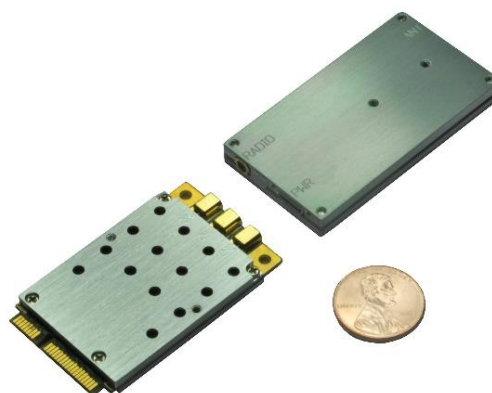


# Doodle Labs Prism-WiFi Transceiver – NM-4600

## 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 40 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

### 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
- 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

### TARGET APPLICATIONS

- Unmanned Aerial Vehicles (Drones)
- Fixed and Mobile PtP and PtmP Networks
- Wireless Ethernet extensions

## Band Introduction – 4600 MHz NATO Band

The 4400 to 4800 MHz frequency band is utilized by NATO Military Forces, Federal & Homeland Security (DHS, DOJ), and Public Safety organizations. DoD uses this band to satisfy many of the requirements for high capacity, multi-channel, fixed and transportable point-to-point communications. The major functions of DoD systems operating in this frequency range are point-to-point communications, data links supporting exchange of sensor data, telemetry and command links for Military Services as well as National Guard units. US forces when deployed use these radios extensively. These systems support tactical as well as training and administrative operations.

DoD also uses this band to support datalinks and video links for Unmanned Aerial Systems (UAS). The primary mission of UAS data links is to provide information gathered by sensors onboard various unmanned aerial vehicles to ground control stations and to control UAS operations.

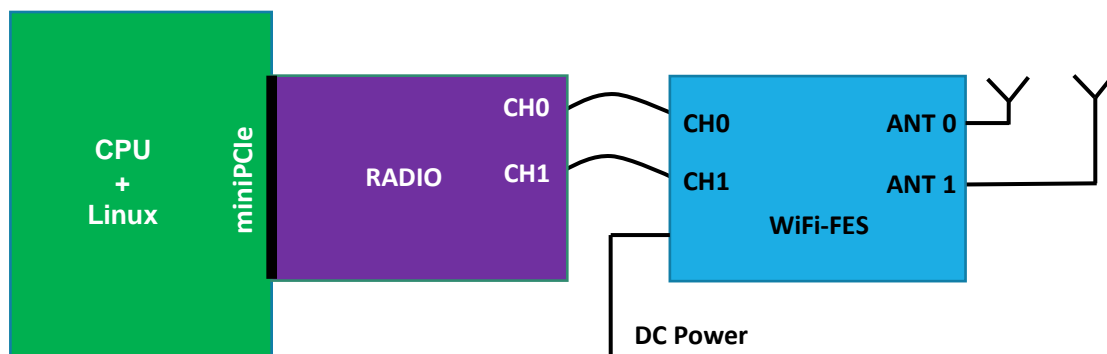
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## Data Sheet

### Doodle Labs Products for 4.4-5.0 GHz Band

Description	Model No.
1x1 COFDM Broadband Transceiver with miniPCle interface (4800-5000 MHz)	<a href="#">NM-4900-1F</a>
2x2 MIMO Broadband Transceiver with miniPCle interface (4800-5000 MHz)	<a href="#">NM-4900-2F</a>
1x1 COFDM Broadband Transceiver with miniPCle interface (4800-5000 MHz)	NM-4600-1F
2x2 MIMO Broadband Transceiver with miniPCle interface (4800-5000 MHz)	NM-4600-2F

### 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 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 (4600 MHz Band)

Model No.	NM-4600-1F	NM-4600-2F
Radio Configuration	1x1 COFDM	2x2 MIMO
Frequency Range	4400-4800 MHz	

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Model No.	NM-4600-1F	NM-4600-2F
	See model <a href="#">NM-4900</a> for 4800-5000 MHz freq range.	
Data Throughput (64 QAM, 20 MHz BW)	50 Mbps	100 Mbps
Operating Range (Indicative)	20 Km	40 Km
	16 dBi antenna on both sides, 20 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	
<b>HARDWARE SPECIFICATIONS</b>		
RF Power Output	800mW (29 dBm) @ BPSK 800mW (29 dBm) @ 16QAM 200 mW (23 dBm) @ 64QAM	1.6W (32 dBm) @ BPSK 1.6W (32 dBm) @ 16QAM 400 mW (26 dBm) @ 64QAM
Min RF Power Output	+15 dBm	
RF Power Control by driver	In 0.5 dBm steps. Accuracy of power calibration loop $\pm 2$ 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

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Model No.	NM-4600-1F	NM-4600-2F
	<p>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.</p>	
Software Support	<p>Open Source <a href="#">ath9k</a> Linux Driver <a href="#">OpenWRT</a> (Wireless Router/Linux OS)</p>	
MAC Chipset	<p>Qualcomm Atheros QCA9590-BR4B with Extended Temperature range</p>	
Host CPU Board	<p>Any CPU board with Industry standard miniPCI-Express interface with minimum 6 mm connector height</p>	
Operating Voltage	<p>3.3 Volts from miniPCI-E interface for radio 3~4.5V for FES</p>	
Power Consumption	<p>- Total 10W (8W @ 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</p>	<p>- Total 18W (16W @ 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</p>
Antenna Signal Strength	<p>-35 to -85 dBm (Recommended), Absolute Maximum=+12 dBm</p>	
Integrated Antenna Port Protection	<p>Able to withstand open port, &gt;10 KV (contact) and &gt;15KV (open air discharge) as per IEC-6100-4-2</p>	
Receiver LNA Gain	<p>&gt;10 dB</p>	
Receiver Adjacent Channel Rejection (ACR)	<p>&gt;18 dB @ 6 Mbps (Typ)</p>	
Receiver Alternate Channel Rejection (ALCR)	<p>&gt;35 dB @ 6 Mbps (Typ)</p>	
Receive chain Noise Figure	<p>6 dB</p>	

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Model No.	NM-4600-1F	NM-4600-2F
Transmitter Adjacent Channel Leakage Power Ratio (ACLR)	45 dB ( $F_c \pm ChBW$ )	
Transmitter Spurious Emission Suppression	-40 dBc	
Freq Accuracy	$\pm 10$ 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	
<b>PHYSICAL, ENVIRONMENTAL SPECIFICATIONS</b>		
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)	
<b>OTHER SPECIFICATIONS</b>		
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.	
NTIA	Supporting information for DD-1494 is available upon request	
RoHS/WEEE Compliance	Yes. 100% Recyclable/Biodegradable packaging	

\* Specifications are subject to change without prior notice.

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**Data Sheet****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/>