

Doodle Labs Smart Radio – RM-915

SWaP Optimized COFDM/MIMO Broadband Radio with Ethernet

Smart Radio Overview

The Smart Radio is a tiny, full-featured broadband MIMO radio and a mesh router. It has an Ethernet interface to allow easy integration into any system. With up to 1W of RF power and 2x2 MIMO technology, the Smart Radio can transmit large amounts of data (e.g. 4K video) in real-time from over 20 km away. Doodle Labs' Smart Radio has been designed to allow OEMs to rapidly develop new Industrial IoT applications.



The Smart Radio's flexible frequency architecture can satisfy customers' requirements in any market or country. The Smart Radios are available in many frequency bands up to 4 GHz and have been designed to be interchangeable, allowing customers to switch the operating bands by simply swapping the radio.

Key Features

PERFORMANCE RF

- Interference resistant COFDM for improved link quality in busy RF environments
- Adaptive radio modulations from DSSS up to 64QAM and continuous per packet optimization to maximize link performance in dynamic environments
- Software defined channel size of 5~40 MHz for efficient re-use of spectrum
- Software defined operating frequency band for global applications
- Exceptional Multipath and NLOS performance
- Convolutional Coding, Forward error correction (FEC), Ack-retransmits for robust data transmission over noisy spectrum
- Maximal Ratio Combining and beam forming for diversity antenna gain
- Spatial Multiplexing for enhanced throughput
- Space Time Block Coding for increased robustness
- Time Division Duplexing (TDD) for bi-directional traffic
- Distributed control with CSMA/CA to auto balance the network for

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Data Sheet

asymmetric up/down traffic and throughput requirements of each node

- Long range (up to 20 km) with adjustable RF power to reduce interference
- Fast handoff for mobile applications

PERFORMANCE NETWORKING

- High data throughput up to 100 Mbps
- Advanced QOS and multimedia traffic prioritizations for low latency Command and Control as well as 4K video streaming on the same link
- Self-healing/self-forming mesh router with high scalability
- Multiple network access and authentication methods
- Support for all topologies, including infrastructure, adhoc, PtP, PtmP, and Repeater modes
- Up to 256-bit AES encryption for over the air data
- Firewall - MAC/IP/protocol/port filtering for restricted access control
- Embedded network management GUI with diagnostics
- Supported Protocols - DNS, HTTP, HTTPS, IP, ICMP, NTP, TCP, UDP, RADIUS, DHCP, VLAN, STP/RSTP, VPN, IPSec, L2TP, GRE

- 3 levels of software licenses to meet customer requirements

ADDITIONAL FEATURES

- Very small size, weight, and power (SWaP) for mobile applications
- Ethernet interface to allow easy integration into various applications
- Available in 100 MHz – 4 GHz frequency range in form factor compatible models
- Rugged construction, Industrial temperature range (-40C to +85C)
- OTA firmware upgrade
- Field proven and deployed in critical applications where failure is not an option
- COTS – Commercial off the Shelf

TARGET APPLICATIONS

- Unmanned Aerial Vehicles (Drones)
- Mobile robotics
- Mines and Construction site machines
- Public Safety/Video surveillance
- Private Networks in Oil and gas fields
- Wireless Ethernet extensions

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Band Introduction – 900 MHz ISM Band

The 900 MHz band is also known as the 33-centimeter band. It ranges from 902 to 928 MHz. The RF signals at 900 MHz can propagate further distances than the traditional Wi-Fi via two mechanisms: penetration and diffraction. Penetration refers to 900 MHz waves ability to penetrate through building walls, vegetation and other obstacles. 900 MHz waves can go through multiple building walls making it an excellent choice for applications that do not have a direct line of sight between sender and receiver. Diffraction describes the characteristic of a 900 MHz wave that it can go around an object such as a building or vegetation. Because of these transmission characteristics, Broadband communication in 900 MHz band is highly desirable to achieve a good balance of range, penetration and throughput.

The 900 MHz band is license free in large parts of the world - all ITU's region 2 (23 countries in Americas) and few Asian countries like China, Australia, New Zealand and South Korea. In the USA, like WiFi, FCC Part 15 certified radios are permitted for unlicensed operation. A private WBWAN implemented in license free band avoids the recurring monthly cost of public cellular network.

Doodle Labs Products for 900 MHz ISM Band

Description	Model No.
1x1 COFDM Broadband Transceiver with miniPCIe interface	NM-915-1G
2x2 MIMO Broadband Transceiver with miniPCIe interface	NM-915-2H
1x1 COFDM Smart Radio with Ethernet interface	RM-915-1G
2x2 MIMO Smart Radio with Ethernet interface	RM-915-2H
1x1 COFDM WiFi Frequency shifter for 915 MHz	GM-915-1
2x2 MIMO WiFi Frequency shifter for 915 MHz	HM-915-2

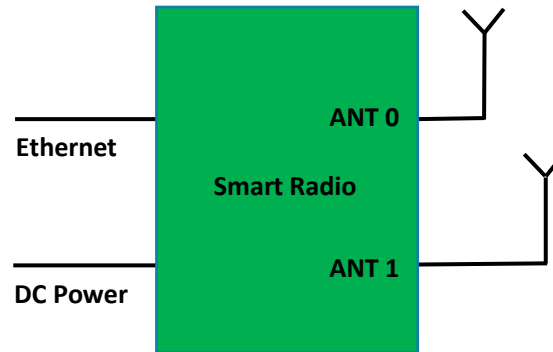
System Integration

The Smart Radio is easy to integrate. Only the Ethernet, Power supply and Antenna connections are required. The Smart Radio integrates the CPU and optimized OpenWRT to free the systems developer from the details.

