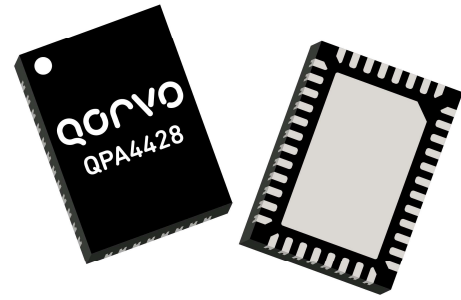


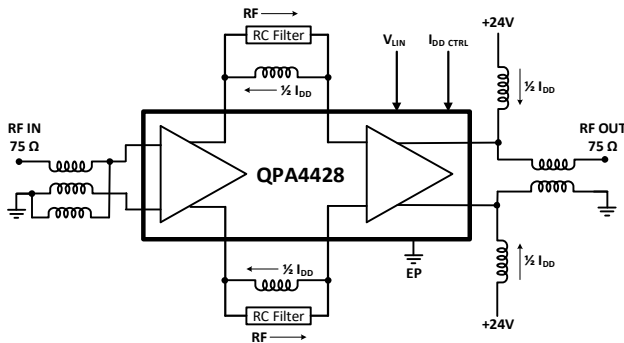
Product Overview

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 Θ_{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 _{DD}) | +30V (5min) |
| Supply Current (I _{DD}) | 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.

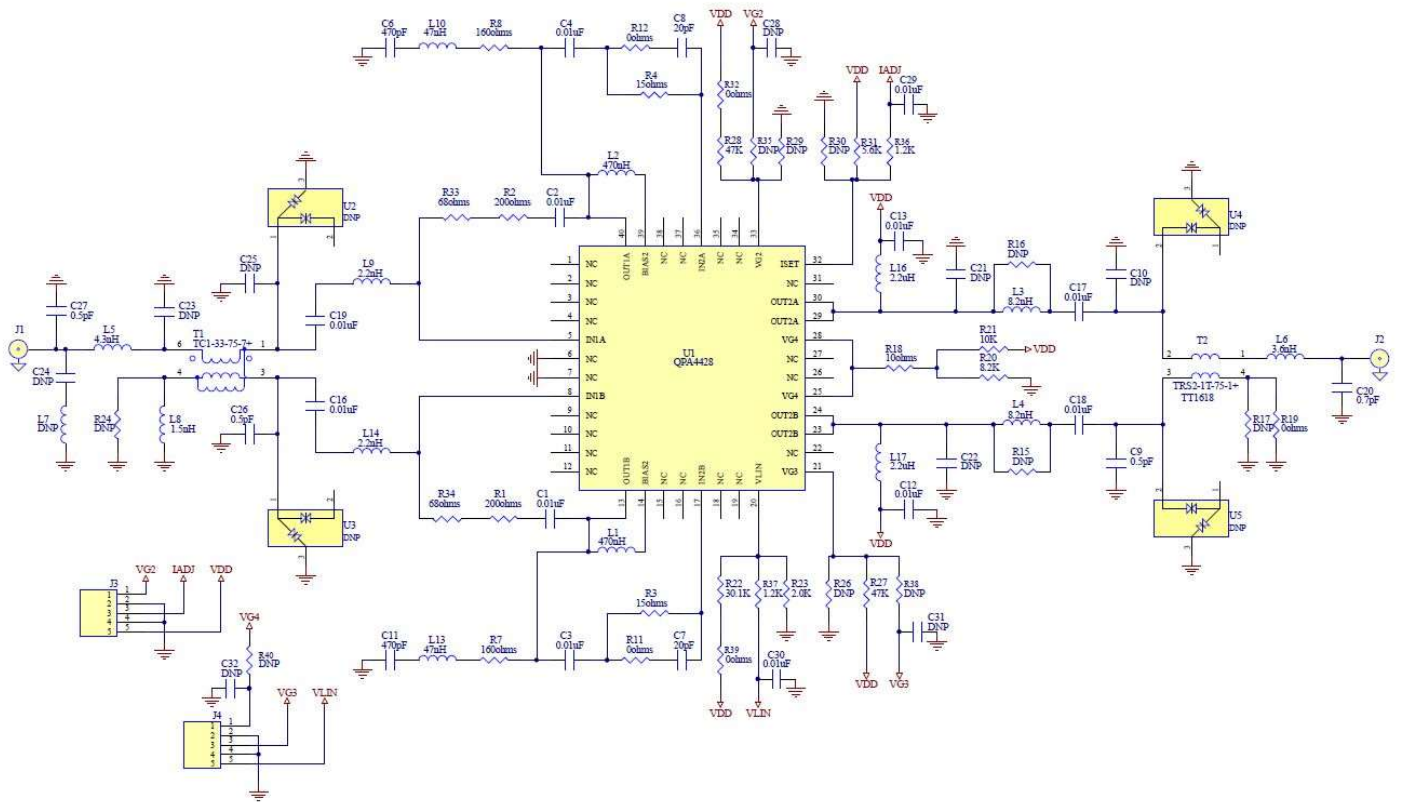
Electrical Specifications – 24V

| Parameter | Condition ⁽¹⁾ | Min | Typ | Max | Unit |
|-----------------------------------|----------------------------------------------------------------------|-----|-------|------|------|
| Supply Voltage (V _{DD}) | | | 24 | | V |
| Supply Current (I _{DD}) | V _{DD} total current | | 290 | | mA |
| Frequency Range | | 47 | | 1218 | MHz |
| Gain ² | 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 _{JB} (Junction to backside of QFN) | | 6.0 | | °C/W |

