TX-M2541 Datasheet

Zigbee + BLE5.0 Combo Module

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Revision History

Revision	Date	Description
0.1	2022.04.08	Initial release
0.2	2022.08.11	1.Add Module internal PCB antenna specification 2.Modify USB
0.3	2022.08.22	Add Coordinate in Physical Dimensions
1.0	2022.12.16	Modify Packing Information

Table of Contents

1. Scope

The TX-M2541 is Bluetooth LE + IEEE802.15.4 multi-standard wireless solution with internal Flash and audio support, which combines the features and functions needed for all 2.4GHz IoT standards into a module. The TX-M2541 combines the radio frequency (RF), digital processing, protocols stack software and profiles for multiple standards into a module. The module supports standards and industrial alliance specifications including Bluetooth Low Energy (up to Bluetooth 5), BLE Mesh, 6LoWPAN, Zigbee, RF4CE, HomeKit and 2.4GHz proprietary standard.

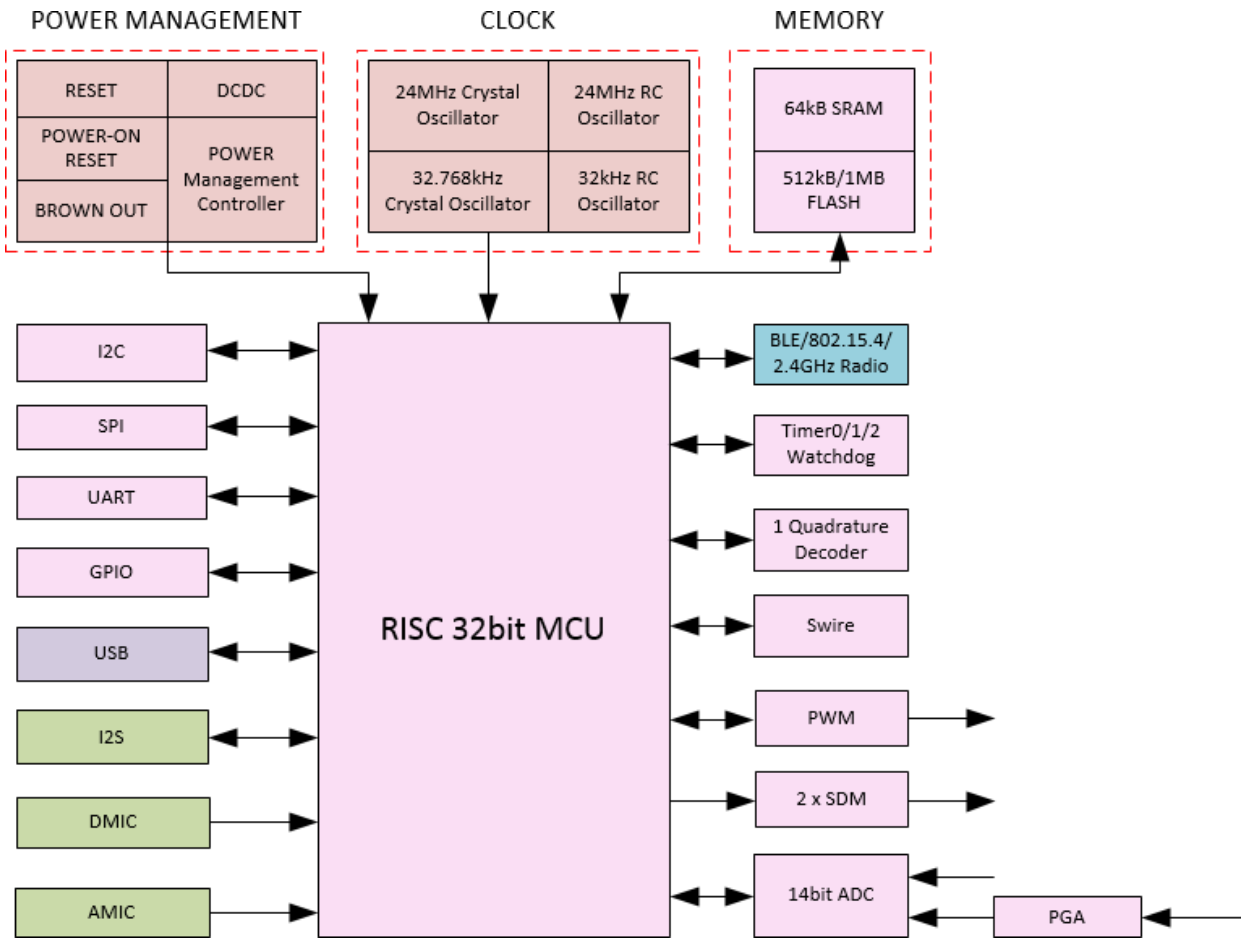
Application :

