improved power efficiency
- Internal crystal oscillator (26MHz)
- Fully shielded for immunity
- Full Bluetooth data rate up to 2,178kbps asymmetric
- Support for Bluetooth power saving modes (Sniff, Hold)
- Support for very low-power modes (deep sleep and power down)
- Optional support for ultra-low-power mode. Standby with Battery-Backup
- PCM Interface Master / Slave supporting 13 or 16 bit linear, 8 bit µ-law or A-law Codecs and CVSD transcoders on up to 3 SCO channels
- Full 8- to 128-bit encryption
- UART, I²C and PCM Interface
- IO operating voltage = 1.8 V nominal
- 3 Channel ADC and 1 Channel DAC
- Bluetooth profiles such as SPP, A2DP and others are available. Refer to Panasonic's RF module website for a listing of the most current releases.
- Manufactured in conformance with RoHS

2.1 SOFTWARE BLOCK DIAGRAM



3 APPLICATIONS FOR THE MODULE

All Embedded Wireless Applications

- Smart Phones
- Industrial Control
- Medical
- Scanners
- Wireless Sensors
- Low Power
- Cable Replacement
- Automotive
- Access Points
- Consumer Electronics
- Monitoring and Control
- Access Points

4 DESCRIPTION FOR THE MODULE

The PAN1315 and PAN1315A are short-range, Class 1 or 2, HCI modules for implementing Bluetooth functionality into various electronic devices. A block diagram can be found in Chapter 7.

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

New designs can be completed quickly by mating the PAN13xx series 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 TI's Stellaris ARM7 controller that includes StoneStreet One's A2DP profile. Other BT profiles are available on custom development basis.

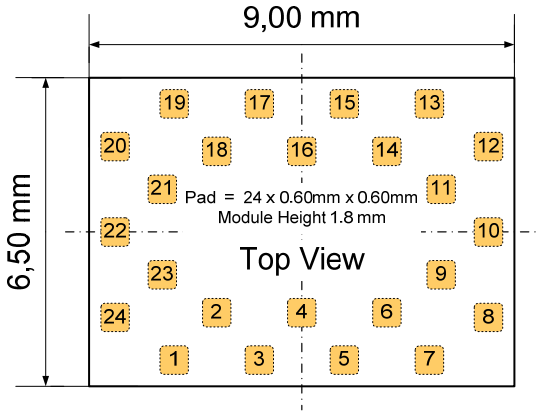
Additional controllers are also supported by the PAN13xx series by using a TI/Panasonic software development partner to port the Bluetooth stack and profiles. Mindtree's Software Development Kit (SDK) is available on TI's website -- www.ti.com/connectivity.com

Contact your local sales office for further details on additional options and services, by visiting www.panasonic.com/rfmodules or write an e-mail to wireless@eu.panasonic.com.

5 DETAILED DESCRIPTION

5.1 TERMINAL LAYOUT

5.1.1 5.1.1. Terminal Layout PAN131x without antenna



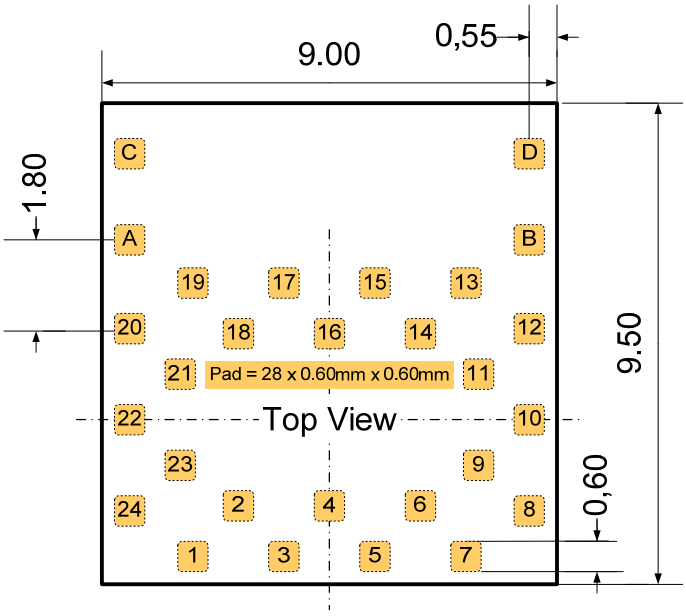
No	Pin Name	Pull at Reset	Def. Dir. [2]	I/O Type [3]	Description of Options (Common)	
1	GND				Connect to Ground	
2	TX_DBG	PU	O	2 mA	Logger output	
3	HCI_CTS	PU	I	8 mA	HCI UART clear-to-send.	
4	HCI_RTS	PU	O	8 mA	HCI UART request-to-send.	
5	HCI_RX	PU	I	8 mA	HCI UART data receive	
6	HCI_TX	PU	O	8 mA	HCI UART data transmit	
7	AUD_FSYNC	PD	IO	4 mA	PCM frame synch. (NC if not used)	Fail safe[4]
8	SLOW_CLK_IN		I		32.768-kHz clock in	Fail safe
9	NC		IO		Not connected	
10	MLDO_OUT		O		Main LDO output (1.8 V nom.)	
11	CL1.5_LDO_IN		I		PA LDO input	
12	GND				Connect to Ground	
13	RF		IO		Bluetooth RF IO	
14	GND				Connect to Ground	
15	MLDO_IN		I		Main LDO input	
16	nSHUTD	PD	I		Shutdown input (active low).	
17	AUD_OUT	PD	O	4 mA	PCM data output. (NC if not used)	Fail safe
18	AUD_IN	PD	I	4 mA	PCM data input. (NC if not used)	Fail safe
19	AUD_CLK	PD	IO	HY, 4 mA	PCM clock. (NC if not used)	Fail safe
20	GND				Connect to Ground	
21	NC				EEPROM I²C SDA (Internal)	
22	VDD_IO		PI		I/O power supply 1.8 V Nom	
23	NC				EEPROM I²C SCL (Internal)	
24	NC		IO		Not connected	

[2] I = input; O = output; IO = bidirectional; P = power; PU = pulled up; PD = pulled down

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

[4] No signals are allowed on the IO pins if no VDD_IO (Pin 22) power supplied, except pin 7, 8, 17-19.

5.1.2 5.1.2. Terminal Layout PAN132x with antenna



No	Pin Name	Pull at Reset	Def. Dir. [5]	I/O Type [6]	Description of Options (Common)
A	GND				Connect to Ground
B	GND				Connect to Ground
C	GND				Connect to Ground
D	GND				Connect to Ground

No 1-24 see above in Chapter 5.1.1. Except PIN 13 is not connected. For RF conducted measurements, either use the PAN1323ETU or de-solder the antenna and solder an antenna connector to the hot pin.

[5] I = input; O = output; IO = bidirectional; P = power; PU = pulled up; PD = pulled down

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

5.2 PIN DESCRIPTION

Pin Name	No	ESD [7] (V)	Pull at Reset	Def. Dir. [8]	I/O Type [9]	Description of Options
Bluetooth IO SIGNALS						
HCI_RX	5	750	PU	I	8 mA	HCI UART data receive
HCI_TX	6	750	PU	O	8 mA	HCI UART data transmit
HCI_RTS	4	750	PU	O	8 mA	HCI UART request-to-send.
HCI_CTS	3	750	PU	I	8 mA	HCI UART clear-to-send.
AUD_FYSNC	7	500	PD	IO	4 mA	PCM frame synch (NC if not used) Fail safe
AUD_CLK	19	500	PD	IO	HY, 4 mS	PCM clock (NC if not used) Fail safe
AUD_IN	18	500	PD	I	4 mA	PCM data input (NC if not used) Fail safe
AUD_OUT	17	500	PD	O	4 mA	PCM data output (NC if not used) Fail safe
TX_DBG	2	1000	PU	O	2 mA	Logger output OPTION: nTX_DBG – logger out (low = 1)
CLOCK SIGNALS						
SLOW_CLK_IN	8	1000		I		32.768-kHz clock in Fail safe
Bluetooth ANALOG SIGNALS						
RF	13	1000		IO		Bluetooth RF IO (not connected with antenna)
nSHUTD	16	1000	PD	I		Shutdown input (active low).
Bluetooth POWER AND GND SIGNALS						
VDD_IO	22	1000		PI		I/O power supply 1.8 V Nom
MLDO_IN	15	1000		I		Main LDO input Connect directly to battery or to a pre-regulated 1.8-V supply
MLDO_OUT	10	1000		O		Main LDO output (1.8 V nom.) Can not be used as 1.8V supply due to internal connection to the RF part.
CL1.5_LDO_IN	11	1000		I		PA LDO input Connect directly to battery or to a pre-regulated 1.8-V supply
GND	1			P		Connect to Ground
GND	12			P		Connect to Ground
GND	14			P		Connect to Ground
GND	20			P		Connect to Ground
EEPROM IO SIGNALS (EEPROM is optional in PAN13x product line)						
NC	23	1000	PU/PD	I	HY, 4mA	EEPROM I²C SCL (Internal)
NC	21	1000	PU/PD	IO	HY, 4mA	EEPROM I²C IRQ (Internal)

Remark:

HCI_CTS is an input signal to the CC256X device:

- When HCI_CTS is low, then CC256X is allowed to send data to Host device.
- When HCI_CTS is high, then CC256X is not allowed to send data to Host device.

[7] ESD: Human Body Model (HBM). JEDEC 22-A114

[8] I = input; O = output; IO = bidirectional; P = power; PU = pulled up; PD = pulled down

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

5.3 DEVICE POWER SUPPLY

The PAN13XX Bluetooth radio solution is intended to work in devices with a limited power budget such as cellular phones, headsets, hand-held PC's and other battery-operated devices. One of the main differentiators of the PAN13XX is its power management – its ability to draw as little current as possible.

The PAN13XX device requires two kinds of power sources:

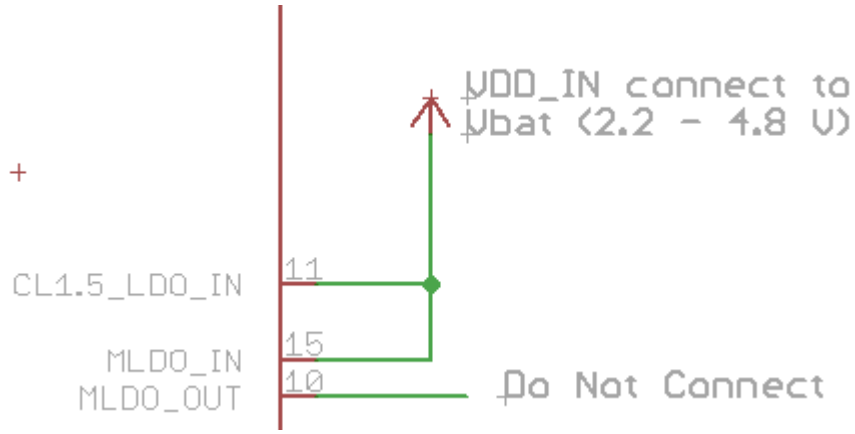
- Main power supply for the Bluetooth - VDD_IN = V_{BAT}
- Power source for the 1.8 V I/O ring - VDD_IO

The PAN13XX includes several on-chip voltage regulators for increased noise immunity. The PAN13XX can be connected either directly to the battery or to an external 1.8-V DC to DC converter.

There are three ways to supply power:

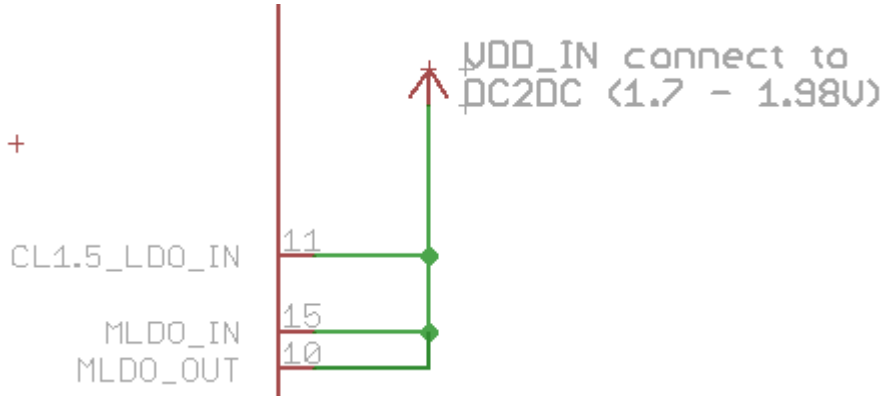
- Full-V_{BAT} system:

Maximum RF output power, but not optimum system power:



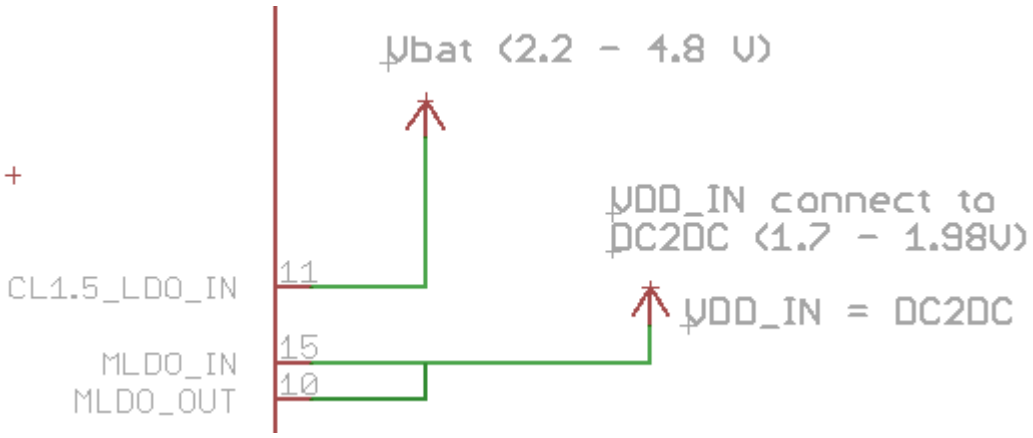
- Full-DC2DC system:

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}:



5.4 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 0-1.8 V.

