

ROSEMOUNT



User Manual

RM5800 Wireless HART™

2.4 GHz Radio Module

Product Description

Rosemount Inc.'s RM5800 Wireless HART™ 2.4GHz Radio Module has been specifically designed to interface with industrial and process control equipment designed and marketed by the Emerson family of companies. The RM5800 is designed to be fully compliant with the wireless HART™ specification. The RM5800 utilizes the global license-free 2.4GHz band at output power levels that are compatible with government regulations throughout the world.

The RM5800's very low power consumption characteristics make it perfect for battery powered equipment. The multi-functional interface of the RM5800 is flexible enough for it to be integrated into many types of sensors. From pressure, temperature, and flow monitoring to machinery health and valve position control, the RM5800 is the best choice for wireless HART™ compatible communications.

Key Features

Reliable Networking

- Mesh networking for redundancy and high reliability (> 99.9% typical network reliability)
- Dynamic channel selection for interference rejection
- Every RM5800 acts as both an endpoint and a router, increasing network reliability.
- Automatic self-organizing mesh-networking capability built-in

Easy Integration

- Well-defined multi-functional interfaces
- High-level Data Link Control (HDLC) serial interface with bidirectional flow control
- Industrial temperature range -40 °C to +85 °C

802.15.4 Standard Radio

- +8 dBm (6.3 mW) conducted RF output power
- -95 dBm receiver sensitivity
- 300 m outdoor range (typical)

Data Security

- Uses AES FIPS PUB 197 (128 bit) encryption



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1.0 Absolute Maximum Ratings

The absolute maximum ratings shown below should under no circumstances be violated. Permanent damage to the device may be caused by exceeding one or more of these parameters.

Table 1 Absolute Maximum Ratings

Parameter	Min	Typ	Max	Units	Comments
Supply voltage (V_{DD} to V_{SS})	-0.3		4.2	V	
Voltage on any digital I/O pin	-0.3		$V_{DD} + 0.3$	V	
Input RF level			10	dBm	Input power at antenna connector
Storage temperature range	-55		+125	°C	
VSWR of antenna			3:1		
ESD protection					
Antenna pad			±250	V	HBM
All other pads			±2	kV	HBM
			±200	V	CDM

* All voltages are referenced to V_{SS}



Caution! ESD sensitive device. Precaution should be used when handling the device in order to prevent permanent damage.

2.0 Normal Operating Conditions

Table 2 Normal Operating Conditions

Parameter	Min	Typ	Max	Units	Comments
Operational supply voltage range (between V_{DD} and V_{SS})	2.1	3.0	3.76	V	Including noise and load regulation
Voltage on analog input pins	0		1.8	V	
Voltage supply noise			250	mV _{p-p}	50 Hz to 2 MHz
Peak current			85	mA	Flash write 35 ms max
			18	mA	TX, 5 ms maximum
			6	mA	Searching for network, 60 minutes maximum
			12	mA	RM5800 boot, see section Error! Reference source not found..
Operating temperature range	-40		+85	°C	
Maximum allowed temperature ramp during operation			8	°C/min	-40 °C to +85 °C
Operating relative humidity	10		90	% RH	Non-condensing

Unless otherwise noted, Table 3 assume V_{DD} is 3.0 V and temperature is 25 °C.

Table 3 RM5800 Current Consumption

Parameter	Min	Typ	Max	Units	Comments
Transmit		18		mA	
Receive		6		mA	
Sleep		2.5		µA	

3.0 Electrical Specifications

Table 4 Device Load

Parameter	Min	Typ	Max	Units	Comments
Total capacitance			0.5	μF	

Unless otherwise noted, V_{DD} is 3.0 V and temperature is $-40\text{ }^{\circ}\text{C}$ to $+85\text{ }^{\circ}\text{C}$.

Table 5 Digital I/O Type 1

Digital Signal	Min	Typ	Max	Units	Comments
V_{IL} (low-level input voltage)	-0.3		0.6	V	
V_{IH} (high-level input voltage)	$0.8 \times V_{DD}$		$V_{DD} + 0.3$	V	
V_{OL} (low-level output voltage)			0.4	V	
V_{OH} (high-level output voltage)	2.4			V	
Digital current*					
Output source (single pin)		3.7		mA	25 °C
Output sink (single pin)		2.0		mA	25 °C
Input leakage current		50		nA	

* This current level guarantees that the output voltage meets V_{OH} and V_{OL} specifications above.