- Smartphone and tablet accessories
- RF Remote control
- Sports and fitness tracking
- Wearable devices

2. Features

- Embedded32-bit high performance MCU with clock up to 48MHz.
- Program memory: internal 512KB/1M Flash
- Data memory: 64KB on-chip SRAM.
- 24MHz & 32.768KHz Crystal and 32KHz/24MHz embedded RC oscillator.
- Up to +10dBm TX power.
- RX sensitivity: -96 dBm @ BLE 1 Mbps, -99.5 dBm @ IEEE 802.15.4 250 kbps mode
- Up to 16 GPIOs
- DMIC (Digital Mic).
- AMIC (Analog Mic)
- Stereo audio output.
- UART with hardware flow control
- SPI/ I2C/ I2S/ Debug Interface.
- Up to 6 channels of PWM, 1-channel IR.
- Sensor: 14-bit 10-channel (only GPIO input) SAR ADC, with 4-channel differential input PGA/Temperature sensor.
- One quadrature decoder.
- Embedded hardware AES.

3. Block Diagram

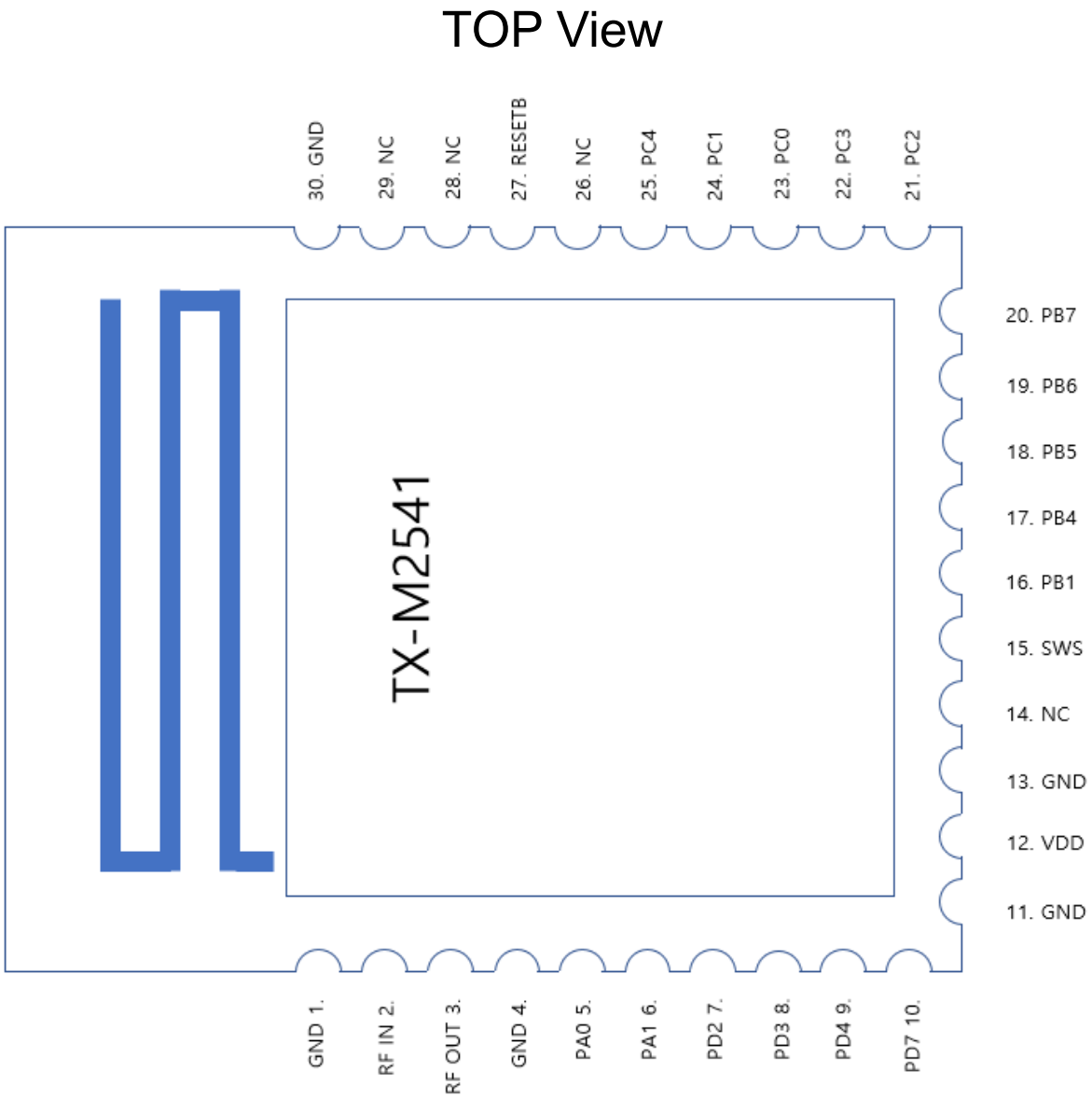


4. Product Information

4.1 Temperature Information

- Operating temperature	-40℃ ~ +85℃
- Storage temperature	-40℃ ~ +125℃

5. Pin Description



Pin	Name	Type	Description
1	GND	GND	Ground
2	RF IN	RF_IN	RF input
3	RF OUT	RF_OUT	RF output
4	GND	GND	Ground
5	PA0	I/O	DMIC data input / PWM0 inverting output / UART_RX / GPIO PA[0]
6	PA1	I/O	DMIC clock / UART7816 clock / I2S clock / GPIO PA[1]
7	PD2	I/O	SPI chip select (Active low) / I2S left right channel select / PWM3 output / GPIO PD[2] /
8	PD3	I/O	PWM1 inverting output / I2S serial data input / UART7816TRX (UART_TX) / GPIO PD[3]