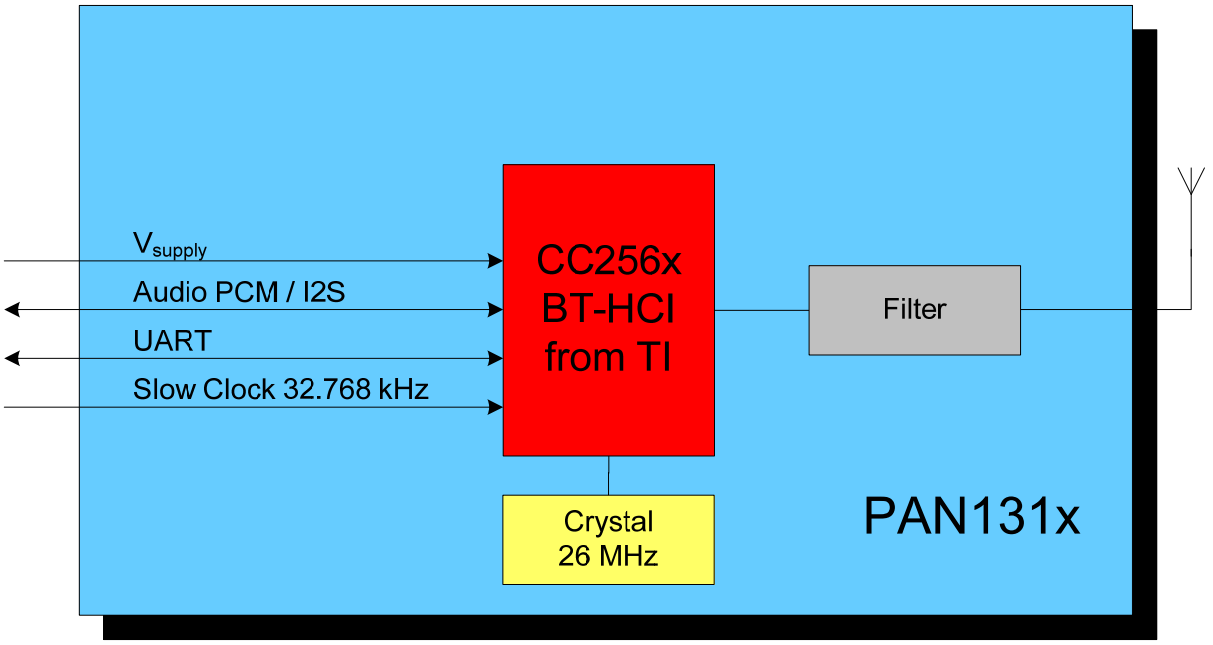
The slow clock's frequency accuracy must be 32.768 kHz ±250 ppm for Bluetooth usage (according to the Bluetooth specification).

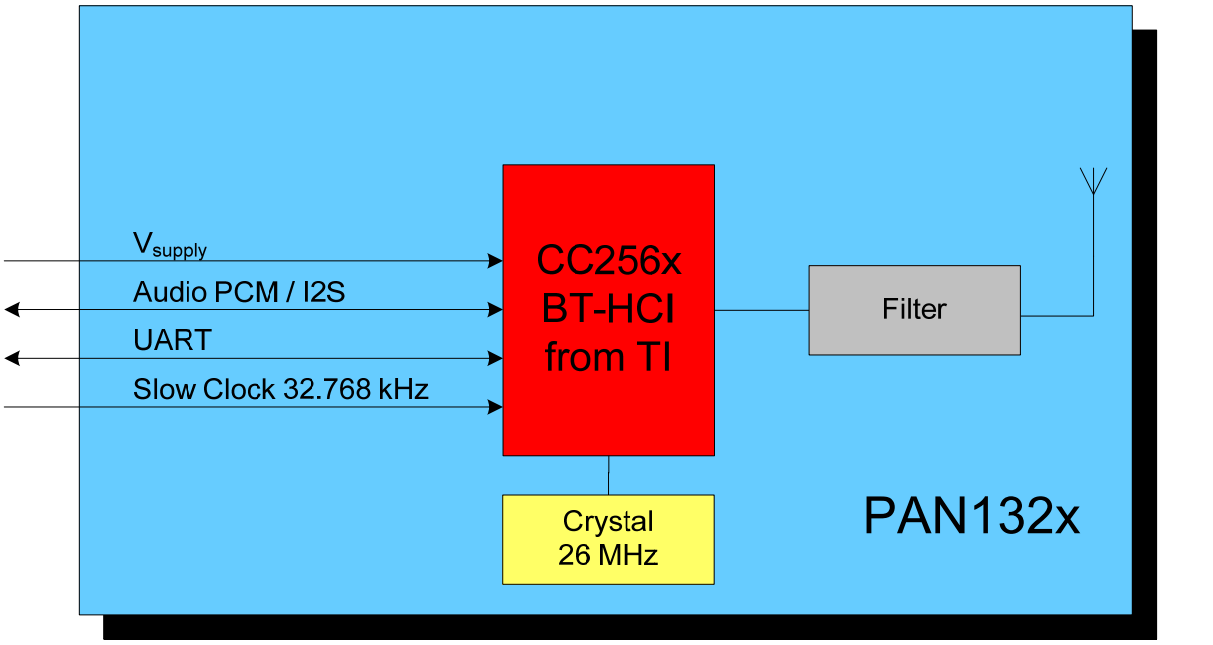
The Slow Clock 32.768 kHz is mandatory to start the internal controller, otherwise the module does not start up.

6 BLUETOOTH FEATURES

- Support of Bluetooth2.1+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. However 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 I2S 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.

7 BLOCK DIAGRAM





Note: The Slow Clock 32.768 kHz is mandatory, otherwise the module does not start up, refer to Chapter 5.4 for additional information.

Note: The IO are 1.8V driven and might need external level shifter and LDO. The MLDO_OUT PIN can not be used as reference due to RF internal connection.

8 TEST CONDITIONS

Measurements shall be made under room temperature and humidity unless otherwise specified.

9 GENERAL DEVICE REQUIREMENTS AND OPERATION

Temperature	25	±	10°C
Humidity	40	to	85%RH
SW-Patch	V2.30		
Supply Voltage	3.3V		

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

9.1 ABSOLUTE MAXIMUM RATINGS

Over operating free-air temperature range (unless otherwise noted).

Note

All parameters are measured as follows unless stated otherwise:

VDD_IN [10] = 3.3 V, VDD_IO = 1.8 V.

No	See [11]		Value	Unit
Ratings Over Operating Free-Air Temperature Range				
1	VDD_IN	Supply voltage range	–0.5 to 5.5	V [12]
2	VDDIO_1.8V		–0.5 to 2.145	V
3	Input voltage to RF (Pin 13)		–0.5 to 2.1	V
4	Operating ambient temperature range		–20 to 70	°C
5	Storage temperature range		–40 to 125	°C
6	Bluetooth RF inputs (Pin 13)		10	dBm
7	ESD: Human Body Model (HBM). JEDEC 22-A114		500	V

[10] VDD_IN is supplied to MLDO_IN (Pin 15) and CL1.5_LDO_IN (Pin 11), other options are described in Chapter 5.3.

[11] 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-rated conditions for extended periods may affect device reliability.

[12] Maximum allowed depends on accumulated time at that voltage: VDD_IN is defined in Reference schematics. When DC2DC supply is used, maximum voltage into MLDO_OUT and LDO_IN = 2.145 V.

9.2 RECOMMENDED OPERATING CONDITIONS

No	Rating	Condition	Symbol	Min	Max	Unit
1	Power supply voltage [13]		VDD_IN	1.7	4.8	V
2	IO power supply voltage		VDD_IO	1.62	1.92	V
3	High-level input voltage	Default	V_{IH}	0.65 x VDD_IO	VDD_IO	V
4	Low-level input voltage	Default	V_{IL}	0	0.35 x VDD_IO	V
5	IO Input rise/fall times, 10% to 90% [14]		Tr/Tf	1	10	ns
6	Maximum ripple on VDD_IN (Sine wave) for 1.8 V (DC2DC) mode	0 to 0.1 MHz			60	mVp-p
		0.1 to 0.5 MHz			50	
		0.5 to 2.5 MHz			30	
		2.5 to 3.0 MHz			15	
		> 3.0 MHz			5	
7	Voltage dips on VDD_IN (V_{BAT}) (duration = 577 µs to 2.31 ms, period = 4.6 ms)				400	mV
8	Maximum ambient operating temperature [15]				70	°C
9	Minimum ambient operating temperature [16]				-20	°C

9.3 CURRENT CONSUMPTION

No	Characteristics	Min 25°C	Typ 25°C	Max 25°C	Min -20°C	Typ -20°C	Max -20°C	Min +70°C	Typ +70°C	Max +70°C	Unit
1	Current consumption in shutdown mode [17]		1	3						7	µA
2	Current consumption in deep sleep mode [18]		40	105						700	µA
3	Total IO current consumption for active mode			1			1			1	mA
4	Current consumption during transmit DH5 full throughput		40								mA

[13] Excluding 1.98 < VDD_IN < 2.2 V range – not allowed.

[14] Asynchronous mode.

[15] The device can be reliably operated for 7 years at $T_{ambient}$ of 70°C, assuming 25% active mode and 75% sleep mode (15,400 cumulative active power-on hours).

[16] The device can be reliably operated for 7 years at $T_{ambient}$ of 70°C, assuming 25% active mode and 75% sleep mode (15,400 cumulative active power-on hours).

[17] Vbat + Vio

[18] Vbat + Vio + Vsd (shutdown)

9.4 GENERAL ELECTRICAL CHARACTERISTICS

No	Rating			Condition	Min	Max	Value
1	High-level output voltage, V_{OH}			at 2/4/8 mA	0.8 x VDD_IO	VDD_IO	V
				at 0.1 mA	VDD_IO – 0.2	VDD_IO	V
2	Low-level output voltage, V_{OL}			at 2/4/8 mA	0	0.2 x VDD_IO	V
				at 0.1 mA	0	0.2	V
3	IO 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	IO pull currents	TX_DBG, PCM bus	PU	typ = 6.5	3.5	9.7	µA
			PD	typ = 27	9.5	55	
		All others	PU	typ = 100	100	300	µA
			PD	typ = 100	100	360	

9.5 NSHUTD REQUIREMENTS

No	Parameter	Symbol	Min	Max	Unit
1	Operation mode level [19]	V_{IH}	1.42	1.98	V
2	Shutdown mode level	V_{IL}	0	0.4	V
3	Minimum time for nSHUT_DOWN low to reset the device		5		ms
4	Rise/fall times	Tr/Tf		20	µs

9.6 EXTERNAL DIGITAL SLOW CLOCK REQUIREMENTS (–20°C TO +70°C)

No	Characteristics	Condition	Symbol	Min	Typ	Max	Unit
1	Input slow clock frequency				32768		Hz
2	Input slow clock accuracy (Initial + temp + aging)	Bluetooth				±250	Ppm
3	Input transition time Tr/Tf – 10% to 90%		Tr/Tf			100	Ns
4	Frequency input duty cycle			15%	50%	85%	
5	Phase noise	at 1 kHz				-125	dBc/Hz
6	Jitter	Integrated over 300 to 15000 Hz				1	Hz
7	Slow clock input voltage limits	Square wave, DC coupled	V_{IH}	0.65 x VDD_IO		VDD_IO	V peak
			V_{IL}	0		0.35 x VDD_IO	
8	Input impedance			1			MΩ
9	Input capacitance					5	pF

[19] Internal pull down retains shut down mode when no external signal is applied to this pin.

10 HOST CONTROLLER INTERFACE

The CC256X incorporates one UART module dedicated to the host controller interface (HCI) transport layer. The HCI interface transports commands, events, ACL, and synchronous data between the Bluetooth device and its host using HCI data packets.

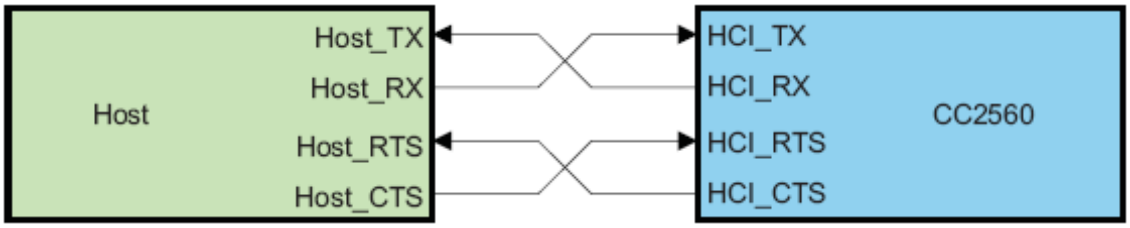
The UART module supports H4 (4-wires) protocol with maximum baud rate of 4 Mbps for all fast clock frequencies.

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 byte-wise 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 its 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.

