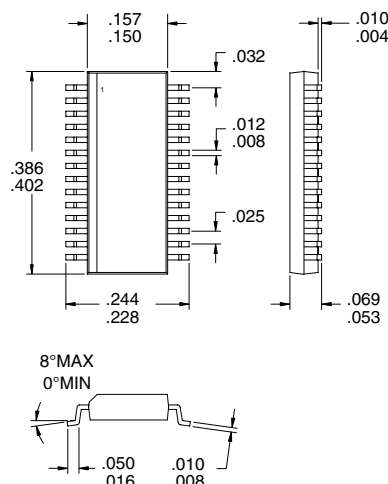


Typical Applications

- Battery Powered AM Transceivers
- 915MHz ISM Applications
- 433MHz and 868MHz ISM Applications
- Wireless Data Transmitter/Receiver
- Wireless Security Systems
- Wireless Meter Reading

Product Description

The RF2907 is a complete AM/ASK transceiver. This highly integrated device operates at frequencies in the 300MHz to 1500MHz range. This transceiver features an AM modulator/transmitter with analog-variable output power up to +7dBm, a dual modulus divide-by 64/65 prescaler, and a complete AM receiver. There is also a sleep mode provided so the device may be turned off to save battery life. Dual time constant control on the demodulator allows for faster settling for wake up mode. The RF2501 or RF2502 VCO ICs are available to provide a high isolation, low cost LO source for the RF2907.



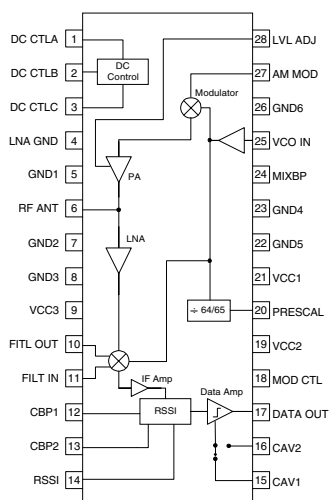
Optimum Technology Matching® Applied

- ☒ Si BJT ☐ GaAs HBT ☐ GaAs MESFET
☐ Si Bi-CMOS ☐ SiGe HBT ☐ Si CMOS

Package Style: SSOP-28

Features

- Power Down Feature
- AM Modulation/Demodulation Capability
- Integrated 64/65 Dual Modulus Prescaler
- +7dBm Transmitter Output Power
- 7dB Typical Receiver Noise Figure
- Micropower Operation



Functional Block Diagram

Ordering Information

RF2907 433/868/915MHz AM/ASK/OOK Transceiver
 RF2907 PCBA Fully Assembled Evaluation Board

RF Micro Devices, Inc.
 7625 Thorndike Road
 Greensboro, NC 27409, USA

Tel (336) 664 1233
 Fax (336) 664 0454
<http://www.rfmd.com>

Absolute Maximum Ratings

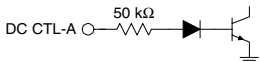
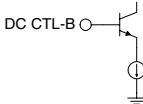
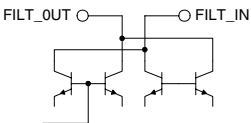
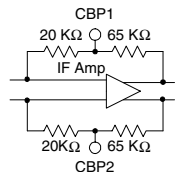
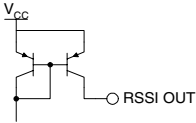
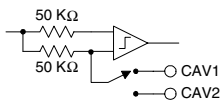
Parameter	Rating	Unit
Supply Voltage	-0.5 to +5.5	V _{DC}
Control Voltages	-0.5 to +5	V
Input RF Power	+10	dBm
Operating Ambient Temperature	-40 to +85	°C
Storage Temperature	-40 to +150	°C

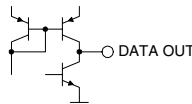
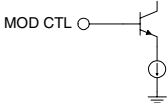
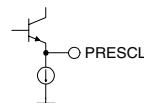
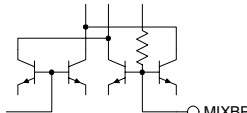
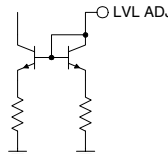


Caution! ESD sensitive device.

