RF Module

Model: CIMX1PRO

Product Manual

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Confidential

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1 GETTING STARTED

1.1. Overview

This manual describes the key features, pin out, recommended operating conditions, working of RF module and operating instructions to test the module for FCC.

CIMCON RF modules are designed to operate within the ZigBee protocol and support the unique needs of low-cost, low-power wireless sensor networks. The modules require minimal power and provide reliable delivery of data between remote devices. The modules operate within the ISM 2.4 GHz frequency band work on ZigBee protocol.

1.2. Key Features

The key features of RF modules are as follows:

- Operates from wide 2.1VDC to 3.6VDC
- Maximum transmit current is 150mA (Typical at 3.0V)
- Maximum Receive current is 38mA
- Maximum transmit power is +22dBm
- Receiver Sensitivity of -104dBm
- Various serial interfaces like UART, SPI (master/ slave), and TWI
- Six external ADC sources with 14-bit resolution
- Urban range of ~85m
- Line of sight range of ~1750m

1.3. FCC Approvals

The CIMCON **SMT** module and **through hole** module with the integrated wire whip Antenna as well as the **SMT** module and **through hole** including the 2.1dBi external antenna complies with FCC CFR Part 15 (USA). The devices meet the requirements for modular transmitter approval.

External Antennas:

Dipole Antenna (P/N: A24-HASM-525; Maximum Antenna Gain: 2.1dBi)
Dipole Antenna (P/N: A24-HASM-450; Maximum Antenna Gain: 2.1dBi)

This device complies with Part 15 of the FCC rules. Operation is subject to the following two conditions:

1) This device may not cause harmful interference.
2) This device must accept any interference received, including interference that may cause undesired operation.

Changes and Modifications not expressly approved by CIMCON can void your authority to operate this equipment under Federal Communications Commission's rules.

The following statement must be included as a CAUTION statement in manuals for OEM products to alert users on FCC RF exposure compliance:

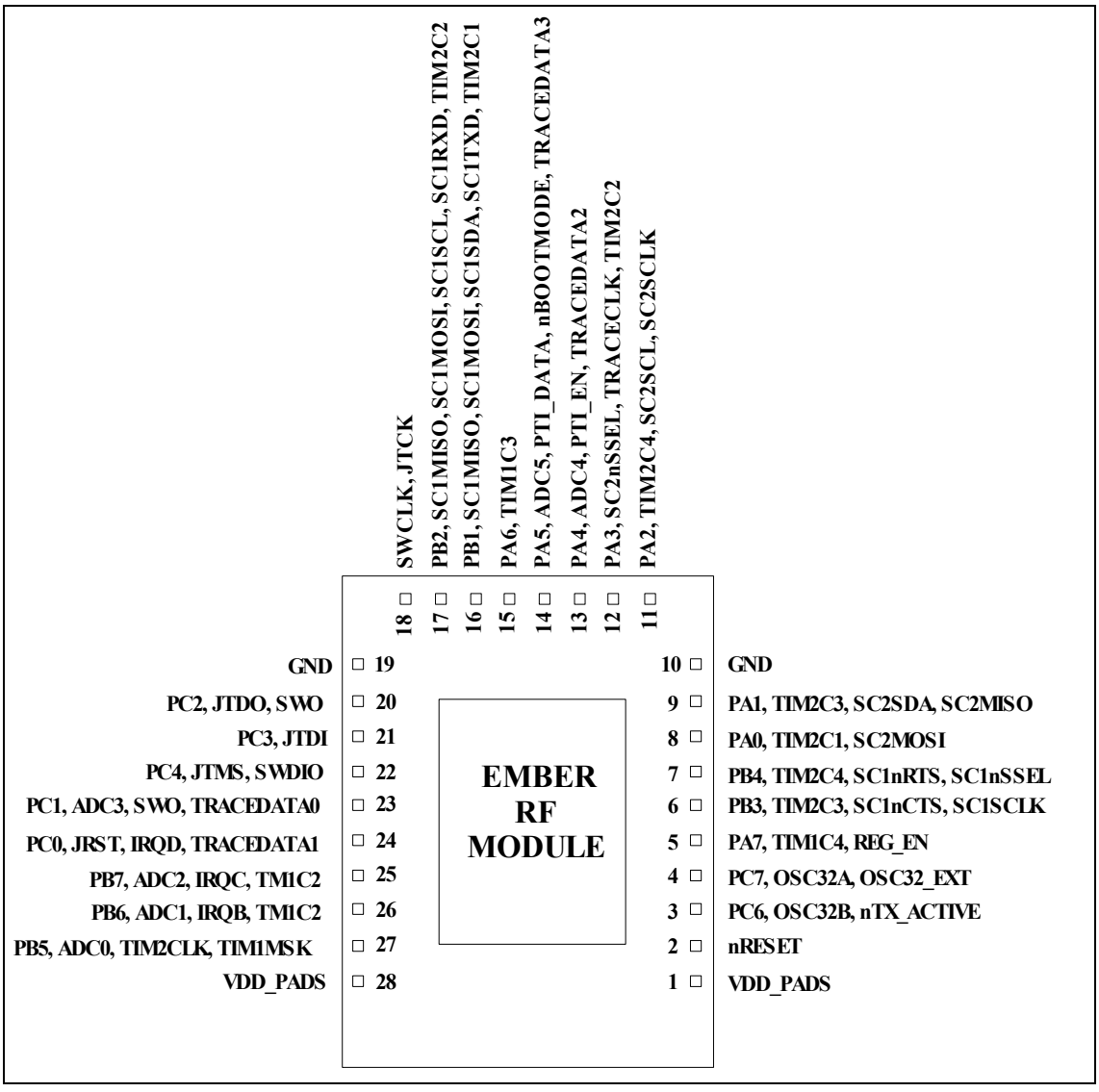
"***WARNING****: To satisfy FCC RF exposure requirements for mobile transmitting devices, a separation distance of 20 CM or more should be maintained between the antenna of this device and persons during operation. To ensure compliance, operations at closer distances than this are not recommended.*"

1.4. FCC Labeling Requirements

When integrating the CIMCON's SMT module or TH module into a product it must be ensured that the FCC labeling requirements are met. This includes a clearly visible label on the outside of the finished product specifying the CIMCON's FCC identifier (FCC ID: S3Z-CIM35X1) as well as the notice above. This exterior label can use wording such as "Contains Transmitter Module FCC ID: S3Z-CIM35X1" or "Contains FCC ID: S3Z-CIM35X1" although any similar wording that expresses the same meaning may be used.

2 SMT MODULE PIN-OUT

Following is the pin out of CIMCON **RF module** with description of each pin:



Descriptions:

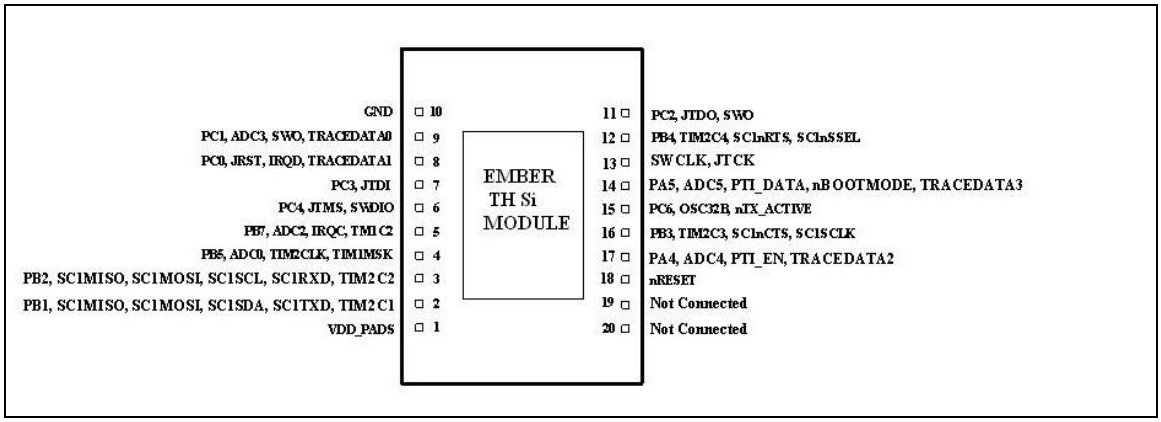
PIN	SIGNAL	DIRECTION	DESCRIPTION
1	**3.3V**	Power	Used to power the CIMCON RF module.
2	**nReset**	I	Active Low chip reset (Internal pull up)
3	**PC6**	I/O	Digital I/O
	OSC32B	I/O	32.768 kHz crystal oscillator
	nTX_ACTIVE	O	Inverted TX_ACTIVE signal (see PC5)
4	**PC7**	I/O	Digital I/O
	OSC32A	I/O	32.768 kHz crystal oscillator

