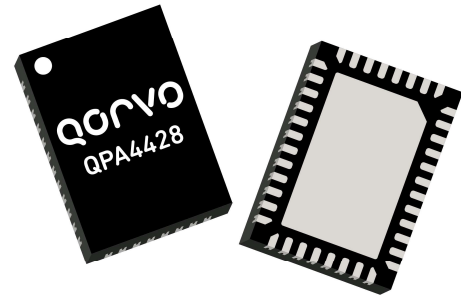


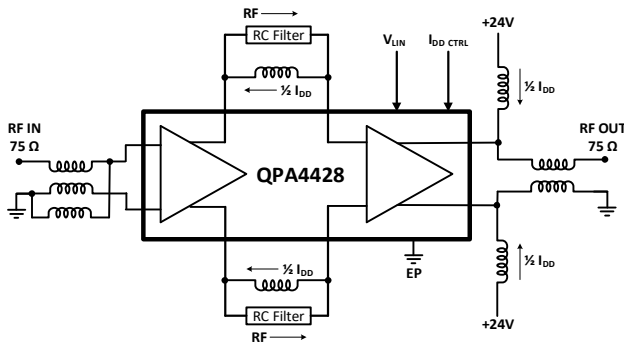
### Product Overview

The QPA4428 is a GaAs pHEMT/MESFET 75-ohm push-pull RF amplifier IC featuring 28dB of flat gain and low noise. This IC is designed to support DOCSIS 3.1 applications up to 1218MHz using a single 24V supply. The QPA4428 offers low noise and low distortion at high efficiency consuming only 7W in a 5x7 QFN package. Its compact size and low  $\Theta_{jc}$  enable integration that is ideally suited for hybrid module applications.



40 pin 5x7 QFN Package

### Functional Block Diagram



### Key Features

- High Gain: 28dB @ 1218MHz
- Adjustable Bias
- 47 - 1218 MHz BW
- 47dBmV/ch flat
- Low Noise: 4.6dB
- Excellent Composite Distortion
- pHEMT / MESFET device technologies
- Compact Size: 40P 5x7 QFN
- Power Consumption (24V, 290mA - 7W)

### Applications

- DOCSIS 3.1
- Broadband CATV hybrid modules
- Head End CMTS Equipment
- 75-ohm amplifiers

### Ordering Information

| Part No.      | Description               |
|---------------|---------------------------|
| QPA4428SB     | Sample bag with 5 pieces  |
| QPA4428SR     | 7" Reel with 100 pieces   |
| QPA4428TR13   | 13" Reel with 2500 pieces |
| QPA4428EVB-01 | 47 – 1218MHz PCBA         |

## Absolute Maximum Ratings

| Parameter                         | Rating        |
|-----------------------------------|---------------|
| Supply Voltage (V <sub>DD</sub> ) | +30V (5min)   |
| Supply Current (I <sub>DD</sub> ) | 350mA         |
| Maximum Input Level (single tone) | +70dBmV       |
| Operating Temperature Range       | -40 to +100°C |
| Storage Temperature Range         | -65 to +165°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.

