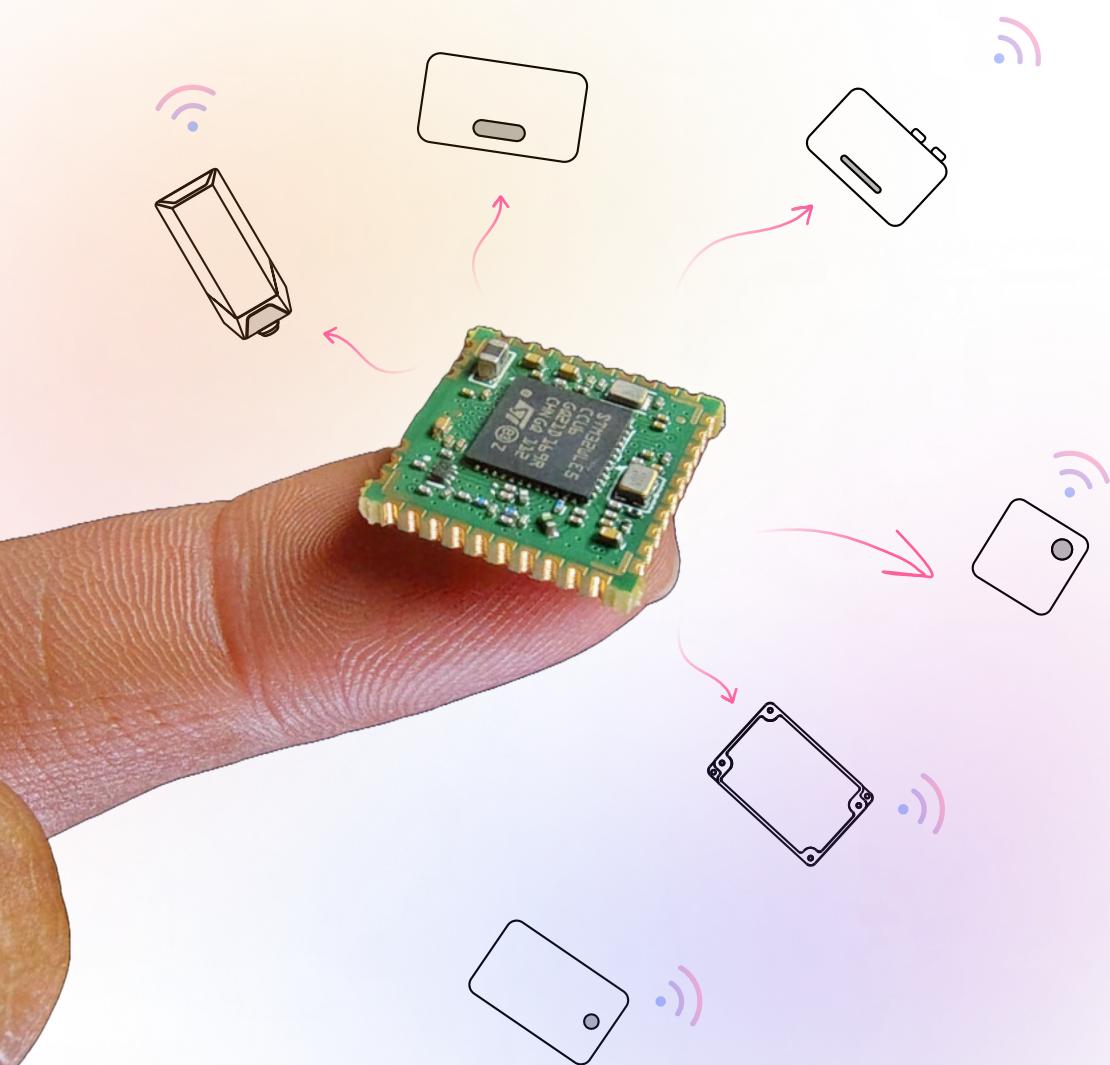


# LoRa Module

## Empowering Your Devices to Speak Wirelessly

MAC32WLE5

Datasheet V 2.02



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# Document Version History

## Version 1.2 - Feature update

Release date	28 November , 2024
Created by	Mr.Dnyaneshwar , Mr.Prabhu Patel
Description	<ul style="list-style-type: none"><li>Added updated reflow and recommendation diagram</li><li>Added pcb layout recommendations</li></ul>

## Version 1.1- Feature update

Release date	23 Oct , 2024
Created by	Mr.Dnyaneshwar , Mr.Prabhu Patel
Description	<ul style="list-style-type: none"><li>Added updated Pinouts</li><li>Added updated SDK in features</li><li>Version 1 of the data sheet created</li></ul>

