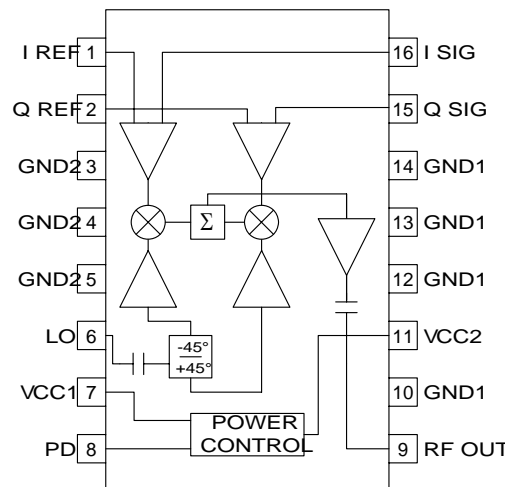


Features

- Single 5V Power Supply
- Integrated RF Quadrature Network
- No Tuning Required
- Low LO Input Level
- Digitally Controlled Power Down Mode
- 800MHz to 2500MHz 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 50Ω from 800MHz to 2500MHz. 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

RF2422 2.5GHz Direct Quadrature Modulator
RF2422PCBA-41X Fully Assembled Evaluation Board

Optimum Technology Matching® Applied

- | | | | |
|--|--------------------------------------|-------------------------------------|-----------------------------------|
| <input checked="" type="checkbox"/> GaAs HBT | <input type="checkbox"/> SiGe BiCMOS | <input type="checkbox"/> GaAs pHEMT | <input type="checkbox"/> GaN HEMT |
| <input type="checkbox"/> GaAs MESFET | <input type="checkbox"/> Si BiCMOS | <input type="checkbox"/> Si CMOS | |
| <input type="checkbox"/> InGaP HBT | <input type="checkbox"/> SiGe HBT | <input type="checkbox"/> Si BJT | |

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Absolute Maximum Ratings

| Parameter | Rating | Unit |
|-------------------------------|--------------|-----------------|
| Supply Voltage | -0.5 to +7.5 | V _{DC} |
| Input LO and RF Levels | +10 | dBm |
| Operating Ambient Temperature | -40 to +85 | °C |
| Storage Temperature | -40 to +150 | °C |



Caution! ESD sensitive device.

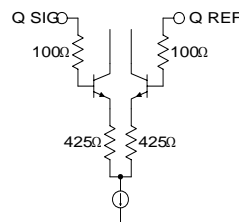
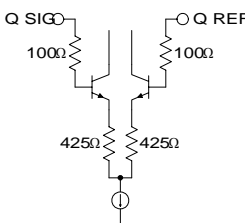
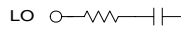
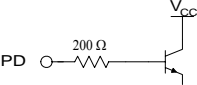
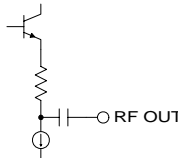
Exceeding any one or a combination of the Absolute Maximum Rating conditions may cause permanent damage to the device. Extended application of Absolute Maximum Rating conditions to the device may reduce device reliability. Specified typical performance or functional operation of the device under Absolute 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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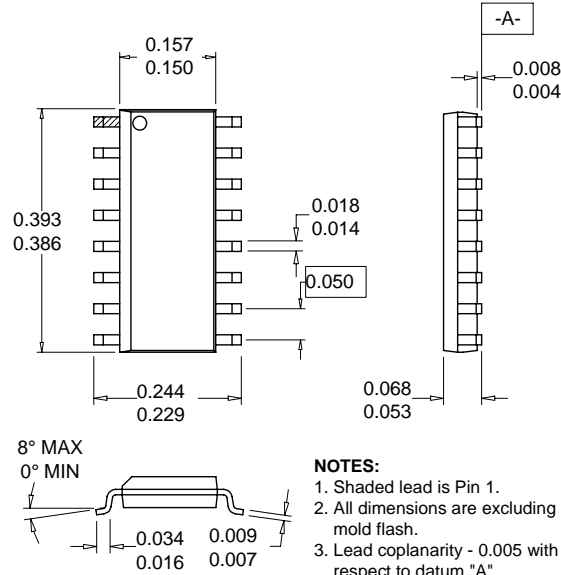
| Parameter | Specification | | | Unit | Condition |
|---------------------------------------|---------------|--------|-----------------------|--------|---|
| | Min. | Typ. | Max. | | |
| Carrier Input | | | | | T=25 °C, V _{CC} =5V |
| Frequency Range | 800 | | 2500 | MHz | |
| Power Level | -6 | | +6 | dBm | |
| Input VSWR | | 5:1 | | | At 900MHz |
| | | 1.8:1 | | | At 1800MHz |
| | | 1.2:1 | | | At 2500MHz |
| Modulation Input | | | | | |
| Frequency Range | DC | | 250 | MHz | |
| Reference Voltage (V _{REF}) | 2.0 | 3.0 | | V | |
| Maximum Modulation (I&Q) | | | V _{REF} ±1.0 | V | |
| Gain Asymmetry | | 0.2 | | dB | |
| Quadrature Phase Error | | 3 | | ° | |
| Input Resistance | | 30 | | kΩ | |
| Input Bias Current | | | 40 | μA | |
| RF Output | | | | | LO=2GHz and -5dBm, I&Q=2.0V _{pp} SSB |
| Output Power | -3 | | +3 | dBm | |
| Output Impedance | | 50 | | Ω | |
| Output VSWR | | 3.5:1 | | | At 900MHz |
| | | 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 ₃ 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 _{CC} =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. | Typ. | Max. | | |
| Power Supply | | | | | |
| Voltage | | 5 | | V | Specifications |
| | 4.5 | | 6.0 | V | Operating Limits |
| Current | | 45 | 50 | mA | Operating |
| | | | 25 | μA | Power Down |