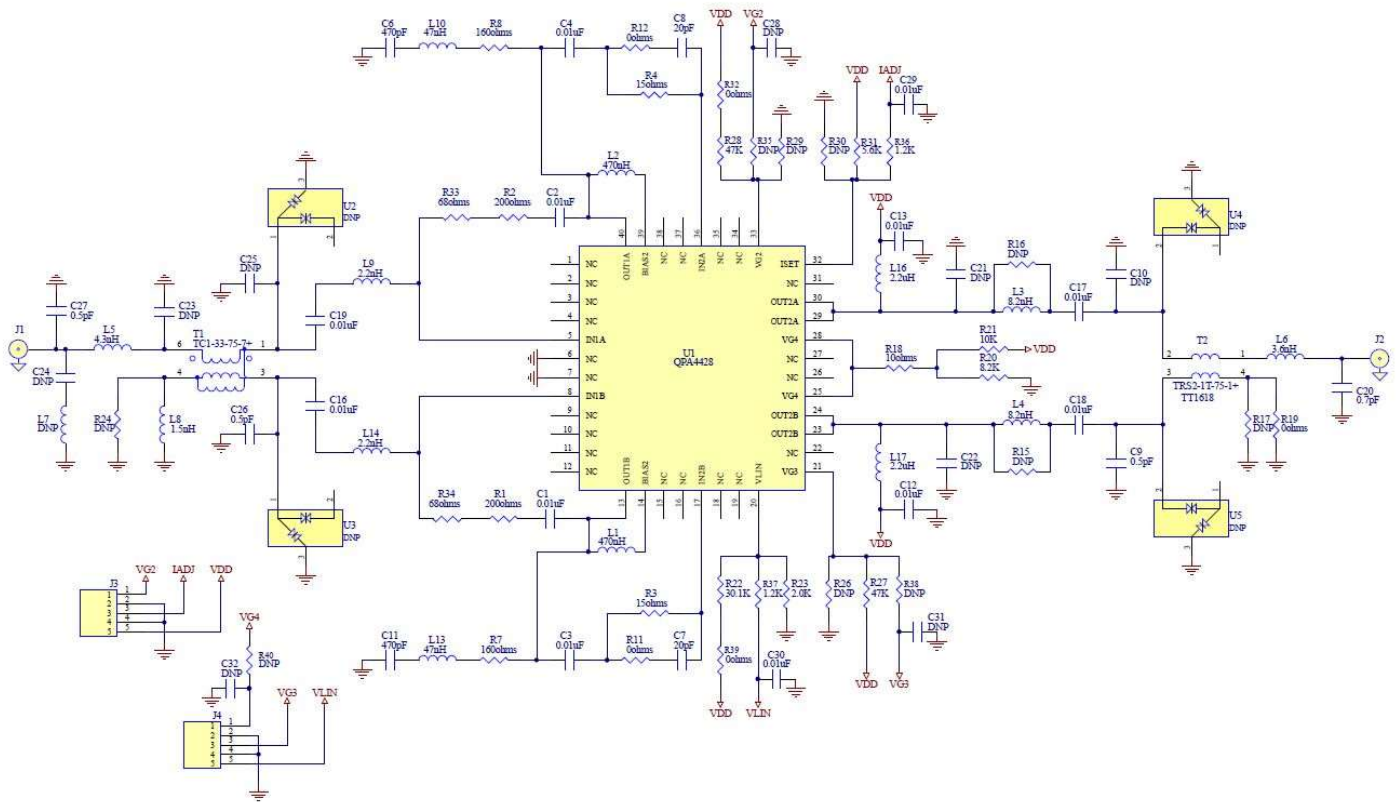
## Electrical Specifications – 24V

| Parameter                         | Condition <sup>(1)</sup>   | Min | Typ   | Max  | Unit |
|-----------------------------------|--|-----|-------|------|------|
| Supply Voltage (V <sub>DD</sub> ) |  |     | 24    |      | V    |
| Supply Current (I <sub>DD</sub> ) | V <sub>DD</sub> total current  |     | 290   |      | mA   |
| Frequency Range                   |  | 47  |       | 1218 | MHz  |
| Gain <sup>2</sup>                 | 1218MHz  |     | 29.7  |      | dB   |
| Gain Flatness                     | Max. deviation from line using least squares fit from 47 to 1218 MHz |     | ±0.5  |      | dB   |
| Gain Slope                        | Gain(1218MHz) - Gain(50MHz)  |     | 1.1   |      | dB   |
| Reverse Isolation                 |  |     | -44   |      | dB   |
| Input Return Loss                 |  |     | 18.9  |      | dB   |
| Output Return Loss                |  |     | 19.5  |      | dB   |
| Noise Figure                      |  |     | 4.6   |      | dB   |
| CSO                               | 80 NTSC + 111 QAM (-6dB offset), 47dBmV/ch out, 0dB tilt             |     | -78.2 |      | dBc  |
| CTB                               |  |     | -75.0 |      | dBc  |
| CCN                               |  |     | 64.0  |      | dB   |
| OIP2                              | Low band: 225MHz, 275.5MHz, 15dBm/tone                               |     | 87.9  |      | dBm  |
|                                   | High band: 1100MHz, 1150.5MHz, 15dBm/tone                            |     | 65.5  |      | dBm  |
| OIP3                              | Low band: 225MHz, 275.5MHz, 15dBm/tone                               |     | 55.8  |      | dBm  |
|                                   | High band: 1100MHz, 1150.5MHz, 15dBm/tone                            |     | 49.3  |      | dBm  |
| Output P1dB                       | 1218 MHz   |     | 28.0  |      | dBm  |
| Thermal Resistance                | Θ <sub>JB</sub> (Junction to backside of QFN)                        |     | 6.0   |      | °C/W |

### Notes:

1. Typical performance at these conditions: Temp = +25°C, V<sub>DD</sub> = +24V, 75Ω system, Full band unless otherwise noted
2. Gain (or Tilt) can be modified between stages by approximately -4dB (S21 = 21dB).

