

# 2.5 GHZ DIRECT QUADRATURE MODULATOR

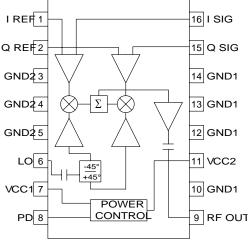
RoHS Compliant & Pb-Free Product Package Style: SOIC-16

### Features

- Single 5V Power Supply
- Integrated RF Quadrature Network
- No Tuning Required
- Low LO Input Level
- Digitally Controlled Power Down Mode
- 800 MHz to 2500 MHz Operation

### **Applications**

- Digital Communications Systems
- Spread-Spectrum Communication Systems
- GMSK, QPSK, DQPSK, QAM Modulation
- GSM, DCS 1800, JDC, D-AMPS Systems
- Commercial and Consumer Systems



Functional Block Diagram

### **Product Description**

The RF2422 is a monolithic integrated quadrature modulator IC capable of universal direct modulation for high-frequency AM, PM, or compound carriers. This low-cost IC implements differential amplifiers for the modulation inputs, 90° carrier phase shift network, carrier limiting amplifiers, two matched double-balanced mixers, summing amplifier, and an output RF amplifier which will drive  $50\Omega$  from 800 MHz to 2500 MHz. Component matching, which can only be accomplished with monolithic construction, is used to full advantage to obtain excellent amplitude balance and phase accuracy.

#### **Ordering Information**

RF24222.5GHz Direct Quadrature ModulatorRF2422PCBA-41XFully Assembled Evaluation Board

### **Optimum Technology Matching® Applied**

🗹 GaAs HBT	□ SiGe BiCMOS	GaAs pHEMT	🗌 GaN HEMT
GaAs MESFET	🗌 Si BiCMOS	Si CMOS	
🗌 InGaP HBT	SiGe HBT	🗌 Si BJT	

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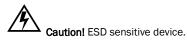
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# **RF2422**



#### **Absolute Maximum Ratings**

Parameter	Rating	Unit
Supply Voltage	-0.5 to +7.5	V <sub>DC</sub>
Input LO and RF Levels	+10	dBm
Operating Ambient Temperature	-40 to +85	°C
Storage Temperature	-40 to +150	°C



Exceeding any one or a combination of the Absolute Maximum Rating conditions may cause permanent damage to the device. Extended application of Absolute Maximum Rating conditions to the device may reduce device reliability. Specified typical performance or functional operation of the device under Absolute Maximum Rating conditions is not implied.

RoHS status based on EU Directive 2002/95/EC (at time of this document revision).

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Doromotor	Specification		Unit			
Parameter	Min.	Тур.	Typ. Max.		Condition	
Carrier Input					T=25°C, V <sub>CC</sub> =5V	
Frequency Range	800		2500	MHz		
Power Level	-6		+6	dBm		
Input VSWR		5:1			At 900 MHz	
		1.8:1			At 1800MHz	
		1.2:1			At 2500MHz	
Modulation Input						
Frequency Range	DC		250	MHz		
Reference Voltage (V <sub>REF</sub> )	2.0	3.0		V		
Maximum Modulation (I&Q)			V <sub>REF</sub> ±1.0	V		
Gain Asymmetry		0.2		dB		
Quadrature Phase Error		3		٥		
Input Resistance		30		kΩ		
Input Bias Current			40	μΑ		
RF Output					LO=2GHz and -5dBm, I&Q=2.0V <sub>PP</sub> , SSB	
Output Power	-3		+3	dBm		
Output Impedance		50		Ω		
Output VSWR		3.5:1			At 900 MHz	
		1.3:1			At 2000MHz	
		1.15:1			At 2500MHz	
Harmonic Output	-30	-35		dBc		
Sideband Suppression	25	35		dB		
Carrier Suppression	30	35		dB		
IM <sub>3</sub> Suppression	30	35		dB	Intermodulation of the carrier and the desired RF signal	
	25	30		dB	Intermodulation of baseband signals	
Broadband Noise Floor					At 20MHz offset, V <sub>CC</sub> =5V.	
					Tied to $V_{REF}$ : ISIG, QSIG, IREF, and QREF.	
		-145		dBm/Hz	At 850MHz	
		-152		dBm/Hz	At 1900MHz	
Power Down						
Turn On/Off Time			100	ns		
PD Input Resistance	50			kΩ		
Power Control "ON"			2.8	V	Threshold voltage	
Power Control "OFF"	1.0	1.2		V	Threshold voltage	





