



ITM-7238-BK

IEEE 802.11b/g/n WLAN + Bluetooth LE 5.2
Combo IoT Module Datasheet

(Preliminary)

V0.2

Revision History

Date	Revision Content	Revised By	Version
2023/11/13	- Initial released (Preliminary)	Pendro Wu	0.1
2023/12/28	- RF parameter update	Pendro Wu	0.2
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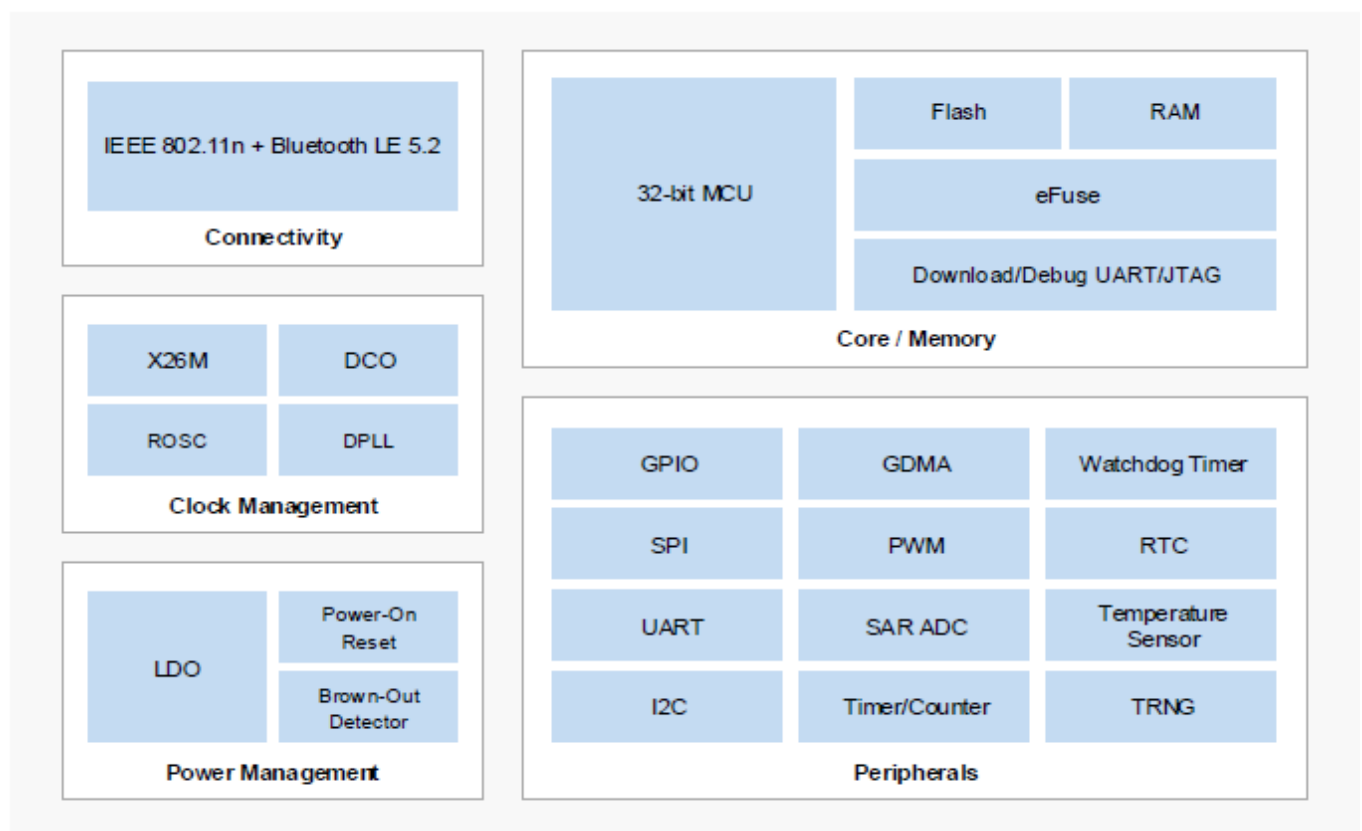
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1. General Description

iTM-7238-BK module features a fully integrated 2.4GHz radio transceiver and baseband processor for Wi-Fi 802.11b/g/n and Bluetooth® v5.2 IoT applications. It can be used as a standalone application-specific communication processor or as a wireless data link in hosted MCU systems where power consumption is critical. It supports flexible memory architecture for storing profiles, stacks and custom application codes, and can be updated using Over-The-Air (OTA) technology.