PIN	SIGNAL	DIRECTION	DESCRIPTION
	OSC32_EXT	I	Digital 32.768 kHz clock input source
5	**PA7**	I/O	Digital I/O
	TIM1C4	O	Timer 1 Channel 4 output
	TIM1C4	I	Timer 1 Channel 4 input
	REG_EN	O	External regulator open drain output
6	**PB3**	I/O	Digital I/O
	TIM2C3	O	Timer 2 channel 3 output
	TIM2C3	I	Timer 2 channel 3 input
	SC1nCTS	I	UART CTS handshake of Serial Controller 1
	SC1SCLK	O	SPI master clock of Serial Controller 1
	SC1SCLK	I	SPI slave clock of Serial Controller 1
7	**PB4**	I/O	Digital I/O
	TIM2C4	O	Timer 2 channel 4 output
	TIM2C4	I	Timer 2 channel 4 input
	SC1nRTS	O	UART RTS handshake of Serial Controller 1
	SC1nSSEL	I	SPI slave select of Serial Controller 1
8	**PA0**	I/O	Digital I/O
	TIM2C1	O	Timer 2 channel 1 output
	TIM2C1	I	Timer 2 channel 1 input
	SC2MOSI	O	SPI master data out of Serial Controller 2
	SC2MOSI	I	SPI slave data in of Serial Controller 2
9	**PA1**	I/O	Digital I/O
	TIM2C3	O	Timer 2 channel 3 output
	TIM2C3	I	Timer 2 channel 3 input
	SC2SDA	I/O	TWI data of Serial Controller 2
	SC2MISO	O	SPI slave data out of Serial Controller 2
	SC2MISO	I	SPI master data in of Serial Controller 2
10	**Ground**	Power	Ground pin of RF module.
11	**PA2**	I/O	Digital I/O
	TIM2C4	O	Timer 2 channel 4 output
	TIM2C4	I	Timer 2 channel 4 input
	SC2SCL	I/O	TWI clock of Serial Controller 2
	SC2SCLK	O	SPI master clock of Serial Controller 2
	SC2SCLK	I	SPI slave clock of Serial Controller 2
12	**PA3**	I/O	Digital I/O
	SC2nSSEL	I	SPI slave select of Serial Controller 2
	TRACECLK	O	Synchronous CPU trace clock
	TIM2C2	O	Timer 2 channel 2 output
	TIM2C2	I	Timer 2 channel 2 input
13	**PA4**	I/O	Digital I/O
	ADC4	Analog	ADC Input 4
	PTI_EN	O	Frame signal of Packet Trace Interface (PTI)
	TRACEDATA2	O	Synchronous CPU trace data bit 2
14	**PA5**	I/O	Digital I/O
	ADC5	Analog	ADC Input 5
	PTI_DATA	O	Data signal of Packet Trace Interface (PTI)
	nBOOTMODE	I	Embedded serial bootloader activation out of reset
	TRACEDATA3	O	Synchronous CPU trace data bit 3
15	**PA6**	I/O	Digital I/O
	TIM1C3	O	Timer 1 channel 3 output
	TIM1C3	I	Timer 1 channel 3 input

