

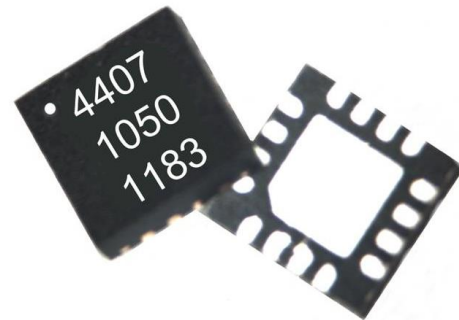
### Product Description

The QORVO TGC4407-SM is a Ka-Band sub-harmonic upconverter with integrated LO buffer amplifier. The TGC4407-SM operates from an RF of 21.5 to 32.5 GHz and is designed using QORVO's pHEMT production process.

The TGC4407-SM typically provides 13 dBm of input TOI at -10 dBm input power per tone and a conversion gain of -9 dB.

The TGC4407-SM is available in a low-cost, surface mount 16 lead 3x3mm QFN package and is ideally suited for Point-to-Point Radio, and Ka-Band VSAT Ground Terminal.

Lead-free and RoHS compliant.

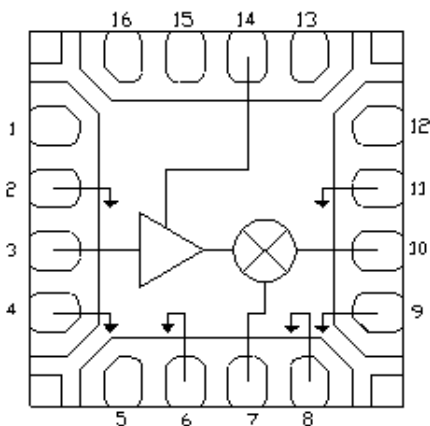


QFN 3x3 mm 16L

### Applications

- VSAT
- Point-to-Point Radio
- Test Equipment & Sensors

### Function Block Diagram



### Product Features

- RF Frequency Range: 21.5 – 32.5 GHz
- Wideband IF Frequency: DC – 7.0 GHz
- Sub-Harmonic Pumped LO Frequency: 11 – 16 GHz
- LO Input Power: 0 to 7.5 dBm
- Conversion Gain: -9 dB
- Bias:  $V_d = 5\text{ V}$ ,  $I_d = 65\text{ mA}$ , Typical
- Package Dimensions: 3.0 x 3.0 x 0.85 mm

### Ordering Information

| Part No.      | Description         |
|---------------|---------------------|
| TGC4407-SM    | Ka-Band Upconverter |
| TGC4407-SMEVB | TGC4407-SM EVB      |

Standard T/R size = 500 pieces on a 7" reel.

### Absolute Maximum Ratings

| Parameter                         | Rating       |
|-----------------------------------|--------------|
| Drain Voltage, Vd                 | +7 V         |
| Drain Current, Id                 | 175 mA       |
| Power Dissipation, Pdiss          | 1.2 W        |
| RF Input Power, CW, 50Ω, T = 25°C | +10 dBm      |
| Channel Temperature, Tch          | 200 °C       |
| Mounting Temperature (30 seconds) | 260 °C       |
| Storage Temperature               | -40 to 150°C |

These are stress ratings only, functional operation of the device at these conditions is not implied. Extended application of Absolute Maximum Rating conditions may reduce device reliability. Operation of this device outside the parameter ranges given above may cause permanent damage.

### Recommended Operating Conditions

| Parameter                    | Min | Typ | Max | Units |
|------------------------------|-----|-----|-----|-------|
| Operating Temp. Range        | -40 | +25 | +85 | °C    |
| Vd                           | 4   | 5   | 6   | V     |
| Id                           |     | 65  |     | mA    |
| Id_drive<br>(Under RF Drive) |     | 76  |     | mA    |

Electrical specifications are measured at specified test conditions. Specifications are not guaranteed over all recommended operating conditions.

### Electrical Specifications

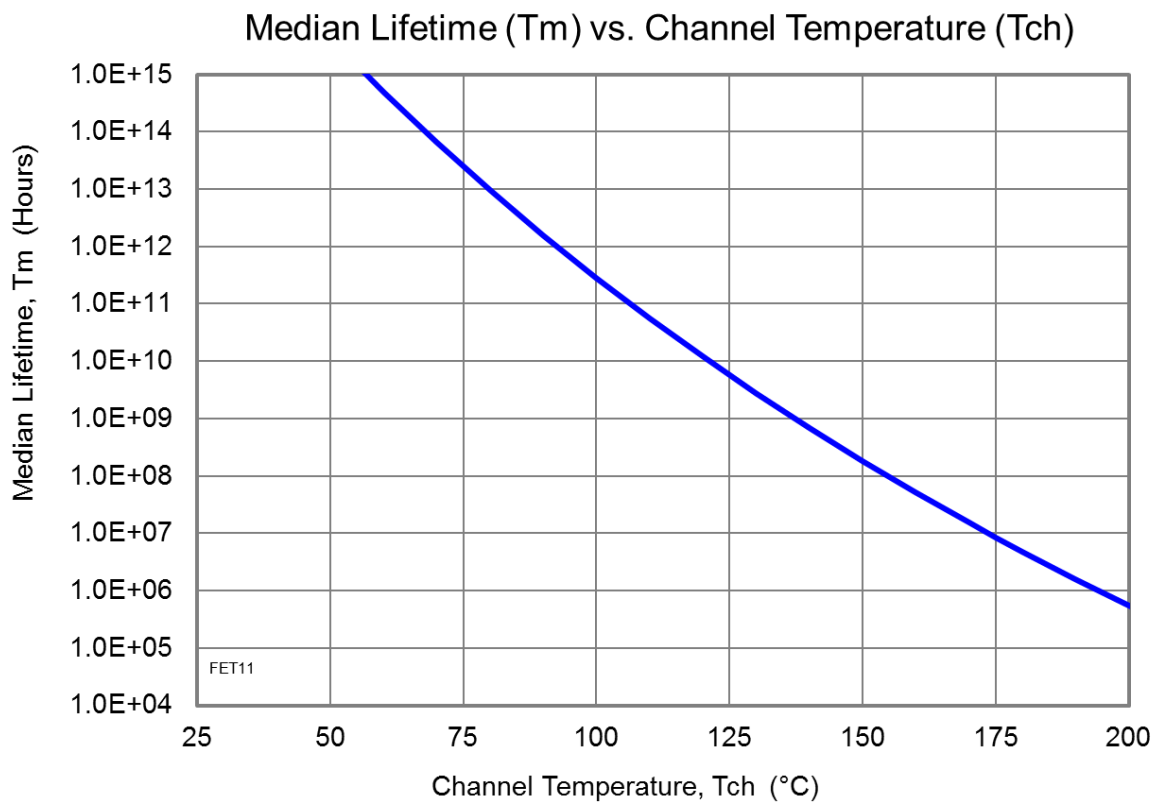
Test conditions unless otherwise noted: 25°C, Vd = 5 V, Id = 65 mA Typical. IF = 500 MHz, LO = 0 dBm.  
 $LSB = 2 \times LO - IF$  and  $USB = 2 \times LO + IF$ .

