

Doodle Labs Smart Radio – RM-2450

Advanced MIMO Mesh Router

Smart Radio Overview



Embedded

The Smart Radio is an advanced 2x2 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 Smart Radio is very popular for mobile IIoT (Industrial Internet of Things) applications like drones, autonomous vehicles, and mobile robotics applications across various industries.

Technical Specifications (RM-2450)



Model Category	Xtreme
ORDERING CODES	
Radio Configuration	2x2 MIMO
Model # (v3 hardware)	RM-2450-2J-XM (Embedded, Industrial temp) RM-2450-2J-XM-C (Embedded, Commercial temp)
Evaluation Kit	EK-2450-2J (Ethernet board for Embedded model)
Design-In Documentation	https://www.doodlelabs.com/technologies/technical-library/
PERFORMANCE OVERVIEW	
Protocol Compatibility	Fully compatible with 2.4GHz (IEEE 802.11g,n)
Max Operating Range (Indicative)	>20 Km (Recommended), (Max field demonstrated range >100km)
Max Data Throughput at 10-meter range (Indicative)	100 Mbps (40 MHz Channel) 80 Mbps (20 MHz Channel)
Over the Air Data Encryption	256-bit AES software encryption (12 Mbps max throughput) (FIPS140-2, Level 2 compliant)
Operating Modes	Mesh, Relay, Routed Client, AP, Transparent Bridge, Internet Gateway
Command & Control Channel	Ultra-Reliable Low Latency Channel (URLLC). Latency 3-30 ms
Video Channel	Optimized video streaming with Unicast and Multicast transmission
Spectrum Scan	Automatic spectrum scan on boot up.
Mesh Automatic Transmit Power Control	Intelligently adjusts Tx output power based on signal strength. Allows the device to be utilized in a dispersed and dynamic mesh.

Model Category	Xtreme
RF SPECIFICATIONS	
Frequency Range	2400-2482 MHz

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Channel Sizes (Software Selectable)	20, 40 MHz
Radio Data Rate (Modulation Coding Scheme – MCS)	Dynamic Link Auto Adaptation
Antenna Signal Strength	-25 to -85 dBm (Recommended), Absolute Maximum= +12 dBm
Receiver LNA Gain	>10 dB
RF Power Control	In 1dB steps, Tolerance +/-1dB
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
Frequency Accuracy	±10 ppm max over life
Control for External Power Amp	DC biased signal over RF port
Automatic Transmit Power Control (ATPC)	Automatic adjustment of Tx power based on signal level, which ensures optimal link health at both short and long distances
NETWORKING SPECIFICATIONS	
Mesh Router	Self-Forming/Self-Healing, Peer to Peer
Video Multicast	High Rate
Custom Software Package Manager	OPKG
Device Management	SSH, RPC-JSON, LuCI, GUI
Access control	Password, MAC, IP, Port filtering
Network Security	VPN, L2TP, GRE, STP
Supported Protocols	IPv6, QoS, DNS, HTTPS, IP, ICMP, NTP, DHCP
Integrate with 3rd Party Apps	Integrate with various apps e.g. ATAK, QGroundControl, and more
Software Upgrade	Over the air software upgrade supported
HARDWARE SPECIFICATIONS	
Case Material	Aluminum (Embedded)
Operating Voltage	6~42V DC

Model Category	Xtreme
Dimensions	65 x 57 x 12 mm, 78 grams (Embedded)
Interfaces	2x RJ45, UART, USB, 2x GPIO
Antenna Connection	2x MMCX-Female (Embedded)
Host Interface (Embedded)	2x Ethernet (100 Base-T) and UART (3.3V FT234XD chipset) OR USB 2.0 Hub
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 (Embedded)	IP 50 (Embedded), Dust Protected, No Liquids
Shock and Vibration Resistance	Compliant to MIL-STD-810H for high shock and vibration
DC Power Consumption	• 14W @ Max RF power in UDP data Tx mode • 2W in data Rx mode • 1.2W in Sleep mode
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 CPU	MIPS 24K, 540 MHz, 32MB Flash, 64MB DDR2 RAM
MTBF	>235k hours (25 years)
Temper Evident Seal	Yes
Humidity (Operating)	0% – 95% (Non-condensing)
Life Cycle Planning	Extended lifespan with 7 years guaranteed availability
REGULATORY INFORMATION	
FCC ID	2AG87RM2450-2J (In Progress)
Industry Canada (IC)	21411-RM24502J (In Progress)

Model Category	Xtreme
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

* Specifications are subject to change without prior notice.

FCC Regulatory Statement:

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.

Warning: 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 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

RF Exposure Statement

This equipment complies with FCC radiation exposure limits set forth for an uncontrolled environment. The antenna used with this transmitter must be installed to provide a minimum separation distance of at least 20 cm from all persons and must not be co-located or operating in conjunction with any other antenna or transmitter, except in accordance with FCC multi-transmitter product procedures. Country Code selection feature to be disabled for products marketed to the US/Canada.

This device is intended only for OEM integrators under the following conditions:

1. The antenna must be installed such that 20cm is maintained between the antenna and users, and
2. The transmitter module may not be co-located with any other transmitter or antenna,

Important Note:

In the event that these conditions cannot be met (for example certain laptop configurations or co-location with another transmitter), then the FCC authorization is no longer considered valid and the FCC ID cannot be used on the final product. In these circumstances, the OEM integrator will be responsible for re-evaluating the end product (including the transmitter) and obtaining a separate FCC authorization.

