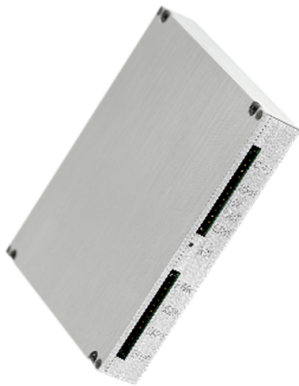# Embedded/External Mesh Rider® Radio – 5725-5875 MHz

## Overview



**Embedded**                                  **External**

The Mesh Rider® Radio is an advanced 2×2 MIMO mesh router designed for easy plug & play integration. The tiny module carries all bi-directional communication (e.g. Telemetry, Video) in a single high-speed broadband RF channel.

Due to its very low SWaP-C (Space, Weight and Power and Cost), the Mesh Rider® Radio is very popular for mobile IIoT (Industrial Internet of Things) applications like drones, autonomous vehicles, and mobile robotics applications across various industries.

The Mesh Rider® Radio employs Doodle Labs' patented Mesh Rider® technology with state-of-the-art RF and networking capabilities that enable communication further, faster, and more reliably than any comparable solution on the market. For example, the Ultra Reliable Low Latency Channel (URLLC) transports important command and control data over the wireless link, while a concurrent video-optimized streaming channel carries crystal clear 4K video.

The Mesh Rider® Radio is available in many frequency bands between 100 MHz and 6 GHz in form-factor compatible models. This allows customers to switch the operating band by simply swapping the radio module, avoiding costly re-design efforts when expanding to new markets that require new frequencies. The Mesh Rider® Radio is available in embedded and external form factors.

**For more information, please visit: https://doodlelabs.com/Mesh-Rider-radio/**

# Key Features - Mesh Rider® Radio Platform

## PERFORMANCE RF

- Long range (field tested >100km) and high throughput (up to 100 Mbps) Mesh Rider waveform
- Interference resistant COFDM for robust link quality in difficult RF environments
- Exceptional Multipath and NrLOS MIMO performance
- Adaptive radio modulations from BPSK up to 64QAM, with fast per packet optimization to maximize link performance in dynamic environments
- Software defined channel bandwidth for efficient re-use of spectrum

- Convolutional coding, Forward Error Correction (FEC), ACK-retransmits, Maximal Ratio Combining, Spatial Multiplexing, and Space Time Block Coding for robust data transmission over noisy channel/spectrum
- Single channel, Time Division Duplexing (TDD) for bi-directional traffic
- Resistant to high-power jamming signals
- ATPC for widely dispersed mesh network
- Built-in Spectrum Scanner to help mitigate interference issues

## PERFORMANCE NETWORKING

- Ultra-Reliable Low Latency Channel (URLLC) for Command and Control
- Optimized video streaming channel for Unicast and Multicast transport
- Self-healing/self-forming multi-frequency mobile mesh for highly reliable network with redundancy

- FIPS Certified AES 256- and 128-bit encryption
- End-to-end IP architecture with Ad Hoc, WDS transparent bridge, Client, AP, and Internet Gateway operating modes
- Embedded network management APIs

- Very small size, weight, and power for mobile applications
- Ethernet, USB, and UART interfaces to allow easy integration into different system architectures
- Leverage the benefits of the most extensible OpenWrt ecosystem and install 3rd party IoT applications

- Rugged, vibration resistant construction to meet MIL-specs
- MIL-spec temp range (-40C to +85C)
- High quality, manufactured in ISO 9001 and ISO 14001 certified facilities
- COTS – Commercial off the Shelf
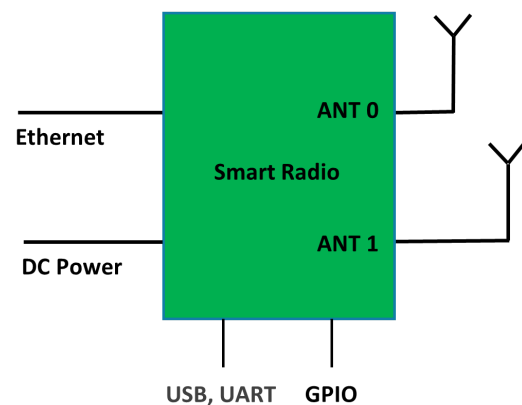- Extended lifespan and availability

# Band Introduction – 5725~5875 MHz ISM Band

The 5.8 GHz ISM Band ranges from 5725~5875 MHz. Due to its globally unlicensed nature, the 5.8 GHz ISM band is popular for establishing wireless data links for Industrial IoT use cases. The major functions of systems operating in this band are point-to-point communications, video surveillance, control of robotic systems and unmanned aerial vehicles data links supporting exchange of sensor data.

# System Integration

The Mesh Rider® Radio has been designed to be nearly plug and play. Only Ethernet/USB, power supply, and antenna connections are required for integration.

Visit Doodle Labs Technical Library for extensive design-in documents.

