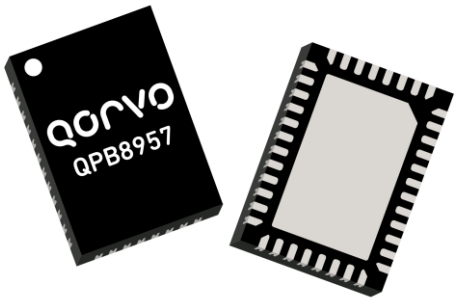
# QPB8957

## 75Ω 28dB CATV Doubler Amplifier 50 - 1003MHz

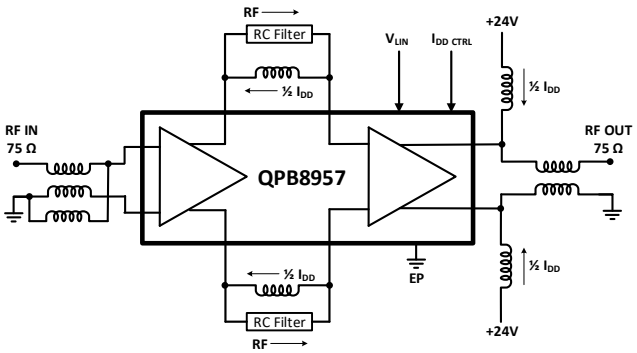
## Product Overview

The QPB8957 is a GaAs pHEMT/MESFET 75-ohm Doubler RF amplifier IC featuring over 28dB of flat gain and low noise. This IC is designed to support applications up to 1003MHz using a single 24V supply. The QPB8957 offers low noise and low distortion at high efficiency consuming only 8.4W in a 5x7 QFN package. Its compact size and low Θjc enable integration that is ideally suited for hybrid module or an alternative to hybrid module applications.




40 pin 5x7 QFN Package

## Functional Block Diagram




## Key Features

- High Gain: 28dB @ 1003MHz
- Adjustable Bias
- 50 - 1003 MHz BW
- 57dBmV/ch virtual 1.0GHz, at 15dB tilt
- Low Noise: 4.5dB
- Excellent Composite Distortion
- pHEMT / MESFET device technologies
- Compact Size: 40P 5x7 QFN
- Power Consumption (24V, 350mA – 8.4W)

## Applications

- DOCSIS 3.0
- Broadband CATV hybrid modules
- Head End CMTS Equipment
- 75-ohm amplifiers

## Ordering Information

| Part No. | Description |
|---|---|
| QPB8957SB | Sample bag with 5 pieces |
| QPB8957SR | 7" Reel with 100 pieces |
| QPB8957TR13 | 13" Reel with 2500 pieces |
| QPB8957EVB | 47 – 1003MHz PCBA |

## Absolute Maximum Ratings

| Parameter | Rating |
|---|---|
| Supply Voltage ($V_{DD}$) | +28V (5min) |
| Supply Current ($I_{DD}$) | 500mA |
| Maximum Input Level (single tone) | +70dBmV |
| Operating Temperature Range | -40 to +100°C |
| Storage Temperature Range | −65 to +150°C |
| Maximum Junction Temperature | +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.

