

Product Overview

The QPD0030 is a 45 W (P3dB) unmatched discrete GaN on SiC HEMT which operates from DC to 5GHz on a +48 V supply rail. It is ideally suited for base station, radar and communications applications and can support both CW and pulsed mode of operations.

The QPD0030 can be used in Doherty architecture for the final stage of a base station power amplifier for small cell, microcell, and active antenna systems. The QPD0030 can also be used as a driver in a macrocell base station power amplifier.

The device is housed in an industry-standard 4x3 mm surface mount QFN package.

Lead-free and ROHS compliant.



20 Pin 3 x 4 mm QFN Package

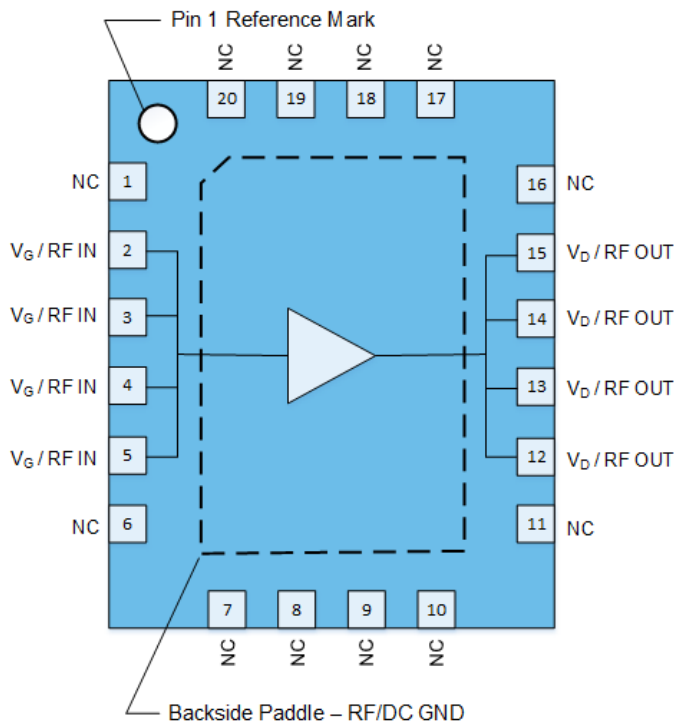
Key Features

- Operating Frequency Range: DC to 5 GHz
- Operating Drain Voltage: +48 V
- Maximum Output Power (P_{SAT}): 49.0 W ⁽¹⁾
- Maximum Drain Efficiency: 71.9% ⁽¹⁾
- Efficiency-Tuned P3dB Gain: 22.1 dB ⁽¹⁾
- Surface Mount Plastic Package

Notes:

1. Load pull performance at 2.2 GHz.

Functional Block Diagram



Applications

- W-CDMA / LTE
- Macrocell Base Station Driver
- Small Cell Final Stage
- Active Antenna
- Land Mobile and Military Radio Communications
- Wideband or Narrowband Amplifiers
- General Purpose Applications

Ordering Information

| Part Number | Description |
|--------------|--------------------------------|
| QPD0030SR | Short Reel – 100 Pieces |
| QPD0030TR7 | 7" Reel – 500 pieces |
| QPD0030EVB01 | 1.2 – 1.4 GHz Evaluation Board |
| QPD0030EVB02 | 1.8 – 2.2 GHz Evaluation Board |

Absolute Maximum Ratings

| Parameter | Rating |
|--|------------------------------|
| Breakdown Voltage (BV_{DG}) | +165 V |
| Gate Voltage Range (V_G) | -7 to +2 V |
| Drain Voltage (V_D) | +55 V |
| Peak RF Input Power | 33 dBm |
| VSWR Mismatch, P1dB Pulse (20% Duty Cycle, 100 μ s Width), $T = +25^\circ\text{C}$ | 10:1 |
| Storage Temperature | -65 to +150 $^\circ\text{C}$ |

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.

Recommended Operating Conditions

| Parameter | Min | Typ | Max | Unit |
|--------------------------------------|-----|------|-----|------|
| Gate Voltage (V_G) | | -2.8 | | V |
| Drain Voltage (V_D) | | +48 | | V |
| Quiescent Drain Current (I_{DQ}) | | 85 | | mA |

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

QPD0030EVB01 Electrical Specifications

| Parameter | Conditions | Min | Typ | Max | Units |
|--------------------------------------|--------------------|------|------|------|-------|
| Operational Frequency Range | | 1200 | | 1400 | MHz |
| Quiescent Drain Current (I_{DQ}) | | | 90 | | mA |
| Linear Gain | $P_{OUT} = 34$ dBm | | 19.9 | | dB |
| Output Power (P3dB) | 3 dB Compression | | 45.6 | | dBm |
| Power-Added Efficiency (%) | 3 dB Compression | | 74.2 | | % |
| Gain | 3 dB Compression | | 16.9 | | dB |

Test conditions unless otherwise noted: $V_D = +48$ V, $I_{DQ} = 90$ mA, $T = +25^\circ\text{C}$, Pulse signal (10% Duty Cycle, 100 μ s Width) at 1300 MHz on a Class AB single-ended reference design fixture tuned for 1.2 – 1.4 GHz.

QPD0030EVB02 Electrical Specifications

| Parameter | Conditions | Min | Typ | Max | Units |
|--------------------------------------|-----------------------------|-------|------|------|-------|
| Operational Frequency Range | | 1800 | | 2200 | MHz |
| Quiescent Drain Current (I_{DQ}) | | | 85 | | mA |
| Linear Gain | $P_{OUT} = 34$ dBm | | 20.2 | | dB |
| Output Power (P3dB) | 3 dB Compression | | 45.2 | | dBm |
| Power-Added Efficiency (%) | 3 dB Compression | | 57.5 | | % |
| Gain | 3 dB Compression | | 16.3 | | dB |
| Gate Leakage | $V_D = +48$ V, $V_G = -7$ V | -13.9 | | | mA |

Test conditions unless otherwise noted: $V_D = +48$ V, $I_{DQ} = 85$ mA, $T = +25^\circ\text{C}$, Pulse signal (10% Duty Cycle, 100 μ s Width) at 2005 MHz on a Class AB single-ended reference design fixture tuned for 1.8 – 2.2 GHz.

