Datasheet

Doodle Labs Smart Radio – RM-915
High-performance embedded MIMO radio/mesh router in a tiny form factor

Smart Radio Overview

The Smart Radios are an advanced 2×2 MIMO mesh system designed for easy plug & play integration. The tiny module carries all the bi-directional, high-speed Broadband communications (Control, Telemetry and Payload) into a single RF channel. Because the design is very low SWaP (Space, Weight and Power), the Smart Radios are very popular for mobile IIoT (Industrial Internet of Things) applications like drones, autonomous vehicles and mobile robotic applications in different industry verticals.

The Smart Radios employ Doodle Labs' BII® technology (Broadband for Industrial IoT) with state-of-the-art RF and networking capabilities to enable communication further, faster, and more reliably than ever before. The Ultra Reliable Low Latency Channel (URLLC) transports important C&C data over the wireless while optimized video streaming channel carries crystal clear 4K video.

Smart Radios are available in many frequency bands between 100 MHz and 4 GHz, allowing customers to switch the operating bands by simply swapping the radio module.

For more information, please visit - https://doodlelabs.com/smart-radio/

Key Features of the Smart Radio Platform

PERFORMANCE RF

- Long range and high throughput

- Interference resistant COFDM/MIMO for improved link quality in difficult RF environments;

- Exceptional Multipath and NrLOS performance

- Adaptive radio modulations from BPSK up to 64QAM, with continuous per packet optimization to maximize link performance in dynamic environments

- Software defined channel size for efficient re-use of spectrum

- Software defined operating frequency for global applications

- Convolutional coding, Forward Error Correction (FEC), ACK-retransmits, Maximal Ratio Combining, Spatial Multiplexing, and Space Time Block Coding for robust data transmission over noisy spectrum

- Time Division Duplexing (TDD) for bi-directional traffic

PERFORMANCE NETWORKING

- Ultra-Reliable Low Latency Channel (URLLC) for Command and Control

- Optimized video streaming channel on the same radio link

- Self-healing/self-forming mobile mesh for highly reliable network with redundancy

- End-to-end IP architecture for Unicast and Multicast traffic

- Up to 256-bit AES encryption for over the air data

- Leverage the benefits of the most advanced and most extensible OpenWrt ecosystem

- Fast hand-off for mobile applications
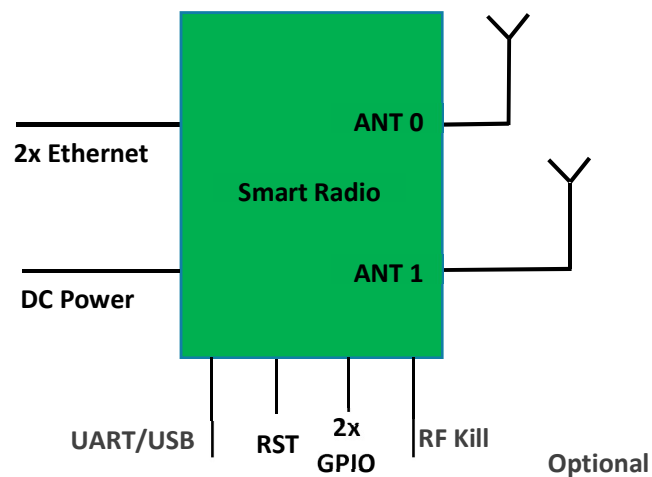
- Embedded network management APIs

ADDITIONAL FEATURES

- Very small size, weight, and power (SWaP) for mobile applications

- Ethernet and UART interfaces to allow easy integration into different system architectures

- Rugged, vibration resistant construction, Industrial temperature range (-40C to +85C)