9	PD4	I/O	Single wire master / I2S serial data output / PWM2 inverting output / GPIO PD[4]
10	PD7	I/O	SPI clock(I2C_SCK) / I2S bit clock / UART7816 TRX (UART_TX) / GPIO PD[7]
11	GND	GND	Ground
12	VDD	Vdd	3.3V Power Supply
13	GND	GND	Ground
14	NC	NC	Not Connect
15	SWS	SWS	Single Wire Slave
16	PB1	I/O	PWM4 output / UART_TX / Antenna select pin2 / Low power comparator input / SAR ADC input / GPIO PB[1]
17	PB4	I/O	SDM positive output 0 / PWM4 output / Low power comparator input/ SAR ADC input / GPIO PB[4]
18	PB5	I/O	SDM negative output 0 / PWM5 output / Low power comparator Input / SAR ADC input / GPIO PB[5]
19	PB6	I/O	SDM positive output 1 / SPI data input(I2C_SDA) / UART_RTS / Low power comparator input / SAR ADC input / GPIO PB[6]
20	PB7	I/O	SDM negative output 1 / SPI data output / UART_RX / Low power Comparator input / SAR ADC input / GPIO PB[7]
21	PC2	I/O	PWM0 output / UART 7816 TRX(UART_TX) / I2C serial data / 32KHz crystal output / PGA right channel positive input / GPIO PC[2]
22	PC3	I/O	PWM1 output / UART_RX/I2C serial clock / 32KHz crystal input / PGA right channel negative input / GPIO PC[3]
23	PC0	I/O	I2C serial data / PWM4 inverting output / UART_RTS / PGA left channel positive input / GPIO PC[0] t
24	PC1	I/O	I2C serial clock / PWM1 inverting output / PMW0 output / PGA left channel negative input / GPIO PC[1]