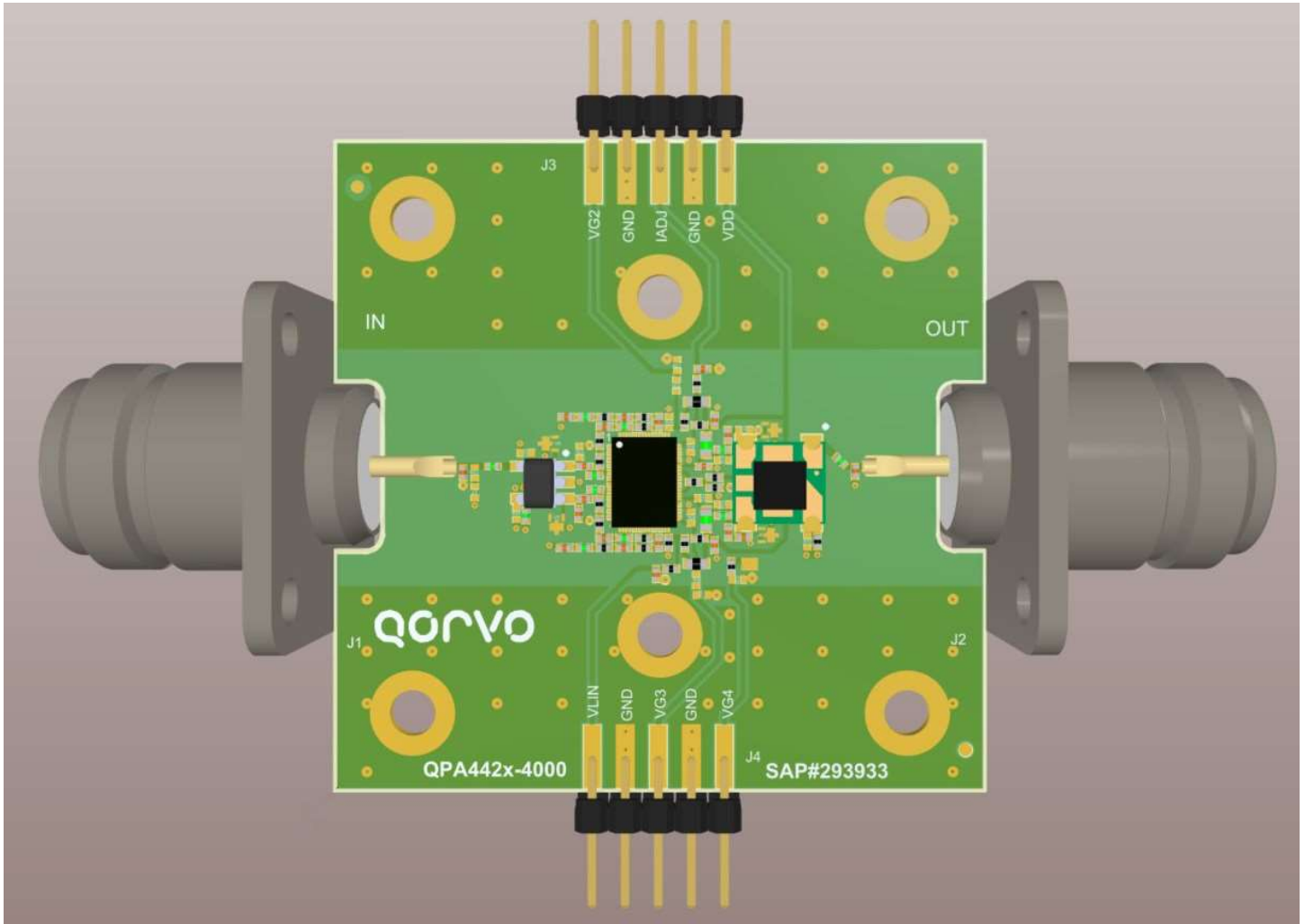
### Evaluation Board Schematic



**Evaluation Board Bill of Materials**

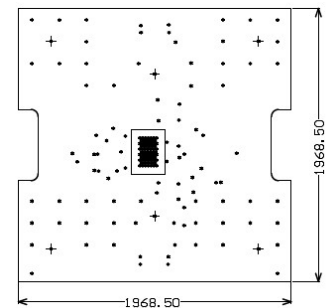
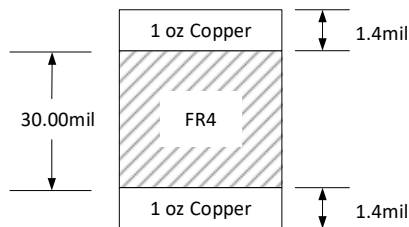
| Reference Designator  | Description                              | Manufacturer  | PART #             |
|---|--|---------------|--------------------|
| U1  | 1.2GHz, 28dB Push-Pull MMIC              | Qorvo         | QPA4428            |
| C1,C2,C3,C4,C12,C13,<br>C16,C17,C18,C19,C29,<br>C30   | CAP, 0.01uF, ±10%, 50V, X7R, 0402        | Murata        | GCM155R71H103KA55D |
| C9, C26, C27  | CAP, 0.5pF, ±0.1pF, 50V, COG, HIQ, 0402  | Murata        | GJM1555C1HR50BB01D |
| C20   | CAP, 0.7pF, ±0.05pF, 50V, HI-Q, 0402     | Murata        | GJM1555C1HR70BB01D |
| C7, C8  | CAP, 20pF, 2%, 50V, HI-Q, 0402           | Murata        | GJM1555C1H200GB01D |
| C6, C11   | CAP, 470pF, 5%, 50V, COG, 0402           | Murata        | GRM1555C1H471JA01D |
| R18   | RES, 10 OHM, 1%, 1/16W, 0402             | Panasonic     | ERJ-2RKF10R0X      |
| R31   | RES, 5.60K ohm, 1%, 1/16W, 0402          | Vishay        | CRCW04025K60FKED   |
| R19, R11, R12   | RES, 0 OHM, 5%, 1/10W, 0402              | Kamaya        | RMC1/16SJPTH       |
| R3, R4  | RES, 15 OHM, 5%, 1/16W, 0402             | Kamaya        | RMC1/16S-150JTH    |
| R33, R34  | RES, 68 OHM, 5%, 1/16W, 0402             | Kamaya        | RMC1/16S-680JTH    |
| R21   | RES, 10K, 1%, 1/16W, 0402                | Panasonic     | ERJ-2RKF1002X      |
| R20   | RES, 8.2K, +/-1%, 1/10W, 0402            | Panasonic     | ERJ-2RKF1801X      |
| R22   | RES, 30.1K, 1/16W, 1%, 04 02             | KOA Speer     | RK73H1ETTP3012F    |
| R27, R28  | RES, 47K, 1%, 1/16W, 0402                | Yageo         | RC0402FR-0747KL    |
| R1, R2  | RES, 200 OHM, 5%, 1/16W, 0402            | Kamaya        | RMC1/16SK2000FTH   |
| R36, R37  | RES, 1.2K, 5%, 1/16W, 0402               | Panasonic     | ERJ-2GEJ122        |
| R32, R39  | RES, 0 OHM, 0603                         | Kamaya        | RMC1/16JPTP        |
| R23   | RES, 2K, 5%, 1/16W, 0402                 | Panasonic     | ERJ-2GEJ202        |
| R7, R8  | 160 OHM,5%,1/16W,0402, LEAD FREE         | KOA Speer     | RK73B1ETTP161J     |
| L1, L2  | IND, 470nH, ±5%, 310mA, 650mHZ, 0402     | Coilcraft     | 0402AF-471XJLW     |
| L9, L14   | IND, 2.2nH, +/-0.3nH, M/L, 0402          | Murata        | LQG15HN2N2S02D     |
| L8  | IND, 1.5nH, +/-0.3nH, M/L, 0402          | Murata        | LQG15HN1N5S02D     |
| L3, L4  | IND, 8.2nH, 5%, M/L, 0402                | Murata        | LQG15HN8N2J02D     |
| L10, L13  | IND, 47nH, 5%, M/L, 0402                 | Murata        | LQG15HN47NJ02D     |
| L5  | IND, 4.3nH, +/-0.1nH, M/L, 0402          | Murata        | LQG15HS4N3B02D     |
| L6  | IND, 3.6nH, +/-0.1nH, M/L, 0402          | Murata        | LQG15HS3N6B02D     |
| L16, L17  | IND, 2.2uH, 20%, 0.36A, 0.7mm, W/W, 0603 | Taiyo Uden    | BRL1608T2R2M       |
| T1  | XFMR, SMT, 75 OHM, CD542, 1:1 BALUN, TC1 | Mini Circuits | TC1-33-75-7+       |
| T2  | TRANS, 75ohm, 30mA, 4.5-3000MHz          | Mini Circuits | TRS2-1T-75-1+      |
| U2,U3, U4,U5,C10,C21,<br>C22, C23,C24,C25,C28,C31,<br>C32,L7,R15,R16,R17,R24<br>R26,R29,R30,R35,R38,R40 | Not Populated                            |               |                    |