Thermal Information

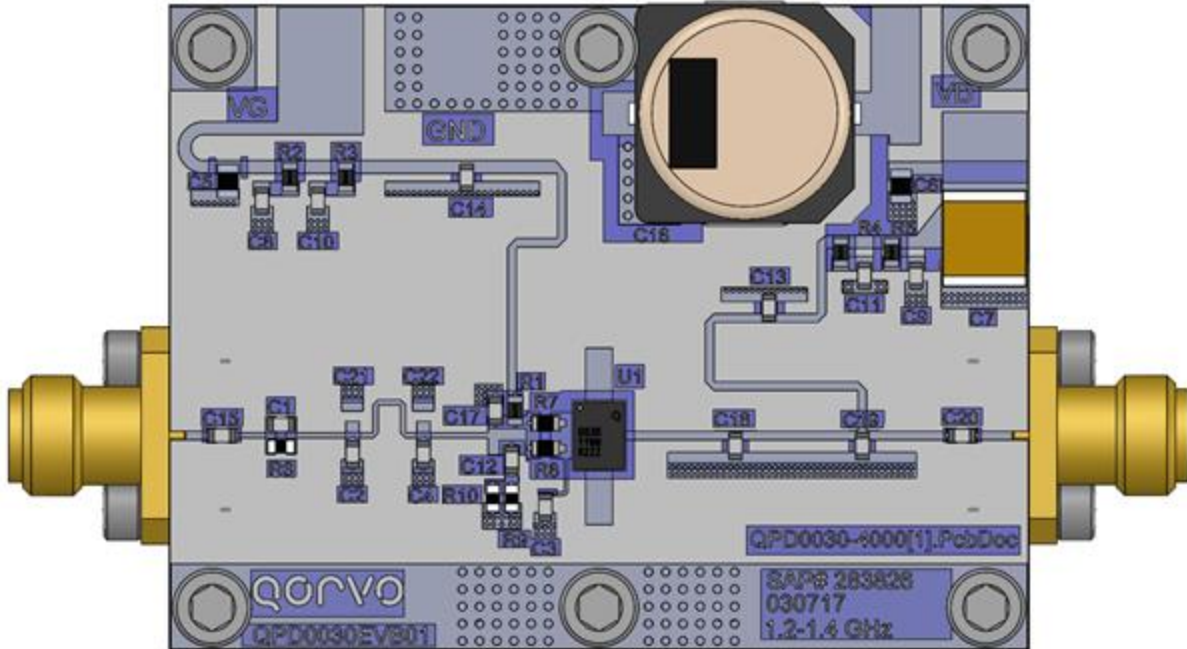
| Parameter | Conditions | Values | Units |
|--|--|--------|--------------------|
| Thermal Resistance, Peak IR Surface Temperature at Average Power (θ_{JC}) | $T_{CASE} = +85^\circ\text{C}$, $T_{CH} = 114^\circ\text{C}$ CW: $P_{DISS} = 9.6$ W, $P_{OUT} = 2.1$ W | 3.0 | $^\circ\text{C/W}$ |

Notes:

1. Thermal resistance is measured to package backside.
2. Refer to the following document: [GaN Device Channel Temperature, Thermal Resistance, and Reliability Estimates](#)

QPD0030EVB01 Layout – 1200 – 1400 MHz Reference Design

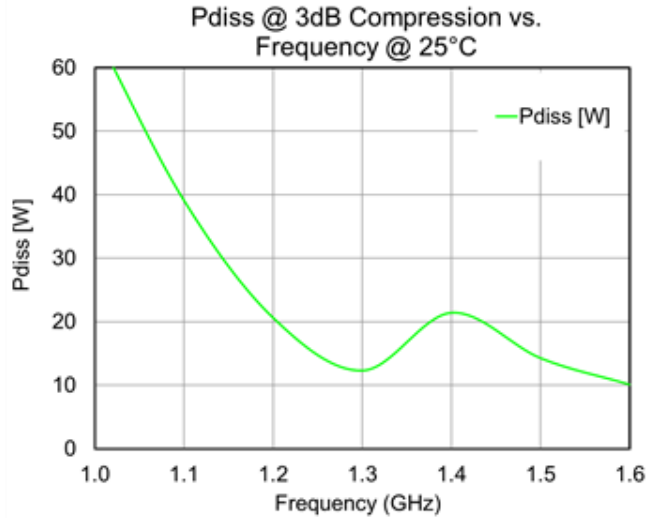
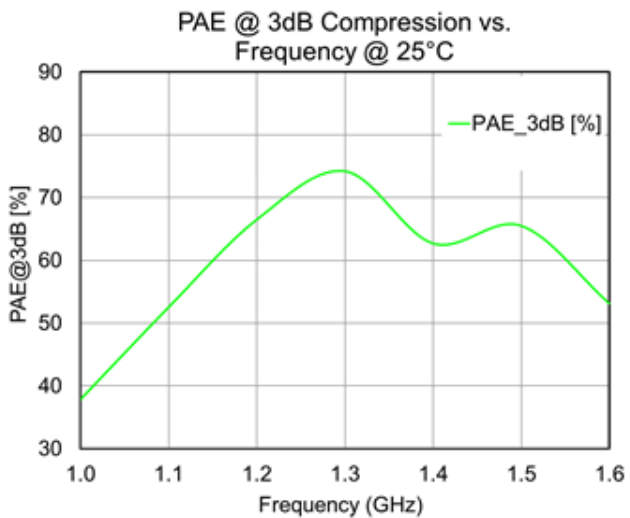
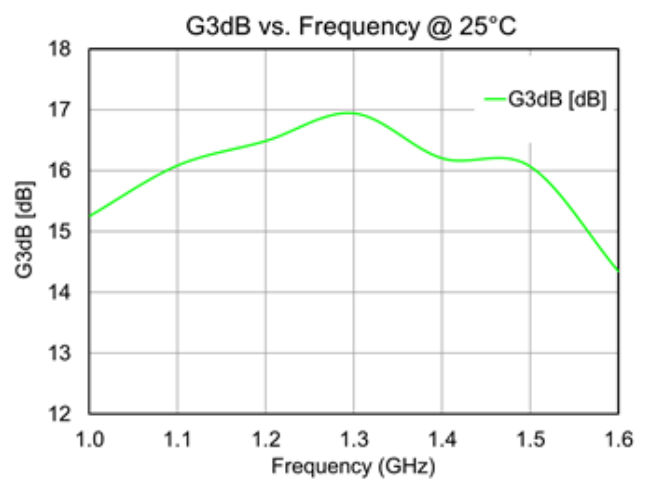
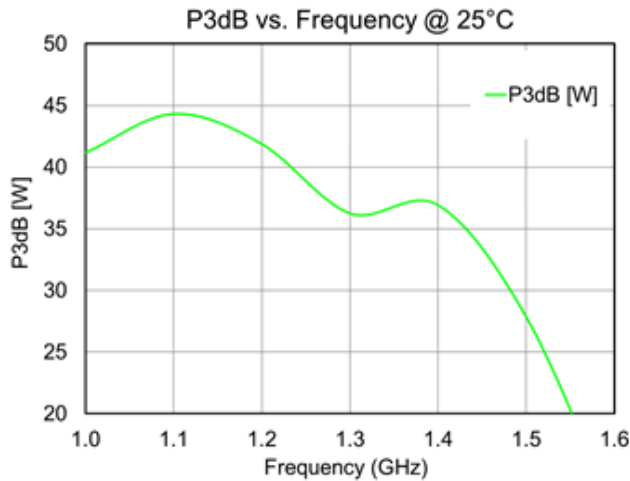
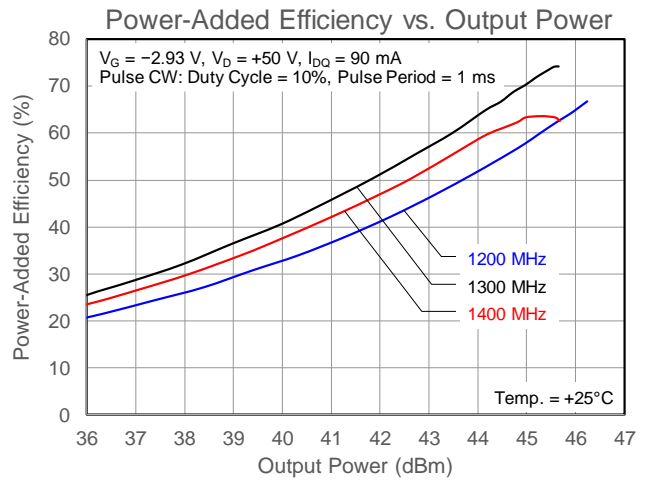
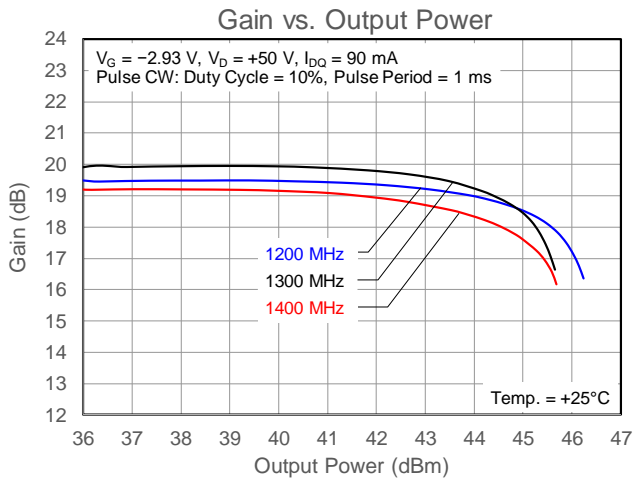
Note: PCB Material is RO6010, 25 mil thick substrate, 1 oz. copper each side.