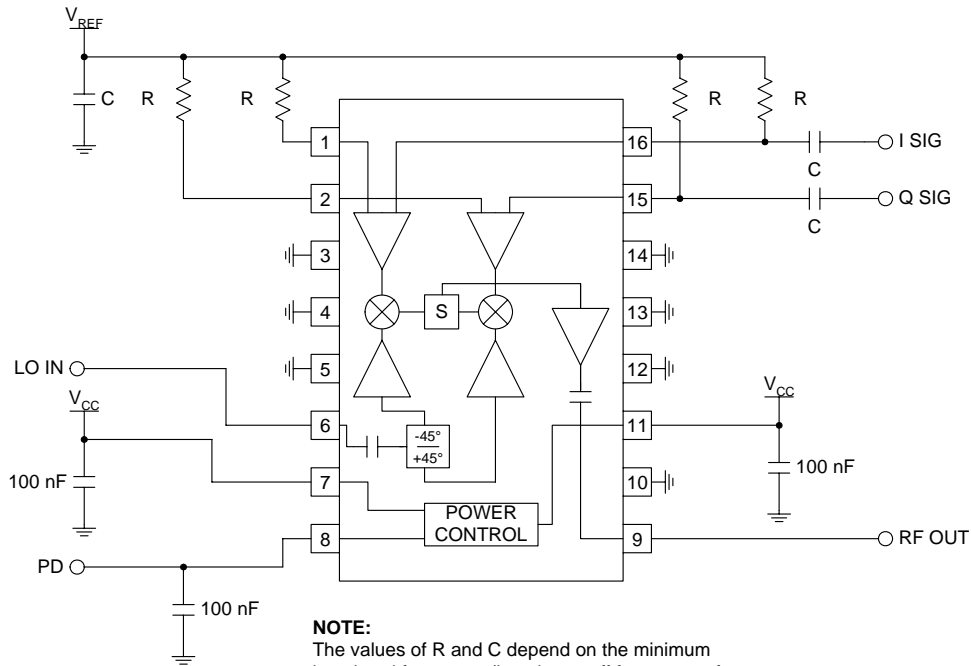
| Pin | Function | Description | Interface Schematic |
|-----|----------|--|---|
| 1 | I REF | Reference voltage for the I mixer. This voltage should be the same as the DC voltage supplied to the I SIG pin. A voltage of 3.0V is recommended. The SIG and REF inputs are inputs of a differential amplifier. 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. |  |
| 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. |  |
| 3 | GND2 | Ground connection of the LO phase shift network. This pin should be connected 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-blocking capacitor. At frequencies higher than 2GHz this port is well-matched to 50Ω. This port is voltage driven so matching at lower frequencies is not required. |  |
| 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 _{CC}), all circuits are operating normally. If PD is below V _{CC} , 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 50Ω 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 Ω @ 1GHz, 27-j10 Ω @ 1.4GHz, 31-j3 Ω @ 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 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 ($V_{REF} - \text{peak modulation amplitude}$) should never drop below 2.0V. The peak maximum voltage on this pin ($V_{REF} + \text{peak modulation amplitude}$) should never exceed 4.0V. | See pin 1. |