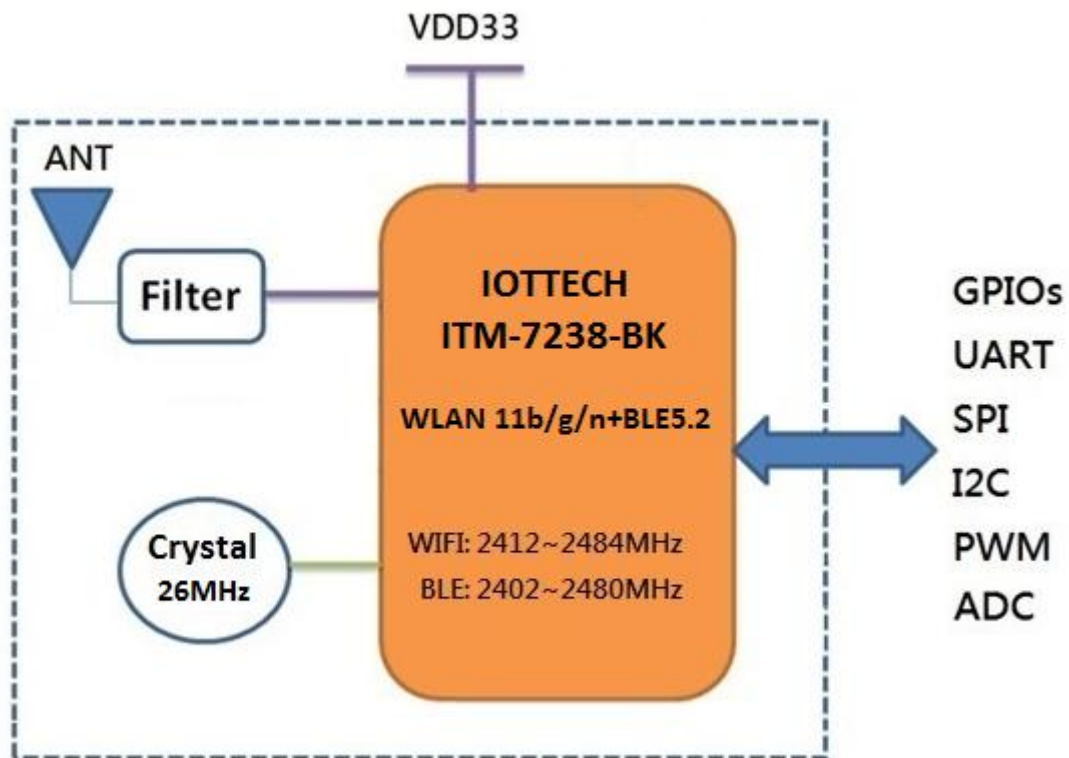
iTM-7238-BK module uses Beken BK7238 SoC. It is equipped with a powerful and cost-competitive 32-bit processor with clock rate up to 160Mhz, 288KB SRAM and 2MB internal flash memory. iTM-7238-BK can be connected to any external MCU through SPI, I2C or UART interfaces and sensors or other devices through GPIOs. The transceiver interfaces directly to the antenna and is fully compliant with the Wi-Fi 802.11b/g/n and Bluetooth 5.2 BLE standards. With integrated antenna switch, RF balun, power amplifier (PA) and low noise amplifier (LNA), the BK7238 allows both Wi-Fi and Bluetooth to minimize PCB design area and external component requirement. The block diagram for BK7238 chipset is shown as below.



2. Features

- Core and Memory
 - 32-bit MCU at up to 160 MHz
 - SiP Flash options: 1 MB / 2 MB
 - 288 KB RAM
 - 4-byte eFuse
 - UART/JTAG for download and debug
- Wi-Fi
 - IEEE 802.11 b/g/n 1x1 compliant
 - Supports 20 MHz channel
 - STBC supported
 - Working mode STA, AP, Direct
 - Concurrent AP + STA
 - WPA/WPA2 security supported
 - Built-in TCP/IP stack
- Bluetooth Low Energy
 - Bluetooth 5.2
 - Bluetooth Low Energy (LE), 1 Mbps, 2 Mbps, and long range (125 kbps and 500 kbps)
 - Advertising extensions
 - Bluetooth direction finding: Angle of Arrival (AoA) and Angle of Departure (AoD)
 - Supports an antenna array with up to sixteen antennae for precise indoor positioning
 - Integrated Bluetooth LE/WLAN coexistence (PTA)
- Bluetooth LE
 - Compliant with Bluetooth 5.2 BLE specifications
 - Master / Slave mode support
 - Long Range / High Data Rate support
 - Built-in BLE stack
 - AoA / AoD positioning support
- Peripherals 256 KB SRAM
 - I/O Interfaces (Totals 19-pins GPIOs)
 - SPI x 1

- UART x 2 (1 with Flash download support)
- I2C x 1
- 32-bit PWM x 6
- 10-bit SAR ADC up to 6 channels
- General-purpose DMA controller (GDMA) with 6 channels
- General-purpose 32-bit timer/counter x 6
- Watchdog timer x 1
- Real-time counter (RTC) x 1
- Temperature sensor x 1
- True random number generator (TRNG) x 1



3. General Specification

3.1 Voltages

3.1.1 Absolute Maximum Ratings

Symbol	Description	Min.	Max.	Unit
VBAT	Input supply Voltage	-0.3	3.6	V

Operating temperature	-20°C to 70°C
Storage temperature	-40°C to 85°C

3.1.2 Recommended Operating Ratings

Test conditions: At room temperature				
Symbol	Min.	Typ.	Max.	Unit
VBAT	2.7	3.3	3.6	V

3.2 Wi-Fi RF Specification (RX)

Parameters	Conditions	Min.	Typ.	Max.	Unit
Frequency Range		2412		2484	MHz
RX Sensitivity 11b @ 8% PER	- 1Mbps		-97		dBm
	- 2Mbps		-94		dBm
	- 5.5Mbps		-92		dBm
	- 11Mbps		-89		dBm
RX Sensitivity 11g @ 10% PER	- 6Mbps		-90		dBm
	- 9Mbps		-90		dBm
	- 12Mbps		-89		dBm
	- 18Mbps		-87		dBm
	- 24Mbps		-84		dBm
	- 36Mbps		-80		dBm
	- 48Mbps		-76		dBm
	- 54Mbps		-74		dBm
Receive Sensitivity (11n,20MHz) @10% PER	- MCS=0		-90		dBm
	- MCS=1		-88		dBm
	- MCS=2		-85		dBm
	- MCS=3		-82		dBm
	- MCS=4		-79		dBm
	- MCS=5		-75		dBm
	- MCS=6		-73		dBm
	- MCS=7		-72		dBm
Receive Sensitivity (11n,40MHz) @10% PER	- MCS=0		-89		dBm
	- MCS=1		-87		dBm
	- MCS=2		-84		dBm
	- MCS=3		-81		dBm
	- MCS=4		-78		dBm
	- MCS=5		-73		dBm
	- MCS=6		-71		dBm
	- MCS=7		-70		dBm
Maximum Receive Level	802.11b		10		dBm
	802.11g		5		dBm
	802.11n		2		dBm

3.3 Wi-Fi RF Specification (TX)

Parameters	Conditions	Min.	Typ.	Max.	Unit
Frequency Range		2412		2484	MHz
Output Power	802.11b (11Mbps)		17.0		dBm
	802.11g (54Mbps)		15.0		dBm
	802.11n (MCS7)		14.0		dBm
@EVM	802.11b (11Mbps)		-18	-10	dB
	802.11g (54Mbps)		-27	-25	dB
	802.11n (MCS7)		-30	-28	dB
VBAT=3.3V, Ambient temperature=25°C					