PIN	SIGNAL	DIRECTION	DESCRIPTION
16	**PB1**	I/O	Digital I/O
	SC1MISO	O	SPI slave data out of Serial Controller 1
	SC1MOSI	O	SPI master data out of Serial Controller 1
	SC1SDA	I/O	TWI data of Serial Controller 1
	SC1TXD	O	UART transmit data of Serial Controller 1
	TIM2C1	O	Timer 2 channel 1 output
	TIM2C1	I	Timer 2 channel 1 input
17	**PB2**	I/O	Digital I/O
	SC1MISO	I	SPI master data in of Serial Controller 1
	SC1MOSI	I	SPI slave data in of Serial Controller 1
	SC1SCL	I/O	TWI clock of Serial Controller 1
	SC1RXD	I	UART receive data of Serial Controller 1
	TIM2C2	O	Timer 2 channel 2 output
	TIM2C2	I	Timer 2 channel 2 input
18	**SWCLK**	I/O	Serial Wire clock input/output with debugger
	JTCK	I	JTAG clock input from debugger
19	**Ground**	Power	Ground pin of RF module.
20	**PC2**	I/O	Digital I/O
	JTDO	O	JTAG data out to debugger
	SWO	O	Serial Wire Output asynchronous trace output to debugger
21	**PC3**	I/O	Digital I/O
	JTDI	I	JTAG data in from debugger
22	**PC4**	I/O	Digital I/O
	JTMS	I	JTAG mode select from debugger
	SWDIO	I/O	Serial Wire bidirectional data to/from debugger
23	**PC1**	I/O	Digital I/O
	ADC3	Analog	ADC Input 3
	SWO	O	Serial Wire Output asynchronous trace output to debugger
	TRACEDATA0	O	Synchronous CPU trace data bit 0
24	**PC0**	I/O	Digital I/O
	JRST	I	JTAG reset input from debugger
	IRQD	I	Default external interrupt source D
	TRACEDATA1	O	Synchronous CPU trace data bit 1
25	**PB7**	I/O	Digital I/O
	ADC2	Analog	ADC Input 2
	IRQC	I	Default external interrupt source C
	TIM1C2	O	Timer 1 channel 2 output
	TIM1C2	I	Timer 1 channel 2 input
26	**PB6**	I/O	Digital I/O
	ADC1	Analog	ADC Input 1
	IRQB	I	External interrupt source B
	TIM1C1	O	Timer 1 channel 1 output
	TIM1C1	I	Timer 1 channel 1 input
27	**PB5**	I/O	Digital I/O
	ADC0	Analog	ADC Input 0
	TIM2CLK	I	Timer 2 external clock input
	TIM1MSK	I	Timer 1 external clock mask input
28	**3.3V**	Power	Used to power the CIMCON RF module.

3 THROUGH HOLE MODULE PIN-OUT

Following is the pin out of CIMCON **TH Si Module** with description of each pin:



Descriptions:

PIN	SIGNAL	DIRECTION	DESCRIPTION
1	**3.3V**	Power	Used to power the CIMCON RF module.
2	PB1	I/O	Digital I/O
	SC1MISO	O	SPI slave data out of Serial Controller 1
	SC1MOSI	O	SPI master data out of Serial Controller 1
	SC1SDA	I/O	TWI data of Serial Controller 1
	SC1TXD	O	UART transmit data of Serial Controller 1
	TIM2C1	O	Timer 2 channel 1 output
	TIM2C1	I	Timer 2 channel 1 input
3	**PB2**	I/O	Digital I/O
	SC1MISO	I	SPI master data in of Serial Controller 1
	SC1MOSI	I	SPI slave data in of Serial Controller 1
	SC1SCL	I/O	TWI clock of Serial Controller 1
	SC1RXD	I	UART receive data of Serial Controller 1
	TIM2C2	O	Timer 2 channel 2 output
	TIM2C2	I	Timer 2 channel 2 input
4	**PB5**	I/O	Digital I/O
	ADC0	Analog	ADC Input 0
	TIM2CLK	I	Timer 2 external clock input
	TIM1MSK	I	Timer 1 external clock mask input
5	**PB7**	I/O	Digital I/O
	ADC2	Analog	ADC Input 2
	IRQC	I	Default external interrupt source C
	TIM1C2	O	Timer 1 channel 2 output