QPD0030EVB01 Bill of Materials

| Reference Des. | Value | Description | Manufacturer | Part Number |
|--------------------|--------|-----------------------------------|---------------|----------------------|
| C1 | 10 pF | RF NPO 250VDC ± 5% Capacitor | ATC | 600S100JT250XT |
| C2, C3 | 1.0 pF | RF NPO 250VDC ± 0.05 pF Capacitor | ATC | 600S1R0AT250XT |
| C4 | 4.7 pF | RF NPO 250VDC ± 0.1 pF Capacitor | ATC | 600S4R7BT250XT |
| C5, C6 | 0.1uF | X7R 100V 10% 0805 Capacitor | TDK | C2012X7R2A104K |
| C7 | 10 uF | X7S 100V 10% 2220 Capacitor | TDK | C5750X7S2A106K230KB |
| C8, C9 | 0.1 uF | X7R 100V 10% 0603 Capacitor | Murata | GRM188R72A104KA35D |
| C10, C11, C12 | 100 pF | RF C0G 250VDC ± 5% Capacitor | TDK | C1608C0G2E101JT080AA |
| C13, C14, C15 | 15 pF | RF NPO 250VDC ± 5% Capacitor | ATC | 600S150JT250XT |
| C16 | 100 uF | ALUM 100V 20% 12.5mm SQ | BC Components | MAL215099907E3 |
| C17 | 7.5 pF | RF NPO 250VDC ± 0.1 pF Capacitor | ATC | 600S7R5BT250XT |
| C18 | 8.2 pF | RF NPO 250VDC ± 0.1 pF Capacitor | ATC | 600S8R2BT250XT |
| C19 | 3.3 pF | RF NPO 250VDC ± 0.1 pF Capacitor | ATC | 600S3R3BT250XT |
| C20 | 5.6 pF | RF NPO 250VDC ± 0.1 pF Capacitor | ATC | 600S5R6BW250XT |
| R1, R2, R3, R4, R5 | 10 Ω | 0603 5% Thick Film Resistor | KOA Speer | RK73B1JTDD100J |
| R6 | 100 Ω | 0603 1% Thick Film Resistor | Panasonic | ERJ-3EKF1000 |
| R7, R8 | 5.1 Ω | 0603 1% Thick Film Resistor | Samsung | RC1608F5R1CS |
| R9, R10 | 240 Ω | 0603 1% Thick Film Resistor | Samsung | RC1608F241CS |

