

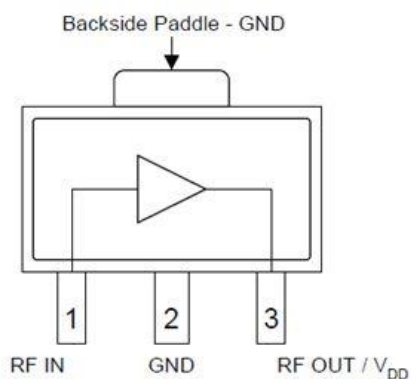
Product Overview

The QPB7400 is a low-cost RF amplifier designed for applications from 47 to 1218 MHz. The balance of low noise and distortion provides an ideal solution for a wide range of broadband amplifiers used in cable television applications such as optical receivers and low noise front ends.

The QPB7400 has features allowing a great deal of design-in flexibility. Gain and return loss are adjustable with an external feedback resistor. An internal bias circuit mitigates the effect of temperature and process variation, and an external resistor may be used to adjust the bias current to optimize distortion or noise performance.

The QPB7400 is fabricated using 6-inch GaAs pHEMT technology to optimize performance and cost. It provides excellent gain and return loss consistency inherent to the pHEMT process.

Functional Block Diagram



Top View



3-pin SOT-89 Package

Key Features

- Gain, return loss, and bias externally adjustable
- 47–1218 MHz bandwidth (DOCSIS 3.1 Compatible)
- CCN – 65 dBc, CSO – 70 dBc, and CTB – 77 dBc for 33 dBmV/ch at output (-6 dB for QAM), 80 NTSC + 108 QAM, flat loading
- +5 V Biasing, 105 mA Current Consumption
- On-chip active bias for consistent bias current and repeatable performance over temperature
- Low Noise: 3.5 dB to 1218 MHz
- +41 dBm typical OIP3
- +60 dBm typical OIP2
- pHEMT device technology

Applications

- Single-ended and Push-Pull Optical Receivers
- Low-noise Drop Amplifiers
- Distribution Amplifiers
- Multi-Dwelling Units
- Single-ended Gain Block

Ordering Information

| Part No. | Description |
|-------------|------------------------------|
| QPB7400SB | Sample bag with 5 pieces |
| QPB7400SR | 7" reel with 100 pieces |
| QPB7400TR13 | 13" reel with 2500 pieces |
| QPB7400PCK | PCBA with 5 piece sample bag |

Absolute Maximum Ratings

| Parameter | Rating |
|------------------------------------|----------------|
| Supply Voltage (V_{DD}) | +7 V |
| Supply Current (I_{DD}) | 130mA |
| Maximum Input Level | 60dBmV |
| Operating Temperature Range | -40 to +100°C |
| Tj for >10 ⁶ hours MTTF | +165 °C |
| Storage Temperature | -65 to +150 °C |

Operation of this device outside the parameter ranges given above may cause permanent damage.

Recommended Operating Conditions

| Parameter | Min | Typ | Max | Units |
|-----------------------------|------|-----|------|-------|
| Supply Voltage (V_{DD}) | +4.5 | | +5.5 | V |
| Supply Current (I_{DD}) | | 105 | | mA |
| | | | | |

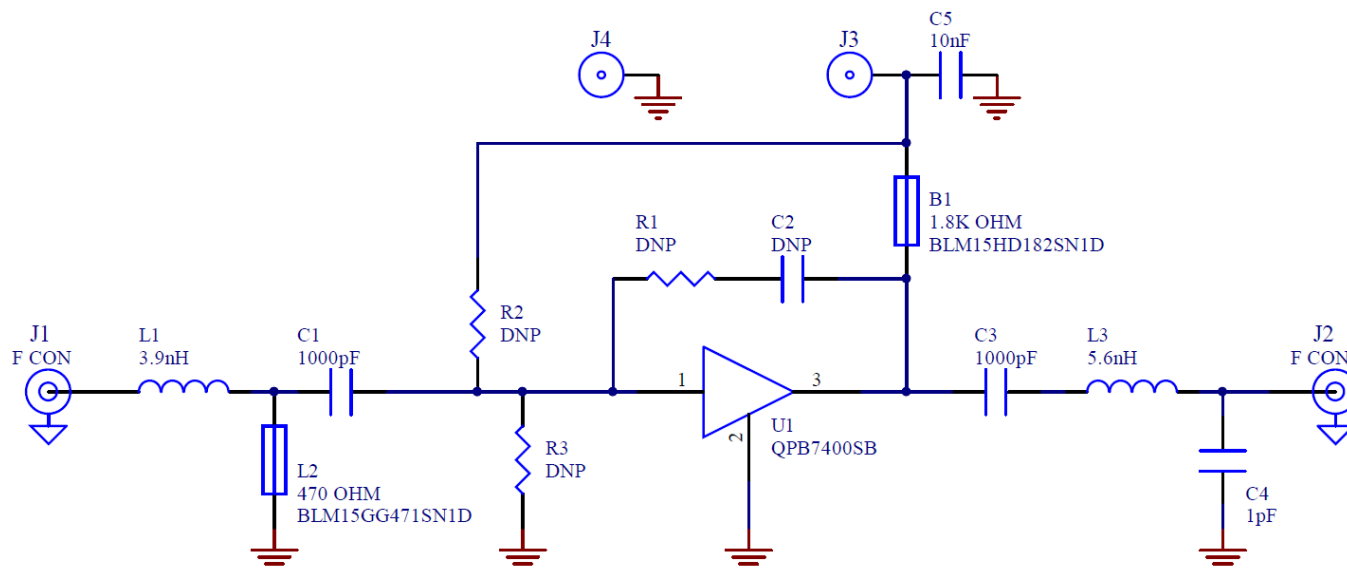
Electrical specifications are measured at specified test conditions. Specifications are not guaranteed over all recommended operating conditions.

