

RM-MS1

SmartMesh® IP module series

Datasheet



RM-MS1 is a 2.4 GHz radio module targeted for applications where proven reliability, highly flexible mesh network and low-power consumption are key requirements.

RM-MS1 module is based on an Analog Devices LTC5800-IPM System-on-Chip (SoC), featuring an IEEE 802.15.4e low-power transceiver and an ARM Cortex-M3 32-bit microprocessor running SmartMesh IP™ networking software stack. SmartMesh IP™ wireless sensor networks are self-managing, low power internet protocol (IP) networks built from wireless nodes.

KEY FEATURES

- 2.4 GHz IEEE 802.15.4e System-on-Chip (SoC)
- Compliant to 6LoWPAN Internet Protocol (IP)
- Integrated or external antenna (u.FL connector)
- TX power: up to +8 dBm
- RX sensitivity: down to -93 dBm
- Range: up to 100 meters
- MCU: 32-bit ARM® Cortex®-M3 core, 512 kB Flash, 72 kB RAM
- Micrium µCOS-II Real Time Operating System
- Supply Voltage: 2.1 V to 3.76 V single power supply
- Operating Temperature Range: -40°C to 85°C
- Dimensions: 25.0 x 20.0 x 5.0 mm

1. Feature List

MCU

- 32-bit ARM® Cortex®-M3 core
- Flash memory: 512 kB program memory
- RAM: 72 kB data memory
- Micrium µCOS-II Real Time Operating System

ANALOG PERIPHERALS

- 10-bit ADC 1.14 Msps - 4 channels

DIGITAL PERIPHERALS

- 2x USART
- 1x I2C
- 2x SPI
- 16-Bit Timers/Counters

ENVIRONMENTAL & REGULATORY

- Operating Temperature¹: -40 to +85°C

DIMENSIONS

- RM-MS1-x: 25.0 x 20.0 x 5.0 mm

RADIO FEATURES

- Frequency band: 2.4 GHz
- IEEE 802.15.4e System-on-Chip
- Programmable RF output power up to +8 dBm
- RX sensitivity: down to -93 dBm
- Range: up to 100 meters LoS
- Industry-Leading Low Power Radio Technology
 - 4.5mA to receive a packet
 - 9.7mA to transmit at 8dBm

NETWORK FEATURES

- Complete radio transceiver, embedded processor, and networking software for forming a self-healing mesh network
- Compliant to 6LoWPAN Internet Protocol (IP) and IEEE 802.15.4e standards
- SmartMesh networks deliver
 - >99.999% network reliability achieved in the most challenging RF environments
 - Sub 50µA routing nodes

¹ Extended temperature range -55°C to +105°C available on request.

2. Ordering Information

Table 1 – Ordering information.

Product Code	Protocol Stack	Antenna	UART APIs
RM-MS1-SAV1	SmartMesh IP	SMD	AD SmartMesh IP APIs
RM-MS1-UAV1	SmartMesh IP	u.FL	AD SmartMesh IP APIs
RM-MS1-SRV1	SmartMesh IP	SMD	RELOC SimpleAPI
RM-MS1-URV1	SmartMesh IP	u.FL	RELOC SimpleAPI

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3. System Overview

RM-MS1 is a 2.4 GHz radio module targeted for SmartMesh® IP applications where proven reliability, highly flexible network and low-power performance are key requirements.

RM-MS1 module is based on an Analog Devices LTC5800-IPM System-on-Chip, featuring an IEEE 802.15.4e low-power transceiver and an ARM Cortex-M3 32-bit microprocessor running SmartMesh® IP networking software stack.

SmartMesh® IP wireless sensor networks are self-managing, low power internet protocol (IP) networks built from wireless nodes. The SmartMesh IP product line enables low power consumption and >99.999% data reliability even in harsh, dynamically changing RF environments.

Module key applications include smart metering, and smart city, energy management systems, industrial monitoring and control, smart parking, and asset tracking devices.

3.1. SmartMesh® IP technology overview

A SmartMesh IP network consists of a highly scalable self-forming multi-hop mesh of wireless nodes, known as motes, which collect and relay data, and a network manager that monitors and manages network performance and security, and exchanges data with a host application.