11 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 codec's. PAN13XX 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

11.1 PCM HARDWARE INTERFACE

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

- Clock—configurable direction (input or output)
- Frame Sync—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-sync 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.

Please contact your sales representative if using the I2S bus over PCM. We strongly recommend adding a low pass filter (series resistor and capacitor to GND) to the bus for better noise suppression. It is not recommended to directly contact the host μController/DSP with the PCM interface.

11.2 DATA FORMAT

The data format is fully configurable:

- The data length can be from 8 to 320 bits, in 1-bit increments, when working with two channels, or up to 640 bits when using 1 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 Sync 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 powerup, Data Out is configured as high-Z.

11.3 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:

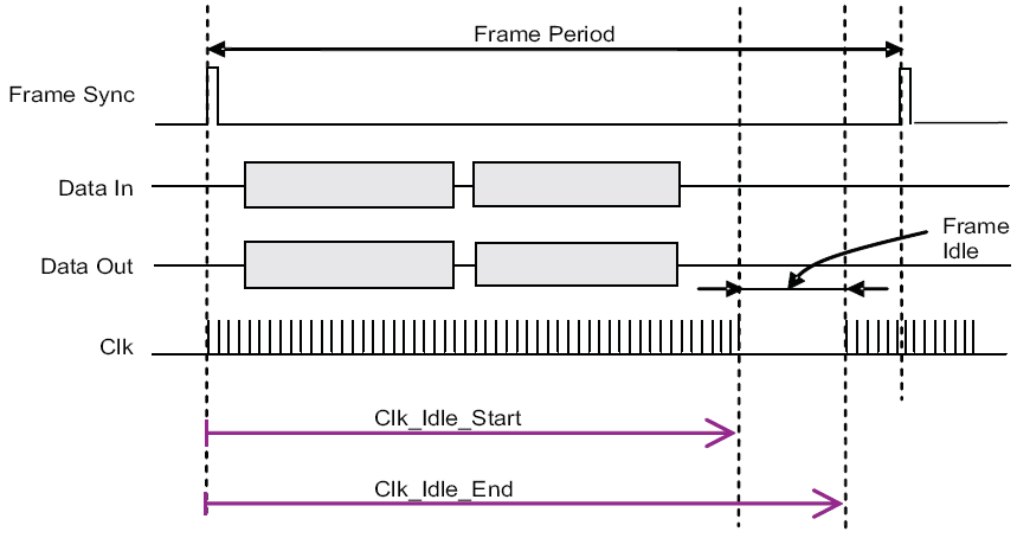
• Clk_Idle_Start – Indicates the number of PCM clock cycles from the beginning of the frame until the beginning of the idle period. After Clk_Idle_Start clock cycles, the clock will become '0'.

• 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 sync period = 10 kHz, Clk_Idle_Start = 60, Clk_Idle_End = 90.

Between each two frame syncs 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.

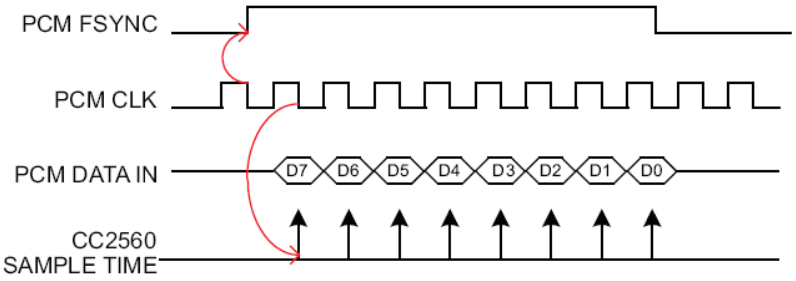


11.4 CLOCK-EDGE OPERATION

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 sync and the data at inversed polarity.

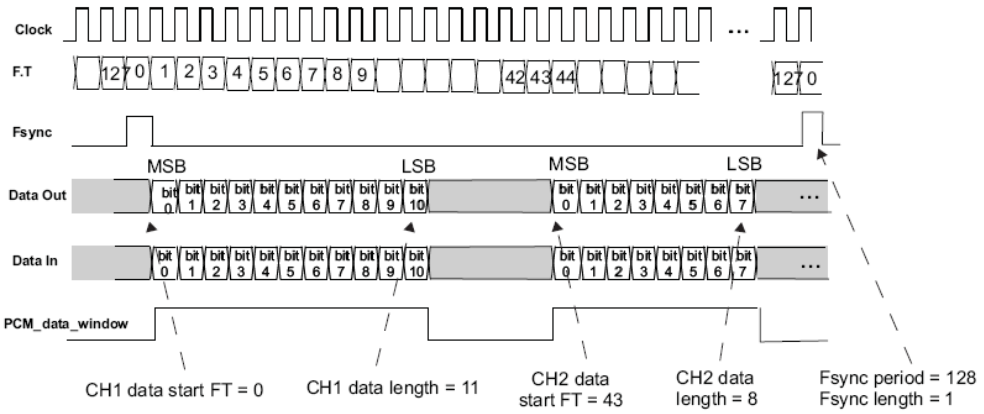
This is the operation of a falling-edge-clock type of codec. The codec is the master of the PCM bus. The frame sync signal is updated (by the codec) on the falling clock edge and therefore shall be sampled (by the CC256X) on the next rising clock. The data from the codec is sampled (by the CC256X) on the clock falling edge.

11.5 TWO-



CHANNEL PCM BUS EXAMPLE

In below figure, a 2-channel PCM bus is shown where the two channels have different word sizes and arbitrary positions in the bus frame. (FT stands for Frame Timer)



11.6 AUDIO ENCODING

The CC256X codec interface can use one of four audio-coding patterns:

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

11.7 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 to 24 bits (depends on the real sample size), in order 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.

11.8 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 behaviour modes: 'allow overflow' and 'don't allow overflow'.

• If overflow is allowed, the Bluetooth will continue receiving data and will overwrite any data not yet sent to the codec.

• If overflow is not allowed, RF voice packets received when buffer is full will be discarded.

11.9 BLUETOOTH INTER-IC SOUND (I2S)

The CC256X can be configured as an Inter-IC Sound (I2S) serial interface to an I2S 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 the microcontroller/DSP directly to the module's PCM interface, a simple RC low pass filter is recommended to improve noise suppression.

11.10 CURRENT CONSUMPTION FOR DIFFERENT BLUETOOTH SCENARIOS

The following table gives average current consumption for different Bluetooth scenarios.

Conditions: VDD_IN = 3.6 V, 25°C, 26-MHz fast clock, nominal unit, 4 dBm output power.

Mode Description	Master/Slave	Average Current	Unit
Idle current (ARM off)	Master/Slave	2.5	mA
SCO link HV3	Master/Slave	12	mA
eSCO link EV3 64 kbps, no retransmission	Master/Slave	11.5	mA
eSCO link 2-EV3 64 kbps, no retransmission	Master/Slave	8.3	mA
GFSK full throughput: TX = DH1, RX = DH5	Master/Slave	38.5	mA
EDR full throughput: TX = 2-DH1, RX = 2-DH5	Master/Slave	39.2	mA
EDR full throughput: TX = 3-DH1, RX = 3-DH5	Master/Slave	39.2	mA
Sniff, 1 attempt, 1.28 s	Master/Slave	76/100	µA
Page or Inquiry Scan 1.28 s, 11.25 ms	Master/Slave	300	µA
Page (1.28 s) and Inquiry (2.56 s) scans, 11.25 ms	Master/Slave	430	µA
Low power scan, 1.28-s interval, quiet environment	Master/Slave	135	µA

12 BLUETOOTH RF PERFORMANCE

No	Characteristics	Typ	BT Spec Max	BT Spec Min
			Class1	Class1
1	Average Power Hopping DH5 [dBm] [21, 22]	7.2	20	4
2	Average Power: Ch0 [dBm] [21, 22]	7.5	20	4
3	Peak Power: Ch0 [dBm] [21, 22]	7.7	23	
4	Average Power: Ch39 [dBm] [21, 22]	7.0	20	4
5	Peak Power: Ch39 [dBm] [21, 22]	7.2	23	
6	Average Power: Ch78 [dBm] [21, 22]	6.7	20	4
7	Peak Power: Ch78 [dBm] [21, 22]	7.0	23	
8	Max. Frequency Tolerance: Ch0 [kHz]	-2.6	75	-75
9	Max. Frequency Tolerance: Ch39 [kHz]	-2.2	75	-75
10	Max. Frequency Tolerance: Ch78 [kHz]	-2.1	75	-75
11	Max. Drift: Ch0_DH1 [kHz]	3.6	25	-25
12	Max. Drift: Ch0_DH3 [kHz]	3.7	40	-40
13	Max. Drift: Ch0_DH5 [kHz]	4.0	40	-40
14	Max. Drift Rate: Ch0_DH1 [kHz]	-2.6	20	-20
15	Max. Drift Rate: Ch0_DH3 [kHz]	-3.2	20	-20
16	Max. Drift Rate: Ch0_DH5 [kHz]	-3.3	20	-20
17	Max. Drift: Ch39_DH1 [kHz]	4.0	25	-25
18	Max. Drift: Ch39_DH3 [kHz]	4.3	40	-40
19	Max. Drift: Ch39_DH5 [kHz]	4.3	40	-40
20	Max. Drift Rate: Ch39_DH1 [kHz]	-3.1	20	-20
21	Max. Drift Rate: Ch39_DH3 [kHz]	-3.6	20	-20
22	Max. Drift Rate: Ch39_DH5 [kHz]	-3.7	20	-20

No	Characteristics	Typ	BT Spec Max	BT Spec Min
			Class1	Class1
23	Max. Drift: Ch78_DH1 [kHz]	4.1	25	-25
24	Max. Drift: Ch78_DH3 [kHz]	4.5	40	-40
25	Max. Drift: Ch78_DH5 [kHz]	4.4	40	-40
26	Max. Drift Rate: Ch78_DH1 [kHz]	-3.4	20	-20
27	Max. Drift Rate: Ch78_DH3 [kHz]	-3.9	20	-20
28	Max. Drift Rate: Ch78_DH5 [kHz]	-4.1	20	-20
29	Delta F1 Avg: Ch0 [kHz]	159.5	175	140
30	Delta F2 Max.: Ch0 [%]	100.0		99.9
31	Delta F2 Avg/Delta F1 Avg: Ch0	0.9		0.8
32	Delta F1 Avg: Ch39 [kHz]	159.8	175	140
33	Delta F2 Max.: Ch39 [%]	100.0		99.9
34	Delta F2 Avg/Delta F1 Avg: Ch39	0.9		0.8
35	Delta F1 Avg: Ch78 [kHz]	159.1	175	140
36	Delta F2 Max.: Ch78 [%]	100.0		99.9
37	Delta F2 Avg/Delta F1 Avg: Ch78	0.9		0.8
45	Sensitivity	-93.0		-81
46	f(H)-f(L): Ch0 [kHz]	918.4	1000	
47	f(H)-f(L): Ch39 [kHz]	918.3	1000	
48	f(H)-f(L): Ch78 [kHz]	918.2	1000	
49	ACPower -3: Ch3 [dBm]	-51.5	-40	
50	ACPower -2: Ch3 [dBm]	-50.4	-40	
51	ACPower -1: Ch3 [dBm]	-18.5		
52	ACPower Center: Ch3 [dBm]	8.1	20	4
53	ACPower +1: Ch3 [dBm]	-19.2		
54	ACPower +2: Ch3 [dBm]	-50.7	-40	
55	ACPower +3: Ch3 [dBm]	-53.3	-40	
56	ACPower -3: Ch39 [dBm]	-51.6	-40	
57	ACPower -2: Ch39 [dBm]	-50.7	-40	
58	ACPower -1: Ch39 [dBm]	-19.0		
59	ACPower Center: Ch39 [dBm]	7.7	20	4
60	ACPower +1: Ch39 [dBm]	-19.7		
61	ACPower +2: Ch39 [dBm]	-50.9	-40	
62	ACPower +3: Ch39 [dBm]	-53.2	-40	
63	ACPower -3: Ch75 [dBm]	-51.7	-40	
64	ACPower -2: Ch75 [dBm]	-50.7	-40	
65	ACPower -1: Ch75 [dBm]	-19.2		
66	ACPower Center: Ch75 [dBm]	7.5	20	4
67	ACPower +1: Ch75 [dBm]	-20.0		
68	ACPower +2: Ch75 [dBm]	-51.0	-40	
69	ACPower +3: Ch75 [dBm]	-53.4	-40	
70	omega i 2-DH5: Ch0 [kHz]	-4.7	75	-75
71	omega o + omega i 2-DH5: Ch0 [kHz]	-6.0	75	-75
72	omega o 2-DH5: Ch0 [kHz]	-1.5	10	-10
73	DEVM RMS 2-DH5: Ch0 [%]	0.0	0.2	
74	DEVM Peak 2-DH5: Ch0 [%]	0.1	0.35	

