

Datasheet

RM024 – RAMP Wireless Module

2.4 GHz FHSS Wireless Module

Version 4.0

REVISION HISTORY

Ver	Date	Notes	Contributor(s)	Approver
1.0		Initial Release		Chris Downey
2.1		Added firmware changes, updated the name of the Force 9600 Pin, removed old references to LT2510 part numbers, added new information on cyclic sleep and Antenna Switch Override. Added a table under Max Power and a table for the Set Max Power command		Chris Downey
2.2		Minor grammatical fixes.		Chris Downey
2.3	27 June 2013	PWM output data was corrected to a 39.3846 µS period vs. 315.077, as was stated previously.		Chris Downey
2.4	12 July 2013	Minor edits, removed Firmware History and references irrelevant to RM024.		Chris Downey
2.5	10 Oct 2013	Corrected Antenna Select Override information error. Changed 0x59 to 0x5B		Chris Downey
3.0	10 Dec 2013	Separated Hardware Integration Guide (HIG) from User Guide information (created two separate documents). Add Related Documents section.		Sue White
3.1	10 Jan 2014	Added 10 mW version information.		Chris Downey
3.2	05 Mar 2015	Added section on Reflow Parameters.		Chris Downey
3.3	22 Jan 2016	Update product numbers. Updated antenna information. Converted to new template. General edits.		N. Zach Hogya
3.4	24 Feb 2016	Updates to antenna information.		Daniel Waters
3.5	10 Aug 2016	Changed from <i>HIG</i> to <i>Datasheet</i> Updated Receiver Sensitivity numbers		Zach Hogya
3.6	26 June 2017	Updated EU DoC for new RED standards		Tom Smith
3.7	28 July 2017	Added RM024-P10-C-30 to the DoC product list		Jonathan Kaye
3.8	3 Nov 2017	Added Note 6		Jonathan Kaye
3.9	01 Feb 2018	Added MIC information		Maggie Teng
3.10	14 Feb 2019	Updated template, logos, and URLs		Sue White
3.11	23 Sept 2019	Updated antenna information		Jonathan Kaye
3.12	30 June 2020	Added PMN to title page; added IC statement; added FlexPIFA antenna to FCC and IC antenna tables		Maggie Teng
4.0	15 Dec 2020	Updated all regulatory information	Maggie Teng Ryan Urness	Jonathan Kaye

CONTENTS

1	RAMP Modules.....	4
1.1	Key Features.....	4
1.2	Detailed Specification.....	5
1.3	Pin Definitions	6
1.4	Input Characteristics.....	8
1.5	Output Characteristics.....	8
1.6	Block Diagram.....	8
1.7	Timing Specifications	9
1.8	RF Hop Frame	9
2	Hardware Interface.....	10
2.1	Pin Descriptions	10
3	Mechanical Considerations	12
4	Reflow Parameters.....	15
5	Ordering Information.....	16
6	Regulatory Information	16
6.1	Current Regulatory Certifications	16
6.2	Certified Antennas.....	16
6.3	FCC Regulatory	17
6.4	ISED (Canada) Statement.....	19
6.5	MIC (Japan) Certification.....	20
6.6	Korea (KC) Regulatory	21
6.7	Australia and New Zealand Regulatory	21
6.8	Taiwan (NCC) Regulatory	22
6.9	EU Regulatory	22
7	Related Documents and Files.....	26
8	Additional Assistance	26

1 RAMP MODULES

Laird Connectivity RAMP (Range Amplified MultiPoint) modules are designed to provide robust wireless communications for any number of applications requiring a wireless transport for serial data. RAMP modules feature a Frequency Hopping Spread Spectrum (FHSS) protocol for excellent interference and multipath immunity. RAMP modules server/client architecture allows for more than 16 million clients to be addressed and communicating within the network.

The RM024 RAMP module improves upon Laird Connectivity's 2.4 GHz RAMP predecessors by lowering power consumption through the use of three different sleep mode options, an improved link budget, the ability for close proximity operation at low power, and the inclusion of a switchable antenna output (RM024-xxxx-M-yy versions only).

The RM024 is available in two versions:

- **RM024-S125-x-xx/RM024-P125-x-xx** – Contains 125 mW maximum conducted output power which is approved for North American and similar markets.
- **RM024-S10-x-xx/RM024-P10-x-xx** – Contains 10 mW maximum conducted output power which is approved for European and similar markets.

These modules are identical except for output power, transmit power consumption, and the number of RF channels available. Differences between the two versions, where applicable, are denoted based on part number.

This document contains information about the hardware and software interface between a Laird Connectivity RM024 transceiver and an OEM host. Information includes the theory of operation, specifications, interface definitions, and mechanical drawings.

Note: Unless mentioned specifically by name, the RM024 modules are referred to as *module*, *radio*, or *transceiver*. Individual naming is used to differentiate product specific features. The host (PC/microcontroller/any device to which the RM024 module is connected) is referred to as *OEM host* or *host*.

1.1 Key Features

- Retries and acknowledgements
- Configurable network parameters
- Multiple generic I/O
- 280 kbps or 500 kbps RF data stream
- Idle current draw of 9.5 mA, sleep current of <1 uA (varies depending on sleep mode)
- Software-selectable interface baud ranging from 1200 bps to 230.4 kbps
- Upgradable FW through serial port
- Low cost, low power, and small size ideal for high volume, portable, and battery powered applications
- All modules are qualified for Industrial temperatures (-40°C to 85°C)
- Advanced configuration available using Laird Connectivity's Command Interface
- Easy-to-use Laird Connectivity Configuration and Test Utility software
- Switchable antenna output, either integrated antenna or external antenna through U.FL (RM024-S125-M, RM024-P125-M, RM024-S10-M, and RM024-P10-M radios only)

1.2 Detailed Specification

Table 1: Specifications table

General			
Form Factor	SMD-ANT+U.FL, Pluggable-ANT+U.FL, SMD-U.FL, Pluggable-U.FL		
Antenna	Dual antenna with integrated antenna and U.FL or External antenna through U.FL connector		
Serial Interface Data Rate	Baud rates from 1200 to 230400. Non-standard baud rates are also supported.		
Channels	125 mW – 42 or 78 selectable channels 10 mW – 42 selectable channels		
Security	Channelization, System ID, Vendor ID, and Extended System ID		
Minimum Flash (EEPROM) Memory Endurance	1000 Write/Erase cycles		
Transceiver			
Frequency Band	2400-2483.5 MHz		
RF Data Rate (Raw)	280 kbps or 500 kbps selectable		
Hop Bin Spacing	900 kHz over 79 hops 1500 kHz over 43 hops		
RF Technology	Frequency Hopping Spread Spectrum		
Modulation	MSK		
Maximum Output Power Conducted ¹	FCC – +5 to +21 dBm (selectable) EU – +3.5 to +10 dBm (not selectable)		
Supply Voltage	2.3-3.6 V ± 50 mV ripple		
Current Draw	RM024 Version	125 mW	10 mW
	Tx Burst	136 mA	40 mA
	Rx Active	36 mA	36 mA
	Idle Current	9.5 mA	9.5 mA
	PM2/Cyclic Sleep	0.9 µA	0.9 µA
	PM3/Deep Sleep	0.38 µA	0.38 µA
Receiver Sensitivity (1% PER)	RF Profile	Receiver Sensitivity (dBm) (1% PER)	
	500 kbps	-88	
	280 kbps	-92	
	FEC 500 kbps	-91 (See Note 5)	
	FEC 280 kbps	-95 (See Note 5)	
*See Note 6			
Range (based on external 2.0 dBi antenna at 280 kbps RF data rate) ²		Outdoor (line-of-sight)	Indoor (estimated)
	125 mW	4 km (2.5 miles)	400 m (1300 feet)
	10 mW	1.0 km (0.6 miles)	100 m (328 feet)
Environmental			
Temperature (Operational)	-40 °C to 85 °C		
Temperature (Storage)	-50 °C to 150 °C		

