

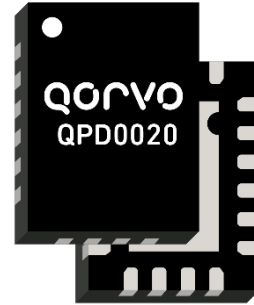
Product Overview

The QPD0020 is a 35 W unmatched discrete GaN on SiC HEMT which operates from DC to 6 GHz 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 QPD0020 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 QPD0020 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 4x3 mm QFN Package

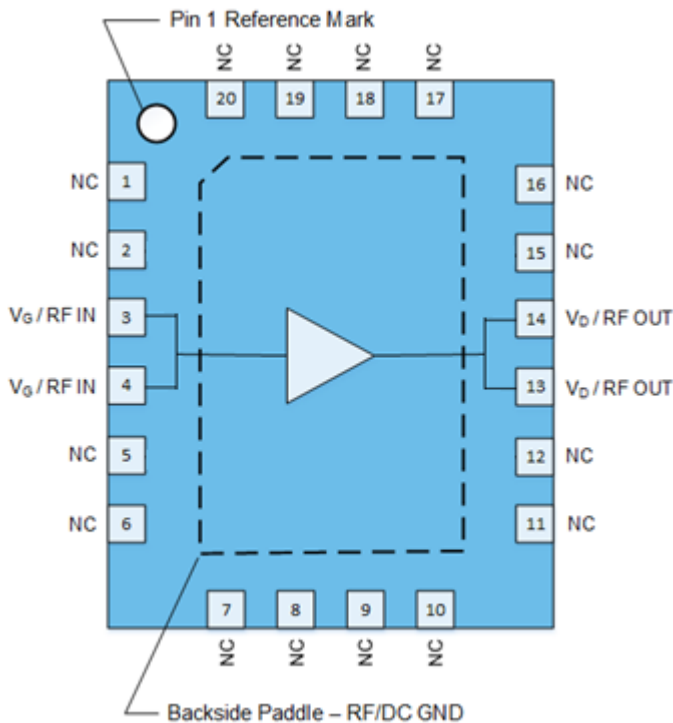
Key Features

- Operating Frequency Range: DC to 6 GHz
- Operating Drain Voltage: +48 V
- Maximum Output Power (P_{SAT}): 34.7 W ⁽¹⁾
- Maximum Drain Efficiency: 77.8% ⁽¹⁾
- Efficiency-Tuned P3dB Gain: 18.8 dB ⁽¹⁾
- Surface Mount Plastic Package

Notes:

1. Based on 2.7 GHz load pull data.

Functional Block Diagram



Applications

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

Ordering Information

| Part Number | Description |
|--------------|----------------------------------|
| QPD0020S2 | Sample – 2 Pieces |
| QPD0020TR7 | 7" Reel – 500 Pieces |
| QPD0020EVB02 | 2.62 – 2.69 GHz Evaluation Board |

Absolute Maximum Ratings

| Parameter | Rating |
|--|--------------|
| Breakdown Voltage (BV_{DG}) | +165 V |
| Gate Voltage Range ($V_{G1,2}$) | -7 to +2 V |
| Drain Voltage ($V_{D1,2}$) | +55 V |
| Peak RF Input Power | 29 dBm |
| VSWR Mismatch, P1dB Pulse (20% Duty Cycle, 100 μ s Width), $T = +25^{\circ}\text{C}$ | 10:1 |
| Storage Temperature | -65 to 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 device may reduce device reliability.

Recommended Operating Conditions

| Parameter | Min | Typ | Max | Units |
|--------------------------------|-----|------|-----|-------|
| Gate Voltage (V_G) | | -2.7 | | V |
| Drain Voltage (V_D) | | +48 | | V |
| Quiescent Current (I_{DQ}) | | 30 | | mA |

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

Electrical Specifications

| Parameter | Conditions | Min | Typ | Max | Units |
|-----------------------------|------------------|------|------|------|-------|
| Operational Frequency Range | | 2620 | | 2690 | MHz |
| Quiescent Current | | | 30 | | mA |
| Gain | 3 dB Compression | | 16.7 | | dB |
| Power (P_{SAT}) | 3 dB Compression | | 44.1 | | dBm |
| Drain Efficiency | 3 dB Compression | | 68.2 | | % |

Test conditions unless otherwise noted: $V_D = +48\text{ V}$, $I_{DQ} = 30\text{ mA}$, $T = +25^{\circ}\text{C}$, pulsed CW signal (10% duty cycle, 1 ms width) on a single-ended reference design fixture tuned for 2620 – 2690 MHz.