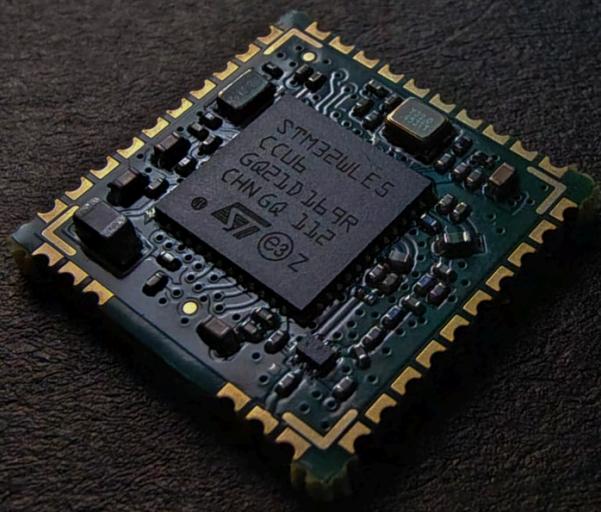
# MAC32WLE5 LoRa Module

The **MAC32WLE5** LoRa module by Macnman Technologies Pvt Ltd is a compact, ultra-low-power wireless communication solution built around the robust STM32WL Series microcontroller. Tailored for long-range, low-power IoT applications, this module is designed to simplify deployment while maximizing range and energy efficiency.

Powered by a high-performance sub-GHz radio transceiver and a built-in LoRaWAN protocol stack, the MAC32WLE5 delivers secure, reliable, and scalable connectivity across wide-area networks. Its flexible RF performance and minimal power consumption make it an ideal choice for battery-operated devices in remote or challenging environments.

From smart agriculture and utility metering to infrastructure monitoring and industrial automation, the MAC32WLE5 is engineered to help developers build future-ready IoT devices with ease, efficiency, and confidence.

## Features



-  **MCU**
-  **SDK**
-  **Dual Core\***
-  **5 Years\***
-  **LoRa**
-  **Rugged**
-  **Size**
-  **Ultra LP**

## Key Parameters

### LoRaWAN Protocol Support

Fully supports global license-free ISM bands, for different regions. (IN 865, EU 868 ,US 915, AU 915)

### LoRa Point-to-Point Communication

Seamless data transfer via LoRa P2P communication.

### RF Output Power

RF Output Power: Up to 22 dBm (approx 150 mW ) at 3.3V supply.

### High Sensitivity

With a sensitivity of -148 dBm, the module offers exceptional long-range connectivity in challenging environments.

### Extended Range

Capable of reliable communication over distances greater than 08 km, making it ideal for wide-area network applications.