| Parameter                    | Conditions | Min  | Typ | Max  | Units |
|------------------------------|------------|------|-----|------|-------|
| RF Frequency Range           |            | 21.5 |     | 31.5 | GHz   |
| LO Frequency Range           |            | 11   |     | 16   | GHz   |
| IF Frequency Range           |            | DC   |     | 7    | GHz   |
| Conversion Gain              |            |      | -9  |      | dB    |
| Noise Figure                 |            |      | 9   |      | dB    |
| 2LO-to-RF Isolation, OIP3    |            |      | 35  |      | dB    |
| Input IP3                    |            |      | 13  |      | dBm   |
| Input 1dB Compression (P1dB) |            |      | 4   |      | dBm   |
| Supply Current               |            |      | 65  |      | mA    |

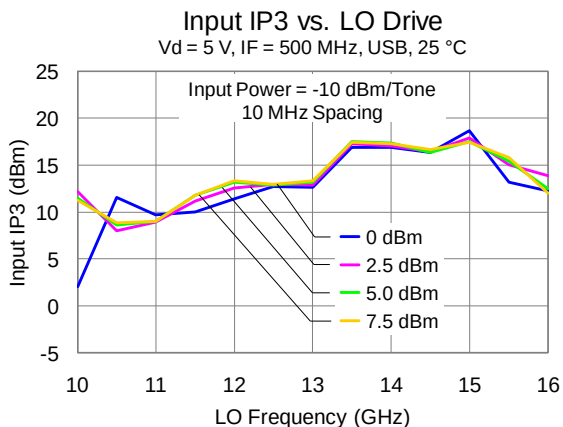
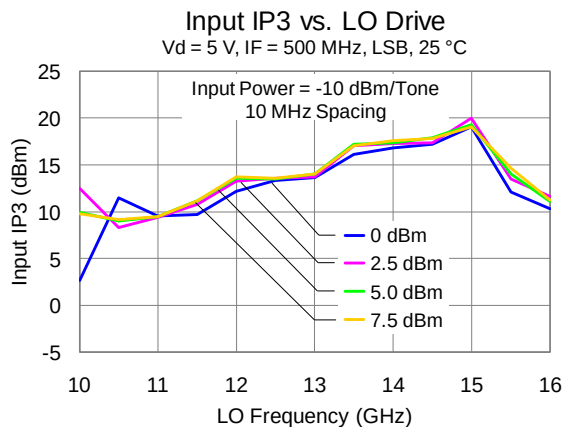
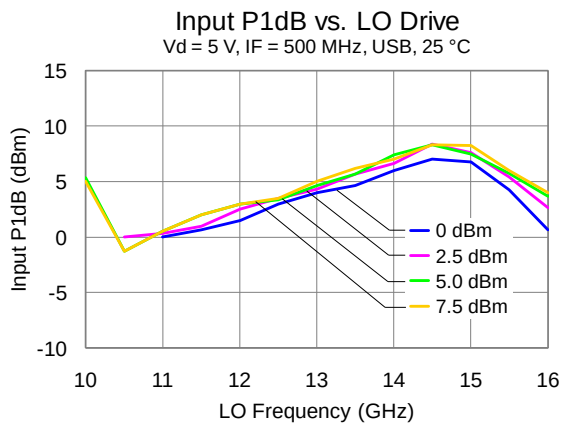
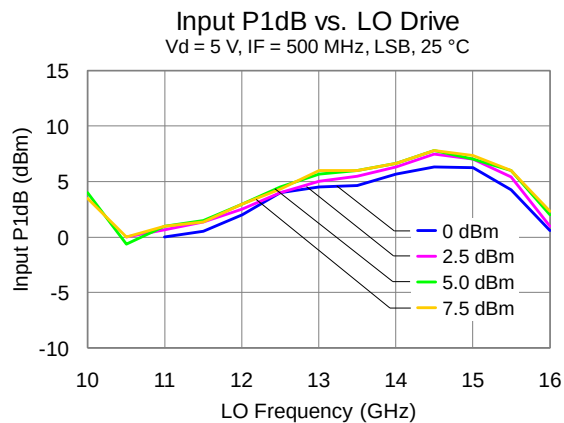
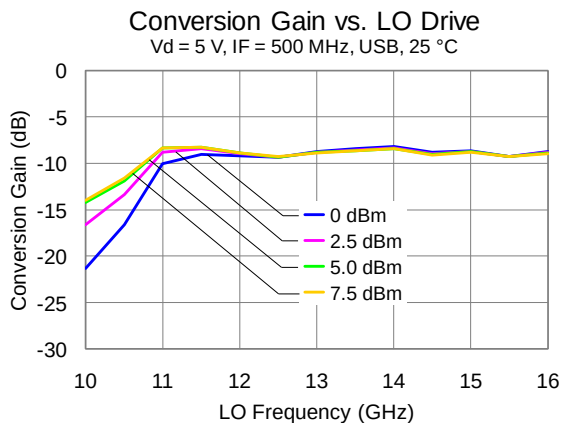
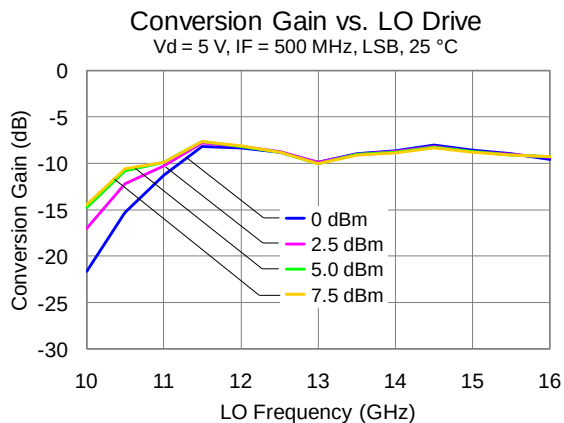
## Thermal and Reliability Information

| Parameter                                                             | Conditions                                                                | Rating                              |
|-----------------------------------------------------------------------|---------------------------------------------------------------------------|-------------------------------------|
| Thermal Resistance, $\theta_{JC}$ , measured to back of package       | Tbase = 85 °C                                                             | $\theta_{JC} = 47$ °C/W             |
| Channel Temperature (Tch), and Median Lifetime (Tm)                   | Tbase = 85 °C,<br>Vd = 5 V, Id = 65 mA<br>Pdis = 0.325 W                  | Tch = 100 °C<br>Tm = 2.9 E+11 Hours |
| Channel Temperature (Tch), and Median Lifetime (Tm)<br>Under RF Drive | Tbase = 85 °C<br>Vd = 5 V, Id_drive = 76 mA<br>Pin = 7 dBm, Pdis = 0.38 W | Tch = 103 °C<br>Tm = 2.2 E+11 Hours |