Electrical Specifications

| Parameter | Condition ⁽¹⁾ | Min | Typ | Max | Unit |
|--------------------|---|-----|-------|------|--------|
| Frequency Range | | 47 | | 1218 | MHz |
| Gain | | | +10.5 | | dB |
| Gain Slope | | | -0.5 | | dB |
| Noise Figure | | | +3.5 | | dB |
| Input Return Loss | | | +18 | | dB |
| Output Return Loss | | | +18 | | dB |
| Output P1dB | | | +17 | | dBm |
| Output IP2 | f1 = 225 MHz, f2 = 325 MHz, Pout = +5 dBm / tone | | +60 | | dBm |
| Output IP3 | f1 = 225 MHz, f2 = 325 MHz, Pout = +5 dBm / tone | | +41 | | dBm |
| CSO | 33 dBmV / ch at output, flat loading (-6 dB for QAM), 80 ch NTSC + 108 QAM to 1218 MHz | | -70 | | dBc |
| CTB | | | -80 | | |
| CCN | | | -65 | | |
| Thermal Resistance | Junction to case | | +42 | | °C / W |

Notes:

1. Typical performance at these conditions: Temp. = +25 °C, V_{DD} = +5 V, 75 Ω system





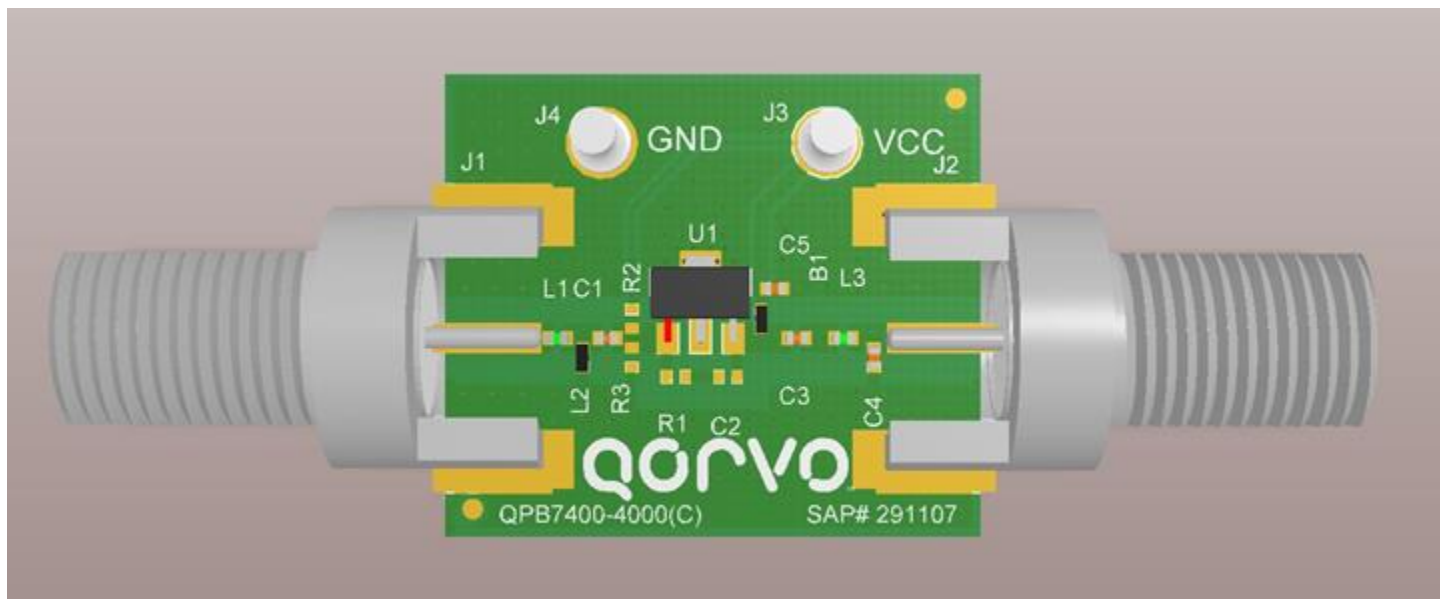
QPB7400

CATV 75Ω Adjustable Low Gain (9–11dB) RF Amplifier

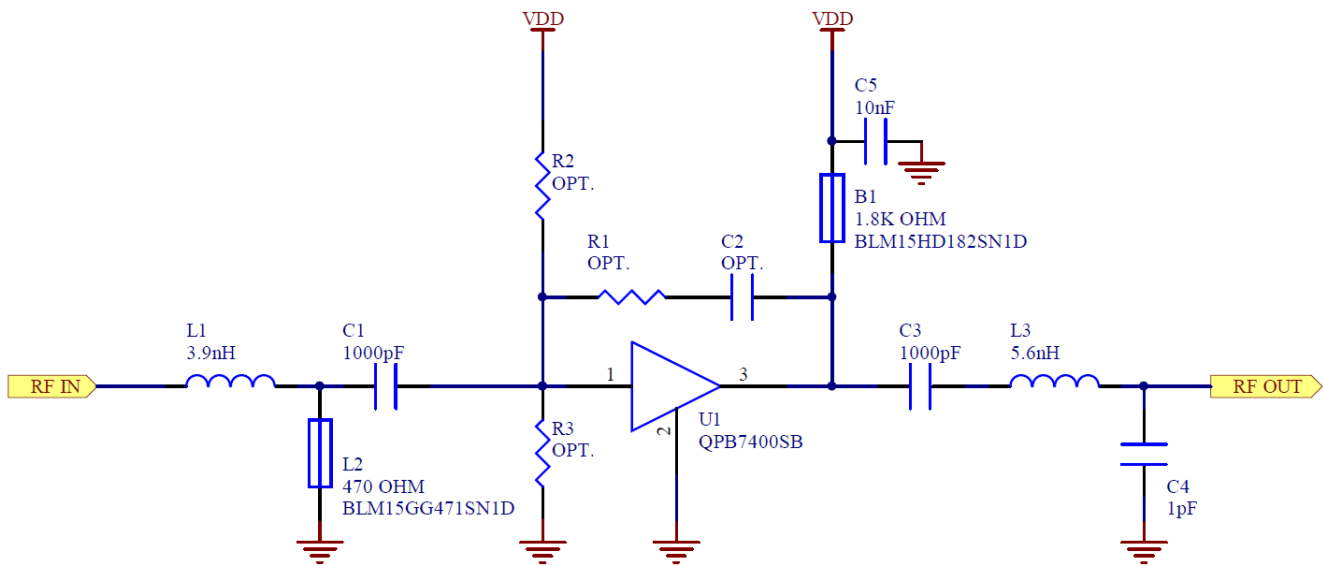
Evaluation Board Bill of Materials

| Description | Designator | Manufacturer | Part Number |
|---|----------------|-------------------------|-------------------------|
| QPB7400 Low Gain GP CATV Amplifier | U1 | Qorvo | QPB7400SB |
| PCB, QPB7400 | | Viasystems Technologies | QPB7400-4000(C) |
| CAP, 1000 pF, 10 %, 50 V, 0402 | C1, C3 | Murata Electronics | GRM155R71H102KA01D |
| CAP, 1 pF ±0.10 pF, 50 V, 0402 | C4 | AVX/Kyocera Asia, Ltd | 04025A1R0BAT2A |
| CAP, 10000 pF, 10 %, 50 V, X7R, 0402 | C5 | Murata Electronics | GRM155R71H103KA88D |
| IND, 3.9 nH, 5%, Ceramic, Lead-free, 0402 | L1 | Murata Electronics | LL1005-FHL3N9S |
| IND, 5.6 nH, +/- .5, LF Ceramic, 0402 | L3 | Murata Electronics | LL1005-FHL5N6S |