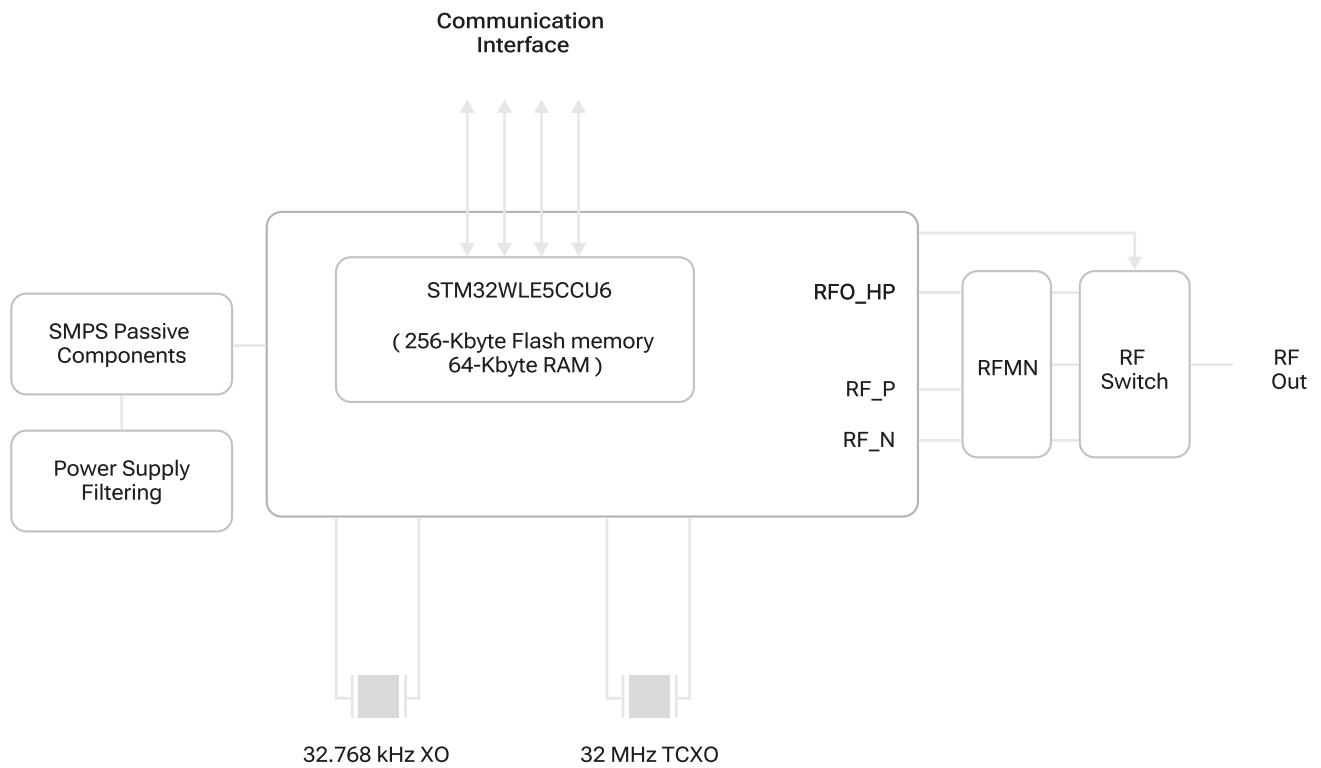
### Ultra-Low Power Consumption

Ultra-low power consumption: < 3  $\mu$ A in sleep mode, ideal for battery-powered applications.

### Versatile Modulation

Supports LoRa, FSK, GFSK, and OOK modulations, allowing for bidirectional 2-way communications.