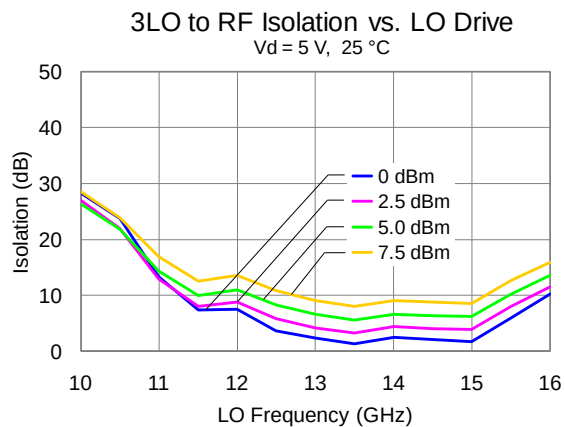
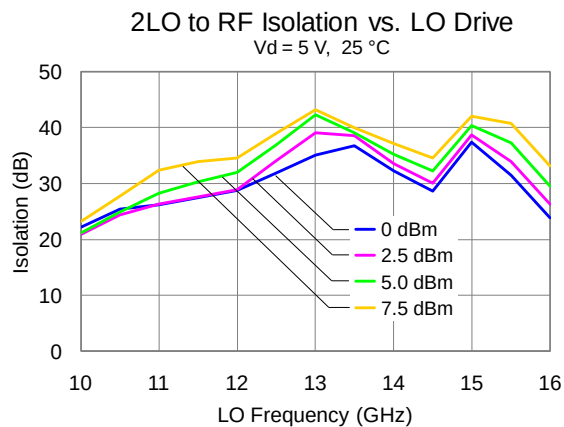
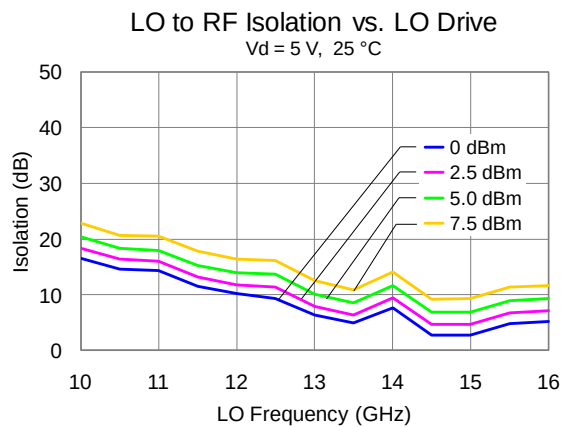
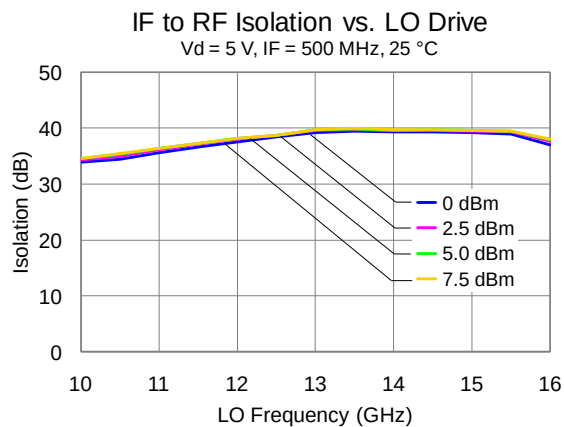
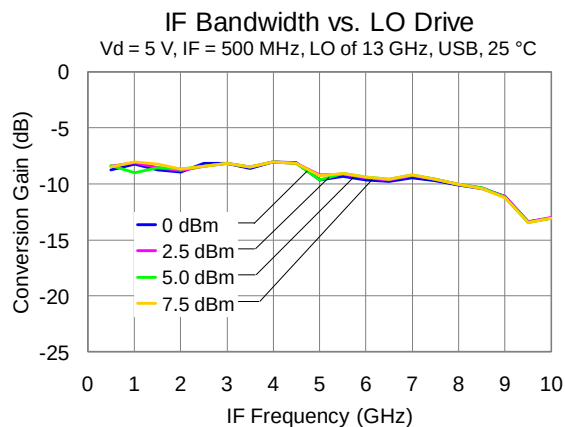
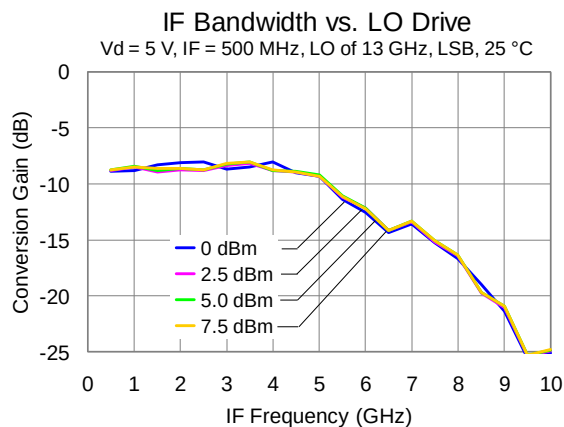
Test Conditions:  $V_D = +6$  V; Failure Criteria = 10 % reduction in  $I_{D\_MAX}$  during DC Life Testing