Package Drawing

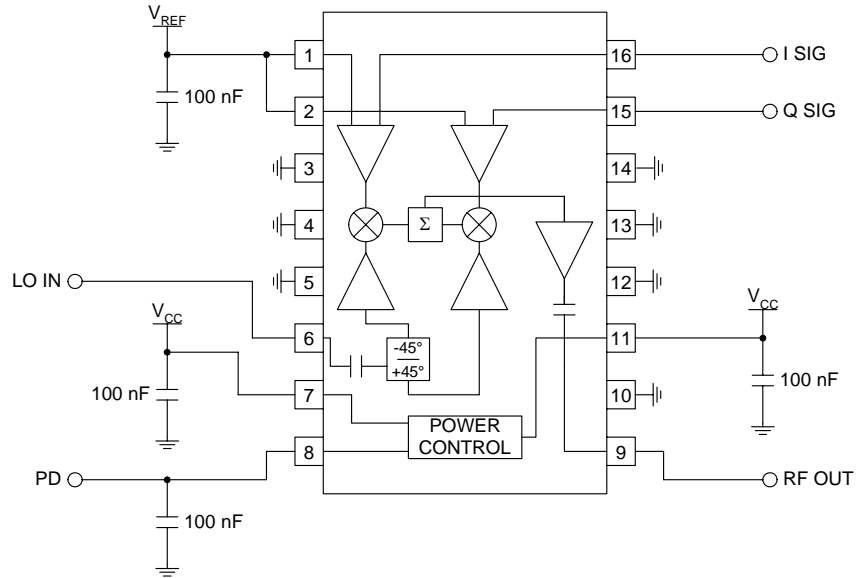


Application Schematic AC-Coupled

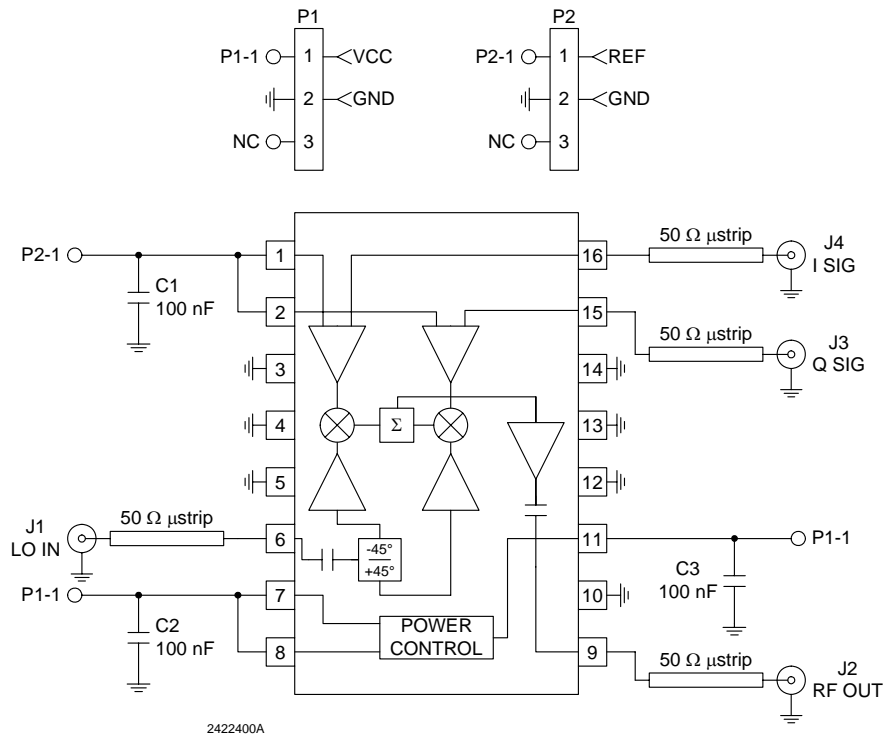


NOTE:
The values of R and C depend on the minimum baseband frequency (i.e., the cutoff frequency of this high pass filter should be lower than the lowest frequency component in the I/Q spectrum).

**Application Schematic
DC-Coupled**

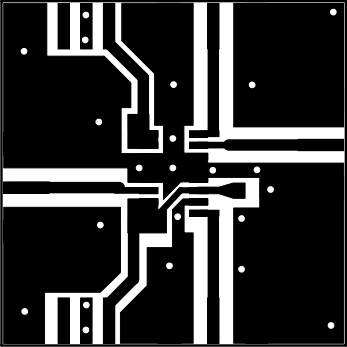
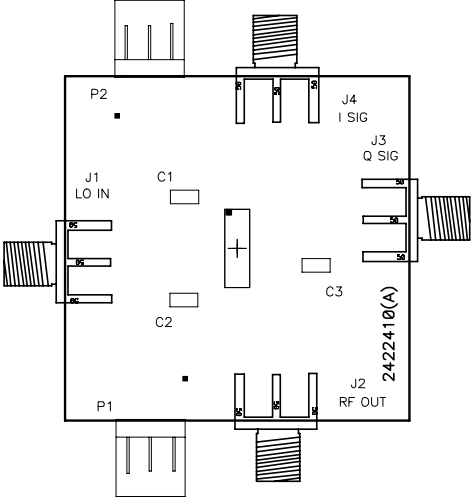


**Evaluation Board Schematic
1.5" x 1.5"**



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 gram 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 |

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* 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