- COTS – Commercial off the Shelf

- Extended lifespan and availability
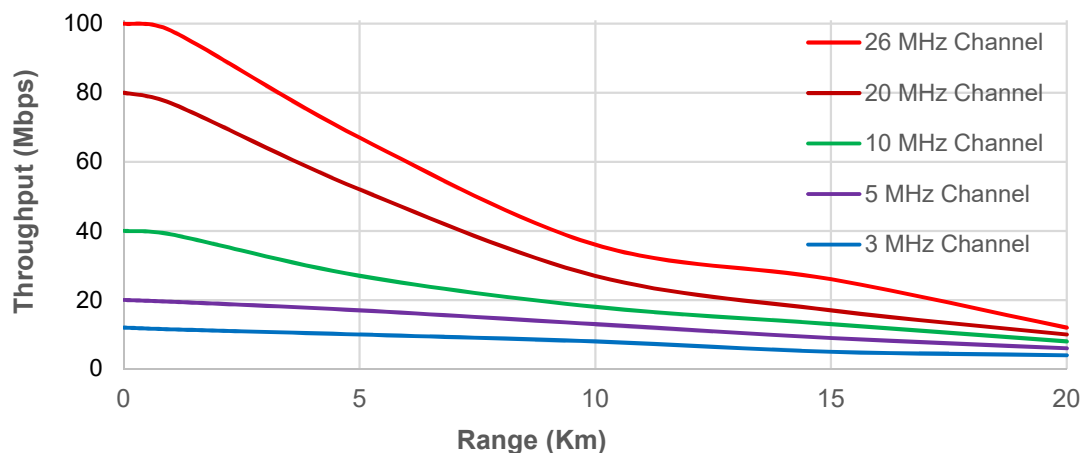
System Integration

The Smart Radio is an embedded module. It has been designed to be nearly plug and play. Only Ethernet, power supply (5.5~42V), and antenna connections are required for integration.

**Doodle Labs provides extensive Design-In documents upon request.
https://doodlelabs.com/contact-us/**

Enabling Industrial Internet Revolution

Xtreme Link Performance (Indicative)

Throughput (Mbps) vs **Range (Km)**

- 26 MHz Channel
- 20 MHz Channel
- 10 MHz Channel
- 5 MHz Channel
- 3 MHz Channel

Link Configuration:
9 dBi antennas on both ends of the link, Cross-polarized H and V antennas for maximum diversity.

> 15 dBm fade margin to account for changing RF conditions.

Pro Link Performance (Indicative)