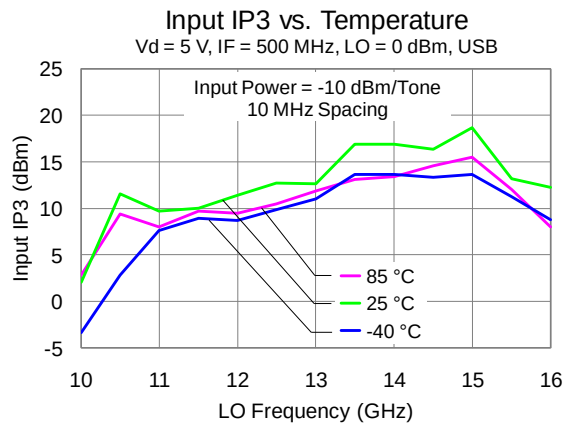
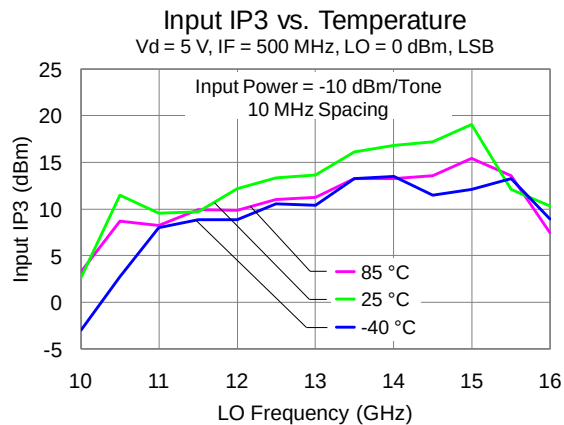
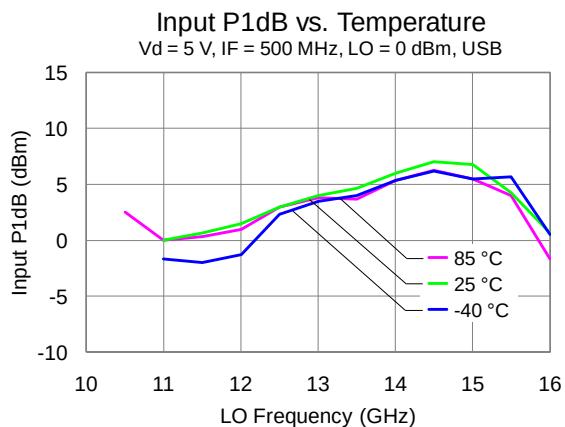
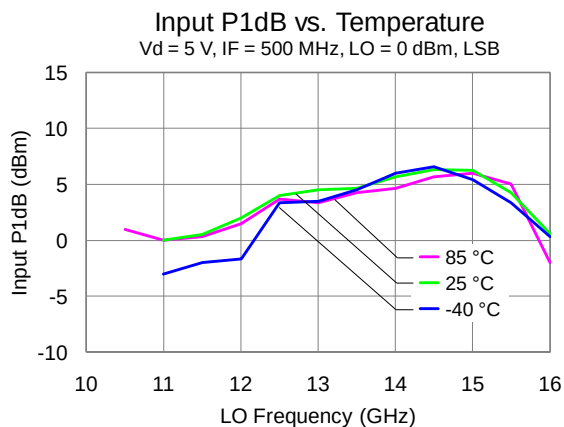
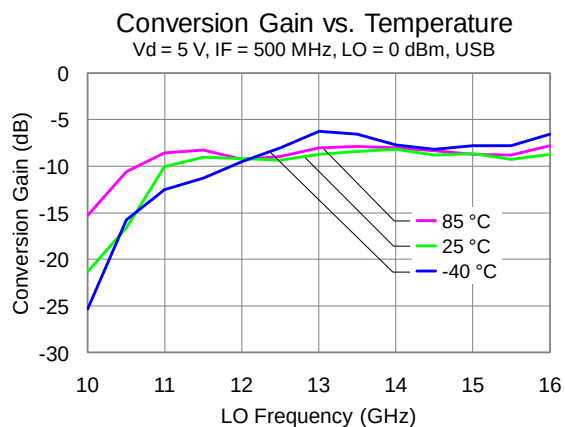
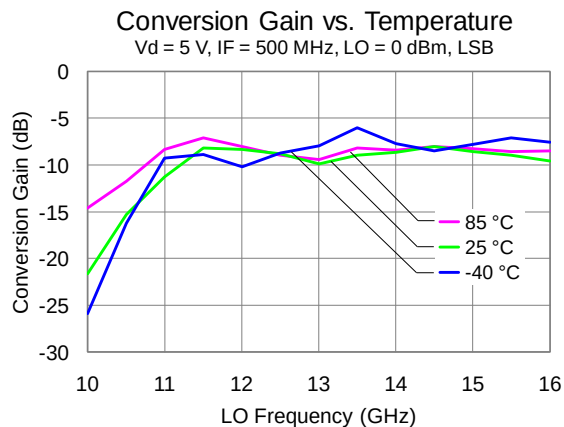
### Performance Plots



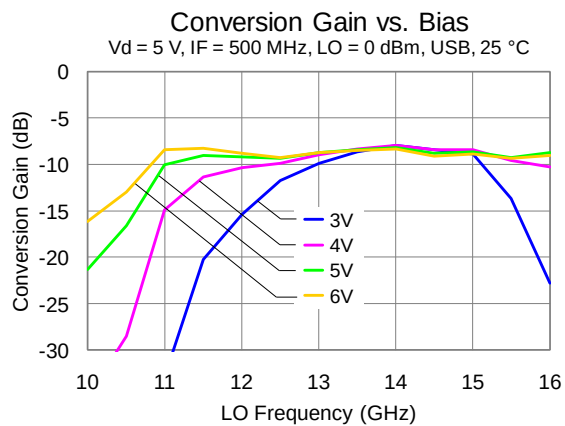
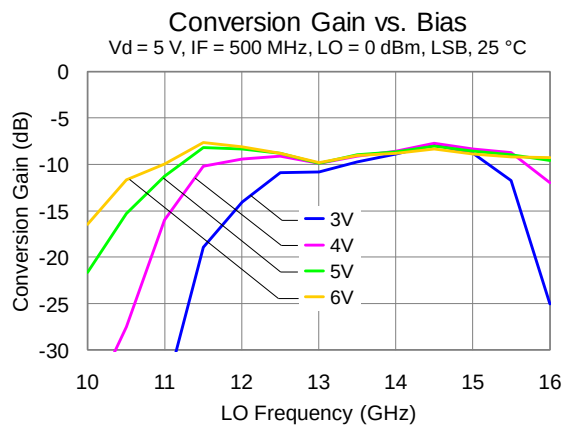
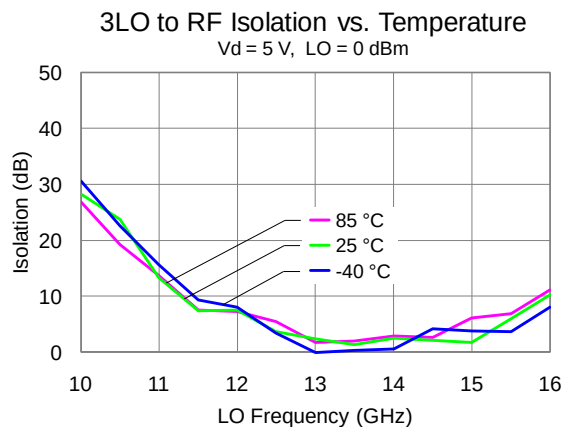
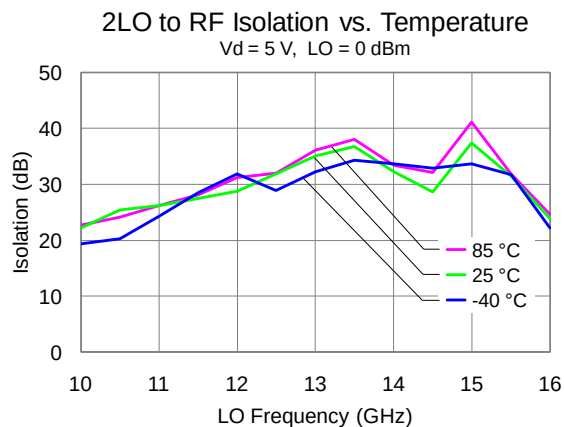
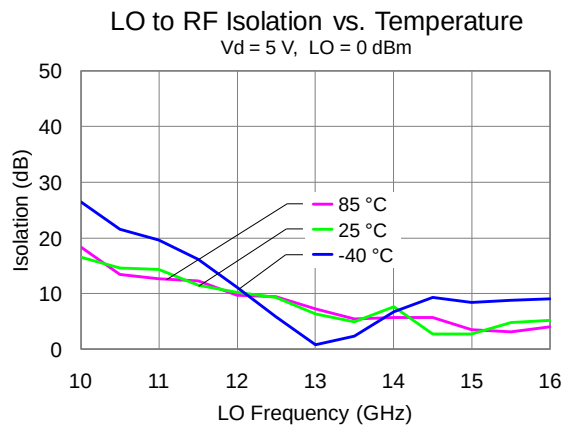
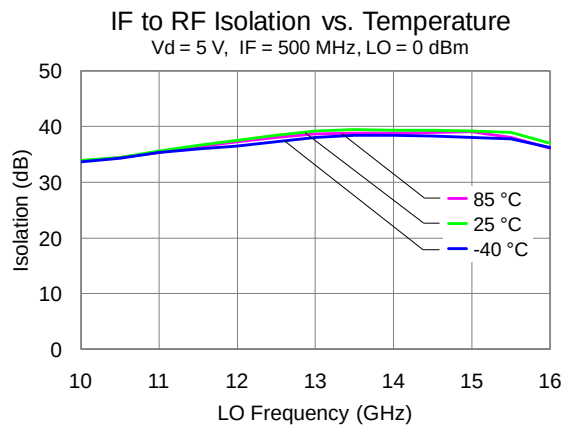
### Performance Plots



