

Doodle Labs Smart Radio – RM-1370

Small, Long-Distance COFDM/MIMO Broadband Radio

Smart Radio Overview

The Smart Radio is a tiny, full-featured 2x2 MIMO radio/mesh router. It has Ethernet and UART interfaces to allow easy integration into any system architecture. Smart Radios can stream 4K video from over 10 km away.



Smart Radios include Doodle Labs' proprietary BII[®] technology to create an advanced solution for a variety of industrial applications. For example, to allow streaming command & control and sensor data on the same link, Smart Radios feature an Ultra Reliable Low Latency Channel (URLLC) and an optimized video streaming channel.

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.

Key Features of the Smart Radio Platform

PERFORMANCE RF

- Long range and high throughput
- Available in 100 MHz – 4 GHz frequency range in form factor compatible models
- Interference resistant COFDM/MIMO for improved link quality in difficult RF environments; Multipath for LOS obstructions
- 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, Beam forming and Space Time Block Coding for robust data transmission over noisy spectrum and dynamic directional orientation due to roll and pitch of mobile vehicles
- Time Division Duplexing (TDD) for bi-directional traffic

Datasheet

PERFORMANCE NETWORKING

- Ultra-Reliable Low Latency Channel (URLLC) for Command and Control as well as optimized video streaming channel on the same radio link
- End-to-end IP architecture for Unicast and Multicast traffic
- 256-bit AES encryption for over the air data

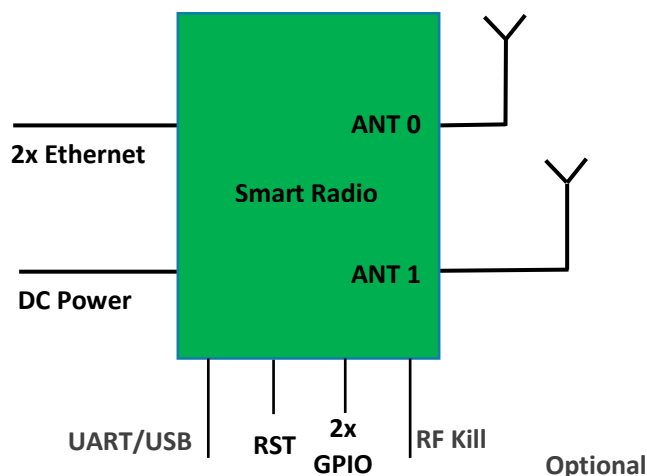
ADDITIONAL FEATURES

- 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

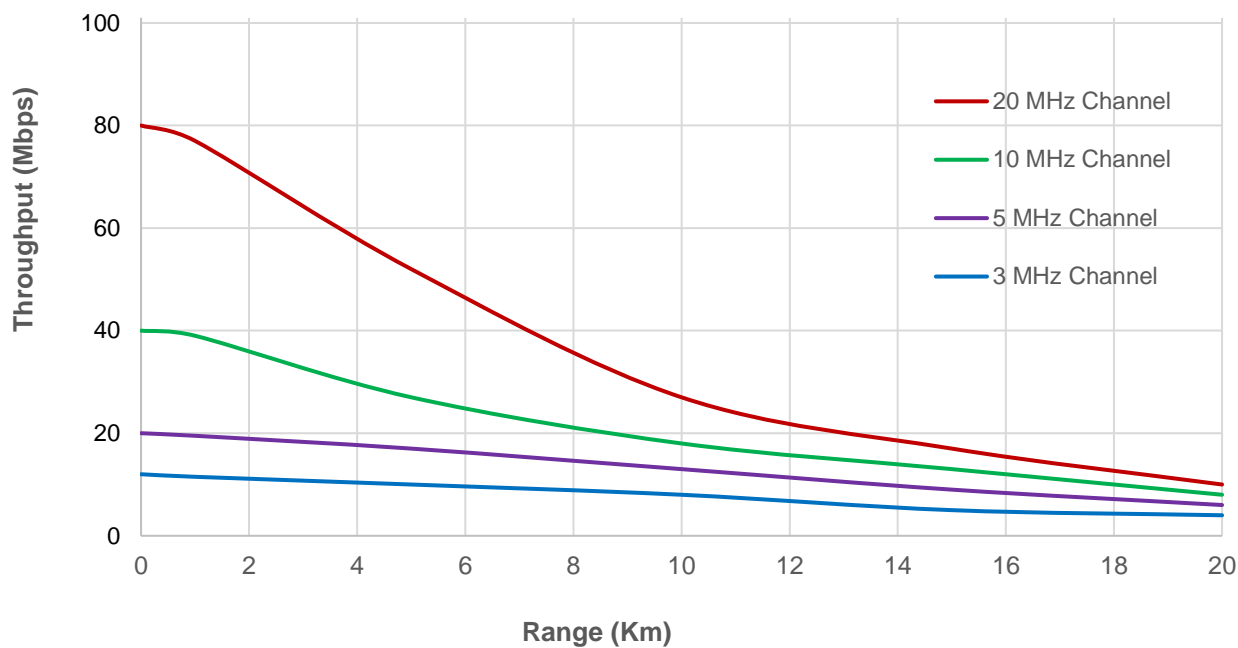
The Smart Radio is an embedded module. It has been designed to be nearly plug and play. Only Ethernet, power supply (5.5~42V), and antenna connections are required for integration.