Labeling and Notice to OEM Integrator

If the FCC ID is not visible when the module is installed inside another device, then the outside of the finished product into which the module is installed must display a label referring to the enclosed module. This exterior label can use wording as follows:

For the RM-2450-2J:

Contains Transmitter Module FCC ID: 2AG87RM2450-2J

or

Contains FCC ID: 2AG87RM2450-2J

A transmitter with a modular grant can be installed in different end-use products (referred to as a host, host product, or host device) by the grantee or other equipment manufacturer, then the host product may not require additional testing or equipment authorization for the transmitter function provided by that specific module or limited module device.

A host product itself is required to comply with all other applicable FCC equipment authorization regulations, requirements, and equipment functions that are not associated with the transmitter module portion. For example, compliance must be demonstrated: to regulations for other transmitter components within a host product; to requirements for unintentional radiators (Part 15 Subpart B), such as digital devices, computer peripherals, radio receivers, etc.; and to additional authorization requirements for the non-transmitter functions on the transmitter module (i.e., Verification or Declaration of Conformity) as appropriate (e.g., Bluetooth and Wi-Fi transmitter modules may also contain digital logic functions).

Reference to KDB Publication 996369 D04 Module Integration Guide (which is available at the FCC Office of Engineering and Technology (OET) Laboratory Division Knowledge Database (KDB) <https://apps.fcc.gov/oetcf/kdb/index.cfm>), any manufacturer of the host device which installs this modular with unlimited modular approval should perform the test of radiated and conducted emission and spurious emission, etc. according to FCC CFR Title 47 Part 15.247 requirement, only if the tests result comply with FCC CFR Title 47 Part 15.247 requirement, then the host can be sold legally.

A user's manual for the finished product should include the following statement:

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 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

IC Regulatory Statement:

This device contains licence-exempt transmitter(s)/receiver(s) that comply with Innovation, Science and Economic Development Canada's licence-exempt RSS(s). Operation is subject to the following two conditions:

1. This device may not cause interference.
2. This device must accept any interference, including interference that may cause undesired operation of the device.

The digital apparatus complies with Canadian CAN ICES - 3 (B)/NMB - 3(B).

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

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

RF exposure statement:

This device meets the exemption from the routine evaluation limits in section 2.5 of RSS 102 and compliance with RSS 102 RF exposure, users can obtain Canadian information on RF exposure and compliance.

The equipment complies with IC Radiation exposure limit set forth for uncontrolled environment. This equipment should be installed and operated with minimum distance 20cm between the radiator and your body.

Important Note:

In the event that these conditions cannot be met (for example certain laptop configurations or co-location with another transmitter), then the Canada authorization is no longer considered valid and the ISSED cannot be used on the final product. In these circumstances, the OEM integrator will be responsible for re-evaluating the end product (including the transmitter) and obtaining a separate Canada authorization.

Dans le cas où ces conditions ne peuvent être satisfaites (par exemple pour certaines configurations d'ordinateur portable ou de certaines co-localisation avec un autre émetteur), l'autorisation du Canada n'est plus considéré comme valide et l'ISED ne peut pas être utilisé sur le produit final. Dans ces circonstances, l'intégrateur OEM sera chargé de réévaluer le produit final (y compris l'émetteur) et l'obtention d'une autorisation distincte au Canada.

Labeling and Notice to OEM Integrator

If the IC ID is not visible when the module is installed inside another device, then the outside of the finished product into which the module is installed must display a label referring to the enclosed module. This exterior label can use wording as follows:

For the RM-2450-2J:

Contains Transmitter Module IC: 21411-RM24502J

or

Contains IC: 21411-RM24502J

L'émetteur/récepteur exempt de licence contenu dans le présent appareil est conforme aux CNR d'Innovation, Sciences et Développement économique Canada applicables aux appareils radio exempts de licence. L'exploitation est autorisée aux deux conditions suivantes :

1. L'appareil ne doit pas produire de brouillage;
2. L'appareil doit accepter tout brouillage radioélectrique subi, même si le brouillage est susceptible d'en compromettre le fonctionnement.

l'appareil numérique du ciem conforme canadien peut - 3 (b) / nmb - 3 (b).

Déclaration d'exposition RF:

cet appareil est conforme à l'exemption des limites d'évaluation courante dans la section 2.5 du cnr - 102 et conformité avec rss 102 de l'exposition aux rf, les utilisateurs peuvent obtenir des données canadiennes sur l'exposition aux champs rf et la conformité.

L'équipement est conforme à la limite d'exposition aux radiations de la IC établie pour un environnement non contrôlé. Cet équipement doit être installé et utilisé avec une distance minimale de 20 cm entre le radiateur et votre corps.

Manual Information to the End User

The OEM integrator has to be aware not to provide information to the end user regarding how to install or remove this RF module in the user's manual of the end product which integrates this module.

The end user manual shall include all required regulatory information/warning as show in this manual.

Manuel d'information à l'utilisateur final

L'intégrateur OEM doit être conscient de ne pas fournir des informations à l'utilisateur final quant à la façon d'installer ou de supprimer ce module RF dans le manuel de l'utilisateur du produit final qui intègre ce module.

Le manuel de l'utilisateur final doit inclure toutes les informations réglementaires requises et avertissements comme indiqué dans ce manuel.