#### Evaluation Board Assembly Drawing

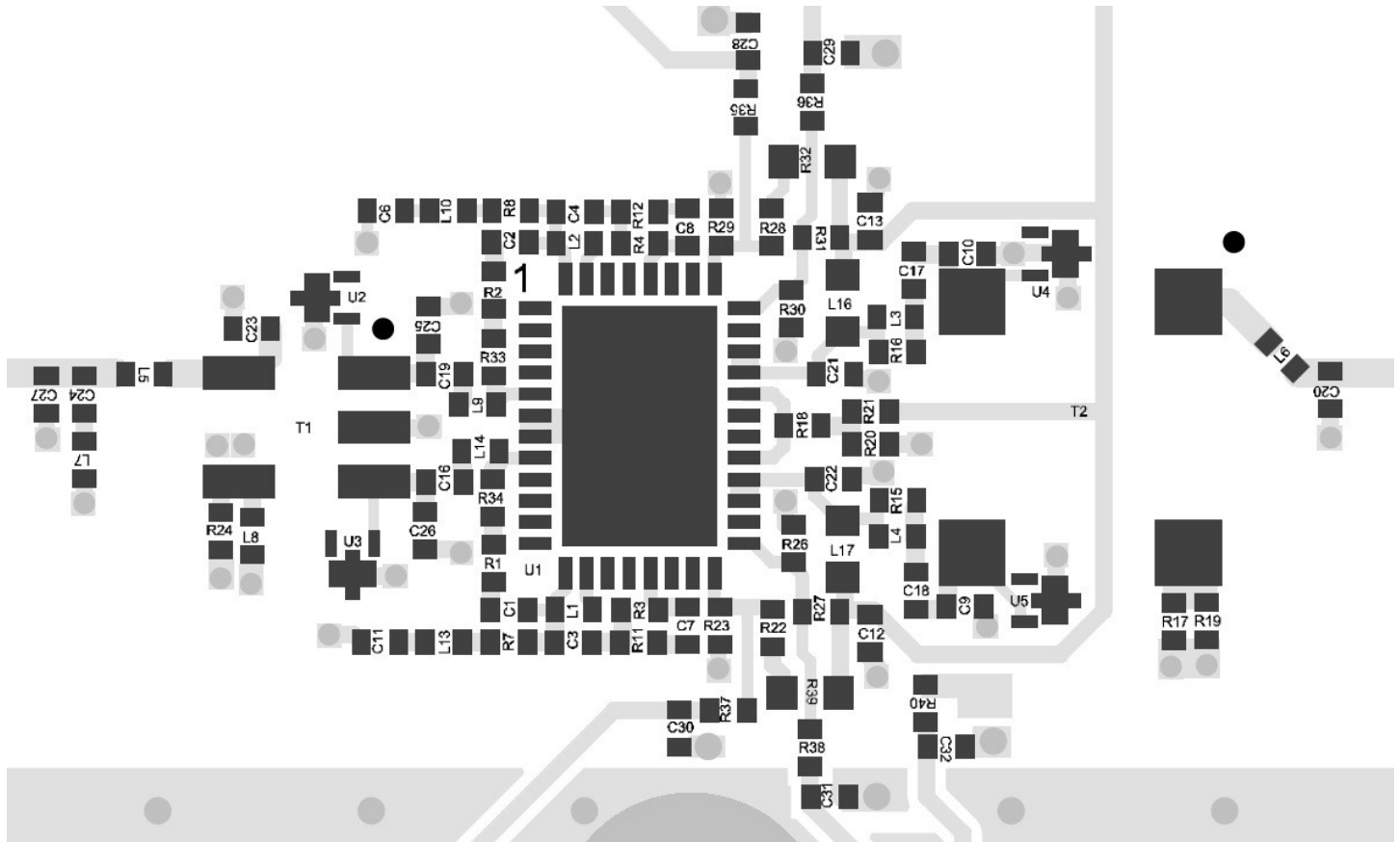


#### EVB PCB Material and Stack-up

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

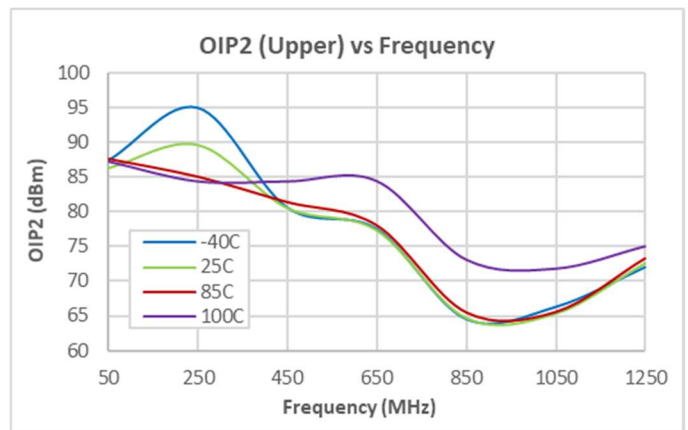