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Parameter	Specification			Unit	Condition
	Min.	Typ.	Max.		
General Characteristics					T=25 °C, V _{CC} =3.6V, LO=913.4MHz, Freq=915 MHz
RX/TX Frequency Range	300	433, 868, 915	1500	MHz	
Modulation Type		ASK,AM			
Receiver RF Characteristics					
Conversion Gain		24		dB	
Cascaded Noise Figure		7		dB	
Cascaded IP3		-30		dBm	
RX Input VSWR		1.5:1			
LO Leakage (@RF_RX)			-50	dBm	
LO Input Level (VCO_IN pin)		-7		dBm	
Receiver IF Characteristics					
IF Bandwidth (-3dB)		3		MHz	
Sensitivity		-97		dBm	10 ⁻³ BER, 2kbps data rate
RSSI Dynamic Range	60			dB	
Data Out Bandwidth		1		MHz	
Data Output V _{OH}	V _{CC} -0.3			V	Z _{LOAD} =1 MΩ 3pF
Data Output V _{OL}			0.3	V	Z _{LOAD} =1 MΩ 3pF
Transmitter RF Characteristics					
TX Output Power	4	7		dBm	
TX Output Power Level Adjust Range	10			dB	
Modulation Rate			1	MHz	
TX Output VSWR		1.5:1			
LO Input Level (VCO_IN)		-7		dB	
Prescaler Characteristics					
Prescaler Divide Ratio		64/65			
Output Voltage Swing		1.3		V _{PP}	Output Load=2.5kΩ
Power Supply					
Operating Voltage	2.7	3.6	5	V	
I _{CC} , RX Mode		11.5	13.5	mA	
I _{CC} , RX Lock Mode		9.5	11.5	mA	
I _{CC} , TX Mode		20		mA	
I _{CC} , Sleep Mode			1	μA	Avg. current with 50% duty cycle, AM_MOD square wave 1-2.4V, TX out=+7dBm

Pin	Function	Description	Interface Schematic
1	DC CTLA	DC control pin. This control signal is used as described in the modes of operation table to control the operating mode of the IC.	
2	DC CTLB	Same as pin 1.	
3	DC CTLC	Same as pin 1.	See pin 2.
4	LNA GND	Ground connection for the LNA. Keep traces physically short and connect immediately to ground plane for best performance.	
5	GND1	Ground connection for the RF mixer. Keep traces physically short and connect immediately to ground plane for best performance.	
6	RF ANT	RF input/output pin. Provides RF input to the LNA when the receiver is enabled and the transmitter is disabled. Provides RF output from the PA when the receiver is disabled and the transmitter is enabled. This pin requires an external DC blocking capacitor.	
7	GND2	Ground connection for the TX PA and receiver IF functions. Keep traces physically short and connect immediately to ground plane for best performance.	
8	GND3	Same as pin 7.	
9	VCC3	This pin supplies DC bias to the TX PA. Requires a bypass capacitor close to the pin for RF bypassing. Recommended values are 100pF for 915MHz and 220pF for 433MHz.	
10	FILT OUT	RF Mixer output. Pins 10 and 11 are open collector, complementary outputs. These pins must be connected to VCC through an inductor to provide DC bias for the mixer. The inductance at these pins should be parallel resonated with a resistor and a capacitor to form a band-limiting tank circuit (see application circuit). The tank resistance will set the Q of the filter and the gain of the mixer.	
11	FILT IN	Same as pin 10.	See pin 10.
12	CBP1	Low-frequency bypass that allows the use of DC feedback to control the bias point of the IF amps.	
13	CBP2	Same as pin 12.	See pin 12.
14	RSSI	Output of the RSSI detector. The RSSI outputs a current, so an external RC circuit defines the output characteristic of the RSSI. Output current increases with increasing signal strength. This output is also used to provide the demodulated AM signal.	
15	CAV1	Averaging capacitor for the single bit A/D converter. Recommended value allows the receiver to setup in 5ms and will receive data from 300bps to 3kbps. Values can be changed to optimize for various data rates and receiver settling times.	
16	CAV2	Averaging capacitor for the single bit A/D converter. Recommended value allows Receiver to setup in 2ms and will receive data from 9kbps to 20kbps.	See pin 15.