Throughput (Mbps) vs **Range (Km)**

- 20 MHz Channel
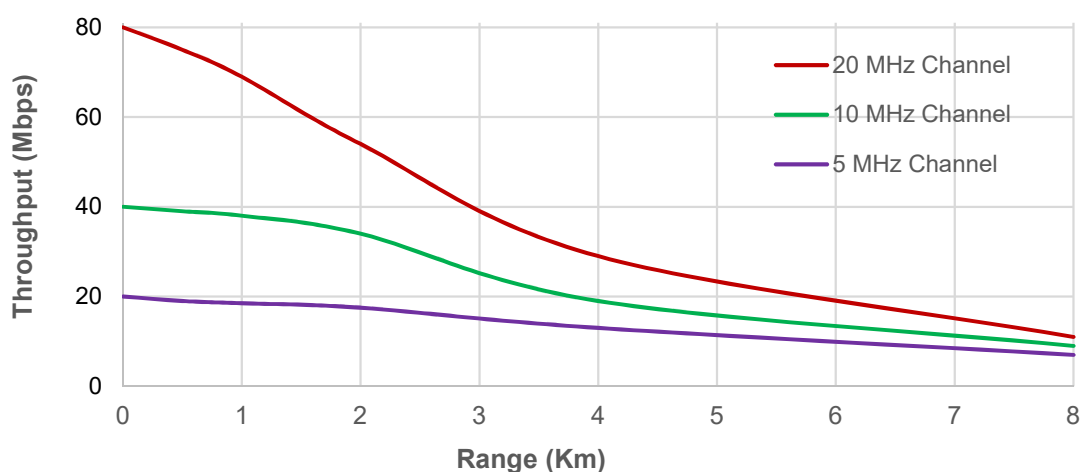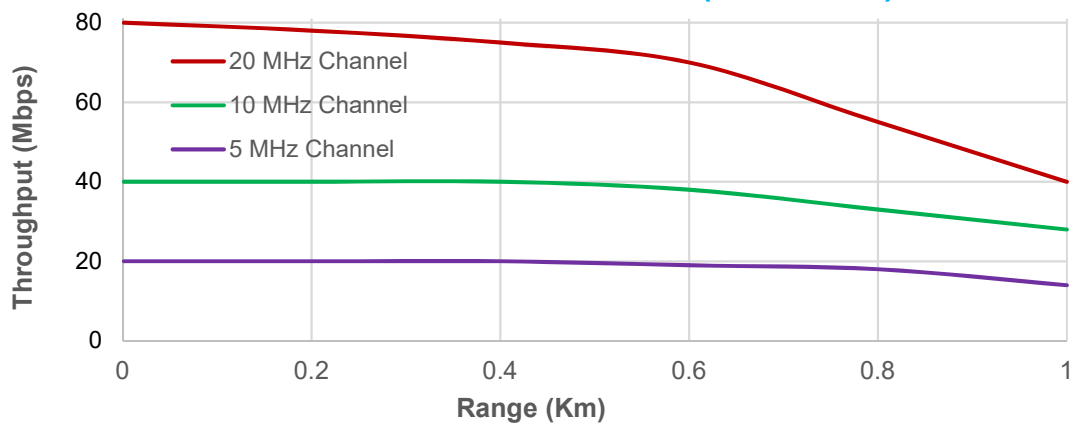- 10 MHz Channel
- 5 MHz Channel

Link Configuration:
6 dBi antennas on both ends of the link, Cross-polarized H and V antennas for maximum diversity.

> 15 dBm fade margin to account for changing RF conditions.

Standard Link Performance (Indicative)

Throughput (Mbps) vs **Range (Km)**

- 20 MHz Channel
- 10 MHz Channel
- 5 MHz Channel

Link Configuration:
3 dBi antennas on both ends of the link, Cross-polarized H and V antennas for maximum diversity.

> 10 dBm fade margin to account for changing RF conditions.

Enabling Industrial Internet Revolution

Technical Specifications (900 MHz Band)

Model Category	Standard	Pro	Xtreme
ORDERING CODES			
Radio Configuration	2x2 MIMO		
With 2x Ethernet and UART interfaces	RM-915-2H-SS	RM-915-2H-PS	RM-915-2H-XS
Evaluation Kit	RM-915-2H-SS-EK	RM-915-2H-PS-EK	RM-915-2H-XS-EK
Design-In Support	Doodle Labs provides extensive Design-In documents upon request. https://doodlelabs.com/contact-us/		
Special Configurations	• Compact models (37x57x11 mm, 40 grams) with Single RF stream • USB and GPIO interfaces		
PERFORMANCE OVERVIEW			
Max Operating Range (Indicative)	1 Km	8 Km	>20 Km
Max Data Throughput at 10-meter range (Indicative)	80 Mbps (20 MHz Channel) 40 Mbps (10 MHz Channel) 20 Mbps (5 MHz Channel)		100 Mbps (26 MHz Channel) 12 Mbps (3 MHz Channel)
Interference Immunity	Standard	SAW filters on RF and ANT ports for strong out of band noise immunity	+ Adjustable squelch for resistance against high-power jamming
Over the Air Data Encryption	128-bit AES hardware data encryption @ full rate		256-bit AES software encryption (12 Mbps max throughput)
Operating Modes	Mesh, AP, Client and Transparent Bridge		+ Gateway
Command & Control channel	Advanced QoS	Ultra-Reliable Low Latency Channel (URLLC)	
Video Channel	Advanced QoS	Optimized video streaming channel	