Table 6 Digital I/O Type 2

Digital Signal	Min	Typ	Max	Units	Comments
V_{IL} (low-level input voltage)	-0.3		0.6	V	
V_{IH} (high-level input voltage)	$0.8 \times V_{DD}$		$V_{DD} + 0.3$	V	
V_{OL} (low-level output voltage, multi-function I/O configured as output)	0		0.6	V	$I_{OL} < 0.6\text{ mA}$, 85 °C
V_{OH} low-level output voltage, multi-function I/O configured as output)	$V_{DD} - 0.6$		V_{DD}	V	$I_{OH} > -0.4\text{ mA}$, 85 °C
Digital current*					
Output source (single pin, multifunction I/O configured as output)		0.4		mA	25 °C
Output sink (single pin, multifunction I/O configured as output)		0.6		mA	25 °C
Input leakage current		50		nA	

* This current level guarantees that the output voltage meets V_{OH} and V_{OL} specifications above.

4.0 Radio

4.1 Detailed Radio Specifications

Table 7 Radio Specifications

Parameter	Min	Typ	Max	Units	Comments
Operating frequency	2.4000		2.4835	GHz	
Number of channels		15			
Channel separation		5		MHz	
Occupied channel bandwidth		2.5		MHz	At -20 dBc

Parameter	Min	Typ	Max	Units	Comments
Frequency Accuracy	-50		+50	kHz	
Modulation					IEEE 802.15.4
Raw data rate		250		kbps	
Receiver operating maximum input level		0		dBm	
Receiver sensitivity		-95		dBm	At 50% PER, $V_{DD} = 3\text{ V}$, 25 °C
		-93		dBm	At 1% PER, $V_{DD} = 3\text{ V}$, 25 °C, (inferred from 50% PER measurement)
Output power, conducted		+8		dBm	$V_{DD} = 3\text{ V}$, 25 °C
Output power , conducted			+7	mW/MHz	Based on 70% of 2.7MHz signal power in a 1 MHz window
Range*	Indoor	100		m	25 °C, 50% RH, 1 meter above ground, +2 dBi omni-directional antenna
	Outdoor	300		m	
* Actual RF range performance is subject to a number of installation-specific variables including, but not restricted to ambient temperature, relative humidity, presence of active interference sources, line-of-sight obstacles, near-presence of objects (for example, trees, walls, signage, and so on) that may induce multipath fading. As a result, actual performance varies for each instance.					

4.2 Antenna Specifications

The antenna must meet specifications in Table 8.

Table 8 Antenna Specifications

Parameter	Value
Frequency range	2.4–2.4835 GHz
Impedance	50 Ω
Maximum VSWR	3:1
Antenna Connector	MMCX

When the RM5800 is placed inside an enclosure, the antenna should be mounted such that the radiating portion of the antenna protrudes from the enclosure, and connected using a coaxial cable. For optimum performance, allow the antenna to be positioned vertically when installed.

