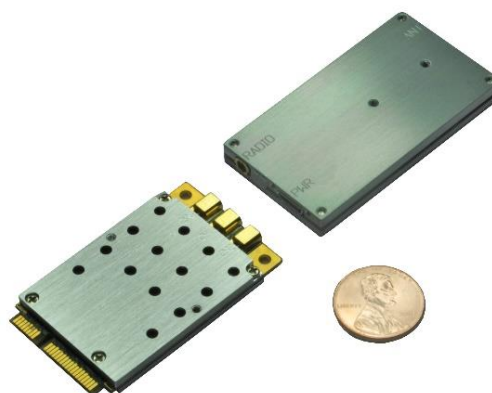


Doodle Labs Prism-WiFi Transceiver – NM-915

High Performance COFDM/MIMO Broadband Transceiver with miniPCle

Prism-WiFi Transceiver Overview

Doodle Labs’ Prism-WiFi are frequency shifted long range Industrial Wi-Fi transceivers. The Prism-WiFi transceivers are targeted for wireless broadband IIoT applications. With up to 1W of RF power and 2x2 MIMO technology, the Prism-WiFi transceiver can transmit large amounts of data (e.g. HD video) in real-time from over 20 km away. The Prism-WiFi’s flexible frequency architecture can satisfy customers’ requirements in any market or country. The Prism-WiFi are available in many frequency bands up to 6 GHz and have been designed to be interchangeable, allowing customers to switch the operating bands by simply swapping the transceiver. These transceivers have been field proven in numerous demanding applications requiring high RF performance while withstanding harsh operating environments.



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

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- Time Division Duplexing (TDD) for bi-directional traffic
- Distributed control with CSMA/CA to auto balance the network for 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
- Available in 100 MHz – 6 GHz frequency range in form factor compatible models
- Rugged construction, Industrial temperature range (-40C to +85C)
- Field proven and deployed in critical applications where failure is not an option
- COTS – Commercial off the Shelf

PERFORMANCE NETWORKING

- High data throughput up to 100 Mbps
- Advanced QOS and multimedia traffic prioritizations for low latency Command and Control as well as HD video streaming on the same link
- Multiple network access and authentication methods
- AES128, 128-bit WPA2-PSK encryption for over the air data

ADDITIONAL FEATURES

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

TARGET APPLICATIONS

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

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

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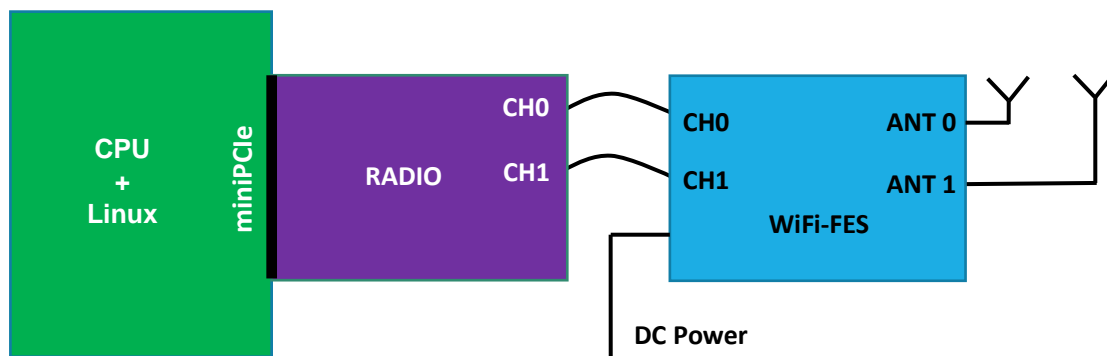
describes the characteristic of a 900 MHz wave that it can go around an object such as a building or vegetation. Because of these transmission characteristics, Broadband communication in 900 MHz band is highly desirable to achieve a good balance of range, penetration and throughput.

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 Prism-WiFi is easy to integrate with CPU boards. Any embedded SBC with standard miniPCI-Express can be used. The Linux distribution [OpenWRT](#) with advanced features is a

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good starting point for customized wireless modem development. The distribution includes the open source [ath9k](#) driver to interface with the Prism-WiFi transceivers. Both OpenWRT and ath9k have extensive online documentation available.

