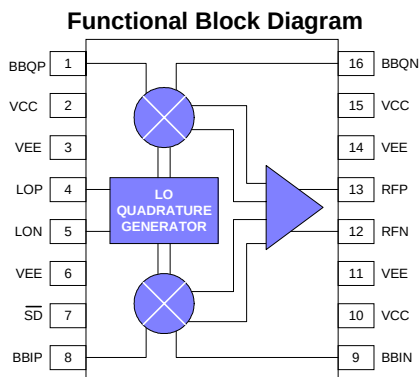




## Product Description

The Sirenza Microdevices' STQ-2016 is a direct quadrature modulator targeted for use in a wide range of communications systems, including cellular/PCS, CDMA2000, UMTS, and ISM datacom. This device features a wide 700-2500 MHz operating frequency band, excellent carrier and sideband suppression, and a low broadband noise floor.

The STQ-2016 uses silicon germanium (SiGe) device technology and delivers a typical output power of -11dBm with greater than 60dB IM3 suppression. A digital input shut-down feature is included that, when enabled, attenuates the output by 60dB. The device is packaged in an industry standard 16 pin TSSOP with exposed paddle for superb RF and thermal ground.



## Product Specifications – RF Output: $T_A = 25^\circ\text{C}$

| Parameters                | Test Conditions (see page 2)                                            | Units              | Min.  | Typ.       | Max.  | Min.  | Typ.       | Max.  |
|---------------------------|-------------------------------------------------------------------------|--------------------|-------|------------|-------|-------|------------|-------|
| RF Frequency Range        |                                                                         | MHz                | 700   |            | 1000  | 1700  |            | 2500  |
| Output Power              |                                                                         | dBm                | -13.0 | -10.5      | -9.0  | -15.0 | -11.5      | -9.0  |
| RF Port Return Loss       | matched to 50 $\Omega$<br>(refer to schematics on pages 6 & 7)          | dB                 |       | 20         |       |       | 16         |       |
| Output P1dB               |                                                                         | dBm                | +3    | +4         |       | 0     | +3         |       |
| Carrier Feedthrough       |                                                                         | dBm                |       | -40        | -34   |       | -40        | -32   |
| Sideband Suppression      |                                                                         | dB                 | 34    | 40         |       | 34    | 40         |       |
| IM3 Suppression           | two-tone baseband input @ 600mVp-p differential per tone                | dB                 | 58    | 62         |       | 58    | 65         |       |
| Broadband Noise Floor     | baseband inputs tied to 1.9V <sub>DC</sub> , -20MHz offset from carrier | dBm/Hz             |       | -154       | -150  |       | -155       | -150  |
| Quadrature Phase Error    |                                                                         | deg                | -2    | $\pm 0.5$  | +2    | -2    | $\pm 0.5$  | +2    |
| I/Q Amplitude Balance     |                                                                         | dB                 | -0.2  | $\pm 0.05$ | +0.2  | -0.2  | $\pm 0.05$ | +0.2  |
| Supply Voltage (Vcc)      |                                                                         | V                  | +4.75 | +5         | +5.25 | +4.75 | +5         | +5.25 |
| Supply Current            |                                                                         | mA                 |       | 73         | 82    |       | 73         | 82    |
| Device Thermal Resistance | junction-case                                                           | $^\circ\text{C/W}$ |       | 25         |       |       | 25         |       |

The information provided herein is believed to be reliable at press time. Sirenza Microdevices assumes no responsibility for inaccuracies or omissions. Sirenza Microdevices assumes no responsibility for the use of this information, and all such information shall be entirely at the user's own risk. Prices and specifications are subject to change without notice. No patent rights or licenses to any of the circuits described herein are implied or granted to any third party. Sirenza Microdevices does not authorize or warrant any Sirenza Microdevices product for use in life-support devices and/or systems.

Copyright 2001 Sirenza Microdevices, Inc. All worldwide rights reserved.