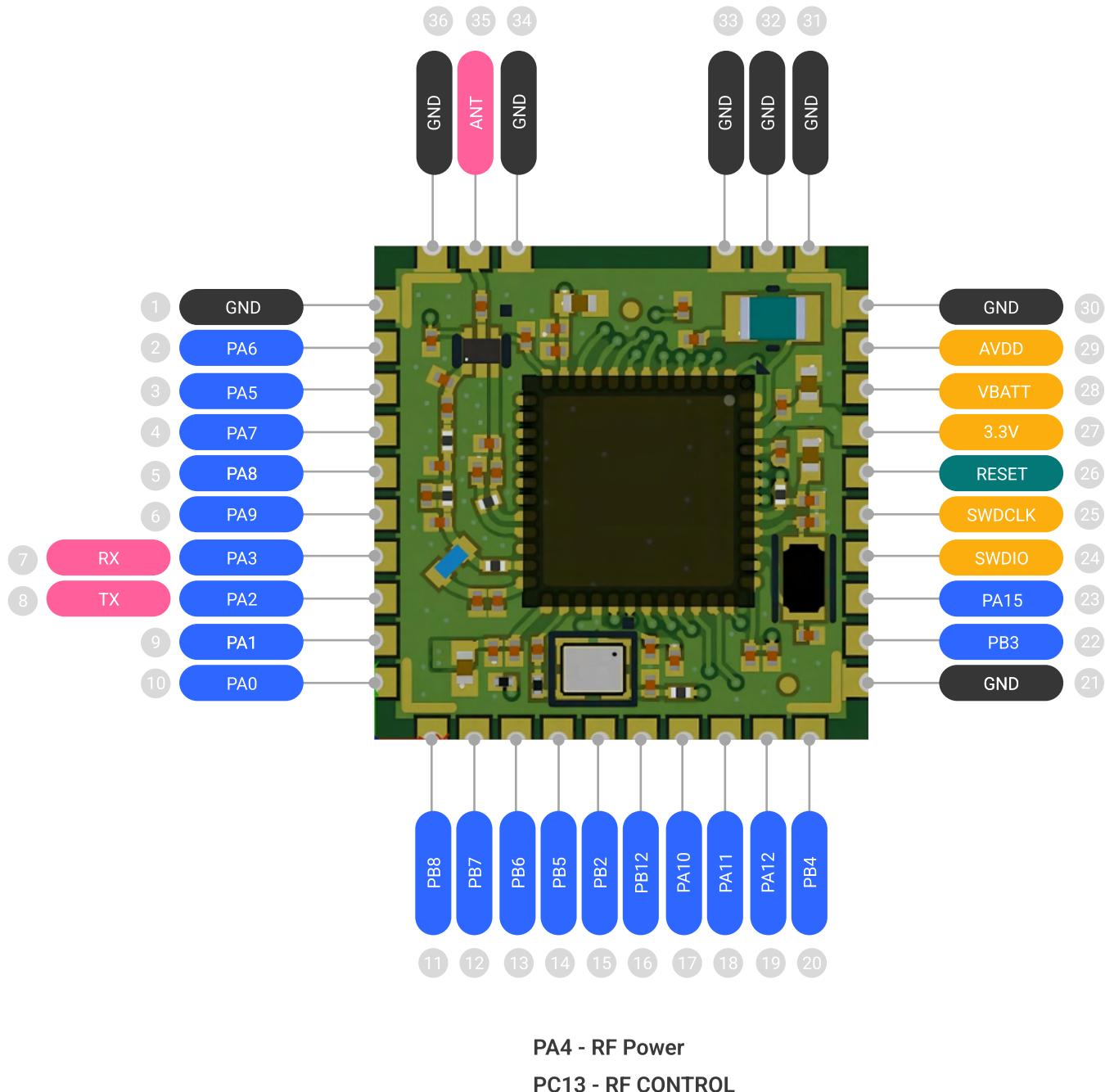
# Block Diagram



# Specifications

SoC used	STM32WLE5CCU6
Core	ARM Cortex M4
Flash Size	256 kB
ADC	12 Bit
Max Clock	48 MHz
Number of I/O	21
DRAM	64 kB
Opearing Voltage	1.8V-3.6V
Temperature	-40c to +80c
Module Size	15 mm X 15 mm X 1.6 mm
Frequency Bands	863 MHz / 915 MHz (ISM Bands)
Output Power	Max ~ 22 dBm
Sensitivity	-148 dBm
Power Consumption	< 3 µA (Sleep Mode)
Supported Protocols	LoRa , LoRaWAN

# Pin Description



# Pin Definition

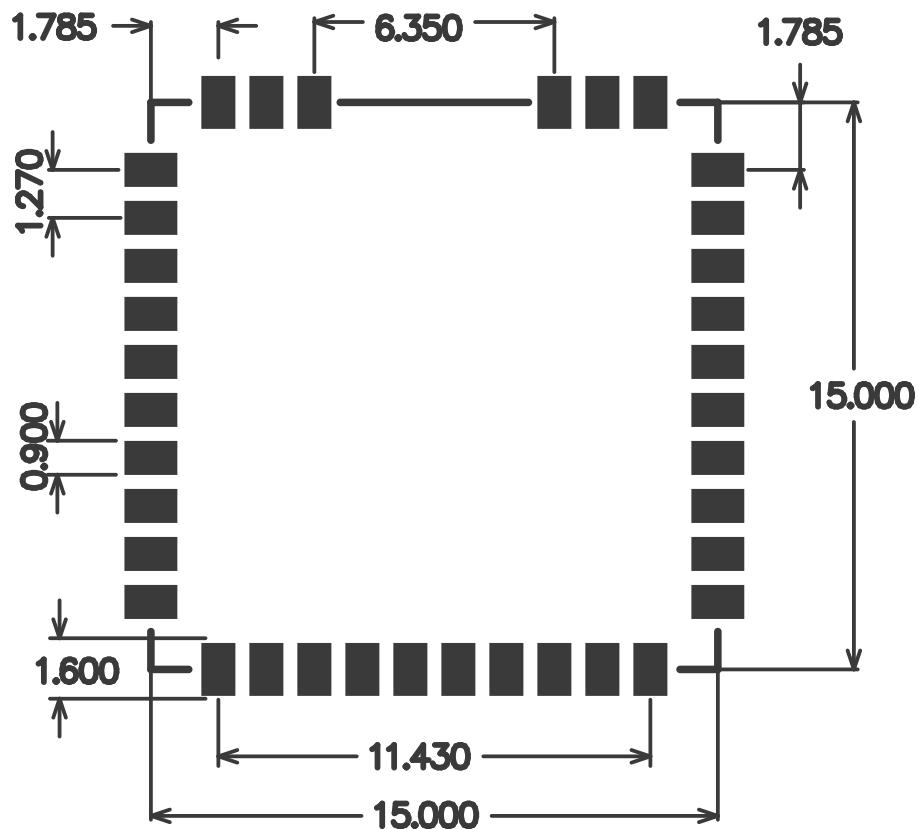
Pin No	Name	Type	Definition
1	VSS/GND	POWER	-
2	PA6	I/O	TIM1_BKIN, I2C2_SMBA, SPI1_MISO, LPUART1_CTS, DEBUG_SUBGHZSPI_MISOOUT, TIM16_CH1, CM4_EVENTOUT
3	PA5	Digital Input	TIM2_CH1, TIM2_ETR, SPI2_MISO, SPI1_SCK, DEBUG_SUBGHZSPI_SCKOUT, LPTIM2_ETR, CM4_EVENTOUT
4	PA7	Digital Input	TIM1_CH1N, I2C3_SCL, SPI1_MOSI, COMP2_OUT, DEBUG_SUBGHZSPI_MOSIOUT, TIM17_CH1, CM4_EVENTOUT
5	PA8	Digital Input	MCO, TIM1_CH1, SPI2_SCK/I2S2_CK, USART1_CK, LPTIM2_OUT, CM4_EVENTOUT
6	PA9	Digital Input	TIM1_CH2, SPI2 NSS/I2S2_WS, I2C1_SCL, SPI2_SCK/I2S2_CK, USART1_TX, CM4_EVENTOUT
7	PA3	Digital Input	TIM2_CH4, I2S2_MCK, USART2_RX, LPUART1_RX, CM4_EVENTOUT
8	PA2	Digital Input	LSCO, TIM2_CH3, USART2_TX, LPUART1_TX, COMP2_OUT, DEBUG_PWR_LDORDY, CM4_EVENTOUT
9	PA1	Digital Input	TIM2_CH2, LPTIM3_OUT, I2C1_SMBA, SPI1_SCK, USART2_RTS, LPUART1_RTS, DEBUG_PWR_REGLP2S, CM4_EVENTOUT