Notes:

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

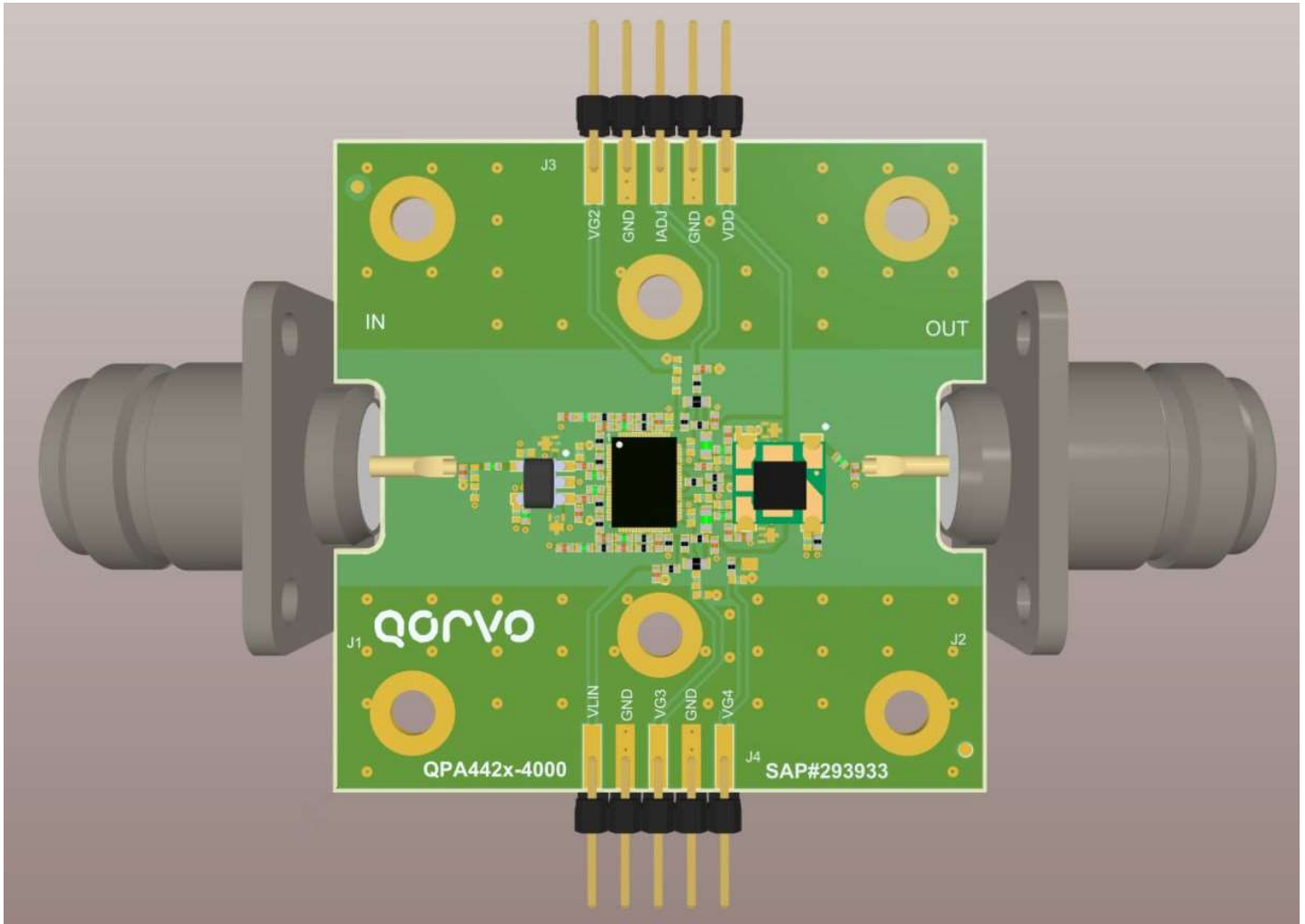
Evaluation Board Schematic



Evaluation Board Bill of Materials

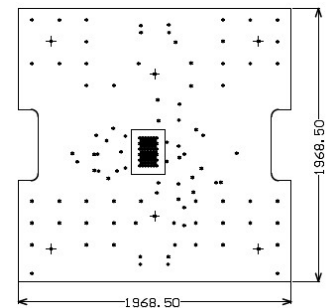
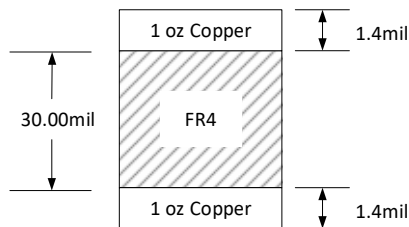
| Reference Designator | Description | Manufacturer | PART # |
|---------------------------------------------------------------------------------------------------------|------------------------------------------|---------------|--------------------|
| U1 | 1.2GHz, 28dB Push-Pull MMIC | Qorvo | QPA4428 |
| C1,C2,C3,C4,C12,C13, C16,C17,C18,C19,C29, 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, C22, C23,C24,C25,C28,C31, C32,L7,R15,R16,R17,R24 R26,R29,R30,R35,R38,R40 | Not Populated | | |

