



ITM-8420

Bluetooth[®] 5.0 Module Datasheet

V1.0

Revision History

Date	Revision Content	Revised By	Version
2024/01/15	- Initial released (Preliminary)	Issac Chen	0.1
2024/12/05	- Official release	Pendro Wu	1.0
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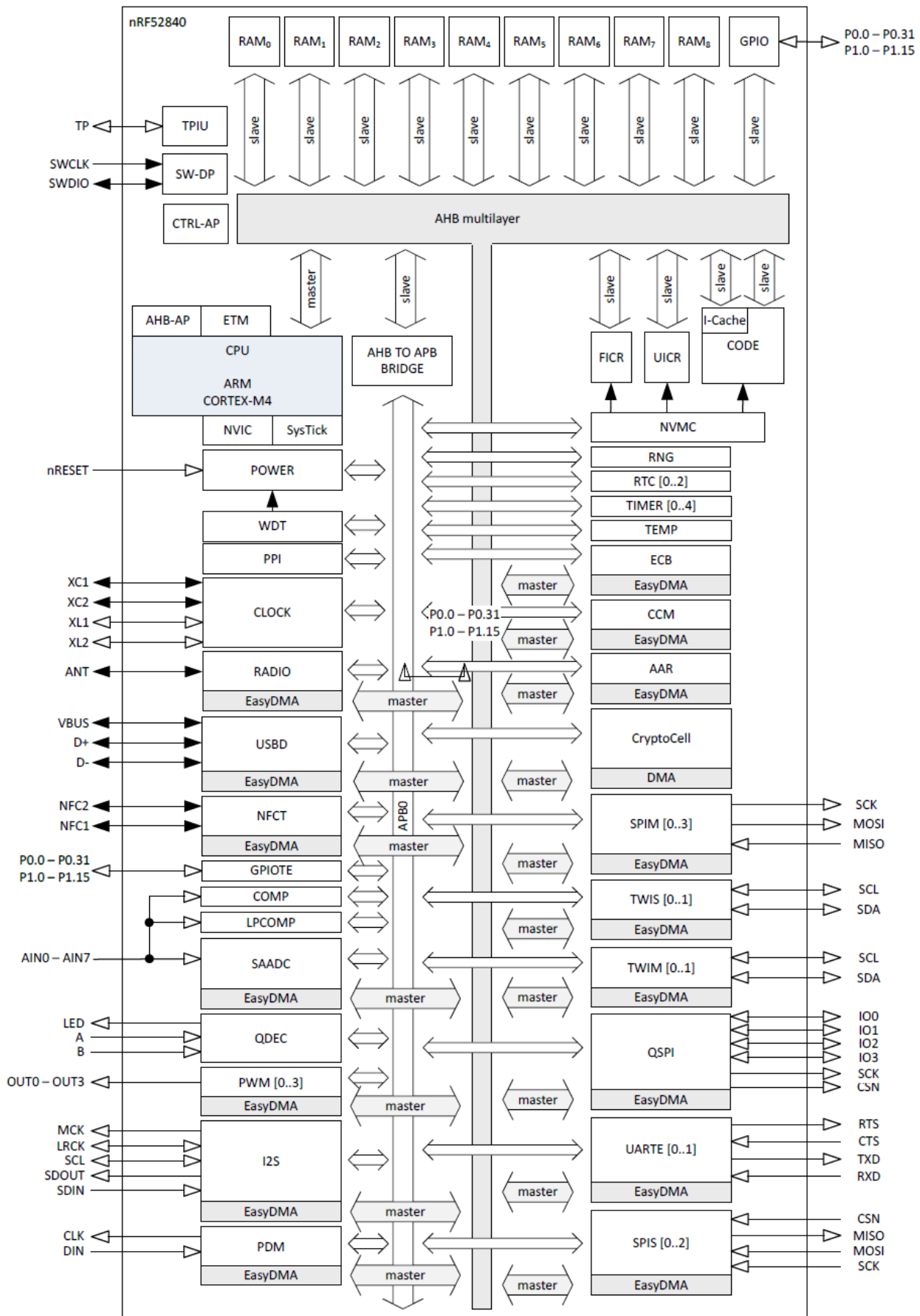
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1. General Description

iTM-8420 module features a fully integrated 2.4GHz radio transceiver and baseband processor for Bluetooth 5.0 applications. It can be used as a standalone application-specific communication processor or as a wireless data link in hosted MCU systems where ultra-low power 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-8420 module uses Nordic nRF52840 BLE chipset. It combines the excellent performance of a leading RF transceiver with a low-power ARM Cortex-M4 and rich powerful supporting features and peripherals. It also contains 256KB RAM, and 1MB flash memory.