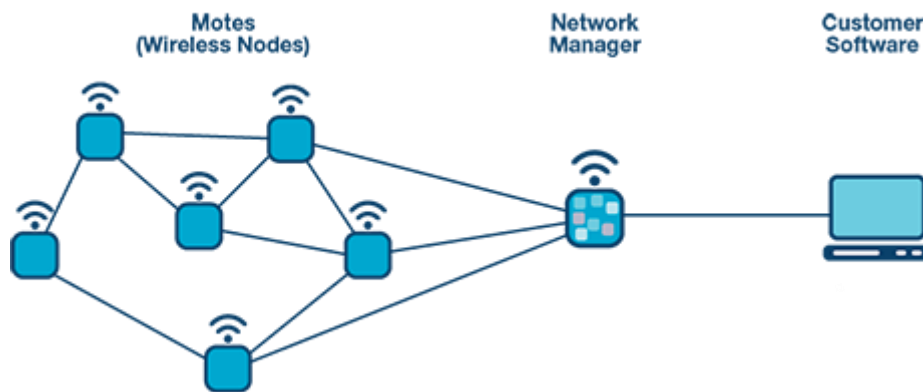


Figure 1 - SmartMesh® IP network.

3.2. Module versions

In order to provide designer with maximum integration flexibility, RM-MS1 module series include two device variants, with different antenna options. RM-MS1-S variant features an on-module SMD antenna whereas RM-SS2-U module option includes an u.FL RF connector.

4. Module Specifications

4.1. General specifications

The following table describes the general specifications for the devices.

Table 2 – RM-MS1 module general specifications.

Specification	RM-MS1-S	RM-MS1-U
Operating frequency bands	2.4 GHz	
Form factor	Surface mount	
Dimensions	20.0 x 25.0 x 5.0 mm	20.0 x 25.0 x 5.0 mm
Operating temperature range	-40 to +85 °C	-40 to +85 °C
Antenna	SMD antenna	u.FL connector

4.2. Electrical specifications

The following tables give detailed specifications for the RM-MS1 module series. $T_{amb} = 25\text{ °C}$ for all parameters given.

4.2.1 Nominal Operating Conditions

Table 3 – RM-MS1 module electrical specifications.

Parameter	Min	Typ	Max	Units	Condition/Notes
Operating Temperature	-40		+85	°C	
Supply Voltage (VSUPPLY)	2.1		3.76	V	
Supply Noise			250	mV	
Operating Relative Humidity	10		90	% RH	
Temperature Ramp Rate	-8		+8	°C/min	

4.2.2 Absolute Maximum Ratings

Table 4 – RM-MS1 module absolute maximum ratings.

Parameter	Min	Max	Units
Supply Voltage (VSUPPLY)		4.20	V
Input Voltage on Analog Inputs (AI_0, AI_1, AI_2, AI_3)		1.80	V
Voltage on Any Digital I/O Pin	-0.3	VSUPPLY+0.3	V
Input RF Level		+10	dBm
Storage Temperature Range	-55	+125	°C
Operating Temperature Range	-40	85	°C
Antenna Pin ESD Protection		±1000	V

Stresses beyond those listed in this table may cause permanent damage to the device. This is a stress rating only; functional operation of the device at these or any other conditions beyond those indicated in the operating conditions of the specification is not implied. Exposure to the absolute maximum rating conditions for extended periods may affect device reliability.

5. Layout Guidelines

5.1. Recommended placement on the application PCB

5.1.1 RM-MS1-Sx

For optimal performance of the RM-MS1 module with SMD antenna, please follow these guidelines:

- Place the module at the edge of the PCB, as shown in the figure below.
- Do not place any metal (traces, components, battery, etc.) within the clearance area of the antenna (shown in the figure below).
- Connect all ground pads directly to a solid ground plane.
- Place the ground vias as close to the ground pads as possible.

