



**RF9904**

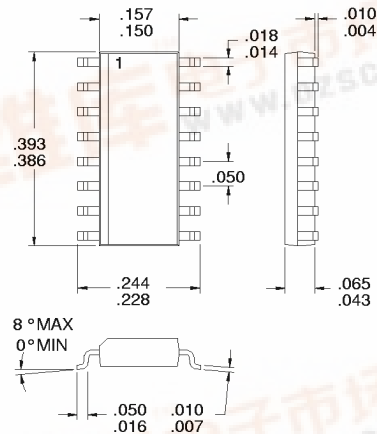
**INTEGRATED TRANSCEIVER**

**Typical Applications**

- Digital Communication Systems
- Spread Spectrum Communication Systems
- 915 MHz Cordless Phones
- 915 MHz ISM Band Systems
- POS Terminals
- Commercial Handheld Systems

**Product Description**

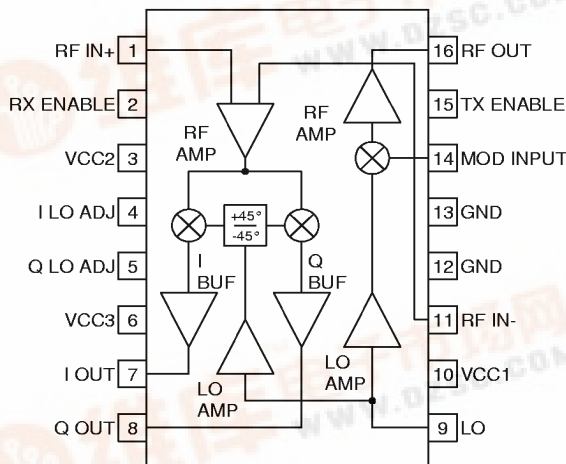
The RF9904 transceiver IC includes a transmit BPSK modulator, and a receive quadrature demodulator, as well as a splitter for the local oscillator signal, and separate transmit and receive LO buffer amplifiers. The IC operates over the 700 to 1100MHz frequency range, which accommodates 902 to 928MHz ISM band spread-spectrum systems as well as first IF stages for higher-frequency systems. The IC contains all circuits required for quadrature demodulation, using an integrated LO phase shift network, as well as all circuits for bi-phase modulation. Both modulation and demodulation are direct (at the carrier frequency), so only a single external LO source is needed. This chip is designed to be operated together with the RF2403 Front End IC.



**Optimum Technology Matching® Applied**

- Si BJT       GaAs HBT       GaAs MESFET  
 Si Bi-CMOS

**Package Style: SOP-16**



**Functional Block Diagram**

**Features**

- Single 4.0V to 6.5V Power Supply
- Direct Modulation and Demodulation
- Separate RX and TX Power Down Mode
- DC to 15MHz Baseband Frequency
- 700MHz to 1100MHz RF Frequency
- Compatible With RF2403 Front End IC

**Ordering Information**

- RF9904      Integrated Transceiver  
 RF9904 PCBA      Fully Assembled Evaluation Board

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## Absolute Maximum Ratings

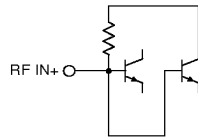
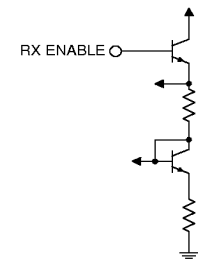
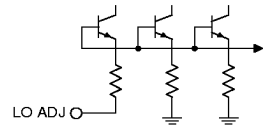
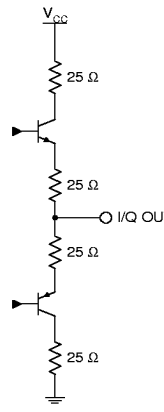
Parameter	Rating	Unit
Supply Voltage	-0.5 to +7.0	V <sub>DC</sub>
RX/TX Enable Voltage	-0.5 to V <sub>CC</sub>	V
Input RF Power	+10	dBm
Operating Ambient Temperature	-40 to +85	°C
Storage Temperature	-40 to +150	°C



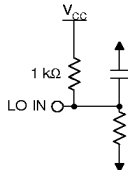
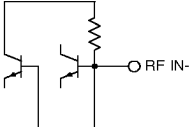
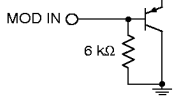
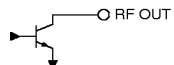
**Caution!** ESD sensitive device.