Physical	
SMD-Multi Antenna Dimensions	25.4 mm x 39 mm x 3.6 mm (1.0" x 1.54" x 0.14")
SMD-U.FL Dimensions	25.4 mm x 32.4 mm x 3.6 mm (1.0" x 1.28" x 0.14")
Pluggable-Multi Antenna Dimensions	26.7 mm x 39.6 mm x 11.3 mm (1.05" x 1.56" x 0.44")
Pluggable-U.FL Dimensions	26.7 mm x 33 mm x 10.6 mm (1.05" x 1.29" x 0.42")
Certifications	
FCC – Part 15.247	KQL-RM024
ISED (Canada)	2268C-RM024
EU	Yes – RM024-x10-x versions
RoHS	Yes
Brazil (Anatel) ⁴	None
AS/NZS	Yes

Notes:

1. Maximum output stated, step measurements for power could vary by +/- 2.0 dBm.
2. Range distances are estimates and vary with the installation environment. Measurements were taken at 4.1 miles with a 5 dBi antenna for FCC modules.
3. See [Regulatory Information](#) in this guide.
4. Contact your sales representative for more details.
5. While the use of FEC does not affect the actual PER, it does allow correct reception at a lower SNR, thus extending communication range. We've measured this to yield an effective sensitivity increase on the order of 3dBm.
6. The RM024 can operate at two different RF baud rates: 250 kbps and 500 kbps. The chip receiver saturation is -11dBm at 250 kbps and -15 dBm at 500 kbps. Inside the module, there is an FEM which has net gain of about 11-13dB. For 500 kbps RF baud rate, the input RF signal must be less than -28 dBm without causing any saturation, and at 250 kbps RF baud rate the signal must be less than -24dbm. In real deployment, some margin to cover the signal variation is required. With all these factors considered, we suggest the received RF signal should not be stronger than -40 dBm.

1.3 Pin Definitions

Table 2: RM024 pins

SMT Pin	Pluggable Pin	Type	Signal Name	Functions
1	7	O	GIO-0	Generic Output / Hop_Frame
2	6	O	GIO_1	Generic Output
3	8		DNC	Do Not Connect
4	17	O	GIO_2	RS485 Driver Enable
5	19	O	GIO_3	PWM Output
6	3	I	RXD	Asynchronous serial data input to transceiver
7	2	O	TXD	Asynchronous serial data output from transceiver
8	10	GND	GND	Signal Ground
9	1	PWR	VCC	2.3 – 3.6 V \pm 50 mV ripple (must be connected)
10	-	PWR	Vpa	2.3 - 3.6 V \pm 50 mV ripple (must be connected on SMT version)

SMT Pin	Pluggable Pin	Type	Signal Name	Functions
11	-	GND	GND	Signal Ground
12	9	I	$\overline{\text{Force 9600}}$ /Sleep Interrupt	<p>Force 9600 – When pulled logic Low and then applying power or resetting, the transceiver's serial interface is forced to a 9600, 8-N-1 rate.</p> <p>Sleep Interrupt – When taken Low, this pin wakes the radio from any of the three sleep modes.</p> <p>Note: <i>Pulling this pin to GND disables some modes of operation, therefore it should not be permanently pulled Low during normal operation.</i></p>
13	14	I	GIO_4	Generic Input
14	5	I	$\overline{\mu\text{P_Reset}}$	Reset – Controlled by the RM024 for power-on reset if left unconnected. After a stable power-on reset, a logic low pulse resets the transceiver.
15	11	I	$\overline{\text{CMD/Data}}$	When logic Low, the transceiver interprets incoming OEM host data as command data. When logic High, the transceiver interprets OEM host data as transmit data.
16	15	O	$\overline{\text{In Range}}$	When logic Low, the client is in range and synchronized with a server. This is always Low on a server.
17	16	I	$\overline{\text{RTS}}$	Request to Send – Floats high if left unconnected. When enabled in EEPROM, the module will not transmit Serial UART data to the OEM Host unless this pin is Low.
18	12	O	$\overline{\text{CTS}}$	Clear to Send – CTS is used for hardware flow control indication to the OEM Host. CTS toggles high when the Serial UART RX input buffer reaches the CTS On threshold and remains high until the buffer recedes below the CTS Off threshold.
19	18		GIO_8	Generic Input
20	13		GIO_5	Reserved for future use. Do not connect.
21	4		GIO_6	Reserved for future use. Do not connect.
22	20	I	GIO_7	Analog to Digital input

Tips:

- All I/O directions are referenced to Vcc.
- All inputs are weakly pulled High via a 20 k Ohm pull-up resistor and may be left floating during normal operation.
- Minimum connections: VCC, VPA, GND, TXD, and RXD.
- Signal direction is with respect to the transceiver.
- Leave unused pins disconnected.

1.4 Input Characteristics

Table 3: Input characteristics

Signal Name	High Min.	High Max.	Low Min.	Low Max.
$\overline{\mu P_Reset}$	0.8 v	Vcc	0 v	0.6 v
RTS	2.31 v	Vcc	0 v	.99 v
AD_In	N/A	Vcc	0 v	N/A
All other inputs	70% Vcc	Vcc	0 v	30% Vcc

1.5 Output Characteristics

Table 4: Output characteristics

Signal Name	High Min.	High Max.	Low Min.	Low Max.	Sink Current
GO_0	2.5 v	3.3 v	0 v	0.4 v	20 mA
GO_1	2.5 v	3.3 v	0 v	0.4 v	20 mA
PWM_Output	N/A	3.3 v	0 v	N/A	4 mA
All other outputs	2.5 v	3.3 v	0 v	0.4 v	4 mA

1.6 Block Diagram

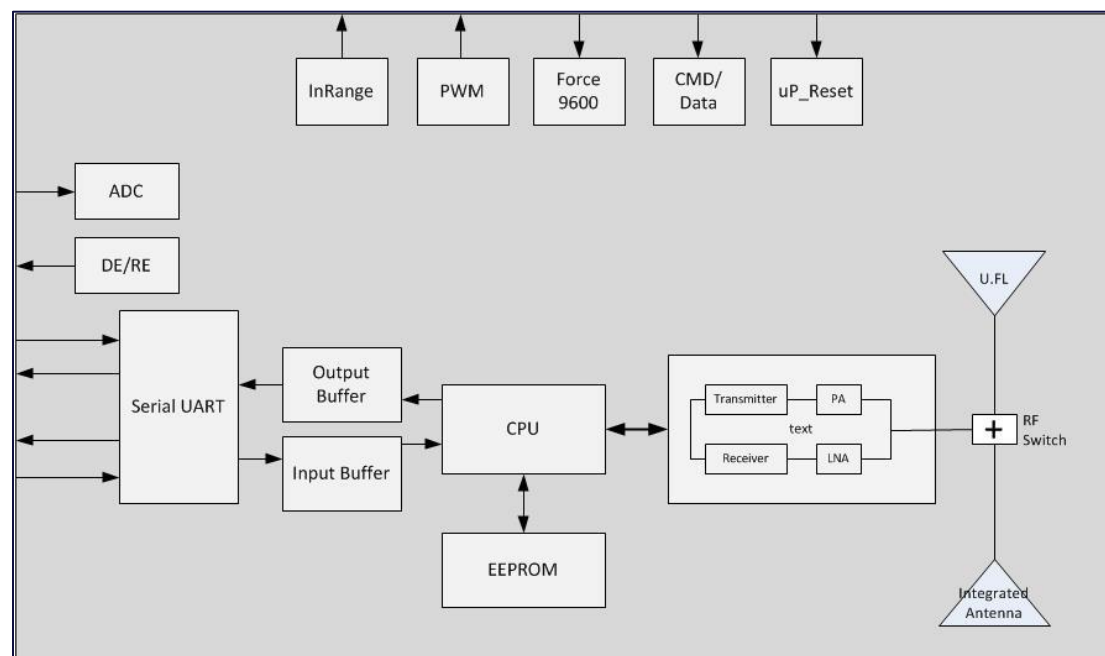


Figure 1: RM024 block diagram

1.7 Timing Specifications

Table 5: Timing specifications

Parameter	Server/Client	Min.	Typ.	Max.	Notes
Power on to CTS Low		5 ms	10 ms	N/A	The first boot after a FW upgrade requires more than the typical amount of time for CTS to toggle Low.
EEPROM Read		800 μ s	1 ms	2 ms	Measured from last byte of command to first byte of response: 870 μ s for 1 byte; 1.1 ms for 80 bytes; 1.4 ms for 256 bytes
EEPROM Write		20 ms	30 ms	40 ms	Measured. EEPROM writes cause the radio to resynchronize.
Power on to In Range	Client only	13 ms	600 ms	1700 ms	Maximum time assuming all beacons are heard; RF interference could extend the maximum time indefinitely.
Hop Period In Range			13.19 ms		
Hop Period Out of Range	Client only		38.4 ms		
Reset Pulse		250 ms			
PWM Output Period			39.3846 μ s		
Restore Default EEPROM Command		10 ms	38 ms		Restore command also initiates a soft reset, so monitoring CTS is the best indication of a completed command.
Non-specific AT Command		1 ms	10 ms		Some AT Commands could wait indefinitely for a response.
Write Flash					For FW upgrade.
Read Flash					