Parameter	Specification		Unit	Condition		
	Min.	Тур.	Max.	Unit	Condition	
Power Supply						
Voltage		5		V	Specifications	
	4.5		6.0	V	Operating Limits	
Current		45	50	mA	Operating	
			25	μΑ	Power Down	





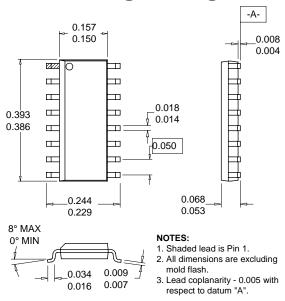
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Pin	Function	Description	Interface Schematic
1	I REF	Reference voltage for the I mixer. This voltage should be the same as the DC voltage supplied to the I SIG pin. A voltage of 3.0V is recommended. The SIG and REF inputs are inputs of a differential amplifier. Therefore the REF and SIG inputs are interchangeable. If swapping the I SIG and I REF pins, the Q SIG and Q REF also need to be swapped to maintain the correct phase. It is also possible to drive the SIG and REF inputs in a balanced mode. This will increase the gain.	Q SIGO 1000 4250 4250 4250
2	Q REF	Reference voltage for the Q mixer. This voltage should be the same as the DC voltage supplied to the Q SIG pin. A voltage of 3.0V is recommended.	Q SIGO 10002 42502 42
3	GND2	Ground connection of the LO phase shift network. This pin should be con- nected directly to the ground plane.	
4	GND2	Same as pin 3.	
5	GND2	Same as pin 3.	
6	LO	The input of the phase shifting network. This pin has an internal DC-block- ing capacitor. At frequencies higher than 2 GHz this port is well-matched to $50\Omega$ . This port is voltage driven so matching at lower frequencies is not required.	LO 0
7	VCC1	Power supply for all circuits except the RF output stage. An external capacitor is needed if no other low frequency bypass capacitor is nearby.	
8	PD	Power Down control. When this pin is "low", all circuits are shut off. A "low" is typically 1.2V or less at room temperature. When this pin is "high" (V <sub>CC</sub> ), all circuits are operating normally. If PD is below V <sub>CC</sub> , output power and performance will be degraded. Operating in this region is not recommended, although it might be useful in some applications where power control is required.	
9	RF OUT	This is the 50 $\Omega$ RF Output. This pin has an internal DC-blocking capacitor. At frequencies higher than 2GHz this port is well-matched. Typical impedances at lower frequencies are: 24-j30 $\Omega$ @ 1GHz, 27-j10 $\Omega$ @ 1.4GHz, 31-j3 $\Omega$ @ 1.8GHz. At those frequencies, external matching may be needed to optimize output power.	
10	GND3	Ground connection for the RF output stage. This pin should be connected directly to the ground plane.	
11	VCC2	Power supply for the RF Output amplifier. An external capacitor is needed if no other low frequency bypass capacitor is near by.	
12	GND1	Ground connection for the LO and baseband amplifiers, and for the mixers. This pin should be connected directly to the ground plane.	
13	GND1	Same as pin 12.	
14	GND1	Same as pin 12.	
15	Q SIG	Baseband input to the Q mixer. This pin is DC-coupled. Maximum output power is obtained when the input signal has a peak to peak amplitude of 2V. The recommended DC level for this pin is 3.0V. The peak minimum voltage on this pin ( $V_{REF}$ - peak modulation amplitude) should never drop below 2.0V. The peak maximum voltage on this pin ( $V_{REF}$ + peak modulation amplitude) should never drop below 2.0V. The peak maximum voltage on this pin ( $V_{REF}$ + peak modulation amplitude) should never exceed 4.0V.	See pin 2.