| Ferrite Bead, 1.8 K Ω, 200 mA, 0402 | B1 | Murata Electronics | BLM15HD182SN1D |
| Ferrite Bead, 470 Ω, 200 mA, 0402 | L2 | Murata Electronics | BLM15GG471SN1D |
| Solder Turret | J3, J4 | Mill-Max Manufacturing | 2533-0-00-44-00-00-07-0 |
| Connector 75 Ω, Edge Launch F | J1, J2 | Lighthouse Technologies | LTI-FSF55NT-P |
| Not Populated | C2, R1, R2, R3 | | |

Evaluation Board Assembly Drawing



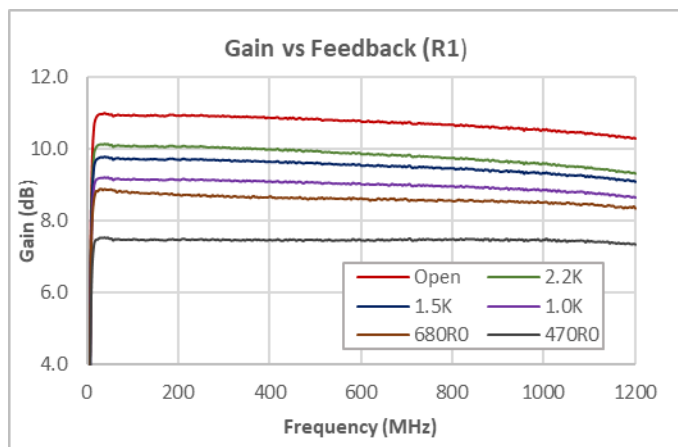
Typical Application Schematic, 47MHz – 1218MHz



Notes:

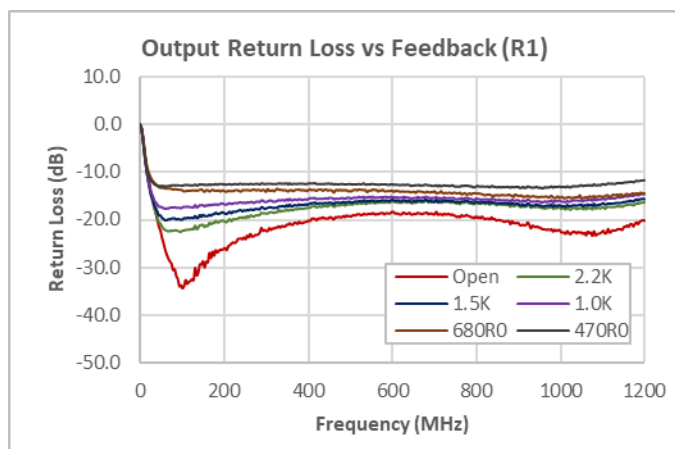
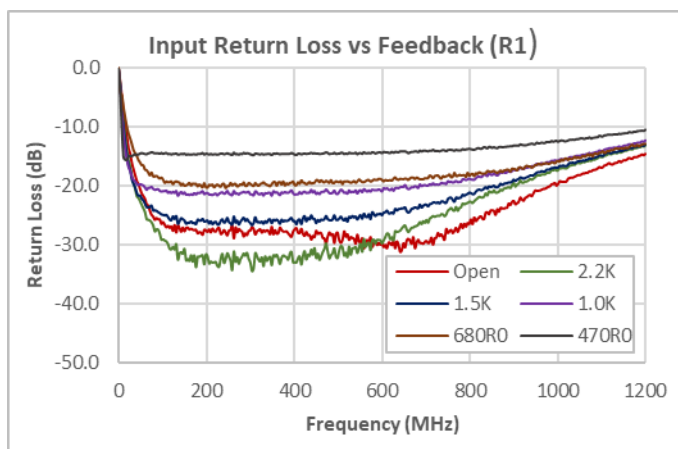
1. L1/L2 tunes input return loss (L2 improves low frequency return loss).
2. C1 and C3 are for DC blocking.
3. L3/C4 tunes output return loss.
4. B1 is a broadband impedance choke for DC bias.
5. R1 provides optional feedback to reduce gain to as low as 7.5dB (typ. gain of 10.5dB with no feedback). When feedback is employed, C2 is required for DC blocking. Refer to Additional Application Data section for values of feedback versus gain.
6. R2, R3 are pullup and pulldown options that can be added to adjust the bias current to tradeoff distortion performance or reduce power consumption. Refer to Additional Application Data section for resistance values versus current and performance tradeoffs.

Additional Application Data; Feedback Resistor Options



Performance at 1GHz for values of R1

| R1 (ohms) | Gain (dB) | S11 (dB) | S22 (dB) |
|--------------|--------------|-------------|-------------|
| Open | 10.5 | -19.8 | -22.6 |
| 2.2K | 9.6 | -17.3 | -17.6 |
| 1.5K | 9.3 | -16.9 | -17.1 |
| 1.0K | 8.9 | -15.7 | -16.1 |
| 680 | 8.5 | -15.9 | -15.4 |
| 470 | 7.5 | -12.5 | -13.2 |