Pin No	Name	Type	Definition
10	PA0	I/O	TIM2_CH1, I2C3_SMBA, I2S_CKIN, USART2_CTS, COMP1_OUT, DEBUG_PWR_REGLP1S, TIM2_ETR, CM4_EVENTOUT
11	PB8	I/O	TIM1_CH2N, I2C1_SCL, RF_IRQ2, TIM16_CH1, CM4_EVENTOUT
12	PB7	I/O	LPTIM1_IN2, TIM1_BKIN, I2C1_SDA, USART1_RX, TIM17_CH1N, CM4_EVENTOUT
13	PB6	I/O	LPTIM1_ETR, I2C1_SCL, USART1_TX, TIM16_CH1N, CM4_EVENTOUT
14	PB5	I/O	LPTIM1_IN1, I2C1_SMBA, SPI1_MOSI, RF_IRQ1, USART1_CK, COMP2_OUT, TIM16_BKIN, CM4_EVENTOUT
15	PB2	I/O	LPTIM1_OUT, I2C3_SMBA, SPI1_NSS, DEBUG_RF_SMPSRDY, CM4_EVENTOUT
16	PB12	I/O	TIM1_BKIN, I2C3_SMBA, SPI2_NSS/ I2S2_WS, LPUART1_RTS, CM4_EVENTOUT
17	PA10	I/O	RTC_REFIN, TIM1_CH3, I2C1_SDA, SPI2_MOSI/I2S2_SD, USART1_RX, DEBUG_RF_HSE32RDY, TIM17_BKIN, CM4_EVENTOUT
18	PA11	I/O	TIM1_CH4, TIM1_BKIN2, LPTIM3_ETR, I2C2_SDA, SPI1_MISO, USART1_CTS, DEBUG_RF_NRESET, CM4_EVENTOUT

Pin No	Name	Type	Definition
19	PA12	I/O	TIM1_ETR, LPTIM3_IN1, I2C2_SCL, SPI1_MOSI, RF_BUSY, USART1_RTS, CM4_EVENTOUT
20	PB4	I/O	NJTRST, I2C3_SDA, SPI1_MISO, USART1_CTS, DEBUG_RF_LDORDY, TIM17_BKIN, CM4_EVENTOUT
21	VSS/GND	POWER	TIM1_CH1N, I2C3_SCL, SPI1_MOSI, COMP2_OUT, DEBUG_SUBGHZSPI_ MOSIOUT, TIM17_CH1, CM4_EVENTOUT
22	PB3	I/O	JTDO/TRACESWO, TIM2_CH2, SPI1_SCK, RF_IRQ0, USART1_RTS, DEBUG_RF_DTB1, CM4_EVENTOUT
23	PA15	I/O	JTDI, TIM2_CH1, TIM2_ETR, I2C2_SDA, SPI1_NSS, CM4_EVENTOUT
24	SWDIO	I/O	
25	SWDCLK	I/O	
26	NRST	I/O	
27	VCC	POWER	
28	VBATT	POWER	
28	AVDD	POWER	

Pin No	Name	Type	Definition
29	AVDD	POWER	-
30	GND	POWER	-
31	GND	POWER	-
32	GND	POWER	-
33	GND	POWER	-
34	GND	POWER	-
35	ANT	RF I/O	-
36	GND	POWER	-

# Mechanical Drawings



Note :