The block diagram of nRF52840 is shown in next page



2. Features

- Bluetooth® 5, IEEE 802.15.4-2006, 2.4 GHz transceiver
 - -95 dBm sensitivity in 1 Mbps Bluetooth® low energy mode
 - -103 dBm sensitivity in 125 kbps Bluetooth® low energy mode (long range)
 - -20 to +8 dBm TX power, configurable in 4 dB steps
 - On-air compatible with nRF52, nRF51, nRF24L, and nRF24AP Series
 - Supported data rates:
 - ◆ Bluetooth® 5 – 2 Mbps, 1 Mbps, 500 kbps, and 125 kbps
 - ◆ IEEE 802.15.4-2006 – 250 kbps
 - ◆ Proprietary 2.4 GHz – 2 Mbps, 1 Mbps
 - Single-ended antenna output (on-chip balun)
 - 128-bit AES/ECB/CCM/AAR co-processor (on-the-fly packet encryption)
 - 4.8 mA peak current in TX (0 dBm)
 - 4.6 mA peak current in RX
 - RSSI (1 dB resolution)
- ARM® Cortex®-M4 32-bit processor with FPU, 64 MHz
 - 212 EEMBC CoreMark® score running from flash memory
 - 52 µA/MHz running CoreMark from flash memory
 - Watchpoint and trace debug modules (DWT, ETM, and ITM)
 - Serial wire debug (SWD)
- Rich set of security features
 - ARM® TrustZone® Cryptocell 310 security subsystem
 - ◆ NIST SP800-90A and SP800-90B compliant random number generator
 - ◆ AES-128 – ECB, CBC, CMAC/CBC-MAC, CTR, CCM/CCM*
 - ◆ Chacha20/Poly1305 AEAD supporting 128- and 256-bit key size
 - ◆ SHA-1, SHA-2 up to 256 bits
 - ◆ Keyed-hash message authentication code (HMAC)
 - ◆ RSA up to 2048-bit key size
 - ◆ SRP up to 3072-bit key size
 - ◆ ECC support for most used curves, including P-256 (secp256r1) and Ed25519/Curve25519
 - ◆ Application key management using derived key model

- Secure boot ready
 - Flash access control list (ACL)
 - Root-of-trust (RoT)
 - Debug control and configuration
 - Access port protection (CTRL-AP)
- Secure erase
- Flexible power management
 - 1.7 V to 5.5 V supply voltage range
 - Automated peripheral power management
 - Fast wake-up using 64 MHz internal oscillator
 - 0.4 μ A at 3 V in System OFF mode, no RAM retention
 - 1.5 μ A at 3 V in System ON mode, no RAM retention, wake on RTC
- 1 MB flash and 256 KB RAM
- Advanced on-chip interfaces
 - USB 2.0 full speed (12 Mbps) controller
 - QSPI 32 MHz interface
 - High-speed 32 MHz SPI
 - Type 2 near field communication (NFC-A) tag with wake-on field
 - ◆ Touch-to-pair support
 - Programmable peripheral interconnect (PPI)
 - 48 general purpose I/O pins
 - EasyDMA automated data transfer between memory and peripherals
- Nordic SoftDevice ready with support for concurrent multiprotocol
- 12-bit, 200 ksps ADC – 8 configurable channels with programmable gain
- 64 level comparator
- 15 level low-power comparator with wake-up from System OFF mode
- Temperature sensor
- 4x four channel pulse width modulator (PWM) unit with EasyDMA
- Audio peripherals – I2S, digital microphone interface (PDM)
- 5x 32-bit timer with counter mode

- Up to 4x SPI master/3x SPI slave with EasyDMA
- Up to 2x I2C compatible two-wire master/slave
- 2x UART (CTS/RTS) with EasyDMA
- Quadrature decoder (QDEC)
- 3x real-time counter (RTC)
- Single crystal operation

3. General Specification

Operating	Temperature: -30°C to 85°C Relative Humidity : ≤ 80%
Storage	Temperature: -40°C to 85°C Relative Humidity : ≤ 60%

3.1 Voltages

3.1.1 Absolute Maximum Ratings

Symbol	Description	Min.	Max.	Unit
VDD	VDD Supply Voltage	-0.3	3.9	V
VDDH	VDDH Supply Voltage	-0.3	5.8	V
VUSB	VUSB USB Supply Voltage	-0.3	5.8	V
VIO	I/O Pin Voltage (VDD ≤ 3.6V)	-0.3	VDD+0.3	V
	I/O Pin Voltage (VDD > 3.6V)	-0.3	3.9	V

3.1.2 Recommended Operating Ratings

Symbol	Min.	Typ.	Max.	Unit
VDD	1.75	3.0	3.6	V
VDDH	2.5	3.7	5.5	V
VUSB	4.45	5.0	5.5	V

3.2 RF Specification (RX)

Parameters	Conditions (VDD=3.0V)	Min.	Typ.	Max.	Unit
Frequency Range		2402		2480	MHz
RX Sensitivity < 30.8% PER	LE 1Mbps		-94		dBm
	LE 2Mbps		-92		dBm
	LE 125Kbps		-103		dBm
	LE 500Kbps		-99		dBm
Maximum Input Level			0		dBm