25	PC4	I/O	PWM2 output / UART_CTS / PWM0 inverting output / SAR ADC input / GPIO PC[4]
26	NC	NC	Not Connect
27	RESETB	Reset	Power on reset, Active low
28	NC	NC	Not Connect
29	NC	NC	Not Connect
30	GND	GND	Ground

6. Electrical Specification

6.1 Absolute Maximum Rating

Item	Min	Max	Unit
Supply Voltage	-0.3	3.6	V
Voltage on input Pin	-0.3	VDD+0.3	V
Output Voltage	0	VDD	V
Storage temperature Range	-65	150	℃

CAUTION: Stresses above those listed in “Absolute Maximum Ratings” may cause permanent damage to the device. This is a stress only rating and operation of the device at these or any other conditions above those indicated in the operational sections of this specification is not implied.

6.2 Recommended Operating condition

Item	Min	Typ	Max	unit	Condition
Power Supply Voltage	1.8	3.3	3.6	V	
Supply rise time (from 1.6V to 2.8V)			10	ms	
Operating temperature range		-40	85	℃	

6.3 Current Consumption

Item	Min	Typ	Max	unit	Condition
Tx	-	4.8	-	mA	Whole chip @ 0 dBm with DCDC
Rx	-	5.3	-	mA	Whole chip
Deep sleep with 8 KB SRAM retention	-	1.0	3.1	uA	Without 32K
Deep sleep with 16 KB SRAM retention	-	1.2	3.3	uA	
Deep sleep with 32KB SRAM retention	-	1.4	3.5	uA	
Deep sleep without SRAM retention	-	0.4	-	uA	

6.4 AC characteristics

6.4.1 Digital inputs/outputs

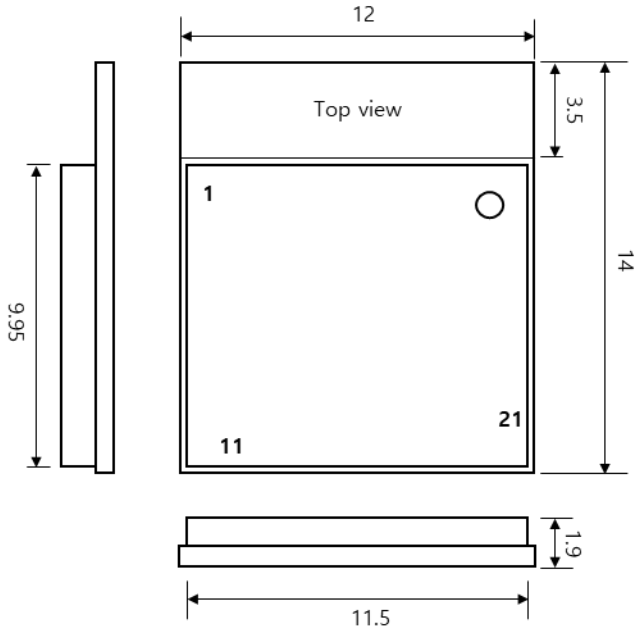
Item	Min	Typ	Max	unit	Condition
Input high voltage	0.7VDD	-	VDD	V	
Input low voltage	VSS	-	0.3VDD	V	
Output high voltage	0.9VDD	-	VDD	V	
Output low voltage	VSS	-	0.1VDD	V	