All the dimensions are in mm

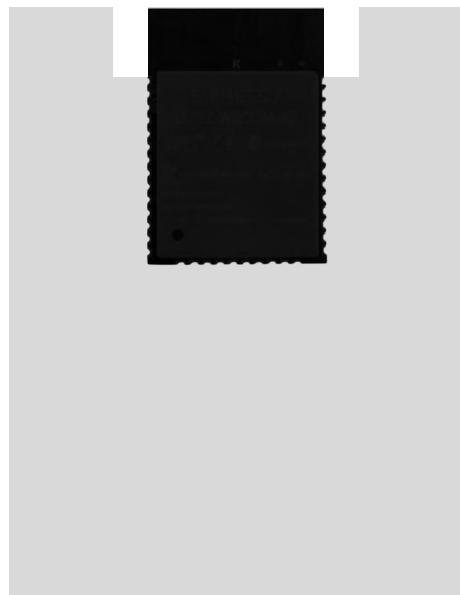
Default tolerance is 0.01 mm

# Recommended PCB Layouts

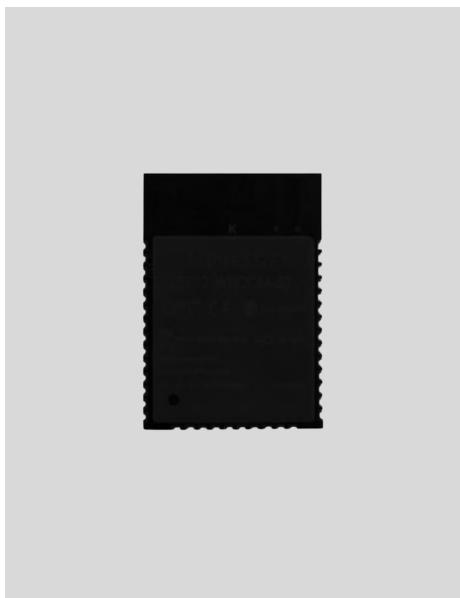
To ensure optimal antenna performance, the module antenna area must remain free of GND planes, metal cross-wiring, or nearby components. It is recommended to design a hollow or clear area around the antenna or position the module along the edge of the PCB.



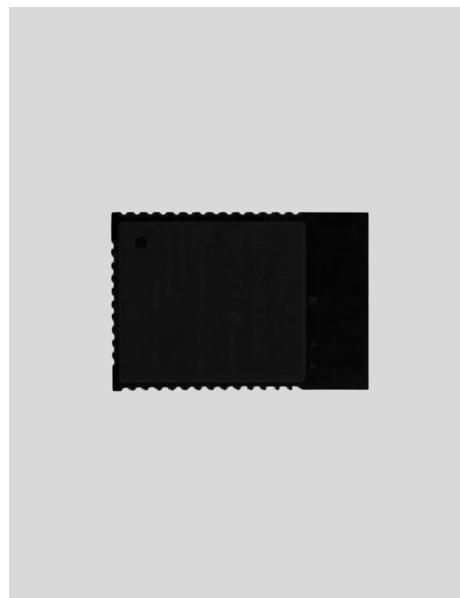
Best Design



Good Design



Bad Design



Bad Design

# For Maximum Performance

## Antenna Clearance

Ensure the module's u.FL connector and external antenna area are completely free from obstructions, especially metallic components or enclosures, as these can significantly degrade antenna performance.

## External Copper Coverage

Apply a copper shield around the PCB, excluding the antenna area, to minimize interference from high-frequency signals, signal cables, and disturbances from other components.

## Clearance Area

Maintain a clearance zone of at least 4 square centi-meters around the antenna area, including any enclosure, to reduce performance degradation caused by proximity to materials or circuits.

## Grounding

Ensure proper grounding of the device and the module. A solid ground plane should be placed beneath the module to reduce parasitic inductance and improve overall stability.

## Avoid Copper Under Antenna

Do not place copper, traces, or ground planes directly under the module's antenna path or near the external antenna connector to prevent signal interference or radiation inefficiencies.

## Distance from Other Circuits

Position the module's antenna at least 15mm away from high-speed signals, power circuits, or noisy components to preserve radiation efficiency and avoid interference.