3.3 RF Specification (TX)

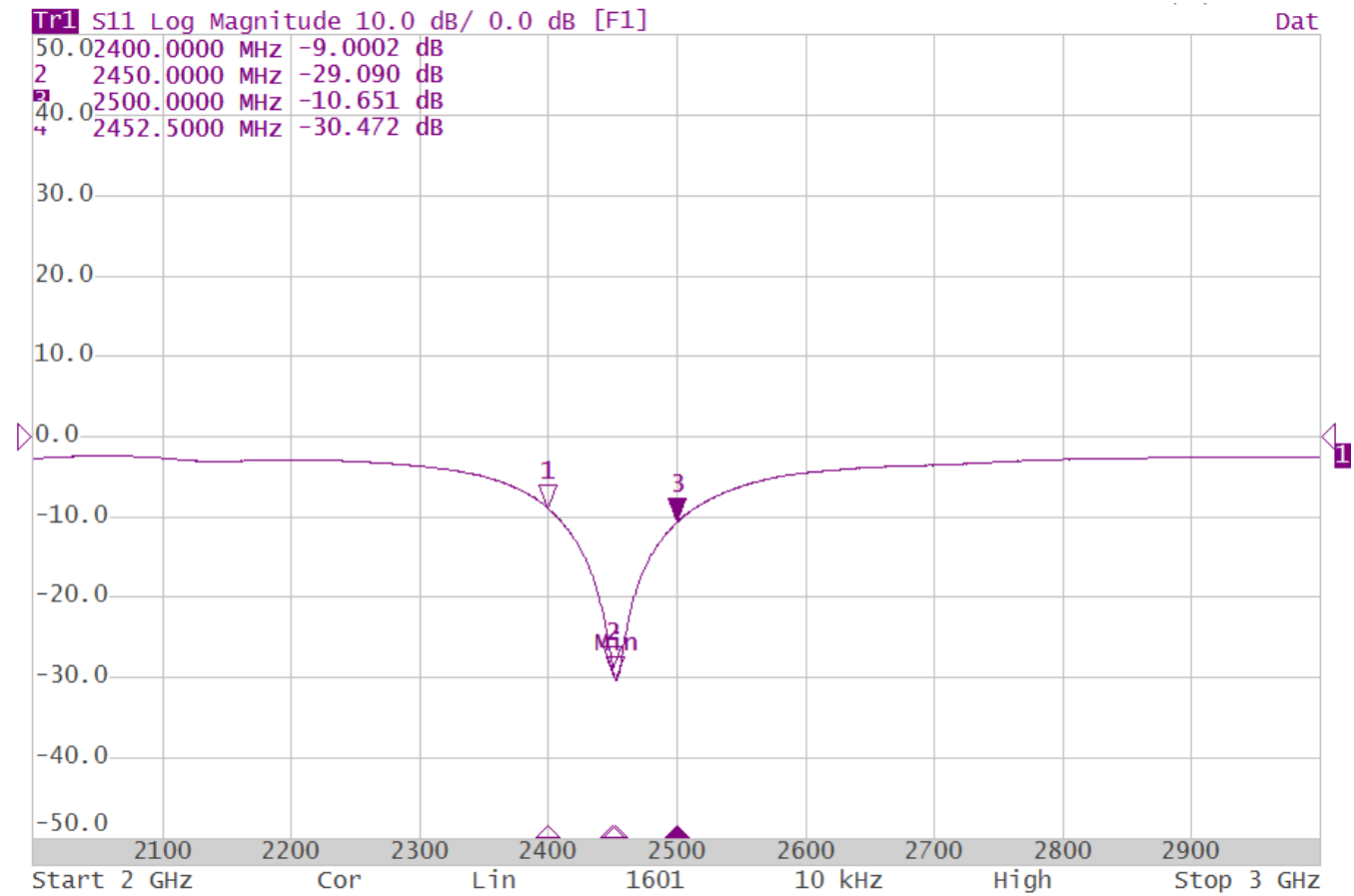
Parameters	Conditions (VDD=3.0V)	Min.	Typ.	Max.	Unit
Frequency Range		2402		2480	MHz
Maximum Output Power		--	--	8	dBm
Power Control Range			28		dB
Power Accuracy			±4		dB

3.4 Power Consumption

Main Chip	
VDD=VDDH=3.0V; Regulator = DC-DC; Temperature=25°C	
Radio Power Consumption	
RX Mode (1Mbps)	6.3 mA (Typical)
TX Mode (0.0 dBm / 1Mbps)	6.4 mA (Typical)
TX Mode (8.0 dBm / 1Mbps)	16.4 mA (Typical)
Low Power Mode:	
Sleep (Full 256KB RAM retention; wakeup by any event)	2.35 uA (Typical)
Power Down (Wakeup by RESET)	0.40 uA (Typical)