Pin	Function	Description	Interface Schematic
17	DATA OUT	Output of the receiver. Expects a load of at least 1 M Ω .	
18	MOD CTL	Control pin for the modulus of the prescaler. This is a digital control pin. Input high ($V > 2V$) results in divide by 64, input low ($V < 1V$) results in divide by 65.	
19	VCC2	This pin supplies DC bias to the Prescaler. Requires a bypass capacitor close to the pin for RF bypassing. Recommended values are 100pF for 915MHz and 220pF for 433MHz.	
20	PRESCL	Prescaler output pin. Output level is 1.3V _{PP} into 2.5k Ω load. The parasitic capacitance on this pin should be minimized.	
21	VCC1	This pin supplies DC bias to the receiver electronics. Requires a bypass capacitor close to the pin for RF bypassing. Recommended values are 100pF for 915MHz and 220pF for 433MHz.	
22	GND5	Ground connection for the TX PA buffer. Keep traces physically short and connect immediately to ground plane for best performance.	
23	GND4	Ground connection for the prescaler. Keep traces physically short and connect immediately to ground plane for best performance.	
24	MIXBP	This pin supplies DC bias and an AC ground to the Mixer. Requires a bypass capacitor close to the pin for RF bypassing. Recommended values are 100pF for 915MHz and 220pF for 433MHz.	
25	VCO IN	50 Ω input for LO signal, needs an external coupling capacitor. Input LO power should be about -12dBm.	
26	GND6	Ground connection for the LO buffer amplifier. Keep traces physically short and connect immediately to ground plane for best performance.	
27	AM MOD	Data input for the transmitter. High impedance ($Z_{IN} > 40k\Omega$) pin. Characteristics are summarized in the performance summary.	
28	LVL ADJ	Transmitter level adjust control pin. Analog voltage control yields a minimum of 10dB transmitter output level control. Increasing voltage causes decreasing output power. Maximum output power is achieved with input voltage of 0V.	

Operation Mode	DC CTLA	DC CTLB	DC CTLC	Function
Sleep Mode	Low	Low	Low	Entire chip is powered down. Total current consumption is $< 1\mu A$.
Transmit Mode	High	Low	Low	Transmitter, prescaler are on.
RX Data 1	High	High	Low	Receiver is on, prescaler is on. A/D converter uses CAV1 to set the output time constant.
RX Data 2	High	Low	High	Receiver, prescaler are on. A/D converter uses CAV2 to set the output time constant.
RX Lock	High	High	High	Mixer, prescaler are on. This mode allows time for a synthesizer loop to lock without spending current on the entire receiver.

RF2907 Theory of Operation and Application Information

The RF2907 is an AM/ASK transceiver IC designed to provide a low cost, extremely low power half duplex link for a variety of applications. The different modes of operation allow the designer to develop systems based on burst data, time multiplexed, sleep/ awake, and/or receive and acknowledge architectures. These modes are controlled by three lines that are internally decoded according to descriptions in Table 1. The range of frequency and data rates make this a useful part for remote keyless entry systems, security systems, meter reading, remote monitoring, and much more.

The RF2907 is designed to interface with an external PLL IC and VCO. There is a dual modulus divide by 64/65 prescaler built-in which allows for a low cost, CMOS PLL IC such as the MC145158 from Motorola. Using the prescaler output minimizes the amount of High frequency signals that need to be routed on the PCB. The RF 2501 or RF2502 buffered VCO was designed to meet the LO requirements for the RF2907 by providing the added buffering to isolate the VCO from the AM modulator. There is a special mode of operation that allows you to power up the mixer and prescaler to let the synthesizer lock up and settle out before turning on the rest of the receiver. The length of time for this lock mode is dependent on the synthesizer design parameters.

The AM modulation is accomplished by modifying the bias current of the predriver amp. This varies the power delivered to the output amp in a linear fashion over a 20dB range. The modulator can also be driven by digital data, either driven directly which yields greater than 40dB of on-off ratio (OOK) or by limiting the voltage swing to produce a desired on-off ratio (ASK). A level adjust pin is also available on the transmitter to set the overall output power level. This is typically controlled by a current setting resistor or can actively be driven if a power ramp-up is desired.