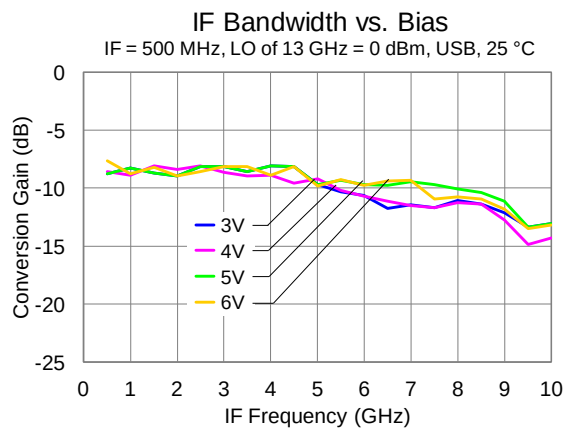
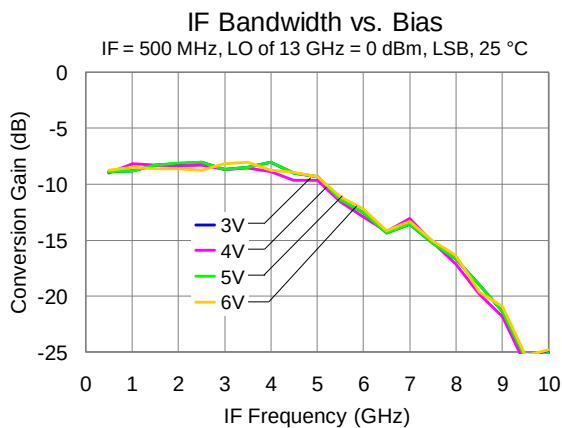
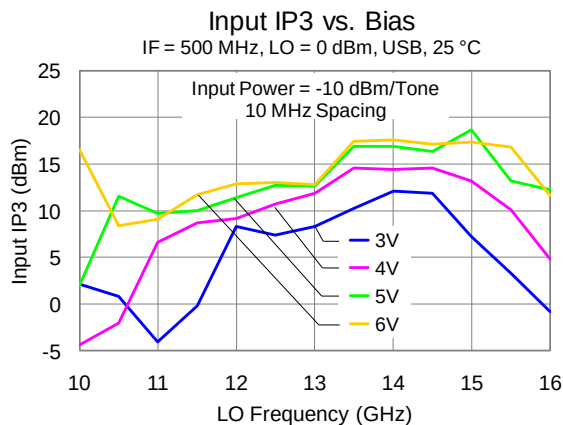
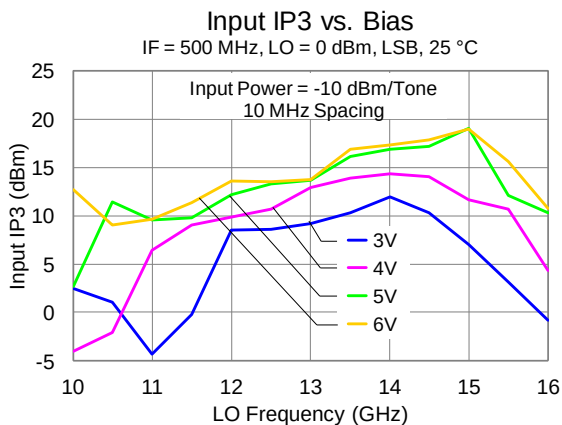
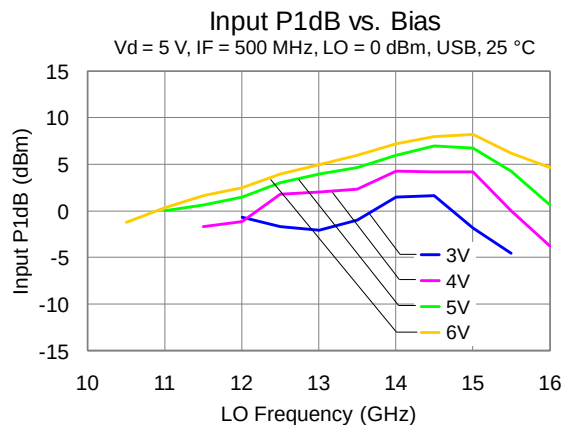
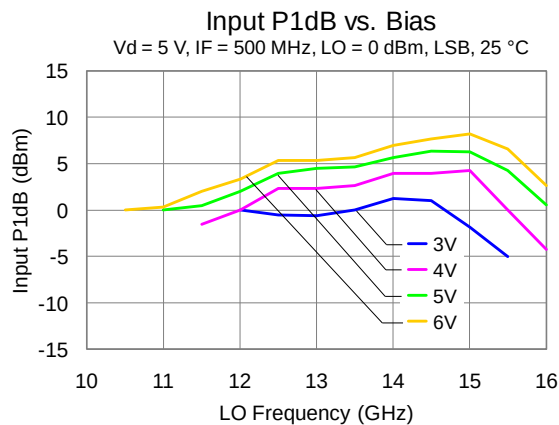
### Performance Plots