Enabling Industrial Internet Revolution

Data Sheet

RF SPECIFICATIONS			
Frequency Range	902-928 MHz Channel plans available for all countries in Americas, Australia, New Zealand, and China		
Channel Sizes (Software Selectable)	5, 10, 20 MHz		3, 5, 10, 20, 26 MHz
RF Power Output (Typ) Each radio individually calibrated	0.1W (20 dBm) @ MCS 0,8 0.1W (20 dBm) @ MCS 3,11 0.1W (20 dBm) @ MCS 5, 13 0.1 mW (20 dBm) @ MCS 7, 15	0.5W (27 dBm) @ MCS 0,8 0.5W (27 dBm) @ MCS 3,11 0.4W (26 dBm) @ MCS 5,13 250mW (24 dBm) @ MCS 7,15	1W (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
RF Power Control	In 1 dBm steps, Tolerance ±1 dBm		
Integrated Antenna Port Protection	NA	Able to withstand open port, >10 KV (contact) and >15KV (open air discharge) as per IEC-61000-4-2	
Hardware RF Kill function for Airborne applications	NA	NA	Pin 4 of AUX connector
NETWORKING SPECIFICATIONS			
Mesh Router	Self-Forming/Self-Healing, Peer to Peer		
Multicast	Standard Rate	High Rate	
Custom Software Package Manager	OPKG		
Radio Management	LuCI Web Interface, and UCI command line interface		
Access control	Password, MAC, IP, Port filtering		
Network Security	VPN, IPSec, L2TP, GRE, STP		
Supported Protocols	IPv6, QoS, DNS, HTTPS, IP, ICMP, NTP, DHCP, VLAN		

Enabling Industrial Internet Revolution

Data Sheet

Software Upgrade	Over the air software upgrade supported		
HARDWARE SPECIFICATIONS			
Operating Voltage	5.5~42V DC		
Dimensions	65 x 57 x 11 mm, 60 grams		
Antenna Connection	2x MMCX-Female		
Host Interface	2x Ethernet (100 Base-T) and UART (3.3V FT234XD chipset)		
Temperature range (Operating)	-10°C to +50°C	-40°C to +70°C	-40°C to +85°C
	System's thermal design should ensure that the radio's case temperature is maintained within these specifications.		
Shock and Vibration Resistance	Standard	Compliant to MIL-STD-202G for high shock and vibration	
DC Power Consumption	• 8W @ Max RF power in UDP data Tx mode • 3.4W in data Rx mode • 1.2W in Sleep mode	• 8.5W @ Max RF power in UDP data Tx mode • 3.4W in data Rx mode • 1.2W in Sleep mode	• 9W @ Max RF power in UDP data Tx mode • 3.4W in data Rx mode • 1.2W in Sleep mode
Reliability	Standard		Extreme Reliability, IPC Class 2 standard with Class 3 options
Integrated CPU	MIPS 24K, 540 MHz, 32MB Flash, 64MB DDR2 RAM		
MTBF	>25 years		
Humidity (Operating)	0% – 95% (Non-condensing)		
Life Cycle Planning	Standard	Extended lifespan with 3 years' guaranteed availability	Extended lifespan with 7 years' guaranteed availability
REGULATORY INFORMATION			
FCC ID	2AG87RM-915-2H		
Industry Canada (IC)	21411-RM9152H		