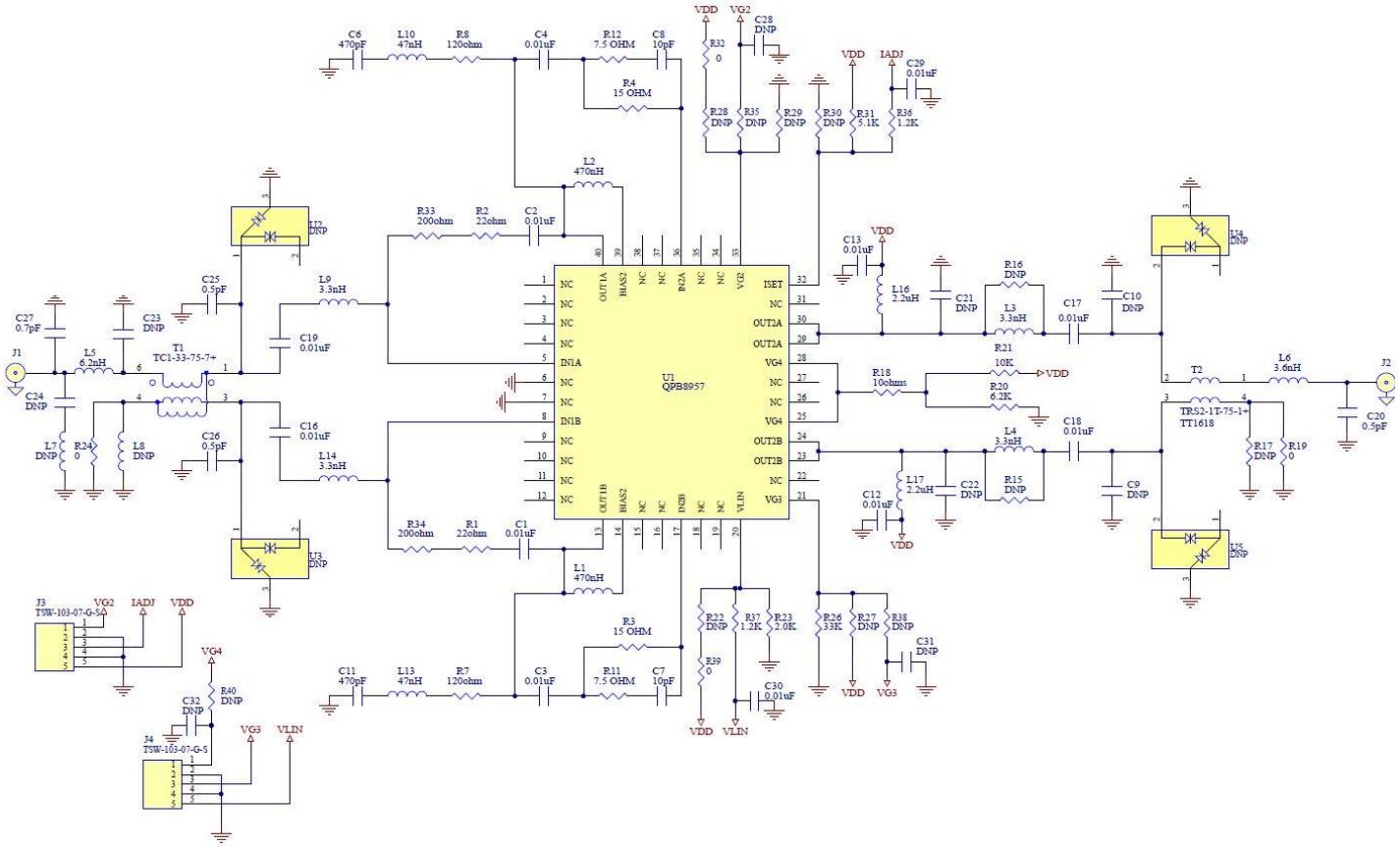
## Electrical Specifications – 24V

| Parameter | Condition [1] | Min | Typ | Max | Unit |
|---|---|---|---|---|---|
| Supply Voltage ($V_{DD}$) | | | 24 | | V |
| Supply Current ($I_{DD}$) | $V_{DD}$ total current | | 350 | | mA |
| Frequency Range | | 50 | | 1003 | MHz |
| Gain[2] | 1003MHz | | 28 | | dB |
| Gain Flatness | Max. deviation from line using least squares fit from 50 to 1003 MHz | | ±0.5 | | dB |
| Gain Slope | Gain(1003MHz) - Gain(50MHz) | | 1.0 | | dB |
| Reverse Isolation | | | -42 | | dB |
| Input Return Loss | | | 18 | | dB |
| Output Return Loss | | | 18 | | dB |
| Noise Figure | | | 4.5 | | dB |
| CSO | 80 NTSC + 72 QAM (-6dB offset), 56dBmV/ch virtual output at 1003MHz @15.6dB tilt | | -79 | | dBc |
| CTB | | | -78 | | dBc |
| CCN | | | 63.5 | | dB |
| OIP2 | Low band: 225MHz, 325MHz, 15dBm/tone | | 90 | | dBm |
| | High band: 900MHz, 950.5MHz, 15dBm/tone | | 85 | | dBm |
| OIP3 | Low band: 225MHz, 325MHz, 15dBm/tone | | 53 | | dBm |
| | High band: 900MHz, 950.5MHz, 15dBm/tone | | 49 | | dBm |
| Output P1dB | 1003 MHz | | 28 | | dBm |
| Thermal Resistance | $\Theta_{JB}$ (Junction to backside of QFN) | | 6 | | ˚C/W |
| | | | | | |

Notes:

1. Typical performance at these conditions: Temp = +25°C, $V_{DD}$ = +24V, 75Ω system, Full band unless otherwise noted

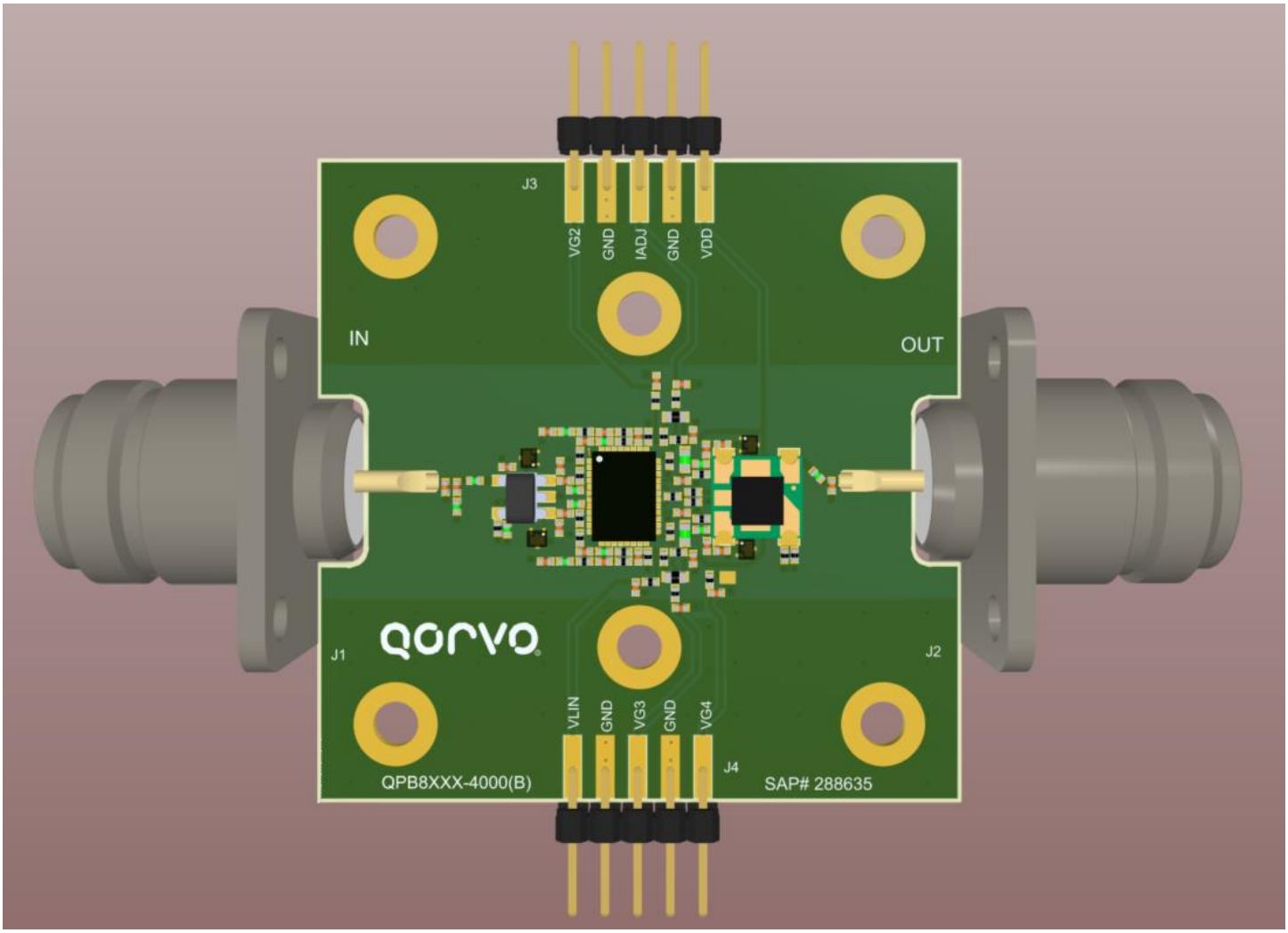
## Evaluation Board Schematic



## Evaluation Board Bill of Materials

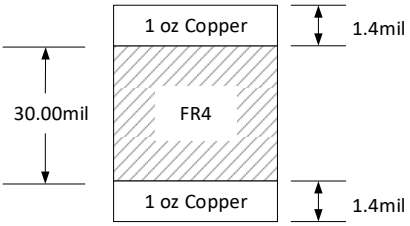
| Reference Designator | Description | Manufacturer | PART # |
|---|---|---|---|
| U1 | 1GHz, 28dB Power Doubler | Qorvo | QPB8957 |
| C1,C2,C3,C4,C12, C13,C16,C17,C18, C19,C29,C30 | CAP, 0.01uF, ±10%, 50V, X7R, 0402 | MURATA | GRM155R71H103KA88D |
| C20,C25,C26 | CAP0402, 0.5pF, ±0.1pF, 50V, C0G, HIQ | MURATA | GJM1555C1HR50BB01D |
| C7,C8 | CAP0402, 10pF, ±2%, 50V, C0G, HIQ | MURATA | GJM1555C1H100GB01D |
| C6,C11 | CAP, 470pF, 5%, 50V, C0G, 0402 | MURATA | GRM1555C1H471JA01D |
| C27 | CAP, 0.7pF, +/-0.05pF, 50V, C0G, 0402 | MURATA | GRM1555C1HR70WA01D |
| R3,R4 | RES, 15 OHM, 1%, 1/16W, 0402 | Kamaya | RMC1/16S-150FTH |
| R18 | RES, 10 OHM, 1%, 1/16W, 0402 | Panasonic | ERJ-2RKF10R0X |
| R19,R24 | RES, 0 OHM, 5%, 1/10W, 0402 | Kamaya | RMC1/16SJPTH |
| R11,R12 | RES, 7.5 OHM, 5%, 1/16W, 0402 | Kamaya | RMC1/16S-7R5JTH |
| R33,R34 | RES, 200 OHM, 1%, 1/16W, 0402 | Panasonic | ERJ-2RKF2000X |
| R21 | RES, 10K, 1%, 1/16W, 0402 | Panasonic | ERJ-2RKF1002X |
| R23 | RES, 2.0K, 1%, 1/16W, 0402 | Panasonic | ERJ-2RKF2001X |
| R26 | RES, 33K, 1%, 1/16W, 0402 | Yageo | RC0402FR-0733KL |
| R31 | RES, 5.1K, 1%, 1/10W, 0402 | Panasonic | ERJ-2RKF5101X |
| R20 | RES, 6.2K, 1%, 1/10W, 0402 | Panasonic | ERJ-2RKF6201X |
| R32,R39 | RES, 0 OHM, 0603 | Kamaya | RMC1/16JPTP |
| R36,R37 | RES, 1.2K, 5%, 1/16W, 0402 | Panasonic | ERJ-2GEJ122 |
| R1,R2 | RES, 22 OHM, 5%, 1/16W, 0402 | Panasonic | ERJ-2GEJ220 |
| R7,R8 | 120 OHM,1%,1/16W,0402 LEAD FREE | KOA | RK73H1ETTP1200F |
| L1,L2 | IND, 470nH, ±5%, 310mA, 650mHZ, 0402 | Coilcraft, Inc. | 0402AF-471XJLW |
| L10,L13 | IND, 47nH, 5%, M/L, 0402 | MURATA | LQG15HN47NJ02D |
| L3,L4,L9,L14 | IND, 3.3nH, +/-0.1nH, M/L, 0402 | MURATA | LQG15HS3N3B02D |
| L6 | IND, 3.6nH, +/-0.1nH, M/L, 0402 | MURATA | LQG15HS3N6B02D |
| L5 | IND, 6.2nH, +/-0.1nH, M/L, 0402 | MURATA | LQG15HS6N2B02D |
| L16,L17 | IND, 2.2uH, 20%, 0.36A, 0.7mm, W/W, 0603 | Taiyo Yuden | BRL1608T2R2M |
| T1 | XFMR, SMT, 75 OHM, CD542, 1:1 BALUN, TC1 | Mini Circuits | TC1-33-75-7+ |
| T2 | Transformer, 2:1, 5 to 1200 MHz, TT1618 | Minicircuits | TRS2-1T-75-1+ |
| R15,R16,R17,R22, R27,R28,R29,R30, R35,R38,R40 | Not Populated | | |
| C9,C10,C21,C22,C23, C24,C28,C31,C32,L7, L8,U2,U3,U4,U5 | Not Populated | | |