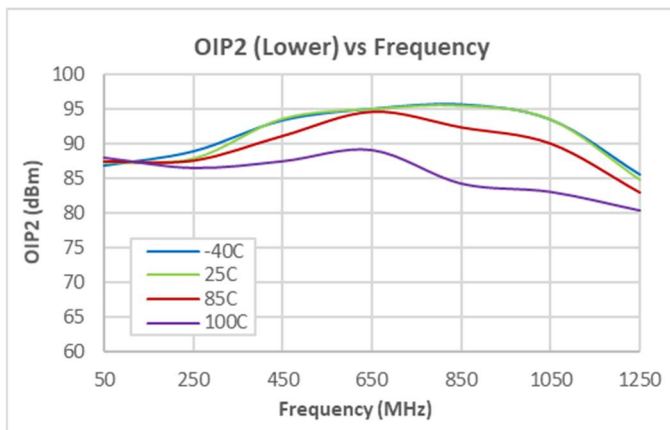
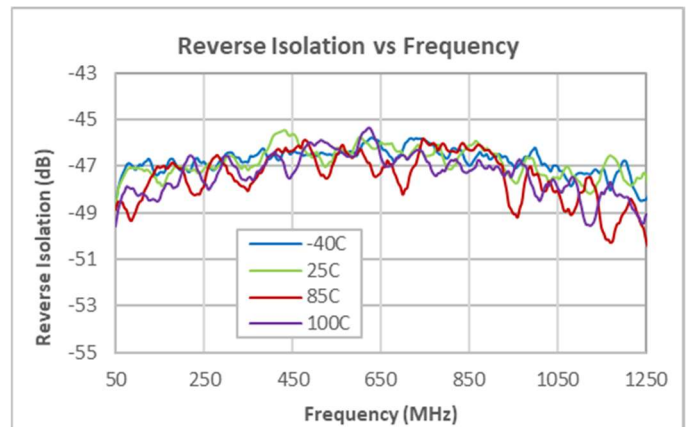
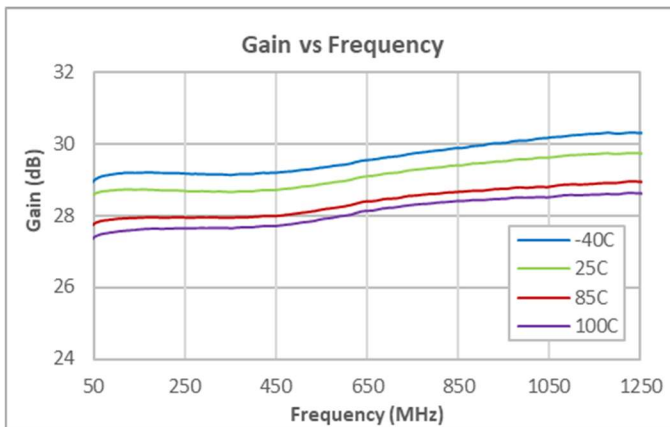
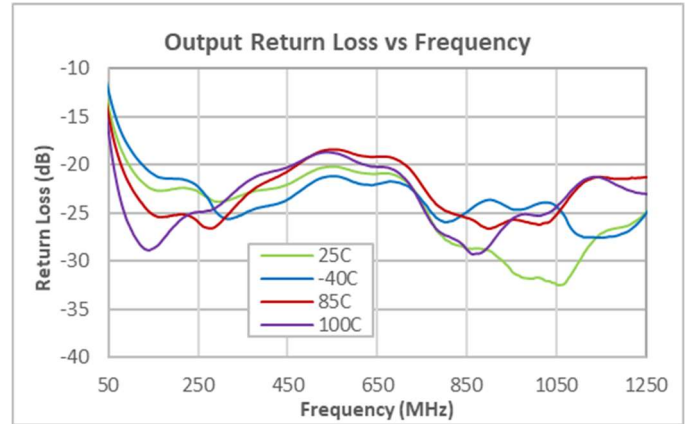
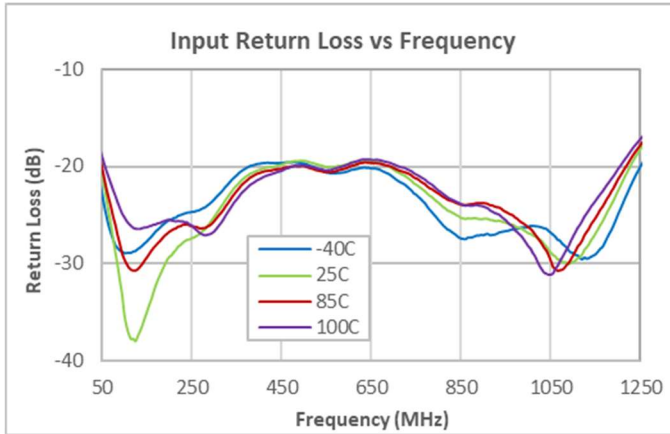