5.0 Pinout

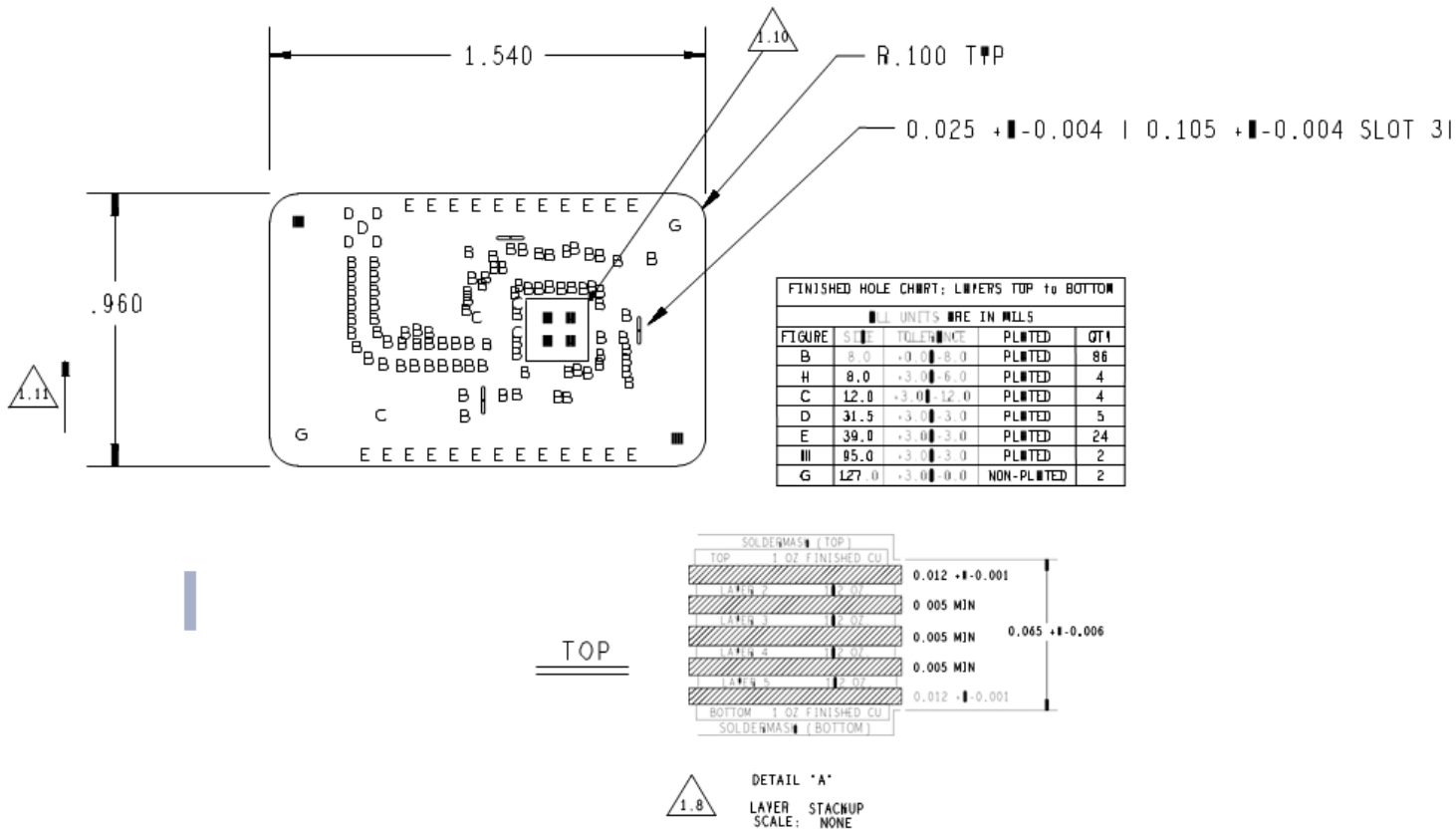
The following is the pinout for the RM5800 module.

Table 9 Pinout Assignments for the RM5800

Pin Number	Pin Description	I/O (relative to radio)
1-1	Circuit Common/Ground	Input
1-2	Power Supply (2.75 V to 3.3 V)	Input
1-3	Keying Pin (no function)	N/A
1-4	Data Transmit (Sensor Board to Radio)	Input
1-5	Data Receive (Radio to Sensor Board)	Output
1-6	Diagnostics LED	Output
1-7	Radio Ready-to-Send (also DIM wake-up)	Output
1-8	Radio Clear-to-Send	Output
1-9	Sensor Board Clear-to-Send	Input

1-10	Radio Time Packet	Input
1-11	Radio Baud Rate Input	Input
2-1	Radio Reset Line	Input
2-2	SPI Chip Select	Input
2-3	Keying Pin (no function)	N/A
2-4	SPI Bus (MISO)	Output
2-5	SPI Bus (MOSI)	Input
2-6	SPI Bus (Clock)	Input
2-7	JTAG (TCK)	Input
2-8	JTAG (TDO)	Output
2-9	JTAG (TDI)	Input
2-10	JTAG (TMS)	Input
2-11	Flash Enable	Input

