# TX-M2542 Datasheet

## Zigbee + BLE5.0 Combo Module

# Notice

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# Revision History

| Revision | Date | Description |
|---|---|---|
| 0.1 | 2022.08.29 | Initial release |
| 1.0 | 2022.12.16 | Modify Packing Information |
| 1.1 | 2023.06.28 | Modify Pin2 |

# Table of Contents

# 1. Scope

The TX-M2542 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-M2542 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.

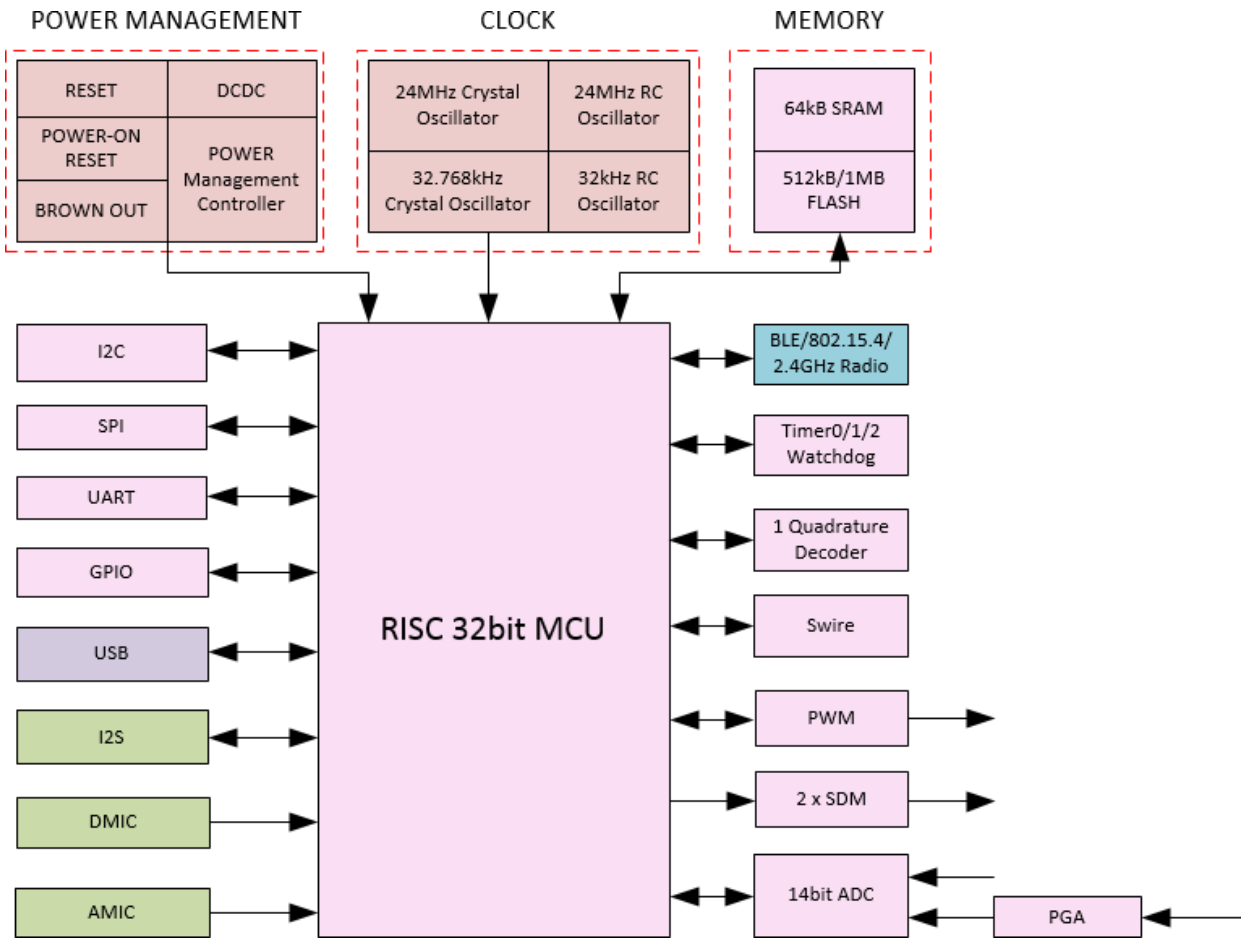
Application :