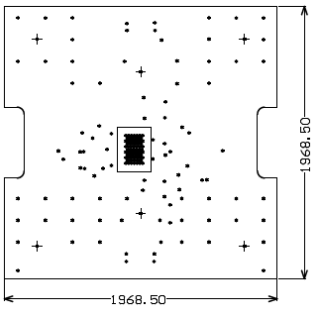
## Evaluation Board Assembly Drawing



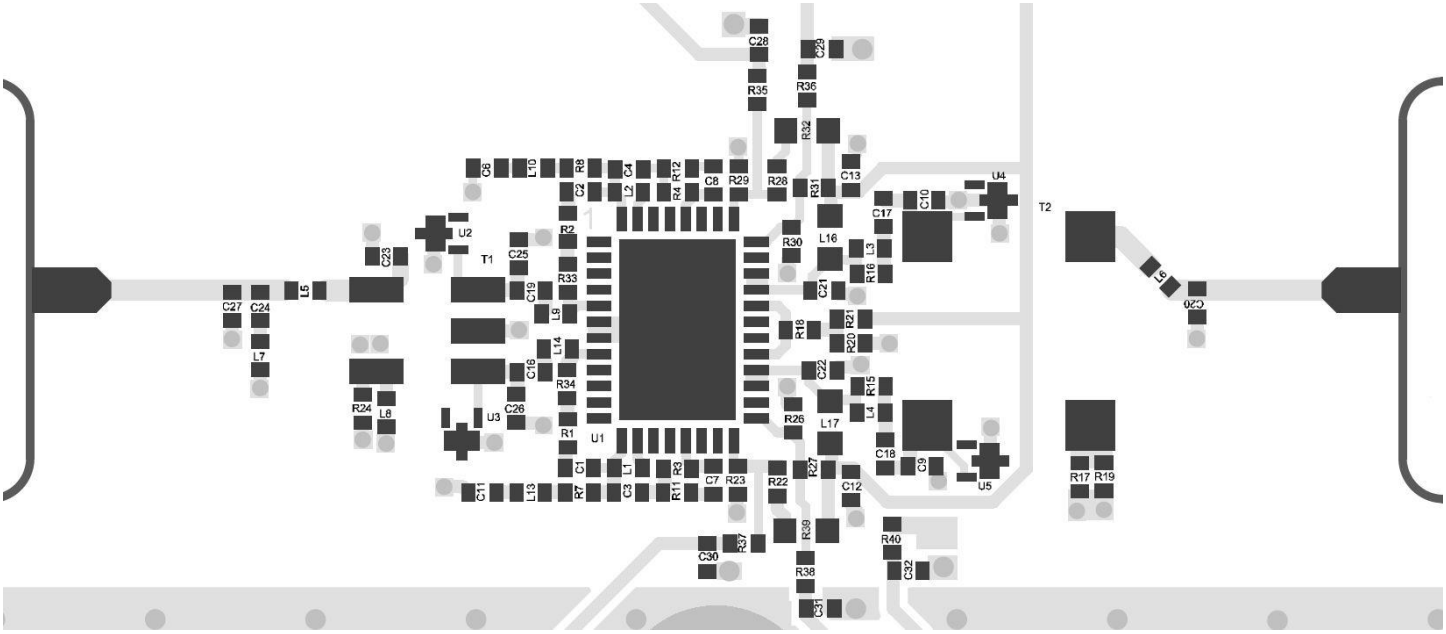

**EVB PCB Material and Stack-up**

Board Material: 0.030" FR4, $\varepsilon_r$=4.2
Plating: 1oz Copper
Board Dimension: 1.9685" x 1.9685"

