Mesh Rider® Radios - Legacy Models ⌄

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Datasheet: Embedded Mesh Rider® Radio – 902~928 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/

Samples available on Mouser: https://www.mouser.com/search/refine.aspx?N=4248121056

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

ADDITIONAL FEATURES

- 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 – 900 MHz ISM Band

The 900 MHz band is also known as the 33-centimeter band. RF signals at 900 MHz can penetrate through building walls, vegetation, and other obstacles. 900 MHz signals can also go around objects by refraction. Due to these transmission characteristics, broadband

communication in the 900 MHz band achieves a good balance of range, penetration, and throughput.

The 900 MHz band is license-free in large parts of the world: all of ITU's region 2 (23 countries in Americas) and some additional countries like Australia, New Zealand and South Korea. In the USA, like WiFi, FCC Part 15 certified radios are permitted for unlicensed operation.

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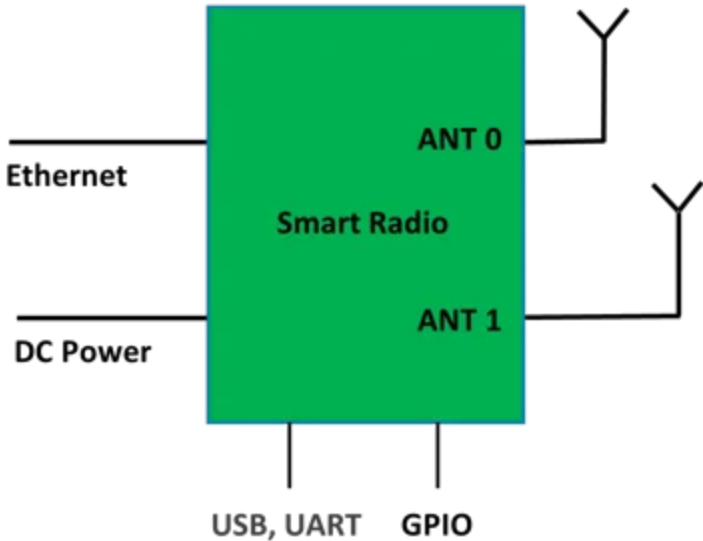
The Mesh Rider® Radio has been designed to be nearly plug and play. Only Ethernet/USB, power supply, and antenna connections are required for integration.

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

Technical Specifications (902~928 MHz)

Model Category	XTreme
ORDERING CODES	
Radio Configuration	2x2 MIMO
Model # (v3 hardware)	RM-915-2J-XM (Embedded, Industrial temp) RM-915-2J-XMC (Embedded, Commercial temp) RM-915-2J-XE (External, Industrial temp) RM-915-2J-XE-C (External, Commercial temp)
Model options	Integrated GPS – add G suffix

	PoE (External only) – add O suffix
Evaluation Kit (Optional)	EK-915-2J (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) 40 Mbps (10 MHz Channel) 20 Mbps (5 MHz Channel) 12 Mbps (3 MHz Channel)
Over the Air Data Encryption	128-bit AES (Full throughput) 256-bit AES (12 Mbps max throughput)
FIPS Certification (Optional)	FIPS 140-3
Operating Modes	Mesh, WDS AP, WDS Client 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	902-928 MHz Channel plans available for all countries in Americas, Australia, New Zealand, and China
Advanced Band Filters	Dedicated SAW filters for high interference immunity
Max RF Power at SMA port (Software control) Each radio individually calibrated	1.0W (30 dBm) @ MCS 0,8 0.8W (29 dBm) @ MCS 3,11 0.4W (26 dBm) @ MCS 5,13 250mW (24 dBm) @MCS 7,15
Channel Sizes (Software Selectable)	3, 5, 10, 20 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)** 6V - 32V DC

	External supports passive POE
DC Power Consumption	9W @ Max RF power in UDP data Tx mode 3.4W in data Rx mode 1.2W in Standby mode
Dimensions	65 x 57 x 12 mm, 78 grams (Embedded) 148 x 137 x 58 mm, 540 grams (External)
Mesh Rider Antenna Ports	2x MMCX-Female (Embedded) 2x SMA-Female (External)
Host Interface	2x Ethernet (100 Base-T), 1x UART (3.3V), 2x USB 2.0 Host, 2x GPIO (Embedded) 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 * 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 IP66 — Protected from high pressure water jets from any direction.
Relative Humidity	5% to 95% non-condensing
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) MMCX-Female connector for external Passive antenna (Embedded) (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	2AG87RM915-2J
Industry Canada (IC)	21411-RM9152J
ANATEL	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)	30	-93	5.4
1	QPSK (1/2)	29	-90	10.62
2	QPSK (3/4)	29	-88	15.66
3	16-QAM (1/2)	29	-85	20.52
4	16-QAM (3/4)	27	-80	29.88
5	64-QAM (2/3)	26	-78	38.88
6	64-QAM (3/4)	25	-75	43.11

7	64-QAM (5/6)	24	-72	47.34
8	BPSK (1/2)	30	-90	10.53
9	QPSK (1/2)	29	-86	20.43
10	QPSK (3/4)	29	-84	29.7
11	16-QAM (1/2)	29	-81	38.52
12	16-QAM (3/4)	27	-77	54.72
13	64-QAM (2/3)	26	-73	69.3
14	64-QAM (3/4)	25	-72	76.14
15	64-QAM (5/6)	24	-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

CE Statement

This is a Class A product. In a domestic environment, this product may cause radio interference, in which case the user may be required to take adequate measures.

CAUTION: To comply with the Europe CE requirement, this device must be installed with CE certified computer equipment which meet with Class A limits. Be aware that outdoor installations require special attention and will only be handled by trained and qualified installation personnel.

All cables used to connect this device must be shielded and grounded. Operation with non-certified computers or incorrect cables may result in interference to other devices or

undesired effects to the product. Particular attention has to be given allowed operational frequencies.

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Datasheet: mini-OEM Helix Mesh Rider Radio - 1625~2500 MHz (M1-M6 Hex bands)

Datasheet: Wearable Mesh Rider Radio – 2400~2482 MHz (WiFi Band)

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