

Doodle Labs WiFi Frequency Shifter – NM-915

Frequency Shifters - Overview

Doodle Labs' family of Wi-Fi Frequency Shifters (WiFi-FES) provide flexibility to system integrators looking to deploy their existing wireless modems at special frequency bands to expand the market opportunities. The WiFi-FES is an in-line module placed between the radio modem and the antenna. Our Prism[®] frequency shifting technology helps achieve the use of state-of-the-art MIMO performance in any frequency band. Additionally, the WiFi-FES amplifies the Tx power and Rx gain to increase the wireless range. A large family of form factor compatible modules in the 100 MHz – 4 GHz range means a simple swap of the WiFi-FES module to switch to a different band to meet customer's requirements in any market or country. One of the primary use of the WiFi-FES blocks is to integrate with newer generation SBC boards with built-in Wi-Fi connectivity to develop Industrial Internet applications that require long range and avoid interference.



Key Features

PERFORMANCE RF

- High purity and low EVM signal distortion to support 2x2 MIMO and 128 QAM signals
- Achieve Long range (20+ km) with up to 1W (30 dBm) Tx power
- LNA to increase Rx sensitivity
- Low Noise Figure
- Fast and automatic switching of Tx/Rx direction switching to support TDD operation
- Up to 40 MHz bandwidth with flat gain

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

ADDITIONAL FEATURES

- Available in 100 MHz – 4 GHz frequency range in form factor compatible models
- Wide DC input voltage range for ease of integration
- Rugged construction, Industrial temperature range (-40C to +85C)
- Field proven and deployed in defense applications where failure is not an option
- COTS – Commercial off the Shelf

Available Frequency Shifters for All Frequency Bands

ANT Freq	RADIO Freq	Description	Model No.
902~928 MHz	2.4 GHz WiFi	License free 915 MHz band in North, South and Latin Americas, Australia 1x1 COFDM, 27 dBm, Extended temp, Rugged	GM-915-1
		2x2 MIMO, 30 dBm, Extended temp, Rugged	HM-915-2
2.4 GHz	2.4 GHz WiFi	Power Booster for Wi-Fi 1x1 COFDM, 30 dBm, Extended temp, Rugged	GM-2450-1
		2x2 MIMO, 33 dBm, Extended temp, Rugged	HM-2450-2
3400~3800 MHz	5.6 GHz WiFi	Communication band in Europe, Canada 1x1 COFDM, 24 dBm, Extended temp, Rugged	GM-3600-1
		2x2 MIMO, 27 dBm, Extended temp, Rugged	HM-3600-2

Band Introduction – 900 MHz ISM Band

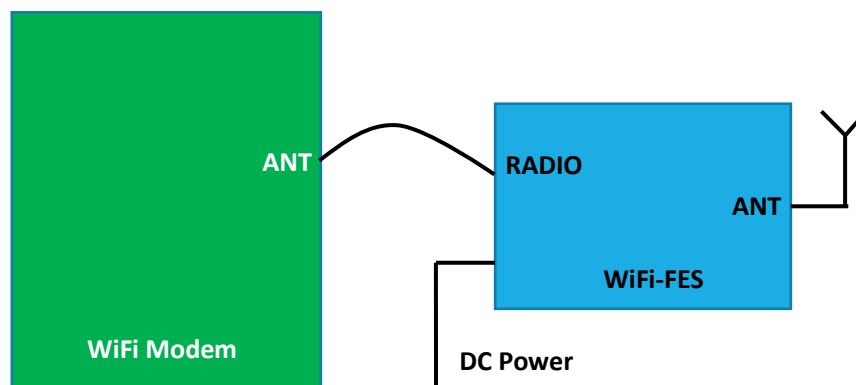
The 900 MHz band is also known as the 33-centimeter band. It ranges from 902 to 928 MHz. The RF signals at 900 MHz have the ability to propagate further distances than the traditional Wi-Fi via two mechanisms: penetration and diffraction. Penetration refers to 900 MHz waves ability to penetrate through 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 miniPCle interface	NM-915-1G
2x2 MIMO Broadband Transceiver with miniPCle 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 modular nature of the WiFi-FES allows very simple system integration with wireless modems. The WiFi-FES works as an in-line module between the modem and the antenna.

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

TECHNICAL SPECIFICATIONS (900 MHz Band)



Model No.	GM-915-1	HM-915-2
RF Configuration	1x1 OFDM	2x2 MIMO
Operating Mode	TDD	
Tx/Rx direction switching	Fast, under 1 micro seconds	
Channel Bandwidth	Up to 20 MHz	
Special Features	Extended lifespan with many years' planned availability Extreme Reliability, IPC Class 2 standard with Class 3 options Compliant to MIL-STD-202G(204D/A-D) for high shock/vibration environments	
ANTENNA PORT SPECIFICATIONS		
ANT Frequency Range	902-928 MHz (RADIO – LO)	
Freq Offset (LO)	Fixed 1527 MHz	
Freq Accuracy	±10 ppm Max	
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
Operating Range (Indicative)	6 Km	10 Km
	6 dBi antenna on both sides, 15 dBm fade margin, BPSK rate	
Tx Power Gain	+15 dBm fixed gain, ± 2 dBm (e.g. Radio=12 dBm, ANT=27 dBm)	
Gain Flatness across the channel	±1 dBm for 20 MHz wide channel	
Interference Immunity	SAW filters on ANT 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	
Antenna Signal Strength	-35 to -85 dBm (Recommended), Absolute Maximum=+12 dBm	
Receiver LNA Gain	8 dB (min)	
Receiver Noise Figure	+6 dB	
Transmitter Adjacent Channel Leakage power Ratio (ACLR)	45 dB (Fc ± ChBW)	
Transmitter Spurious Emission Suppression	-55 dBc	
ANT port connection	1x MMCX-Female	2x MMCX-Female

Data Sheet

Model No.	GM-915-1	HM-915-2
RADIO PORT SPECIFICATIONS		
Radio Frequency Range	2420-2450 MHz (e.g. Wi-Fi 2442 MHz (Channel 7) → 915 MHz)	
Input Level for Radio port	0 dBm to +15 dBm (Recommended), Absolute Max=+20 dBm	
RADIO port connection	1x MMCX-Female	2x MMCX-Female
PHYSICAL, ENVIRONMENTAL SPECIFICATIONS		
Dimensions	30x56x6 mm, 23 grams	60x56x6 mm, 40 grams
Operating Voltage	Wide range 6~40 Volts, USB-Micro connector	
Power Consumption	3.6W @ Max Tx power, in continuous data transfer mode 1.1W in continuous data receive mode	6.7W @ Max Tx power in continuous data transfer mode 2.2W in continuous data receive mode
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	2AG87NM-915-2G (paired with Doodle's radio)	
Industry Canada (IC)	21411-NM9152G (paired with Doodle's radio)	
Regulatory Requirements	Designed and Verified to meet various regulatory requirements. Formal testing and approval is required based on the Integrator's particular 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.

Portfolio Index

Doodle Labs' Industrial IoT radio module portfolio provides radio configurations optimized for a vast variety of project needs. For information on other products, please visit - <https://www.doodlelabs.com/products/>