3.4 BLE RF Specification (RX)

Parameters	Conditions	Min.	Typ.	Max.	Unit
Frequency Range		2402		2480	MHz
RX Sensitivity	LE 1Mbps, 30.8% PER		-98		dBm
Maximum Input Level		-10			dBm

3.5 BLE RF Specification (TX)

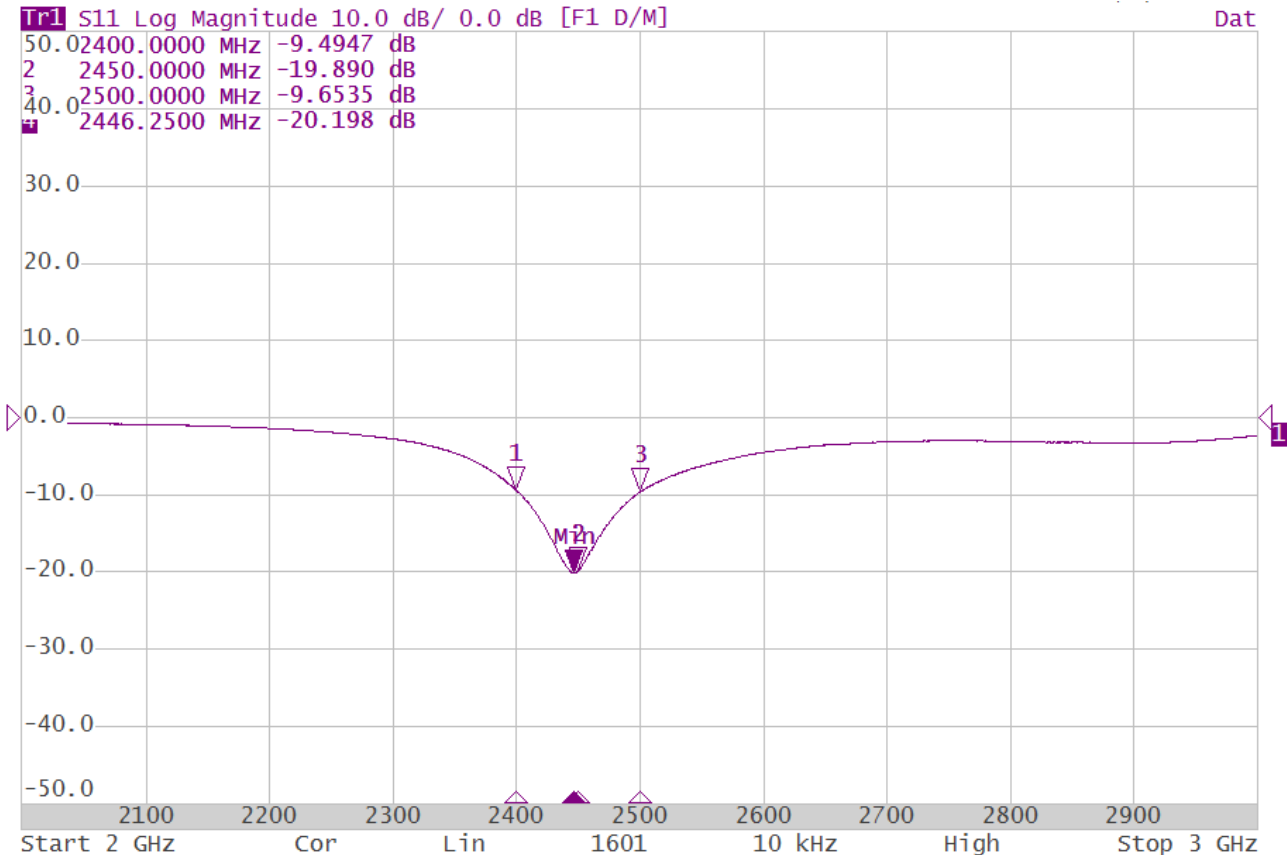
Parameters	Conditions	Min.	Typ.	Max.	Unit
Frequency Range		2402		2480	MHz
Output Power			6		dBm
20dB Bandwidth			1		MHz

3.6 Power Consumption

Parameters	Conditions	Min.	Typ.	Max.	Unit
Continuous TX	802.11b/11Mbps/17dB,		265		mA
Continuous TX	802.11g/54Mbps/15dB,		230		mA
Continuous TX	802.11n/HT20-MCS7/14dB,		220		mA
RX mode	802.11b/11Mbps		30		mA
RX mode	802.11g/54Mbps		33		mA
RX mode	802.11n/HT20-MCS7		33		mA
Normal Standby			300		uA
Low-voltage Standby			75		uA
Deep Sleep			10		uA
Shutdown			1		uA