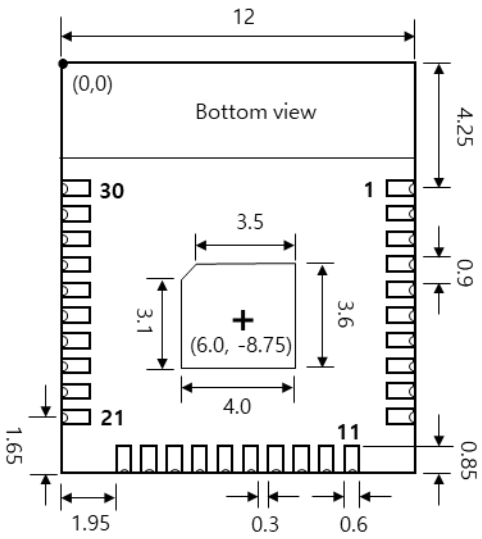
7. RF Specification

Nomal Condition : T=25℃, VDD=3.3V

Item		Min	Typ	Max	unit	Condition
RF frequency range		2380		2500	MHz	Programmable in 1MHz step
Data rate		BLE/2.4G proprietary 1Mbps, ±250kHz deviation BLE/2.4G proprietary 2Mbps, ±500kHz deviation BLE 125kbps, ±250kHz deviation BLE 500kbps, ±250kHz deviation IEEE 802.15.4 250kbps, ±500kHz deviation 2.4G proprietary 500kbps, ±125kHz deviation 2.4G proprietary 250kbps, ±62.5kHz deviation				
BLE 1Mbps RF_Rx Performance (±250kHz Deviation)						
Sensitivity	1Mbps		-96		dBm	
Frequency offset tolerance		-250		+300	kHz	
Co-channel rejection			11		dB	Wanted signal at -67dBm
In-band blocking rejection (equal modulation interference)	+1/-1MHz offset		-1/-3		dB	Wanted signal at -67dBm
	+2/-2MHz offset		-37/-39		dB	
	≥3MHz offset		-42		dB	
Image rejection			-37		dB	Wanted signal at -67dBm
BLE 1Mbps RF_Tx Performance						
Output power, maximum setting			10	12	dBm	
Output power, minimum setting			-45		dBm	
Programmable output power range		55			dB	
Modulation 20dB bandwidth			1.4		MHz	
IEEE 802.15.4 250kbps RF_Rx Performance (±500kHz Deviation)						
Sensitivity	250kbps		-99.5		dBm	
Frequency offset tolerance		-300		+300	kHz	
Adjacent channel rejection (-1/+1 channel)			-42/-42		dB	Wanted signal at -82dBm
Adjacent channel rejection (-2/+2 channel)			-42/-42		dB	Wanted signal at -82dBm
IEEE 802.15.4 250kbps RF_Tx Performance						
Output power, maximum setting			10	12	dBm	
Output power, minimum setting (resolution)			-45		dBm	
Programmable output power range		55			dB	
Modulation 20dB bandwidth			2.7		MHz	
Error vector magnitude (EVM)				2	%	Max(10dBm) power output