522 Almanor Ave., Sunnyvale, CA 94085

Phone: (800) SMI-MMIC

1

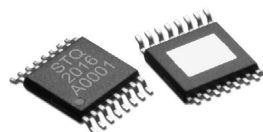
<http://www.sirenza.com>

EDS-102083 Rev C

## STQ-2016

700 - 2500 MHz

Direct Quadrature Modulator



16 pin TSSOP with Exposed Ground Pad

Package Footprint: 0.197 x 0.252 inches, (5.0 x 6.4 mm)

Package Height: 0.039 inches (1.0 mm)

## Product Features

- Excellent carrier feedthrough, -40 dBm
- Wide baseband input, DC - 500 MHz
- Superb phase accuracy and amplitude balance,  $\pm 0.5$  deg./ $\pm 0.2$  dB
- No external IF filter required
- Very low noise floor, -155 dBm/Hz
- Low LO drive requirement, -5 dBm
- Single +5 volt supply with digital shut-down

## Applications

- Cellular/PCS/CDMA2000/UMTS transceivers
- ISM band transceivers, 900 & 2400 MHz
- GMSK, QPSK, QAM, SSB modulators



## STQ-2016 Direct Quadrature Modulator

### Test Conditions

(for all product specification tables unless otherwise noted)

|                                      |                                                                                                               |
|--------------------------------------|---------------------------------------------------------------------------------------------------------------|
| V <sub>CC</sub> (pins 2,10,15)       | +5V                                                                                                           |
| T <sub>A</sub>                       | +25°C                                                                                                         |
| Baseband Input<br>(Pins 1, 8, 9, 16) | 1.9V DC bias, 200kHz frequency, 300mVp-p per pin = 600mVp-p differential drive, I and Q signals in quadrature |
| LO Input<br>(Pins 4, 5)              | -5dBm @ 1960 MHz                                                                                              |

### Product Specifications - Baseband Modulation Input: T<sub>A</sub> = 25°C

| Parameters                 | Additional Test Conditions                            | Unit  | Min. | Typ. | Max. |
|----------------------------|-------------------------------------------------------|-------|------|------|------|
| Baseband Frequency Input   | -3dB bandwidth, baseband inputs terminated in 50 ohms | MHz   | DC   |      | 500  |
| Baseband Input Resistance  | per pin                                               | kohms |      | 4.4  |      |
| Baseband Input Capacitance | per pin                                               | pF    |      | 0.5  |      |

### Product Specifications - LO Input: T<sub>A</sub> = 25°C

| Parameters          | Additional Test Conditions                          | Unit | Min. | Typ. | Max. |
|---------------------|-----------------------------------------------------|------|------|------|------|
| LO Frequency        |                                                     | MHz  | 700  |      | 2500 |
| LO Drive Level      |                                                     | dBm  | -8   | -5   | -2   |
| LO Port Return Loss | matched to 50Ω (refer to schematics on pages 6 & 7) | dB   |      | 16   |      |