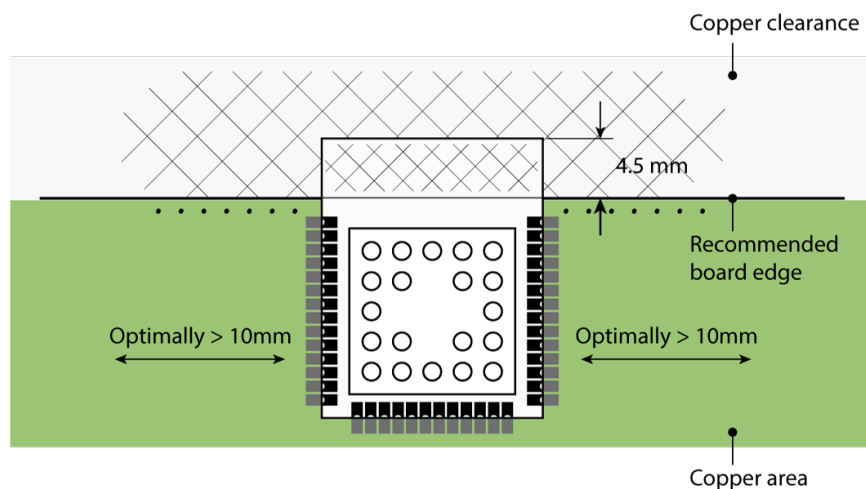


Figure 2 - Placement guidelines for RM-MS1-Sx device.

5.1.2 RM-MS1-Ux

For optimal performance of the RM-MS1 module with u.FL antenna connector, please follow these guidelines:

- Place the module at the edge of the PCB, as shown in the figure below.
- Place a solid GND plane under the module, including the antenna connector section.
- Connect all ground pads directly to a solid ground plane.
- Place the ground vias as close to the ground pads as possible.

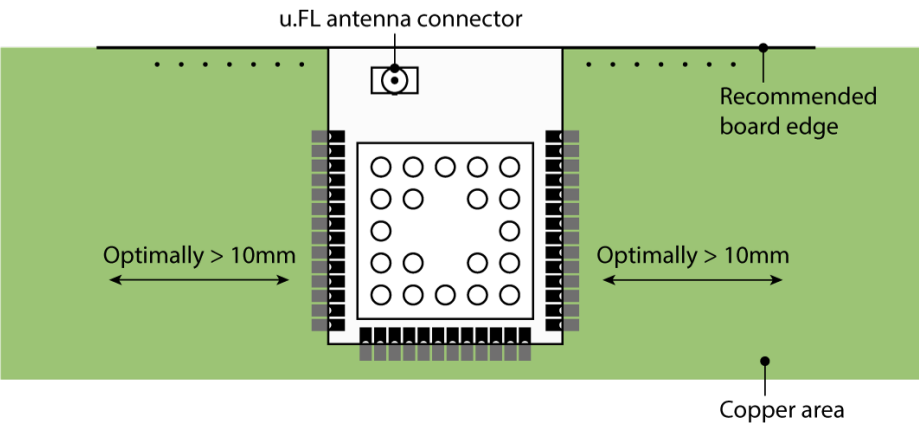


Figure 3 - Placement guidelines for RM-MS1-Sx device.

6. Pin Definitions

6.1. Pin Numbering

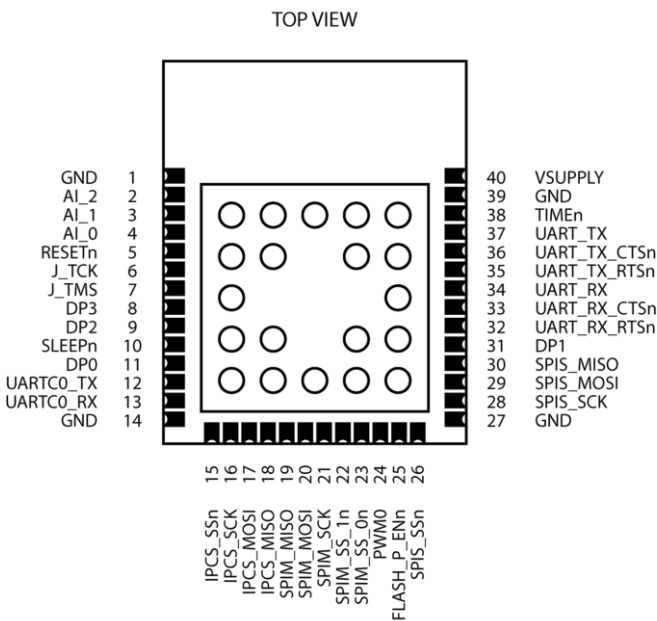


Figure 4 – RM-MS1-x pinout.