1.8 RF Hop Frame

The RM024 hops every 13.19 milliseconds and can be configured for two different RF data rates to provide options for range or throughput. During each hop, the RM024 reserves a certain amount of time for overhead such as the synchronization beacon, internal messaging, and user data transmission. The diagrams below outline the various transmissions that occur during a hop. These transmissions are transparent to the user sending data, but may be useful for applications that require critical timing. User data is only transmitted during the data slots and after the Interface Timeout or RF Packet Size criteria has been met. Data transmission only begins at the beginning of a data slot. When configured for Full Duplex, data slot 1 is reserved for the server and data slot 2 is shared by all clients for transmissions.

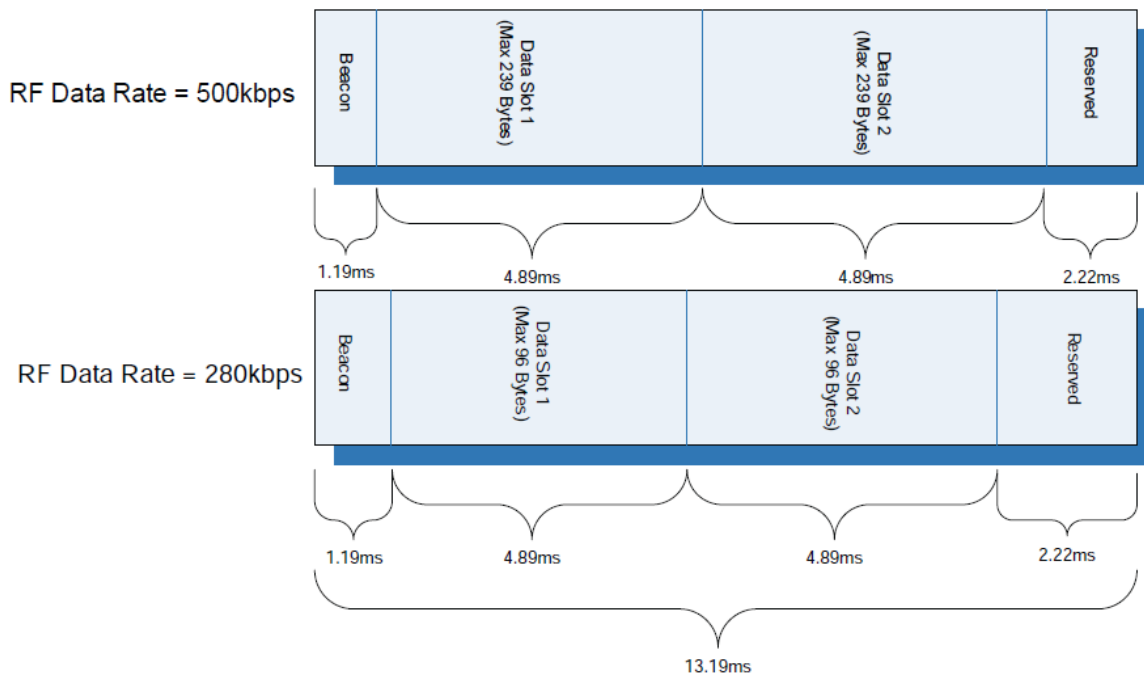


Figure 2: RF hop frame diagram

2 HARDWARE INTERFACE

2.1 Pin Descriptions

2.1.1 RXD and TXD

The RM024 accepts 3.3 VDC TTL level asynchronous serial data from the OEM host via the RXD pin. Data is sent from the transceiver, at 3.3 volt levels, to the OEM host via the TXD pin. Pins should be left floating or high when not in use. Leaving the RXD tied low results in the radio transmitting garbage serial data across the RF.

2.1.2 Force 9600 /Sleep Interrupt

When pulled logic Low before applying power or resetting, the transceiver's serial interface is forced to 9600, 8-N-1 (8 data bits, no parity, 1 stop bit) regardless of the actual EEPROM setting. RTS is ignored, the interface timeout is also set to three milliseconds, and the RF packet size is set to the default size for the selected RF data rate. To exit, the transceiver must be reset or power-cycled with the test pin logic High or disconnected. When in Force 9600 mode, the radio's receiver is disabled.

When enabled in the EEPROM, the 9600 Boot option causes the 9600 pin to be ignored on cold boot (power-up), command boot (0xCC 0xFF), and brown-out conditions. Therefore, the 9600 pin is only observed on warm boots (reset pin toggled). This can be helpful so that brown-out conditions don't cause the baud rate to change if the 9600 pin happens to be low at the time. When 9600 Boot option is disabled, the 9600 pin is used for all boot conditions. 9600 Boot option is enabled by default.

Force 9600 is also used to wake the radio from sleep. When the pin is taken low, the radio wakes. The transceiver does not sleep if the pin is low when the sleep command is issued.

Note: Because this pin disables some modes of operation, it should not be permanently pulled Low during normal operation.

2.1.3 $\overline{\mu P_RESET}$

μP_Reset provides a direct connection to the reset pin on the RM024 microprocessor and is used to force a hard reset. For a valid reset, reset must be asserted Low for an absolute minimum of 250 nanoseconds (ns).

2.1.4 $\overline{Command/Data}$

When logic High, the transceiver interprets incoming serial data as transmit data to be sent to other transceivers. When logic Low, the transceiver interprets incoming serial data as command data. When logic Low, data packets from the radio are not transmitted over the RF interface, however, incoming packets from other radios are still received. Enabling CMD/Data RX Disable in the EEPROM causes incoming RF packets to be queued by the receiving radio while CMD/Data is low. When CMD/Data goes high, the data is sent over the serial interface.

2.1.5 $\overline{In_Range}$

The In_Range pin is driven low when a client radio's frequency hopping is synchronized with that of a server. In_Range is always driven low on a server. Following boot, In_Range transitions low in approximately 12 milliseconds on a server. For a client, the In_Range takes an average of 500 milliseconds; this time is dependent on the signal strength of the received beacon, the presence and strength of interference, and randomness of the sync function. It can vary from 150 milliseconds to over 1500 milliseconds.

2.1.6 $\overline{GO_0/Hop_Frame}$

The Hop Frame indicator functionality is disabled by default and controlled by the Control 1, Bit-6 EEPROM setting. When enabled, this pin transitions logic Low at the start of a hop and transitions logic High at the completion of a hop. The OEM host is not required to monitor hop frame.

2.1.7 \overline{RTS} and Handshaking

With RTS mode disabled, the transceiver sends any received data to the OEM host as soon as it is received. However, some OEM hosts are not able to accept data from the transceiver at all times. With RTS enabled in EEPROM, the OEM host can prevent the transceiver from sending data by de-asserting RTS (High). Once RTS is re-asserted (Low), the transceiver sends packets to the OEM host as they are received.

Note: Leaving RTS de-asserted for too long can cause data loss once the transceiver's transmit buffer reaches capacity.

2.1.8 \overline{CTS} Handshaking

If the transceiver buffer fills up and more bytes are sent to it before the buffer can be emptied, data loss occurs. The transceiver prevents this loss by de-asserting CTS high as the buffer fills up and asserting CTS low as the buffer is emptied. CTS should be monitored by the host device and data flow to the radio should be stopped when CTS is high.

2.1.9 $\overline{DE/RE}$

When enabled, RS485 Data Enable uses the DE/RE pin to control the DE pin on external RS-485 circuitry. When the transceiver has data to send to the host, it asserts DE/RE High, sends the data to the host, and then takes DE/RE low.

2.1.10 PWM Output

PWM output can be configured to output on any of three pins (SMT Pins 5, 6, or 7). The PWM Output can optionally produce a pulse width modulation for RSSI with a period of 39.3846 μ S.