Doodle Labs provides following documents upon request: integration guide, 3D CAD model, mechanical drawing, cable drawing, and thermal map.



Data Sheet

Xtreme Link Performance (Indicative)



Link Configuration:

- 11 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.

Data Sheet

Technical Specifications (1350-1370 MHz Band)

Model Category	Xtreme
ORDERING CODES	
Radio Configuration	2x2 MIMO
With 2x Ethernet and UART interfaces	RM-1370-2H-XS
Evaluation Kit	RM-1370-2H-XS-EK
Special Configurations	<ul style="list-style-type: none"> • Compact models (37x57x11 mm, 40 grams) with Single RF stream • USB and GPIO interfaces
PERFORMANCE OVERVIEW	
Max Operating Range (Indicative)	>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) 12 Mbps (3 MHz Channel)
Interference Immunity	SAW filters 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 encryption channel for sensitive data
Operating Modes	Mesh, AP, and Client + Transparent Bridge + Gateway
Command & Control channel	Ultra-Reliable Low Latency Channel (URLLC)
Video Channel	Optimized video streaming channel
RF SPECIFICATIONS	
Frequency Range	1350-1370 MHz
Channel Sizes (Software Selectable)	3, 5, 10, 20 MHz

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Model Category	Xtreme
RF Power Output (Typical) Each radio individually calibrated	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	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	Pin 4 of AUX connector
NETWORKING SPECIFICATIONS	
Mesh Router	Self-Forming/Self-Healing, Peer to Peer
Multicast	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
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 and UART ports
Shock and Vibration Resistance	Compliant to MIL-STD-202G for high shock and vibration
Reliability	Extreme Reliability, IPC Class 2 standard with Class 3 options

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Model Category	Xtreme
Temperature range (Operating)	-40°C to +85°C
	System's thermal design should ensure that the radio's case temperature is maintained within these specifications.
DC Power Consumption	<ul style="list-style-type: none"> • 10W @ Max RF power in UDP data Tx mode • 4W in data Rx mode • 1.2W in Sleep mode
Integrated CPU	MIPS 24K, 540 MHz, 32MB Flash, 64MB DDR2 RAM
MTBF	>25 years
Humidity (Operating)	0% – 95% (Non-condensing)
Life Cycle Planning	Extended lifespan with 7 years' guaranteed availability
REGULATORY INFORMATION	
FCC ID	NA
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)

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Model Category	Xtreme
	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	DC biased signal over RF port
Receiver LNA Gain	>10 dB
Rx Sensitivity (3 MHz Channel BW)	-100 dBm @ MCS 0 -97 dBm @ MCS 1 -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

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Model Category	Xtreme
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 -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

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Model Category	Xtreme
	-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
Receive Adjacent Channel Rejection (ACR)	>18 dB @ 6 Mbps (Typ)
Receive Alternate Channel 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.

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Band Introduction – 1370 MHz Band

The 1370 MHz band ranges from 1350~1390 MHz. This band's transmission characteristics make it desirable to achieve a good balance of range and penetration for mobile ground-based robots. The RF signals at 1370 MHz have the ability to propagate further distances via two mechanisms: penetration and diffraction. Penetration refers to 1370 MHz waves ability to penetrate through building walls, vegetation and other obstacles. 1370 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 1370 MHz wave that it can go around an object such as a building or vegetation. 1370 MHz waves have smaller Fresnel zone.

The DoD operates telemetry systems in this band that are used to transmit and receive data from airborne vehicles at test and training ranges. Additionally, the DoD operates transportable tactical point-to point communication systems in the 1370 MHz band. These tactical communication systems are used for command and control networks for military ground forces. This is the only transmission media available to the Marine Corps with sufficient bandwidth to carry large quantities of critical data such as maps, overlays, intelligence pictures, and other data to the battlefield commanders. These systems are used within the United States for comprehensive and realistic training to maintain a high level of combat readiness. The DoD will continue to operate tactical transportable fixed point-to-point communication systems in this band for the foreseeable future.