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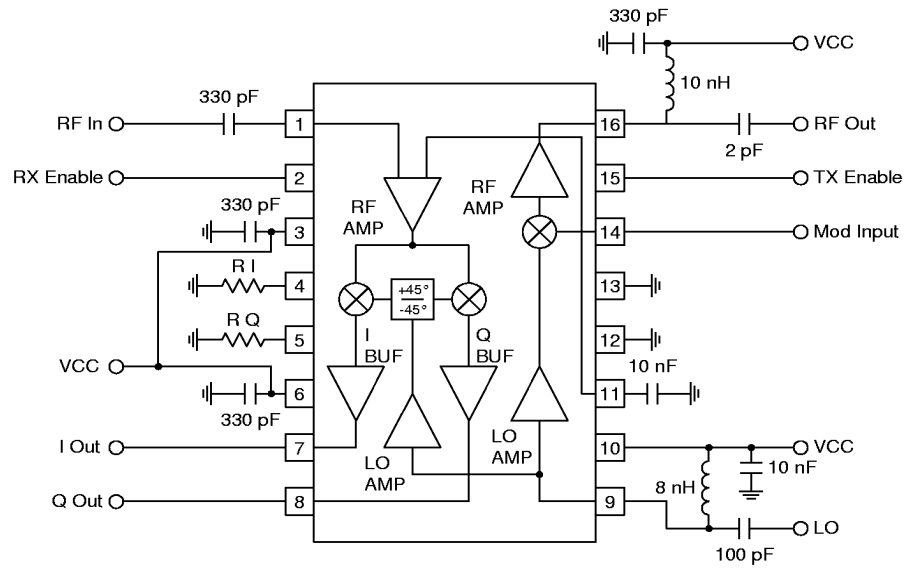
Parameter	Specification			Unit	Condition
	Min.	Typ.	Max.		
<b>Overall</b>					T=25 °C, V <sub>CC</sub> =5.0V, Freq=915MHz
Frequency Range		700 to 1100		MHz	
LO Input Level	-5	0	+5	dBm	
LO Input VSWR			1.4:1		
<b>Receiver Section</b>					P <sub>IN</sub> =-30dBm, F <sub>IN</sub> =916MHz, P <sub>LO</sub> =-30dBm, F <sub>LO</sub> =915MHz
Input VSWR			1.4:1		
Noise Figure		10		dB	
Voltage Gain	1	4	7	dB	
Input P <sub>1dB</sub>		-2		dBm	
Input IP <sub>3</sub>		+8		dBm	
Baseband Frequency		15		MHz	3 dB Bandwidth, Load=1MΩ  1 pF
I/Q Amplitude Error		±0.5	±1.0	dB	
I/Q Phase Error		±1	±5	°	
I/Q Output Impedance		50		Ω	
I/Q Output DC Level		3.5		V	
DC Offset Between I and Q		5		mV	
Max I/Q Output Level		1.0		V <sub>PP</sub>	
<b>Transmitter Section</b>					F <sub>MOD</sub> =100kHz, V <sub>MOD</sub> =0.5V <sub>PP</sub>
Modulation Frequency		15		MHz	
Mod Input Impedance		6		kΩ	
Modulation Voltage		0.5		V <sub>PP</sub>	
Allowed DC at Mod Input	-1.0		1.0	V	
RF Output Power	-11	-10		dBm	
Carrier Suppression	-26			dBc	
Image Suppression		-22		dBc	
Second Harmonic of RF				dBc	
Output Impedance				Ω	
<b>Power Down Control</b>					
"OFF" Voltage			0.5	V	Voltage supplied to the input; device is "OFF"
"ON" Voltage	V <sub>CC</sub> -1			V	Voltage supplied to the input; device is "ON"
"OFF" to "ON" time			100	ns	
<b>Power Supply</b>					
Operating Voltage	4.0		6.5	V	
RX Current Consumption	20	25	35	mA	
TX Current Consumption	7	10	20	mA	
Power Down Current			200	μA	V <sub>CC</sub> =5.0V, RX ENABLE=TX ENABLE=0V

Pin	Function	Description	Interface Schematic
1	RF IN+	50Ω RF input for the receiver. DC voltage at this point is about 3V, and an external DC blocking capacitor is required.	
2	RX ENABLE	Enables the RX circuits (RX LO amplifiers, demodulators, buffer amplifiers, and RF amplifier) when high.	
3	VCC2	Power supply pin for the TX output stage, I LO amplifier, and I demodulator. An external RF decoupling capacitor should be placed as close to the pin as possible.	
4	I LO ADJ	This pin is used to adjust the balance of the bias for the I LO amplifier by adjusting the value of the external resistor (R <sub>i</sub> ) to ground. Typical values are between 0Ω and 200Ω. The optimum value for a given application is dependent on the LO frequency, LO level, and power supply voltage. For a given operating point an optimum value can be found which results in minimum phase and amplitude error, and a minimum sensitivity of the LO level. In other words, optimizing the value for minimum phase and amplitude error alone is not enough, since a value may be found which makes the phase and/or amplitude error depend heavily on LO level; thus a small change would result in a large change of phase/amplitude error. There are combinations of R <sub>I</sub> and R <sub>Q</sub> that result in low amplitude and phase error, as well as maximum tolerance for LO level and frequency changes. Some values are given in the application schematic as a starting point.	
5	Q LO ADJ	Same as pin 4, for the Q mixer.	See pin 4.
6	VCC3	Power supply pin for the second TX LO amplifier stage, modulator, Q LO amplifier and Q demodulator. An external RF decoupling capacitor should be placed as close to the pin as possible.	
7	I OUT	Baseband output of the I demodulator. This is a push-pull output, with a 50Ω impedance. The DC level at this point is about 3.5V when running of a 5V power supply.	
8	Q OUT	Baseband output of the Q demodulator.	See pin 7.