Evaluation Board Assembly Drawing

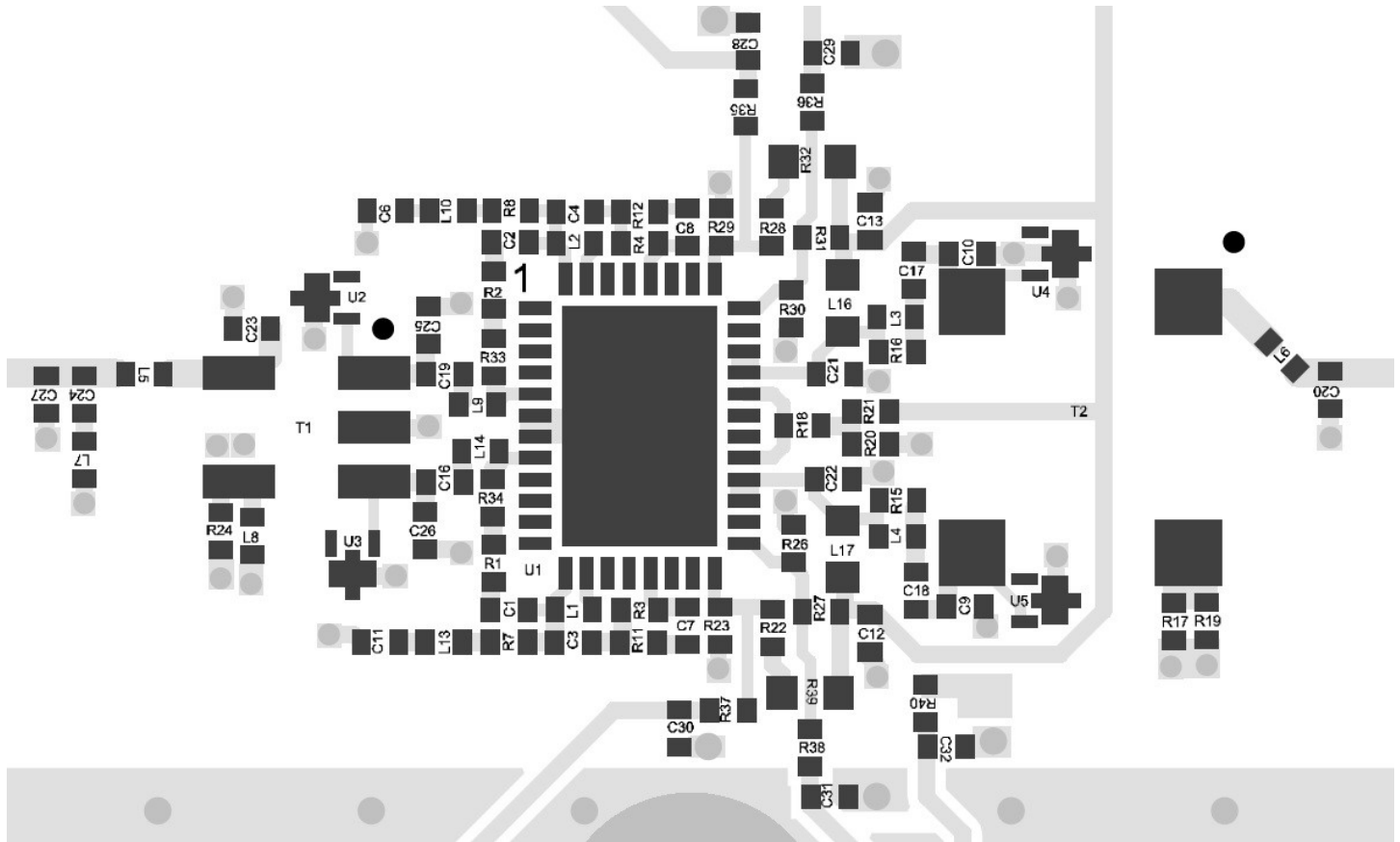


EVB PCB Material and Stack-up

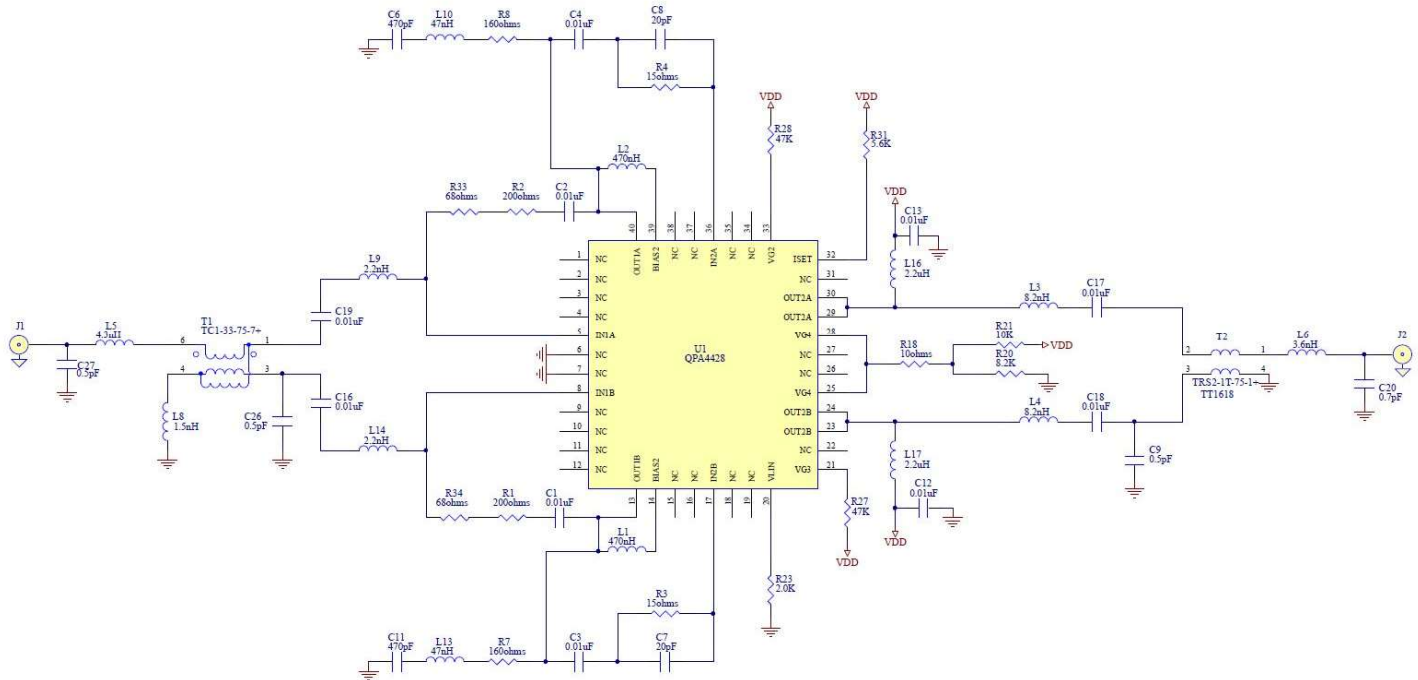
Board Material: 0.030" FR4, $\epsilon_r=4.2$