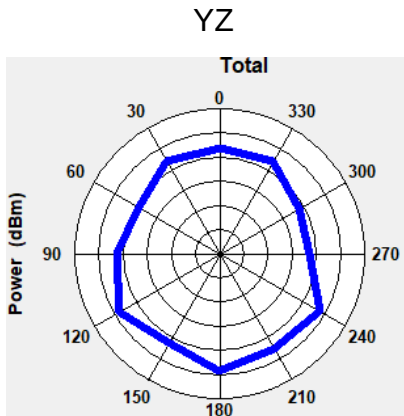
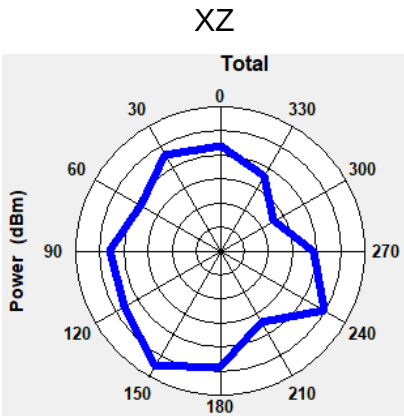
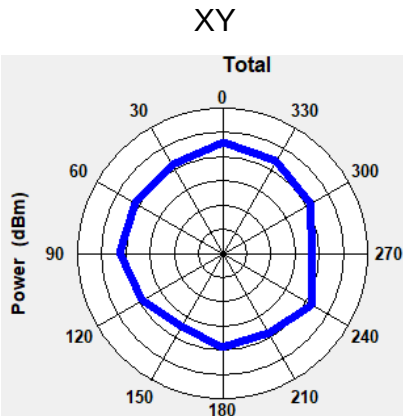
4. Antenna

4.1 S11 Parameter



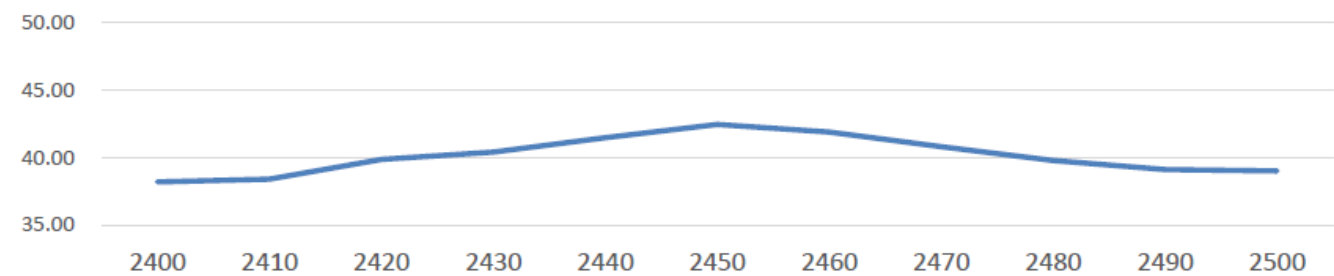
4.2 Gain Pattern

Passive Test (Free Space)



4.3 Efficiency

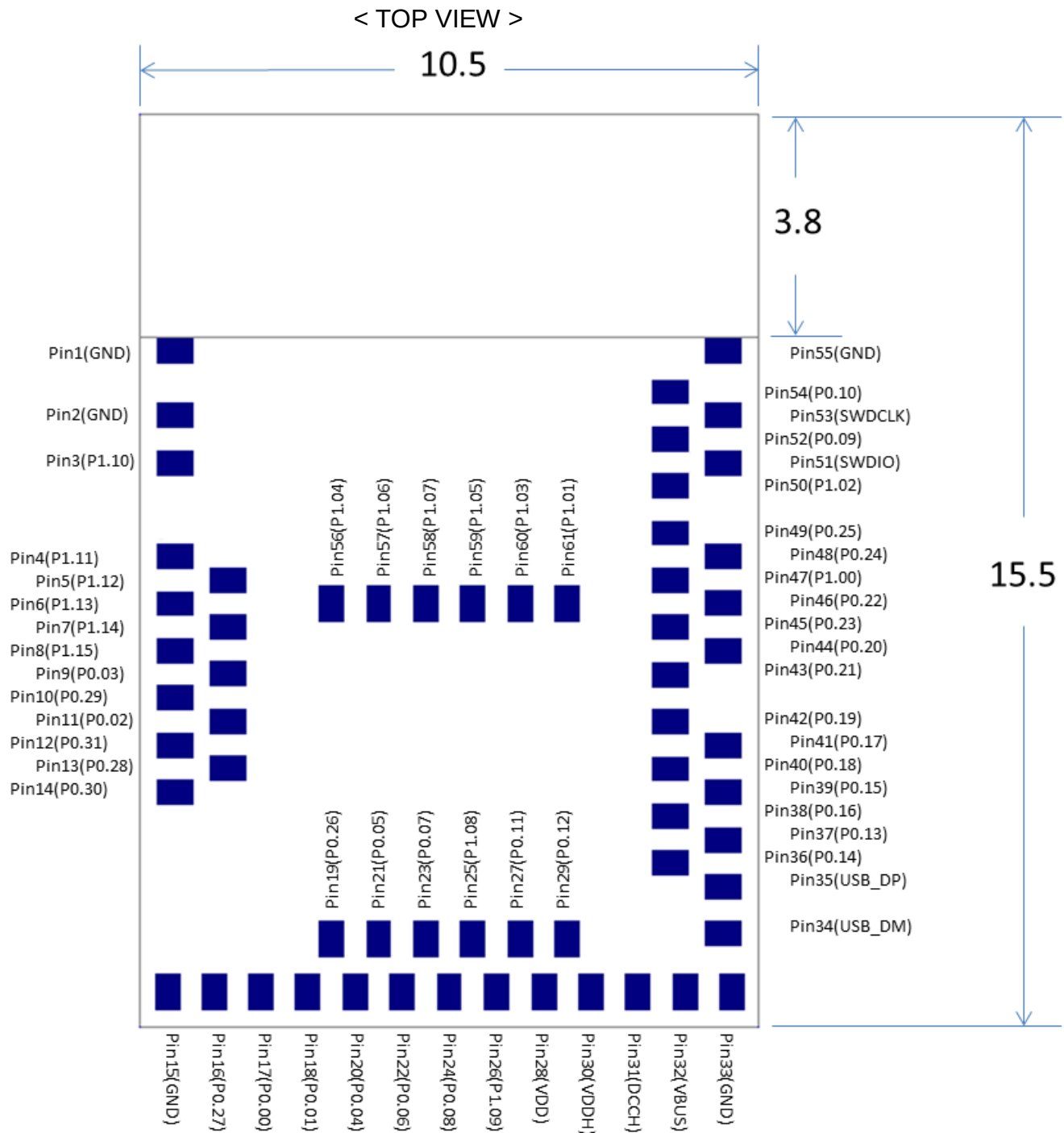
2400MHz~2500MHz (Average Efficiency = 40%)