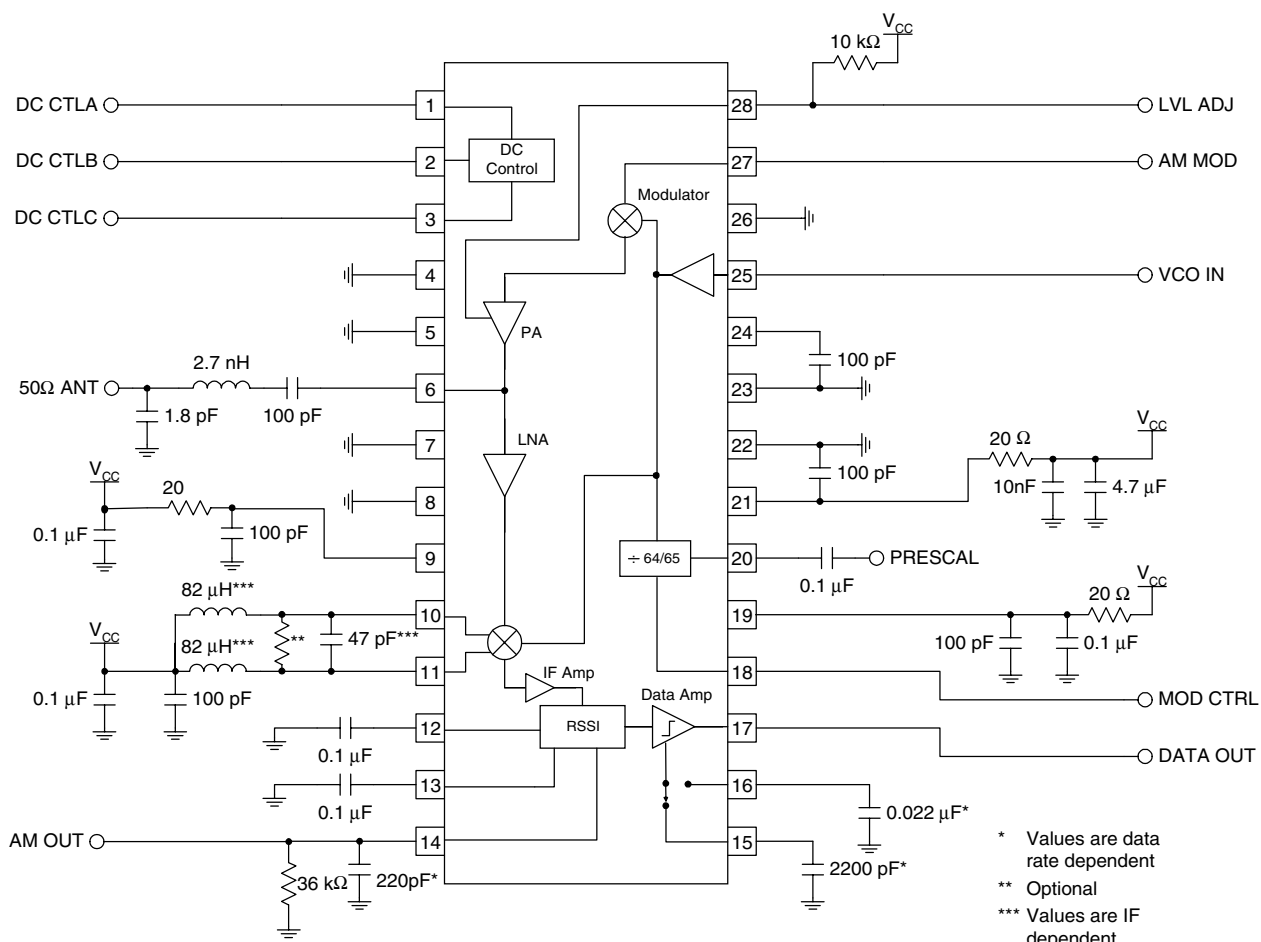
The PA output and LNA input are internally connected eliminating the need for a TX/RX switch. In transmit mode, the LNA is powered down and seen as a high impedance load on the node leaving just the external loading network on the PA. In receive mode, the opposite occurs with the PA seen as a high impedance and the LNA seen as a 50 Ω load on the node. The control lines are decoded such that the PA and LNA are not on at the same time.

There are two available modes for receiving. These are based on the desire for the system to be in sleep mode for a period of time, then wake up and look for a desired transmission. Upon receipt of a valid preamble, the receiver switches into a receive data mode 2. Two charging capacitors are available for generating a reference voltage for the data comparator. A small value cap is used for the wake up and detection mode. Here, the reference voltage is generated fast to look for the preamble. If the preamble is not found, the receiver goes back to sleep. This will minimize the wake up time and extend battery life. When a valid preamble is received, the receiver can be switched into the second mode which would use a larger value cap for filtering out more of the modulation on the RSSI signal. This provides greater noise immunity in the receiver data.