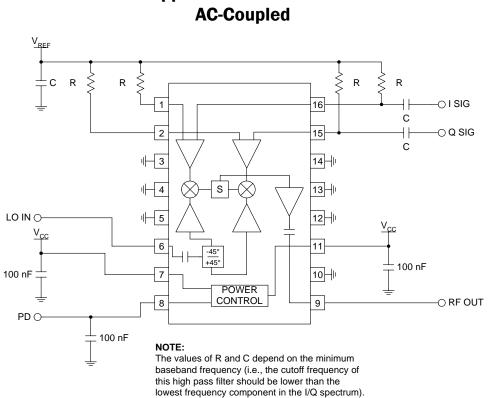


Pin	Function	Description	Interface Schematic
16	I SIG	Baseband input to the I mixer. This pin is DC-coupled. Maximum output power is obtained when the input signal has a peak to peak amplitude of 2V. The recommended DC level for this pin is 3.0V. The peak minimum voltage on this pin ( $V_{REF}$ - peak modulation amplitude) should never drop below 2.0V. The peak maximum voltage on this pin ( $V_{REF}$ + peak modula- tion amplitude) should never exceed 4.0V.	See pin 1.



### **Package Drawing**



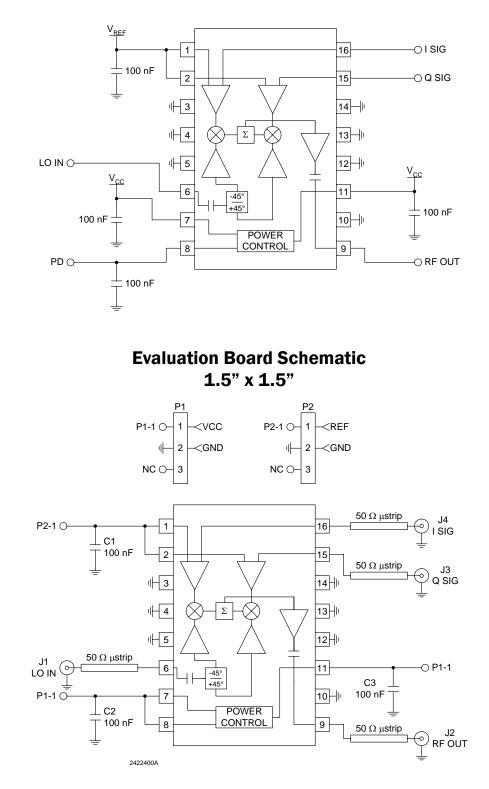


Application Schematic AC-Coupled



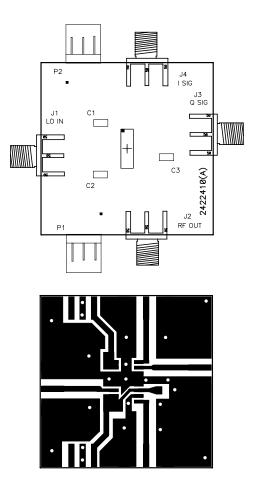








### Evaluation Board Layout Board Size 1.510" x 1.510" Board Thickness 0.031", Board Material FR-4





## **RoHS\* Banned Material Content**

RoHS Compliant:	Yes
Package total weight in gran	0.147
Compliance Date Code:	0520
Bill of Materials Revision:	Rev -
Pb Free Category:	e3

Bill of Materials	Parts Per Million (PPM)						
	Pb	Cd	Hg	Cr VI	PBB	PBDE	
Die	0	0	0	0	0	0	
Molding Compound	0	0	0	0	0	0	
Lead Frame	0	0	0	0	0	0	
Die Attach Epoxy	0	0	0	0	0	0	
Wire	0	0	0	0	0	0	
Solder Plating	0	0	0	0	0	0	

This RoHS banned material content declaration was prepared solely on information, including analytical data, provided to RFMD by its suppliers, and applies to the Bill of Materials (BOM) revision noted above.

\* DIRECTIVE 2002/95/EC OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL of 27 January 2003 on the restriction of the use of certain hazardous substances in electrical and electronic equipment

# **RF2422**