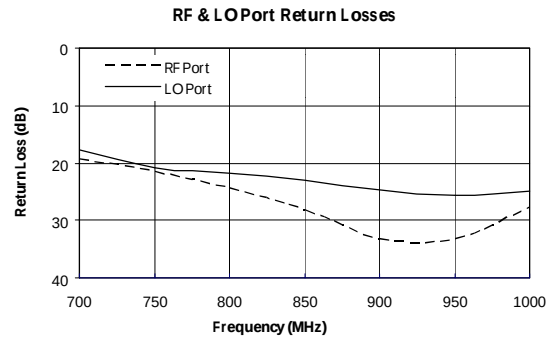
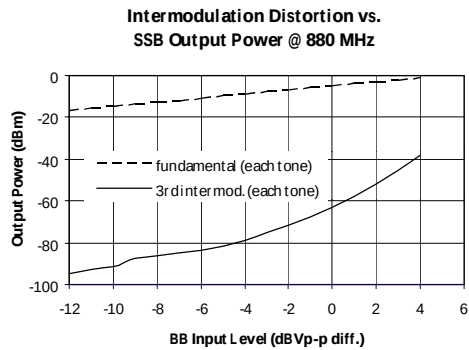
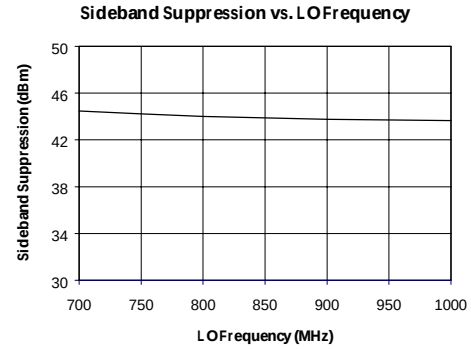
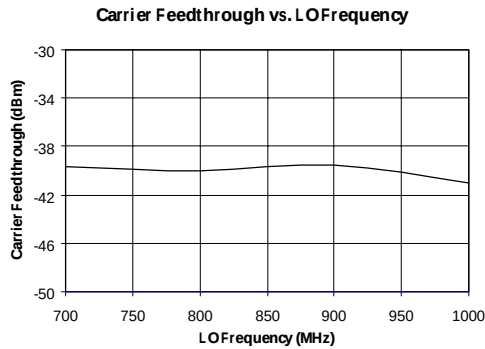
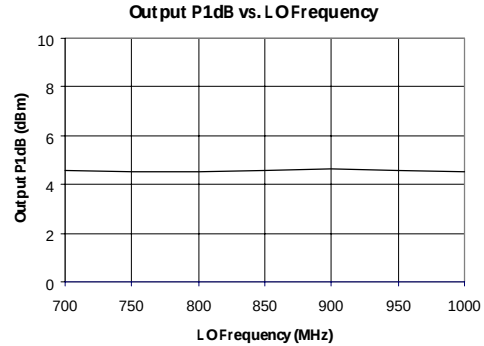
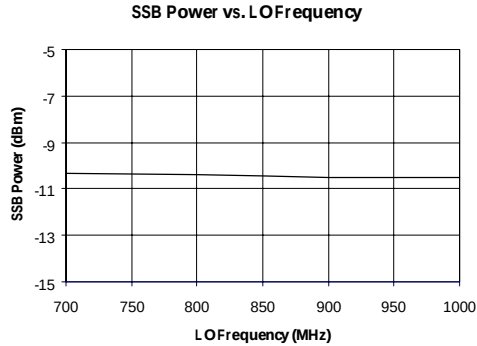
### Product Specifications – Miscellaneous: T<sub>A</sub> = 25°C

| Parameters                           | Additional Test Conditions            | Unit | Min. | Typ. | Max.            |
|--------------------------------------|---------------------------------------|------|------|------|-----------------|
| Shut-Down Attenuation                |                                       | dB   |      | 60   |                 |
| Shut-Down Pin Resistance             | @ 1MHz                                | kohm |      | 11.9 |                 |
| Shut-Down Pin Capacitance            | @ 1MHz                                | pF   |      | 5.2  |                 |
| Shut-down Control Voltage Thresholds | Shut-down disabled (normal operation) | V    | 3.75 |      | V <sub>CC</sub> |
|                                      | Shut-down enabled                     | V    | 0.0  |      | 1.5             |
| Shut-Down Settling Time              |                                       | ns   |      | <450 |                 |