To simplify the data recovery and reduce overall power and cost, this approach of filtering the RSSI data to produce a reference voltage was used. While the desired effects are worth while, there is a dependency on the DC value of the transmitted data stream that can produce undesired results. A long string of transmitted "1's" will charge up the voltage on the filtering cap until the data comparator can no longer differentiate the received data. There are several ways to mitigate this problem. The most effective way is to use coding such as Manchester to guarantee a constant DC average. The cost of using such coding is in the increased data bandwidth. For low data rate systems this may be an advantage in that the size of the filtering cap need not be as big.

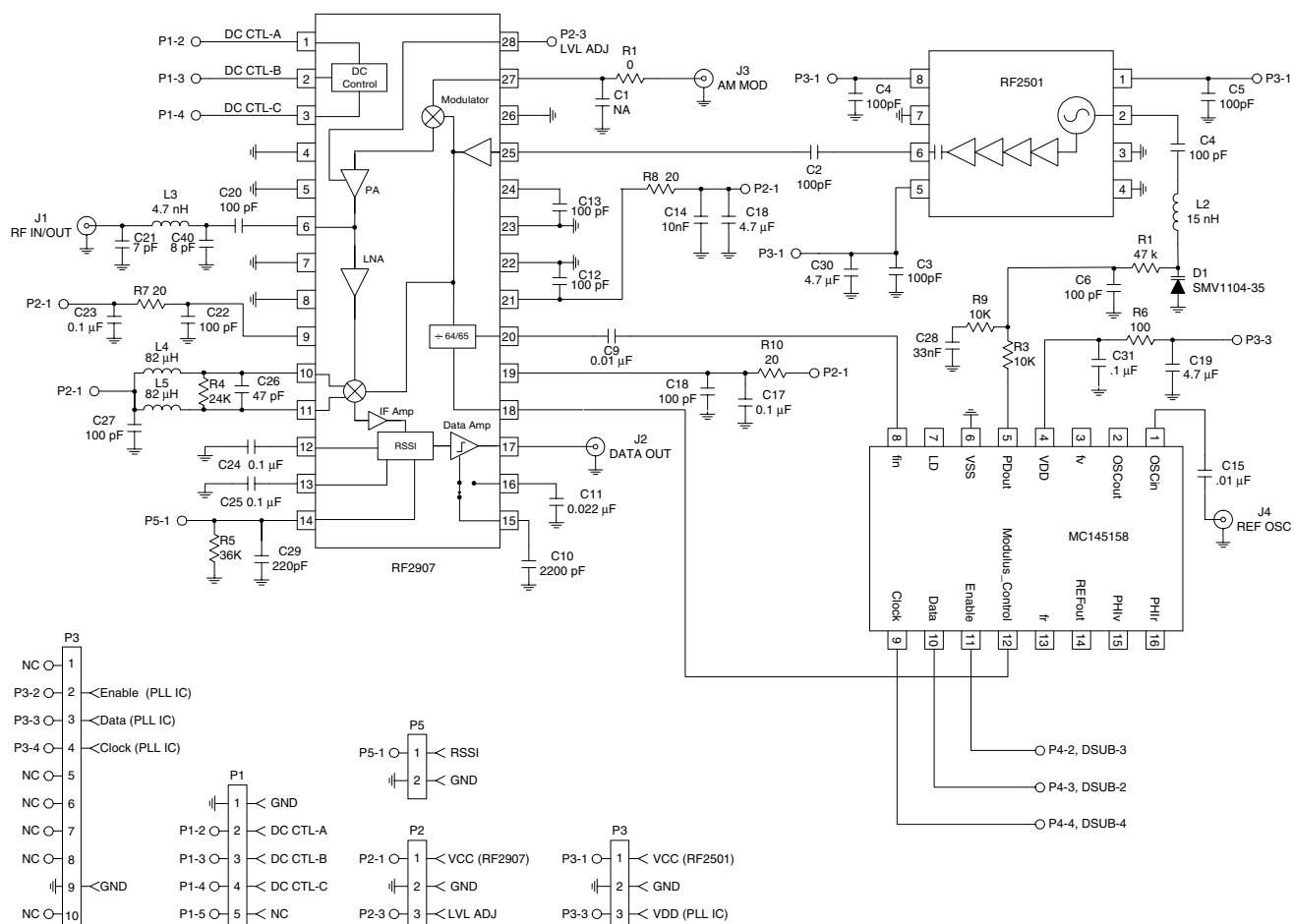
Spectral whitening or scrambling codes can be used to average out the DC value. These work well in terms of reducing the DC variations otherwise present in the data stream. These codes do not add to the required bandwidth but may need additional preambles or seeds to sync up on which can fractionally add to the transmission time dependent upon the coding overhead required.