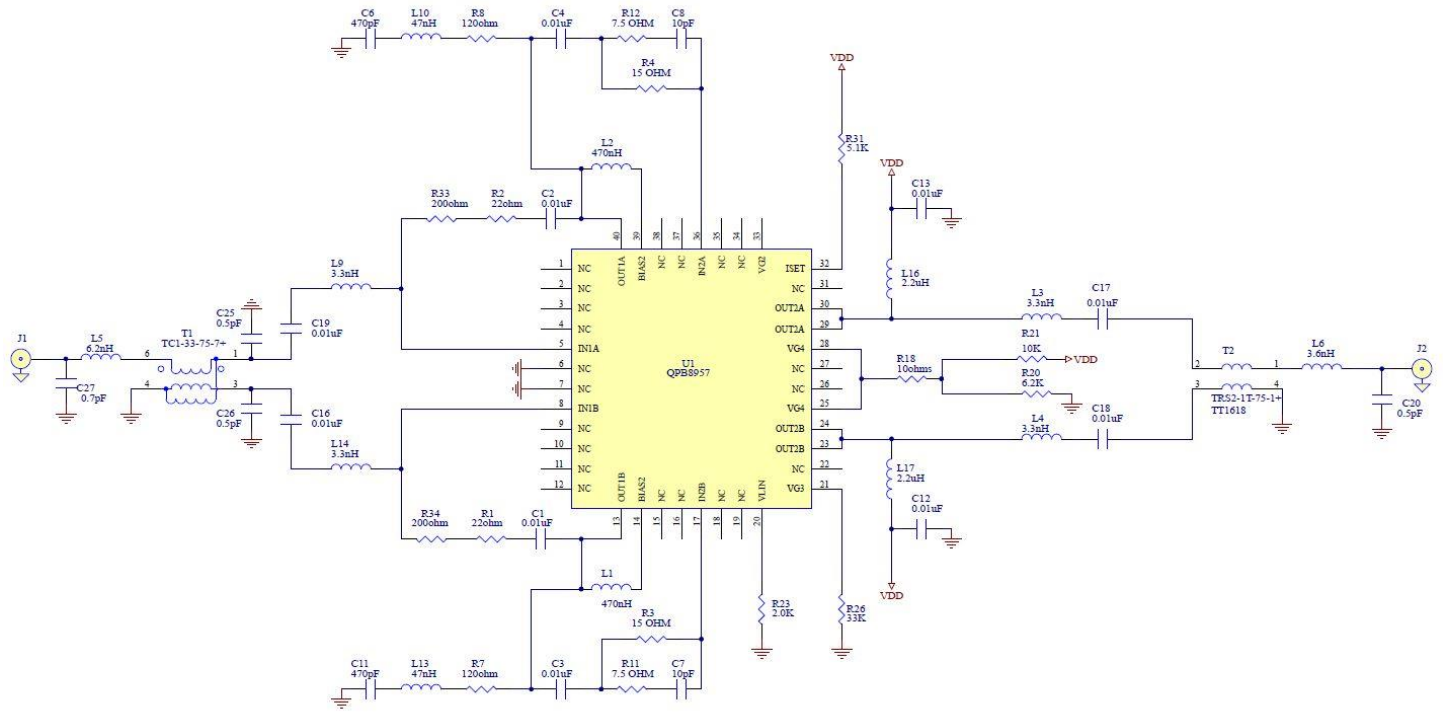


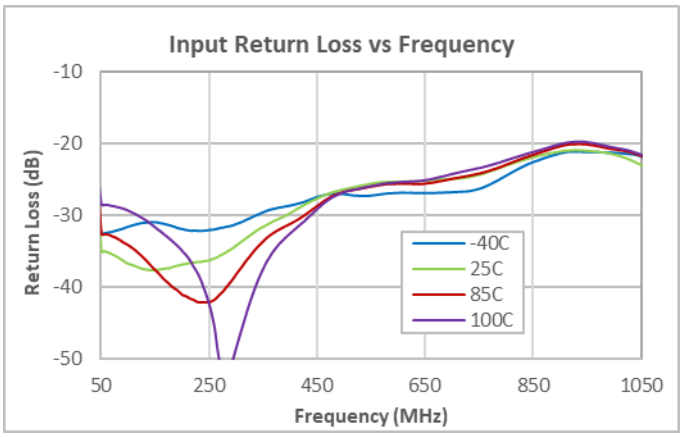
## Evaluation Board Component Placement

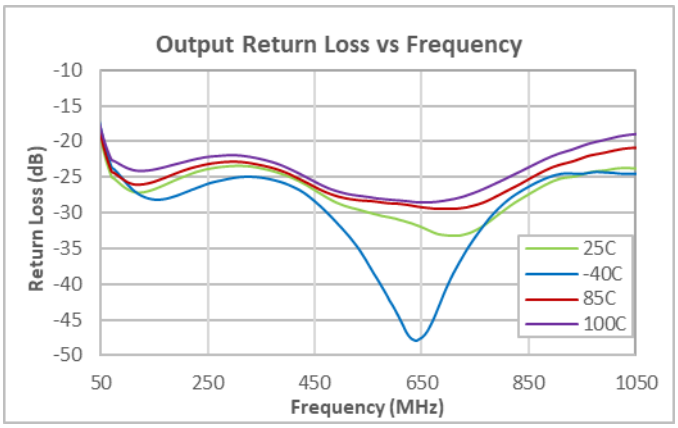


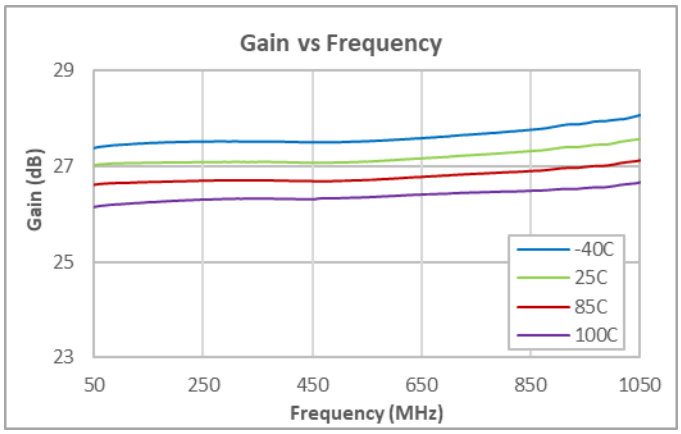

## Typical Application Schematic; 24V

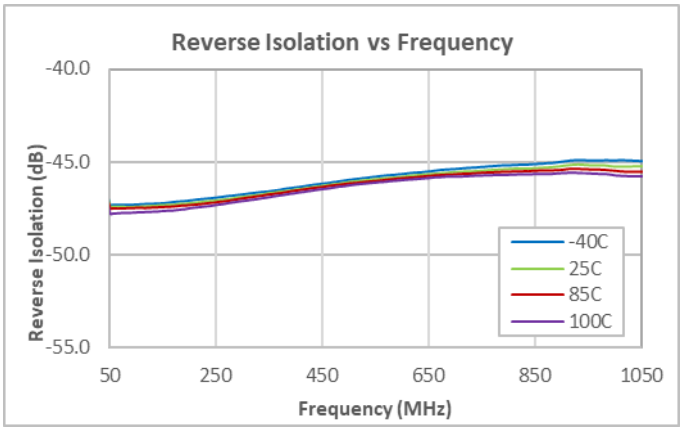


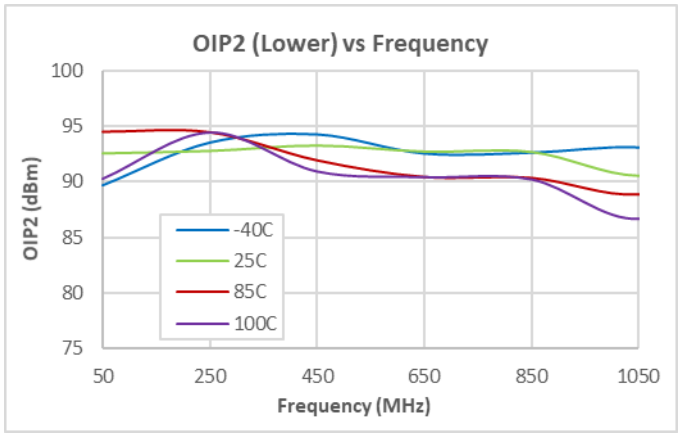