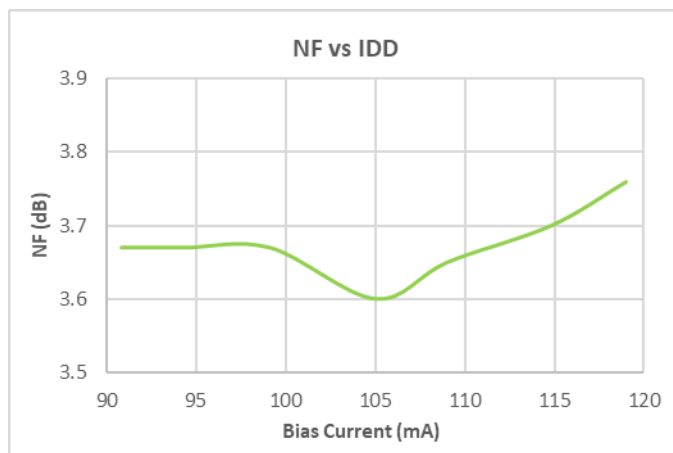
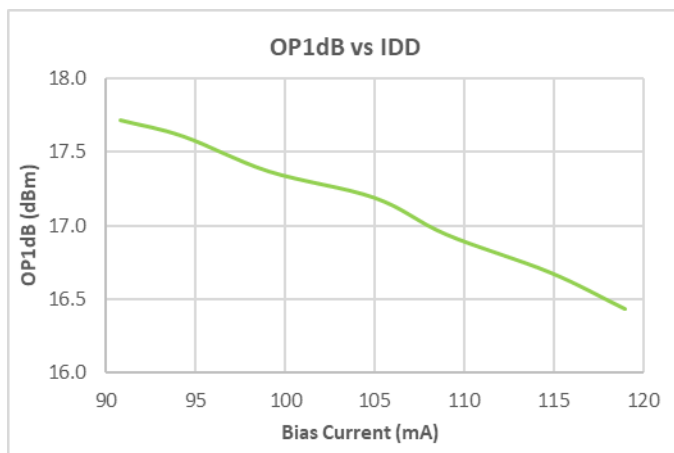
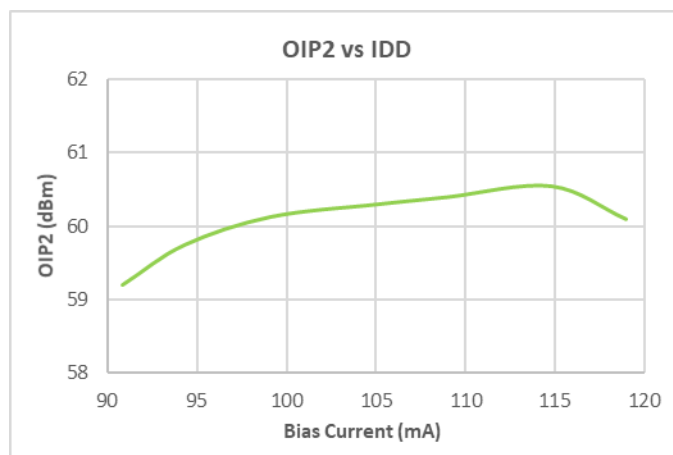
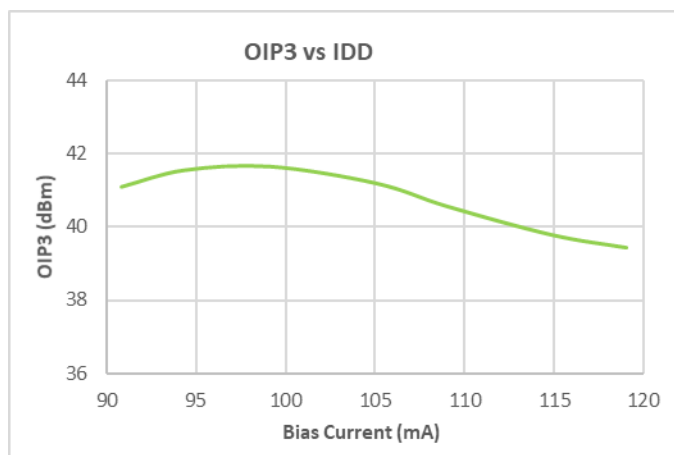
Notes:

- (1) R1 value as noted, C2 = 10nF, V_{DD} = 5V

Additional Application Data; Pullup Resistor Options

Bias Current vs R2/R3

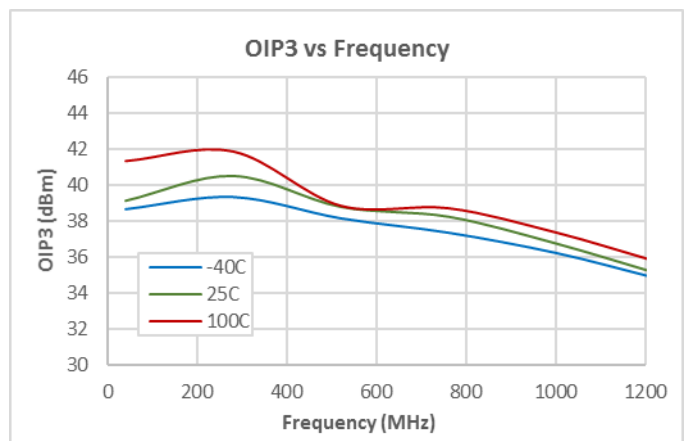
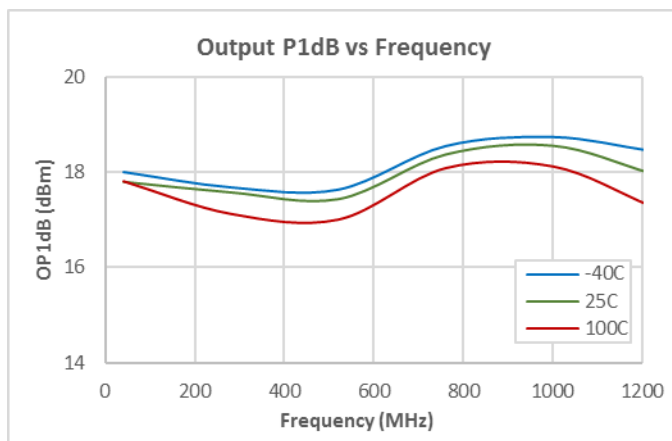
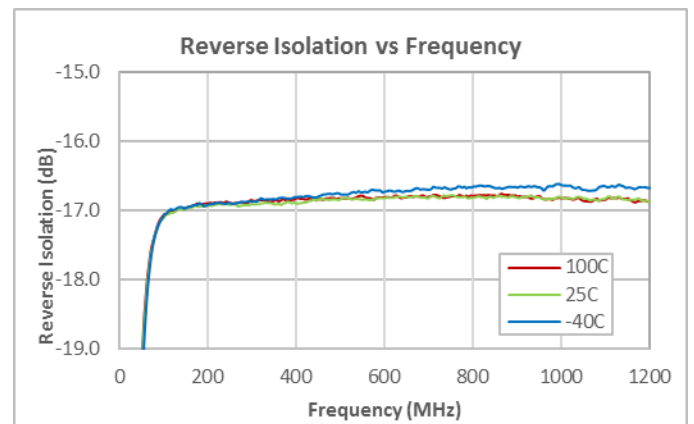
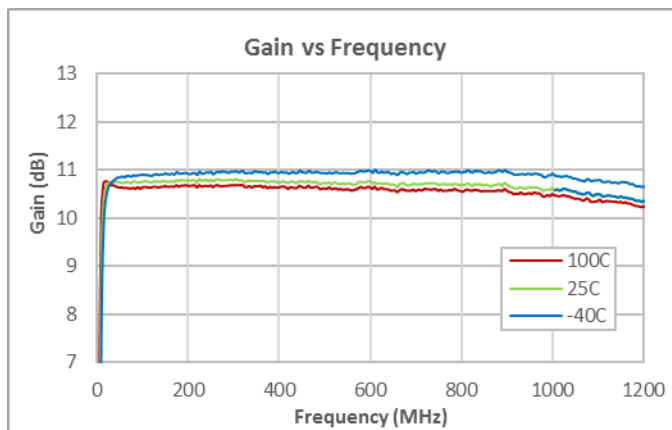
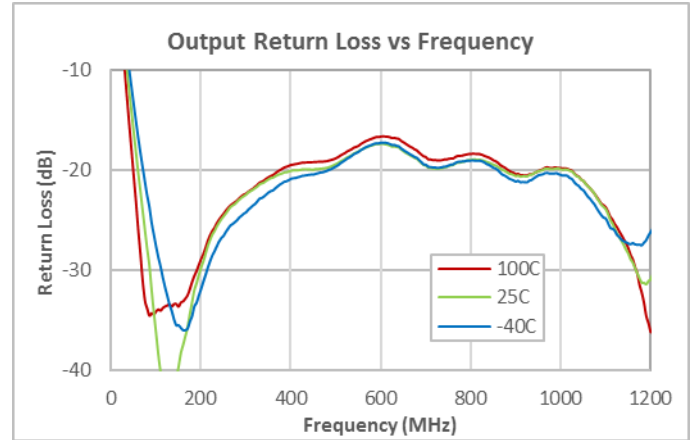
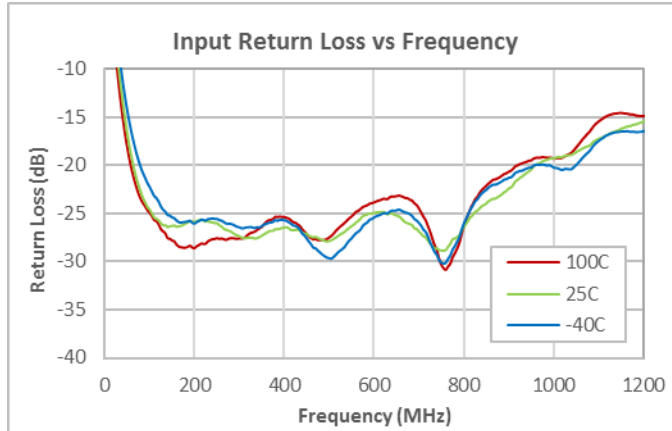
| R2 Pullup (ohms) | R3 Pulldown (ohms) | IDD (mA) |
|---------------------|-----------------------|-------------|
| Open | 3.3K | 91 |
| Open | 4.7K | 94 |
| Open | 10K | 99 |
| Open | Open | 105 |
| 10K | Open | 109 |
| 4.7K | Open | 115 |
| 3.3K | Open | 119 |



Notes:

(1) $V_{DD} = 5V$

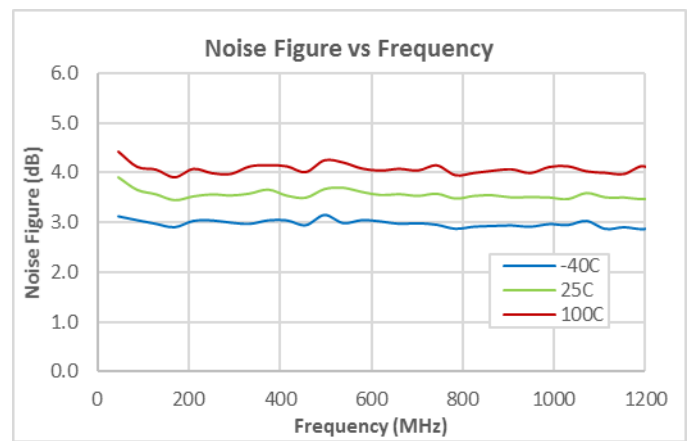
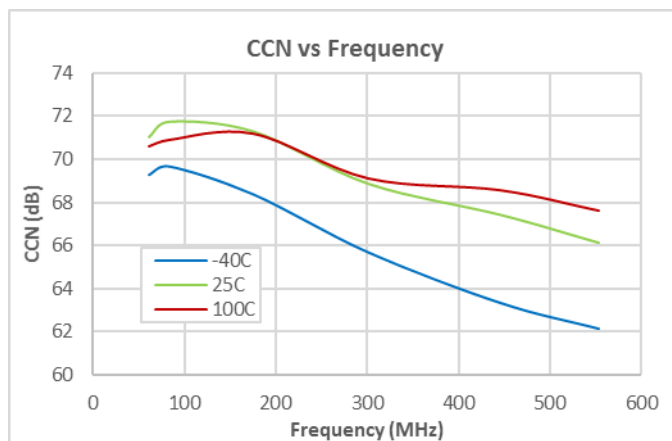
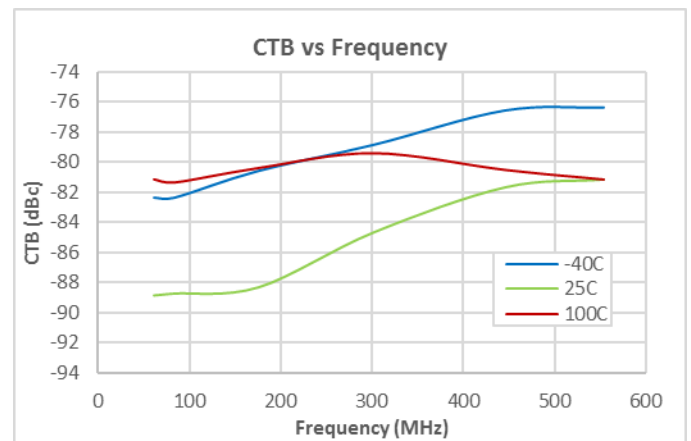
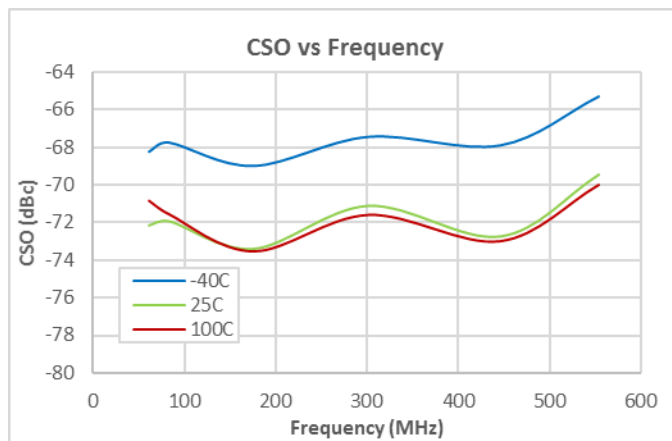
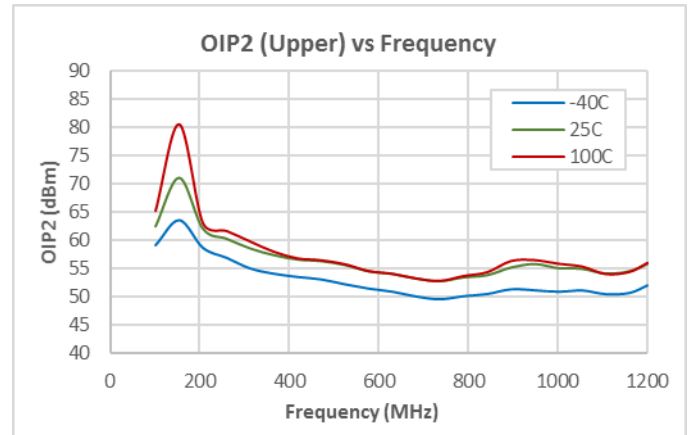
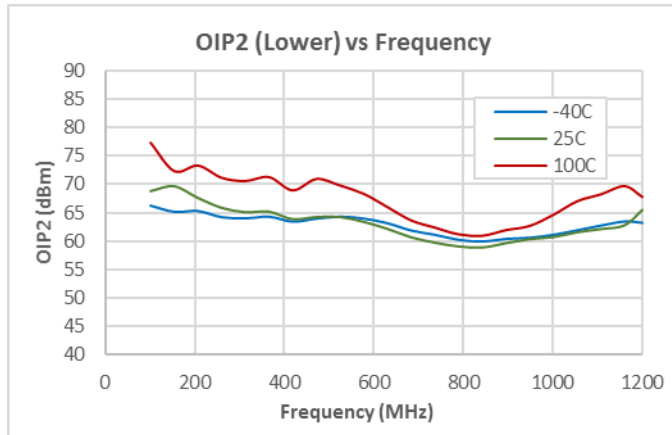
Performance Data – 5V