3 MECHANICAL CONSIDERATIONS

3.1 Mechanical Drawing

The pluggable versions of the RM024 consist of the surface mount RM024 on a pluggable adapter board. RM024 –C versions, which only feature an U.FL connector and no integrated antenna, are the same dimensions as in the mechanical drawings below (Figure 3 and Figure 4) with the stub for the antenna connector removed. For the surface mount units, this means the module is 32.38 mm long. For the pluggable units, the module is 33.02 mm long.

Note on Mechanical Drawings:

- All dimensions are in millimeters
- PC board material is 0.79 mm thick FR4
- Provide clearance of at least 1.5 mm around the module to be free of other components and features
- Module should not exceed 260°C during reflow soldering

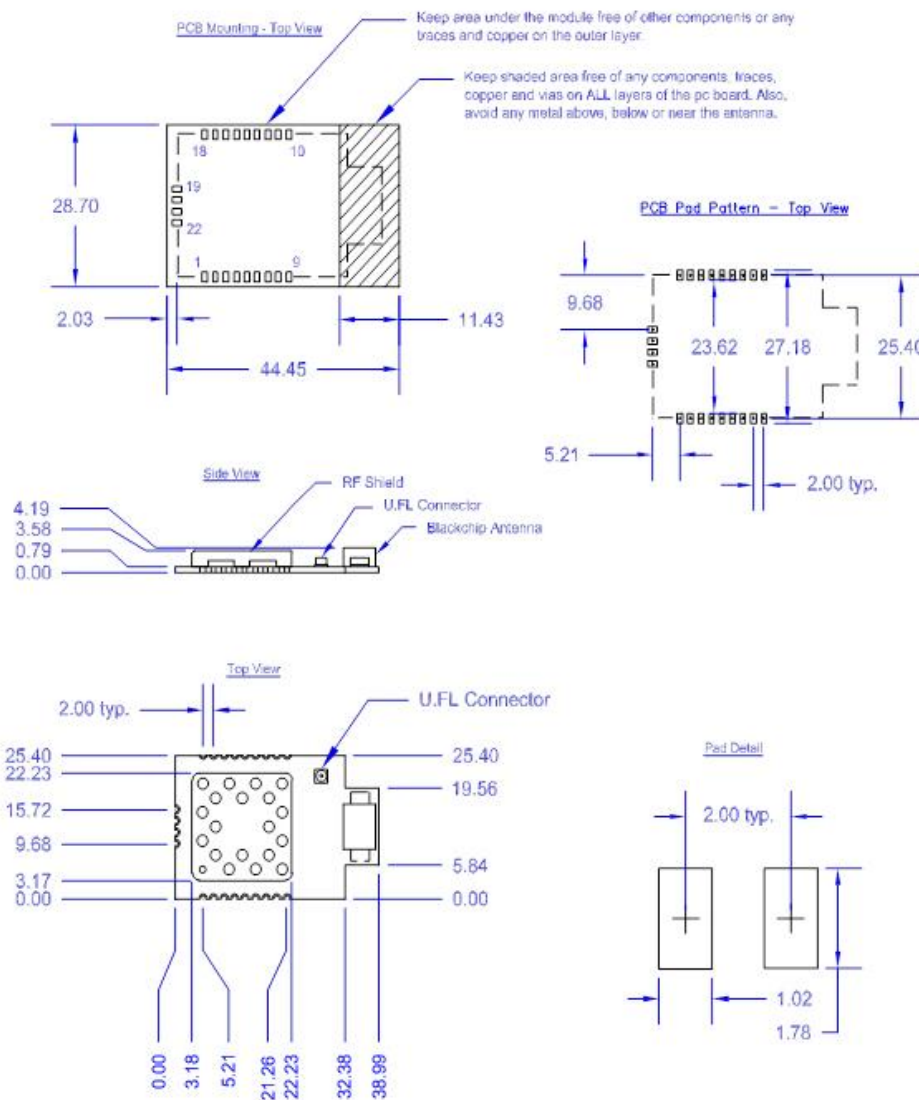


Figure 3: RM024 mechanical drawings

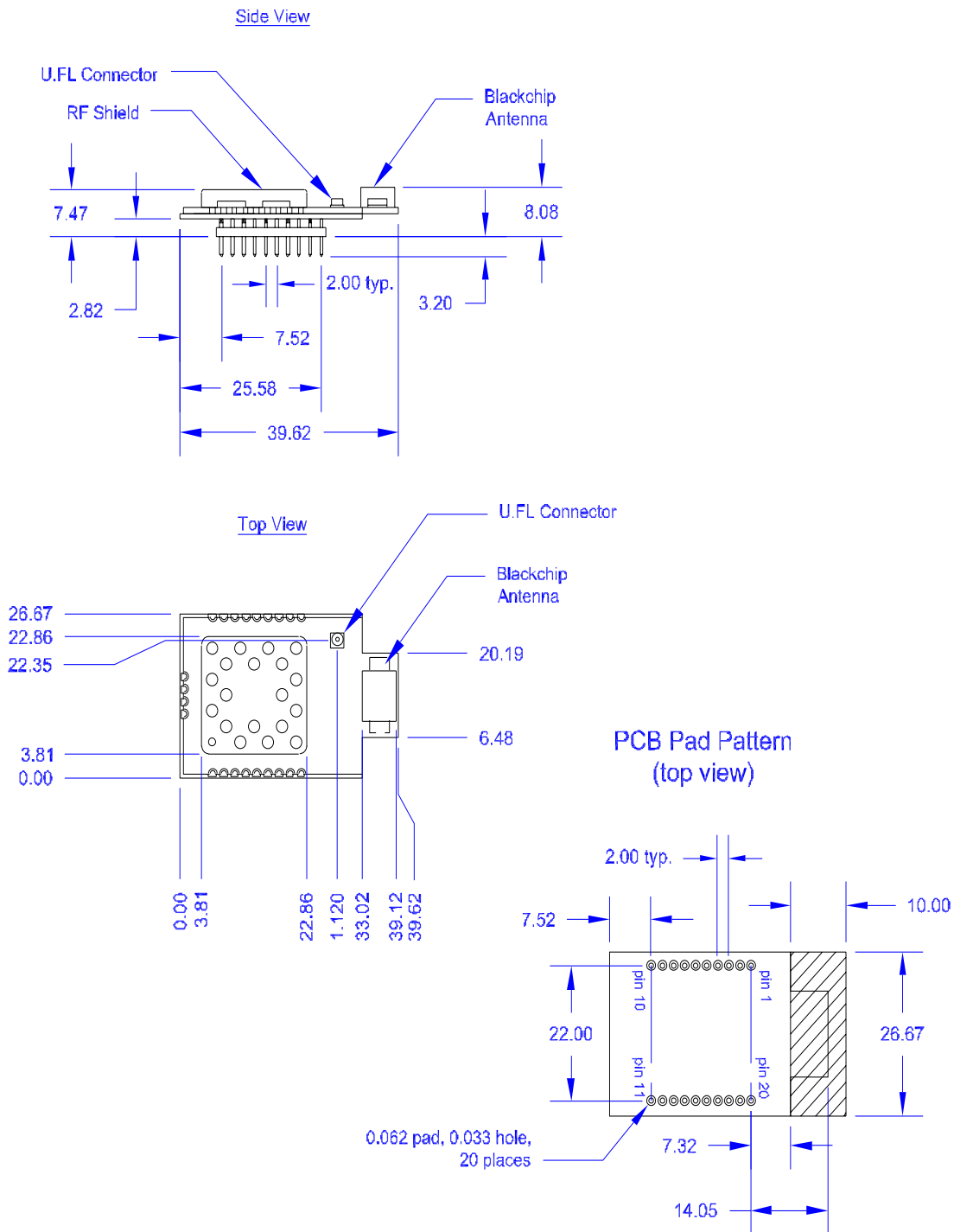


Figure 4: RM024 mechanical drawings

The pluggable RM024 uses a single row header with two mil spacing. The Mill Max 831-43-010-10-001000 is used on the RM024 development kit as a mating connector.