## Performance Data 24V

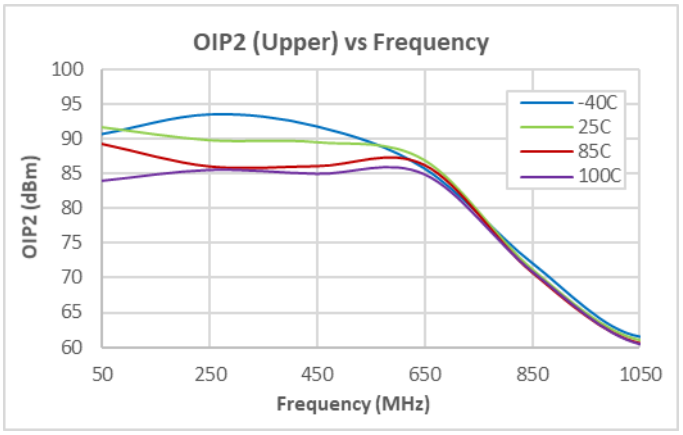


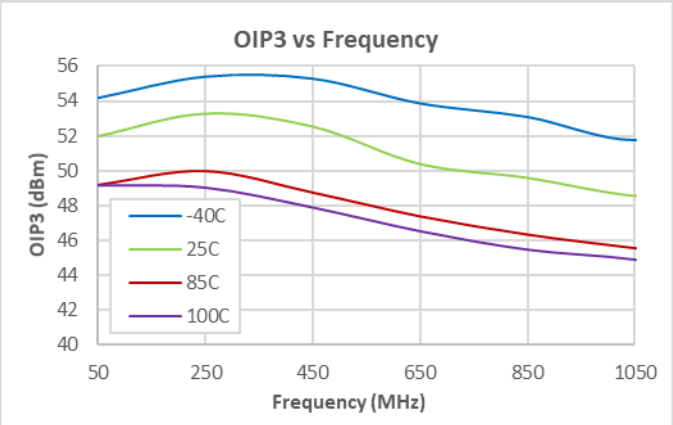



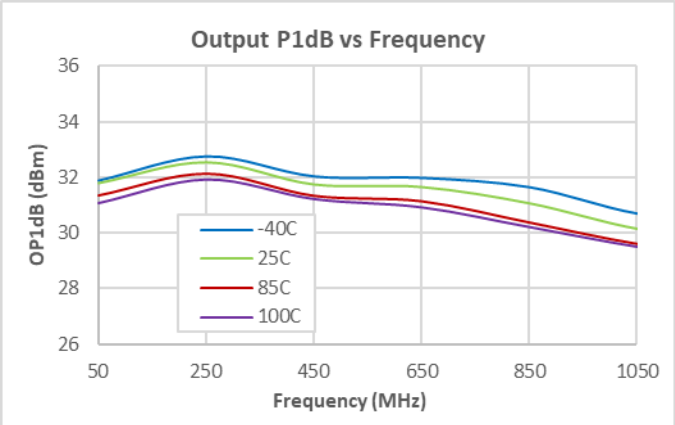



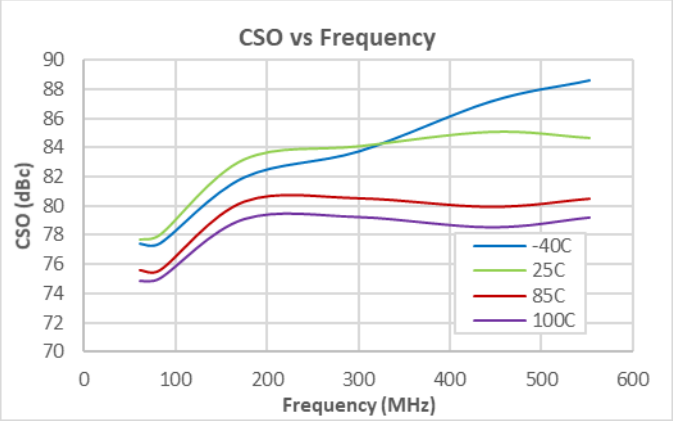

Test Conditions:

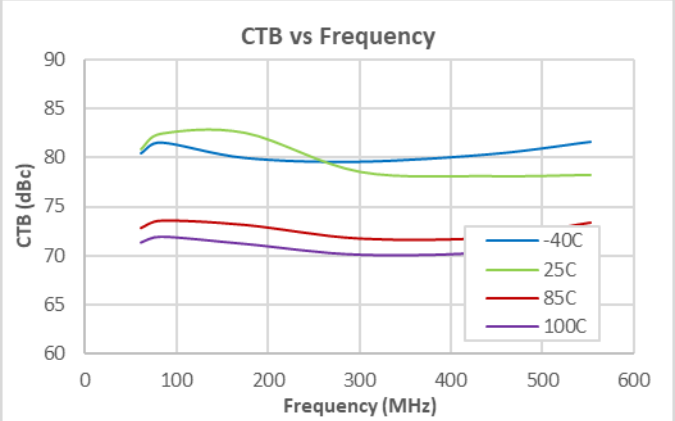
1. Test conditions unless otherwise noted: $V_{DD}$ =+24 V, $Z_o$ = 75Ω
2. OIP2: +15dBm per Tone.