 Plating: 1oz Copper
 Board Dimension: 1.9685" x 1.9685"



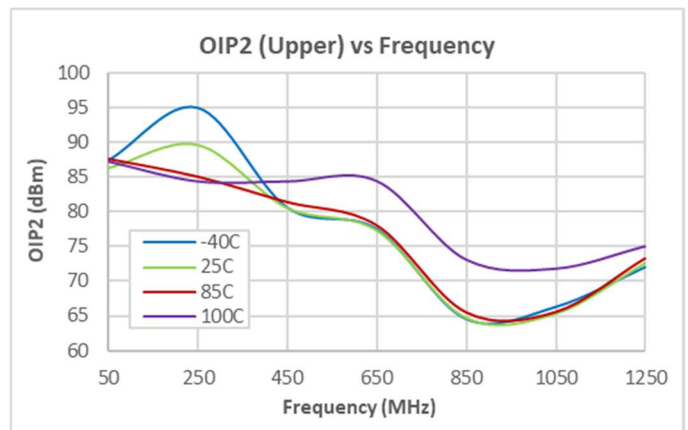
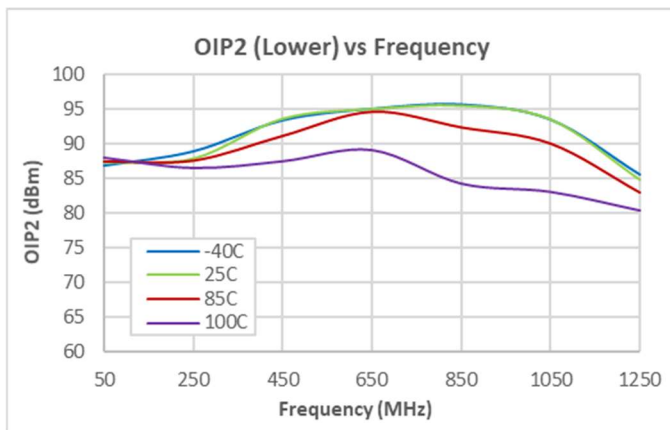
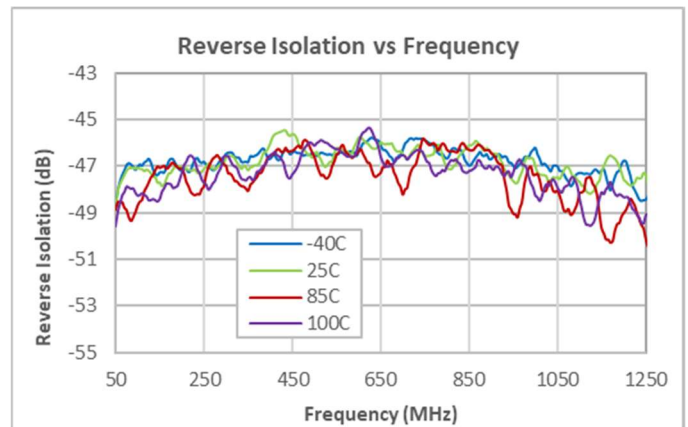