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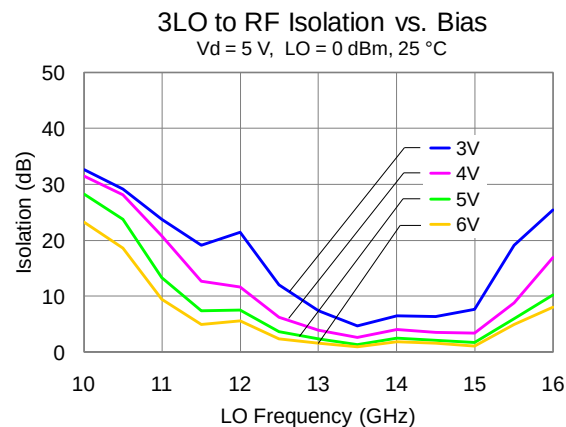
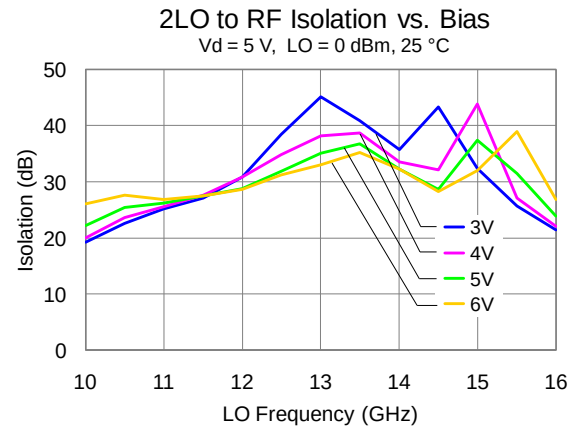
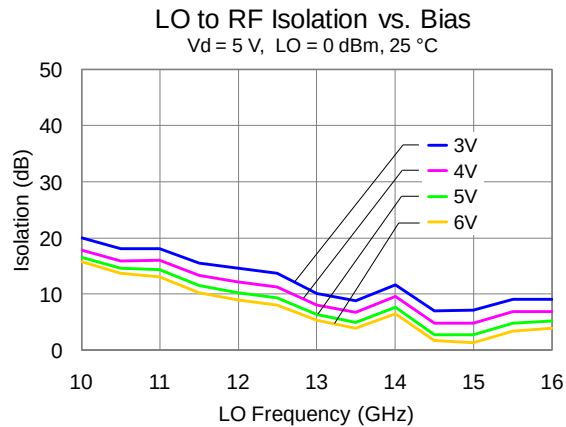


### Performance Plots





### Performance Plots

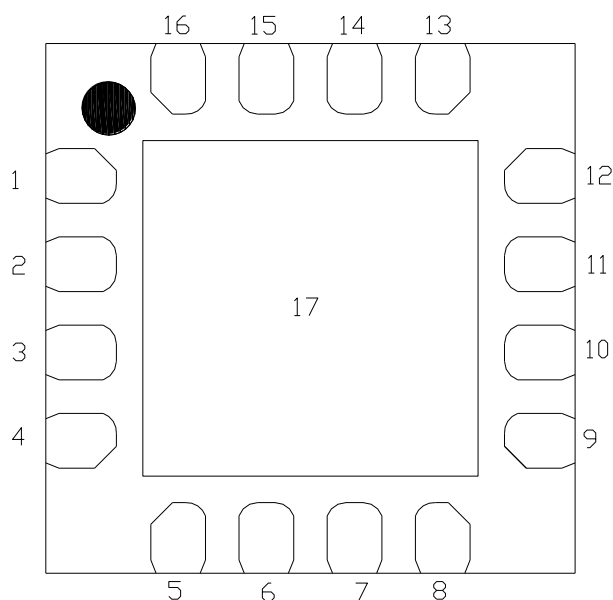


### M x N Spurious Outputs

LO at 13 GHz and 0 dBm; IF at 1 GHz and -10 dBm; Vd = 5 V; 25 °C; All values are in dBc from USB.

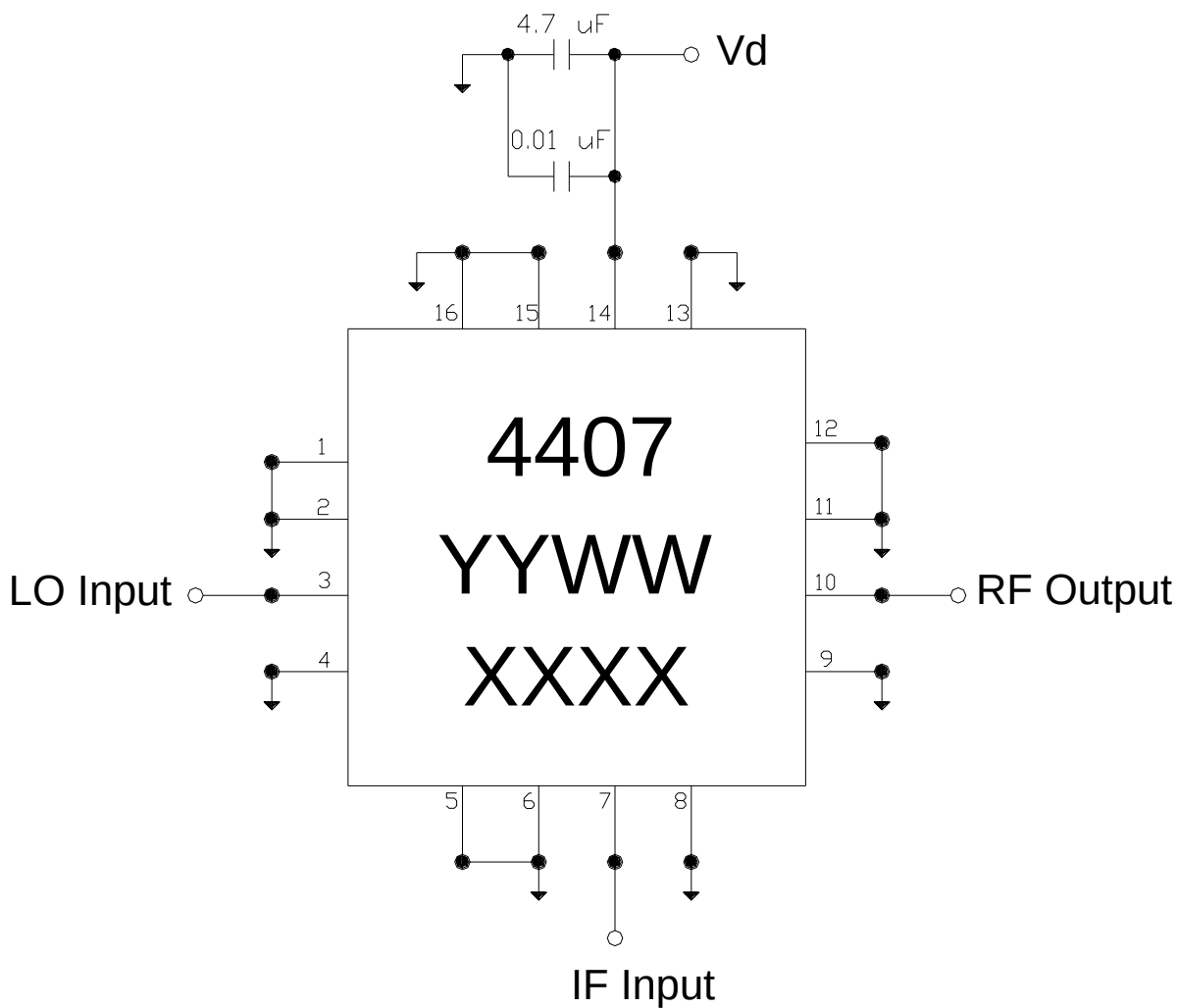
|     | nLO |     |     |     |
|-----|-----|-----|-----|-----|
| mRF | 3   | 2   | 1   | 0   |
| -2  | -32 | -39 | -53 | -59 |
| -1  | -35 | -1  | -40 | -24 |
| 0   | 18  | -16 | 12  |     |
| 1   | -35 | 0   | -35 |     |
| 2   | -29 | -43 | -42 |     |
| 3   |     | -49 | -75 |     |