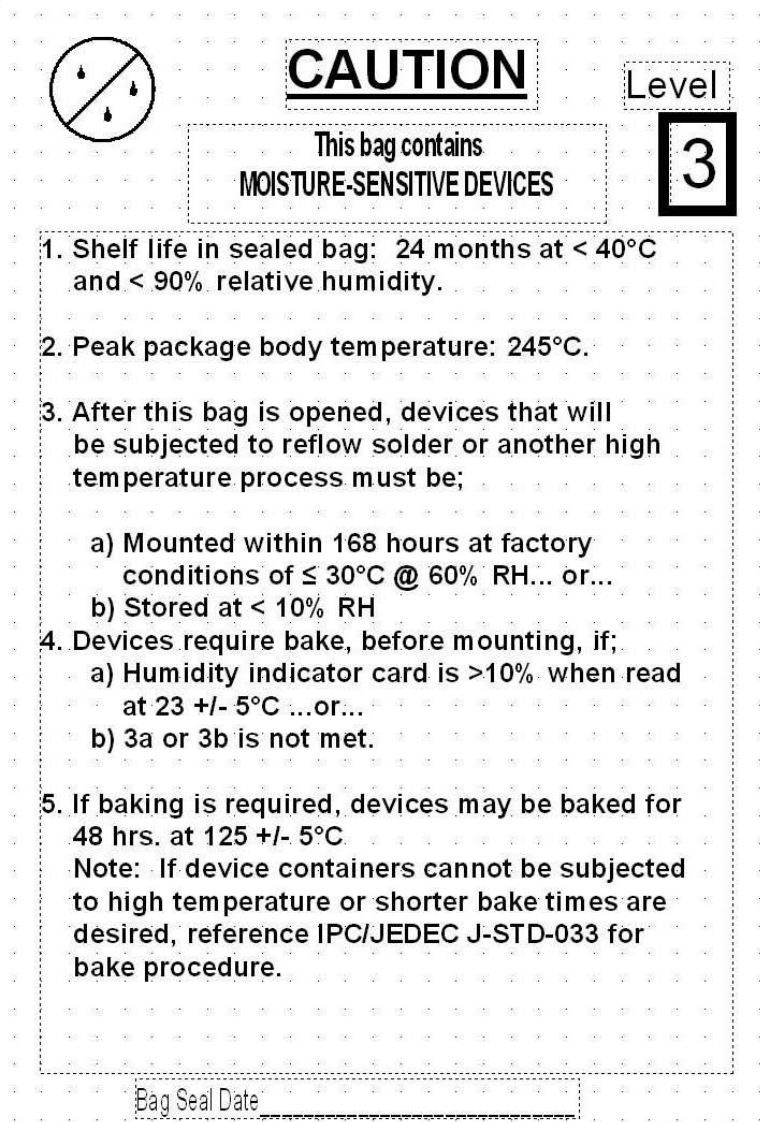


Figure 5: Moisture Content Warning

4 REFLOW PARAMETERS

Laird Connectivity's surface mount modules are designed to be easily manufactured, including reflow soldering to a PCB. Ultimately, it is the responsibility of the customer to choose the appropriate solder paste and to ensure oven temperatures during reflow meet the requirements of the solder paste. Laird Connectivity's surface-mount modules conform to J-STD-020D1 standards for reflow temperatures.

IMPORTANT: During reflow, modules should not be above 260°C and not for more than 30 seconds.

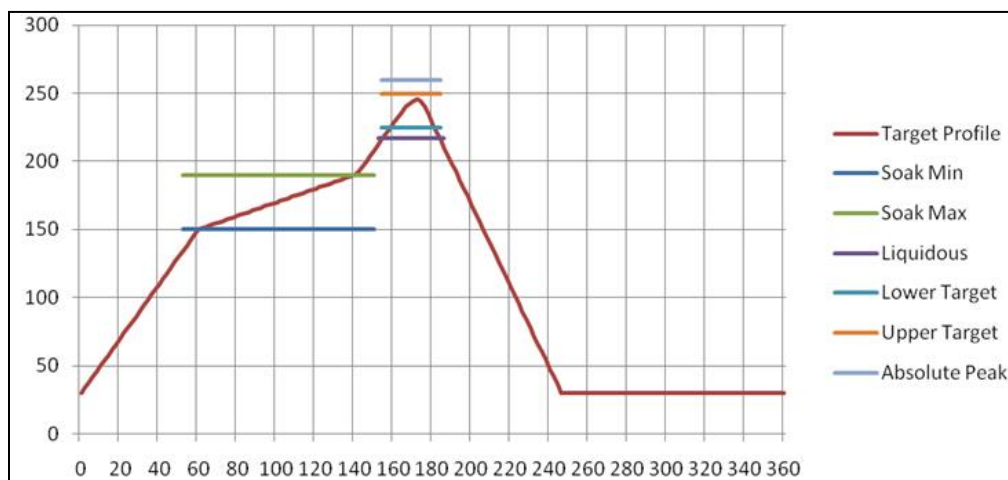


Figure 6: Recommended reflow temperature

Temperatures should not exceed the minimums or maximums presented in Figure 6.

Table 6: Reflow temperatures

Specification	Value	Unit
Temperature increase/decrease rate (maximum)	3	°C/Second
Temperature decrease rate (goal)	2-3	°C/Second
Soak temperature increase rate (goal)	.5-1	°C/Second
Flux soak period (minimum)	60	Seconds
Flux soak period (maximum)	90	Seconds
Flux soak temperature (minimum)	150	°C
Flux soak temperature (maximum)	190	°C
Time above liquidus (maximum)	60	Seconds
Time above liquidus (minimum)	20	Seconds
Time in target reflow range (goal)	30	Seconds
Time at absolute peak (maximum)	30	Seconds
Liquidus temperature (SAC305)	217	°C
Lower target reflow temperature	225	°C
Upper target reflow temperature	250	°C
Absolute peak temperature	260	°C

5 ORDERING INFORMATION

5.1 Product Part Numbers

RM024 Part Number	Form Factor	Maximum Tx Power	Antenna	EERPOM Product ID
RM024-S125-C-30	SMT	125 mW	u.FL Jack	RM024125C30
RM024-P125-C-30	Pluggable	125 mW	u.FL Jack	RM024125C30
RM024-S10-C-30	SMT	10 mW (CE)	u.FL Jack	RM02410C30
RM024-P10-C-30	Pluggable	10 mW (CE)	u.FL Jack	RM02410C30

Developer Kit Part Number	Description
DVK-RM024-CE	RM024 Developer Kit, Pluggable, 3.3V TTL Serial, 10 mW, Multiple Antennas, CE Approved
DVK-RM024-FCC	RM024 Developer Kit, Pluggable, 3.3V TTL Serial, 125mW, Multiple Antenna

6 REGULATORY INFORMATION

6.1 Current Regulatory Certifications

The RM024 holds current certifications in the following countries:

Country/Region	Regulatory ID
USA (FCC)	KQL-RM024
EU	N/A
Canada (ISED)	2268C-RM024
Japan (MIC)	RM024-S10-M: 204-320033 RM024-P10-M: 204-320034 RM024-P10-C: 204-820089
Taiwan (NCC)	N/A
Korea (KC)	RM024-S10-C/RM024-S10-M: R-C-LAI-RM024-S10-C
Australia	N/A
New Zealand	N/A
Russia	N/A

6.2 Certified Antennas

The antennas listed below were tested for use with the RM024. The OEM can choose a different manufacturer's antenna but must make sure it is of same type and that the gain is less than or equal to the antenna that is approved for use.*

***Note:** Japan (MIC) lists applicable antennas on its certificates. If your antenna is not on the approved list, regardless of whether it is comparative, it must be added to the certificate before it can be used in Japan.