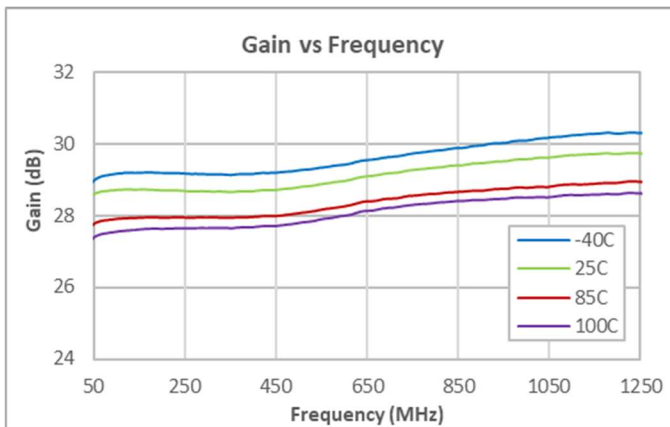
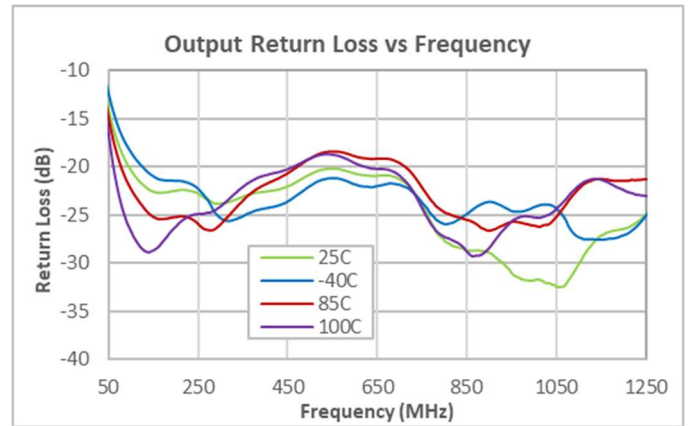
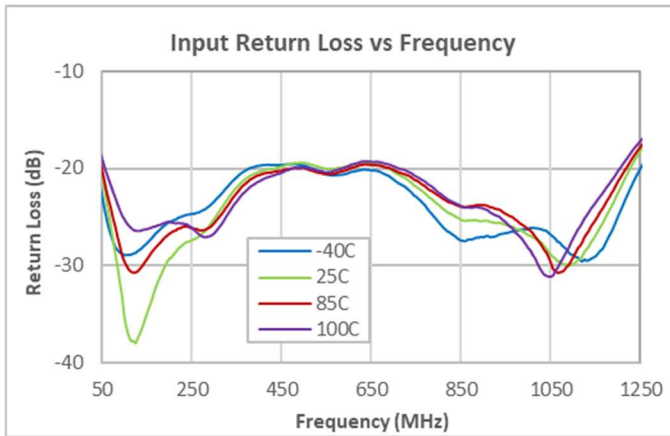
Evaluation Board Component Placement