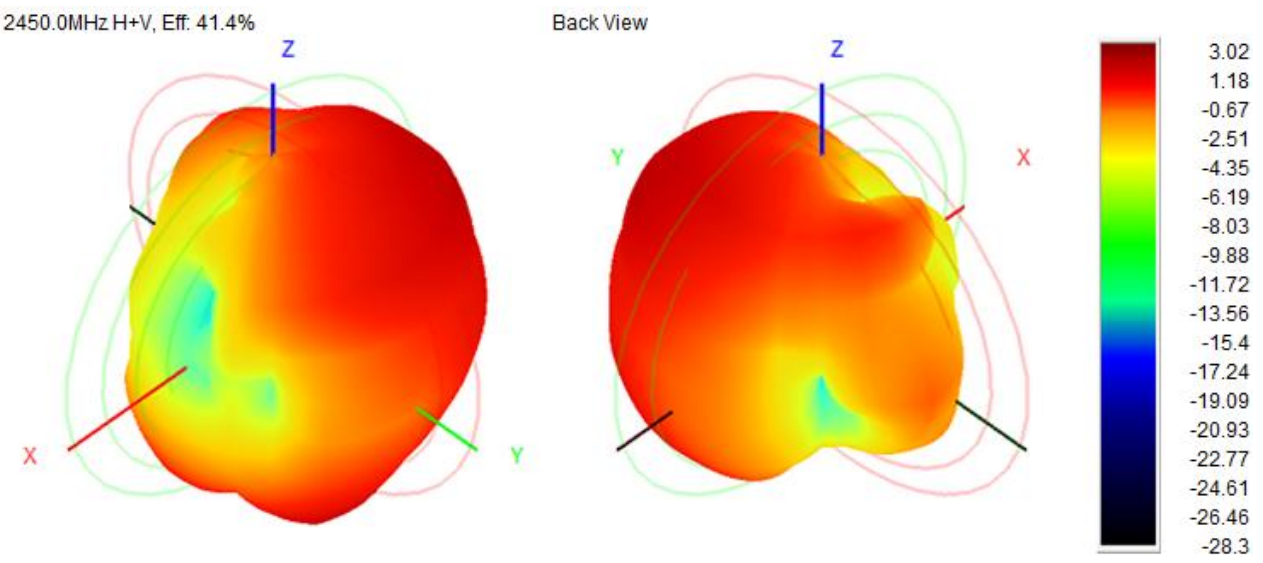
4. Antenna

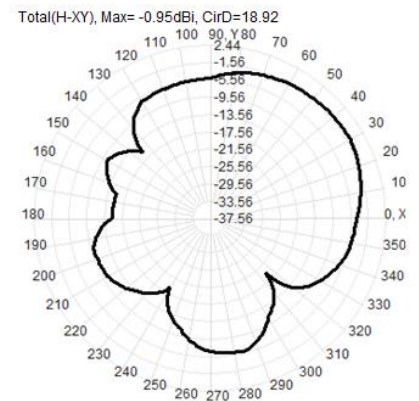
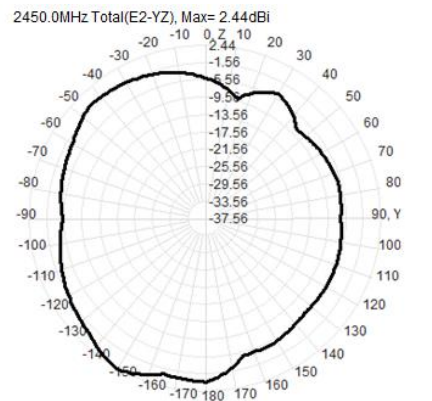
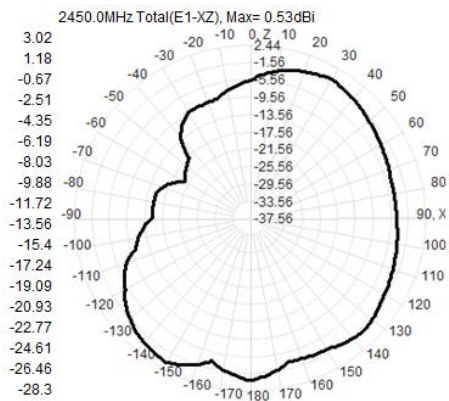
4.1 S11 Parameter



4.2 Gain Pattern

Passive Test (Free Space)

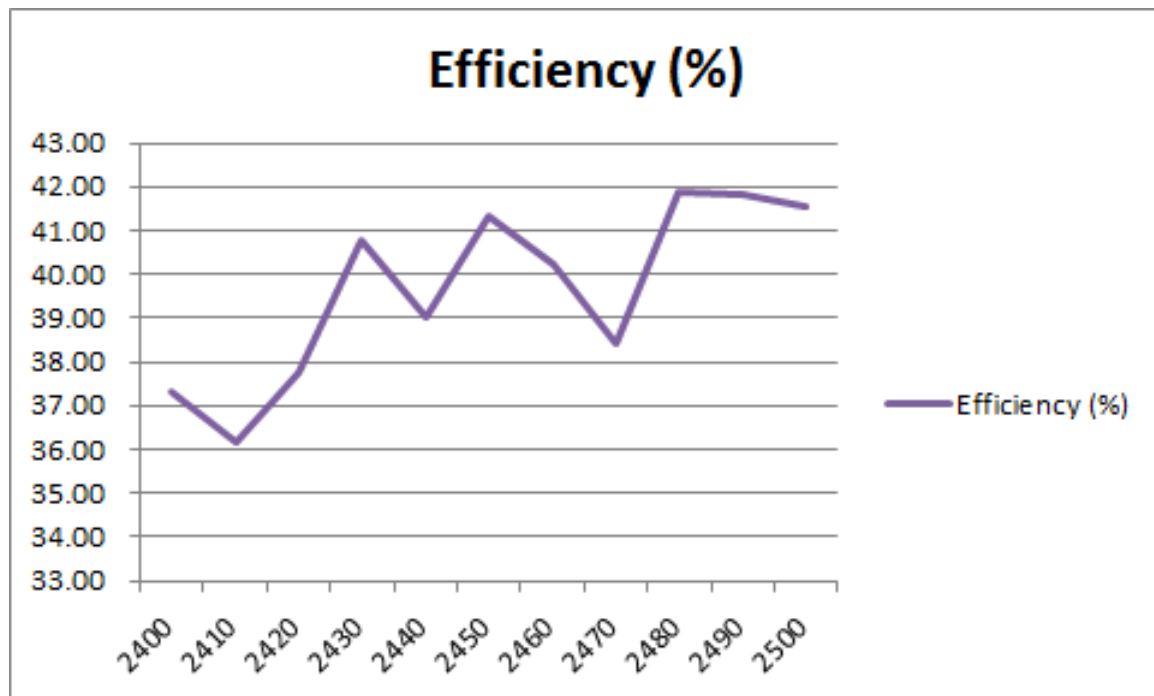




4.3 Efficiency

2400MHz~2500MHz (Average Efficiency = 40%)

Frequency ID	1	2	3	4	5	6	7	8	9	10	11
Frequency (MHz)	2400	2410	2420	2430	2440	2450	2460	2470	2480	2490	2500
Efficiency (dBi)	-4.28	-4.42	-4.23	-3.89	-4.09	-3.83	-3.96	-4.16	-3.78	-3.78	-3.81
Gain (dBi)	2.95	2.66	2.53	3.07	2.58	3.02	2.77	2.47	2.92	2.83	2.92
Efficiency (%)	37.32	36.14	37.74	40.81	39.04	41.36	40.22	38.40	41.88	41.84	41.56
Directivity (dB)	7.23	7.08	6.76	6.96	6.66	6.85	6.72	6.62	6.70	6.62	6.73