### Evaluation Board Component Placement





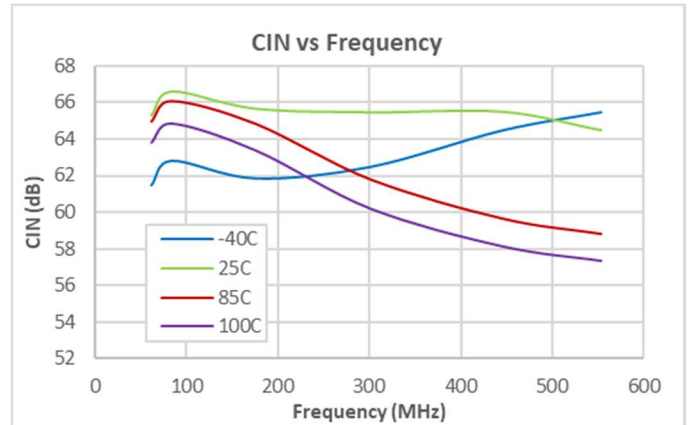
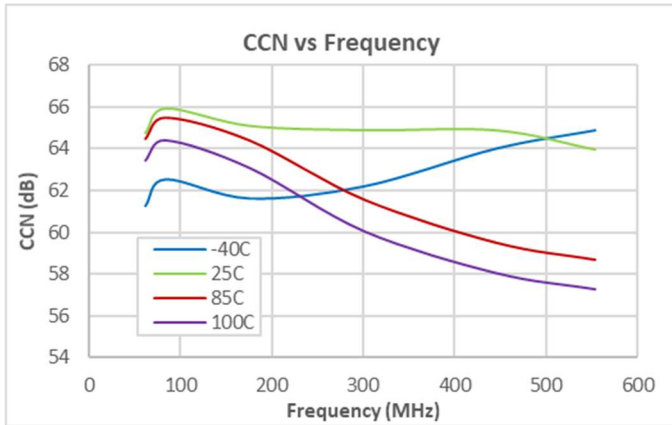
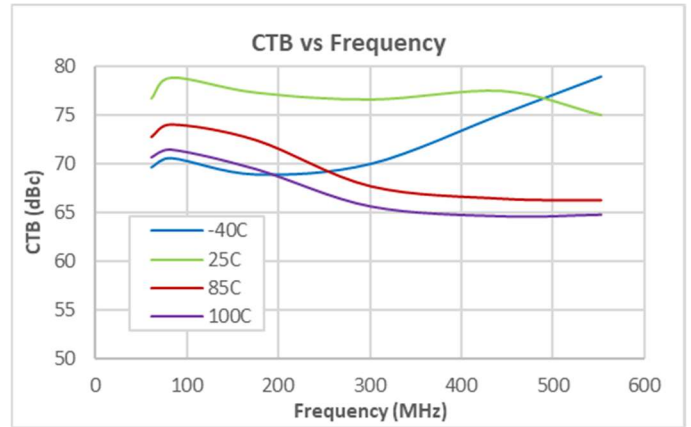
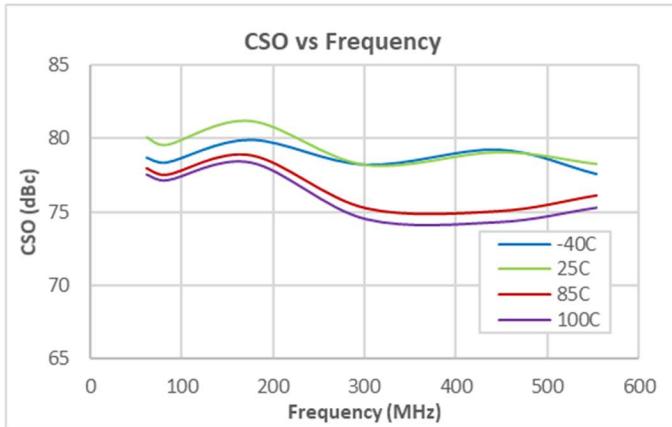
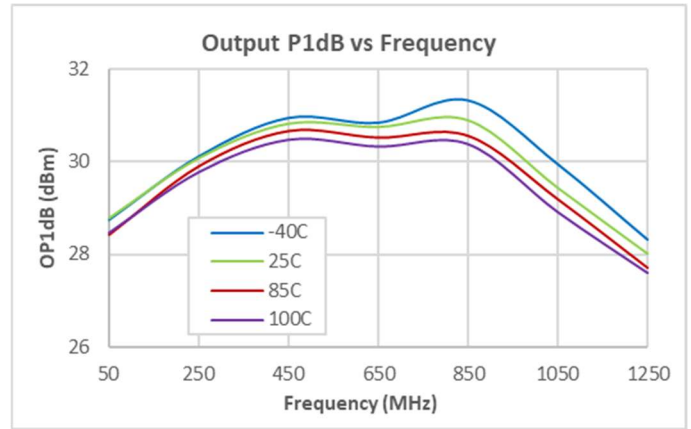
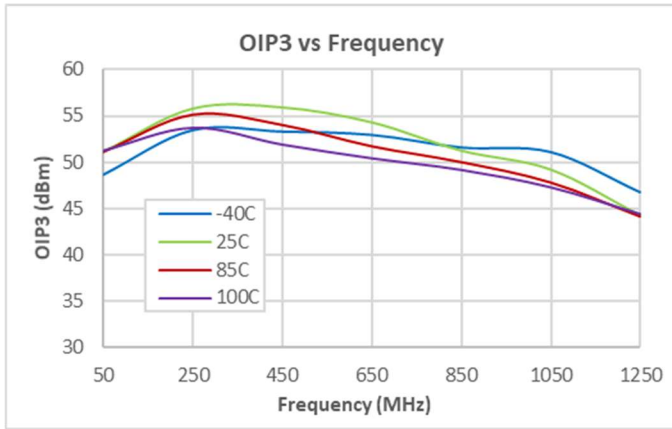
### Performance Data 24V