Manufacturer	Manufacturer Part Number	Laird Connectivity Part Number	Type	Gain (dBi)
Laird Connectivity	WIC2450-A	0600-00042	Chip	2
Laird Connectivity	NZH2400-MMCX	2150-00006	Microstrip	1
Laird Connectivity	ID2450-RS36	CAF95990	Panel	9
Laird Connectivity	IG2450-RS36	CAF94722	Omni	6
Laird Connectivity		001-0014	FlexPIFA	2
Nearson	S181FL-6-PX-2450S	0600-00040	Dipole	2

6.3 FCC Regulatory

Product Family	US/FCC
RM024	KQL-RM024

6.3.1 RM024 Family

Part Number *	Form Factor	Tx Output	Antenna
RM024-S125-C-XX	Surface Mount	125 mW	U.FL
RM024-S125-M-XX	Surface Mount	125 mW	U.FL or Chip
RM024-P125-C-XX	Pluggable	125 mW	U.FL
RM024-P125-M-XX	Pluggable	125 mW	U.FL or Chip
RM024-S10-C-XX	Surface Mount	10 mW	U.FL
RM024-S10-M-XX	Surface Mount	10 mW	U.FL or Chip
RM024-P10-C-XX	Pluggable	10 mW	U.FL
RM024-P10-M-XX	Pluggable	10 mW	U.FL or Chip

* The last two slots (XX) in the Part Number column are used for custom setups. They can be values ranging from 01-99, aa-zz. Currently, these values are -30, for FW version 3.0.

6.3.2 Antenna Information

The RM024 family is designed to operate with the antennas listed below and a maximum gain of 9 dBi. The required antenna impedance is 50 ohms.

Manufacturer	Manufacturer Part Number	Laird Connectivity Part Number	Type	Gain (dBi)
Laird Connectivity	WIC2450-A	0600-00042	Chip	2
Laird Connectivity	NZH2400-MMCX	2150-00006	Microstrip	1
Laird Connectivity	ID2450-RS36	CAF95990	Panel	9
Laird Connectivity	IG2450-RS36	CAF94722	Omni	6
Laird Connectivity		001-0014	FlexPIFA	2
Nearson	S181FL-6-PX-2450S	0600-00040	Dipole	2

Note: The OEM is free to choose another vendor's antenna of like type and equal or lesser gain as an antenna appearing in the table and still maintain compliance. Reference FCC Part 15.204(c)(4) for further information on this topic.

To reduce potential radio interference to other users, the antenna type and gain should be chosen so that the equivalent isotropically radiated power (EIRP) is not more than that permitted for successful communication.

6.3.3 FCC Documentation Requirements

Federal Communication Commission Interference Statement

This equipment has been tested and found to comply with the limits for a Class B digital device, pursuant to Part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference in a residential installation. This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instructions, may cause harmful interference to radio communications.

However, there is no guarantee that interference will not occur in an installation. If this equipment does cause harmful interference to radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by one of the following measures:

- Reorient or relocate the receiving antenna.
- Increase the separation between the equipment and receiver.
- Connect the equipment into an outlet on a circuit different from that to which the receiver is connected.
- Consult the dealer or an experienced radio/TV technician for help.

FCC Caution: Any changes or modifications not expressly approved by the party responsible for compliance could void the user's authority to operate this equipment.

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.

FCC Radiation Exposure Statement

This product complies with the US portable RF exposure limit set forth for an uncontrolled environment and is safe for intended operation as described in this manual. Further RF exposure reduction can be achieved if the product is kept as far as possible from the user body or is set to a lower output power if such function is available.

This transmitter must not be co-located or operated in conjunction with any other antenna or transmitter.

This device is intended only for OEM integrators under the following condition:

1. The transmitter module may not be co-located with any other transmitter or antenna,

If the condition above is met, further transmitter testing is not required. However, the OEM integrator is still responsible for testing their end-product for any additional compliance requirements required with this installed module.

IMPORTANT NOTE:

If this condition cannot be met (for example, certain laptop configurations or co-location with another transmitter), then the FCC authorization is no longer considered valid and the FCC ID **cannot** be used on the final product. In these circumstances, the OEM integrator is responsible for re-evaluating the end product (including the transmitter) and obtaining a separate FCC authorization.

End-Product Labeling

The end product must be labeled in a visible area with the following: **Contains FCC ID: KQL-RM024**

Manual Information to the End User

The OEM integrator must be aware not to provide information to the end user regarding how to install or remove this RF module in the user's manual of the end product which integrates this module.

The end user manual shall include all required regulatory information/warning as show in this manual.

6.4 ISED (Canada) Statement

6.4.1 Industry Canada Statement

Product Family	Canada/IC
RM024	2268C-RM024

The end user manual shall include all required regulatory information/warning as shown in this manual.

This device complies with Industry Canada's license-exempt RSSs. 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.

Le présent appareil est conforme aux CNR d'Industrie Canada applicables aux appareils radio exempts de licence. L'exploitation est autorisée aux deux conditions suivantes:

1. *l'appareil ne doit pas produire de brouillage;*
2. *l'utilisateur de l'appareil doit accepter tout brouillage radioélectrique subi, même si le brouillage est susceptible d'en compromettre le fonctionnement.*

Radiation Exposure Statement

The product complies with the Canada portable RF exposure limit set forth for an uncontrolled environment and are safe for intended operation as described in this manual. The minimum separation distance for portable use is limited to 15mm assuming use of antenna with 2 dBi of gain. The further RF exposure reduction can be achieved if the product can be kept as far as possible from the user body or set the device to lower output power if such function is available.

Déclaration d'exposition aux radiations:

Le produit est conforme aux limites d'exposition pour les appareils portables RF pour les Etats-Unis et le Canada établies pour un environnement non contrôlé. La distance de séparation minimale pour l'utilisation portative est limitée à 15mm en supposant l'utilisation de l'antenne avec 2 dBi de gain. Le produit est sûr pour un fonctionnement tel que décrit dans ce manuel. La réduction aux expositions RF peut être augmentée si l'appareil peut être conservé aussi loin que possible du corps de l'utilisateur ou que le dispositif est réglé sur la puissance de sortie la plus faible si une telle fonction est disponible.

This device is intended only for OEM integrators under the following conditions:

1. The transmitter module may not be co-located with any other transmitter or antenna.

If the condition above is met, further transmitter testing is not required. However, the OEM integrator is still responsible for testing their end-product for any additional compliance requirements required with this module installed.

Cet appareil est conçu uniquement pour les intégrateurs OEM dans les conditions suivantes:

1. *Le module émetteur peut ne pas être coïmplanté avec un autre émetteur ou antenne.*

Tant que les 1 condition ci-dessus sont remplies, des essais supplémentaires sur l'émetteur ne seront pas nécessaires. Toutefois, l'intégrateur OEM est toujours responsable des essais sur son produit final pour toutes exigences de conformité supplémentaires requis pour ce module installé.

IMPORTANT NOTE:

If this condition cannot be met (for example, certain laptop configurations or co-location with another transmitter), then the Canada authorization is no longer considered valid and the IC ID **cannot** be used on the final product. In these circumstances, the OEM integrator is responsible for re-evaluating the end product (including the transmitter) and obtaining a separate Canada authorization.

NOTE IMPORTANTE:

Dans le cas où ces conditions ne peuvent être satisfaites (par exemple pour certaines configurations d'ordinateur portable ou de certaines co-localisation avec un autre émetteur), l'autorisation du Canada n'est plus considéré comme valide et l'ID IC ne peut pas être utilisé sur le produit final. Dans ces circonstances, l'intégrateur OEM sera chargé de réévaluer le produit final (y compris l'émetteur) et l'obtention d'une autorisation distincte au Canada.

End-Product Labeling

The final end product must be labeled in a visible area with the following: **Contains IC: xxx**

Plaque signalétique du produit final

Le produit final doit être étiqueté dans un endroit visible avec l'inscription suivante: **Contient des IC: xxx**

Manual Information to the End User

The OEM integrator has to be aware not to provide information to the end user regarding how to install or remove this RF module in the user's manual of the end product which integrates this module.

The end user manual shall include all required regulatory information/warning as show in this manual.

Manuel d'information à l'utilisateur final

L'intégrateur OEM doit être conscient de ne pas fournir des informations à l'utilisateur final quant à la façon d'installer ou de supprimer ce module RF dans le manuel de l'utilisateur du produit final qui intègre ce module.

Le manuel de l'utilisateur final doit inclure toutes les informations réglementaires requises et avertissements comme indiqué dans ce manuel.

Manufacturer	Manufacturer Part Number	Laird Connectivity Part Number	Type	Gain (dBi)
Laird Connectivity	WIC2450-A	0600-00042	Chip	2
Laird Connectivity	NZH2400-MMCX	2150-00006	Microstrip	1
Laird Connectivity	ID2450-RS36	CAF95990	Panel	9
Laird Connectivity	IG2450-RS36	CAF94722	Omni	6
Laird Connectivity	-	001-0014	FlexPIFA	2
Nearson	S181FL-6-PX-2450S	0600-00040	Dipole	2

6.5 MIC (Japan) Certification

The following are the applicable MIC certificates and IDs (Table)

MIC	Associated Products
204-320034	RM024-P10-M
204-320033	RM024-S10-M
204-820089	RM024-P10-C

6.5.1 Antenna Information

The RM024 series was tested with antennas listed below.