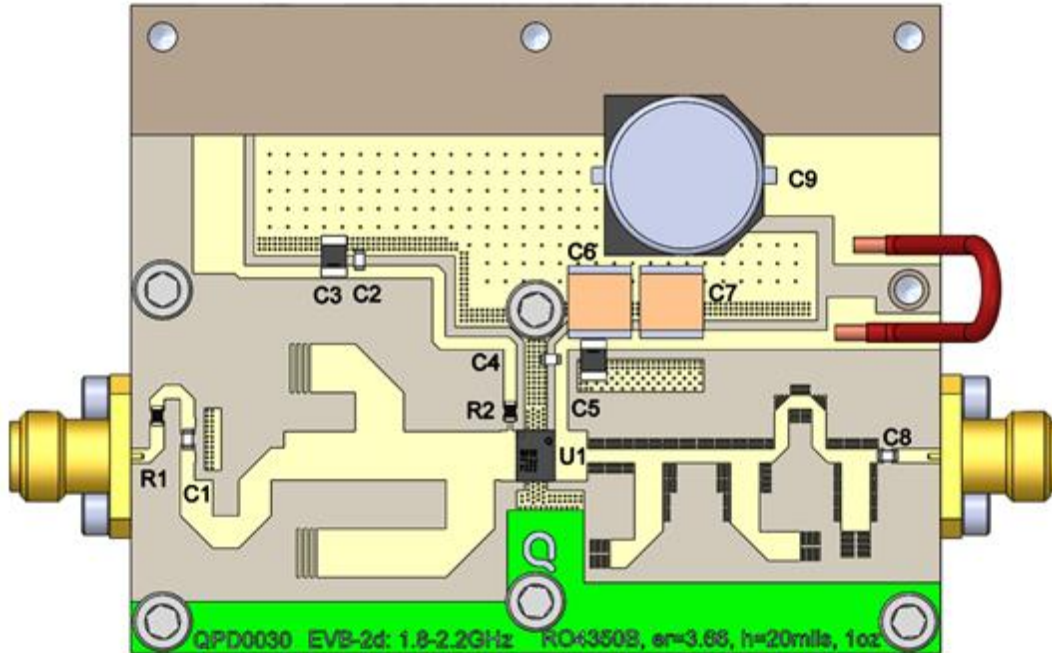
QPD0030EVB01 Performance Plots



Test conditions unless otherwise noted: $V_D = +48\text{ V}$, $I_{DQ} = 90\text{ mA}$, $T = +25^\circ\text{C}$, Pulsed (10% Duty Cycle, 100 μs Width) on a reference design tuned for 1.2 – 1.4 GHz.

QPD0030EVB02 Layout – 1.8 – 2.2 MHz Reference Design

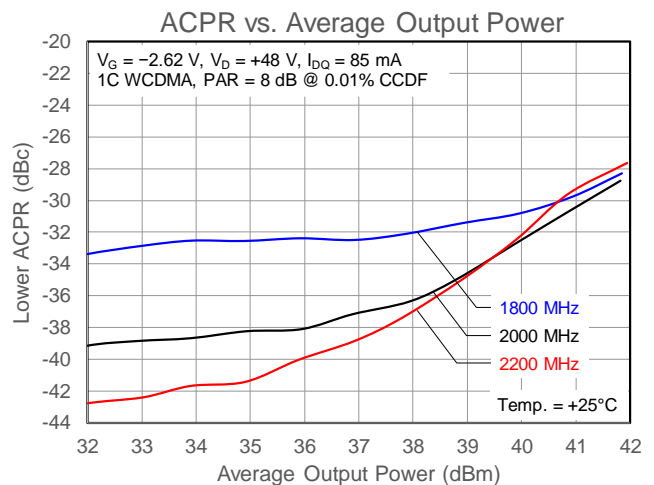
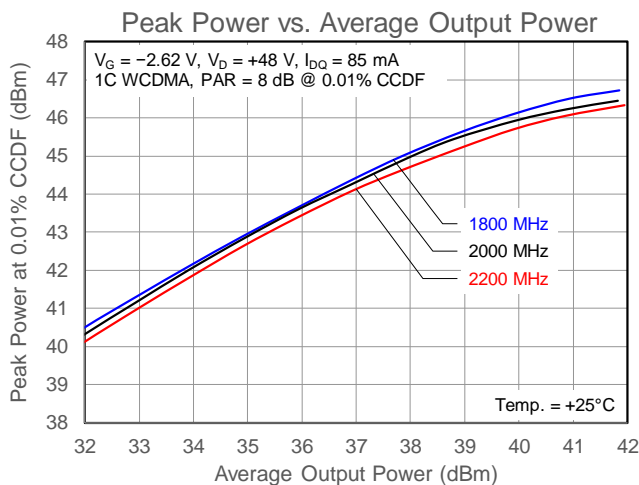
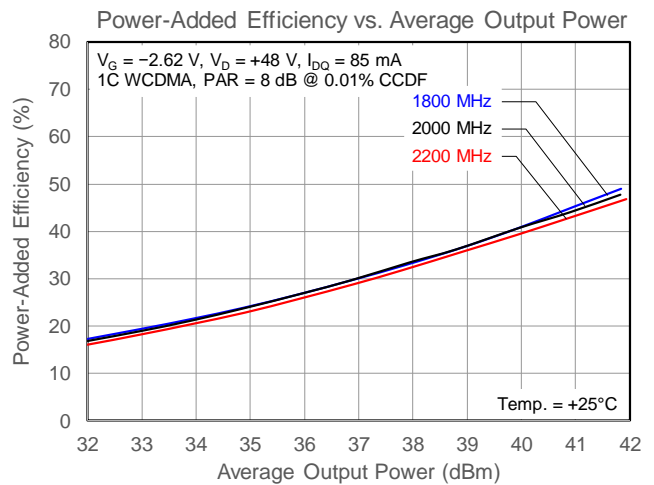
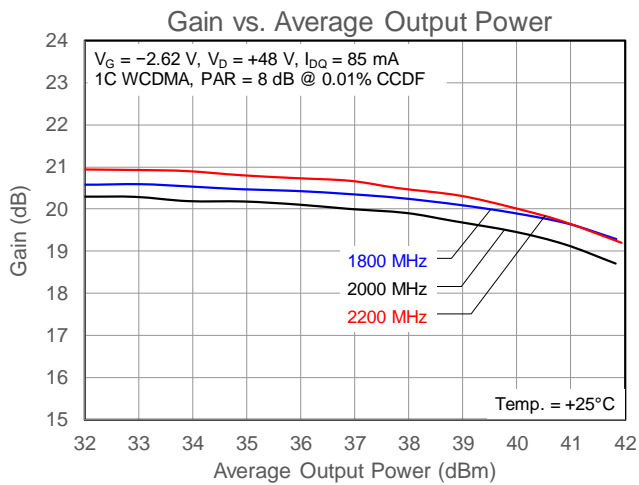
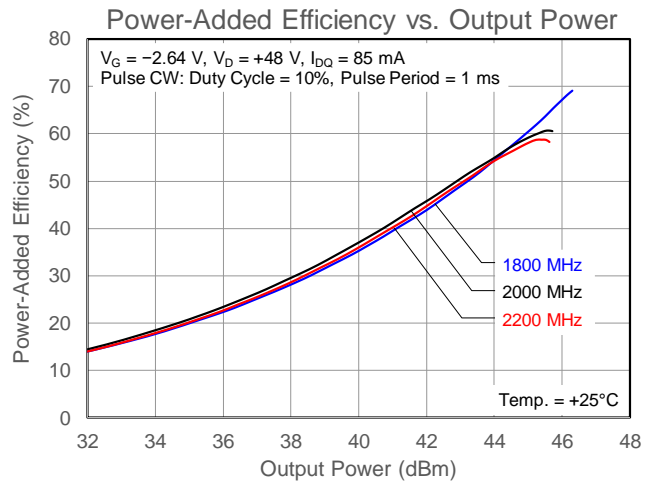
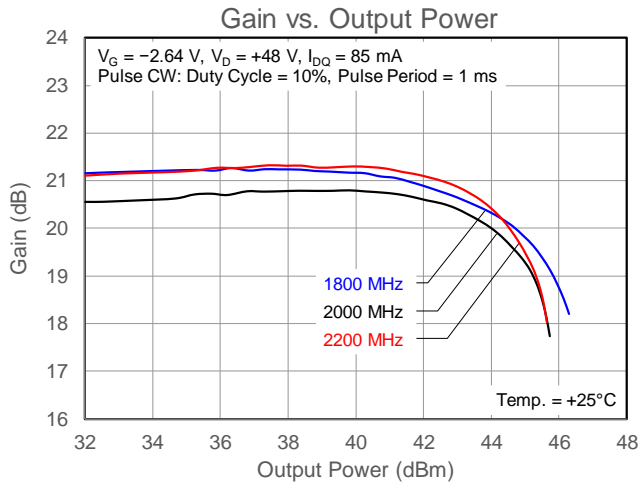
Note: PCB Material is RO4350B, 20 mil thick substrate, 1 oz. copper each side.