## Placement

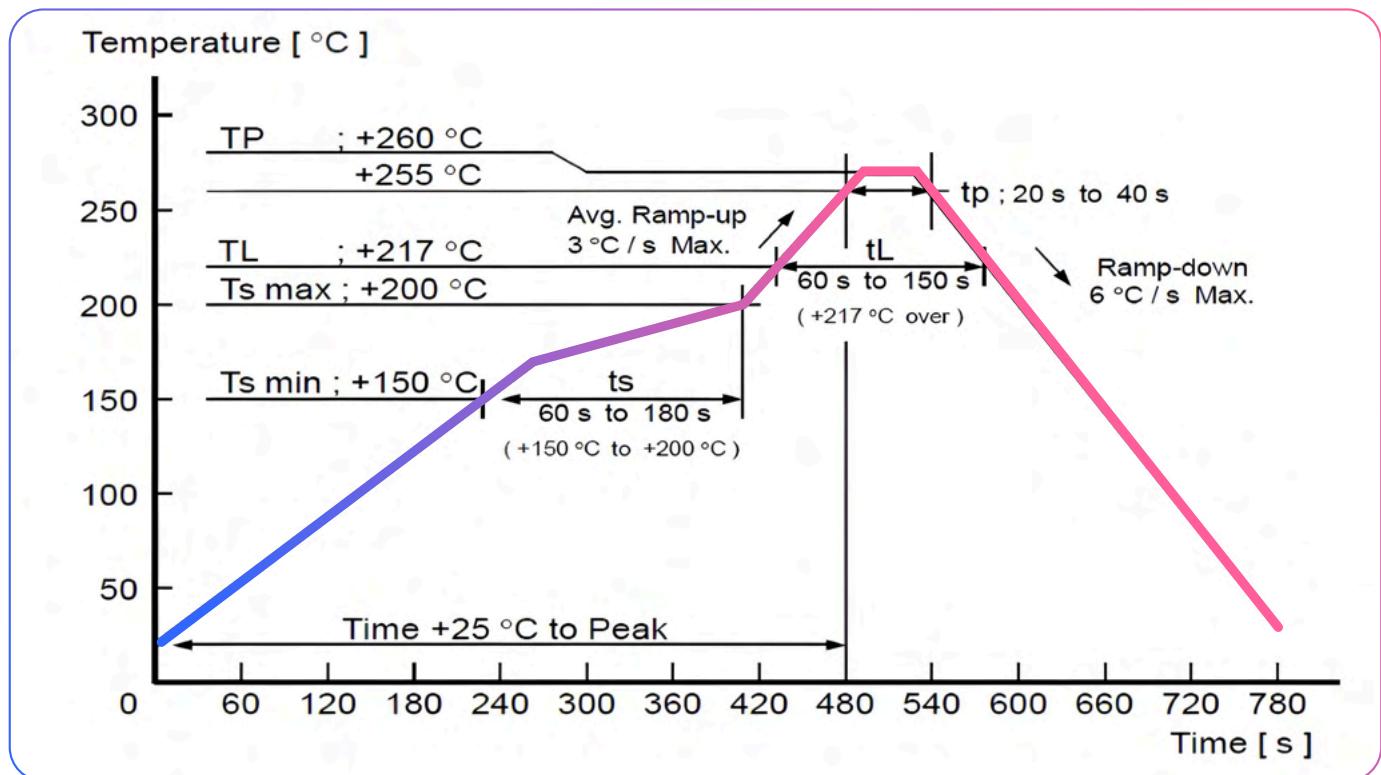
Place the MAC32WLE5 module near the edge of the PCB, with the u.FL connector facing outward to minimize interference and ensure the external antenna can radiate freely.

Keep the module away from dense circuitry to enhance RF performance.

## Power Supply Isolation

Use magnetic beads and low-ESR capacitors to insulate and filter the power supply to the module, ensuring clean and stable voltage delivery. This reduces noise interference and enhances overall stability.

# Reflow & Soldering



Perform SMT following the specified reflow oven temperature profile, ensuring the maximum temperature does not exceed **260°C**.

Adhere to the **IPC/JEDEC** standards for soldering processes, with a peak temperature maintained below **260°C**.

Limit the reflow soldering process to **≤2 times**, with a strong recommendation to perform only one reflow soldering on the module surface to avoid affecting double-pad SMT areas.

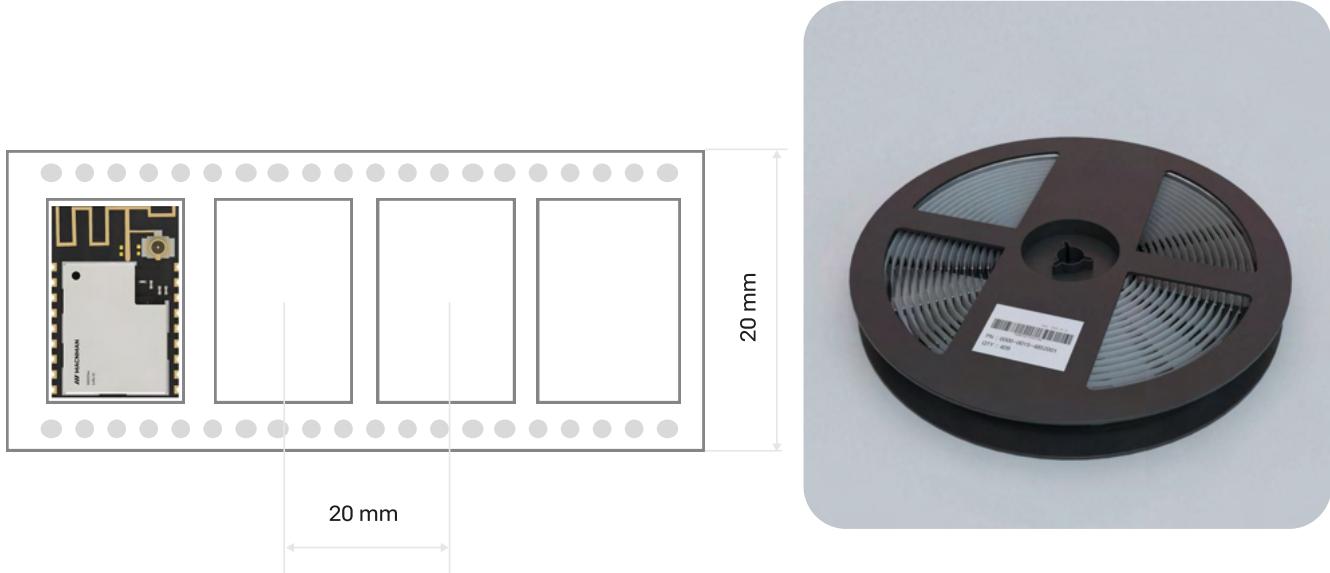
**Steel Mesh Recommendation** - Use a 0.2mm thickness partial ladder steel mesh for module SMT. Extend the opening by 0.8mm for optimal solder paste application.