Enabling Industrial Internet Revolution

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

ADDITIONAL RF SPECIFICATIONS		
Radio Data Rates (Dynamic Per Packet Link Auto Adaptation)	MCS15 = 64QAM (5/6) MCS14 = 64 QAM (3/4) MCS13 = 64 QAM (2/3) MCS12 = 16QAM (3/4) MCS11 = 16QAM (1/2) MCS10 = QPSK (3/4) MCS9 = QPSK (1/2) MCS8 = BPSK (1/2) MCS7 = 64QAM (5/6) MCS6 = 64 QAM (3/4) MCS5 = 64 QAM (2/3) MCS4 = 16QAM (3/4) MCS3 = 16QAM (1/2) MCS2 = QPSK (3/4) MCS1 = QPSK (1/2) MCS0 = BPSK (1/2)	
Wireless Protocol	TDD with Carrier Sense Multiple Access with Collision Avoidance	
Wireless Error Correction	FEC, ARQ	
Freq Accuracy	±10 ppm Max over life	
Antenna Signal Strength	-25 to -85 dBm (Recommended), Absolute Maximum=+12 dBm	
Control for External Power Amp	NA	DC biased signal over RF port
Receiver LNA Gain	>10 dB	
Rx Sensitivity (3 MHz Channel BW)	NA	-100 dBm @ MCS 0 -97 dBm @ MCS 1

Enabling Industrial Internet Revolution

		-95 dBm @ MCS 2
		-92 dBm @ MCS 3
		-87 dBm @ MCS 4
		-85 dBm @ MCS 5
		-82 dBm @ MCS 6
		-79 dBm @ MCS 7
		-97 dBm @ MCS 8
		-83 dBm @ MCS 9
		-91 dBm @ MCS 10
		-88 dBm @ MCS 11
		-84 dBm @ MCS 12
		-80 dBm @ MCS 13
		-79 dBm @ MCS 14
		-78 dBm @ MCS 15
Rx Sensitivity (5 MHz Channel BW)	-98 dBm @ MCS 0	
	-95 dBm @ MCS 1	
	-93 dBm @ MCS 2	
	-90 dBm @ MCS 3	
	-85 dBm @ MCS 4	
	-83 dBm @ MCS 5	
	-80 dBm @ MCS 6	
	-77 dBm @ MCS 7	
	-95 dBm @ MCS 8	
	-91 dBm @ MCS 9	
	-89 dBm @ MCS 10	
	-85 dBm @ MCS 11	
	-82 dBm @ MCS 12	
	-78 dBm @ MCS 13	
	-77 dBm @ MCS 14	
	-76 dBm @ MCS 15	
Rx Sensitivity (10 MHz Channel BW)	-96 dBm @ MCS 0	

Enabling Industrial Internet Revolution

	-93 dBm @ MCS 1 -91 dBm @ MCS 2 -88 dBm @ MCS 3 -83 dBm @ MCS 4 -81 dBm @ MCS 5 -78 dBm @ MCS 6 -75 dBm @ MCS 7 -93 dBm @ MCS 8 -89 dBm @ MCS 9 -87 dBm @ MCS 10 -84 dBm @ MCS 11 -80 dBm @ MCS 12 -76 dBm @ MCS 13 -75 dBm @ MCS 14 -74 dBm @ MCS 15
Rx Sensitivity (20 MHz Channel BW)	-93 dBm @ MCS 0 -90 dBm @ MCS 1 -88 dBm @ MCS 2 -85 dBm @ MCS 3 -80 dBm @ MCS 4 -78 dBm @ MCS 5 -75 dBm @ MCS 6 -72 dBm @ MCS 7 -90 dBm @ MCS 8 -86 dBm @ MCS 9 -84 dBm @ MCS 10 -81 dBm @ MCS 11 -77 dBm @ MCS 12 -73 dBm @ MCS 13 -72 dBm @ MCS 14 -71 dBm @ MCS 15