- 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

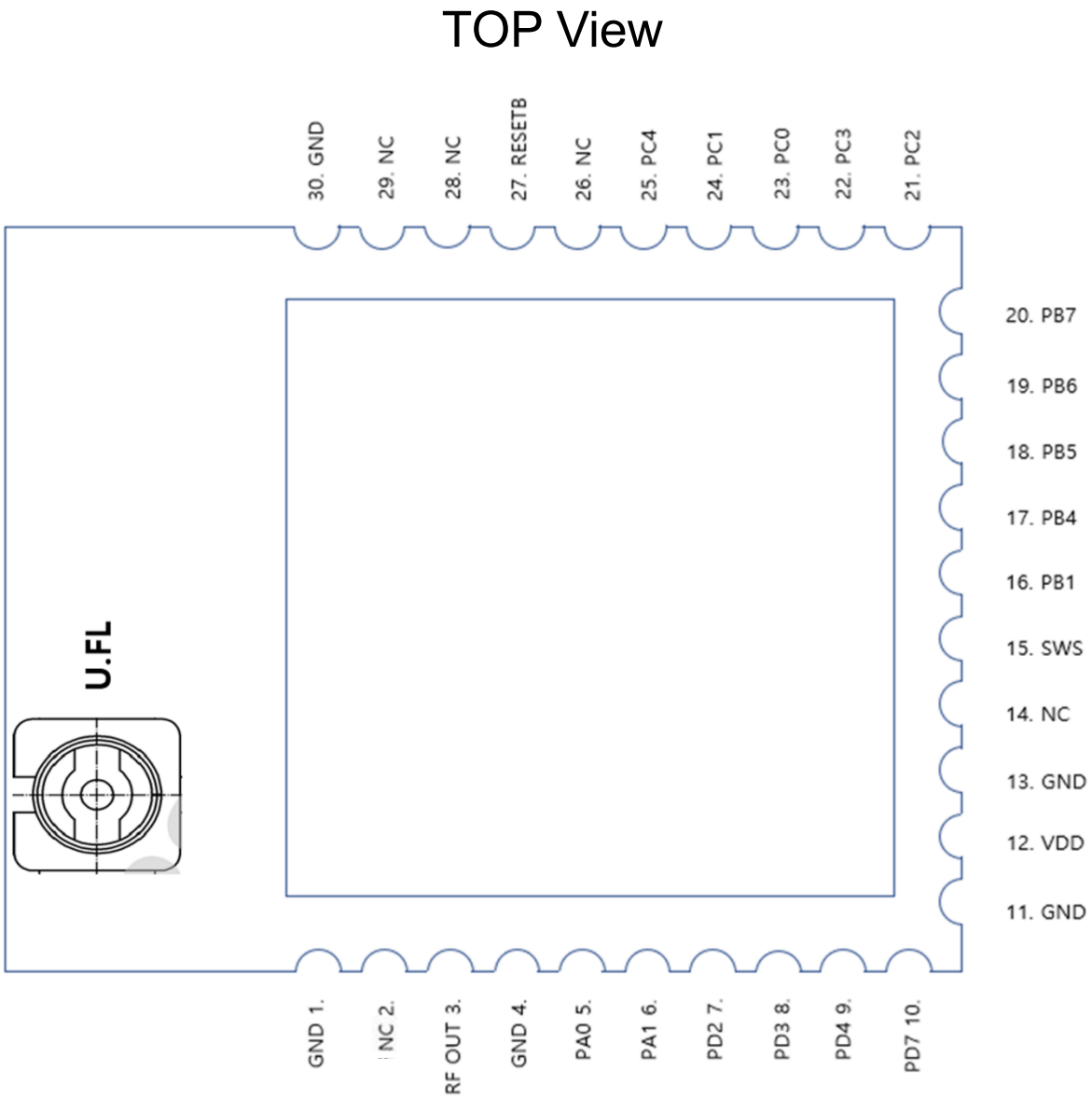


# 4. Product Information

## 4.1 Temperature Information

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

# 5. Pin Description



| Pin | Name | Type | Description |
|---|---|---|---|
| 1 | GND | GND | Ground |
| 2 | NC | NC | Not Connect |
| 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

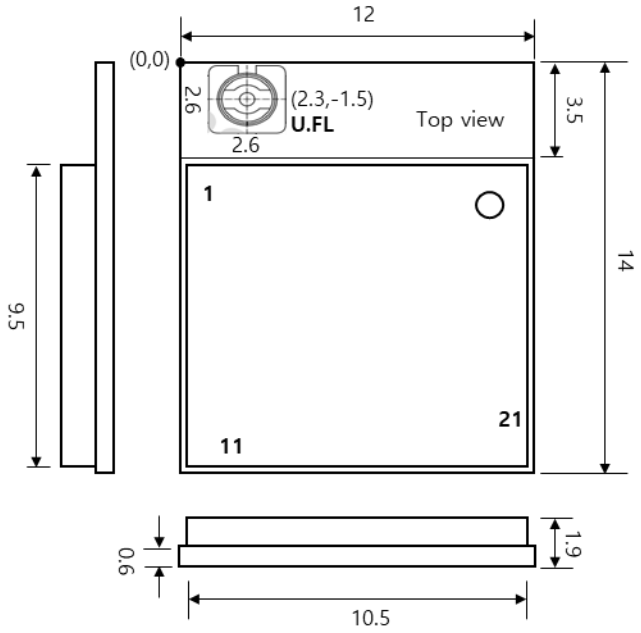
| Item | Min | Typ | Max | unit | Condition |
|---|---|---|---|---|---|
| Input high voltage | 0.7VDD | - | VDD | V | |