6.2. Pin Description

Device pinout is detailed in the table below. Several system-on-chip ports and peripherals are routed to the module pins, providing designer with access to microcontroller main functionalities (see SoC Pin # column).

Table 5 - RM-MS1-x module pin connections and descriptions.

Pin #	Pin Name	Type	Description	SoC Pin #
1	GND	GND	Ground Connection	GND
2	AI_2	Analog Input	Analog Input 2	15
3	AI_1	Analog Input	Analog Input 1	16
4	AI_0	Analog Input	Analog Input 0	17
5	RESETn	Reset Input	Reset Input, Active Low	22
6	TCK	JTAG	JTAG Test Clock	26
7	TMS	JTAG	JTAG Test Mode Select	25
8	DP3 TIMER8_EXT	Digital I/O	General Purpose Digital I/O (GPIO22) External Input to 8-Bit Timer/Counter	33
9	DP2 LPTIMER_EXT	Digital I/O	General Purpose Digital I/O (GPIO21) External Input to Low Power Timer/Counter	34
10	SLEEPn GPIO14	Digital I/O	Deep Sleep, Active Low General Purpose Digital I/O (GPIO14)	35
11	DP0 SPIM_SS_2n	Digital I/O	General Purpose Digital I/O (GPIO0) SPI Master Slave Select 2, Active Low	36
12	UARTC0_TX	Serial Port	CLI UART 0 Transmit	37
13	UARTC0_RX	Serial Port	CLI UART 0 Receive	38
14	GND	GND	Ground Connection	GND
15	IPCS_SSn LPTIMER_EXT GPIO3	SPI Port	SPI Flash Emulation Slave Select, Active Low External Input to Low Power Timer/Counter General Purpose Digital I/O (GPIO3)	45
16	IPCS_SCK TIMER8_EXT GPIO4	SPI Port	SPI Flash Emulation (SCK) Serial Clock Port External Input to 8-Bit Timer/Counter General Purpose Digital I/O (GPIO4)	44
17	IPCS_MOSI TIMER16_EXT GPIO5	SPI Port	SPI Flash Emulation (MOSI) Master Out Slave In Port External Input to 16-bit Timer/Counter General Purpose Digital I/O	42

18	IPCS_MISO TIMER16_OUT GPIO6	SPI Port	SPI Flash Emulation (MISO) Master In Slave Out Port 16-Bit Timer/Counter Match Output/PWM Output General Purpose Digital I/O (GPIO6)	40
19	SPIM_MISO GPIO11	SPI Port	SPI Master (MISO) Master In Slave Out Port General Purpose Digital I/O (GPIO11)	39
20	SPIM_MOSI GPIO10	SPI Port	SPI Master (MOSI) Master Out Slave In Port General Purpose Digital I/O (GPIO10)	41
21	SPIM_SCK GPIO9	SPI Port	SPI Master (SCK) Serial Clock Port General Purpose Digital I/O (GPIO9)	43
22	SPIM_SS_1n GPIO13	SPI Port	SPI Master (SS) Slave Select 1, Active Low General Purpose Digital I/O (GPIO13)	46
23	SPIM_SS_0n GPIO12	SPI Port	SPI Master (SS) Slave Select 0, Active Low General Purpose Digital I/O (GPIO12)	47
24	PWM0 TIMER16_OUT GPIO16		Pulse Width Modulator 0 16-Bit Timer/Counter Match Output/PWM Output General Purpose Digital I/O (GPIO16)	49
25	FLASH_P_ENn		Flash Program Enable, Active Low	55
26	SPIS_SSn SDA	SPI Port	SPI Slave Select, Active Low I2C Serial Data	53
27	GND	GND	Ground Connection	GND
28	SPIS_SCK SCL	SPI Port	SPI Slave (SCK) Serial Clock Port I2C Serial Clock	52
29	SPIS_MOSI UARTC1_RX GPIO26	SPI Port	SPI Slave (MOSI) Master Out Slave In Port CLI UART 1 Receive General Purpose Digital I/O (GPIO26)	51
30	SPIS_MISO UARTC1_TX 1_WIRE	SPI Port	SPI Slave (MISO) Master In Slave Out Port CLI UART 1 Transmit 1 Wire Master	50
31	DP1 TIMER16_EXT	Digital I/O	General purpose digital I/O 1 (GPIO20) External Input to 16-Bit Timer/Counter	48