**Test Conditions:**

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

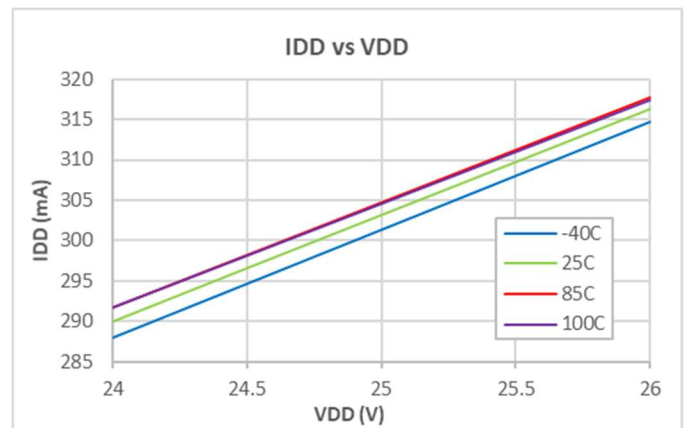
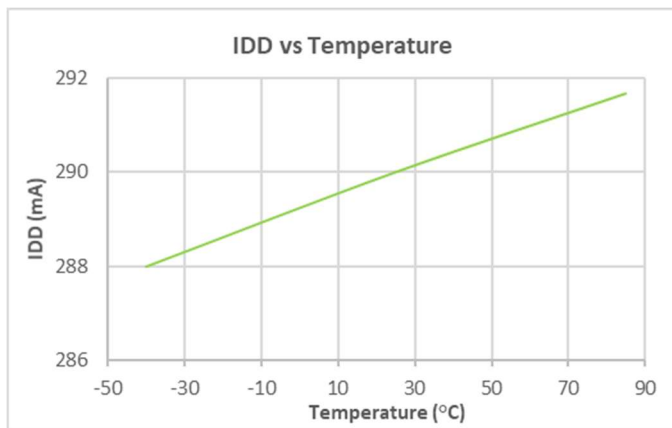
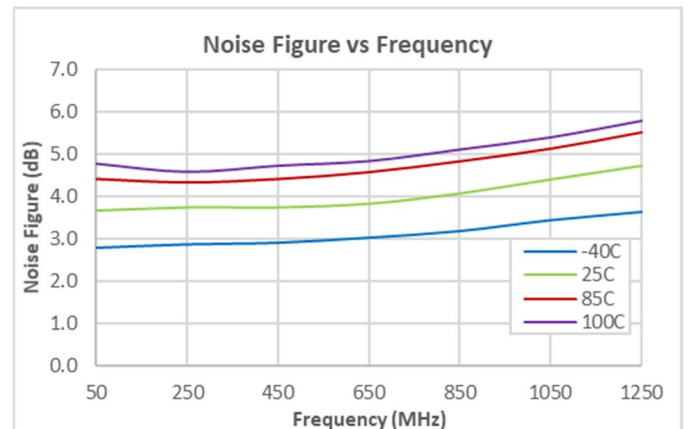
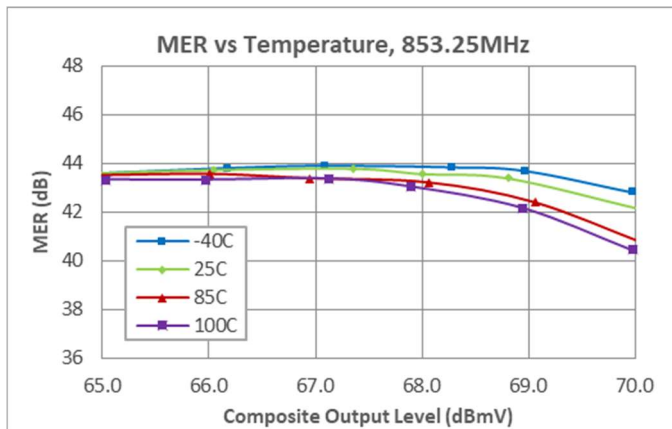
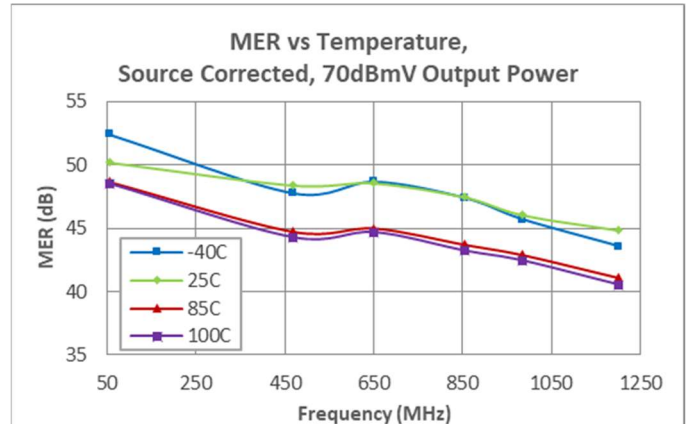
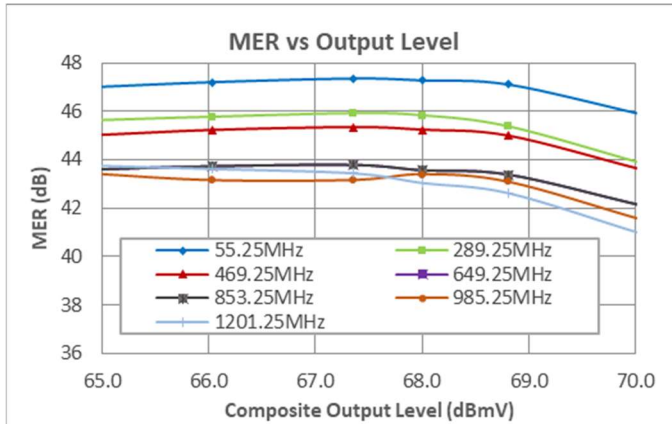
Performance Data 24V