| Input low voltage | VSS | - | 0.3VDD | V | |
| Output high voltage | 0.9VDD | - | VDD | V | |
| Output low voltage | VSS | - | 0.1VDD | V | |

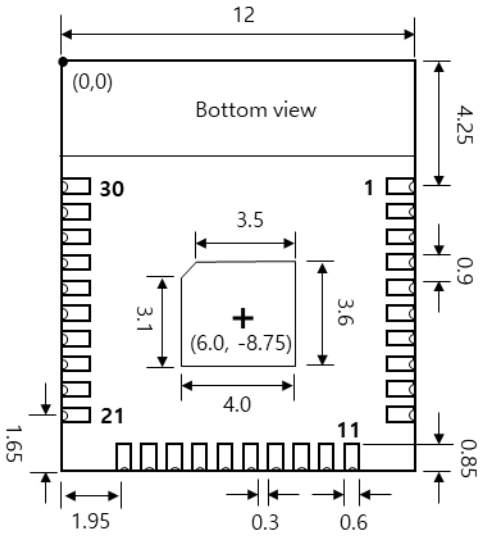
# 7. RF Specification

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<br>BLE/2.4G proprietary 2Mbps, ±500kHz deviation<br>BLE 125kbps, ±250kHz deviation<br>BLE 500kbps, ±250kHz deviation<br>IEEE 802.15.4 250kbps, ±500kHz deviation<br>2.4G proprietary 500kbps, ±125kHz deviation<br>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)