32	UART_RX_RTSn	Serial Port	UART Receive (RTS) Request to Send, Active Low	66
33	UART_RX_CTSn	Serial Port	UART Receive (CTS) Clear to Send, Active Low	67
34	UART_RX	Serial Port	UART Receive	68
35	UART_TX_RTSn	Serial Port	UART Transmit (RTS) Request to Send, Active Low	69
36	UART_TX_CTSn	Serial Port	UART Transmit (CTS) Clear to Send, Active Low	70
37	UART_TX	Serial Port	UART Transmit	71
38	TIMEn		Time Capture Request, Active Low	72
39	GND	GND	Ground Connection	GND
40	VSUPPLY	Power Supply	Power Supply Input (2.1V ÷ 3.76V)	65

7. Package Specifications

7.1. Module dimensions

The figure below shows the RM-MS1 module dimensions.

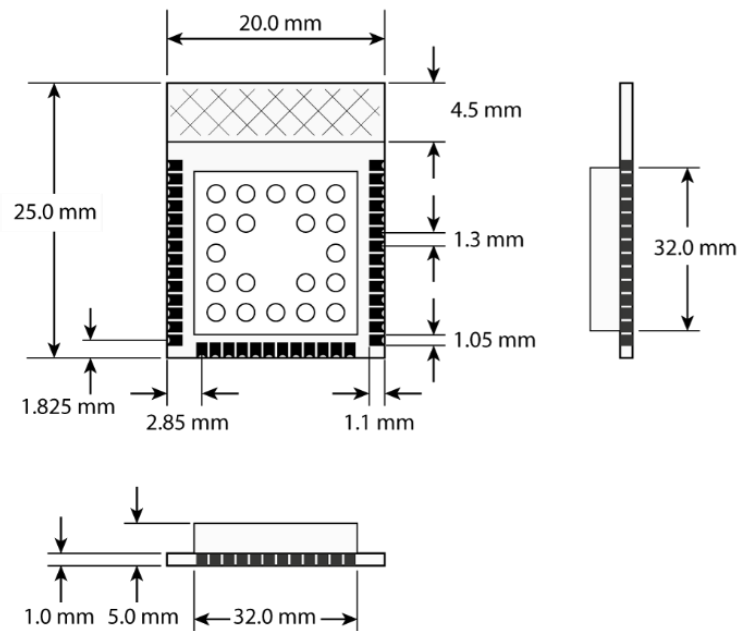


Figure 5 - RM-MS1-x module dimensions.

7.2. Module land pattern

The figure below shows the RM-MS1 module recommended land pattern.

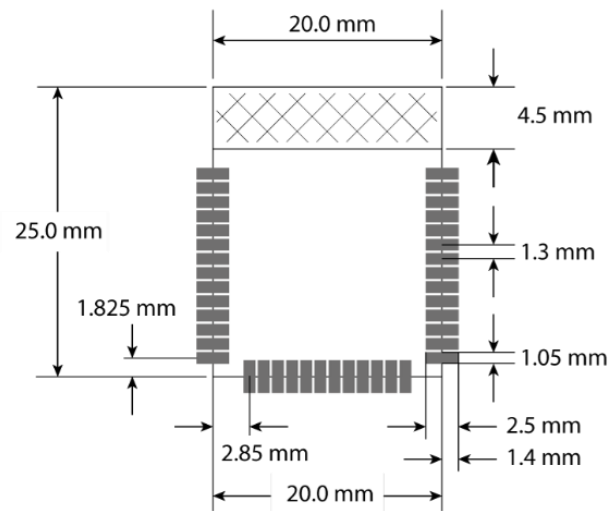


Figure 6 - RM-MS1-x suggested footprint.

References

- [1] Analog Devices, "LTC5800-IPM - SmartMesh IP Node 2.4GHz 802.15.4e Wireless Mote-on-Chip" datasheet

<https://www.analog.com/media/en/technical-documentation/data-sheets/5800ipmfa.pdf>

Revision History

REVISION	DATE	STATUS / COMMENTS	AUTHOR
0.8A	15/06/2020	Initial release	AR
0.9	01/03/2022	Minor changes	AR/LDB
1.0	28/06/2023	Pinout fixed	AR

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