QPD0030EVB02 Bill of Materials

| Reference Des. | Value | Description | Manufacturer | Part Number |
|----------------|--------------|---------------------------------------|--------------|---------------------|
| C1 | 6.8 pF | RF NPO 250VDC \pm 0.25 pF Capacitor | ATC | 600S6R8CT250XT |
| C2, C4 | 15 pF | RF NPO 250VDC \pm 5% Capacitor | ATC | 600S150JT250XT |
| C3 | 4.7 uF | X7R 50V 10% 1206 Capacitor | Kemet | C1206C475K5RACTU |
| C5 | 1000 pF | X7R 630V 10% 1206 Capacitor | Murata | GRM31BR72J102KW01L |
| C6, C7 | 10 uF | X7S 100V 20% 2220 Capacitor | TDK | C5750X7S2A106M230KB |
| C8 | 20 pF | RF NPO 250VDC \pm 5% Capacitor | ATC | 600S200JT250XT |
| C9 | 100 uF | 100V Electrolytic 20% 12.5mm SQ | Vishay | MAL215099907E3 |
| R1 | 5.1 Ω | 0603 5% Thick Film Resistor | Vishay | CRCW06035R10JNEA |
| R2 | 10 Ω | 0603 5% Thick Film Resistor | Vishay | CRCW060310R0JNEA |
| C9 | 100 uF | 100V Electrolytic 20% 12.5mm SQ | Vishay | MAL215099907E3 |

QPD0030EVB02 Performance Plots



Test conditions unless otherwise noted: $V_D = +48 \text{ V}$, $I_{DQ} = 85 \text{ mA}$, $T = +25^\circ\text{C}$, on a reference design tuned for 1.8 – 2.2 GHz.

Power-Matched Load Pull Performance

| Frequency (MHz) | Source Impedance (Ω) | Load Impedance (Ω) | P3dB (dBm) | Drain Efficiency (%) | G3dB (dB) |
|-----------------|-------------------------------|-----------------------------|------------|----------------------|-----------|
| 1800 | 22.34 – j5.34 | 9.30 + j4.15 | 46.9 | 60.2 | 21.7 |
| 2000 | 26.00 + j1.18 | 7.55 + j5.63 | 46.5 | 62.5 | 21.3 |
| 2200 | 18.40 + j2.92 | 7.04 + j4.47 | 46.9 | 56.3 | 19.5 |
| 2500 | 19.94 + j0.77 | 6.62 + j3.94 | 46.8 | 59.4 | 18.4 |
| 2700 | 17.74 – j2.94 | 6.58 + j3.97 | 46.9 | 61.7 | 17.9 |
| 4300 | 9.54 + j1.75 | 4.99 + j1.48 | 46.9 | 59.9 | 14.8 |
| 4900 | 9.42 – j2.51 | 3.37 – j0.36 | 46.7 | 57.4 | 14.0 |

Test conditions unless otherwise noted: $V_D = +48\text{ V}$, $I_{DQ} = 85\text{ mA}$, $T = +25^\circ\text{C}$, Pulse (10% Duty Cycle, 100 μs Width).

Efficiency-Matched Load Pull Performance

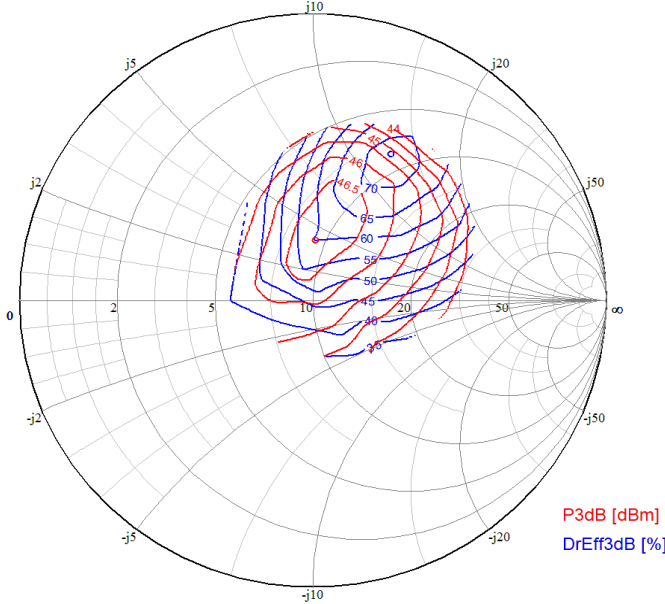
| Frequency (MHz) | Source Impedance (Ω) | Load Impedance (Ω) | P3dB (dBm) | Drain Efficiency (%) | G3dB (dB) |
|-----------------|-------------------------------|-----------------------------|------------|----------------------|-----------|
| 1800 | 22.34 – j5.34 | 8.37 + j12.72 | 45.3 | 72.5 | 23.9 |
| 2000 | 26.00 + j1.18 | 7.47 + j10.34 | 45.4 | 70.4 | 22.7 |
| 2200 | 18.40 + j2.92 | 5.05 + j10.28 | 45.2 | 71.9 | 22.1 |
| 2500 | 19.94 + j0.77 | 4.22 + j8.18 | 45.2 | 71.3 | 20.1 |
| 2700 | 17.74 – j2.94 | 3.38 + j8.00 | 44.6 | 71.5 | 19.7 |
| 4300 | 9.54 + j1.75 | 3.26 + j3.23 | 46.1 | 62.4 | 15.9 |
| 4900 | 9.42 – j2.51 | 2.52 + j1.60 | 45.7 | 59.3 | 15.5 |

Test conditions unless otherwise noted: $V_D = +48\text{ V}$, $I_{DQ} = 85\text{ mA}$, $T = +25^\circ\text{C}$, Pulse (10% Duty Cycle, 100 μs Width).