Notes:

(2) OIP3: Pout = +5dBm/tone

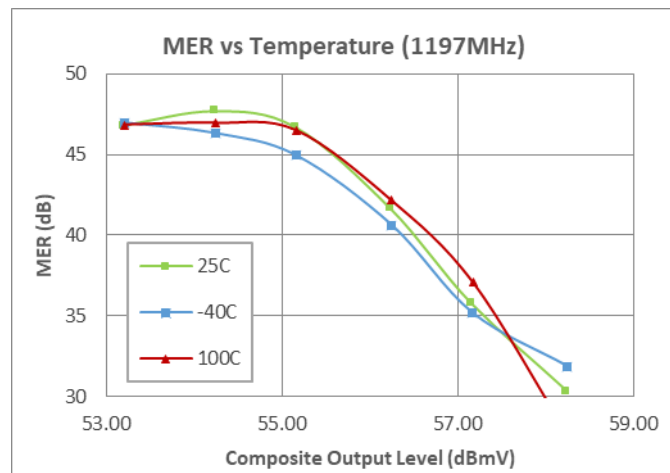
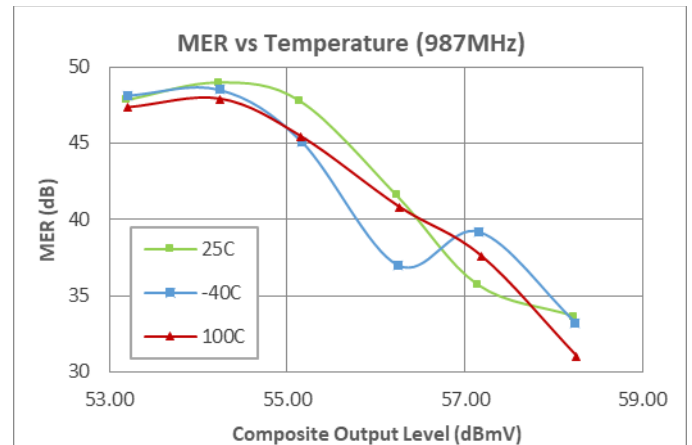
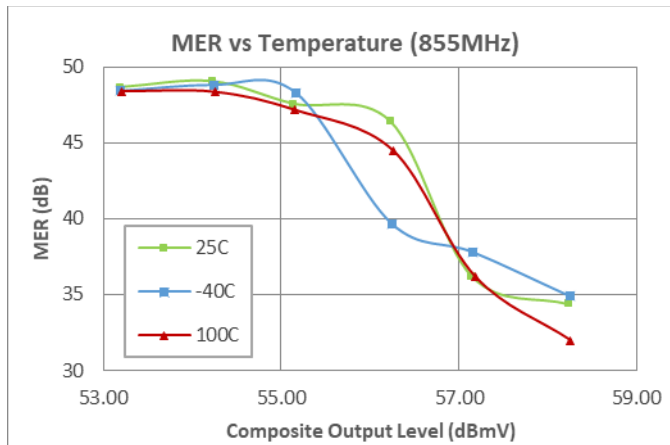
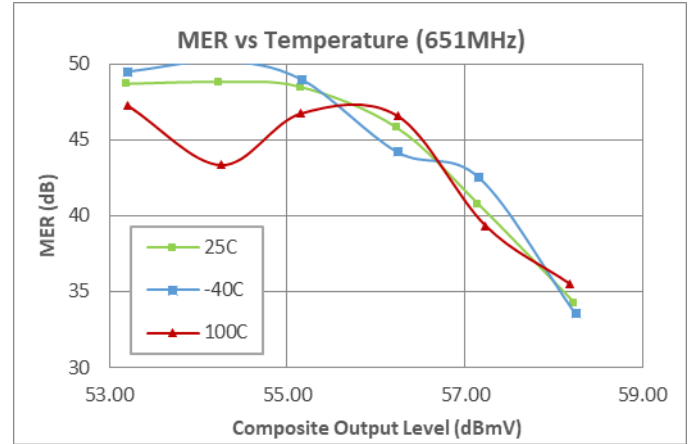
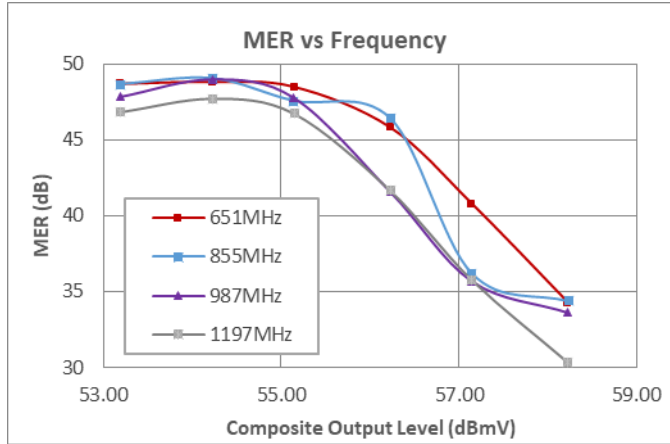
Performance Data – 5V