8. Physical Dimensions (Unit : mm)



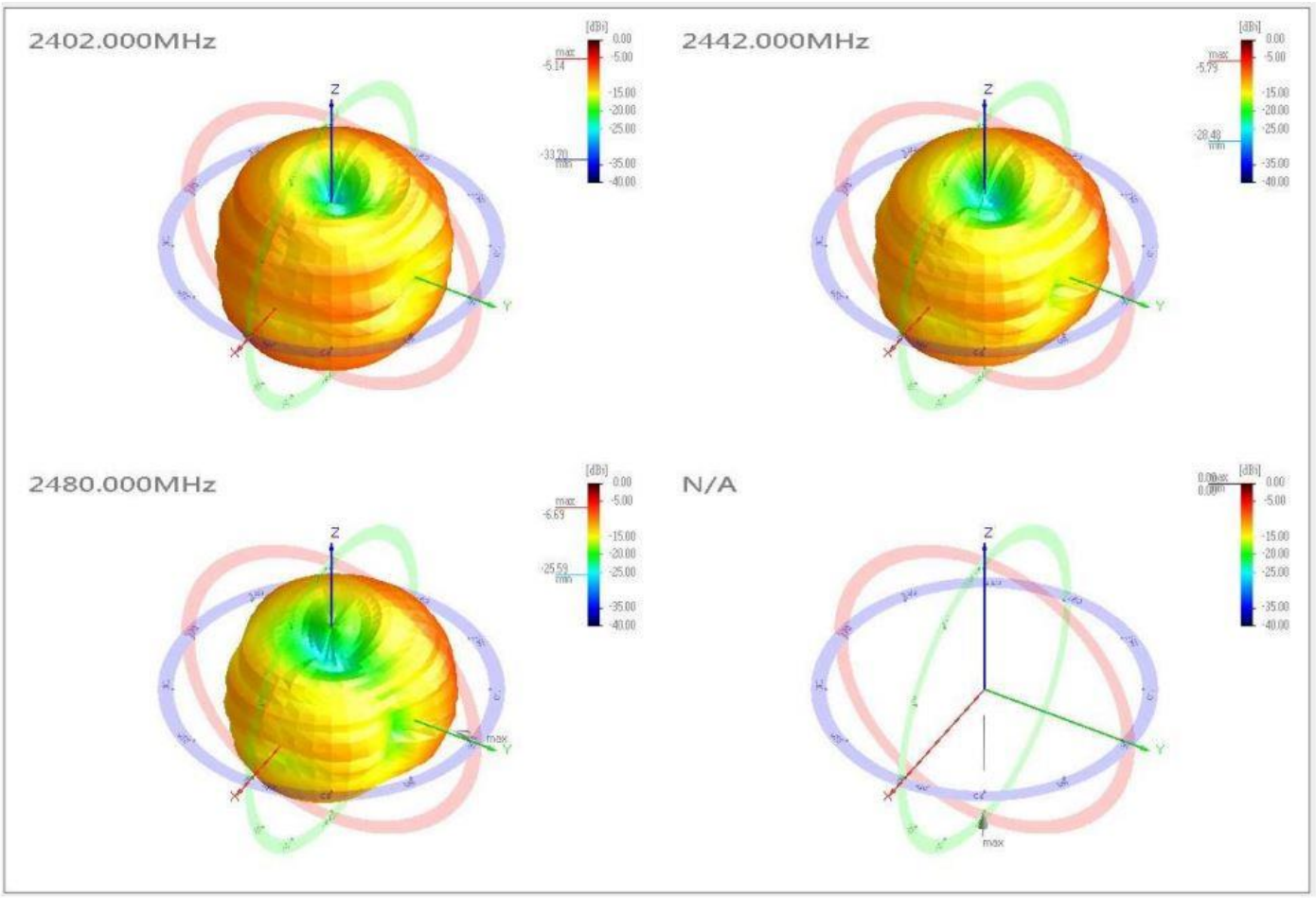


9. Module Internal PCB Antenna Specification

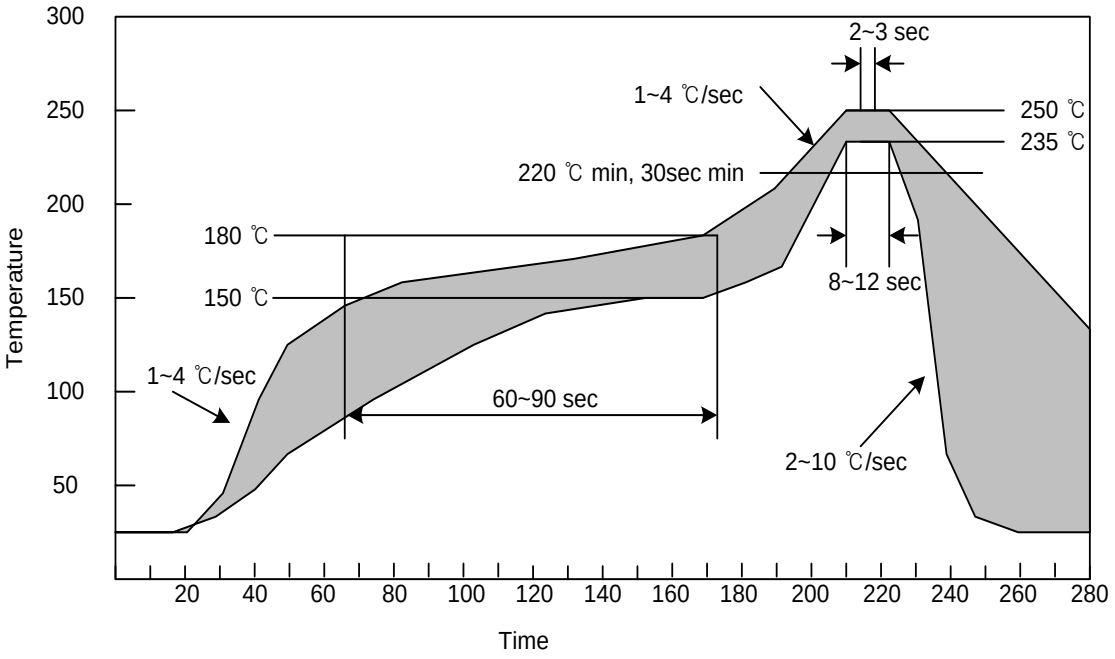
9.1 Antenna 2D Radiation Pattern

		PwrSum					H(θ=90)				E1(φ=0)				E2(φ=90)			
No.	Freq.	Eff.[%]	Avg.[dBi]	Peak[dBi]	θ[deg]	φ[deg]	Avg.[dBi]	Peak[dBi]	φ[deg]	BW[deg]	Avg.[dBi]	Peak[dBi]	θ[deg]	BW[deg]	Avg.[dBi]	Peak[dBi]	θ[deg]	BW[deg]