## STQ-2016 Direct Quadrature Modulator

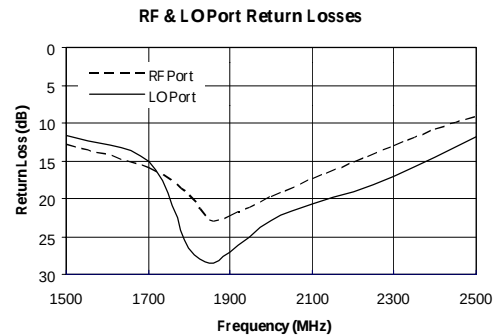
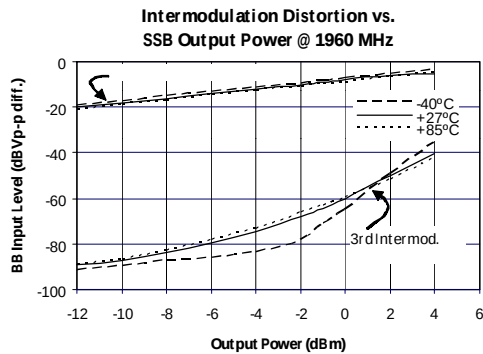
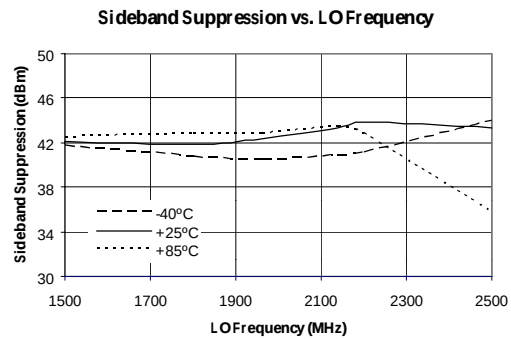
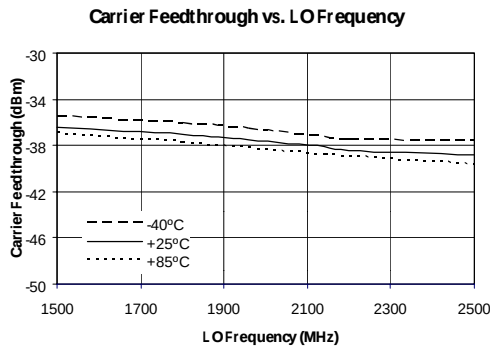
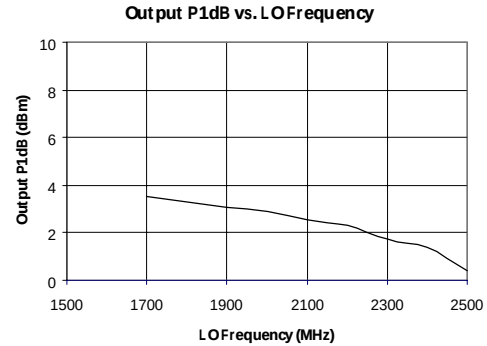
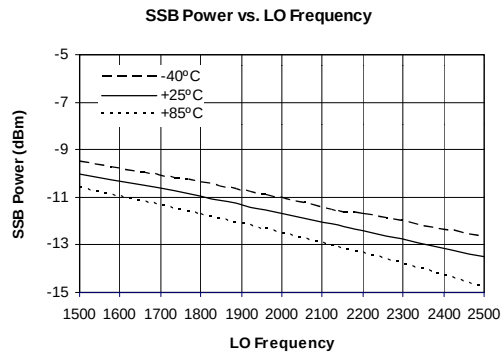
### 700 - 1000 MHz Typical Device Performance