Notes:

- (1) OIP2: Pout = +5 dBm/ tone
- (2) CSO/CTB, CCN: 33 dBmV/ ch at output, flat loading (–6 dB for QAM), 80 ch NTSC + 108 QAM to 1218 MHz

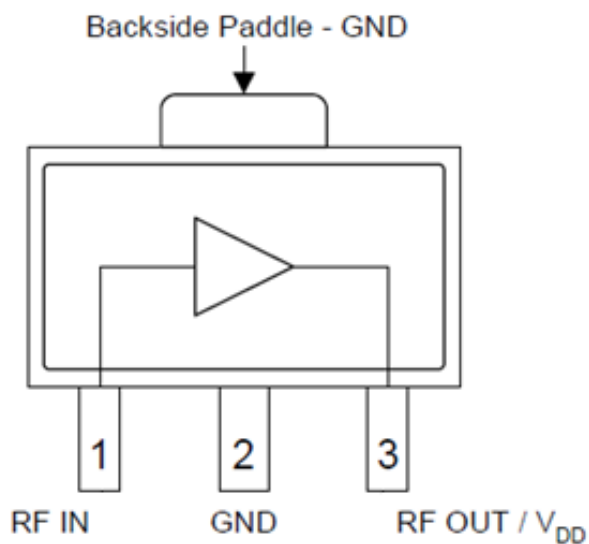
Performance Data – 5V



Notes:

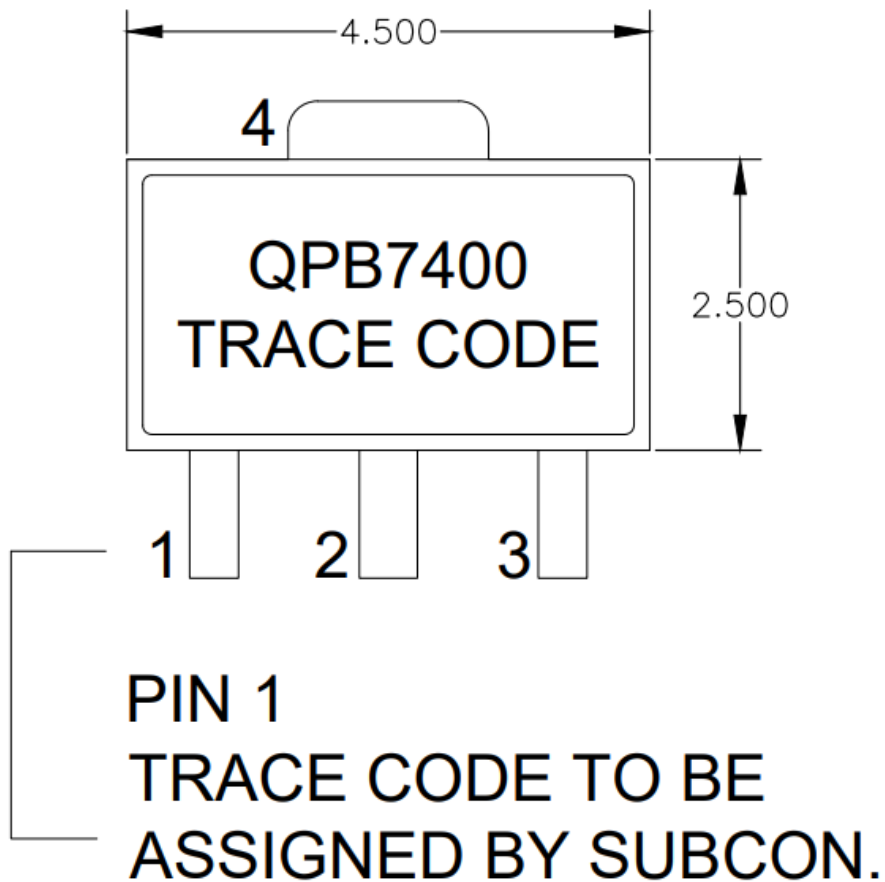
- (1) MER: 79 ch NTSC + 111 QAM to 1218 MHz, 0db tilt (QAM -6dB), ITU-T J.83, Annex B

Pin Configuration and Description

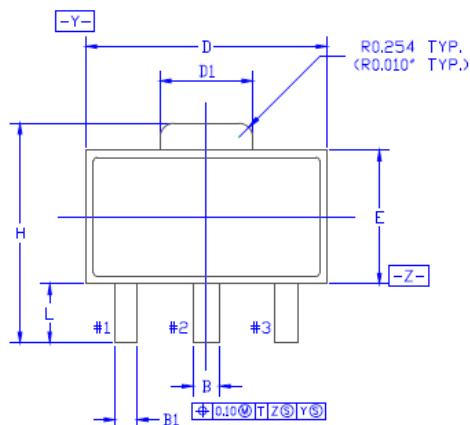


| Pin Number | Label | Description |
|------------|------------|---|
| 1 | RF IN | RF Input – DC blocking capacitor required |
| 2 | GND | GND – DC, RF, and Thermal |
| 3 | RF OUT/VDD | RF Output – VDD bias choke required |