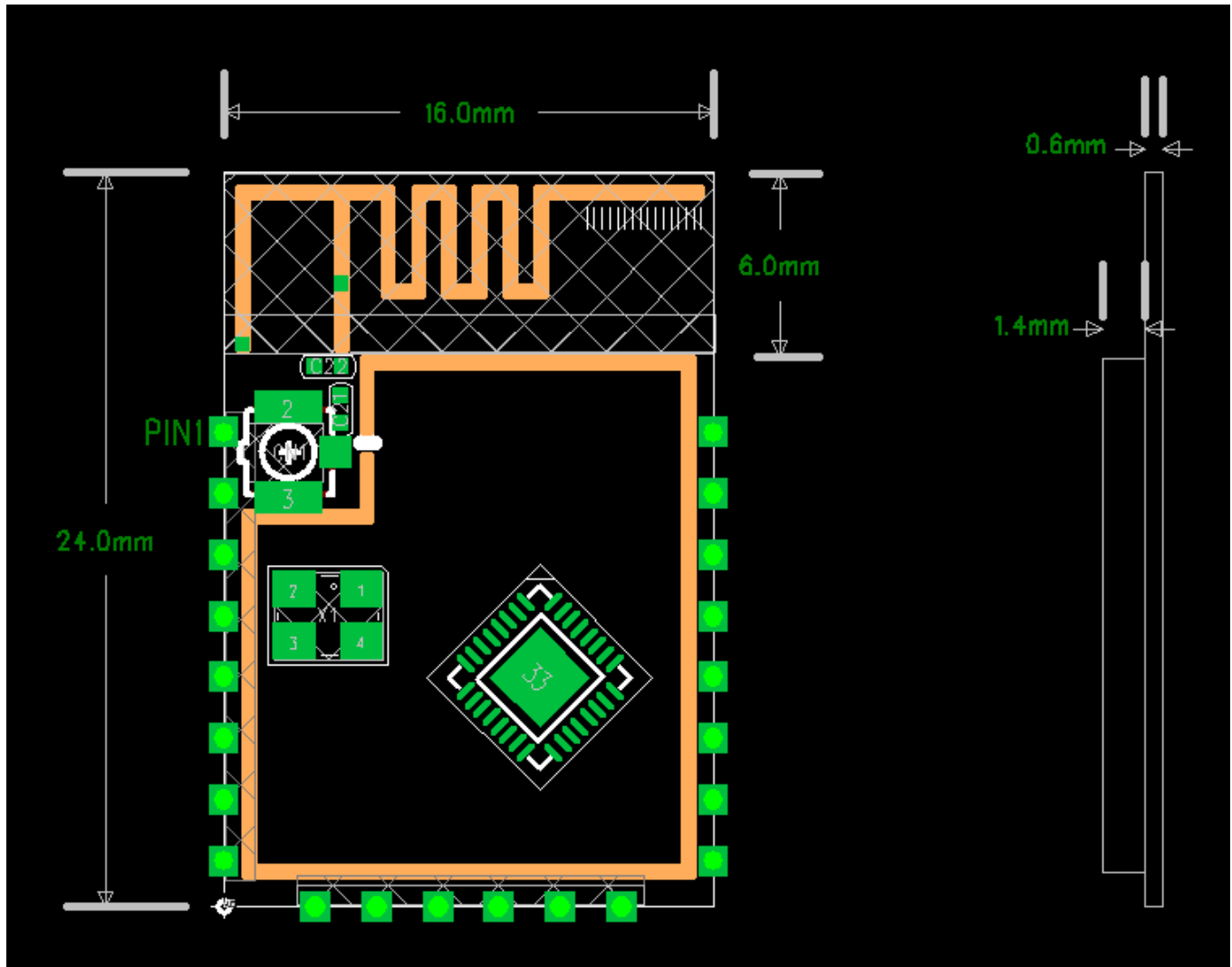


5. Pin Assignments

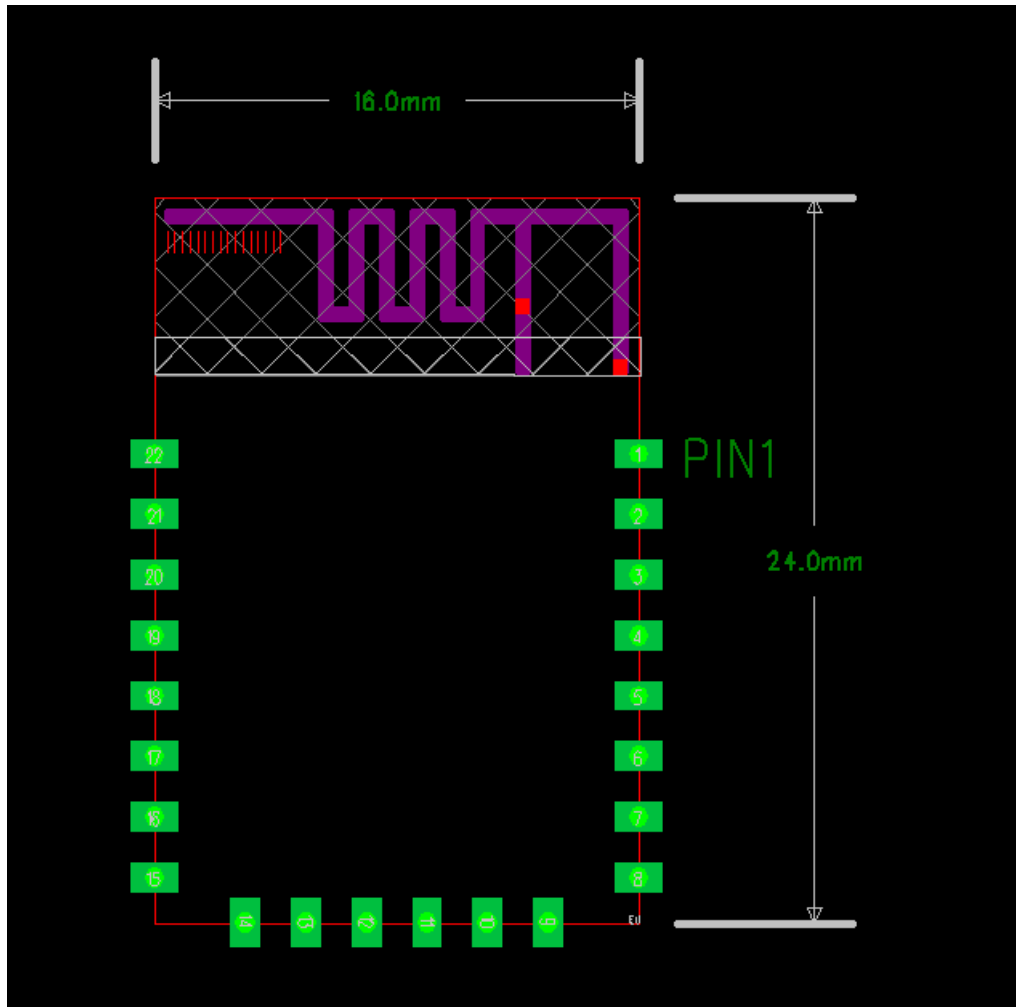
5.1 PCB Pin Outline

< TOP VIEW >

< SIDE VIEW >



< BOTTOM VIEW >



5.2 Pin Definition

Pin	Pin-Define	Type	Description
1	P28 / ADC4	I/O	GPIO28 / ADC CH4
2	P20 / ADC3	I/O	GPIO20 / ADC CH3
3	CEN	I	Chip Enable (Active high)
4	P21	I/O	GPIO21
5	P14 / SCK	I/O	GPIO14 / SPI clock
6	P17 / MISO / SDA	I/O	GPIO17 / SPI MOSI / I2C SDA
7	P16 / MOSI	I/O	GPIO16 / SPI MOSI
8	VBAT	P	Main Power Supply Input
9	P22	I/O	GPIO22
10	P23	I/O	GPIO23
11	P24 / ADC2 / PWM4 / SCL / LPO_CLK	I/O	GPIO24 / ADC CH2 / PWM CH4 / I2C SCL / LPO_CLK (32KHz clock output)
12	P26 / ADC1 / PWM5 / SDA	I/O	GPIO17 / ADC CH1 / PWM CH5 / I2C SDA
13	P6 / PWM0 / TCK / CLKO_13M	I/O	GPIO6 / PWM CH0 / JTAG TCK / CLKO_13M
14	P7 / PWM1 / TMS	I/O	GPIO7 / PWM CH1 / JTAG TMS
15	GND	P	Ground
16	P15 / SPI_CSN / SCL	I/O	GPIO15 / SPI CSN / I2C SCL
17	P11 / UART1_TX	I/O	GPIO11 / UART1_TXD
18	P10 / ADC6 / UART1_RX	I/O	GPIO10 / ADC CH6 / UART1_RXD
19	P8 / PWM2 / TDI / CLKO_26M	I/O	GPIO8 / PWM CH2 / JTAG TDI / CLKO_26M
20	P9 / PWM3 / TDO	I/O	GPIO9 / PWM CH3 / JTAG TDO
21	P1 / ADC5 / UART2_RX	I/O	GPIO1 / ADC CH5 / UART2_RXD
22	P0 / UART2_TX	I/O	GPIO0 / UART2_TXD