No	Characteristics	Typ	BT Spec Max	BT Spec Min
			Class1	Class1
75	DEVM 99% 2-DH5: Ch0 [%]	100.0		99
76	omega i 3-DH5: Ch0 [kHz]	-3.7	75	-75
77	omega o + omega i 3-DH5: Ch0 [kHz]	-5.8	75	-75
78	omega o 3-DH5: Ch0 [kHz]	-2.6	10	-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 [%]	100.0		99
82	omega i 2-DH5: Ch39 [kHz]	-4.8	75	-75
83	omega o + omega i 2-DH5: Ch39 [kHz]	-6.1	75	-75
84	omega o 2-DH5: Ch39 [kHz]	-1.4	10	-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 [%]	100.0		99
88	omega i 3-DH5: Ch39 [kHz]	-3.8	75	-75
89	omega o + omega i 3-DH5: Ch39 [kHz]	-5.9	75	-75
90	omega o 3-DH5: Ch39 [kHz]	-2.6	10	-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 [%]	100.0		99
94	omega i 2-DH5: Ch78 [kHz]	-4.9	75	-75
95	omega o + omega i 2-DH5: Ch78 [kHz]	-6.2	75	-75
96	omega o 2-DH5: Ch78 [kHz]	-1.4	10	-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 [%]	100.0		99
100	omega i 3-DH5: Ch78 [kHz]	-3.8	75	-75
101	omega o + omega i 3-DH5: Ch78 [kHz]	-6.0	75	-75
102	omega o 3-DH5: Ch78 [kHz]	-2.7	10	-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 [%]	100.0		99

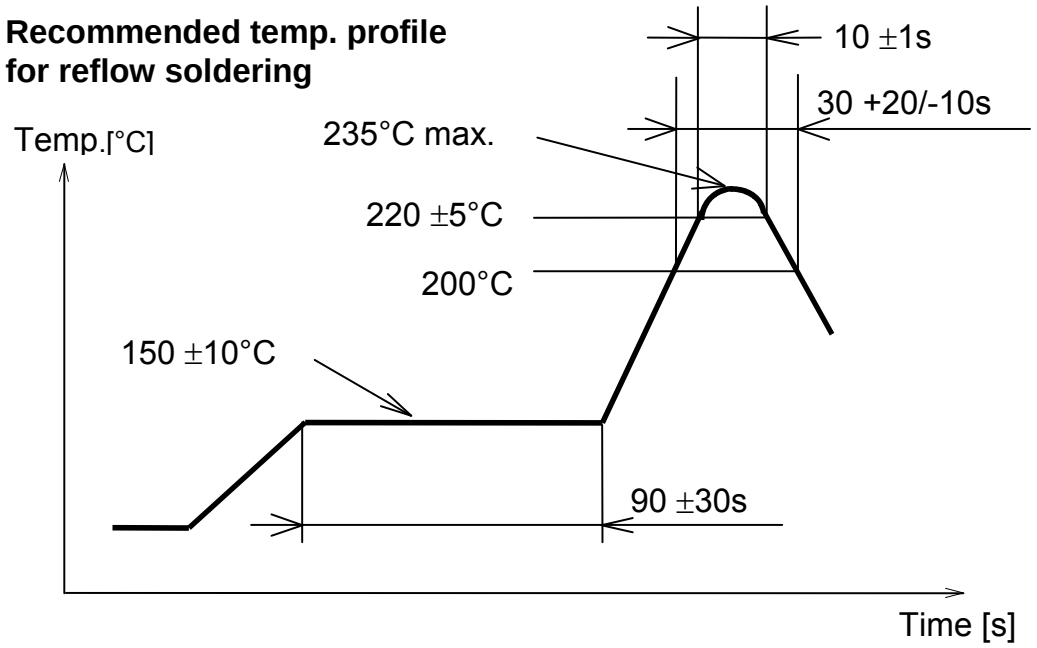
No	Characteristics	Condition	Min	Typ	Max	BT Spec	Unit
1	Operation frequency range		2402		2480		MHz
2	Channel spacing			1			MHz
3	Input impedance			50			Ω
4	Sensitivity, Dirty Tx on	GFSK, BER = 0.1%		-93.0		-70	dBm
		Pi/4-DQPSK, BER = 0.01%		-92.5		-70	
		8DPSK, BER = 0.01%		-85.5		-70	

No	Characteristics	Condition	Typ	Max	Unit
1	Tx and Rx out-of-band emissions Output signal = 7dBm	30 kHz to 1 GHz [20], [21], [22]		-30	dBm
		1 to 12.75 GHz [20, 21, 22]		-30	
2	2nd harmonic	at 7dBm output power [20, 21, 22]		-30	dBm
3	3rd harmonic	at 7dBm output power [20, 21, 22]		-30	dBm

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.

13 SOLDERING TEMPERATURE-TIME PROFILE (FOR REFLOW SOLDERING)

13.1 FOR LEAD SOLDER



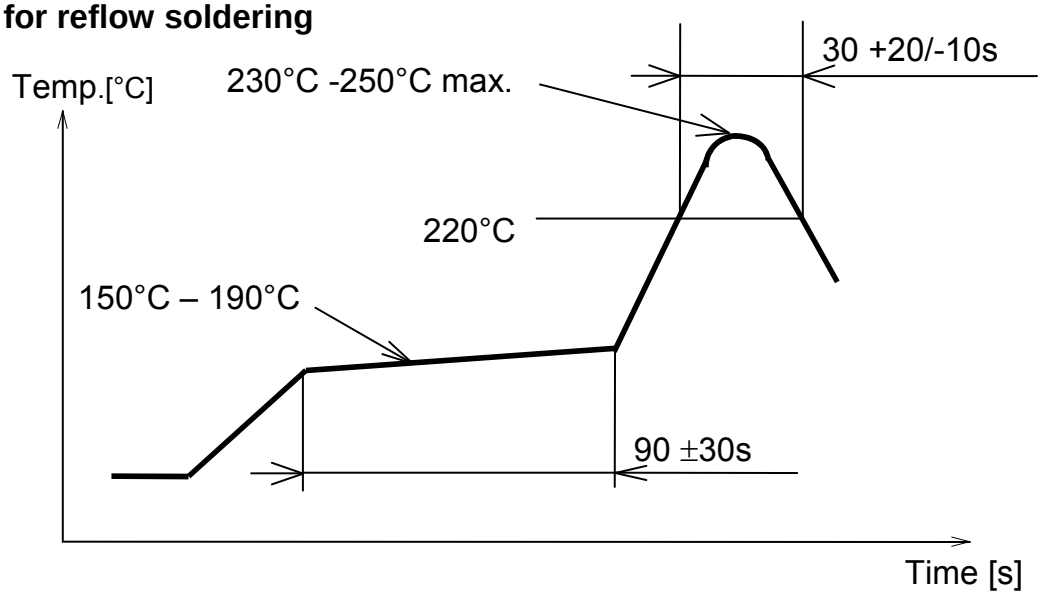
[20] Includes effects of frequency hopping

[21] Average according FCC, IC and ETSI requirements. Above +7dBm output power (refer also to 22) the customer has to verify the final product against national regulations.

[22] +7dBm related to power register value 18, according to TI service pack 2.30

13.2 FOR LEADFREE SOLDER

Our used temp. profile for reflow soldering



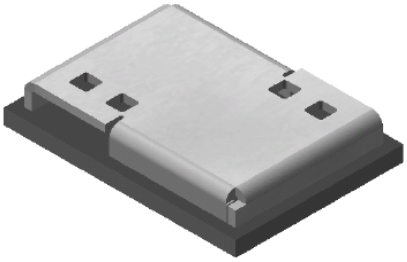
Reflow permissible cycle: 2
Opposite side reflow is prohibited due to module weight.

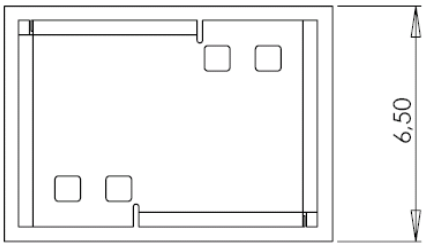
14 MODULE DIMENSION

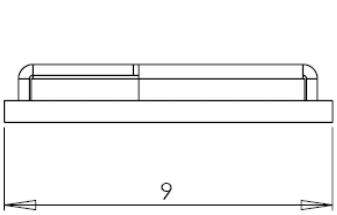
14.1 MODULE DIMENSIONS PAN131X WITHOUT ANTENNA

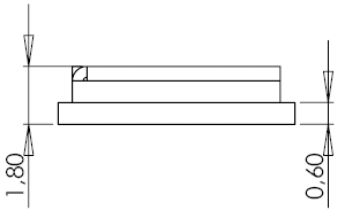
No.	Item	Dimension	Tolerance	Remark
1	Width	6.50	± 0.20	
2	Lenght	9.00	± 0.20	
3	Height	1.80	± 0.20	With case

PAN131X Module Drawing





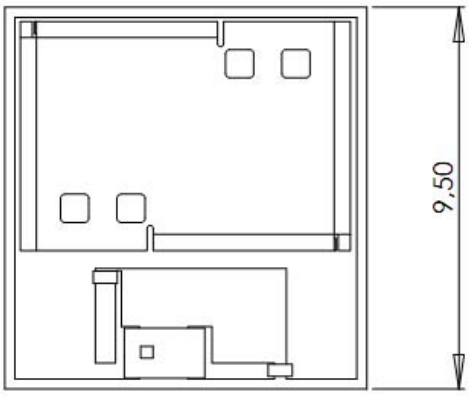


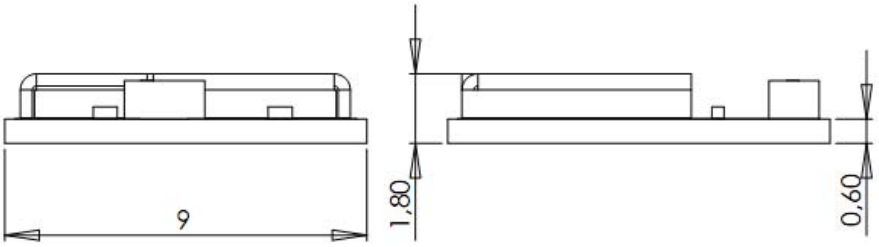


14.2 MODULE DIMENSIONS PAN132X WITH ANTENNA

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

PAN132X Module Drawing



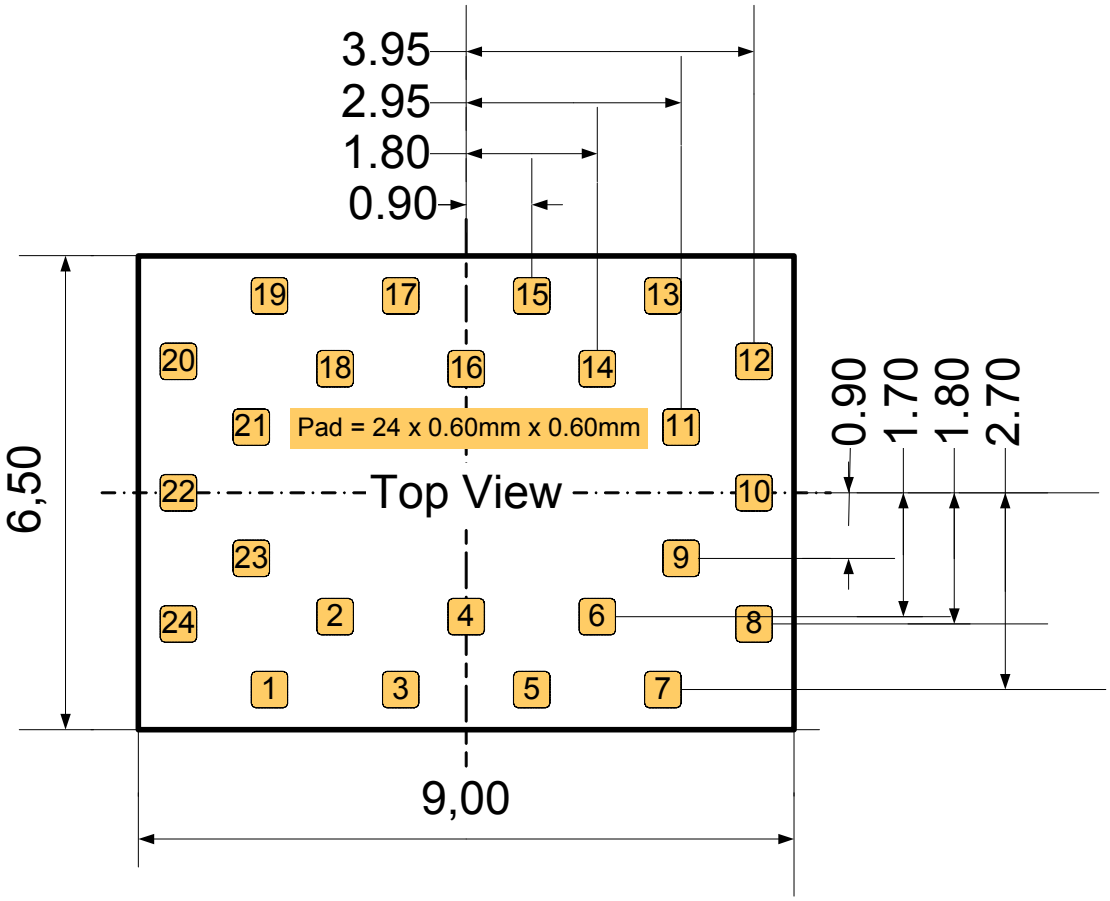


15 FOOTPRINT OF THE MODULE

15.1 FOOTPRINT PAN131X WITHOUT ANTENNA

All dimensions are in millimeters.
The outer dimensions have a tolerance of ± 0.2mm.