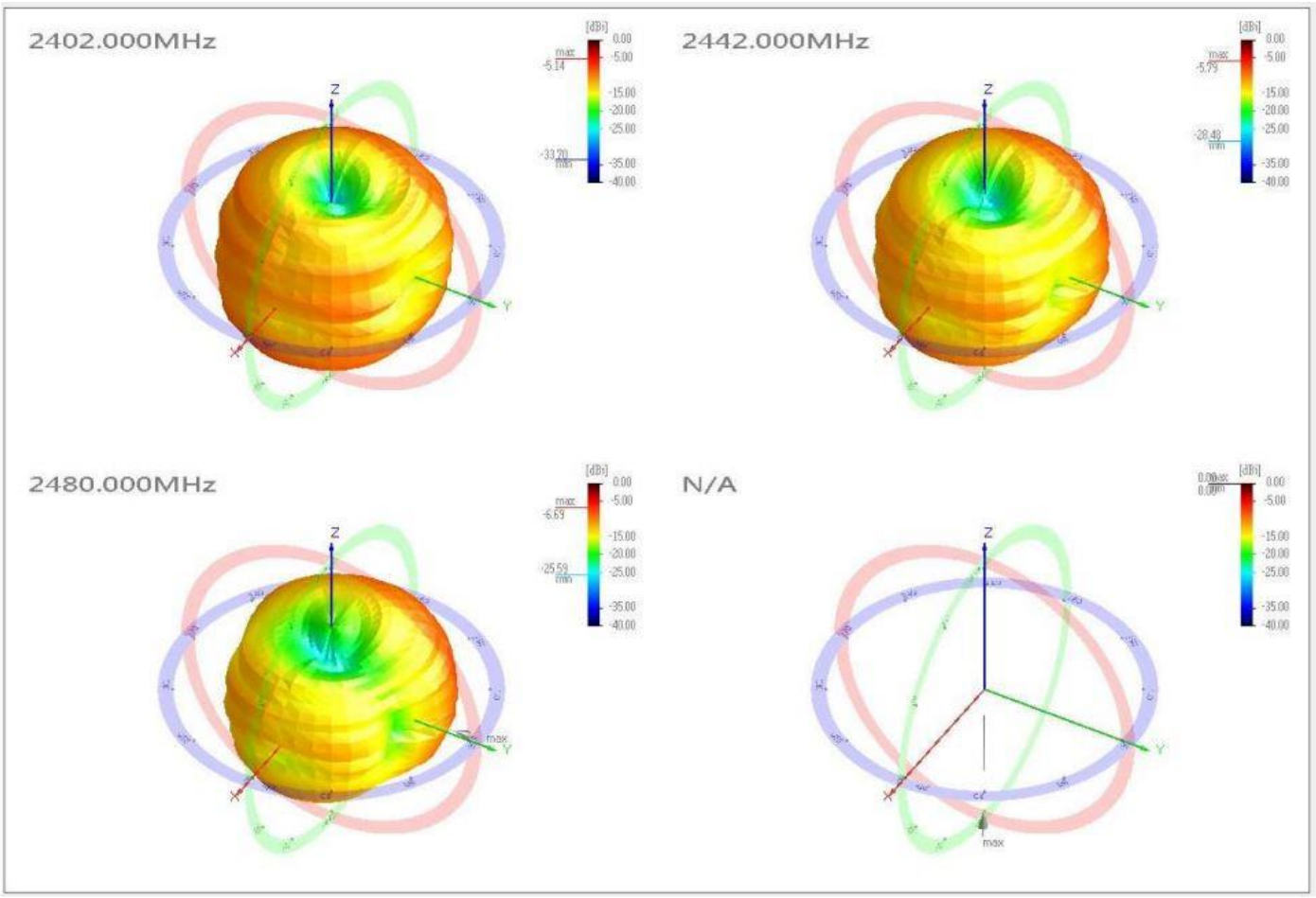



# 9. Module Internal PCB Antenna Specification

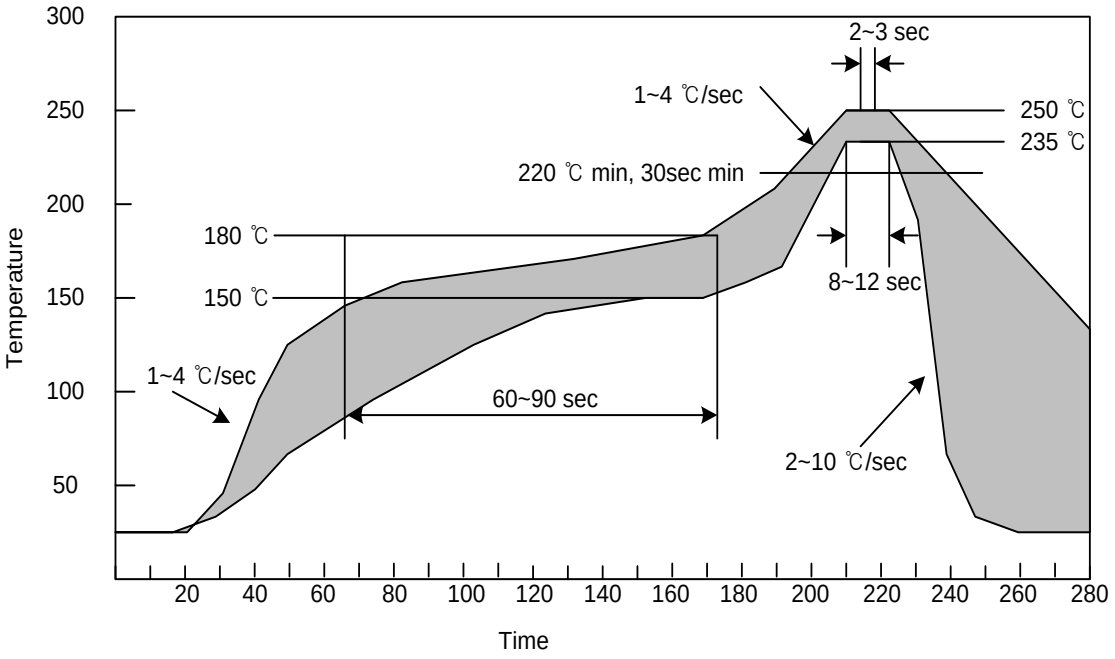
## 9.1 Antenna 2D Radiation