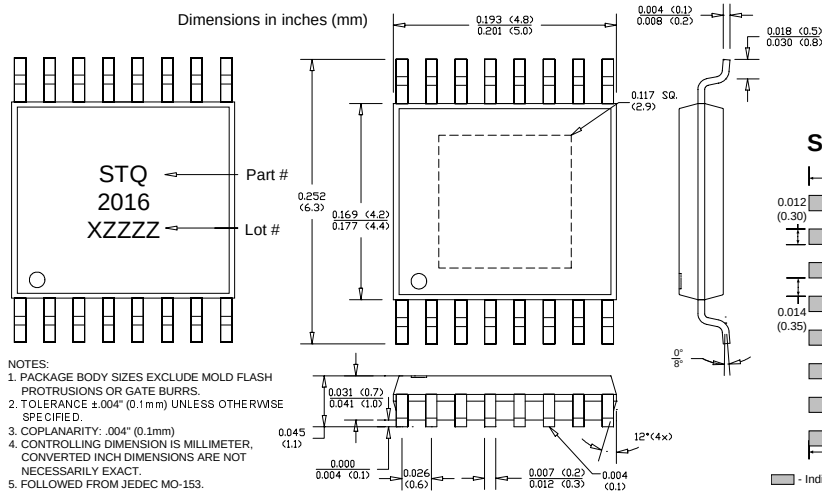
## STQ-2016 Direct Quadrature Modulator

### 1500 - 2500 MHz Typical Device Performance

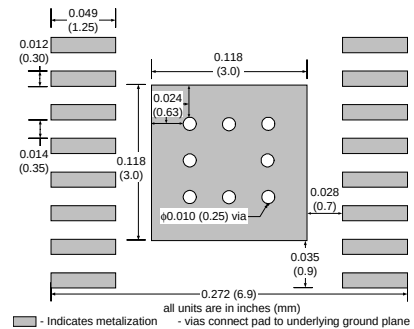




## Package Dimensions ("16" Package)



## Suggested PCB Pad Layout



## Pin Out Description

| Pin # | Function | Description                                 | Additional Comments                                           |
|-------|----------|---------------------------------------------|---------------------------------------------------------------|
| 1     | BBQP     | Q-channel baseband input, positive terminal | Nominal DC bias voltage is 1.9V (biased internally)           |
| 2     | VCC      | Positive supply (+5V)                       |                                                               |
| 3     | VEE      | Ground                                      |                                                               |
| 4     | LOP      | Local oscillator input, positive terminal   | Nominal DC voltage is 2.0V. Input should be AC-coupled.       |
| 5     | LON      | Local oscillator input, negative terminal   | Nominal DC voltage is 2.0V. Input should be AC-coupled.       |
| 6     | VEE      | Ground                                      |                                                               |
| 7     | SD       | Shut-down control                           | Logic high = normal operation; logic low = shut-down enabled. |
| 8     | BBIP     | I-channel baseband input, positive terminal | Nominal DC bias voltage is 1.9V (biased internally)           |
| 9     | BBIN     | I-channel baseband input, negative terminal | Nominal DC bias voltage is 1.9V (biased internally)           |
| 10    | VCC      | Positive supply (+5V)                       |                                                               |
| 11    | VEE      | Ground                                      |                                                               |
| 12    | RFN      | RF output, negative terminal                | Nominal DC voltage is 2.4V. Output should be AC-coupled.      |
| 13    | RFP      | RF output, positive terminal                | Nominal DC voltage is 2.4V. Output should be AC-coupled.      |
| 14    | VEE      | Ground                                      |                                                               |
| 15    | VCC      | Positive supply (+5V)                       |                                                               |
| 16    | BBQN     | Q-channel baseband input, negative terminal | Nominal DC bias voltage is 1.9V (biased internally)           |

## Absolute Maximum Ratings

| Parameters                                          | Value       | Unit            |
|-----------------------------------------------------|-------------|-----------------|
| Supply Voltage (VCC)                                | 6.0         | V <sub>DC</sub> |
| LO, RF Input (LOP, LON, RFP, RFN)                   | +10         | dBm             |
| Baseband Min Input Voltage (BBIP, BBIN, BBQP, BBQN) | 0           | V <sub>DC</sub> |
| Baseband Max Input Voltage (BBIP, BBIN, BBQP, BBQN) | 3           | V <sub>DC</sub> |
| Operating Temperature                               | -40 to +85  | °C              |
| Storage Temperature                                 | -65 to +150 | °C              |

Operation of this device beyond any one of these limits may cause permanent damage. For reliable continuous operation the device voltage and current must not exceed the maximum operating values specified in the table on page one.

## Part Number Ordering Information

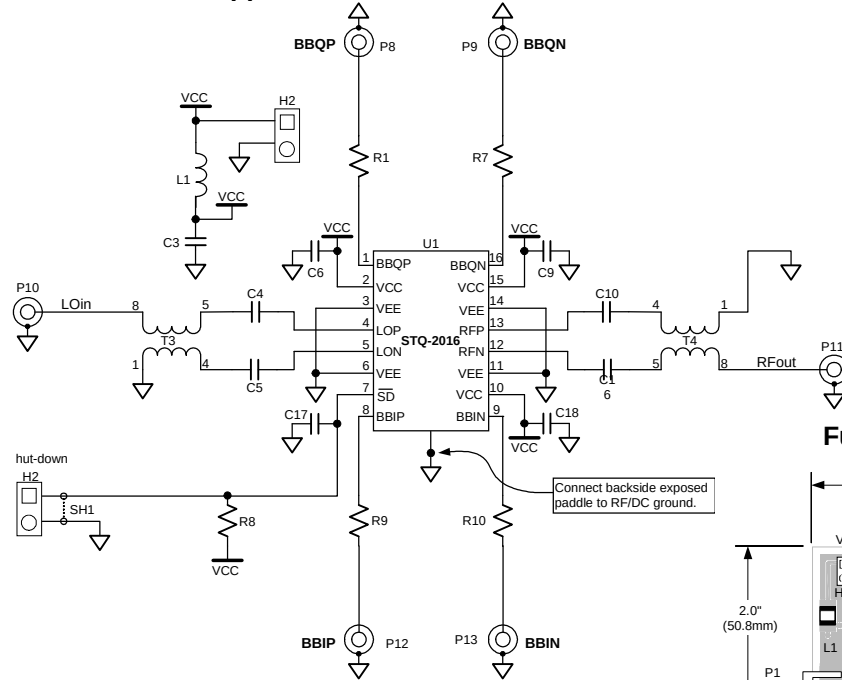
| Part Number | Reel Size | Devices/Reel |      |
|-------------|-----------|--------------|------|
|             |           | Min.         | Max. |
| STQ-2016    | 7"        | 500          | 1000 |