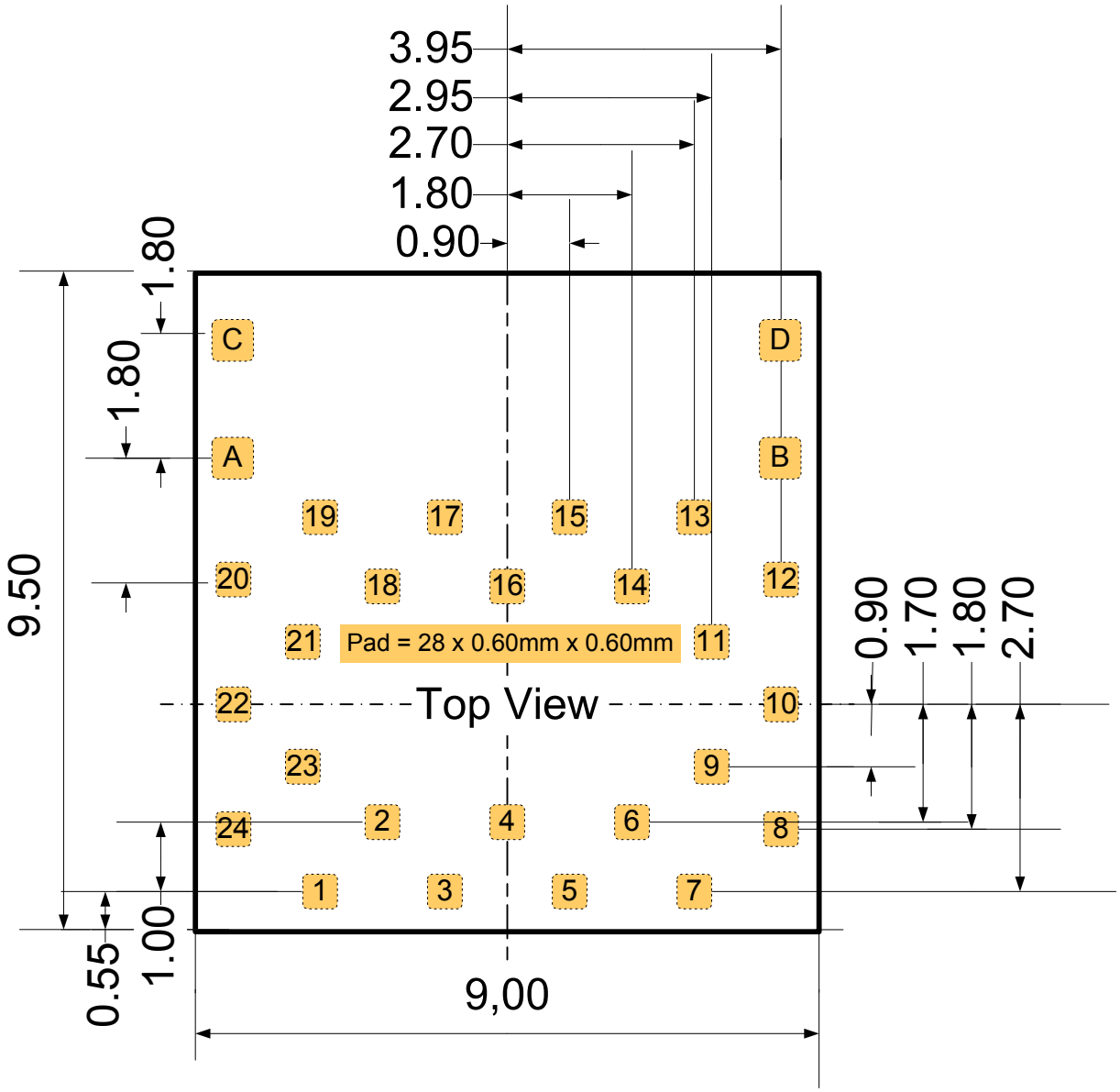
The layout is symetric to center. The inner pins (2,4,6,9,11,14,16,18,21,23) are shifted to the center by 1mm.



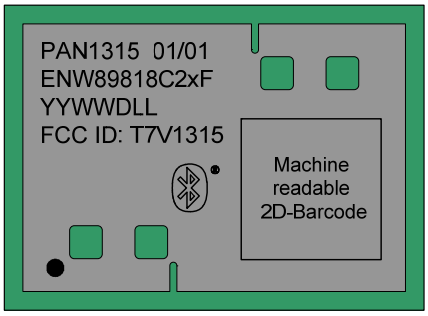
15.2 FOOTPRINT PAN132X WITH ANTENNA

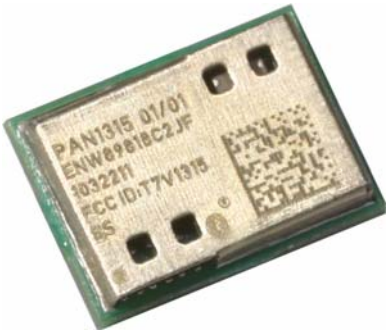
All dimensions are in millimeters.
The outer dimensions have a tolerance of ± 0.2mm.

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



16 LABELING DRAWING





The above pictures show the laser marking on the top case, this is only an example from PAN1315.

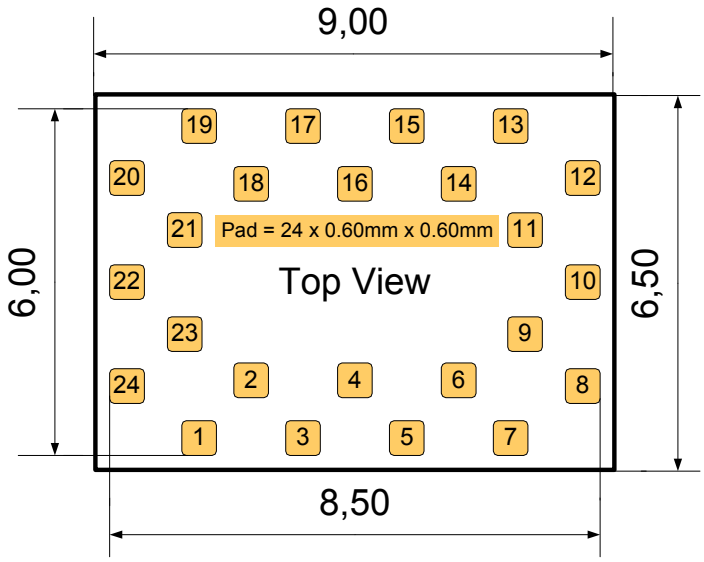
17 MECHANICAL REQUIREMENTS

No.	Item	Limit	Condition
1	Solderability	More than 75% of the soldering area shall be coated by solder	Reflow soldering with recommendable temperature profile
2	Resistance to soldering heat	It shall be satisfied electrical requirements and not be mechanical damage	See Chapter 13.2

18 RECOMMENDED FOOT PATTERN

18.1 RECOMMENDED FOOT PATTERN PAN131X WITHOUT ANTENNA

Dimensions in mm.



The land pattern dimensions above are meant to serve only as a guide. This information is provided without any legal liability.

For the solder paste screen, use as a first guideline the same foot print as shown in the figure above. Solder paste screen cutouts (with slightly different dimensions) might be optimum depending on your soldering process. For example, the solder paste screen thickness chosen might have an effect. The solder screen thickness depends on your production standard 120µm to 150µm is recommended.

IMPORTANT:
Although the bottom side of PAN131X is fully coated, no copper such as through hole vias, planes or tracks on the board component layer should be located below the PAN131X to avoid creating a short. In cases where a track or through hole via has to be located under the module, it must be kept away from PAN131X bottom pads. The PAN131X multilayer pcb contains an inner RF shielding plane, therefore no pcb shielding plane below the module is needed.

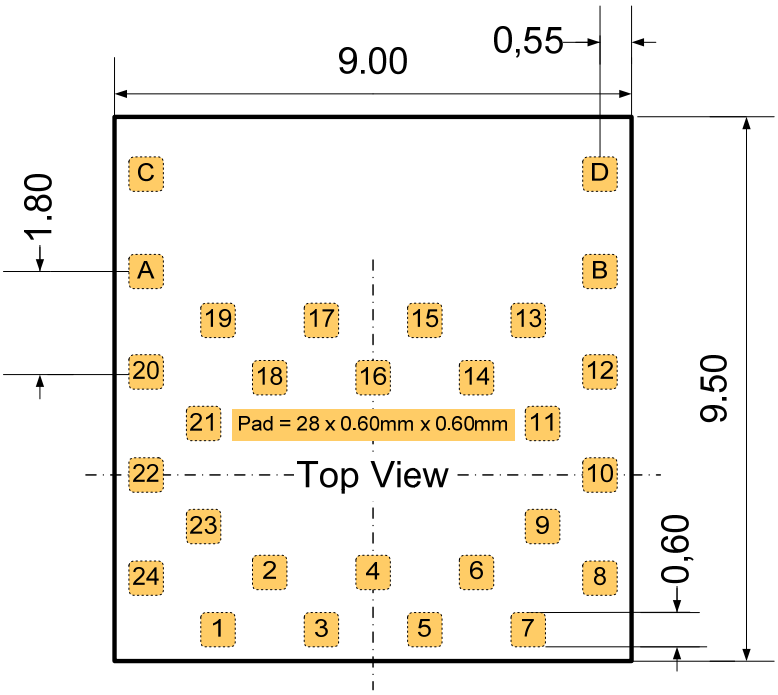
When using an onboard ceramic antenna, place the antenna on the edge of your carrier board (if allowable).

If you have any questions on these points, contact your local Panasonic representative.

Schematics and layouts may be sent to wireless@eu.panasonic.com for final review.

18.2 RECOMMENDED FOOT PATTERN PAN132X WITH ANTENNA

Dimensions in mm.



The land pattern dimensions above are meant to serve only as a guide.

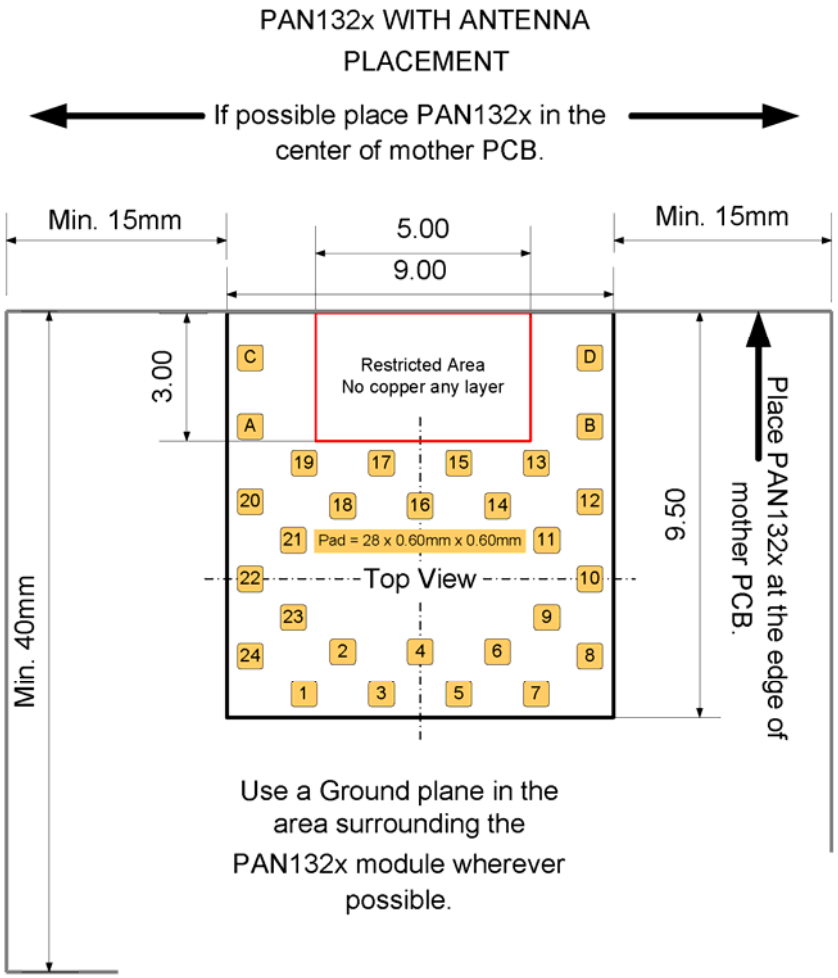
For the solder paste screen, use as a first guideline the same foot print as shown in the Figure above. Solder paste screen cutouts (with slightly different dimensions) might be optimum depending on your soldering process. For example, the solder paste screen thickness chosen might have an effect. The solder screen thickness depends on your production standard 120µm to 150µm is recommended.

IMPORTANT: In cases where a track or through hole via has to be located under the module, it must be kept away from PAN132X bottom pads. The PAN132X multilayer pcb contains an inner RF shielding plane, therefore no pcb shielding plane below the module is needed.

If you have any questions on these points, contact your local Panasonic representative.

Schematics and layouts may be sent to wireless@eu.panasonic.com for final review.

19 LAYOUT RECOMMENDATIONS WITH ANTENNA (PAN132X)



20 BLUETOOTH LE (LOW ENERGY) PAN1316/26

20.1 NETWORK TOPOLOGY

Bluetooth Low Energy is designed to reduce power consumption. It can be put into a sleep mode and is only activated for event activities such as sending files to a gateway, PC or mobile phone. Furthermore the maximum power consumption is set to less than 15 mA and the average power consumption is about 1 uA. The benefit of low energy consumption are short messages and establishing very fast connections (few ms). Using these techniques, energy consumption is reduced to a tenth of a Classic Bluetooth unit. Thus, a small coin cell – such as a CR2032 – is capable of powering a device for up to 10 years of operation.