Test Conditions:

1. Test conditions unless otherwise noted:  $V_{DD} = +24V$ ,  $Z_o = 75\Omega$
2. OIP3: +15dBm per Tone.
3. CSO, CTB, CCN: 80 NTSC + 111 QAM (-6dB offset), 47dBmV/ch out, 0dB tilt

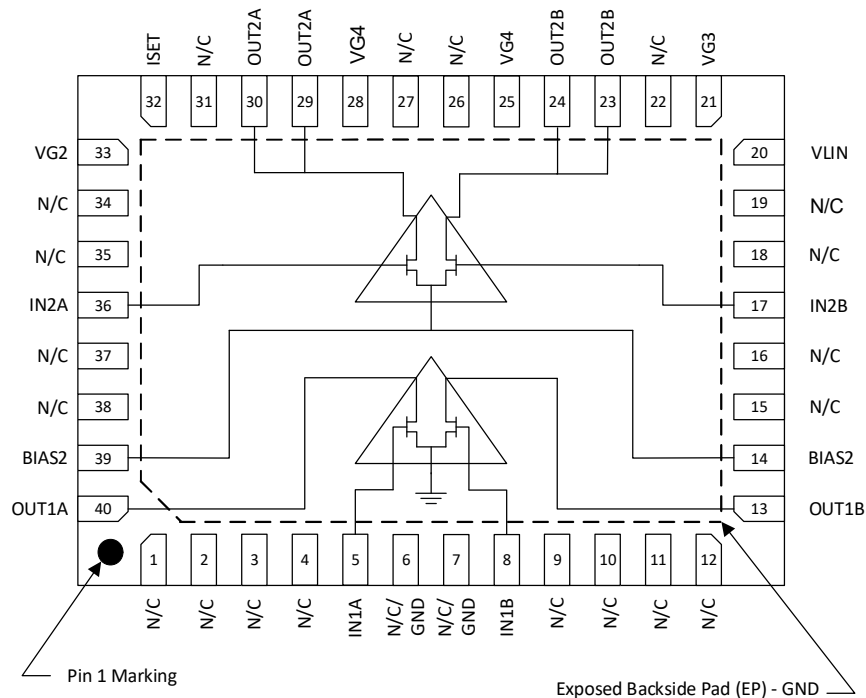
### Performance Data 24V



**Test Conditions:**

1. Test conditions unless otherwise noted:  $V_{DD} = +24V$ ,  $Z_o = 75\Omega$
2. MER: 190 QAM256 Channels Flat Tilt, 57-1215MHz, ITU-T J.83, Annex B

### Pin Configuration and Description



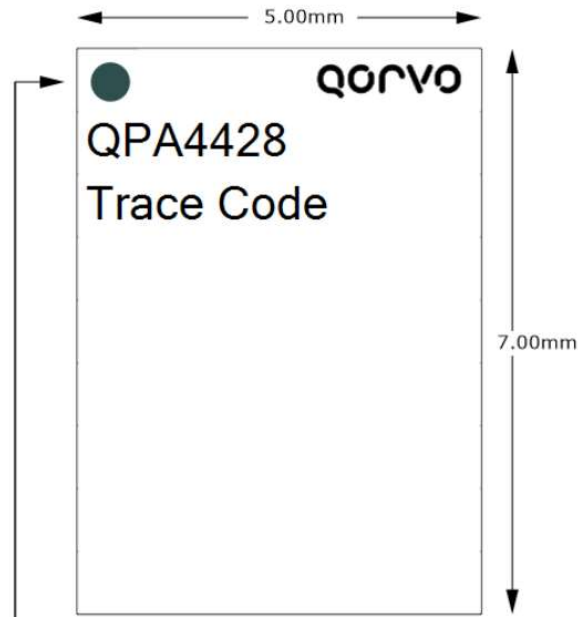
Top View

| 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     | VG2 adjust   |
| 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 Marking

---



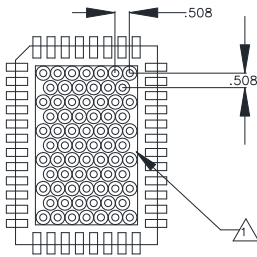
Pin 1 Indicator

Qorvo Logo - Use Qo5D

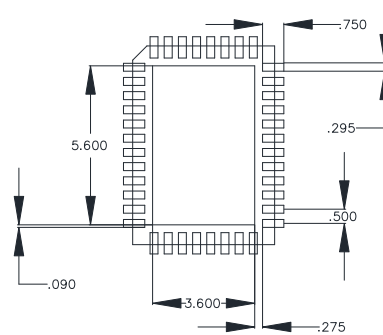
Trace Code to be assigned by SubCon

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.

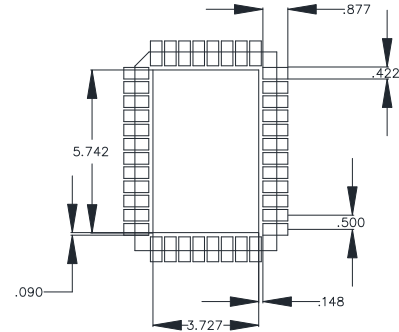
## Recommended Mounting Pattern



VIA PATTERN



LAND PATTERN



SOLDER MASK

NOTES:



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)     | Class 1B (500V)  | ANSI / ESDA / JEDEC JS-001 |
| ESD – Charged Device Model (CDM) | Class 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<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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