Pattern

| | | 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



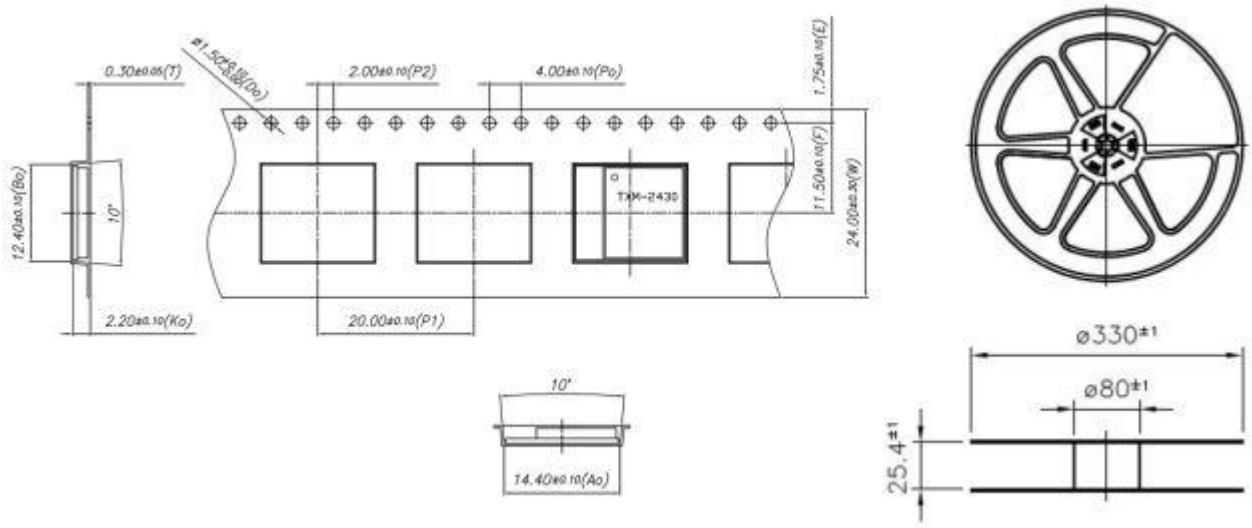
# 10. SMT Temperature Sequence (Pb-free)