6.0 Physical Drawing



- 1.6 SURFACE FINISH OF PCB TO BE ELECTROLESS NICKEL/IMMERSION GOLD (ENIG) PER IPC-4552.
- 1.5 MARK ON BOTTOM LAYER OF PCB, VENDOR CODE AND MANUFACTURING DATE MARKING TO BE PERMANENT, NON-CONDUCTIVE INK (WHITE OR OTHER CONTRASTING COLOR) OR PLACED INTO THE SOLDER MASK. IF PLACED INTO THE SOLDER MASK, CAN NOT BE PLACED OVER ANY COPPER FEATURES.
- 1.4 COVER BOTH SIDES OF PCB WITH LIQUID PHOTO IMAGEABLE SOLDER MASK, GREEN IN COLOR, APPLIED OVER BARE COPPER. SEE PS-18 FOR APPROVED MATERIALS.
- 1.3 MATERIAL SHALL BE ISOLA 370HR LAMINATE, T_g RATING 170C OR GREATER WITH UL RECOGNIZED FLAME RATING OF 94V-0 OR GREATER AND MIN CTI OF 100.
- 1.2 FOR REFERENCE ONLY: SCHEMATIC DRAWING 00754-3036 AND PCA DRAWING 00754-3038
- 1.1 THIS PCB MUST MEET ALL REQUIREMENTS OF ROSEMOUNT PROCUREMENT SPECIFICATION 18 (PS-18) UNLESS OTHERWISE SPECIFIED.

- 1.11 ARROW DENOTES ORIENTATION IN PANEL.
- 1.10 VIA PLUGGING REQUIRED IN DESIGNATED AREAS. FOLLOW IPC-4761 TYPE IV (B) OR TYPE VI FOR PLUGGING THE VIA HOLES. VIAS NEED TO BE DOUBLE-SIDED PLUGGED AND COVERED OR FULLY PLUGGED.
- 1.9 THIS DRAWING HAS BEEN SUBMITTED FOR THIRD PARTY CERTIFICATION. ANY CHANGES TO THIS DRAWING REQUIRES THIRD PARTY APPROVAL.
- 1.8 BOARD THICKNESS AND SPACING BETWEEN LAYERS IS AS DEFINED PER DETAIL 'A' BOARD THICKNESS MEASUREMENTS TO BE TAKEN OVER SOLDER MASK AND NOT OVER COPPER.
- 1.7 THIS DRAWING CONTAINS A REPLICA OF THE PCB ARTWORK FOR PURPOSES OF INSPECTION AND IDENTIFICATION. DO NOT USE THIS REPLICA TO GENERATE PCBs. MASTER ARTWORK WILL BE SUPPLIED UPON REQUEST.

NOTES:

Figure 1 RM5800 Mechanical Drawing

7.0 Regulatory and Standards Compliance

The RM5800 has achieved modular radio certification on a reference design for the United States, Canada . The reference design has been certified for Part 15.247 (Intentional Radiator) of the FCC rules an regulations, Industry Canada RSS-210.

This device complies with part 15 of the FCC Rules. Operation is subject to the following two conditions: (1) This device may not cause harmful interference, and (2) this device must accept any interference received, including interference that may cause undesired operation.

Note: This equipment has been tested and found to comply with the limits for a Class A digital device, pursuant to part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a commercial environment. This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instruction manual, may cause harmful interference to radio communications. Operation of this equipment in a residential area is likely to cause harmful interference in which case the user will be required to correct the interference at his own expense.

The RM5800 complies with Part 15.247 modular (Intentional Radiator) FCC rules and regulations. Changes or modifications not expressly approved by Rosemount Inc. could void the user's authority to operate the equipment.

This device complies with Industry Canada licence-exempt RSS standard(s). Operation is subject to the following two conditions: (1) this device may not cause interference, and (2) this device must accept any interference, including interference that may cause undesired operation of the device.

Cet appareil est conforme à la norme RSS Industrie Canada exempt de licence. Son fonctionnement est soumis aux deux conditions suivantes: (1) cet appareil ne doit pas provoquer d'interférences et (2) cet appareil doit accepter toute interférence, y compris les interférences pouvant causer un mauvais fonctionnement du dispositif.

7.1 FCC Testing

In order to fulfill FCC certification requirements, products incorporating the RM5800 must comply with the following:

1. An external label must be provided on the outside of the final product enclosure specifying the FCC identifier as described in 7.3 below.
2. The antenna must be electrically identical to the FCC-approved antenna specifications for the RM5800 as described in 7.2 with the exception that the gain may be lower than specified in Section 7.2
3. The device integrating the RM5800 may not cause harmful interference, and must accept any interference received, including interference that may cause undesired operation.
4. An unintentional radiator scan must be performed on the device integrating the RM5800, per FCC rules and regulations, CFR Title 47, Part 15, Subpart B. See FCC rules for specifics on requirements for declaration of conformity.