Frequency (MHz)	2400	2410	2420	2430	2440	2450	2460	2470	2480	2490	2500
Efficiency (%)	38.20	38.39	39.85	40.41	41.47	42.45	41.89	40.80	39.76	39.10	39.00
Gain (dBi)	1.02	1.16	1.41	1.77	2.16	2.84	2.18	1.98	1.86	1.72	1.55

5. Pin Assignments

5.1 PCB Pin Outline (10.5mm x 15.5mm x 2.0mm)



5.2 Pin Definition

Pin No.	Pin-Define	Type	Description
1	GND	G	Ground
2	GND	G	Ground
3	P1.10	DIO	GPIO P1.10 (Std. Drive/Low Freq. IO only).
4	P1.11	DIO	GPIO P1.11 (Std. Drive/Low Freq. IO only)
5	P1.12	DIO	GPIO P1.12 (Std. Drive/Low Freq. IO only)
6	P1.13	DIO	GPIO P1.13 (Std. Drive/Low Freq. IO only)
7	P1.14	DIO	GPIO P1.14 (Std. Drive/Low Freq. IO only)
8	P1.15	DIO	GPIO P1.15 (Std. Drive/Low Freq. IO only)
9	P0.03/AIN1	DIO/AI	GPIO P0.03 (Std. Drive/Low Freq. IO only) / Analog Input 1
10	P0.29/AIN5	DIO/AI	GPIO P0.29 (Std. Drive/Low Freq. IO only) / Analog Input 5
11	P0.02/AIN0	DIO/AI	GPIO P0.02 (Std. Drive/Low Freq. IO only) / Analog Input 0
12	P0.31/AIN7	DIO/AI	GPIO P0.31 (Std. Drive/Low Freq. IO only) / Analog Input 7
13	P0.28/AIN4	DIO/AI	GPIO P0.28 (Std. Drive/Low Freq. IO only) / Analog Input 4
14	P0.30/AIN6	DIO/AI	GPIO P0.30 (Std. Drive/Low Freq. IO only) / Analog Input 6
15	GND	G	Ground
16	P0.27	DIO	GPIO P0.27
17	P0.00/XL1	DIO/AI	GPIO P0.00 / 32.768kHz Crystal Input
18	P0.01/XL2	DIO/AI	GPIO P0.01 / 32.768kHz Crystal Input
19	P0.26	DIO	GPIO P0.26
20	P0.04/AIN2	DIO/AI	GPIO P0.04 / Analog Input 2
21	P0.05/AIN3	DIO/AI	GPIO P0.05 / Analog Input 3
22	P0.06	DIO	GPIO P0.06
23	P0.07/TRACECLK	DIO	GPIO P0.07 / Trace Buffer Clock
24	P0.08	DIO	GPIO P0.08
25	P1.08	DIO	GPIO P1.08
26	P1.09/TRACEDATA3	DIO	GPIO P1.09 / Trace Buffer Data[3]
27	P0.11/TRACEDATA2	DIO	GPIO P0.11 / Trace Buffer Data[2]
28	VDD	P	Power Supply