Enabling Industrial Internet Revolution

Rx Sensitivity (26 MHz Channel BW)	NA	-92 dBm @ MCS 0 -89 dBm @ MCS 1 -87 dBm @ MCS 2 -84 dBm @ MCS 3 -79 dBm @ MCS 4 -77 dBm @ MCS 5 -74 dBm @ MCS 6 -71 dBm @ MCS 7 -89 dBm @ MCS 8 -85 dBm @ MCS 9 -83 dBm @ MCS 10 -80 dBm @ MCS 11 -76 dBm @ MCS 12 -72 dBm @ MCS 13 -71 dBm @ MCS 14 -70 dBm @ MCS 15
Receive Adjacent Channel Rejection (ACR)	>18 dB @ 6 Mbps (Typ)	
Receive Alternate Chanel Rejection (ALCR)	>35 dB @ 6 Mbps (Typ)	
Receive Noise Figure	+4 dB	
Transmitter Adjacent Channel Leakage Ratio (ACLR)	-28 dBr (Fc ± ChBW)	
Transmitter Spurious Emission Suppression	-55 dBc	

* Specifications are subject to change without prior notice.

Enabling Industrial Internet Revolution

Band Introduction – 900 MHz ISM Band

The 900 MHz band is also known as the 33-centimeter band and ranges from 902 to 928 MHz. 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 China, Australia, New Zealand and South Korea. In the USA, like WiFi, FCC Part 15 certified radios are permitted for unlicensed operation. A private wireless broadband network implemented in a license-free band avoids the recurring monthly cost of public cellular network.

Additional Doodle Labs Products - 900 MHz ISM Band

Description	Model No.
2×2 MIMO Broadband Transceiver with miniPCIe interface	NM-915
2×2 MIMO Smart Radio with Ethernet interface	RM-915
2x2 MIMO Band shifter for Wi-Fi to 915 MHz	FM-915

Enabling Industrial Internet Revolution

OCEAN CHIPS
Океан Электроники
Поставка электронных компонентов

Компания «Океан Электроники» предлагает заключение долгосрочных отношений при поставках импортных электронных компонентов на взаимовыгодных условиях!

Наши преимущества:

- Поставка оригинальных импортных электронных компонентов напрямую с производств Америки, Европы и Азии, а так же с крупнейших складов мира;
- Широкая линейка поставок активных и пассивных импортных электронных компонентов (более 30 млн. наименований);
- Поставка сложных, дефицитных, либо снятых с производства позиций;
- Оперативные сроки поставки под заказ (от 5 рабочих дней);
- Экспресс доставка в любую точку России;
- Помощь Конструкторского Отдела и консультации квалифицированных инженеров;
- Техническая поддержка проекта, помощь в подборе аналогов, поставка прототипов;
- Поставка электронных компонентов под контролем ВП;
- Система менеджмента качества сертифицирована по Международному стандарту ISO 9001;
- При необходимости вся продукция военного и аэрокосмического назначения проходит испытания и сертификацию в лаборатории (по согласованию с заказчиком);
- Поставка специализированных компонентов военного и аэрокосмического уровня качества (Xilinx, Altera, Analog Devices, Intersil, Interpoint, Microsemi, Actel, Aeroflex, Peregrine, VPT, Syfer, Eurofarad, Texas Instruments, MS Kennedy, Miteq, Cobham, E2V, MA-COM, Hittite, Mini-Circuits, General Dynamics и др.);

Компания «Океан Электроники» является официальным дистрибьютором и эксклюзивным представителем в России одного из крупнейших производителей разъемов военного и аэрокосмического назначения «JONHON», а так же официальным дистрибьютором и эксклюзивным представителем в России производителя высокотехнологичных и надежных решений для передачи СВЧ сигналов «FORSTAR».

«JONHON» (основан в 1970 г.)

Разъемы специального, военного и аэрокосмического назначения:

(Применяются в военной, авиационной, аэрокосмической, морской, железнодорожной, горно- и нефтедобывающей отраслях промышленности)

«FORSTAR» (основан в 1998 г.)

ВЧ соединители, коаксиальные кабели, кабельные сборки и микроволновые компоненты:

(Применяются в телекоммуникациях гражданского и специального назначения, в средствах связи, РЛС, а так же военной, авиационной и аэрокосмической отраслях промышленности).