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9	<b>LO IN</b>	50 $\Omega$ LO input port. This pin has an internal 1 k $\Omega$ resistor to V <sub>CC</sub> , hence an external DC blocking capacitor is recommended.	
10	<b>VCC1</b>	Power supply pin for the first TX LO amplifier. An external RF decoupling capacitor should be placed as close to the pin as possible.	
11	<b>RF IN-</b>	Complementary input of pin 1. Normally this pin has an external RF decoupling capacitor.	
12	<b>GND</b>	Ground connection.	
13	<b>GND</b>	Ground connection.	
14	<b>MOD IN</b>	Modulation input. This pin has an internal 6 k $\Omega$ resistor to ground. The allowed DC voltage at this input is -1 V to +1 V. An external DC blocking capacitor is recommended to maintain a DC level of 0V.	
15	<b>TX ENABLE</b>	Enables the TX circuits (TX LO buffer amplifier, modulator, output amplifier) when high.	Same as pin 2.
16	<b>RF OUT</b>	Open collector RF output. This pin requires an external inductor to V <sub>CC</sub> for biasing.	

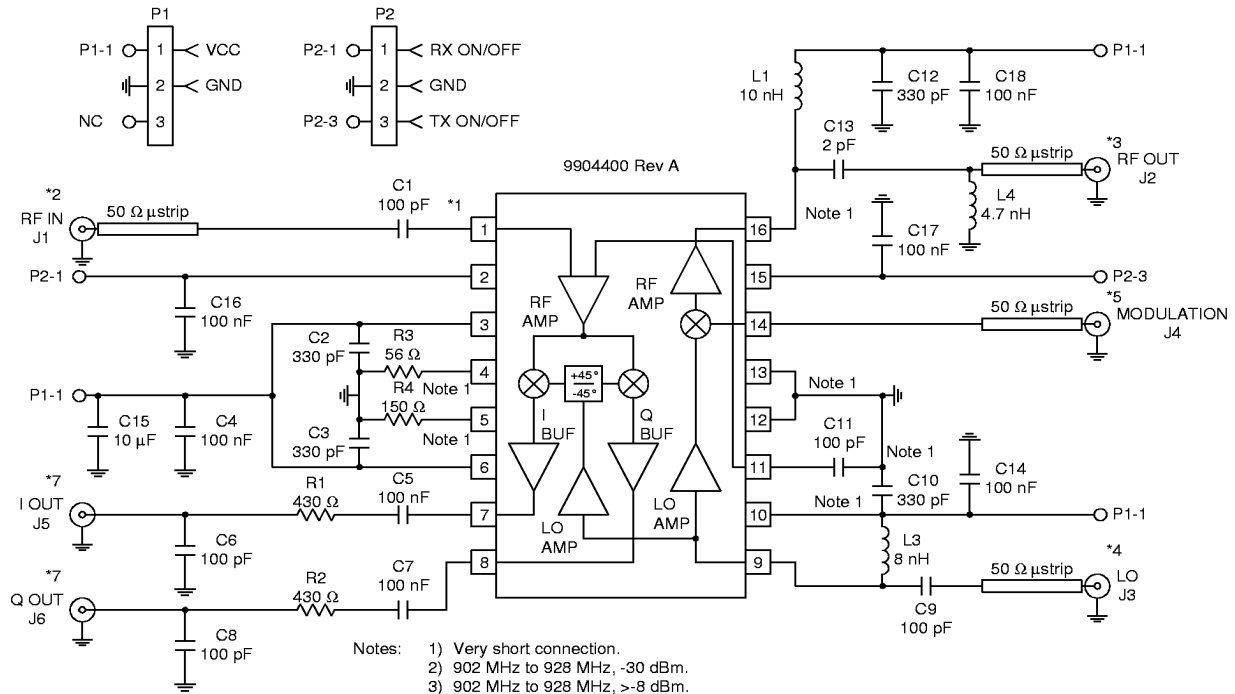
## Application Schematic



# RF9904

## Evaluation Board Schematic

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



### Evaluation Board Layout