7.2 FCC-approved Antennas

The following antennas have been approved for use with the RM5800.

- A. 2.0dBi Omni, Rosemount 00753-2035-0051/0052/0055
- B. 4.5dBi Omni, Rosemount 00753-2035-0054/0056
- C. 8dBi Omni, PCTEL MFB24008DC
- D. 12dBi Yagi, L-com HG2412SY-NF
- E. 17dBi Sector, L-com HG2417P-120
- F. 24dBi Parabolic, L-com HG2424EG

The antenna(s) used for this transmitter must be installed to provide a separation distance of at least 20 cm from all persons and must not be collocated or operating in conjunction with any other antenna or transmitter within a host device, except in accordance with FCC multi-transmitter product procedures.

Note: The following FCC rule (15.203) must be ensured in the final design of the product. This can be done by either ensuring the professional installation of the final product (See Ref 1) or designing it in such a way as to make the antenna integral to the final product (See Ref 2). Further, the RM5800 is only for sale to OEM's and is not available to the general public. The RM5800 is an industrial network communication module and only works on Wireless Hart protocols and as such is part of an industrial process control system professionally installed and maintained.

Ref 1

- (1) Installation must be controlled.
- (2) Installed by licensed professionals (*e.g.*, device sold to dealer who hire installers).
- (3) Installation requires special training (*e.g.*, special programming, access to keypad, field strength measurements made).

Ref 2

- (1) Use of permanent, industrial epoxy, "Loctite" or solder to make the connection permanent prior to shipping.
- (2) Allow use of standard connectors if the transmitter has a sensing circuitry that disables the transmitter if an unauthorized antenna is used. An application should detail how this is accomplished.
- (3) Use of a standard connector is also allowed if the connector is within the transmitter enclosure and can only be accessed by disassembly of the transmitter, where such disassembly is not normally required. The user manual must not show that user has access to the connector.
- (4) BIOS lock—Radio card and host (*e.g.*, laptop computer) exchange code to ensure only the authorized transmission system works in the host.

CFR Title 47, Chapter 1, Subchapter A, Part 15, Subpart C, Section 15.203 Antenna Requirement

An [intentional radiator](#) shall be designed to ensure that no antenna other than that furnished by the responsible party shall be used with the device. The use of a permanently attached antenna or of an antenna that uses a unique coupling to the [intentional radiator](#) shall be considered sufficient to comply with the provisions of this section. The manufacturer may design the unit so that a broken antenna can be replaced by the user, but the use of a standard antenna jack or electrical connector is prohibited. This requirement does not apply to carrier current devices or to devices operated under the provisions of [§ 15.211](#), [§ 15.213](#), [§ 15.217](#), [§ 15.219](#), or [§ 15.221](#). Further, this requirement does not apply to [intentional radiators](#) that must be professionally installed, such as [perimeter protection](#)

[systems](#) and some field disturbance sensors, or to other [intentional radiators](#) which, in accordance with [§ 15.31\(d\)](#), must be measured at the installation site. However, the installer shall be responsible for ensuring that the proper antenna is employed so that the limits in this part are not exceeded.

7.3 Final FCC Labeling Requirements

The outside of the final product enclosure must have a label with the following (or similar) text specifying the FCC identifier. The FCC ID and certification code must be in Latin letters and Arabic numbers and visible without magnification.

Contains transmitter module FCC ID: LW2-RM5800

Or Contains FCC ID: LW2-RM5800

7.4 IC Testing

The RM5800 is certified for modular Industry Canada (IC) RSS-210 approval. The OEM is responsible for its product to comply with IC ICES-003 and FCC Part 15, Sub. B - Unintentional Radiators. The requirements of ICES-003 are equivalent to FCC Part 15 Sub. B and Industry Canada accepts FCC test reports or CISPR 22 test reports for compliance with ICES-003.

7.5 Final IC Labeling Requirements

The Original Equipment Manufacturer (OEM) must ensure that IC labeling requirements are met. The outside of the final product enclosure must have a label with the following (or similar) text specifying the IC identifier. The IC ID and certification code must be in Latin letters and Arabic numbers and visible without magnification

Contains IC: 2731A-RM5800

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