PIN	SIGNAL	DIRECTION	DESCRIPTION
	TIM1C2	I	Timer 1 channel 2 input
6	**PC4**	I/O	Digital I/O
	JTMS	I	JTAG mode select from debugger
	SWDIO	I/O	Serial Wire bidirectional data to/from debugger
7	PC3	I/O	Digital I/O
	JTDI	I	JTAG data in from debugger
8	PC0	I/O	Digital I/O
	JRST	I	JTAG reset input from debugger
	IRQD	I	Default external interrupt source D
	TRACEDATA1	O	Synchronous CPU trace data bit 1
9	**PC1**	I/O	Digital I/O
	ADC3	Analog	ADC Input 3
	SWO	O	Serial Wire Output asynchronous trace output to debugger
	TRACEDATA0	O	Synchronous CPU trace data bit 0
10	**Ground**	Power	Ground pin of RF module.
11	PC2	I/O	Digital I/O
	JTDO	O	JTAG data out to debugger
	SWO	O	Serial Wire Output asynchronous trace output to debugger
12	**PB4**	I/O	Digital I/O
	TIM2C4	O	Timer 2 channel 4 output
	TIM2C4	I	Timer 2 channel 4 input
	SC1nRTS	O	UART RTS handshake of Serial Controller 1
	SC1nSSEL	I	SPI slave select of Serial Controller 1
13	**SWCLK**	I/O	Serial Wire clock input/output with debugger
	JTCK	I	JTAG clock input from debugger
14	**PA5**	I/O	Digital I/O
	ADC5	Analog	ADC Input 5
	PTI_DATA	O	Data signal of Packet Trace Interface (PTI)
	nBOOTMODE	I	Embedded serial bootloader activation out of reset
	TRACEDATA3	O	Synchronous CPU trace data bit 3
15	**PC6**	I/O	Digital I/O
	OSC32B	I/O	32.768 kHz crystal oscillator
	nTX_ACTIVE	O	Inverted TX_ACTIVE signal (see PC5)
16	**PB3**	I/O	Digital I/O
	TIM2C3	O	Timer 2 channel 3 output
	TIM2C3	I	Timer 2 channel 3 input
	SC1nCTS	I	UART CTS handshake of Serial Controller 1
	SC1SCLK	O	SPI master clock of Serial Controller 1
	SC1SCLK	I	SPI slave clock of Serial Controller 1
17	**PA4**	I/O	Digital I/O
	ADC4	Analog	ADC Input 4
	PTI_EN	O	Frame signal of Packet Trace Interface (PTI)
	TRACEDATA2	O	Synchronous CPU trace data bit 2
18	**nReset**	I	Active Low chip reset (Internal pull up)
19	**NC**	N/A	N/A
20	**NC**	N/A	N/A

4 CONFIGURATION INFORMATION

4.1. Absolute Maximum Ratings of RF Module

The following table provides maximum ratings of RF Module:

Sr. No.	Parameter	Symbol	Absolute Maximum ratings	Unit
1	Supply Voltage	Vcc	-0.3 to +3.6	VDC
2	Voltage on any GPIO including nReset and JCLK	VIN	-0.3 to Vcc+0.3	VDC
3	Voltage on any GPIO [PA4, PA5, PB5, PB6, PB7, PC1] when used as input to ADC	VIN	-0.3 to +2.0	VDC
4	Storage Temperature Range	Tstg	-40 to +105	'C
5	Operating Temperature Range	Top	-40 to +85	'C
6	ESD on any pin (HBM)	Vhbm	+/-2	KV
7	ESD on RF port (CDM)	Vcdm	+/-225	V
8	Moisture Sensitivity Level (MSL)		MSL3	
9	Reflow Temperature	Treflow	Refer in next pages	

4.2. Recommended Operating Conditions

Sr. No	Parameter	Symbol	Recommended Operating Conditions	Unit
1	Supply Voltage	Vcc	2.1 to 3.6	VDC
2	Operating frequency	Fin	2405 to 24	MHz
3	Operating Temperature	Top	-40 to +85'C	'C

4.3. DC Electrical Characteristics

Parameter	Test Conditions	Min.	Typical	Max	Unit
Voltage supply		2.1		3.6	VDC
Low Schmitt switching threshold	VSWIL Schmitt input threshold going from high to low	0.42 x VDD_PADS		0.50 x VDD_PADS	
High Schmitt switching threshold	VSWIH Schmitt input threshold going from low to high	0.62 x VDD_PADS		0.80 x VDD_PADS	V
Input current for logic 0	IIL			-0.5	uA
Input current for logic 1	IIH			+0.5	uA
Input pull-up resistor value	RIPU	24	29	34	kΩ

Parameter	Test Conditions	Min.	Typical	Max	Unit
Input pull-down resistor value	RIPD	24	29	34	kΩ
Output voltage for logic 0	VOL (IOL = 4 mA for standard pads, 8 mA for high current pads)	0		0.18 x VDD_PADS	V
Output voltage for logic 1	VOH (IOH = 4 mA for standard pads, 8 mA for high current pads)	0.82 x VDD_PADS		VDD_PADS	V
Output source current (standard current pad)	IOHS			4	mA
Output sink current (standard current pad)	IOLS			4	mA
Output source current high current pad: PA6, PA7, PB6, PB7, PC0	IOHH			8	mA
Output sink current high current pad: PA6, PA7, PB6, PB7, PC0	IOLH			8	mA
Total output current (for I/O Pads)	IOH + IOL			40	mA

4.4. Power Settings for Regulatory Compliance

Because of the high gain of the frontend module output power of up to 24dBm can be achieved When the antenna gain is included then the output power of the EM357 transceivers needs to be reduced for regulatory compliance. The following tables list the maximum permitted power setting for the different antenna types listed. This is the power out of the EM357 chip, and the power delivered to the antenna will be higher by the gain of the PA.

settxpower P (set the channel power)

UFL Antenna Unit

- Channel 11: P = -5 [dBm]
- Channel 18: P = -5 [dBm]
- Channel 25: P = -7 [dBm]

Fixed Antenna Unit

- Channel 11: P = -3 [dBm]
- Channel 18: P = -3 [dBm]
- Channel 25: P = -3 [dBm]

5 BOARD LAYOUT

CIMCON RF modules do not have any specific sensitivity to nearby processors, crystals or other PCB components. Other than mechanical considerations, no special PCB placement is required for integrating CIMCON RF radios. In general, Power and GND traces should be thicker than signal traces and be able to comfortably support the maximum currents.

The radios are also designed to be self-sufficient and work with wire whip and external antennas without the need for additional ground planes on the host PCB. However, considerations should be taken on the choice of antenna and antenna location. Metal objects that are near an antenna cause reflections and may reduce the ability for an antenna to efficiently radiate. Using an integral antenna (like a wire whip antenna) in an enclosed metal box will greatly reduce the range of a radio. For this type of application an external antenna would be a better choice. External antennas should be positioned away from metal objects as much as possible. Metal objects next to the antenna or between transmitting and receiving antennas can often block or reduce the transmission distance. Some objects that are often overlooked are metal poles, metal studs or beams in structures, concrete (it is usually reinforced with metal rods), metal enclosures, vehicles, elevators, ventilation ducts, refrigerators and microwave ovens.