## Pin Configuration and Description



| Pin No.              | Label  | Description                                                                                                                                                     |
|----------------------|--------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 1, 5, 12, 13, 15, 16 | N/C    | No internal connection; must be grounded on PCB.                                                                                                                |
| 2, 4, 6, 8, 9, 11    | GND    | Internal grounding; must be grounded on PCB.                                                                                                                    |
| 3                    | LO IN  | Local Oscillator Input, matched to 50 ohms, AC Coupled.                                                                                                         |
| 7                    | IF IN  | IF Input matched to 50 ohms, DC Coupled.                                                                                                                        |
| 10                   | RF OUT | RF Output matched to 50 ohms, AC Coupled.                                                                                                                       |
| 14                   | Vd     | Drain voltage. Bias network is required; see Application Circuit on page 11 as an example.                                                                      |
| 17                   | GND    | Backside Paddle. Multiple vias should be employed to minimize inductance and thermal resistance; see Mounting Configuration on page 13 for suggested footprint. |

## Applications Circuit



### Bias-up Procedure

Set  $I_d$  limit to 175 mA

Set  $V_d$  to 5 V,  $I_d$  is typically 65 mA (Self Bias)

Apply RF signals to LO and IF Inputs

### Bias-down Procedure

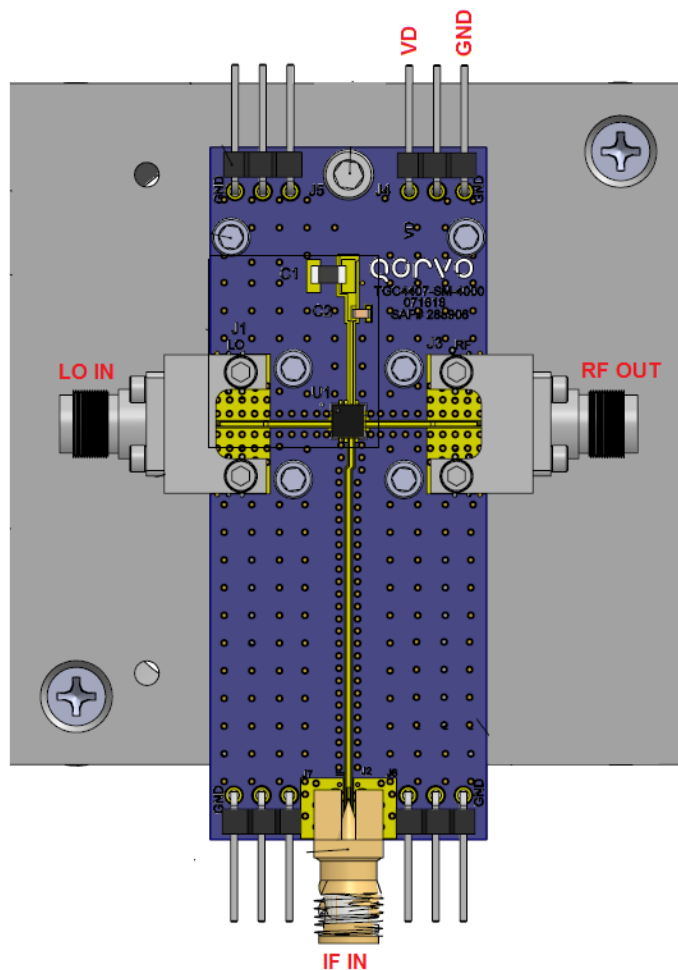
Turn off RF signals

Reduce  $V_d$  to 0 V

Turn Off  $V_d$

### Evaluation Board (EVB) Assembly Layout

Board material is RO4003C 0.012" thickness with ½ oz copper cladding.

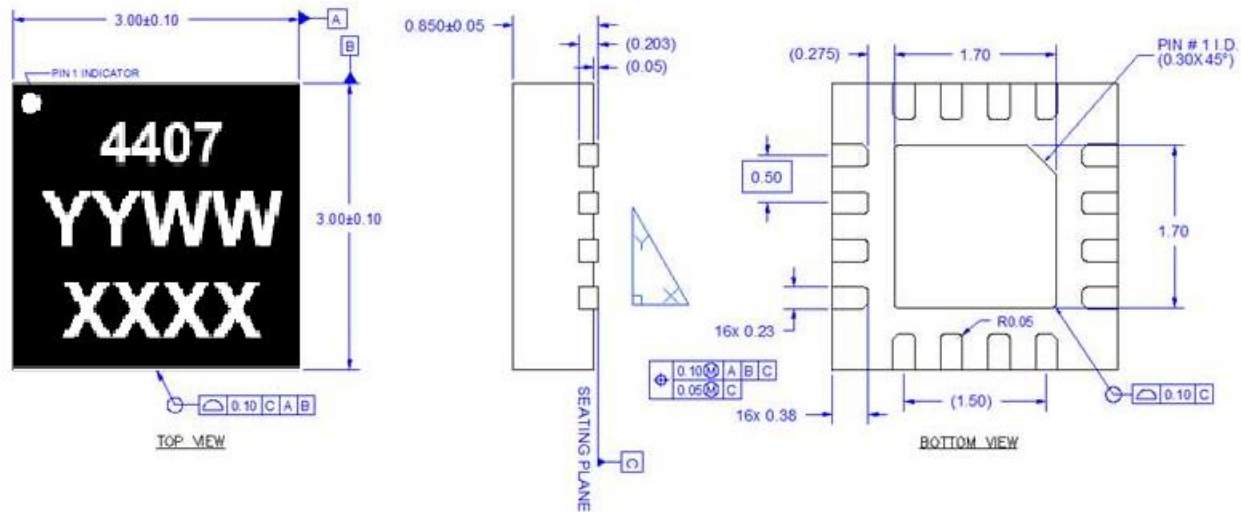


### Bill of Material

| Ref Des | Value        | Description              | Manufacturer | Part Number |
|---------|--------------|--------------------------|--------------|-------------|
| C1      | 4.7 $\mu$ F  | Cap, 1206, 50V, 10%, X7R | various      |             |
| C2      | 0.01 $\mu$ F | Cap, 0603, 25V, 10%, X7R | various      |             |
| U1      |              | Ka-Band Up-Converter     | Qorvo        | TGC4407-SM  |

## Package Marking and Dimensions

All dimensions are in millimeters.