To be backwards compatible with Classic Bluetooth and to be able to offer an affordable solution for very inexpensive devices, Panasonic Low Energy Bluetooth modules are offered in two versions:

Dual-mode: Bluetooth Low Energy technology combined with Classic Bluetooth functionality on a single module. Dual mode devices act as gateways between these two technologies.

Single Mode: Bluetooth Low Energy technology to optimize power consumption, which is particularly useful for products powered by small batteries. These modules have embedded controllers allowing the module to operate autonomously in low cost applications that lack intelligence.

This data sheet describes dual-mode Bluetooth Low Energy technology combined with Classic Bluetooth functionality on a single module. Additional information on Panasonic's single mode products can be found by visiting www.panasonic.com/rfmodules or write an e-mail to wireless@eu.panasonic.com.

20.2 MODULE FEATURES

Fully compliant with Bluetooth 4.0:

- Optimized for proximity and sports use
- Supports up to 10 simultaneous connections
- Multiple sniff instances are tightly coupled to minimize power consumption
- Independent buffering allows a large number of multiple connections without affecting BR/EDR performance
- Includes built-in coexistence and prioritization handling for BR/EDR and LE

20.3 CURRENT CONSUMPTION FOR DIFFERENT LE SCENARIOS

Conditions: VDD_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 1.28msec advertising interval 15Bytes advertise Data	104	µA
Advertising, discoverable	Advertising in all 3 channels 1.28msec advertising interval 15Bytes advertise Data	121	µA
Scanning	Listening to a single frequency per window 1.28msec scan interval 11.25msec scan window	302	µA
Connected (master role)	500msec connection interval 0msec Slave connection latency Empty Tx/Rx LL packets	169	µA

21 ANT PAN1317/27

ANT+ (sometimes ANT + or ANT Plus) is an interoperability function that can be added to the base ANT protocol (a proprietary wireless sensor network technology).[

21.1 NETWORK TOPOLOGY

ANT™ is a wireless sensor network protocol operating in the 2.4 GHz spectrum. Designed for ultra-low power, ease of use, efficiency and scalability, ANT supports peer-to-peer, star, tree and fixed mesh topologies. It provides reliable data communications, flexible and adaptive network operation and cross-talk immunity. The ANT protocol stack is compact, requiring minimal microcontroller resources to reduce system costs, lighten the computational burden and improve efficiency. Low-level security is implemented to allow user-defined network security.

PAN1317/1327 provides the first wireless, single-chip solution with dual-mode ANT and Bluetooth connectivity with inclusion of TI's CC2567 device. This solution wirelessly connects 13 million ANT-based devices to the more than 3 billion Bluetooth endpoint devices used by people every day, creating new market opportunities for companies building ANT products and Bluetooth products alike. CC2567 requires 80% 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.

21.2 MODULE FEATURES

Fully compliant with ANT protocol:

• ANT solution optimized for fitness, health and consumers use cases
• Supports up to eight simultaneous connections, various network topologies and high-resolution proximity pairing
• Includes built-in coexistence and prioritization handling for BR/EDR and ANT

Features	Benefits
Dual-mode ANT+ and Bluetooth (Bluetooth v2.1 + EDR) on a single chip	- Requires 80% less board area than any dual module or device design - Reduces costs associated with incorporating two wireless technologies
Fully validated optimized single antenna solution	- Enables simultaneous operation of ANT+ and Bluetooth without the need for two devices or modules - Includes built-in coexistence
Best-in-class Bluetooth and ANT RF performance: - +10 dBm Tx power with transmit power control - -93 dBm sensitivity	- Delivers twice the distance between the aggregator and ANT sensor device than competitive single-mode ANT solutions - Enables a robust and high-throughput connection with extended range
Support for: - ANT+ ultra low power (master and slave devices) - Bluetooth power saving modes (park, sniff, hold) - Bluetooth ultra low power modes (deep sleep, power down)	- Improves battery life and power efficiency of the finished product
Turnkey solution: - Fully integrated module - Complete development kit with software and documentation - TI MSP430 hardware and software platform integration (optional)	- Ease of integration into system allows quick time to market - Reduces costs and time associated with certification

21.3 ANT CURRENT CONSUMPTION

Mode	Description	Average Current	Unit
Rx message mode	250msec interval	380	µA
Rx message mode	500msec interval	205	µA
Rx message mode	1000msec interval	118	µA

22 TRIPLE MODE (BR/EDR + BLUETOOTH LOW ENERGY + ANT) PAN1323

The PAN1323 has been engineered to give designers the flexibility to implement Bluetooth Classic (BR/EDR), Bluetooth Low Energy and ANT into an application using a single module, reducing cost and footprint area. Refer to the paragraphs above for complete descriptions on each of the three protocols. The module is fully hardware compatible with the PAN1315, 15A, 16, 17, 25, 25A, 26 and 27. A highly efficent 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.Customers interested in this unique module are encouraged to contact StoneStreetOne for a Bluetooth SIG certified stack.

22.1 TRIPLE MODE CURRENT CONSUMPTION

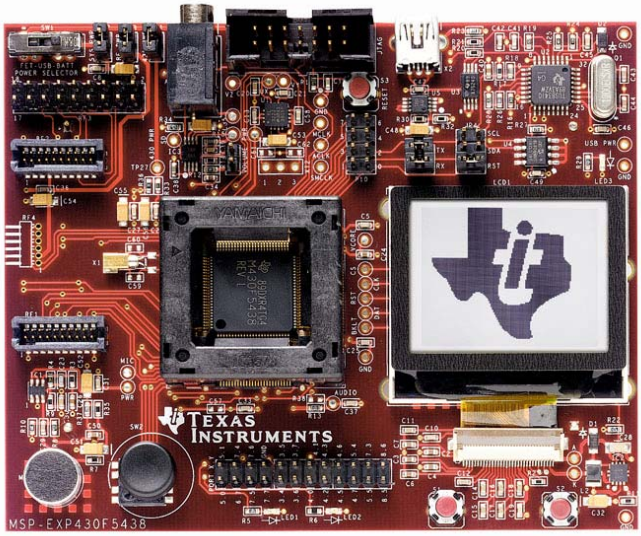
The current consumption of the PAN1326 is a function of the protocol that the module is running at any point in time. Refer to the paragraphs above for details on current consumption for each of the three protocols or software vendor.

23 DEVELOPMENT OF APPLICATIONS

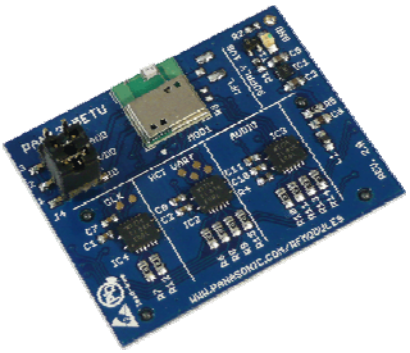
Mindtree Ltd. has developed a Bluetooth SPP freeware for TIs MSP430 and Panasonics PAN1315(A) and PAN1325(A). For other software refer to Chapter 24 or visit the following link www.panasonic.com/rfmodules.

23.1 TOOLS TO BE NEEDED

Tool	Source
TI - MSP-EXP430F5438 - Experimenter Board	MSP-EXP430F5438
TI - MSP-FET430UIF430 - Debugging Interface	MSP-FET430UIF430
PAN1323EMK - Bluetooth Evaluation Module Kit for MSP430	TI PAN1323EMK
	Panasonic PAN1323ETU
For information on Bluetooth + ANT kit for PAN1327	CC2567-PAN1327ANT-BTKIT
	CC2567 + PAN1327 wiki



MSP-EXP430F5438
MSP430F5438 Experimenter Board



PAN1323ETU

In addition you need the software development environment, e.g. IAR Embedded Workbench, refer to:
http://wiki.msp430.com/index.php/MSP430_Bluetooth_Platform

Evaluation kits and modules are available through Panasonic's network of authorized distributors. For any additional information, please visit www.panasonic.com/rfmodules.

24 LIST OF PROFILES

Profile	Software Developer	Controller	Availability
Bluetooth			
SPP and others	MindTree	TI, MSP430	Now
SPP	Seeran	STM32, MSP430	Now
HDP, SPP	Stollmann	TI, MSP430	Now
A2DP, AVRCP, SPP	StoneStreetOne	TI, Stellaris	Now
SPP and others	ARS	Multiple	Now
Bluetooth LE			
All	ARS, MindTree, StoneStreetOne, Stollmann	TI, MSP430 and others	Upon request
ANT Protocoll			
ANT	Dynastream	MSP430 and others	Now
Triple Mode Stack			
SPP	StoneStreetOne	MSP430 and others	Now

For all other profiles contact your local sales representative.

25 RELIABILITY TESTS

The measurement should be done after being exposed to room temperature and humidity for 1 hour.

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

26 CAUTIONS

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

26.1 DESIGN NOTES

(1) Follow the conditions written in this specification, especially the control signals of this module.
(2) The supply voltage has to 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 47uF directly at the module).
(3) This product should not be mechanically stressed when installed.
(4) Keep this product away from heat. Heat is the major cause of decreasing the life of these products.
(5) Avoid assembly and use of the target equipment in conditions where the products' temperature may exceed the maximum tolerance.
(6) The supply voltage should not be exceedingly high or reversed. It should not carry noise and/or spikes.
(7) Keep this product away from other high frequency circuits.

26.2 INSTALLATION NOTES

(1) Reflow soldering is possible twice based on the conditions in Chapter 15. Set up the temperature at the soldering portion of this product according to this reflow profile.
(2) Carefully position the products so that their heat will not burn into printed circuit boards or affect the other components that are susceptible to heat.
(3) Carefully locate these products so that their temperatures will not increase due to the effects of heat generated by neighboring components.
(4) If a vinyl-covered wire comes into contact with the products, then the cover will melt and generate toxic gas, damaging the insulation. Never allow contact between the cover and these products to occur.
(5) This product should not be mechanically stressed or vibrated when reflowed.
(6) To repair a board by hand soldering, keep the conditions of this chapter.
(7) Do not wash this product.
(8) Refer to the recommended pattern when designing a board.
(9) Pressing on parts of the metal cover or fastening objects to the metal will cause damage to the unit.

26.3 USAGE CONDITIONS NOTES

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

26.4 STORAGE NOTES

(1) The module should not be stressed mechanically during storage.
(2) Do not store these products in the following conditions or the performance characteristics of the product, 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 range, or where the humidity may be outside the 45 to 85% range.
- Storage of the products for more than one year after the date of delivery Storage period: check the adhesive strength of the embossed tape and soldering after 6 months of storage.

(3) Keep this product away from water, poisonous gas and corrosive gas.
(4) This product should not be stressed or shocked when transported.
(5) Follow the specification when stacking packed crates (max. 10).

26.5 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, then 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.

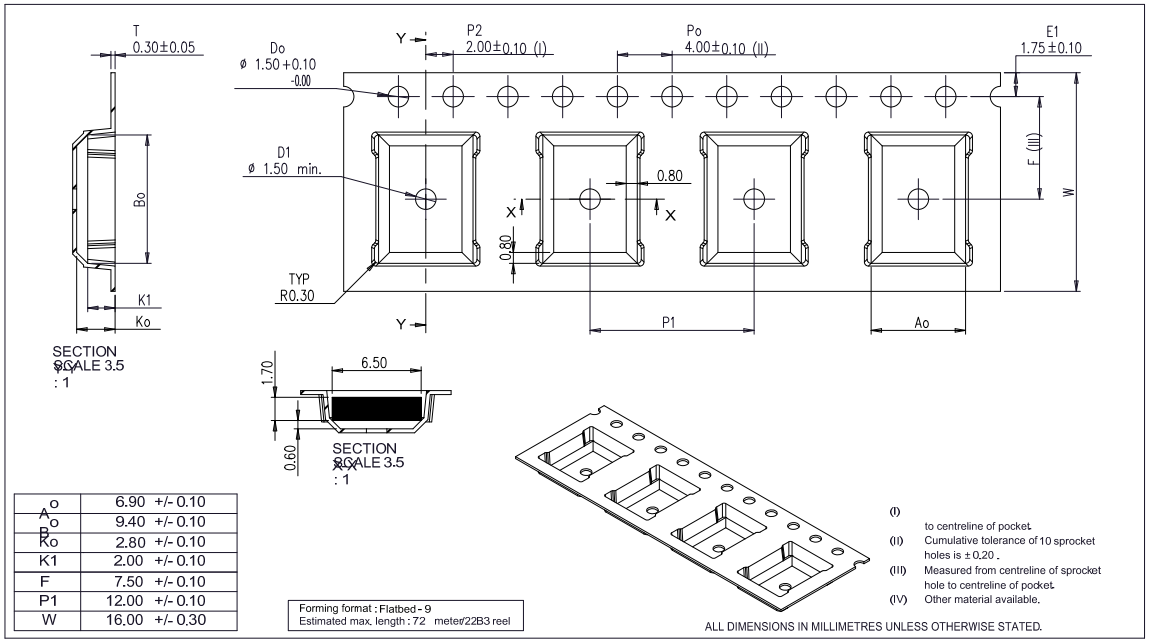
26.6 OTHER CAUTIONS

(1) This specification sheet is copyrighted.
(2) Do not use the products for other purposes than those listed.
(3) Be sure to provide an appropriate fail-safe function on your product to prevent an additional damage that may be caused by the abnormal function or the failure of the product.
(4) This product has been manufactured without any ozone chemical controlled under the Montreal Protocol.
(5) These products are not intended for other uses, other than under the special conditions shown below. Before using these products under such special conditions, check their performance and reliability under the said special conditions carefully 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)
(6) If an abnormal voltage is applied due to a problem occurring in other components or circuits, replace these products with new products because they may not be able to provide normal performance even if their electronic characteristics and appearances appear satisfactory.
(7) When you have any question or uncertainty, contact Panasonic.