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

Technical Specifications (900 MHz Band)



Model No.	NM-915-1G	NM-915-2H
Radio Configuration	1x1 COFDM	2x2 MIMO
Frequency Range	902-928 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	
Channel Bandwidth	5, 10, and 20 MHz	
Operating Modes	AP, Client and Adhoc modes to implement Access Point, PtP, PtmP, and Mesh networks	
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	128-bit AES, 64 and 128-bit WPA2-PSK data encryption	
Special Features	Extended lifespan with many years' planned availability. Extreme Reliability, IPC Class 2 standard with Class 3 options. Compliant to MIL-STD-202G for high shock/vibration environments	
HARDWARE SPECIFICATIONS		

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Model No.	NM-915-1G	NM-915-2H
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 by driver	In 0.5 dBm steps. Accuracy of power calibration loop ± 2 dBm. Each transceiver individually calibrated and tested.	
Rx Sensitivity (5 MHz Channel BW)	-95 dBm @ BPSK -86 dBm @ 16QAM -79 dBm @ 64QAM	-98 dBm @ BPSK -89 dBm @ 16QAM -82 dBm @ 64QAM
	The Rx sensitivity reduces by 3 dBm when doubling the Channel bandwidth. It is advantageous to use the smallest Channel Bandwidth that can support the Throughput requirements. Smaller bandwidths provide more channels in the band and help avoid interference issues. The system's SNR is higher at smaller Channel Bandwidths and Range is longer.	
Software Support	Open Source ath9k Linux Driver OpenWRT (Wireless Router/Linux OS)	
MAC Chipset	Qualcomm Atheros QCA9590-BR4B with Extended Temperature range	
Host CPU Board	Any CPU board with Industry standard miniPCI-Express interface with minimum 6 mm connector height	
Operating Voltage	3.3 Volts from miniPCI-E interface for radio 6~40V for FES	
Power Consumption	- Total 6W (4W @ Max power for FES + 2W for radio module) in data transfer mode - Total 2.8W (1.3W for FES + 1.5W for radio module) in data receive mode @ Max power, in continuous data transfer mode	- Total 10W (8W @ Max power for FES + 2W for radio module) in data transfer mode - Total 4W (2.5W for FES + 1.5W for radio module) in data receive mode @ Max power, in continuous data transfer mode
Antenna Signal Strength	-35 to -85 dBm (Recommended), Absolute Maximum=+12 dBm	

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Model No.	NM-915-1G	NM-915-2H
Interference Immunity	SAW filters on 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 ($F_c \pm ChBW$)	
Transmitter Spurious Emission Suppression	-55 dBc	
Freq Accuracy	± 10 ppm Max	
RF Hardware Disable (RF Kill)	Pin 20 of miniPCI-E interface. (Required for FAA compliance)	
Control for External Power Amp	DC biased signal over RF ports	
PHYSICAL, ENVIRONMENTAL SPECIFICATIONS		
Dimensions (Mechanical drawing and 3D-CAD files available upon request)	30 x 50 x 6 mm Radio module 30 x 56 x 6 mm FES module Total 27 grams (14 + 23)	30 x 50 x 6 mm Radio module 60 x 56 x 6 mm FES module Total 50 grams (14 + 36)
Antenna Connection	1x MMCX-Female	2x MMCX-Female
Host Interface	miniPCI-Express 1.2 Standard	
Cable Assembly	Initial samples Include the harness with RF cable and DC power. Cable assembly drawing available upon request.	
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)	

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Model No.	NM-915-1G	NM-915-2H
OTHER SPECIFICATIONS		
MTBF	25 years	
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.	
FCC ID	2AG87NM-915-2G	2AG87NM-915-2H
Industry Canada (IC)	21411-NM9152G	21411-NM9152H
RoHS/WEEE Compliance	Yes. 100% Recyclable/Biodegradable packaging	

* Specifications are subject to change without prior notice.

Portfolio Index

Doodle Labs' Industrial IoT Smart Radio portfolio provides configurations optimized for a vast variety of project needs. All models are form-factor compatible. For information on other models, please visit - <https://www.doodlelabs.com/products/industrial-iot-radio-platform/>