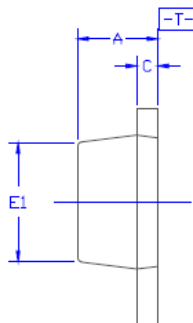
Package Marking



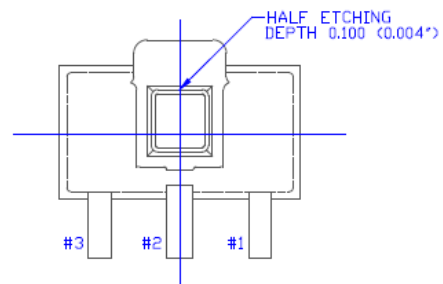
Package Outline



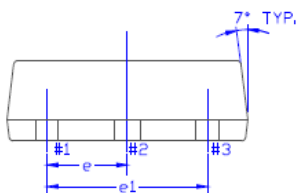
TOP
VIEW



SIDE
VIEW



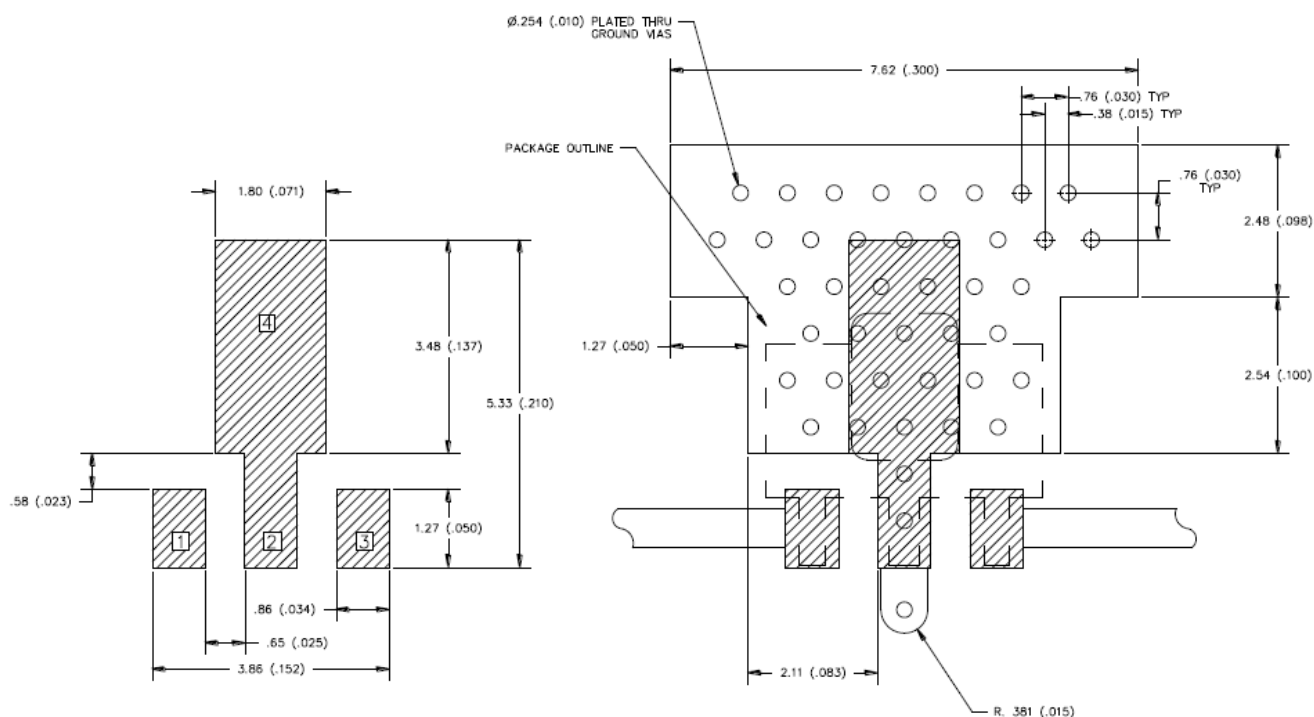
BOTTOM
VIEW



SIDE
VIEW

| SYMBOL | Common | | | | | |
|--------|-----------------------|------|------|-----------------|-------|-------|
| | DIMENSIONS MILLIMETER | | | DIMENSIONS INCH | | |
| | MIN. | NOM. | MAX. | MIN. | NOM. | MAX. |
| A | 1.40 | 1.50 | 1.60 | 0.055 | 0.059 | 0.063 |
| B | 0.44 | 0.50 | 0.56 | 0.017 | 0.020 | 0.022 |
| B1 | 0.36 | 0.42 | 0.48 | 0.014 | 0.017 | 0.019 |
| C | 0.35 | 0.40 | 0.44 | 0.014 | 0.016 | 0.017 |
| D | 4.40 | 4.50 | 4.60 | 0.173 | 0.177 | 0.181 |
| D1 | 1.62 | 1.73 | 1.83 | 0.064 | 0.068 | 0.072 |
| E | 2.30 | 2.50 | 2.60 | 0.091 | 0.098 | 0.102 |
| E1 | 2.13 | 2.20 | 2.29 | 0.084 | 0.087 | 0.090 |
| e | 1.50 BSC. | | | 0.059 BSC. | | |
| e1 | 3.00 BSC. | | | 0.118 BSC. | | |
| H | 3.95 | 4.10 | 4.25 | 0.156 | 0.161 | 0.167 |
| L | 0.90 | 1.10 | 1.20 | 0.035 | 0.043 | 0.047 |

PCB Mounting Pattern



Notes:

1. Ground/thermal vias are critical for the proper performance of this device. Vias should use a .35 mm (#80/.0135") diameter drill and have a final, plated thru diameter of 0.25 mm (0.010").
2. Add as much copper as possible to inner and outer layers near the part to ensure optimal thermal performance.
3. RF trace width depends upon the PC board material and construction.
4. All dimensions are in millimeters (inches). Angles are in degrees.

Handling Precautions

| Parameter | Rating | Standard |
|----------------------------------|-------------------|--------------------------|
| ESD – Human Body Model (HBM) | Class 1C (2000V) | ESDA / JEDEC JS-001-2014 |
| ESD – Charged Device Model (CDM) | Class C3 (>1000V) | JEDEC JESD22-C101F |
| MSL– Moisture Sensitivity Level | Level 3 | IPC/JEDEC J-STD-020 |



Caution!
ESD-Sensitive Device

Solderability

Compatible with both lead-free (260 °C max. reflow temp.) and tin/lead (245 °C max. reflow temp.) soldering processes.

Solder profiles available upon request.

Contact plating: NiPdAu

RoHS Compliance

This part is compliant with 2011/65/EU RoHS directive (Restrictions on the Use of Certain Hazardous Substances in 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 (C₁₅H₁₂Br₄O₂) 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

Email: customer.support@qorvo.com

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