27 PACKAGING

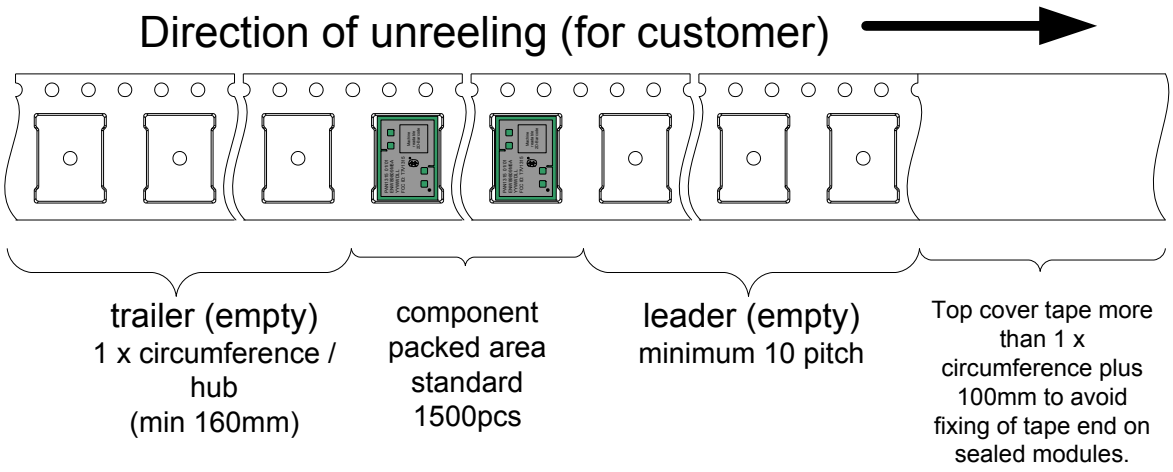
27.1 PACKAGING OF PAN131X WITHOUT ANTENNA

Tape Dimension



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

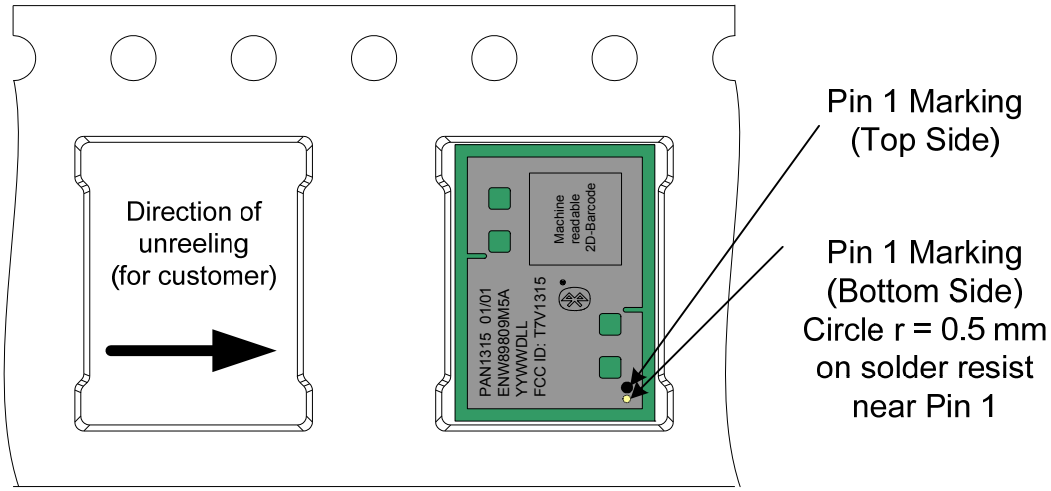
Packing in Tape



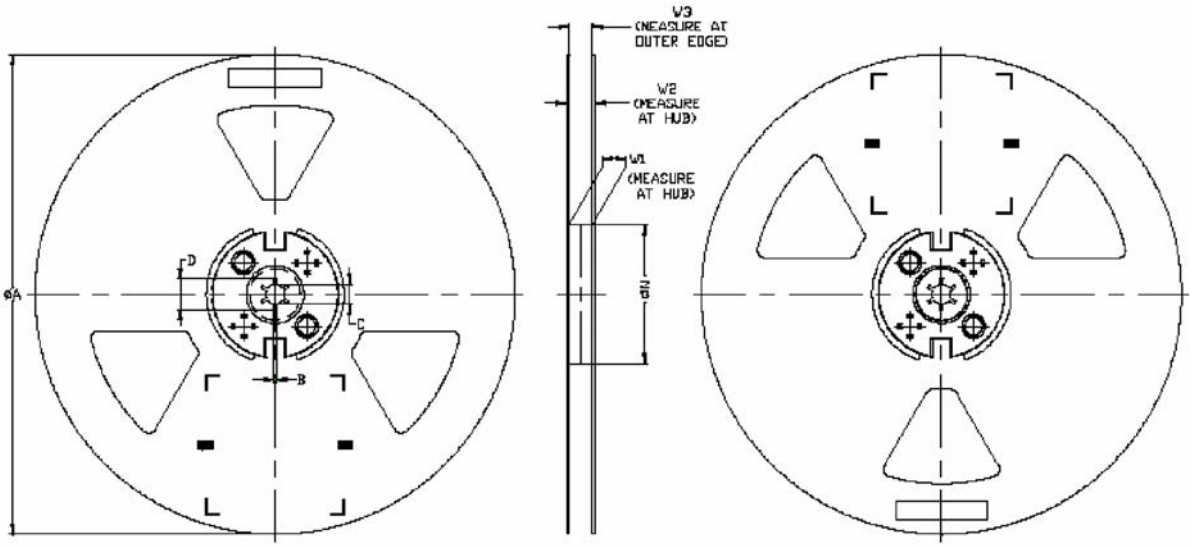
Empty spaces in component packed area shall be less than two per reel and those spaces shall not be consecutive.

Top cover tape shall not be found on reel holes and shall not stick out from reel.

Component direction



Reel dimension

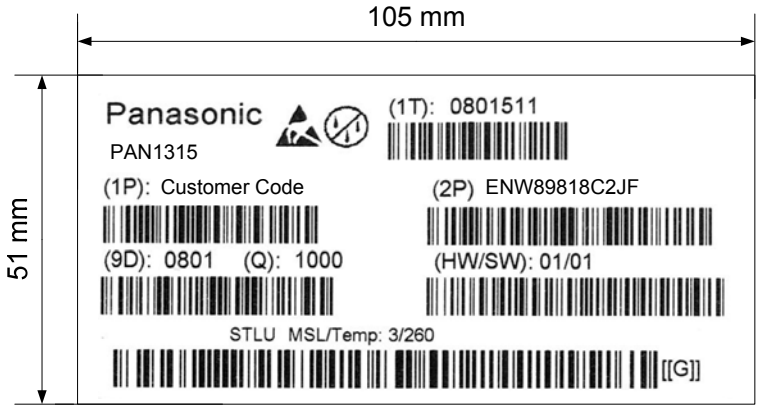


TAPE SIZE	A MAX	B MIN	C	D MIN	N ±1.0	W1	W2 MAX	W3	Assembly Method
24mm	330.0	1.5	13 +0.5 -0.2	20.2	100.0	25.0 +2.0 -0.0	30.4	24.4 +3.0 -0.5	*Latch

All dimensions in millimeters unless otherwise stated

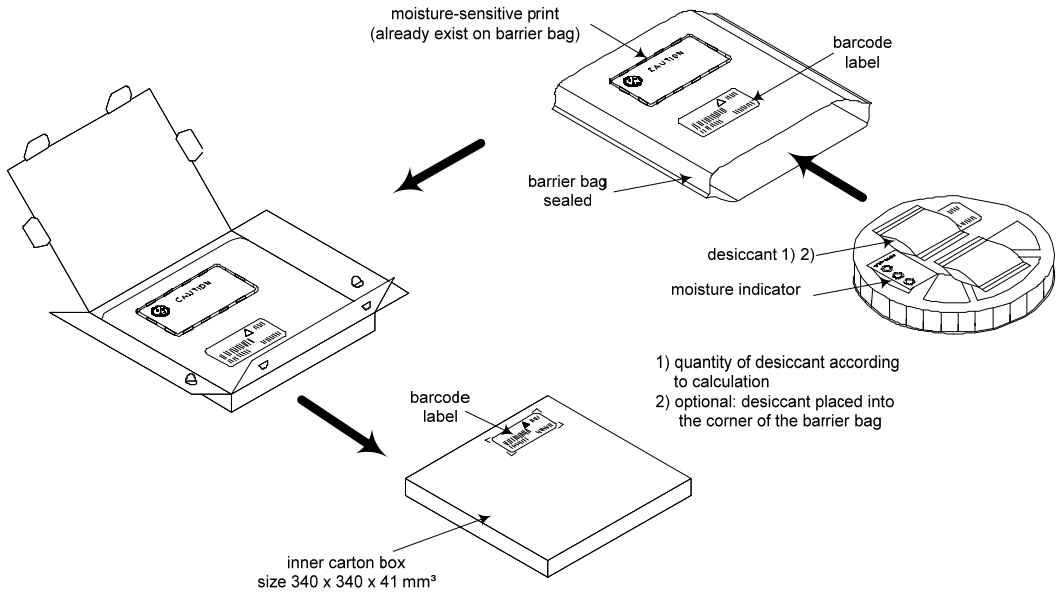
*Latch (2PC)

Label for Package



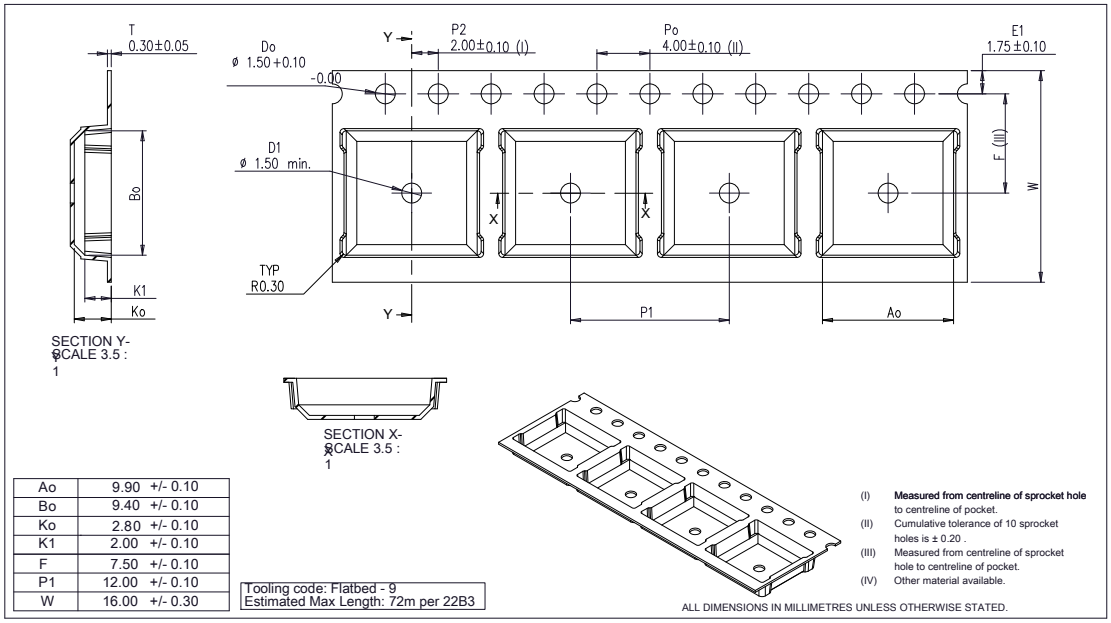
(1T)	Lotcode [YYWWDLL]		Example from above:
	YY	year	printed 08
	WW	normal calendar week	printed 01
	D	day	printed 5 (Friday)
	L	line identifier, if more as one	printed 1
	L	lot identifier per day	printed 1
(1P)	Customer Order Code, if any, otherwise company name will be printed		
(2P)	Panasonic Order Code fix as ENW89818C2JF		
(9D)	Datecode as [YYWW]		
(Q)	Quantity [XXXX], variable max. 1500		
(HW/SW)	Hardware /Software Release		