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Doodle Labs provides following documents upon request - Integration Guide, 3D CAD model, Mechanical Drawing and Cable Drawing.



Technical Specifications (900 MHz Band)



Model No.	RM-915-1G	RM-915-2H
Radio Configuration	1x1 COFDM	2x2 MIMO
Frequency Range	902-928 MHz	
Channel Bandwidth	5, 10, and 20 MHz	
Data Throughput (64 QAM, 20 MHz BW)	50 Mbps	100 Mbps
Operating Range (Indicative)	8 Km	16 Km
	6 dBi antenna on both sides, 15 dBm fade margin, BPSK rate	
RF Power Output	0.5W (27 dBm) @ BPSK 0.5W (27 dBm) @ 16QAM 125 mW (21 dBm) @ 64QAM	1W (30 dBm) @ BPSK 1W (30 dBm) @ 16QAM 250 mW (25 dBm) @ 64QAM
RF Power Control	In 0.5 dBm steps. Accuracy of power calibration loop ± 2 dBm. Each transceiver individually calibrated and tested.	
Rx Sensitivity (5 MHz Channel BW)	-92 dBm @ BPSK -73 dBm @ 64QAM	-95 dBm @ BPSK -72 dBm @ 64QAM

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Data Sheet

Model No.	RM-915-1G	RM-915-2H
Radio Data Rates (Dynamic Link Adaptation)	1, 2, 5.5, 6, 9, 11, 12, 18, 24, 36, 48 and 54 Mbps, MCS0-7	1, 2, 5.5, 6, 9, 11, 12, 18, 24, 36, 48 and 54 Mbps, MCS0-15
Wireless Protocol	TDD with Carrier Sense Multiple Access with Collision Avoidance	
Wireless Error Correction	FEC, ARQ	
Wireless Data Encryption	Up to 256-bit AES data encryption	
Special Features	<p>Extended lifespan with many years' planned availability</p> <p>Extreme Reliability, IPC Class 2 standard with Class 3 options</p> <p>Compliant to MIL-STD-202G for high shock/vibration environments</p>	
SOFTWARE SPECIFICATIONS		
Operating Modes	AP, Client and Adhoc modes to implement Access Point, PtP, PtmP, and Mesh networks	
Traffic Prioritization	Advanced QOS and multimedia traffic prioritizations for low latency Command and Control as well as 4K video streaming on the same link	
Mesh Router	Self-Forming/Self-Healing, Peer to Peer	
Firewall	MAC/IP/protocol/port filtering for restricted access control	
Supported Protocols	DNS, HTTP, HTTPS, IP, ICMP, NTP, TCP, UDP, RADIUS, DHCP, VLAN, STP/RSTP, VPN, IPSec, L2TP, GRE	
Software License	<p>3 Levels of Software licenses to meet customer requirements. See separate Software datasheet for more details.</p> <ol style="list-style-type: none"> 1. Doodle Labs OpenWRT (DO) – For customers requiring plug and play operation. An optimized instance of OpenWRT to maximize the radio's hardware capabilities 2. Rajant Instamesh (RI) – For customers needing advanced mobile mesh 3. Generic OpenWRT (GO) – For customers requiring own Linux based custom software development 	

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Data Sheet

Model No.	RM-915-1G	RM-915-2H
HARDWARE SPECIFICATIONS		
Operating Voltage	5.5~40V DC	
Power Consumption	6.3W @ Max power, in continuous data transfer mode 2.2W in continuous data receive mode 1W in Sleep mode	9W @ Max power in continuous data transfer mode 3.4W in continuous data receive mode 1.2W in Sleep mode
Antenna Signal Strength	-35 to -85 dBm (Recommended), Absolute Maximum=+12 dBm	
Interference Immunity	SAW filters on ANT and RF ports for immunity against high power cellular transmissions in the neighboring 900 MHz bands	
Integrated Antenna Port Protection	Able to withstand open port, >10 KV (contact) and >15KV (open air discharge) as per IEC-6100-4-2	
Receiver LNA Gain	>10 dB	
Receiver Adjacent Channel Rejection (ACR)	>18 dB @ 6 Mbps (Typ)	
Receiver Alternate Channel Rejection (ALCR)	>35 dB @ 6 Mbps (Typ)	
Receive chain Noise Figure	+6 dB	
Transmitter Adjacent Channel Leakage Power Ratio (ACLR)	45 dB (Fc ± ChBW)	
Transmitter Spurious Emission Suppression	-55 dBc	
Freq Accuracy	±10 ppm Max	
Control for External Power Amp	DC biased signal over RF ports	
PHYSICAL, ENVIRONMENTAL SPECIFICATIONS		

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Model No.	RM-915-1G	RM-915-2H
Dimensions	37x57x11 mm, 40 grams	65x57x11 mm, 60 grams
Antenna Connection	1x MMCX-Female	2x MMCX-Female
Host Interface	Ethernet	
Shield case temperature range (Operating)	-40°C to +85°C System's thermal design should ensure that the transceiver's case temperature is maintained within these specifications.	
Humidity (Operating)	0% – 95% (Non-condensing)	
OTHER SPECIFICATIONS		
MTBF	25 years	
FCC ID	2AG87RM-915-1G	2AG87RM-915-2H
Industry Canada (IC)	21411-RM9151G	21411-RM9152H
Regulatory Requirements	Designed and Verified to meet various regulatory requirements. Formal testing and approval is required based on the Integrator's host platform and antenna type. The Integrator is also responsible for obtaining all required regulatory approvals in target markets for the finished product.	
RoHS/WEEE Compliance	Yes. 100% Recyclable/Biodegradable packaging	

* Specifications are subject to change without prior notice.

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