# Technical Specifications (5725~5875 MHz)

| Model Category | XTreme |
| --- | --- |
| **ORDERING CODES** | |
| **Radio Configuration** | 2x2 MIMO |
| **Model #**<br>**(v3 hardware)** | RM-5800-2J-XM (Embedded, Industrial temp)<br>RM-5800-2J-XM-C (Embedded, Commercial temp)<br><br>RM-5800-2J-XE (External, Industrial temp)<br>RM-5800-2J-XE-C (External, Commercial temp) |
| **Model options** | Integrated GPS – add G suffix<br>PoE (External only) – add O suffix |
| **Evaluation Kit (Optional)** | EK-5800-2J (Ethernet board for Embedded model) |
| **Design-In Documentation** | Doodle Labs Technical Library |
| **PERFORMANCE OVERVIEW** | |
| **Data Throughput at 10-meter range with Attached 3 dBi Antennas (Indicative)** | 80 Mbps (20 MHz Channel)<br>40 Mbps (10 MHz Channel)<br>20 Mbps (5 MHz Channel)<br>12 Mbps (3 MHz Channel) |
| **Over the Air Data Encryption** | 128-bit AES (Full throughput)<br>256-bit AES (12 Mbps max throughput) |
| **FIPS Certification (Optional)** | FIPS 140-3 |
| **Operating Modes** | Mesh, WDS AP, WDS Client<br>Bridged or Internet Gateway with NAT |
| **Command & Control channel** | Ultra-Reliable Low Latency Channel (URLLC). Latency 1.5-10 ms |

| | |
|---|---|
| **Video Channel** | Optimized video streaming with Unicast and Multicast transmission |

| RF SPECIFICATIONS | |
|---|---|
| **Protocol Compatibility** | Fully compatible with Doodle Labs Mesh Rider Waveform |
| **Frequency Range** | 5725-5875 MHz |
| **Advanced Band Filters** | Dedicated SAW filters for high interference immunity |
| **Max RF Power at SMA port (Software control) Each radio individually calibrated** | 800mW (29 dBm) @ MCS 0,8<br>400mW (26 dBm) @ MCS 3,11<br>250mW (24 dBm) @ MCS 5,13<br>200mW (23 dBm) @MCS 7,15 |
| **Channel Sizes (Software Selectable)** | 3, 5, 10, 20, 40 MHz |
| **Radio Data Rate** | Auto adapting Modulation Coding Scheme (MCS0-15) |
| **Antenna Signal Strength** | -25 to -85 dBm (Recommended), Absolute Maximum= +12 dBm |
| **RF Power Control** | In 1 dBm steps, Tolerance ±1 dBm |
| **Automatic Transmit Power Control (ATPC)** | Intelligently adjusts the transmit power for very close range operation |
| **Integrated Antenna Port Protection** | Able to withstand open port, >10 KV (contact) and >15KV (open air discharge) as per IEC-61000-4-2 |
| **Wireless Error Correction** | FEC, ARQ |
| **Receive Noise Figure** | +4 dB |
| **Receive Adjacent Channel Rejection (ACRR)** | 34 dB @ MCS0 for 20 MHz channel (Typ) |

| | |
|---|---|
| **Transmitter Adjacent Channel Leakage Ratio (ACLR)** | < 28 dBr (Fc ± ChBW) |
| **Transmitter Spurious Emission Suppression** | < 55 dBc |
| **Frequency Accuracy** | ±10 ppm max over life |
| **Control for External Power Amp** | DC biased signal over RF port |

## NETWORKING SPECIFICATIONS

| | |
|---|---|
| **Mesh Router** | Self-Forming/Self-Healing, Peer to Peer |
| **Custom Software Package Manager** | Image Builder, OPKG, ipk |
| **Radio Management** | Web GUI (HTTPs), SSH and JSON-RPC |
| **Access control** | Password, MAC, IP, Port filtering |
| **Supported Protocols** | IPv6, QoS, DNS, HTTPS, IP, ICMP, NTP, DHCP |
| **Software Upgrade** | Over the air software upgrade supported |

## HARDWARE SPECIFICATIONS

| | |
|---|---|
| **Case Material** | Aluminum (Embedded & External) |
| **Power Input** | 6V - 42V DC **(EOL August 2022)**<br>6V - 32V DC<br><br>External supports passive POE |
| **DC Power Consumption** | 14.5W @ 30dBm RF power in UDP data Tx mode<br>9.8W @ 200mW (23 dBm) RF power in UDP data Tx mode<br>5.6W in data Rx mode<br>1.2W in Standby mode |