**Storage After Unsealing** If the module is not fully used after unsealing, vacuum-seal it for storage to prevent exposure to air, which may cause moisture absorption and solder pad oxidation. For intervals of 7 to 30 days before SMT, bake the module at **65-70°C for 24 hours** without removing the tape.

**ESD Protection** Implement ESD protection measures before handling or using the module for SMT to safeguard against static damage.

For specialized requirements or unique processes, please contact us for further guidance and support.

# Package



## Details :

Code : MAC32WLE5

500 Pcs

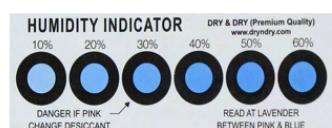
20 mm X 20 mm Max Dimensions

3.1 Kg

# Part List



Carrier tape packaging tray



Humidity Indicator



Desiccant



Vacuum bag



Inner carton

# Storage Condition

## Usage Timeline

Please ensure the product is used within 6 months of receipt.

## Unopened Package Storage

Store the product in its unopened package at an ambient temperature of 5°C to 35°C with a humidity range of 20% to 70%RH.

## Extended Storage

If the product remains unused for more than 6 months after receipt, it must be inspected and confirmed before use.

## Non-Corrosive Environment

Store the product in an environment free from corrosive gases, such as Cl<sub>2</sub>, NH<sub>3</sub>, SO<sub>2</sub>, and NOx.

## Packaging Care

Avoid mechanical shocks or damage to the packaging materials, such as punctures from sharp objects or dropping the product.

## Moisture Sensitivity Level

This product complies with MSL2 standards (per JEDEC J-STD-020).

# Guidelines After Opening the Package

## Storage After Opening

Once opened, store the product at a temperature of ≤30°C with humidity below 60%RH. Use the product within 3 to 6 months of opening.

## Indicator Color Change

If the moisture indicator in the package changes color, bake the product before soldering. Baking is not required for up to 1 year if storage conditions remain below 30°C and 60%RH.

## Moisture Sensitivity

Refer to MSL2 guidelines for exposure criteria. If the product is exposed to conditions of ≥168h @ 85°C/60%RH or stored for more than 1 year, baking is recommended.

# Recommended Baking Conditions

## High-Temperature Baking

Bake at  $120^{\circ}\text{C} \pm 5^{\circ}\text{C}$  for 8 hours (1 cycle). Ensure products are baked individually on heat-resistant trays, as packaging materials (base tape, reel tape, and cover tape) may deform at this temperature.

## Moderate-Temperature Baking

Bake at  $90^{\circ}\text{C} +8/-0^{\circ}\text{C}$  for 24 hours (1 cycle). The base tape can be baked together with the product at this temperature, but ensure uniform heat distribution during the process.

# Handling Precautions

## Avoid Mechanical Stress

Exercise caution during handling and transportation to prevent excessive stress or mechanical shocks, as these can damage the product.

## Inspect for Damage

Handle products carefully to avoid cracks or damage to terminals. Any such damage may alter the product's performance and characteristics.

## Prevent Contamination

Avoid direct contact with the product using bare hands, as this can compromise solderability and introduce contaminants.

## ESD Protection

Protect the product from static electrical discharge by using appropriate anti-static measures, such as wrist straps, gloves, and anti-static mats.

y to serve you. तुमची सेवा करण्याची संधी दिल्याबद्दल धन्यवाद. मैक्स नेव चॅनेअल्स के अवसर के लिए धन्यवाद भवतः सेवायाः अवसरस्य कृते धन्यवादः तमारी सेवा करवानी

## Say Hello

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