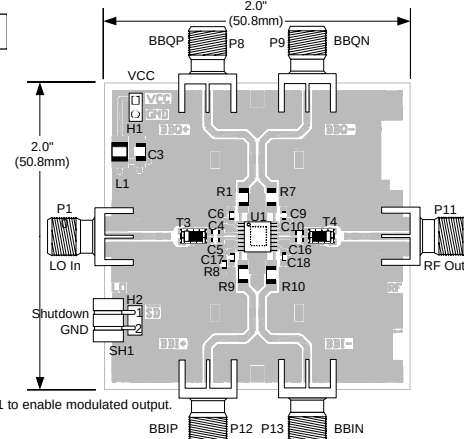
## Caution: ESD Sensitive

Appropriate precaution in handling, packaging and testing devices must be observed.

## 700 – 1000 MHz Application Schematic



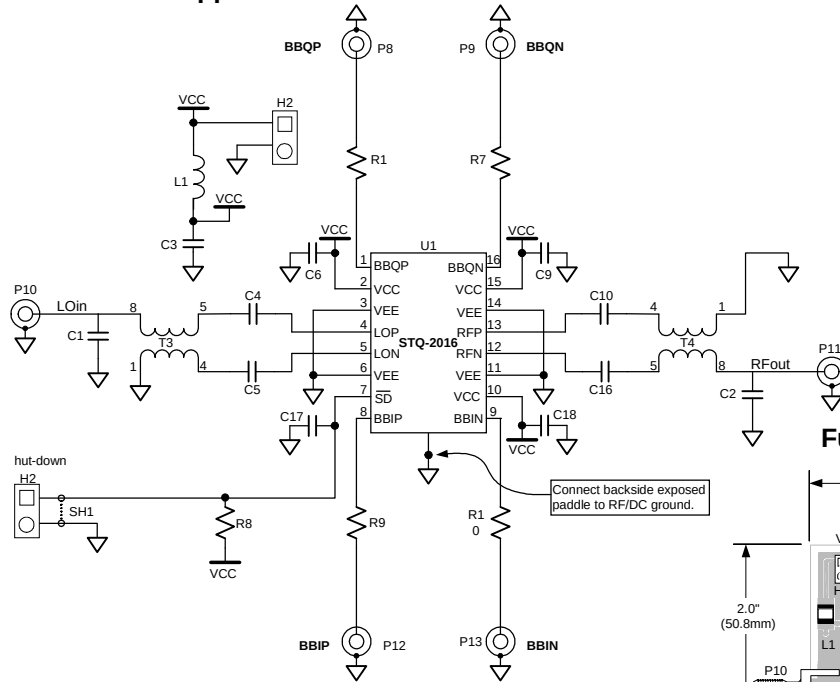
## Fully Assembled PCB



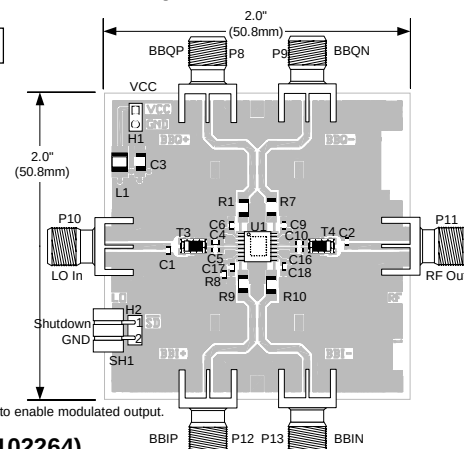
## Bill of Materials (for 700 – 1000 MHz Evaluation Board P/N EEB-102263)