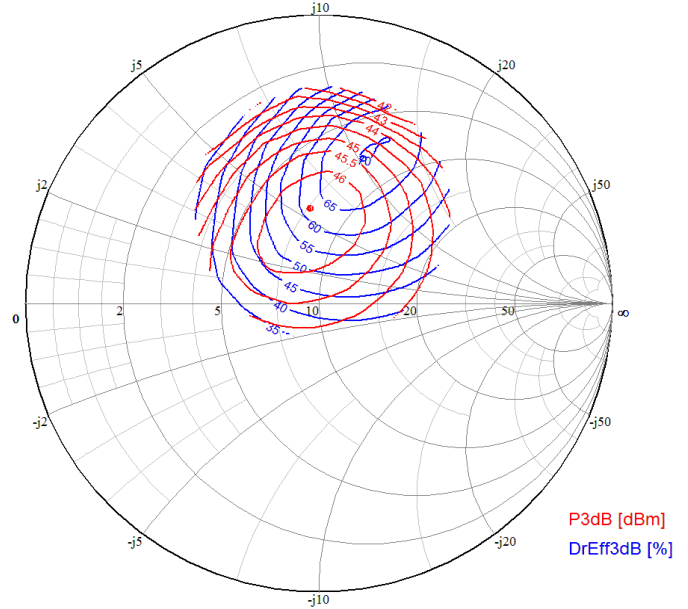
Load Pull Contours

Test Conditions unless otherwise noted: $V_D = +48\text{ V}$, $I_{DQ} = 85\text{ mA}$, $T = +25^\circ\text{C}$, Pulse (10% Duty Cycle, 100 μs Width).