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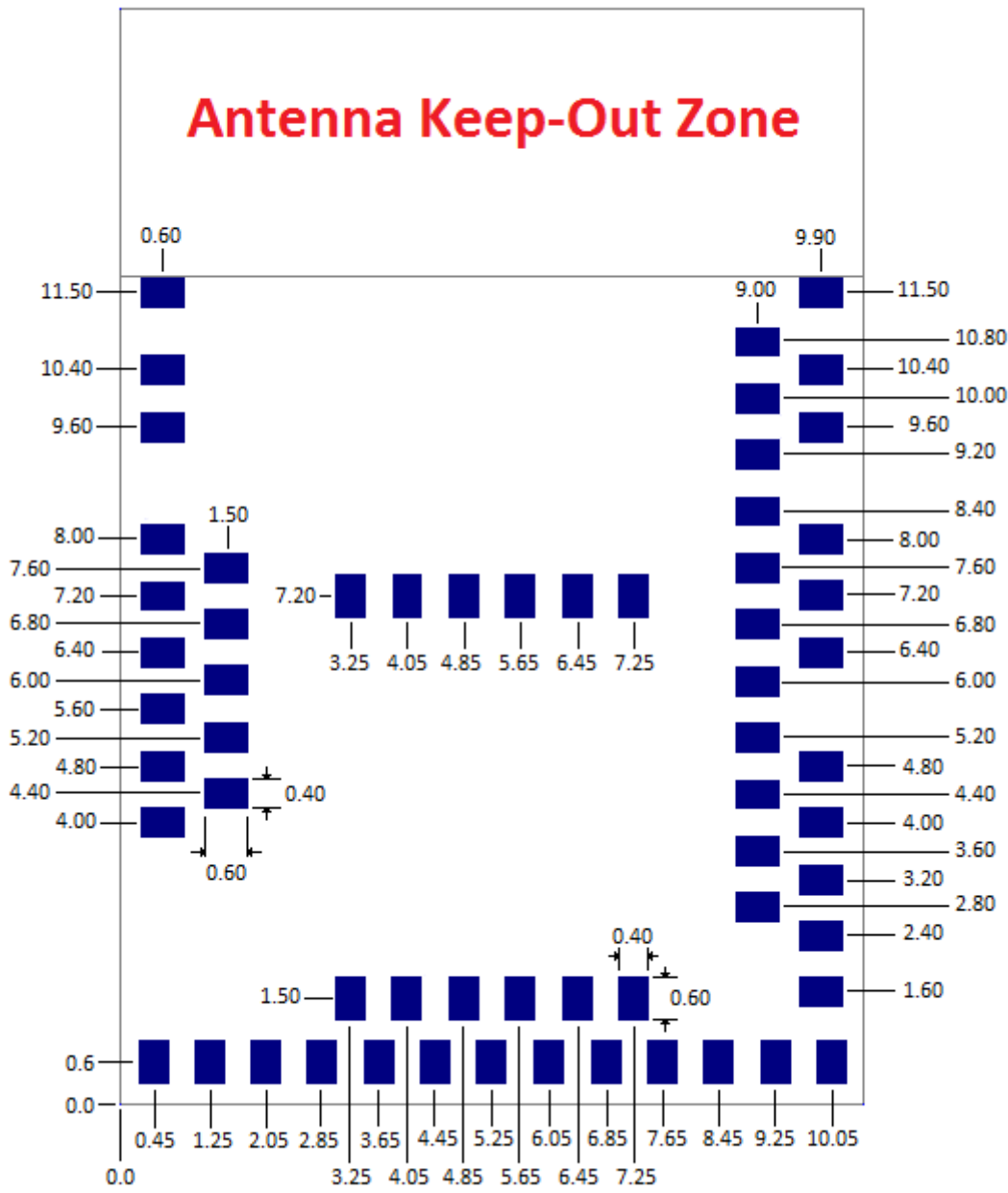
29	P0.12/TRACEDATA1	DIO	GPIO P0.12 / Trace Buffer Data[1]
30	VDDH	P	High Voltage Power Supply
31	DCCH	P	DC/DC Converter Output
32	VBUS	P	5V Input for USB 3.3V Regulator
33	GND	G	Ground
34	USB_DM	AIO	USB DM Signal
35	USB_DP	AIO	USB DP Signal
36	P0.14	DIO	GPIO P0.14
37	P0.13	DIO	GPIO P0.13
38	P0.16	DIO	GPIO P0.16
39	P0.15	DIO	GPIO P0.15
40	P0.18 / nRESET	DIO	GPIO P0.18 / Configurable as System Reset
41	P0.17	DIO	GPIO P0.17
42	P0.19	DIO	GPIO P0.19
43	P0.21	DIO	GPIO P0.21
44	P0.20	DIO	GPIO P0.20
45	P0.23	DIO	GPIO P0.23
46	P0.22	DIO	GPIO P0.22
47	P1.00/TRACEDATA0	DIO	GPIO P1.00 / Trace Buffer Data[0]
48	P0.24	DIO	GPIO P0.24
49	P0.25	DIO	GPIO P0.25
50	P1.02	DIO	GPIO P1.02 (Std. Drive/Low Freq. IO only)
51	SWDIO	DIO	Serial Wire Debug I/O
52	P0.09 / NFC1	DIO / AI	GPIO P0.09 (Std. Drive/Low Freq. IO only) / NFC Antenna Input 1
53	SWDCLK	DIO	Serial Wire Debug Clock
54	P0.10 / NFC2	DIO / AI	GPIO P0.10 (Std. Drive/Low Freq. IO only) / NFC Antenna Input 2
55	GND	G	Ground
56	P1.04	DIO	GPIO P1.04 (Std. Drive/Low Freq. IO only)
57	P1.06	DIO	GPIO P1.06 (Std. Drive/Low Freq. IO only)
58	P1.07	DIO	GPIO P1.07 (Std. Drive/Low Freq. IO only)
59	P1.05	DIO	GPIO P1.05 (Std. Drive/Low Freq. IO only)
60	P1.03	DIO	GPIO P1.03 (Std. Drive/Low Freq. IO only)
61	P1.01	DIO	GPIO P1.01 (Std. Drive/Low Freq. IO only)