RF2907 Application Schematic For ASK Transceiver

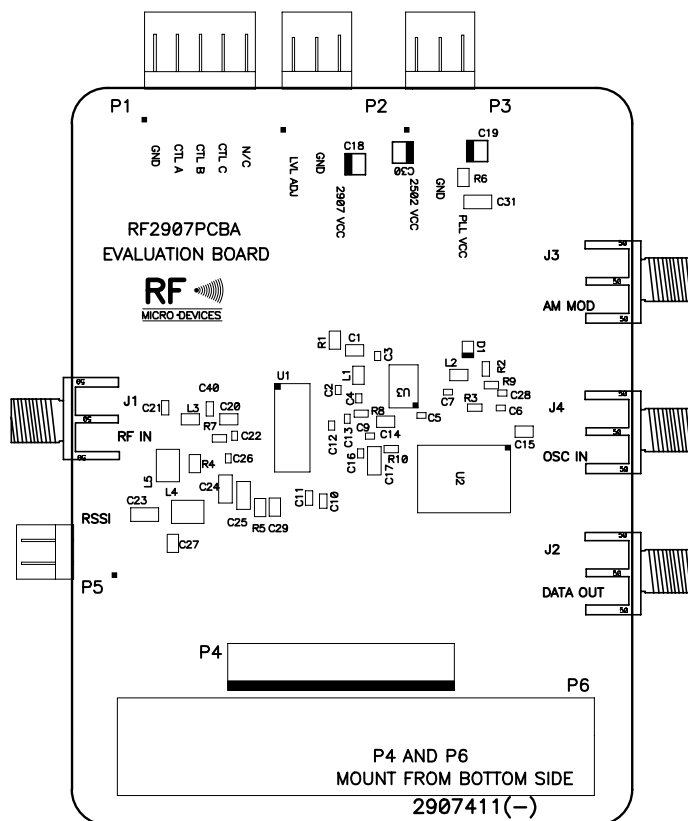


Evaluation Board Schematics

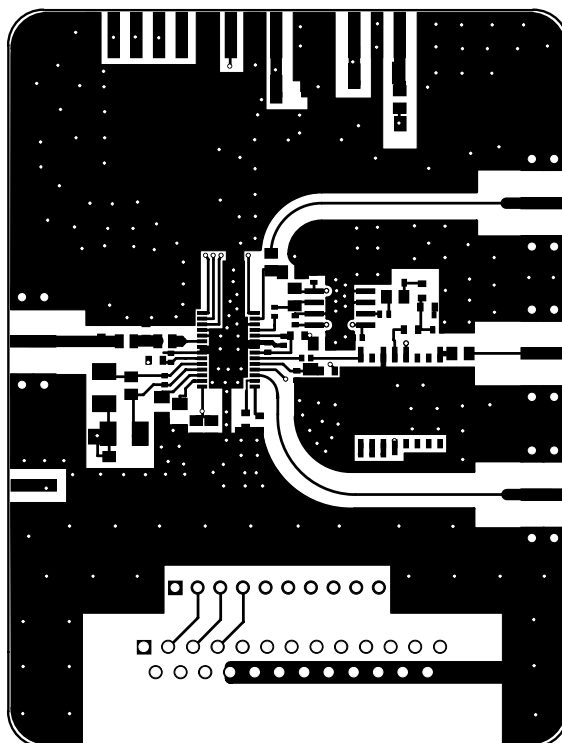
(Download [Bill of Materials](http://www.rfmd.com) from www.rfmd.com.)



Evaluation Board Layout 2.472" x 3.242" Assembly



Evaluation Board Layout cont'd Top Layer



Mid layer