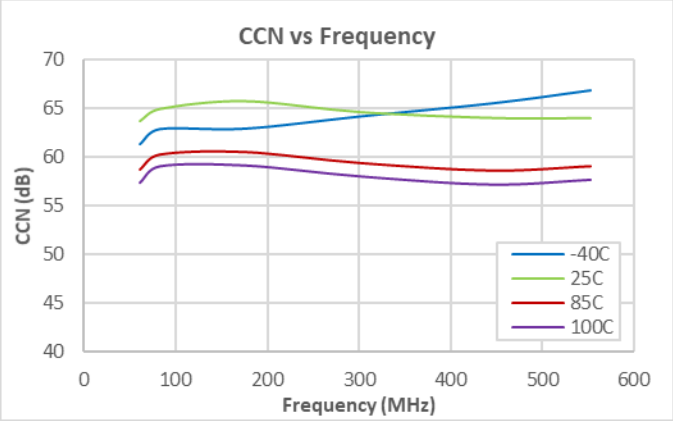
## Performance Data 24V

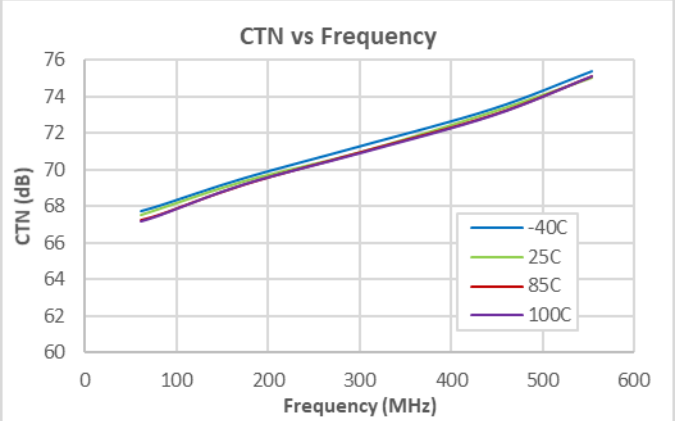


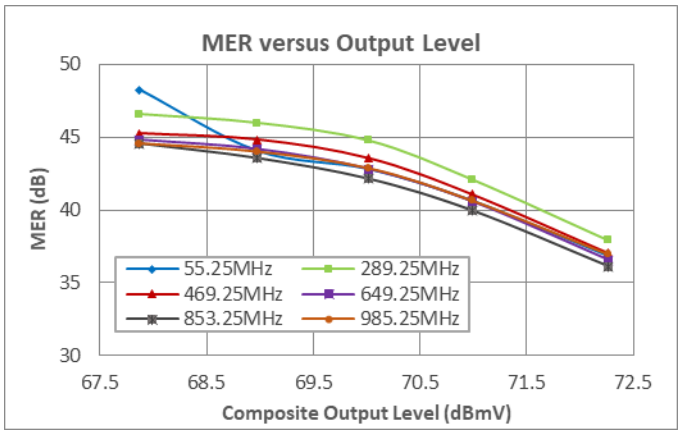



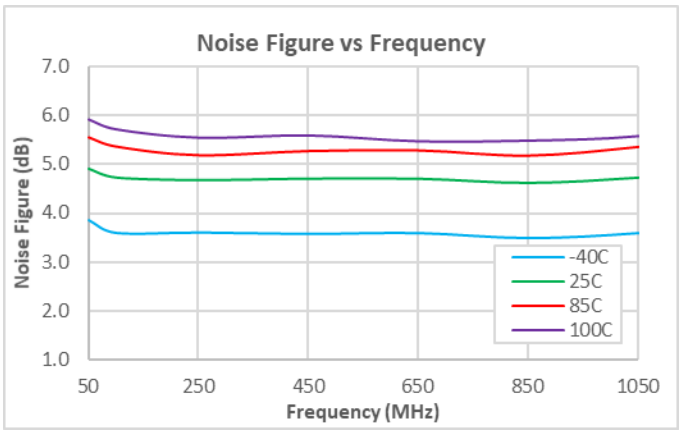



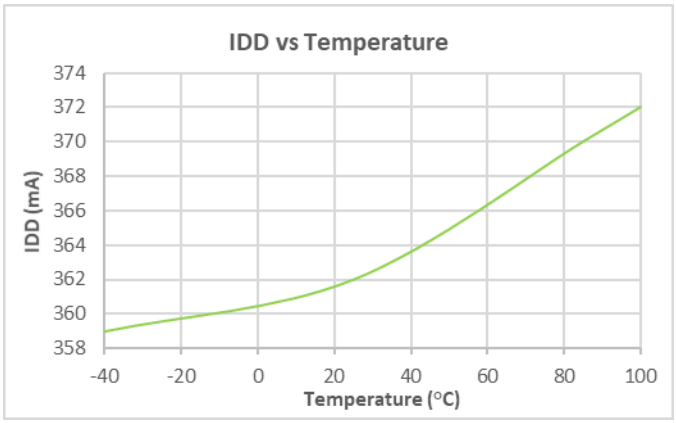

Test Conditions:

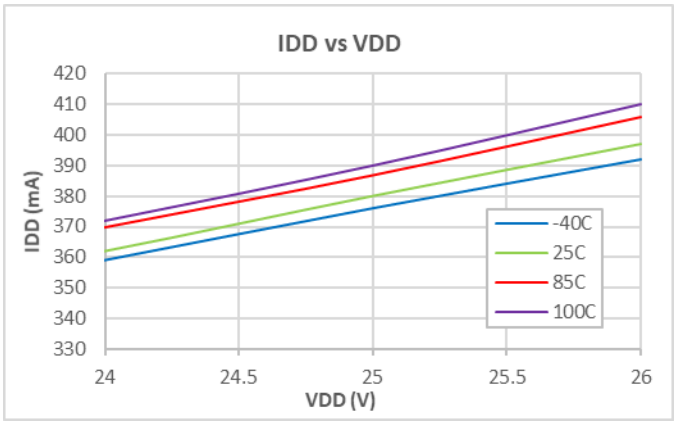
1. Test conditions unless otherwise noted: $V_{DD}$ =+24 V, $Z_o$ = 75Ω
2. OIP3: +15dBm per Tone.
3. CSO, CTB, CCN, CTN: 80 NTSC + 72 QAM (-6dB offset), 56dBmV/ch out, 15.6dB tilt

## Performance Data 24V



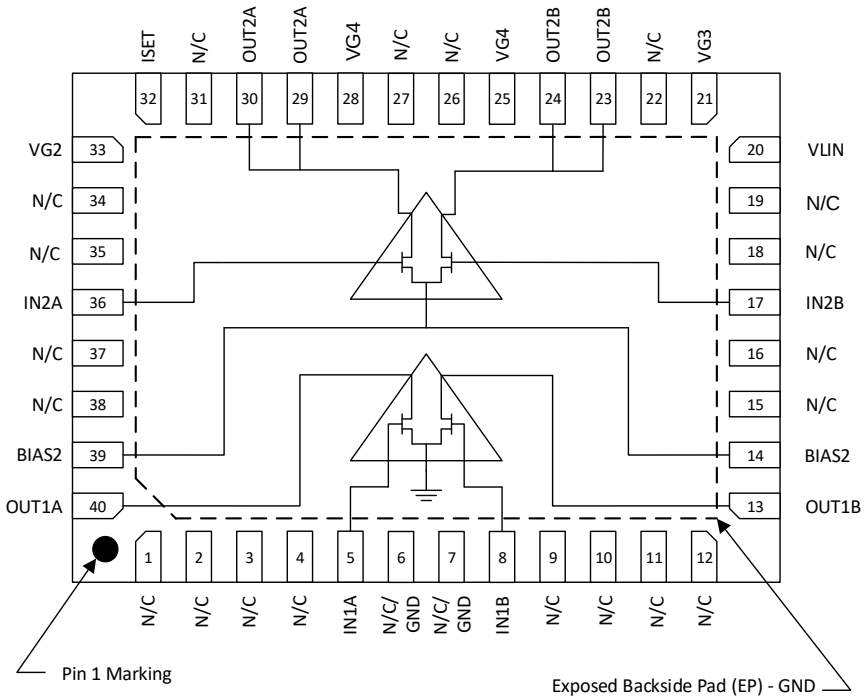




Test Conditions:

1. Test conditions unless otherwise noted: $V_{DD}$ =+24 V, $Z_o$ = 75Ω
2. MER: 160 QAM256 Channels Flat Tilt, 57-1003MHz, ITU-T J.83, Annex B