6. Dimensions

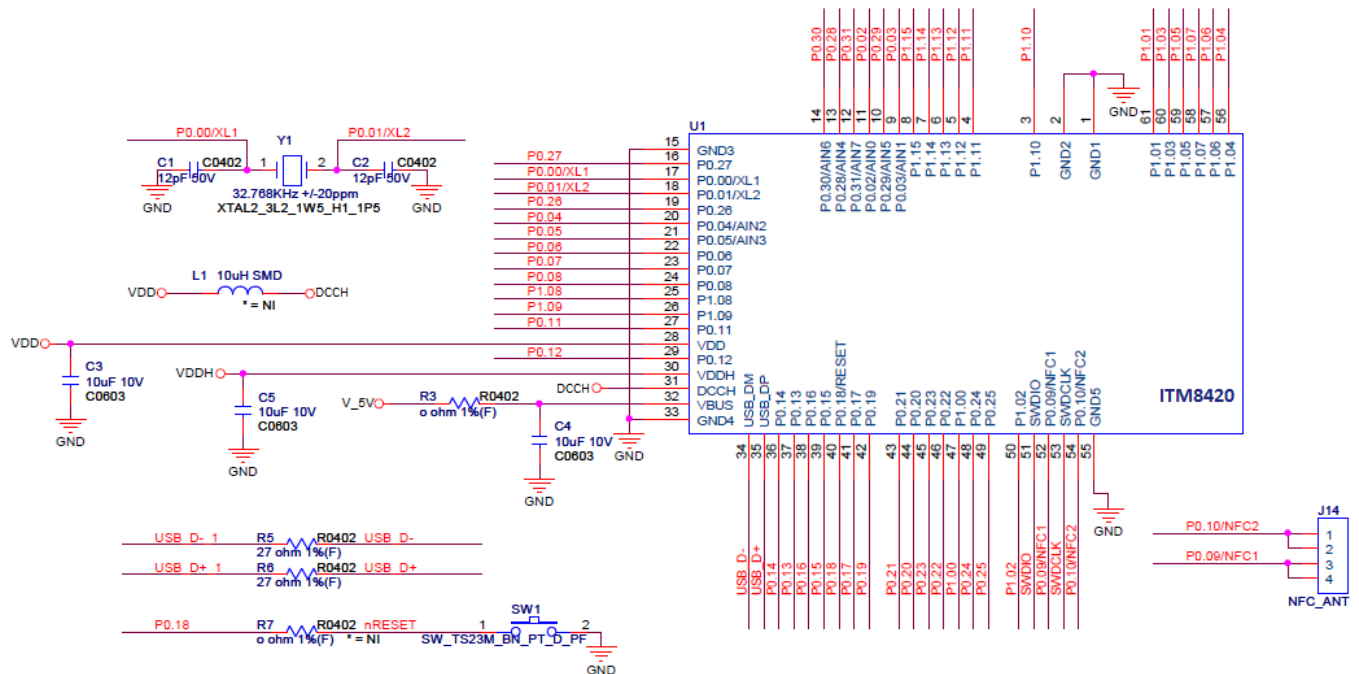
6.1 Layout Recommendation

(Unit: mm)

< TOP VIEW >



7. Reference Design



Power Mode

- Supply power voltage lower than 3.6V (power from VDD)
 - L1=NC (REG0 Disabled)
- Supply power voltage higher than or equal to 3.6V (power from VDDH)
 - L1=10uH (REG0 = Enabled, DC/DC Mode)
 - L1=NC (REG0 = Enabled, LDO Mode)