Typical Application Schematic; 24V



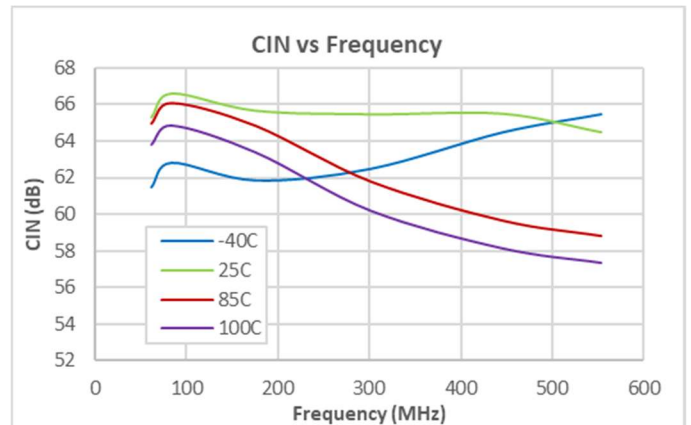
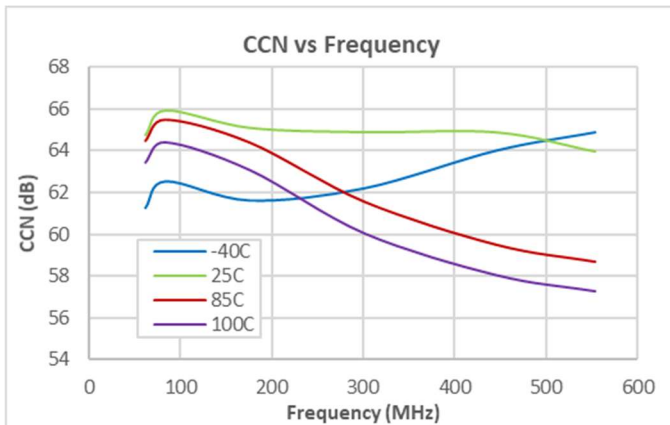
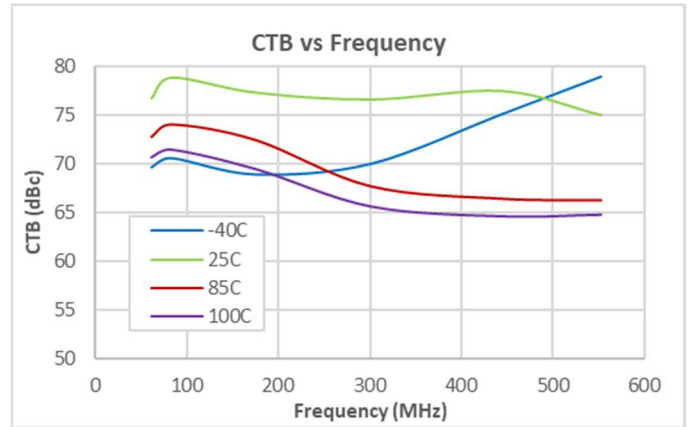
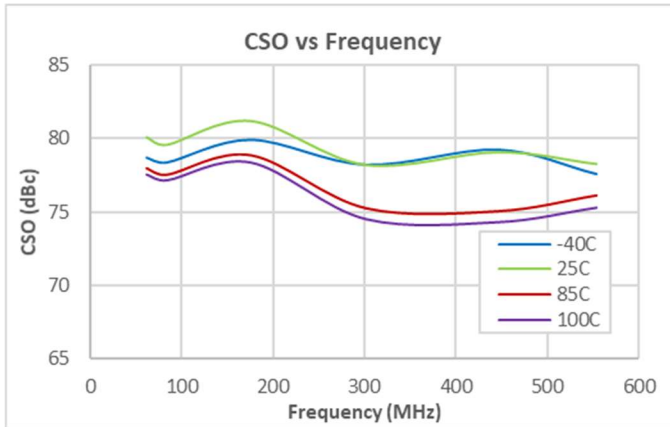
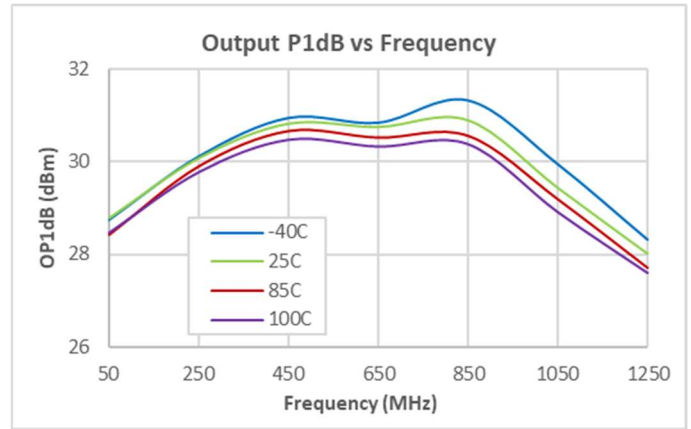
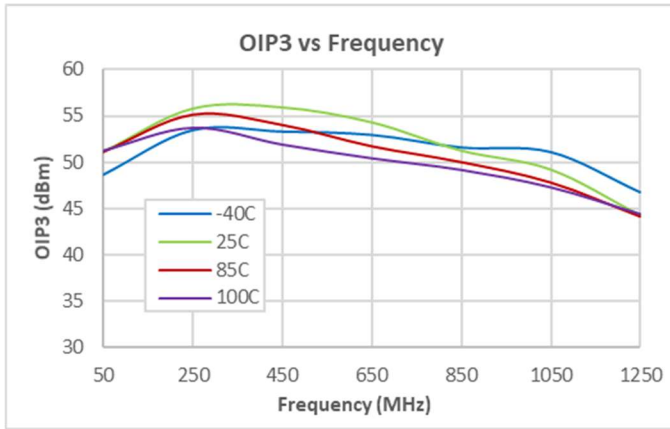
Performance Data 24V



Test Conditions:

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

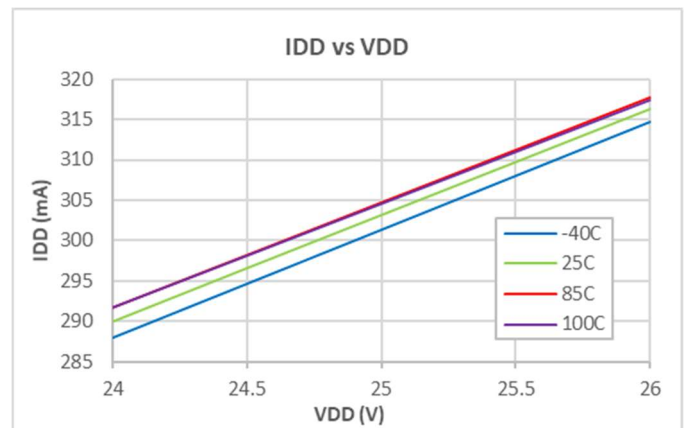
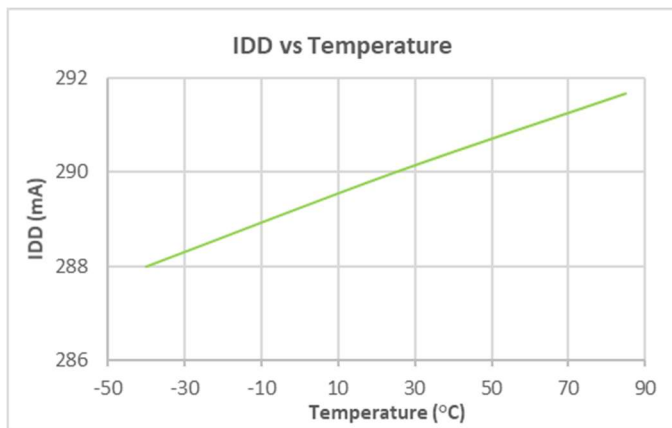
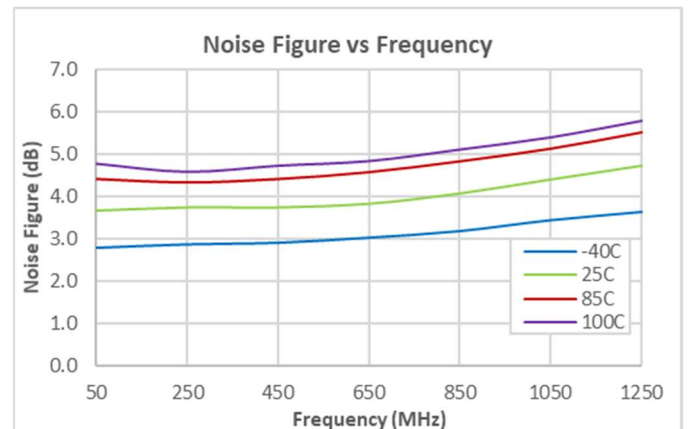
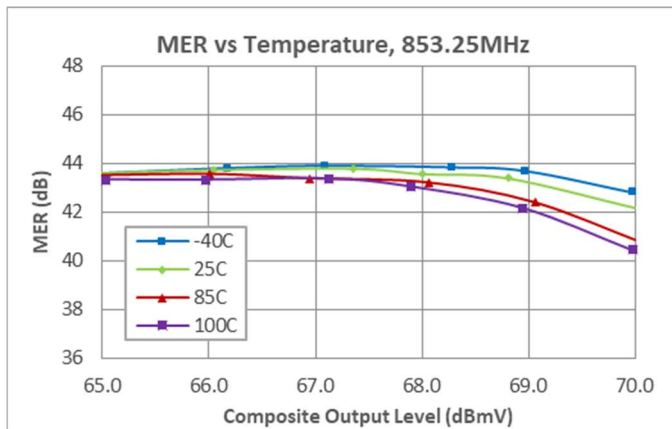
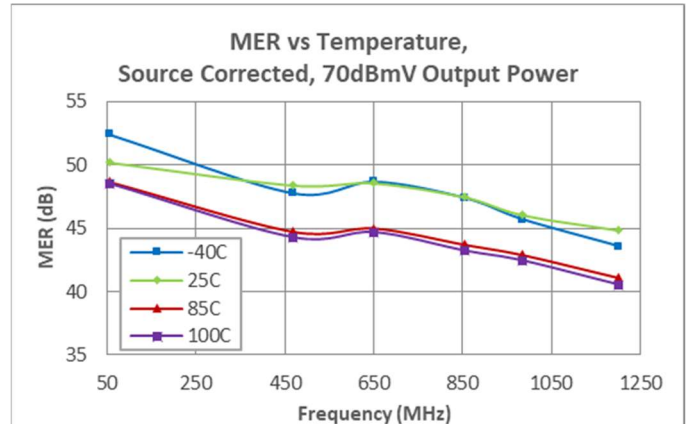
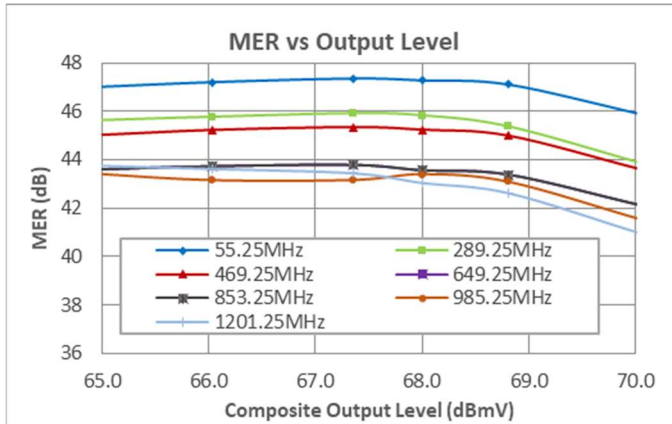
Performance Data 24V