The *Wire Whip Antenna* should be straight and perpendicular to the ground plane and/or chassis. It should reside above or away from any metal objects like batteries, tall electrolytic capacitors or metal enclosures. If the antenna is bent to fit into a tight space, it should be bent so that as much of the antenna as possible is away from metal. Caution should be used when bending the antenna, since this will weaken the solder joint where the antenna connects to the module. Antenna elements radiate perpendicular to the direction they point. Thus a vertical antenna emits across the horizon

6 SOLDERING TEMPERATURE PROFILE

6.1. Leaded Process

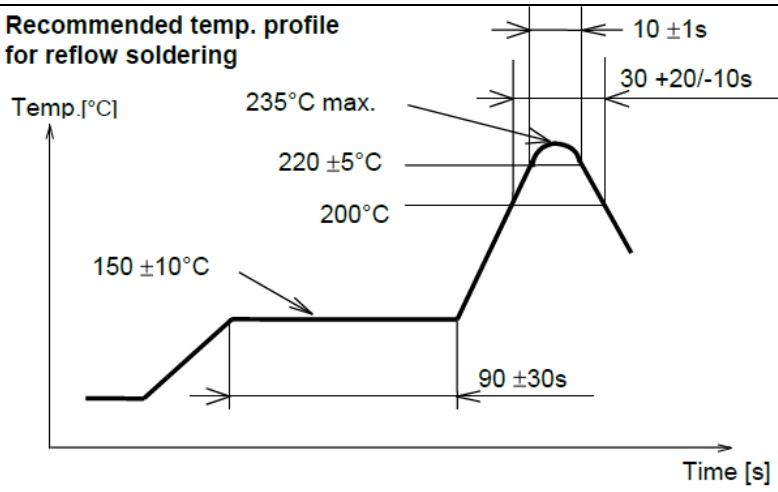


Figure 8. Temperature Profile for Lead Solder

6.2. Lead Free Process

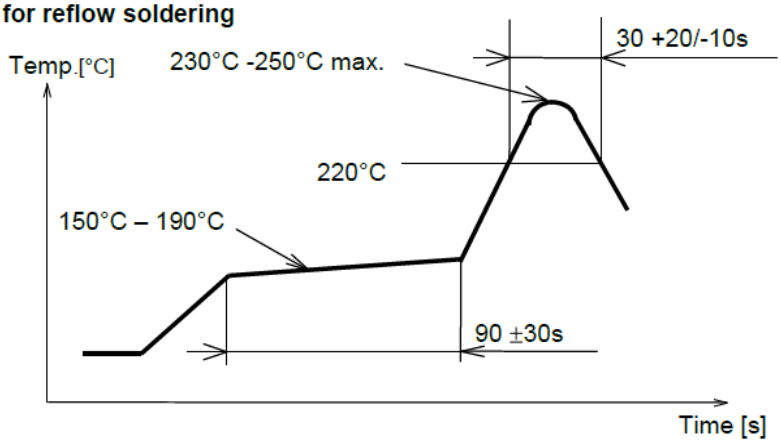
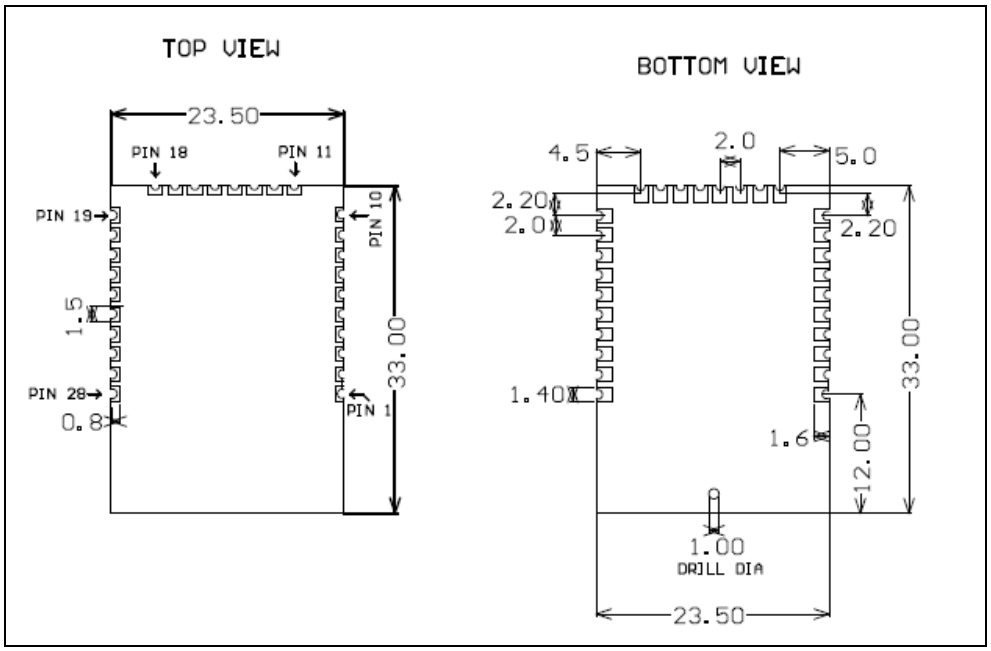
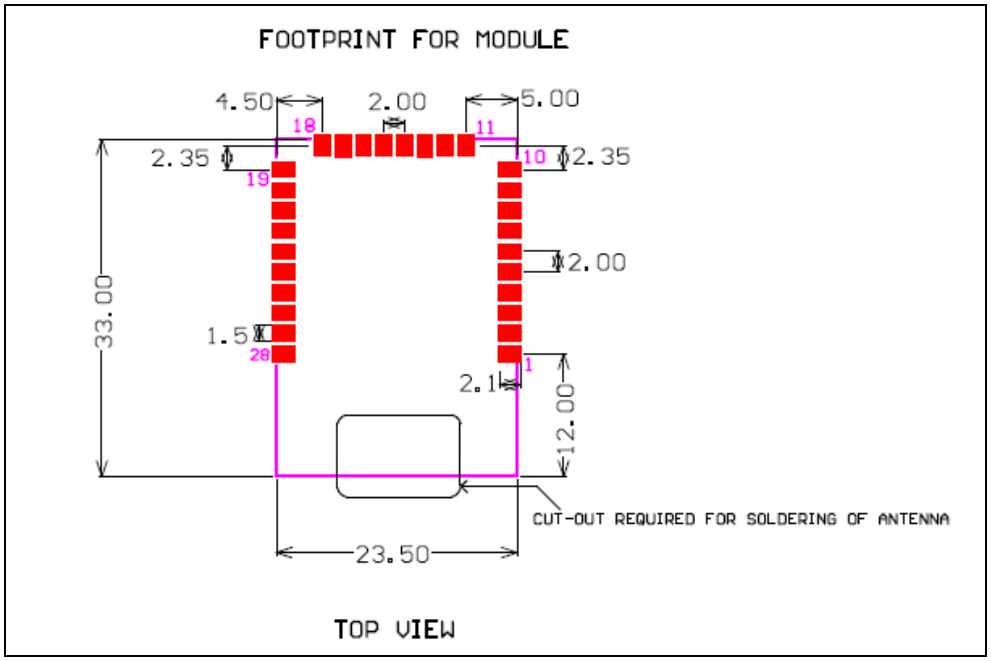


Figure 9. Temperature Profile for Lead-free Solder

NB:
Maximum Reflow Cycles: 2
Opposite-side reflow is prohibited due to the module's weight. (I.e. you must not place the module on the bottom / underside of your PCB and re-flow).

7 MECHANICAL DIMENSIONS OF THE SMT MODULES





8 MECHANICAL DIMENSIONS FOR THROUGH HOLE MODULE