USB Function

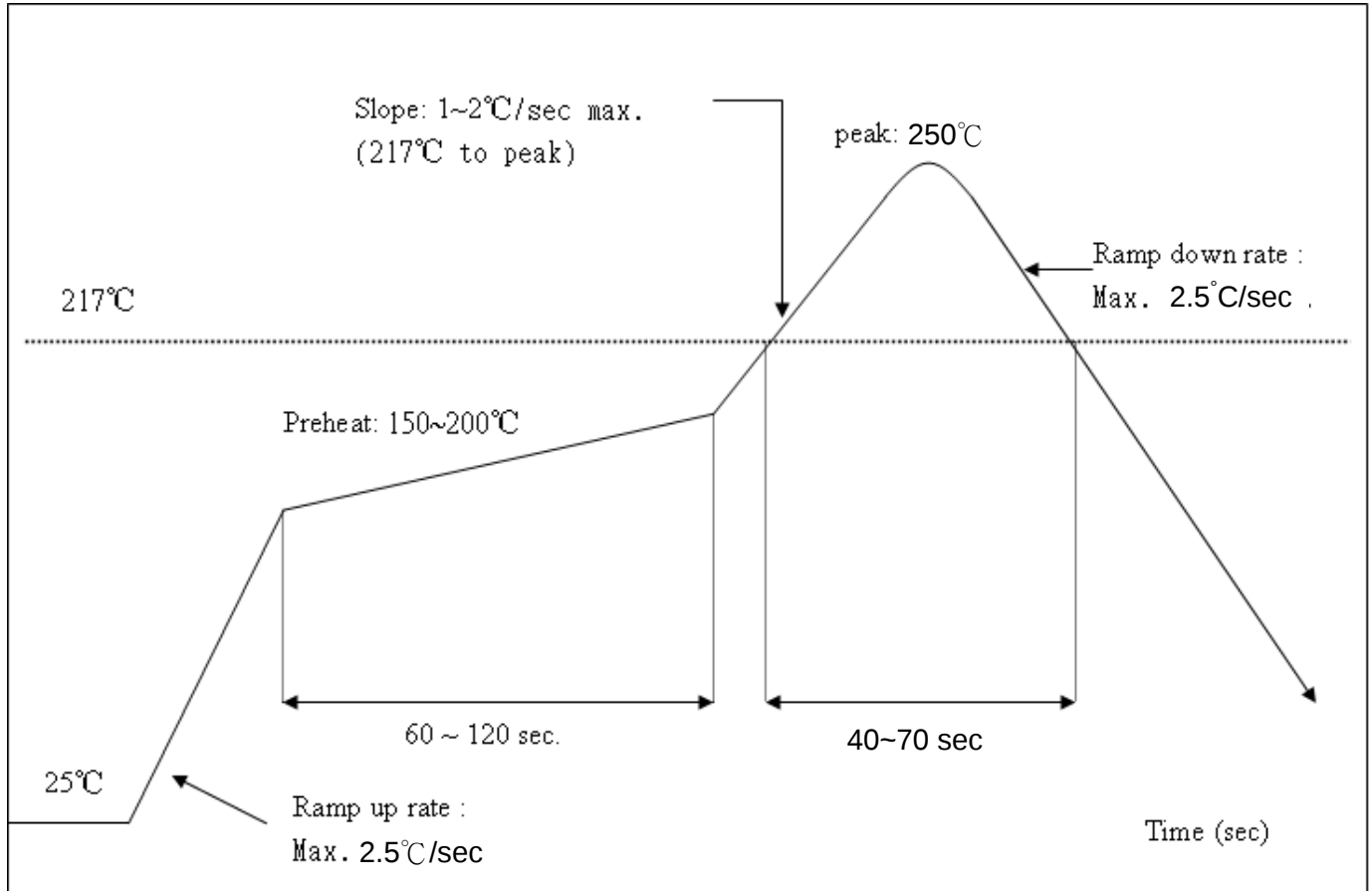
- Enable: VBUS =5V
- Disable: VBUS=GND

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 This bag contains MOISTURE-SENSITIVE DEVICES	LEVEL 3
	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: <u>250</u> °C If 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: <u>168</u> hours of factory conditions If blank, see adjacent bar code label 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: _____ If blank, see adjacent bar code label Note: Level and body temperature defined by IPC/JEDEC J-STD-020		

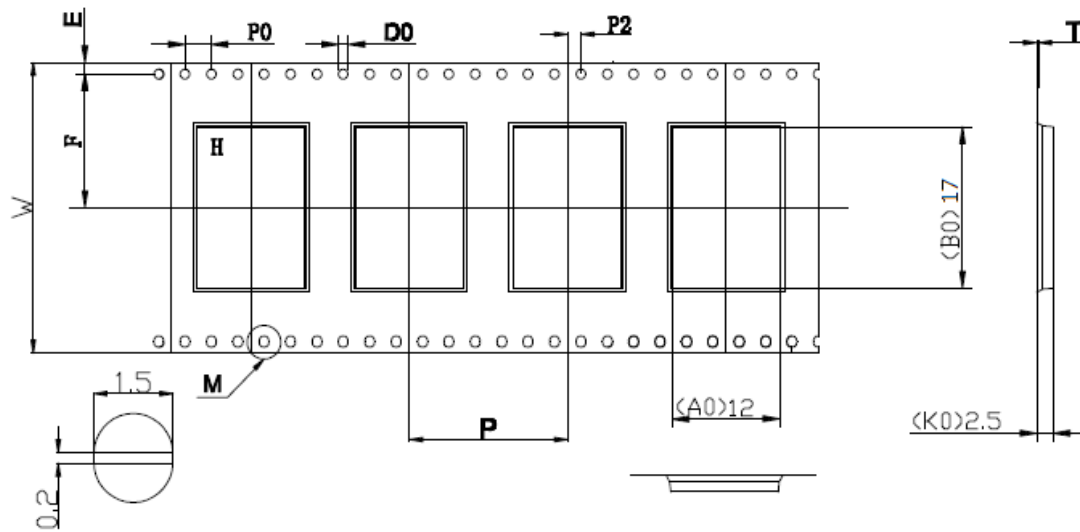
Label C → Inner box label .

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	12.0±0.10	17.0±0.10	2.50±0.10	3.00±0.10	17.0±0.10	2.00±0.10
Symbol	W	T	E	F	DO	
Spec	44.0±0.30	0.30±0.05	1.75±0.10	20.2±0.10	1.50±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 ± 0.05 mm.
6. Packing length per 22" reel : 98.5 Meters.(1:3)
7. Component load per 13" reel : 1500 pcs.