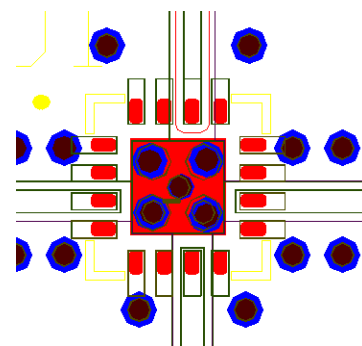
This package is lead-free/RoHS-compliant with a copper alloy base (CDA194), and the plating material on the leads is 100% matte Sn. It is compatible with both lead-free (maximum 260 °C reflow temperature) and tin-lead (maximum 245 °C reflow temperature) soldering processes

The TGC4407-SM will be marked with the "4407" designator and a lot code marked below the part designator. The "YY" represents the last two digits of the year the part was manufactured, the "WW" is the work week, and the "XXXX" is an auto generated number.

## PCB Mounting Pattern

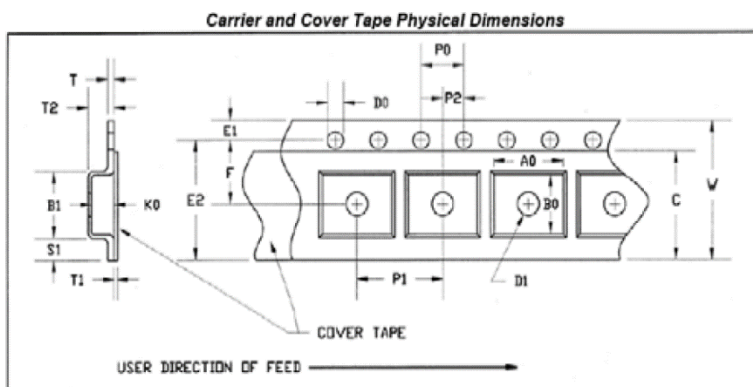
Notes:

1. The pad pattern shown has been developed and tested for optimized assembly at Qorvo. The PCB land pattern has been developed to accommodate lead and package tolerances. Since surface mount processes vary from company to company, careful process development is recommended.
2. Ground / thermal vias are critical for the proper performance of this device. Vias should use a final plated thru of 0.40 mm diameter.



## Tape and Reel Information

Standard T/R size = 500 pieces on a 7" reel.



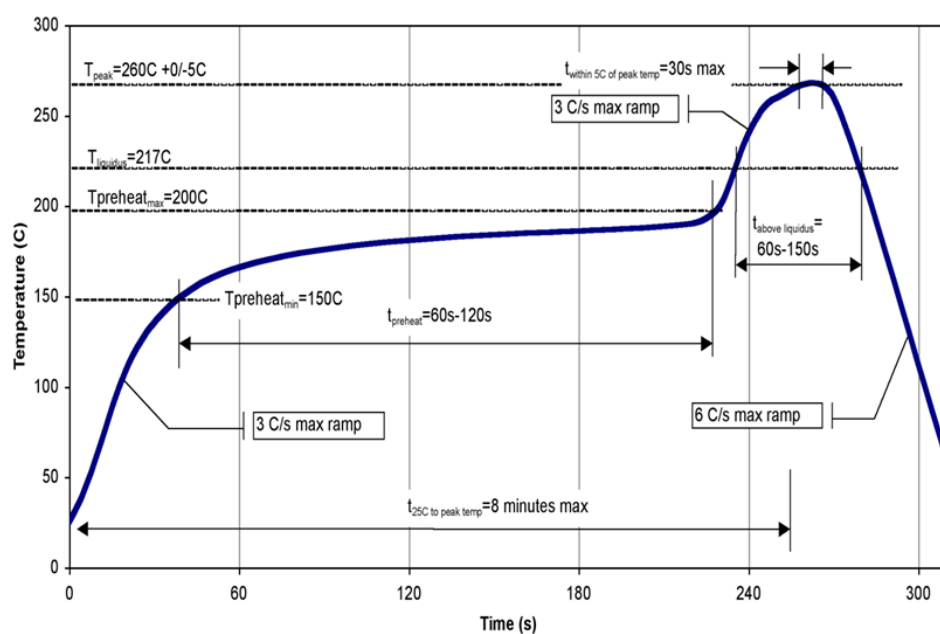
## CARRIER AND COVER TAPE DIMENSIONS

| Part                        | Feature                                | Symbol | Size (in) | Size (mm) |
|-----------------------------|----------------------------------------|--------|-----------|-----------|
| Cavity                      | Length                                 | A0     | 0.134     | 3.4       |
|                             | Width                                  | B0     | 0.126     | 3.2       |
|                             | Depth                                  | K0     | 0.055     | 1.4       |
|                             | Pitch                                  | P1     | 0.315     | 8.0       |
| Distance Between Centerline | Cavity to Perforation Length Direction | P2     | 0.079     | 2.0       |
|                             | Cavity to Perforation Width Direction  | F      | 0.217     | 5.5       |
| Cover Tape                  | Width                                  | C      | 0.374     | 9.5       |
| Carrier Tape                | Width                                  | W      | 0.472     | 12.0      |

## Assembly Notes

- Compatible with both lead-free (260°C peak reflow temperature) and tin/lead (240°C peak reflow temperature) soldering process.
- The use of no-clean solder to avoid washing after soldering is recommended.
- Contact plating: Ni-Pd-Au.

## Recommended Soldering Temperature Profile



### Handling Precautions

| Parameter                        | Rating   | Standard                 |
|----------------------------------|----------|--------------------------|
| ESD – Human Body Model (HBM)     | Class 1A | ESDA / JEDEC JS-001-2012 |
| ESD – Charged Device Model (CDM) | Class 3  | JEDEC JESD22-C101        |
| MSL – Moisture Sensitivity Level | Level 3  | IPC/JEDEC J-STD-020      |



Caution!  
ESD-Sensitive Device

### RoHS Compliance

This product is compliant with the 2011/65/EU RoHS directive (Restrictions on the Use of Certain Hazardous Substances Electrical and Electronic Equipment), as amended by Directive 2015/863/EU. This product also has the following attributes

- Lead Free
- Halogen Free (Chlorine, Bromine)
- Antimony Free
- TBBP-A (C<sub>15</sub>H<sub>12</sub>Br<sub>4</sub>O<sub>2</sub>) Free
- PFOS Free
- SVHC Free

### Contact Information

For the latest specifications, additional product information, worldwide sales and distribution locations:

Tel: 1-844-890-8163

Web: [www.qorvo.com](http://www.qorvo.com)

Email: [customer.support@qorvo.com](mailto:customer.support@qorvo.com)

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