Note: Japan (MIC) lists applicable antennas on its certificates. If your antenna is not on the approved list, regardless of whether it is comparative, it must be added to the certificate before it can be used in Japan.

Manufacturer	Manufacturer Part Number	Laird Connectivity Part Number	Type	Gain (dBi)
Laird Connectivity	WIC2450-A	0600-00042	Chip	2
Laird Connectivity	NZH2400-MMCX	2150-00006	Microstrip	1
Laird Connectivity	ID2450-RS36	CAF95990	Panel	9
Laird Connectivity	IG2450-RS36	CAF94722	Omni	6
Laird Connectivity	-	001-0014	FlexPIFA	2
Nearson	S181FL-6-PX-2450S	0600-00040	Dipole	2

6.5.2 Labeling Requirements


It is recommended that the host device bears a label showing the Japanese “GITEKI” mark and the certification number accompanied by the following statement:

当該機器には電波法に基づく、技術基準適合証明等を受けた特定無線設備を装着している

Translation: *This equipment contains specified radio equipment that has been certified to the Technical Regulation Conformity Certification under the Radio Law.*

 R 204-320033

 R 204-320034

 R 204-820089

6.6 Korea (KC) Regulatory

The RM024-S10-C/RM024-S10-M is approved for use in the Korean market.

Model	Certificate Number
RM024	R-C-LAI-RM024-S10-C



R-C-LAI-RM024-S10-C

6.7 Australia and New Zealand Regulatory

RCM: Pending Compliant to standards EN 300 328 V1.9.1, AS/NZS 4268: 2012-A1:2013, and EN 55022:2010/AC:2011

If this device is used in a product, the OEM has responsibility to verify compliance of the final end product to the Australia/New Zealand (RCM) Standards. All end-products require their own certification (SDoc). You will not be able to leverage the module certification and ship product into the country.

6.8 Taiwan (NCC) Regulatory

The RM024 is approved for use in the Taiwan market.

Model	Certificate Number
RM024-P10-C-20	CCAL14LP0583T3
RM024-P10-M-20	CCAL14LP0580T0
RM024-S10-C-20	CCAL14LP0581T2
RM024-S10-M-20	CCAL14LP0582T1

第十二條→經型式認證合格之低功率射頻電機，非經許可，公司，商號或使用者均不得擅自變更頻率、加大功率或變更原設計之特性及功能。

第十四條→低功率射頻電機之使用不得影響飛航安全及干擾合法通信；經發現有干擾現象時，應立即停用，並改善至無干擾時方得繼續使用。

前項合法通信，指依電信法規定作業之無線電通信。低功率射頻電機須忍受合法通信或工業、科學及醫療用電波輻射性電機設備之干擾。

Note: You must place “本產品內含射頻模組：XXXXYYXXYYXXYY” on the host product in such a location that it can be seen by an operator at the time of purchase.

6.9 EU Regulatory

Part Number *	Form Factor	Tx Output	Antenna
RM024-S10-C-XX	Surface Mount	10 mW	U.FL
RM024-S10-M-XX	Surface Mount	10 mW	U.FL or Chip
RM024-P10-C-XX	Pluggable	10 mW	U.FL
RM024-P10-M-XX	Pluggable	10 mW	U.FL or Chip

* The last two slots (XX) in the Part Number column are used for custom setups. They can be values ranging from 01-99, aa-zz. Currently, these values are -30, for FW version 3.0.

6.9.1 Certified Antennas

The part numbers listed above are approved for use in CE markets with antennas having a maximum gain of 2.0 dBi. Antennas having a gain greater than the maximum allowed are strictly prohibited for use with this device. The required antenna impedance is 50 ohms.

Manufacturer	Manufacturer Part Number	Laird Connectivity Part Number	Type	Gain (dBi)
Laird Connectivity	WIC2452-A	MAF95029	Chip	2
Laird Connectivity	NZH2400-MMCX	2150-00006	Microstrip	1
Nearson	S181FL-6-PX-2450S	0600-00040	Dipole	2
Laird Connectivity	WCP2400	WCP2400	Dipole	2

Note: The OEM is free to choose another vendor's antenna of like type and equal or lesser gain as an antenna appearing in the table and still maintain compliance. Antennas listed in this table have been test with the RM024.

6.9.1.1 User's Guide Requirements

The integrator must include specific information in the user's guide for the device into which the BT85x is integrated. In addition to the required FCC and IC statements outlined above, the following Radio Equipment Directive (RED) statements must be added in their entirety and without modification into a prominent place in the user's guide for the device into which the **xxx** is integrated:

- This device complies with the essential requirements of the 2014/53/EU – Radio Equipment Directive (RED). The following test methods have been applied in order to prove presumption of conformity with the essential requirements of the 2014/53/EU – Radio Equipment Directive (RED):
 - **EN 62368-1:2014/A11:2017**
Safety requirements for audio/video, information, and technology equipment
 - **EN 300 328 v2.2.2 (2019-07)**
Electromagnetic compatibility and Radio Spectrum Matters (ERM); Wideband Transmission systems; Data transmission equipment operating in the 2.4 GHz ISM band and using spread spectrum modulation techniques; Harmonized EN covering essential requirements under article 3.2 of the R&TTE Directive
 - **EN 62311:2008 | EN 50665:2017 | EN 50385:2017**
RF exposure
 - **EN 301 489-1 v2.2.0 (2017-03)**
Electromagnetic compatibility and Radio Spectrum Matters (ERM); ElectroMagnetic Compatibility (EMC) standard for radio equipment and services; Part 1: Common technical requirements
 - **EN 301 489-17 V3.2.0 (2017-03)**
Electromagnetic compatibility and Radio spectrum Matters (ERM); ElectroMagnetic Compatibility (EMC) standard for radio equipment and services; Part 17: Specific conditions for 2,4 GHz wideband transmission systems and 5 GHz high performance RLAN equipment
 - **EU 2015/863 (RoHS 3)**
Declaration of Compliance – EU Directive 2015/863; Reduction of Hazardous Substances (RoHS)

This device is a 2.4 GHz wideband transmission system (transceiver), intended for use in all EU member states and EFTA countries, except in France and Italy where restrictive use applies.

In Italy the end-user should apply for a license at the national spectrum authorities in order to obtain authorization to use the device for setting up outdoor radio links and/or for supplying public access to telecommunications and/or network services.

This device may not be used for setting up outdoor radio links in France and in some areas the RF output power may be limited to 10 mW EIRP in the frequency range of 2454 – 2483.5 MHz. For detailed information the end-user should contact the national spectrum authority in France.

Български [Bulgarian]	С настоящото [име на производителя] декларира, че това устройство [вид оборудване] е в съответствие със съществените изисквания и други приложими разпоредби на Директиви 2014/53/EC
Hrvatski [Croatian]	[naziv proizvođača] ovim putem izjavljuje da je ovaj uređaj [vrsta opreme] sukladan osnovnim zahtjevima i ostalim bitnim odredbama Direktiva 2014/53/EU
Česky [Czech]	[Jméno výrobce] tímto prohlašuje, že tento [typ zařízení] je ve shodě se základními požadavky a dalšími příslušnými ustanoveními směrnice 2014/53/EU.
Dansk [Danish]	Undertegnede [fabrikantens navn] erklærer herved, at følgende udstyr [udstyrets typebetegnelse] overholder de væsentlige krav og øvrige relevante krav i direktiv 2014/53/EU.
Deutsch [German]	Hiermit erkläre [Name des Herstellers], dass sich das Gerät [Gerätetyp] in Übereinstimmung mit den grundlegenden Anforderungen und den übrigen einschlägigen Bestimmungen der Richtlinie 2014/53/EU befindet.
Eesti [Estonian]	Käesolevaga kinnitab [tootja nimi] seadme [seadme tüüp] vastavust direktiivi 2014/53/EL põhinõuetele ja nimetatud direktiivist tulenevatele teistele asjakohastele sätetele.