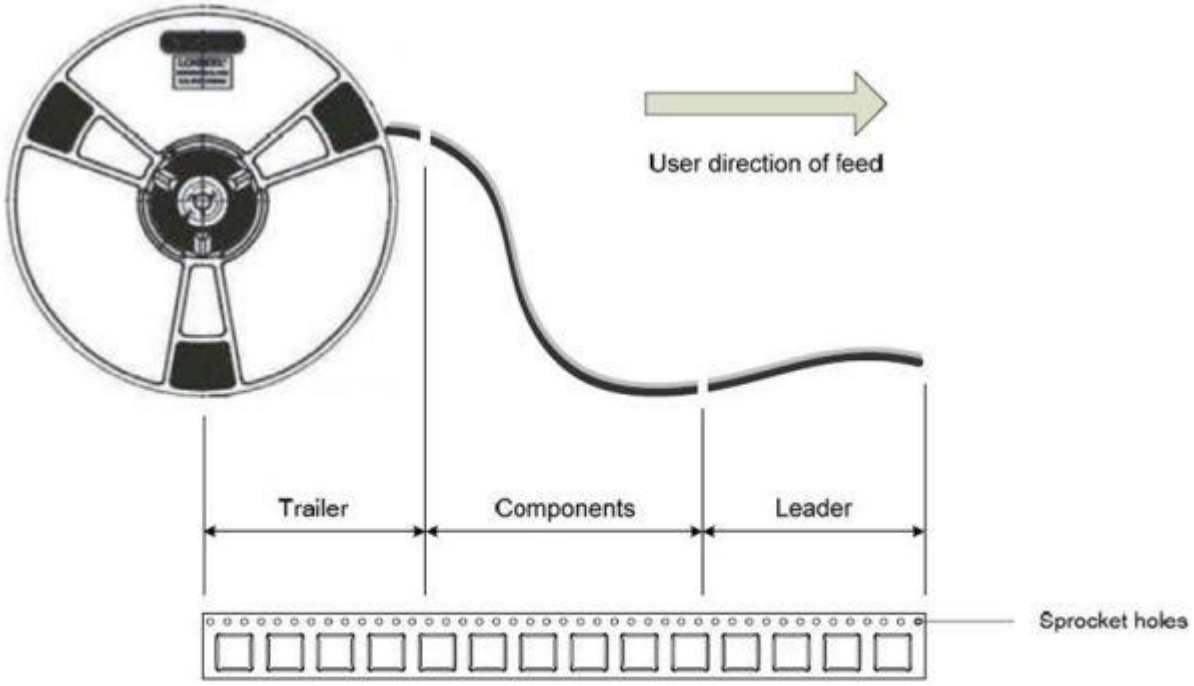

| Process | Parmeter | Data |
|---|---|---|
| Reflow Profile | Conveyer Speed | min 0.8m/min max 0.95m/min |
| | O2 농도 | 3000 ppm以下 |
| | Pre-Heating | 150~180℃[60~90sec] |
| | Heating | 220℃[30~60sec] |
| | Peak | 235~250℃ |

# 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 |