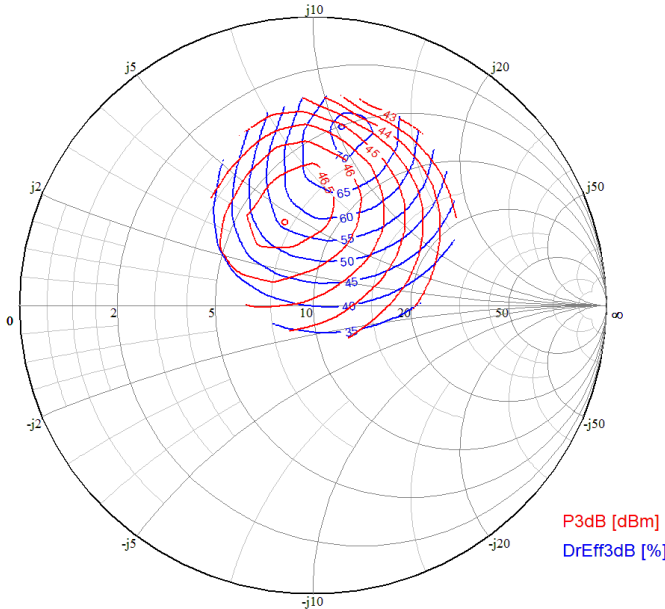
Load Pull at 1.8 GHz



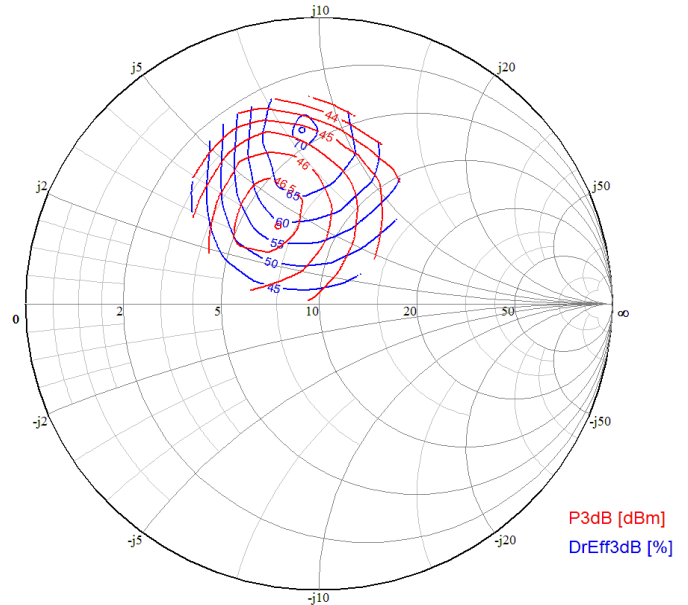
Load Pull at 2 GHz



Load Pull at 2.2 GHz

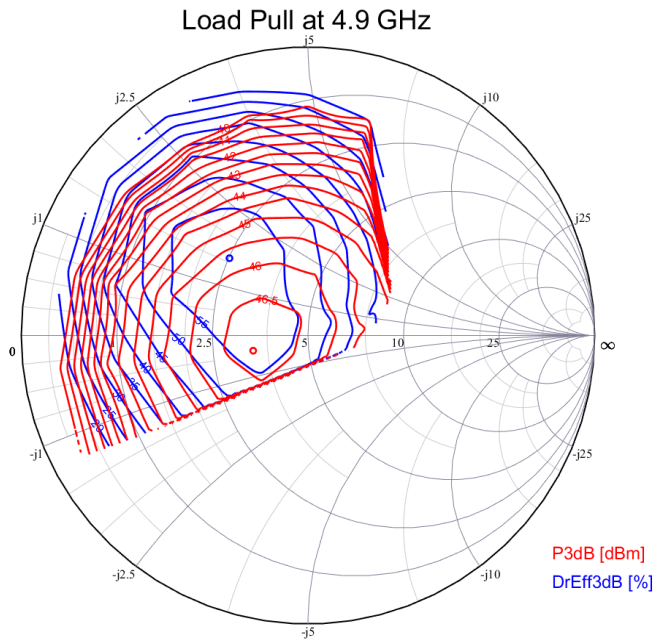
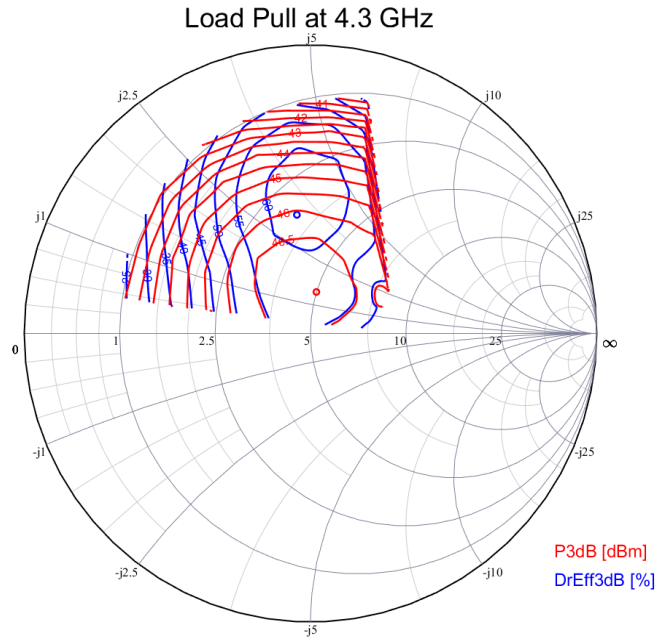
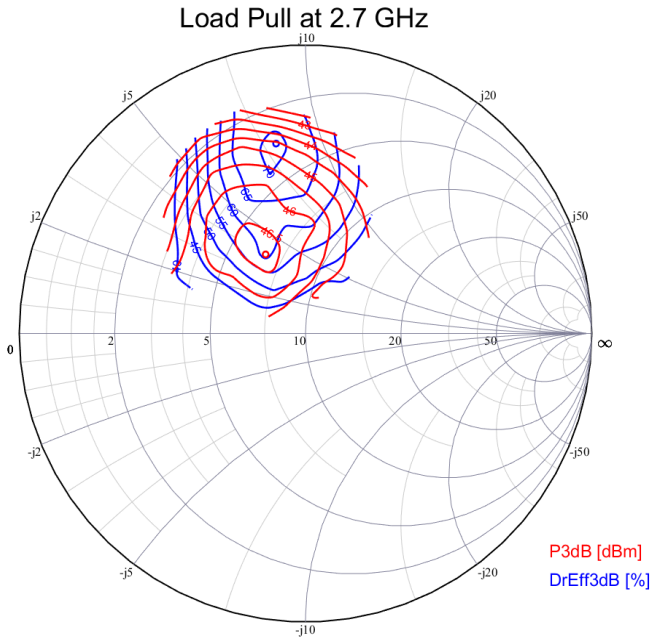


Load Pull at 2.5 GHz



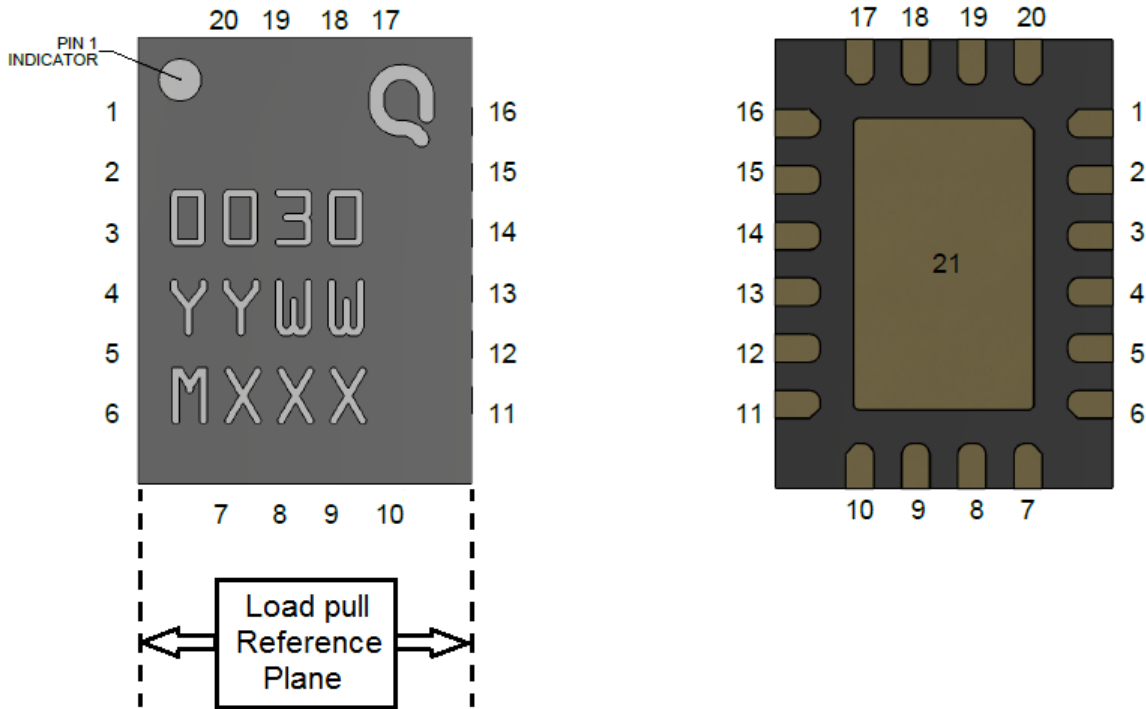
Load Pull Contours

Test Conditions unless otherwise noted: $V_D = +48\text{ V}$, $I_{DQ} = 150\text{ mA}$, $T = +25^\circ\text{C}$, Pulse (10% Duty Cycle, 100 μs Width).



Package Marking and Pin Configuration

Marking: Qorvo Logo
 Part Number and Package Version – 0030
 Date Code – YYWW
 Production Lot Number - MXXX



| Pin Number | Label | Description |
|----------------------|-------------|-----------------------------------|
| 1 | NC | Not Connected |
| 2, 3, 4, 5 | RF IN / VG | RF Input / Gate Voltage |
| 6, 7, 8, 9, 10, 11 | NC | Not Connected |
| 12, 13, 14, 15 | RF OUT / VD | RF Output / Drain Voltage |
| 16, 17, 18, 19, 20 | NC | Not Connected |
| 21 (Backside Paddle) | GND | Source to be connected to ground. |