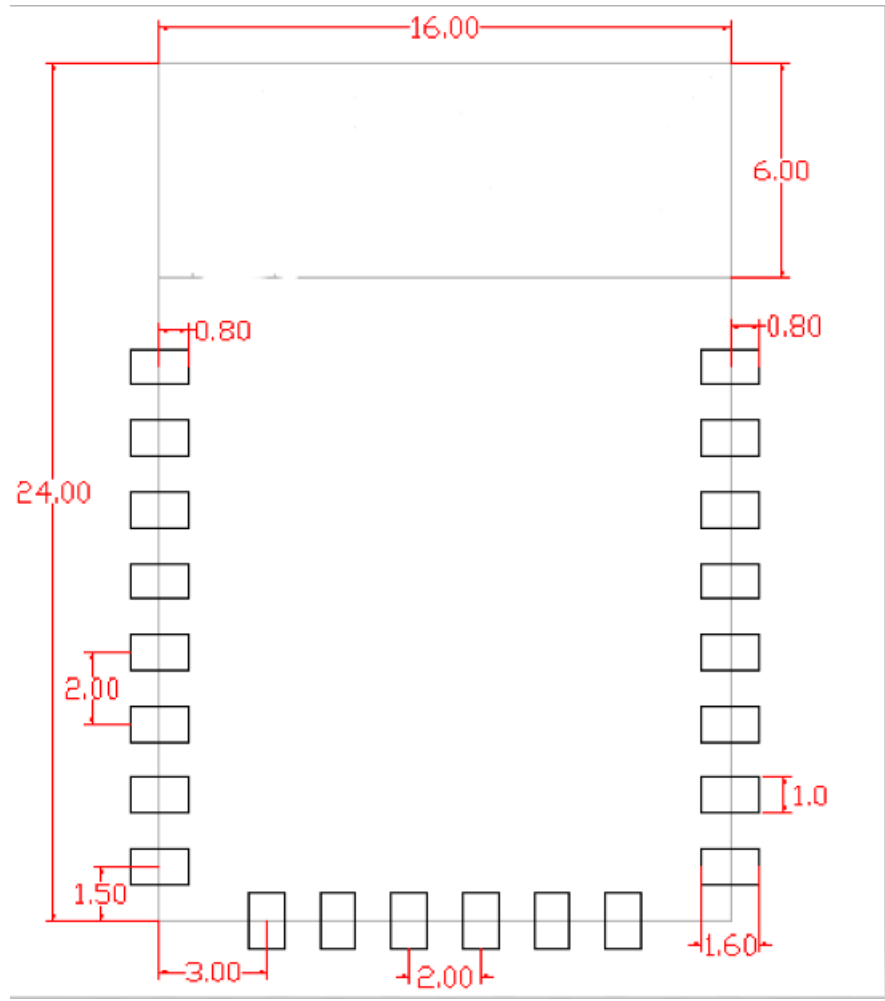
* UART1 supports firmware download

6. Dimensions

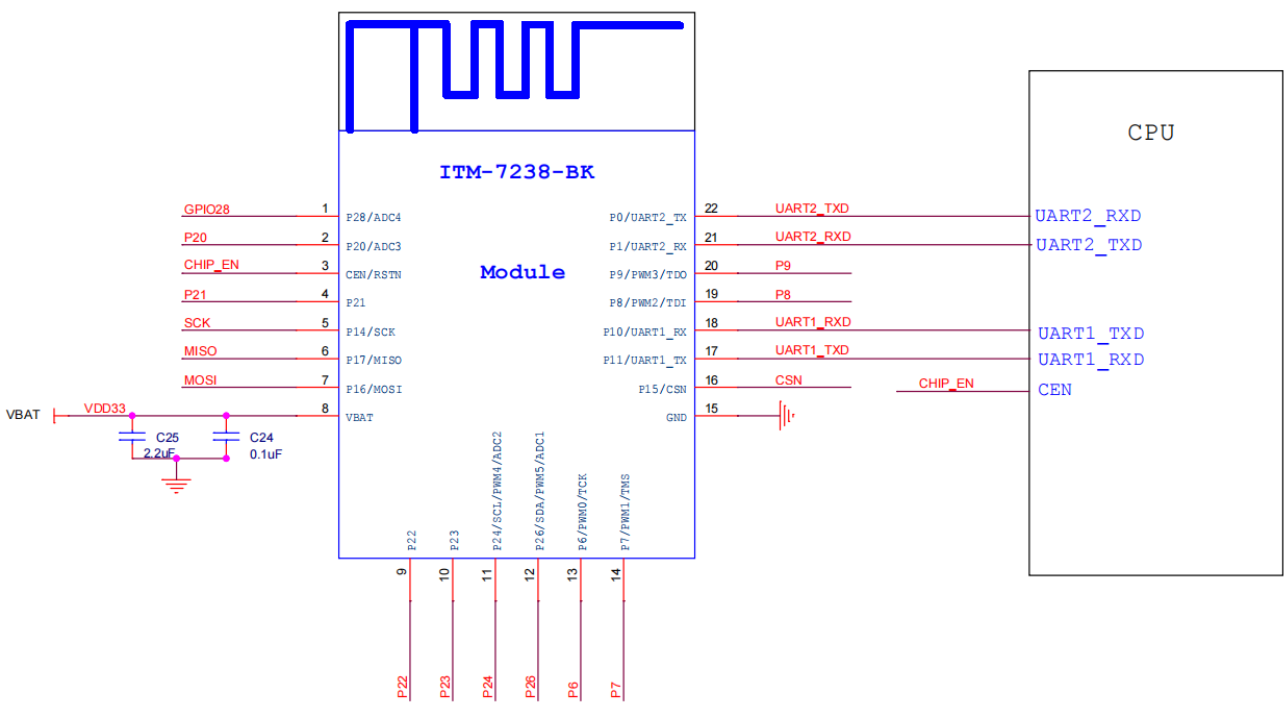
6.1 Layout Recommendation

(Unit: mm)