Total Package



27.2 PACKAGING FOR PAN132X WITH ANTENNA

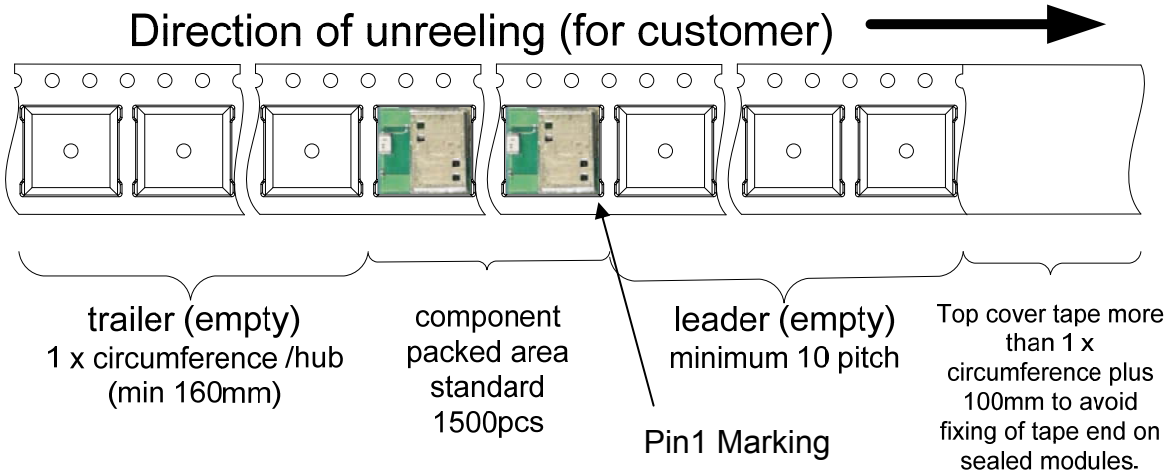
Tape Dimension



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

Tooling code: Flatbed - 9
Estimated Max Length: 72m per 22B3

Packing in Tape



All other packaging information is similar to Chapter 27.1

28 ORDERING INFORMATION

Version	Function	Controller	Part number	Antenna on board	Notes	MOQ (1)
PAN1315(2)	Bluetooth v2.1 + EDR	CC2560	ENW89818C2JF	NO	CC2560A offers reductions in init script size over CC2560 and is recommended for all new designs	1500
PAN1315A		CC2560A	ENW89829C2JF	NO		
PAN1325(2)	Bluetooth v2.1 + EDR	CC2560	ENW89818A2JF	YES	CC2560A offers reductions in init script size over CC2560 and is recommended for all new designs.	1500
PAN1325A		CC2560A	ENW89829A2JF	YES		
PAN1316	Bluetooth v2.1 + EDR BLE 4.0	CC2564	ENW89823C2JF	NO		1500
PAN1326	Bluetooth v2.1 + EDR BLE 4.0	CC2564	ENW89823C2JF	YES		1500
PAN1317	Bluetooth v2.1 + EDR ANT	CC2567	ENW89827C2JF	NO		1500
PAN1327	Bluetooth v2.1 + EDR ANT	CC2567	ENW89827A2JF	YES		1500
PAN1323	Bluetooth v2.1 + EDR BLE 4.0 ANT	CC2569	ENW89842A2JF	YES	Check with your software developer for details on triple mode functionality.	1500
PAN1323ETU	Bluetooth v2.1 + EDR BLE 4.0 ANT	CC25xx	ENW89825A2JF	YES	Evaluation kit for the whole series. PAN1315-PAN1327.	1

Notes:

(1) Abbreviation for Minimum Order Quantity (MOQ). The standard MOQ for mass production are 1500 pieces, fewer only on customer demand. Samples for evaluation can be delivered at any quantity.

(2) Not recommended for new designs, please refer to Chapter 1.1

29 ROHS DECLARATION

Declaration of environmental compatibility for supplied products:

Hereby we declare to our best present knowledge based on declaration of our suppliers that this product do not contain by now the following substances which are banned by Directive 2002/95/EC (RoHS) or if contain a maximum concentration of 0,1% by weight in homogeneous materials for

- Lead and lead compounds
- Mercury and mercury compounds
- Chromium (VI)
- PBB (polybrominated biphenyl) category
- PBDE (polybrominated biphenyl ether) category

And a maximum concentration of 0,01% by weight in homogeneous materials for

- Cadmium and cadmium compounds

30 DATA SHEET STATUS

This data sheet contains the final specification (RELEASE).

Panasonic reserves the right to make changes at any time without notice in order to improve design and supply the best possible product.

Supplementary data will be published at a later date.

Consult the most recently issued data sheet before initiating or completing a design.

Use this URL to search for the most recent version of this data sheet: PAN13xx Latest Data Sheet!

31 HISTORY FOR THIS DOCUMENT

Revision	Date	Modification / Remarks
0.90	18.12.2009	1st preliminary version
0.95	01.03.2010	Updated Chapter 14.2 and 28.
0.96	Not released	Change ESD Information on foot note 7 in chapter Pin Description
0.97	25.03.2010	Various updates. Deleted links to TI Datasheet.
0.98	21.04.2010	Updated Links Some minor changes in Chapter 8 and 9.1 and change the base for the values in Chapter 9.
0.99	22.10.2010	Adopted changes according to CC2560 Datasheet. Included Interface Description, performance values. Not released.
1.00	04.11.2010	1st internal Release.
1.01	03.12.2010	Included reference to PAN1325 Application Note. AN-1325-2420-111.pdf
1.02	10.01.2011	Changed wording in Chapter 34.2 "Industry Canada Certification".
1.03	23.05.2011	Included DOC for PAN1315 series. Included PAN13xx ANT and BLE Addendum Rev1.x.pdf reference. Included Note for IO voltage and MLD_OUT pin.
1.04	02.07.2011	Corrected wording in Chapter 34.3 European R&TTE Declaration of Conformity.
1.05	28.10.2011	Including CC2560A silicon PAN1315A HW40 at Chapter 1.1, Chapter New PAN1315A and Chapter 0. Deleted ES label in Chapter
1.06	15.11.2011	Added overview for the core specification and their addendums. Updated front page. Updated Related Documents.
3.00	11.01.2012	Merging PAN13xx documents into this specification and correct some format
3.10	16.01.2012	Minor mistakes fixed
3.20	29.05.2012	DoC replaced with revised version
3.30	11.06.2012	Added triple mode stack Module PAN1323, add PAN1323 to ordering and software information overview, Software Block Diagram added, Bluetooth Inter IC-Sound chapter information added Layout Recommandations with Antenna added, Application Note LGA added
3.31	27.06.2012	Added design information to use low pass filter (chapter 11.1 / 11.9) for better noise surpression when using PCM interface
3.40	18.07.2012	Re-organize chapter Regulatory Information and added 2 chapters 1. NCC Statement (only valid for PAN1325) 2. Bluetooth SIG Statement 3. Chapter 11.9, Second Paragraph was updated 4. Link in Chapter 34.1.1. was fixed

32 RELATED DOCUMENTS

For an update, search in the suitable homepage.

[1] PAN1323ETU Design-Guide: http://www.panasonic.com/industrial/includes/pdf/PAN1323ETUDesignGuide.pdf

[2] CC2560 Product Bulletin: http://focus.ti.com/pdfs/wtbu/cc2560_slyt377.pdf

[3] Bluetooth SW for MSP430 is supported by IAR IDE service pack 5.10.6 and later. Use full IAR version edition (not the kick-start version). You can find info on IAR at http://www.iar.com/website1/1.0.1.0/3/1/ and www.MSP430.com . Note, that there is an option for a 30-day free version of IAR evaluation edition.

[4] PAN13xx CAD data: http://www.pedeu.panasonic.de/pdf/174ext.zip

[5] Application Note Land Grid Array: http://www.pedeu.panasonic.de/pdf/184ext.pdf

33 GENERAL INFORMATION

This document may contain errors. Panasonic reserves the right to make corrections, modifications, enhancements, improvements, and other changes to its literature at any time. Customers should obtain the latest relevant information before placing orders and should verify that such information is current and complete. All products are sold subject to Panasonic's terms and conditions of sale supplied at the time of order acknowledgment.

If we deliver ES samples to the customer, these samples have the status Engineering Samples. This means, the design of this product is not yet concluded. Engineering Samples may be partially or fully functional, and there may be differences to be published Data Sheet.
Engineering Samples are not qualified and are not to be used for reliability testing or series production.

Disclaimer:
Customer acknowledges that samples may deviate from the Data Sheet and may bear defects due to their status of development and the lack of qualification mentioned above.
Panasonic rejects any liability or product warranty for Engineering Samples. In particular, Panasonic disclaims liability for damages caused by

- the use of the Engineering Sample other than for Evaluation Purposes, particularly the installation or integration in an other product to be sold by Customer,
- deviation or lapse in function of Engineering Sample,
- improper use of Engineering Samples.

Panasonic disclaimes any liability for consequential and incidental damages. Panasonic assumes no liability for applications assistance or customer product design. Customers are responsible for their products and applications using Panasonic components. To minimize the risks associated with customer products and applications, customers should provide adequate design and operating safeguards. In case of any questions, contact your local sales representative.

34 REGULATORY INFORMATION

34.1 FCC FOR US

34.1.1 FCC Notice

The devices PAN13xx, for details refer to Chapter 28 in this document, including the antennas, which are listed in Chapter 34.5 of this data sheet, 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.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.

34.1.2 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. 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

34.1.3 Labeling Requirements

The Original Equipment Manufacturer (OEM) must ensure that FCC labeling 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**. This FCC identifier is valid for all PAN13xx modules, for details, see the Chapter 28. Ordering Information.

In any case the end product must be labelled exterior with "Contains FCC ID: T7V1315"

34.1.4 Antenna Warning

For the related part number of PAN13xx refer to Chapter 28. Ordering Information.

This devices are tested with a standard SMA connector and with the antennas listed below. When integrated in the OEMs 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 Section 15.247 for emissions. The FCC identifier for this device with the antenna listed in item 1 are the same (FCC ID: T7V1315).

34.1.5 Approved Antenna List

Note: We are able to qualify your antenna and will add to this list as that process is completed.

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

34.1.6 RF Exposure PAN13xx

To comply with FCC RF Exposure requirements, the Original Equipment Manufacturer (OEM) must ensure that the approved antenna in the previous table must be installed.

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 PAN13xx with mounted ceramic antenna (FCC ID: T7V1315) is far below the FCC radio frequency exposure limits. Nevertheless, the PAN13xx 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.

34.2 INDUSTRY CANADA CERTIFICATION

PAN1315 is licensed to meet the regulatory requirements of Industry Canada (IC), license: IC: 216Q-1315

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 Table 20 above, having a maximum gain of 1.3 dBi. Antennas not included in this list or having a gain greater than 1.3 dBi 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.

34.3 EUROPEAN R&TTE DECLARATION OF CONFORMITY

Hereby, Panasonic Industrial Devices Europe GmbH, declares that the Bluetooth module PAN1315 and their versions is in compliance with the essential requirements and other relevant provisions of Directive 1999/5/EC. As a result of the conformity assessment procedure described in Annex III of the Directive 1999/5/EC, the end-customer equipment should be labelled as follows:

CE

PAN13xx and their versions in the specified reference design can be used in the following countries: Austria, Belgium, Cyprus, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, Poland, Portugal, Slovakia, Slovenia, Spain, Sweden, The Netherlands, the United Kingdom, Switzerland, and Norway.

Declaration of Conformity (DoC) 1999/5/EC

We, Panasonic Industrial Devices Europe GmbH
Wireless Connectivity, Power Electronics R&D Center
Zeppelinstrasse 19, 21337 Lueneburg, Germany

declare under our sole responsibility that the product:

Type of equipment: Bluetooth Module

Brand name: PAN1315, PAN1315A, PAN1316, PAN1317
PAN1323, PAN1325, PAN1325A, PAN1326, PAN1327

Model name: ENW898xxC2JF (xx = 18, 29, 23 or 27)
ENW898xxA2JF (xx = 28, 18, 29, 23 or 27)

to which this declaration relates, is in compliance with all the applicable essential requirements, and other provisions of the European Council Directive:

1999/5/EC	Radio and Telecommunications Terminal Equipment Directive (R&TTE)

The conformity assessment procedure used for this declaration is Annex IV of this Directive.

Product compliance has been demonstrated on the basis of:

- EN 60950-1: 2006 - EN 50371: 2002	For article 3.1 (a) : Health and Safety of the User
- EN 301 489-1 V1.8.1 - EN 301 489-17 V2.1.1	For article 3.1 (b) : Electromagnetic Compatibility
- EN 300 328 V1.7.1	For article 3.2 : Effective use of spectrum allocated

The technical contruction file is kept available at:

Panasonic Industrial Devices Europe GmbH, Zeppelinstrasse 19, 21337 Lueneburg, Germany

Issued on: 29th of May 2012

Signed by the manufacturer:

(Company name) Panasonic Industrial Devices Europe GmbH

(Signature) 

(Printed name) Heino Kaehler

(Title) Manager Wireless Connectivity

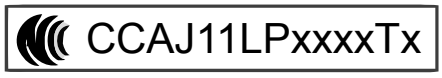
34.4 NCC FOR TAIWAN

34.4.1 Labeling Requirements

Due to the limited size on the module, the NCC ID is not visible on the module.

When the module is installed inside another device, then the outside of the device into which the module is installed must also display a label referring to the enclosed module. This exterior label can use wording such as the following:

"Contains Transmitter Module NCC ID:" or "Contains NCC ID:"



Any similar wording that expresses the same meaning may be used.

Panasonic is able to provide the above content from the label as a vector graphic, please ask at wireless@eu.panasonic.com.

34.4.2 NCC Statement

Due to the national rule from Taiwan we have to print the below statement in Chinese language.

根據NCC低功率電波輻射性電機管理辦法 規定:

1.1 第十二條 1.2 經型式認證合格之低功率射頻電機，非經許可，公司、商號或使用者均不得擅自變更頻率、加大功率或變更原設計之特性及功能。

1.3 第十四條 1.4 低功率射頻電機之使用不得影響飛航安全及干擾合法通信；經發現有干擾現象時，應立即停用，並改善至無干擾時方得繼續使用。

前項合法通信，指依電信法規定作業之無線電通信。

低功率射頻電機須忍受合法通信或工業、科學及醫療用電波輻射性電機設備之干擾。

34.5 BLUETOOTH SIG STATEMENT

35 LIFE SUPPORT POLICY

This Panasonic 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 for any damages resulting.