| Component Designator       | Value   | Qty | Vendor             | Part Number        | Description                                               |
|----------------------------|---------|-----|--------------------|--------------------|-----------------------------------------------------------|
| U1                         |         | 1   | SMDI               | STQ-2016           | SiGe Direct Quadrature Modulator                          |
| P8, P9, P10, P11, P12, P13 |         | 6   | Johnson Components | 142-0701-851       | SMA connector, end launch with tab, for .062" thick board |
| H1, H2                     |         | 2   | AMP                | 640453-2           | 2-pin header, right angle                                 |
| T3, T4                     | 1:1     | 2   | Panasonic          | EHF-FD1618         | RF transformer, 700-1300MHz                               |
| L1                         | 1uH     | 1   | Panasonic          | ELJ-FA1R0KF2       | Inductor, 1210 footprint, ±10% tolerance                  |
| R1, R7, R9, R10            | 200 ohm | 4   | Venkel             | CR1206-8W-2000T    | Resistor, 1206 footprint, ±1% tolerance                   |
| R8                         | 1 kohm  | 1   | Venkel             | CR0603-16W-1001FT  | Resistor, 0603 footprint, ±1% tolerance                   |
| C6, C18                    | 33pF    | 2   | Venkel             | C0603COG500-330JNE | Capacitor, 0603 footprint, COG dielectric, ±5% tolerance  |
| C9, C17                    | 1nF     | 2   | Venkel             | C0603COG500-102JNE | Capacitor, 0603 footprint, COG dielectric, ±5% tolerance  |
| C3                         | 2.2uF   | 1   | Venkel             | C1206Y5V160-225ZNE | Capacitor, 1206 footprint, Y5V dielectric, 16V rating     |
| C4, C5, C10, C16           | 10pF    | 4   | Venkel             | C0603COG500-100JNE | Capacitor, 0603 footprint, COG dielectric, ±5% tolerance  |
| SH1                        |         | 1   | 3M                 | 929950-00          | Shunt for 2-pin header                                    |

## 1.7 – 2.5 GHz Application Schematic



## Fully Assembled PCB



## Bill of Materials (for 1.7 – 2.5 GHz Evaluation Board P/N EEB-102264)

| Component Designator       | Value   | Qty | Vendor             | Part Number        | Description                                                  |
|----------------------------|---------|-----|--------------------|--------------------|--------------------------------------------------------------|
| U1                         |         | 1   | SMDI               | STQ-2016           | SiGe Direct Quadrature Modulator                             |
| P8, P9, P10, P11, P12, P13 |         | 6   | Johnson Components | 142-0701-851       | SMA connector, end launch with tab, for .062" thick board    |
| H1, H2                     |         | 2   | AMP                | 640453-2           | 2-pin header, right angle                                    |
| T3, T4                     | 1:1     | 2   | Panasonic          | EHF-FD1619         | RF transformer, 1200-2200MHz                                 |
| L1                         | 1uH     | 1   | Panasonic          | ELJ-FA1R0KF2       | Inductor, 1210 footprint, ±10% tolerance                     |
| R1, R7, R9, R10            | 200 ohm | 4   | Venkel             | CR1206-8W-2000T    | Resistor, 1206 footprint, ±1% tolerance                      |
| R8                         | 1 kohm  | 1   | Venkel             | CR0603-16W-1001FT  | Resistor, 0603 footprint, ±1% tolerance                      |
| C1, C2                     | 0.5pF   | 2   | Venkel             | C0603COG500-0R5CNE | Capacitor, 0603 footprint ±0.25pF tolerance                  |
| C6, C18                    | 6.8pF   | 2   | Venkel             | C0603COG500-6R8CNE | Capacitor, 0603 footprint, COG dielectric, ±0.25pF tol.      |
| C9, C17                    | 1nF     | 2   | Venkel             | C0603COG500-102JNE | Capacitor, 0603 footprint, COG dielectric, ±5% tolerance     |
| C3                         | 2.2uF   | 1   | Venkel             | C1206Y5V160-225ZNE | Capacitor, 1206 footprint, Y5V dielectric, 16V rating        |
| C4, C5, C10, C16           | 2.2pF   | 4   | Venkel             | C0603COG500-2R2CNE | Capacitor, 0603 footprint, COG dielectric, ±0.25pF tolerance |
| SH1                        |         | 1   | 3M                 | 929950-00          | Shunt for 2-pin header                                       |

## Direct Quadrature Modulator: General Test Set-Up