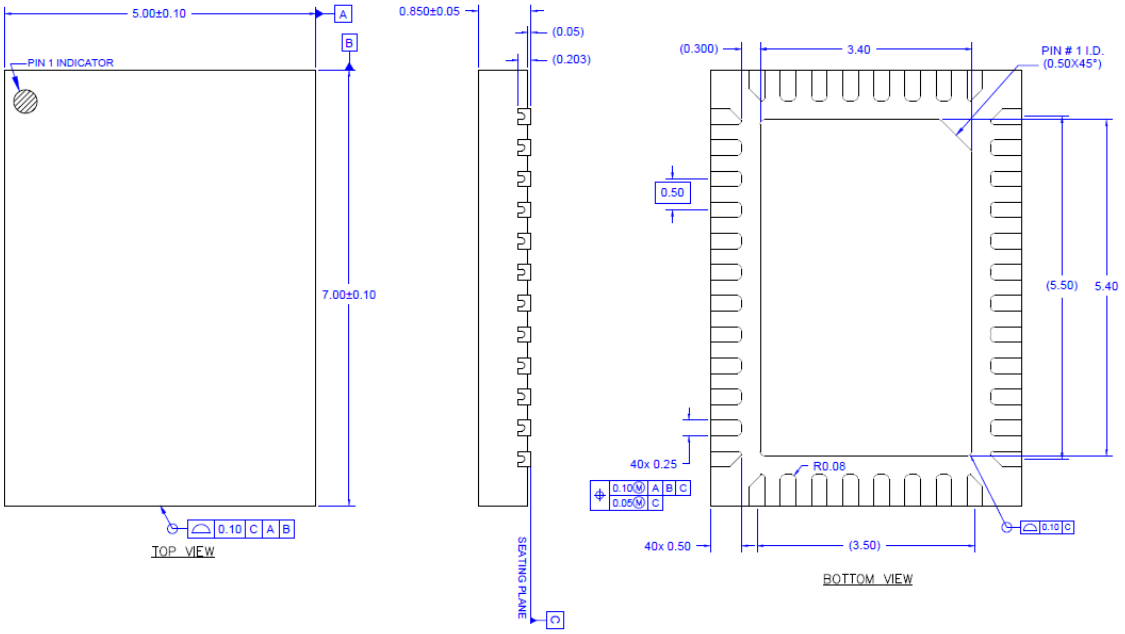
## Pin Configuration and Description




Top View

| Pad No. | Label | Description |
|---|---|---|
| 5 | IN1A | RF input 1A |
| 8 | IN1B | RF input 1B |
| 13 | OUT1B | RF output 1B |
| 14, 39 | BIAS2 | 2nd Stage virtual ground |
| 17 | IN2B | RF input 2B |
| 20 | VLIN | Linearizer current set |
| 21 | VG3 | VG3 adjust |
| 23, 24 | OUT2B | RF output 2B |
| 25, 28 | VG4 | VG4 set |
| 29, 30 | OUT2A | RF output 2A |
| 32 | ISET | IDD set |
| 33 | VG2 | No Connect |
| 36 | IN2A | RF input 2A |
| 40 | OUT1A | RF output 1A |
| 1, 2, 3, 4, 9, 10, 11, 12, 15, 16, 18, 19, 22, 26, 27, 31, 34, 35, 37, 38 | N/C | No Connect |
| 6,7 | N/C/GND | No Connect or Ground |
| Backside Paddle | GND | Ground. Use recommended via pattern to minimize inductance and thermal resistance. See PCB Mounting Pattern for suggested footprint. |

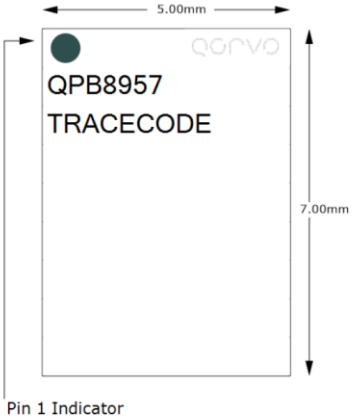
## Package Outline




Notes:

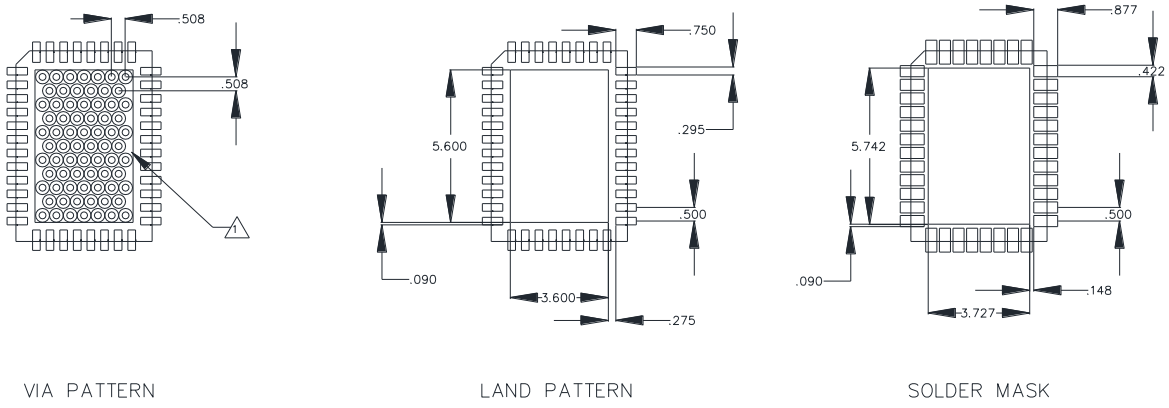
1. Dimensions in millimeters

## Package Marking




1. Dimension and tolerance formats conform to ASME Y14.4M-1994.
2. The terminal #1 identifier and terminal numbering conform to JESD 95-1 SPP-012.
3. Co-planarity applies to the exposed ground/thermal pad as well as the contact pins.
4. Package body length/width does not include plastic flash protrusion across mold parting line.

## Recommended Mounting Pattern




NOTES:

1. GROUND/THERMAL VIAS AND MOUNTING HOLES ARE ESSENTIAL FOR THE PROPER DEVICE PERFORMANCE. DO NOT OMIT. VIAS SHOULD USE A .35mm (#80/.0135") DIAMETER DRILL AND HAVE A FINAL, PLATED THRU DIAMETER OF .25mm (.010").
2. TO ENSURE RELIABLE OPERATION, DEVICE GROUND PADDLE-TO-GROUND PAD SOLDER JOINT IS CRITICAL. NO SOLDER MASK ON BACKSIDE OF PCB IN HEAT SINK CONTACT AREA.
3. ALL DIMENSIONS ARE IN MILLIMETERS. ANGLES ARE IN DEGREES.

- Ensure good package backside paddle solder attach for reliable operation and best electrical performance.
- Place mounting screws near the part to fasten a back-side heat sink.
- Do not apply solder mask to the back side of the PC board in the heat sink contact region.
- Ensure that the backside via region makes good physical contact with the heat sink.

## Handling Precautions

| Parameter | Rating | Standard |
|---|---|---|
| ESD – Human Body Model (HBM) | 1B (500V) | ANSI / ESDA / JEDEC JS-001 |
| ESD – Charged Device Model (CDM) | C3 (1000V) | ANSI / ESDA / JEDEC JS-002 |
| 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 ($C_{15}H_{12}Br_4O_2$) 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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