1	2402.000	9.44	-10.25	-5.14	-135.00	50.00	-10.61	-8.69	130.00	145.51	-10.87	-6.29	-145.00	37.35	-12.76	-8.05	-135.00	32.09
2	2442.000	8.64	-10.63	-5.79	-135.00	50.00	-10.66	-7.91	130.00	144.00	-11.20	-6.91	-145.00	45.63	-13.51	-8.90	-135.00	31.85
3	2480.000	7.18	-11.44	-6.69	125.00	140.00	-11.19	-7.87	130.00	142.93	-12.14	-8.29	-145.00	115.39	-14.49	-10.26	-135.00	34.61

9.2 Antenna 3D Radiation Pattern



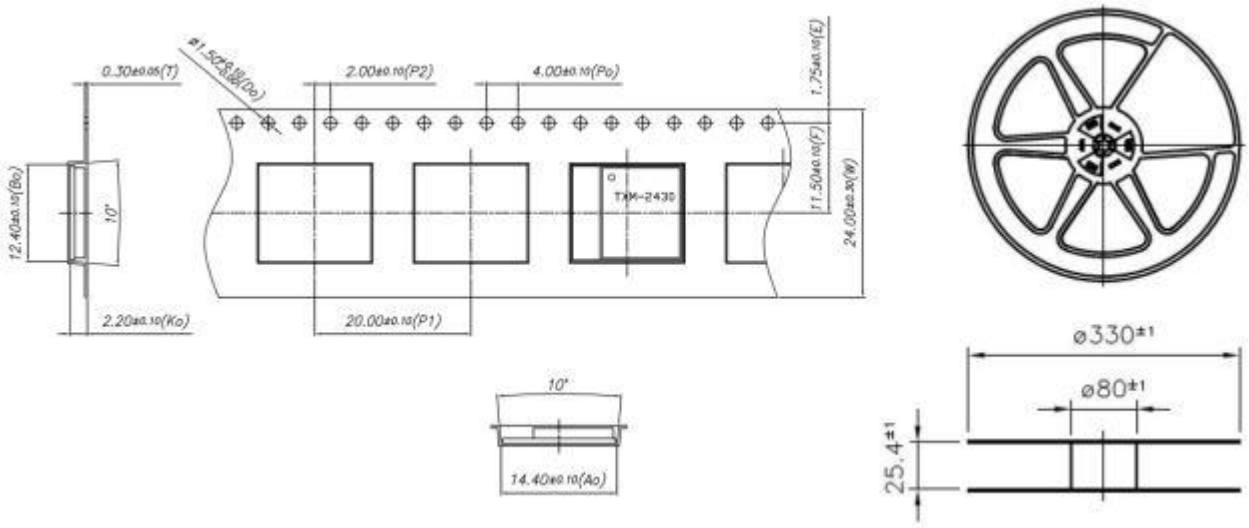
10. SMT Temperature Sequence (Pb-free)