< TOP VIEW >



7. Reference Design

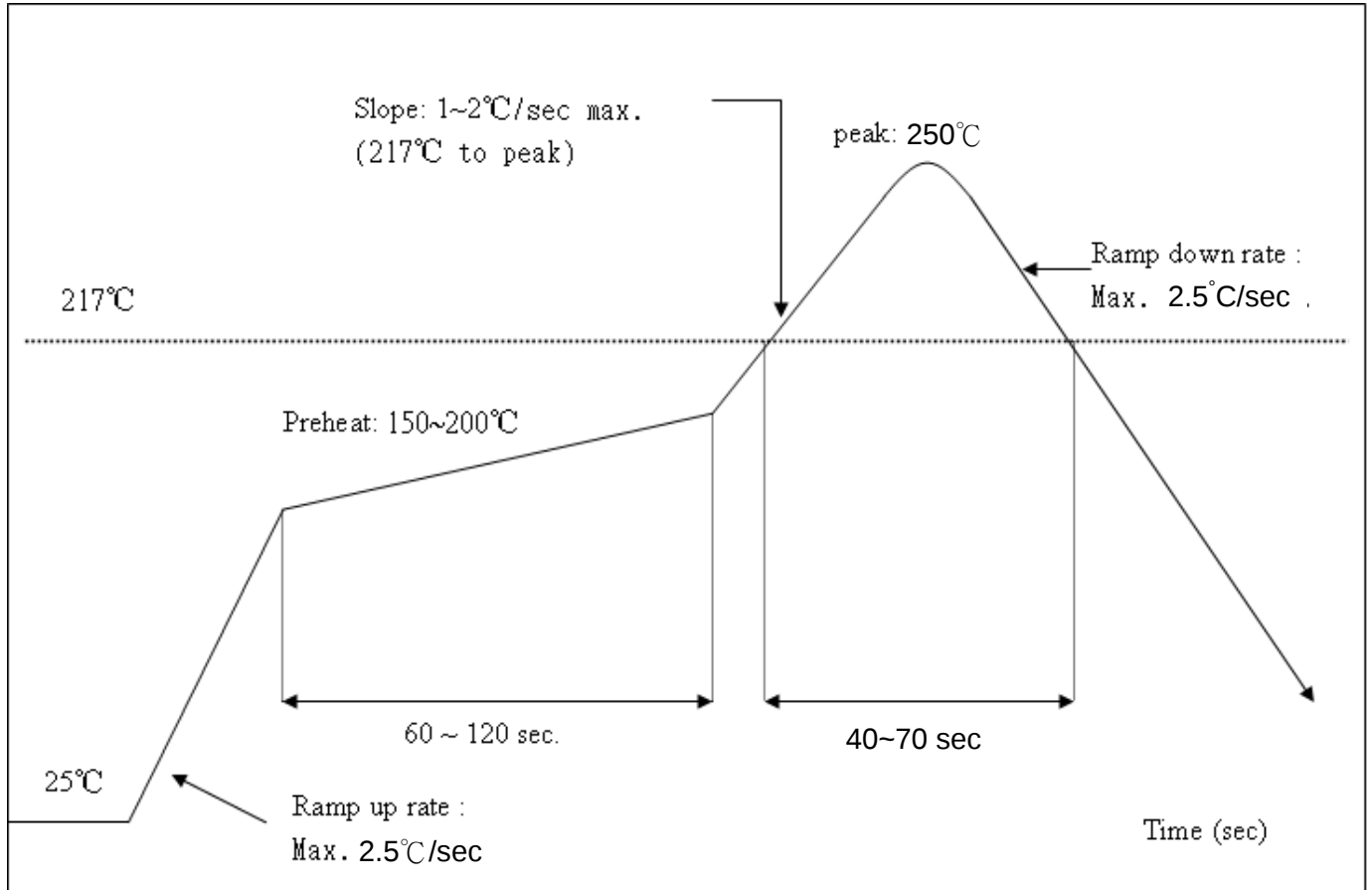


8. Recommended Reflow Profile

Referred to IPC/JEDEC standard.

Peak Temperature : $<250^{\circ}\text{C}$

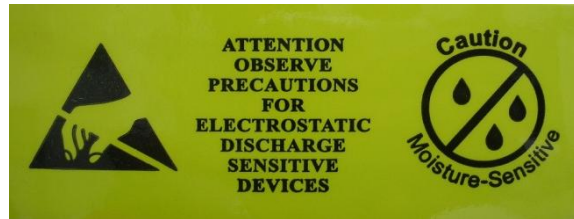
Number of Times : ≤ 2 times



9. Packing Information

9.1 Label

Label A → Anti-static and humidity notice



Label B → MSL caution / Storage Condition

Caution		LEVEL
This bag contains MOISTURE-SENSITIVE DEVICES		 If blank, see adjacent bar code label
1. Calculated shelf life in sealed bag: 12 months at <40°C and <90% relative humidity (RH) 2. Peak package body temperature: _____ °C # blank, see adjacent bar code label 3. After bag is opened, devices that will be subjected to reflow solder or other high temperature process must be a) Mounted within: _____ hours of factory conditions # blank, see adjacent bar code label ≤30°C/60% RH, or b) Stored per J-STD-033 4. Devices require bake, before mounting, if: a) Humidity Indicator Card reads >10% for level 2a - 5a devices or >60% for level 2 devices when read at 23 ± 5 °C b) 3a or 3b are not met 5. If baking is required, refer to IPC/JEDEC J-STD-033 for bake procedure Bag Seal Date: _____ # blank, see adjacent bar code label Note: Level and body temperature defined by IPC/JEDEC J-STD-020		

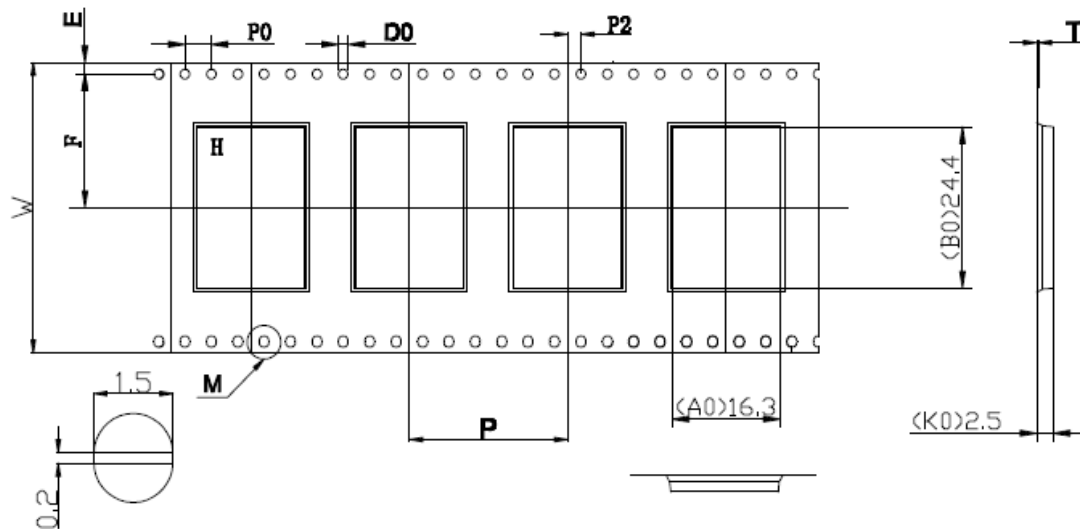
Label C → Inner box label .

PKG S/N :	
Model:	
P/N :	
Qty :	
Date Code	
Lot Code :	

Label D → Carton box label .

iotTech Corporation	
Model Name :	
Part No :	
Quantity :	
Lot D/C :	
Manufacture :	

9.2 Dimension



Symbol	AO	BO	KO	PO	P	P2
Spec	16.3 $\pm$ 0.10	24.4 $\pm$ 0.10	2.50 $\pm$ 0.10	4.00 $\pm$ 0.10	32.0 $\pm$ 0.10	2.00 $\pm$ 0.10
Symbol	W	T	E	F	DO	
Spec	44.0 $\pm$ 0.30	0.30 $\pm$ 0.05	1.75 $\pm$ 0.10	20.2 $\pm$ 0.10	1.50 $\pm$ 0.10	

1. 10 sprocket hole pitch cumulative tolerance ± 0.20 .
2. Carrier camber is within 1 mm in 250 mm.
3. Material : Black Conductive Polystyrene Alloy.
4. All dimensions meet EIA-481-D requirements.
5. Thickness : 0.30 $\pm$ 0.05mm.
6. Packing length per 22" reel : 98.5 Meters.(1:3)
7. Component load per 13" reel : 1000 pcs.