English	Hereby, <i>[name of manufacturer]</i> , declares that this <i>[type of equipment]</i> is in compliance with the essential requirements and other relevant provisions of Directive 2014/53/EU.
Español [Spanish]	Por medio de la presente <i>[nombre del fabricante]</i> declara que el <i>[clase de equipo]</i> cumple con los requisitos esenciales y cualesquiera otras disposiciones aplicables o exigibles de la Directiva 2014/53/UE.
Ελληνική [Greek]	ΜΕ ΤΗΝ ΠΑΡΟΥΣΑ <i>[όνομα του κατασκευαστή]</i> ΔΗΛΩΝΕΙ ΟΤΙ <i>[εξοπλισμού]</i> ΣΥΜΜΟΡΦΩΝΕΤΑΙ ΠΡΟΣ ΤΙΣ ΟΥΣΙΩΔΕΙΣ ΑΠΑΙΤΗΣΕΙΣ ΚΑΙ ΤΙΣ ΛΟΙΠΕΣ ΣΧΕΤΙΚΕΣ ΔΙΑΤΑΞΕΙΣ ΤΗΣ ΟΔΗΓΙΑΣ 2014/53/ΕΕ.
Français [French]	Par la présente <i>[nom du fabricant]</i> déclare que l'appareil <i>[type d'appareil]</i> est conforme aux exigences essentielles et aux autres dispositions pertinentes de la directive 2014/53/UE.
Íslenska [Icelandic]	Hér, <i>[Nafn framleiðanda]</i> , því yfir að þetta <i>[gerð búnaðar]</i> tæki er í samræmi við grunnkröfur og önnur viðeigandi ákvæði tilskipana 2014/53/ ESB
Italiano [Italian]	Con la presente <i>[nome del costruttore]</i> dichiara che questo <i>[tipo di apparecchio]</i> è conforme ai requisiti essenziali ed alle altre disposizioni pertinenti stabilite dalla direttiva 2014/53/UE.
Latviešu valoda [Latvian]	Ar šo <i>[izgatavotājanosaukums]</i> deklarē, ka <i>[iekārtas tips]</i> atbilst Direktīvas 2014/53/ES būtiskajām prasībām un citiemar to saistītajiem noteikumiem.
Lietuvių kalba [Lithuanian]	Šiuo <i>[gamintojo pavadinimas]</i> deklaruoją, kad šis <i>[įrangos tipas]</i> atitinka esminius reikalavimus ir kitas 2014/53/ES Direktyvos nuostatas.
Nederlands [Dutch]	Hierbij verklaart <i>[naam van de fabrikant]</i> dat het toestel <i>[type van toestel]</i> in overeenstemming is met de essentiële eisen en de andere relevante bepalingen van richtlijn 2014/53/EU.
Malti [Maltese]	Hawnhekk, <i>[isem tal-manifattur]</i> , jiddikjara li dan <i>[il-mudel tal-prodott]</i> jikkonforma mal-htigijiet essenzjali u ma provvedimenti oħrajn rilevanti li hemm fid-Dirrettiva 2014/53/UE.
Magyar [Hungarian]	Alulírott, <i>[gyártó neve]</i> nyilatkozom, hogy a <i>[... típus]</i> megfelel a vonatkozó alapvető követelményeknek és az 2014/53/EU irányelv egyéb előírásainak.
Norsk [Norwegian]	Herved <i>[navnet på produsenten]</i> , erklærer at denne <i>[type utstyr]</i> enheten, er i samsvar med de grunnleggende kravene og andre relevante bestemmelser i direktivene 2014/53/EU
Polski [Polish]	Niniejszym <i>[nazwa producenta]</i> oświadczam, że <i>[nazwa wyrobu]</i> jest zgodny z zasadniczymi wymogami oraz pozostałymi stosownymi postanowieniami Dyrektywy 2014/53/UE.
Português [Portuguese]	<i>[Nome do fabricante]</i> declara que este <i>[tipo de equipamento]</i> está conforme com os requisitos essenciais e outras disposições da Directiva 2014/53/UE.
Română [Romanian]	Prin prezenta, <i>[numele producătorului]</i> declară că acest dispozitiv <i>[tipul de echipament]</i> este în conformitate cu cerințele esențiale și alte prevederi relevante ale Directivelor 2014/53/UE
Slovenščina [Slovenian]	<i>[Ime proizvajalca]</i> izjavlja, da je ta <i>[tip opreme]</i> v skladu z bistvenimi zahtevami in ostalimi relevantnimi določili direktive 2014/53/EU.
Slovenčina [Slovak]	<i>[Menovýrobcu]</i> týmto vyhlasuje, že <i>[typzariadenia]</i> spĺňa základné požiadavky a všetky príslušné ustanovenia Smernice 2014/53/EU.
Suomi [Finnish]	<i>[Valmistaja]</i> vakuuttaa täten että <i>[laitteen tyyppimerkintä]</i> tyyppinen laite on direktiivin 2014/53/EU oleellisten vaatimusten ja sitä koskevien direktiivin muiden ehtojen mukainen.
Svenska [Swedish]	Härmed intygar <i>[företag]</i> att denna <i>[utrustningstyp]</i> står i överensstämmelse med de väsentliga egenskapskrav och övriga relevanta bestämmelser som framgår av direktiv 2014/53/EU.

6.9.2 EU Declaration of Conformity

Manufacturer	Laird Connectivity		
Products	Model:	RM024	
	Part Numbers:		
	RM024-S10-C-20	RM024-P10-M-24	RM024-S10-M-24
	RM024-P10-M-20	RM024-S10-M-20	RM024-P10-C-24
	RM024-S10-C-24	RM024-P10-C-20	RM024-P10-C-30
Product Description	2.4 GHz Radio Modules		
EU Directives	2014/53/EU – Radio Equipment Directive (RED)		




Reference standards used for presumption of conformity:

Article Number	Requirement	Reference standard(s)
3.1a	Low voltage equipment safety	EN 62368-1:2014+A11:2017
3.1b	Protection requirements – Electromagnetic compatibility	EN 301 489-1 v2.2.0 (2017-03) EN 301 489-17 v3.2.0 (2017-03)
3.2	Means of the efficient use of the radio frequency spectrum (ERM)	EN 300 328 v2.1.1 (2016-11)

Declaration:

We, Laird Connectivity, declare under our sole responsibility that the essential radio test suites have been carried out and that the above product to which this declaration relates is in conformity with all the applicable essential requirements of Article 3 of the EU Radio Equipment Directive 2014/53/EU, when used for its intended purpose.

Place of Issue:	Laird Connectivity W66N220 Commerce Court, Cedarburg, WI 53012 USA tel: +1-262-375-4400 fax: +1-262-364-2649
Date of Issue:	2020, June 3
Name of Authorized Person:	Ryan Urness
Signature of Authorized Person:	

7 RELATED DOCUMENTS AND FILES

Additional RM024 technical documents and software downloads are available from the [Laird Connectivity RM024 product page](#) under the Documentation tab and Software Downloads tabs.

8 ADDITIONAL ASSISTANCE

Please contact your local sales representative or our support team for further assistance:

Laird Connectivity
Support Centre: <https://www.lairdconnect.com/resources/support>
Email: wireless.support@lairdconnectivity.com
Phone: Americas: +1-800-492-2320
Europe: +44-1628-858-940
Hong Kong: +852 2923 0610
Web: <https://www.lairdconnect.com/products>

Note: Information contained in this document is subject to change.

Copyright 2020 Laird Connectivity. All Rights Reserved. Patent pending. Any information furnished by Laird Connectivity and its agents is believed to be accurate and reliable. All specifications are subject to change without notice. Responsibility for the use and application of Laird Connectivity materials or products rests with the end user since Laird Connectivity and its agents cannot be aware of all potential uses. Laird Connectivity makes no warranties as to non-infringement nor as to the fitness, merchantability, or sustainability of any Laird Connectivity materials or products for any specific or general uses. Laird Connectivity or any of its affiliates or agents shall not be liable for incidental or consequential damages of any kind. All Laird Connectivity products are sold pursuant to the Laird Connectivity Terms and Conditions of Sale in effect from time to time, a copy of which will be furnished upon request. Nothing herein provides a license under any Laird Connectivity or any third-party intellectual property right.