| | |
|---|---|
| **Dimensions** | 65 x 57 x 12 mm, 78 grams (Embedded)<br>148 x 137 x 58 mm, 540 grams (External) |
| **Mesh Rider Antenna Ports** | 2x MMCX-Female (Embedded)<br>2x SMA-Female (External) |
| **Host Interface** | 2x Ethernet (100 Base-T), 1x UART (3.3V), 2x USB 2.0 Host, 2x GPIO (Embedded)<br><br>2x Ethernet (100 Base-T), 1x UART (RS232), 2x USB 2.0 Host, 2x GPIO (External) |
| **Temperature range (Operating)** | Industrial: -40°C to +85°C, Commercial: -10°C to +65°C<br><br>*System's thermal design should ensure that the radio's case temperature is maintained within these specifications.* |
| **Ingress Protection** | IP 50 (Embedded), Dust Protected, No Liquids<br><br>IP66 — Protected from high pressure water jets from any direction. |
| **Relative Humidity** | 5% to 95% noncondensing |
| **Shock and Vibration Resistance** | Compliant to MIL-STD-810H for high shock and vibration |
| **Reliability** | Extreme Reliability, IPC Class 2 standard with Class 3 options |
| **Integrated GPS (optional)** | Simultaneous multiple constellations (GPS/Galileo/Glonass/BeiDou/QZSS), 1.5 meter CEP position accuracy, -163 dBm tracking sensitivity |
| **Integrated GPS Module with LNA** | u-blox MAX-M8 series Concurrent GNSS Module (u-blox.com) |

| | |
|---|---|
| **GPS Antenna** | SMA-Female connector for external Passive antenna (External) <br> MMCX-Female connector for external Passive antenna (Embedded) <br><br> *(use of Active GPS antenna is not recommended)* |
| **Integrated CPU** | MIPS 24Kc, 540 MHz, 32MB Flash, 64MB DDR2 RAM |
| **ESD Protection** | IEC 61000-4-2 test criteria, Level 3 (±6KV) for Contact Discharge and Level 4 (±15KV) for Air Discharge |
| **MTBF** | >235k hours (25 years) |
| **Life Cycle Planning** | Extended lifespan with 7 years guaranteed availability |
| **REGULATORY INFORMATION** | |
| **J/F-12 Certification** | 11929 (NTIA DD1494 available upon request) |
| **FCC ID** | 2AG87RM-5800 |
| **Industry Canada (IC)** | 21411-RM5800 |
| **Flammability Rating** | UL94 V-0 compliant |
| **Regulatory Requirements** | Designed and verified to meet various regulatory requirements. Formal testing and approval are required for the Integrator's antenna type. The Integrator is responsible for obtaining all regulatory approvals in target markets for the finished product. |
| **RoHS/WEEE Compliance** | Yes. 100% Recyclable/Biodegradable packaging |
| **EXPORT INFORMATION** | |
| **ECCN Code** | 5A992 |
| **HS Code** | 85256010 |

## ADDITIONAL RF SPECIFICATIONS

| MCS Rate | Modulation | Combined Output Power (dBm) | Sensitivity (dBm) | UDP Throughput (Mbps) |
|---|---|---|---|---|
| 0 | BPSK (1/2) | 29 | -93 | 5.4 |
| 1 | QPSK (1/2) | 28 | -90 | 10.62 |
| 2 | QPSK (3/4) | 28 | -88 | 15.66 |
| 3 | 16-QAM (1/2) | 28 | -85 | 20.52 |
| 4 | 16-QAM (3/4) | 26 | -80 | 29.88 |
| 5 | 64-QAM (2/3) | 25 | -78 | 38.88 |
| 6 | 64-QAM (3/4) | 24 | -75 | 43.11 |
| 7 | 64-QAM (5/6) | 23 | -72 | 47.34 |
| 8 | BPSK (1/2) | 29 | -90 | 10.53 |
| 9 | QPSK (1/2) | 28 | -86 | 20.43 |
| 10 | QPSK (3/4) | 28 | -84 | 29.7 |
| 11 | 16-QAM (1/2) | 28 | -81 | 38.52 |
| 12 | 16-QAM (3/4) | 26 | -77 | 54.72 |
| 13 | 64-QAM (2/3) | 25 | -73 | 69.3 |
| 14 | 64-QAM (3/4) | 24 | -72 | 76.14 |
| 15 | 64-QAM (5/6) | 23 | -71 | 82.8 |

Note 1: Performance based on 20-MHz bandwidth
Note 2: Sensitivity and throughput are approximately proportional to bandwidth.

# FCC Statement

Changes or modifications not expressly approved by the party responsible for compliance could void the user's authority to operate the equipment.

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 a particular 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 or more 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

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

# IC Statement

This device complies with Industry Canada's licence-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.

The term "IC: " before the certification/registration number only signifies that the Industry Canada technical specifications were met. This product meets the applicable Industry Canada technical specifications.

Le présent appareil est conforme aux CNR d'Industrie Canada applicable aux appareils radio exempts de licence. L'exploitation est autorisée aux deux conditions suivantes : (1) l'appareil ne doit pas produire de brouillage, et (2) l'utilisateur de l'appareil doit accepter

tout brouillage radioélectrique subi, même si le brouillage est susceptible d'en compromettre le fonctionnement