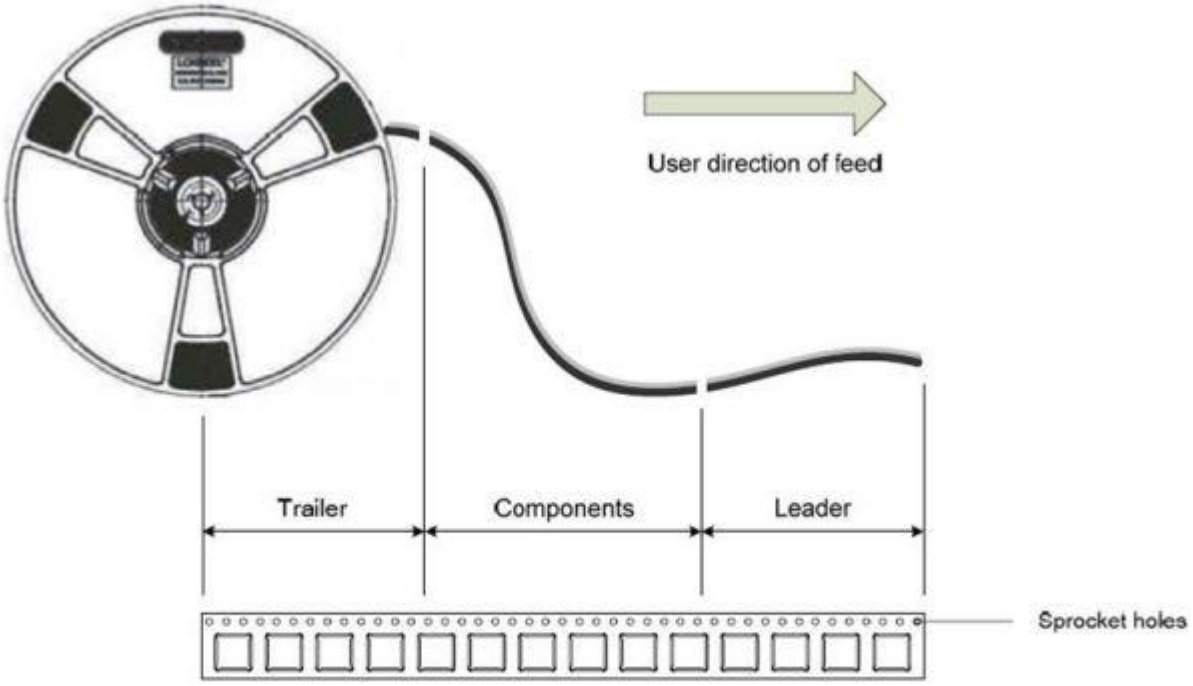
Process	Parmeter	Data
Reflow Profile	Conveyer Speed	min 0.8m/min max 0.95m/min
	O2 농도	3000 ppm以下
	Pre-Heating	150~180℃[60~90sec]
	Heating	220℃[30~60sec]
	Peak	235~250℃

11. Packing Information

11.1 Carrier Tape and Reel Information



11.2 Leader and Trailer length



Leader (Empty carrier tape)	Components	Trailer (Empty carrier tape)	Reel / Hub size (mm)
Min. 500mm	1,400 pcs / Reel	Min. 500mm	330 / 25.4