

Doodle Labs Band Shifter – FM-3600

Band Shifters - Overview

Doodle Labs' family of Band Shifters provide flexibility to system integrators looking to deploy their existing wireless modems at special frequency bands to expand the market opportunities. The Band Shifters are 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 band shifters amplify the Tx power and Rx gain to increase the wireless range. A large family of form factor compatible modules in the 100 MHz – 6 GHz range means a simple swap of the module to switch to a different band to meet customer's requirements in any market or country.



Key Features

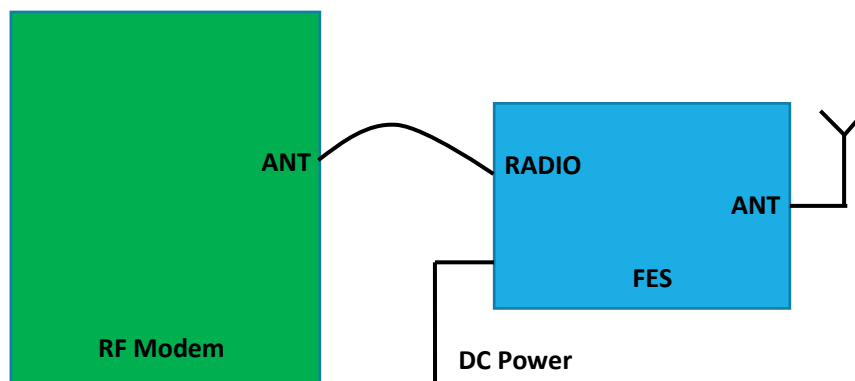
PERFORMANCE RF

- High purity and low EVM signal distortion to support 2x2 MIMO and 64QAM 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 20 MHz bandwidth with flat gain

ADDITIONAL FEATURES

- Available in 100 MHz – 6 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
- Very small size, weight, and power (SWaP) for mobile applications
- COTS – Commercial off the Shelf

System Integration



The modular nature of the FES allows very simple system integration with wireless modems. The 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 (3.6 GHz Band)

Model No.	FM-3600-1G	FM-3600-2G
RF Configuration	1x1 COFDM	2x2 MIMO
Operating Mode	TDD	
Tx/Rx direction switching	Fast, under 1 micro seconds	
Channel Bandwidth	Up to 20 MHz	
Special Features	<ul style="list-style-type: none"> 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	3400-3800 MHz (RADIO – LO)	
Freq Offset (LO)	Fixed 2000 MHz (e.g. Input 5600 MHz ↔ 3600 MHz Output)	
Freq Accuracy	±10 ppm Max	
RF Power Output	0.2W (23 dBm) @ BPSK 0.2W (23 dBm) @ 16QAM 50 mW (17 dBm) @ 64QAM	0.4W (26 dBm) @ BPSK 0.4W (26 dBm) @ 16QAM 100 mW (20 dBm) @ 64QAM

Model No.	FM-3600-1G	FM-3600-2G
Operating Range (Indicative)	3 Km	5 Km
	6 dBi antenna on both sides, 12 dBm fade margin, BPSK rate	
Tx Power Gain	+12 dBm fixed gain, ± 2 dBm (e.g. Radio=11 dBm, ANT=23 dBm)	
Gain Flatness across the channel	± 1 dBm for 20 MHz wide channel	
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 ($F_c \pm ChBW$)	
Transmitter Spurious Emission Suppression	-40 dBc	
ANT port connection	1x MMCX-Female	2x MMCX-Female
RADIO PORT SPECIFICATIONS		
Radio Frequency Range	5400-5800 MHz (e.g. 5600 MHz \rightarrow 3600 MHz)	
Input Level for Radio port	+8 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	<ul style="list-style-type: none"> 4W @ Max Tx power, in continuous data transfer mode 1.1W in continuous data receive mode 	<ul style="list-style-type: none"> 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	
Regulatory Requirements	Designed and Verified to meet various regulatory requirements. Formal testing and approval is required based on the Integrator's	

Model No.	FM-3600-1G	FM-3600-2G
	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.

Band Introduction – 3.6 GHz Band

The European Commission (EC) supports ‘Rapid access to spectrum for wireless electronic communications services through more flexibility’. In accordance with this, the EC has adopted a decision on the harmonization of the Pan-European 3400-3800 MHz frequency band for fixed, nomadic and mobile applications in the European Union (EU). Technological neutrality and service neutrality have been underlined by Member States in the Radio Spectrum Policy Group (RSPG) opinion to achieve a more flexible use of spectrum.

The Pan-European designation of the 3 400-3 800 MHz band for fixed, nomadic and mobile applications offers a significant opportunity to install high-density and high-speed broadband wireless networks, which can provide innovative Broadband communication services to end users.

The entire band is assigned to Mobile service (except aeronautical mobile) and Fixed services (PtmP and PtP). In the lower half, 3400-3600 MHz frequency band, both the FDD and the TDD modes are allowed, but TDD is the preferred mode. In the upper half, 3600-3800 MHz frequency band, only TDD allocation is defined, therefore only TDD systems can be used here. Block Edge Masks (BEM) are technical parameters that apply to the entire block of spectrum of a specific user, irrespective of the number of channels occupied by the user's chosen technology.

Related Products for 3.6 GHz ISM Band

Description	Model No.
1x1 COFDM Broadband Transceiver with miniPCIe interface	NM-3600-1G
2x2 MIMO Broadband Transceiver with miniPCIe interface	NM-3600-2H
1x1 Band Shifter	FM-3600-1G
2x2 MIMO Band Shifter	FM-3600-2H
1x1 COFDM Smart Radio with Ethernet, UART interfaces	RM-3600-1G
2x2 MIMO Smart Radio with Ethernet, UART interfaces	RM-3600-2H

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/>