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

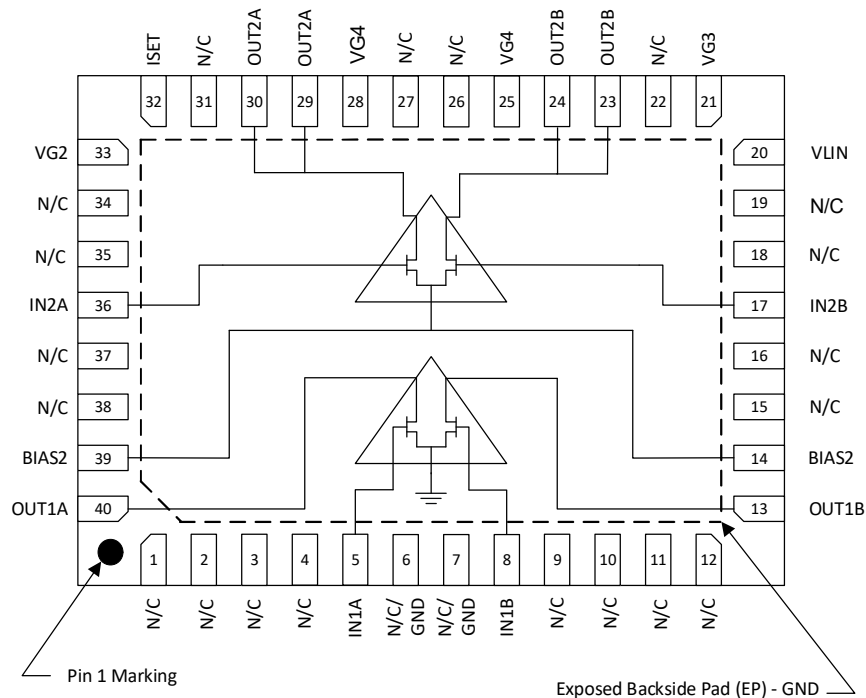
Performance Data 24V



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

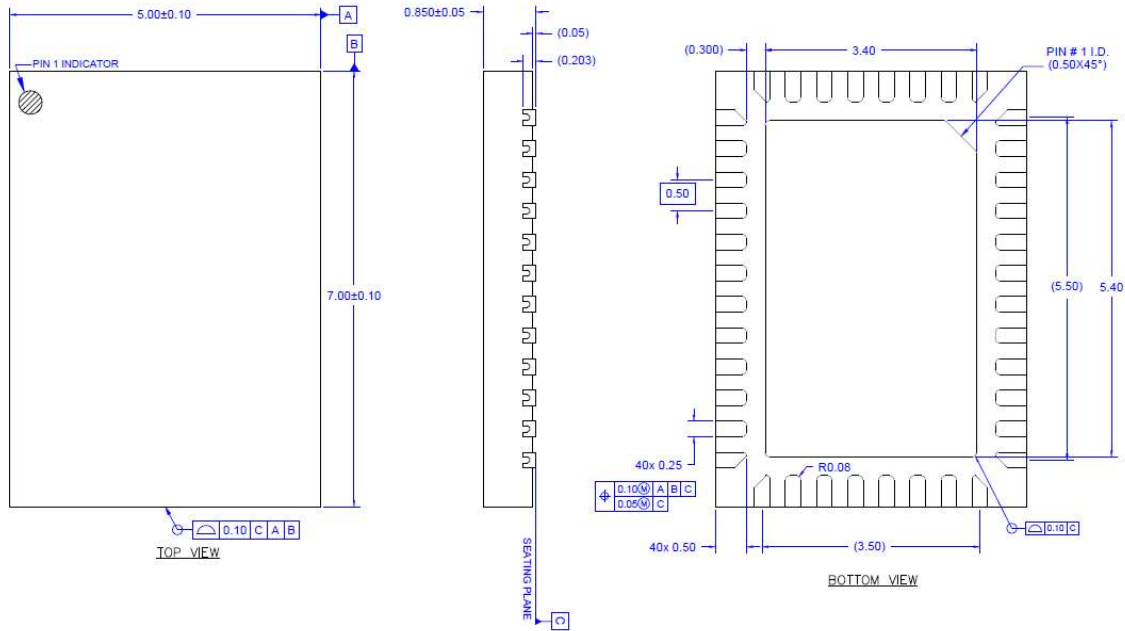
Pin Configuration and Description



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. |

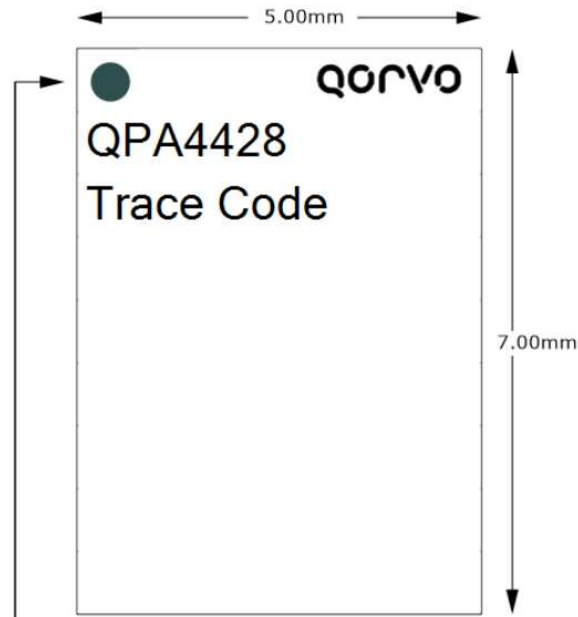
Package Outline



Notes:

1. Dimensions in millimeters

Package Marking



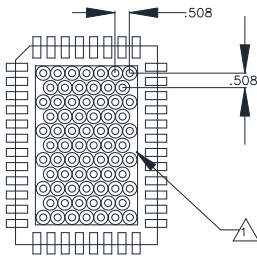
Pin 1 Indicator

Qorvo Logo - Use Qo5D

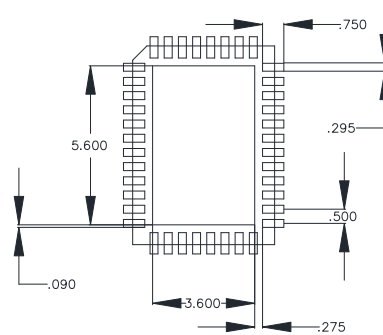
Trace Code to be assigned by SubCon

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.

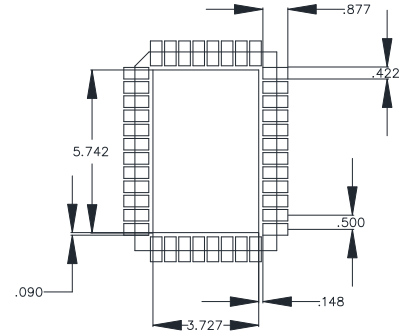
Recommended Mounting Pattern



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 (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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