Bias Procedure

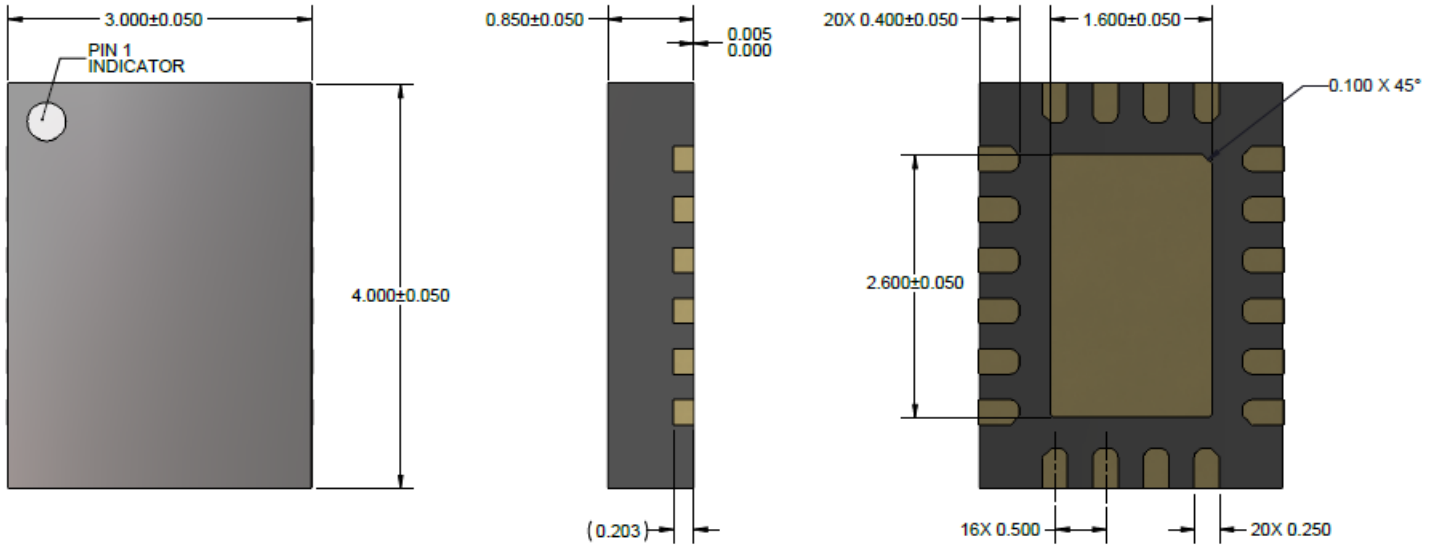
Bias On

1. Turn ON V_G to -4 V.
2. Turn ON V_D to $+48$ V.
3. Slowly adjust V_G until I_D is set to 85 mA.
(Typically, $V_G = -2.8$ V.)
5. Turn ON RF.

Bias Off

1. Turn OFF RF.
2. Set V_G to -5 V.
3. Turn OFF V_D .
4. Wait two (2) seconds to allow drain capacitor to discharge.
5. Turn OFF V_G .

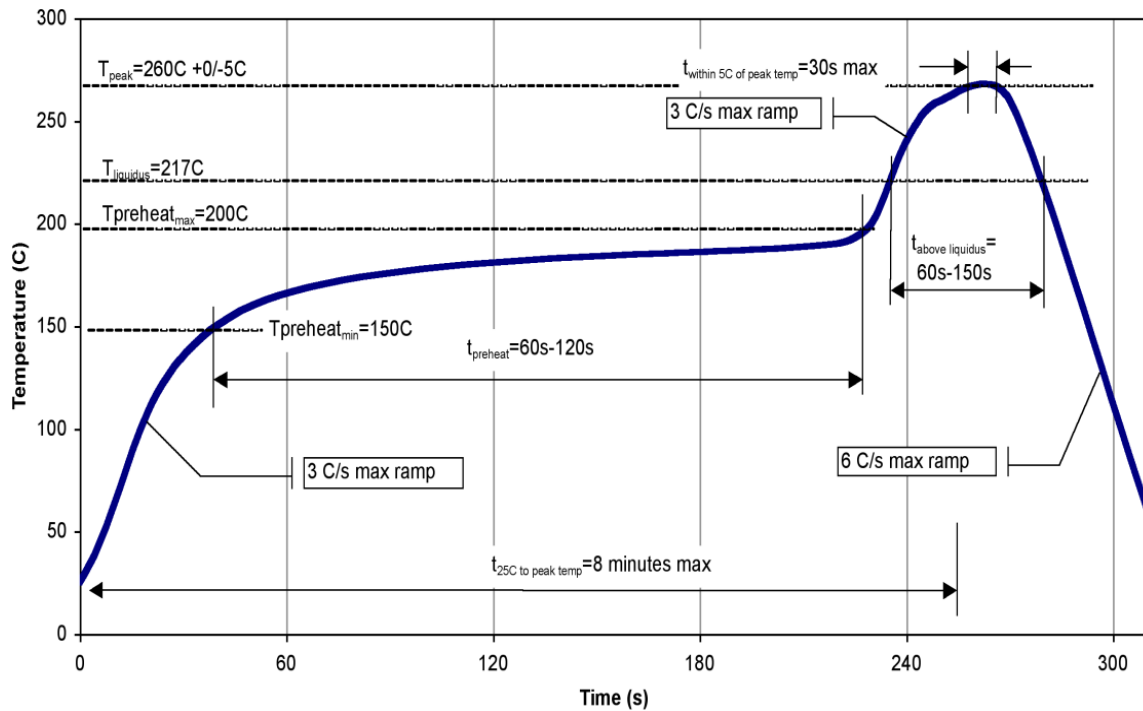
Package Dimensions



Notes:

1. Dimensions are in millimeters. Angles are in degrees.
2. Part is overmold encapsulated.
3. Contact plating is NiPdAu. Au thickness is 0.00254 to 0.01501 μm .
4. General tolerance is ± 0.050 .

Recommended Solder Temperature Profile



Handling Precautions

| Parameter | Rating | Standard |
|--|----------|--|
| ESD – Human Body Model (HBM) | Class 1A | ANSI/ESDA/JEDEC Standard JS-001 |
| ESD – Charged Device Model (CDM) | Class C3 | ANSI/ESDA/JEDEC Standard JS-002 |
| MSL – Moisture Sensitivity Level | Level 3 | IPC/JEDEC Standard J-STD-020 |
| HAST – Highly Accelerated Temperature and Humidity Stress Test | Pass | JESD22-A110, 96 Hour Test Conditions, Preconditioned to MSL3 per JESD22-A113 |



Solderability

Compatible with lead-free (260°C max. reflow temp.) soldering processes.

Package lead plating is NiPdAu. Au thickness is 0.00254 to 0.01501 μm.

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:

Web: www.qorvo.com

Tel: 1-844-890-8163

Email: customer.support@qorvo.com

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[CGH40010F](#) [CGH40025F](#) [CGH40035F](#) [CGH40045F](#) [CGH40120F](#) [CGH55015F2](#) [CGH60008D](#) [CGH60030D](#) [CGHV14500F](#) [CGHV1F006S](#)
[CGHV1J006D](#) [CGHV27030S](#) [CGHV27060MP](#)