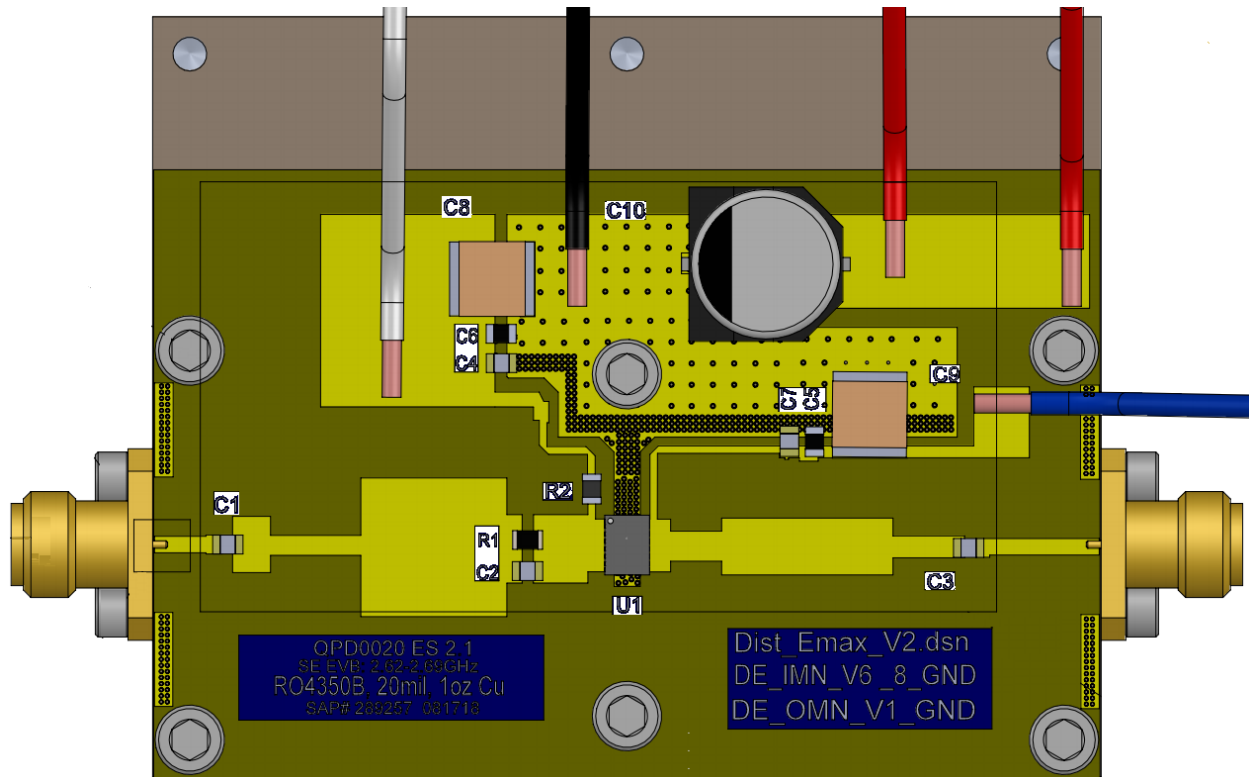
Thermal Information

| Parameter | Conditions | Values | Units |
|--|---|--------|----------------------|
| Thermal Resistance, Peak IR Surface Temperature at Average Power (θ_{JC}) | $T_{CASE} = +105^{\circ}\text{C}$, $T_{CH} = 144^{\circ}\text{C}$ CW: $P_{DISS} = 7.4\text{ W}$, $P_{OUT} = 1.6\text{ W}$ | 5.3 | $^{\circ}\text{C/W}$ |
| Thermal Resistance, Peak IR Surface Temperature at Average Power (θ_{JC}) | $T_{CASE} = +105^{\circ}\text{C}$, $T_{CH} = 169^{\circ}\text{C}$ CW: $P_{DISS} = 10.9\text{ W}$, $P_{OUT} = 5.6\text{ W}$ | 5.9 | $^{\circ}\text{C/W}$ |

Notes:

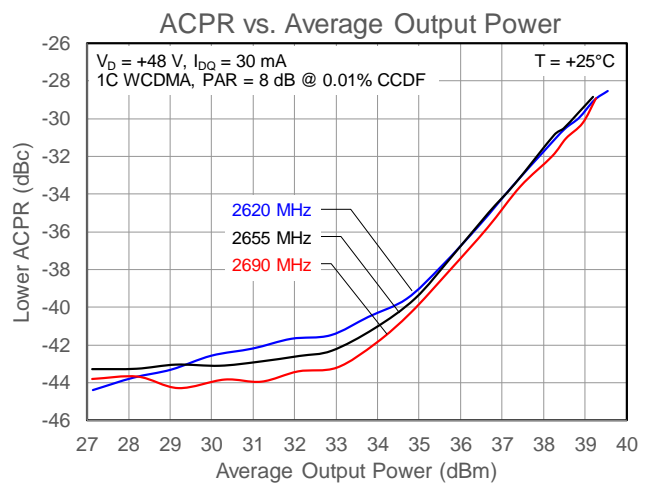
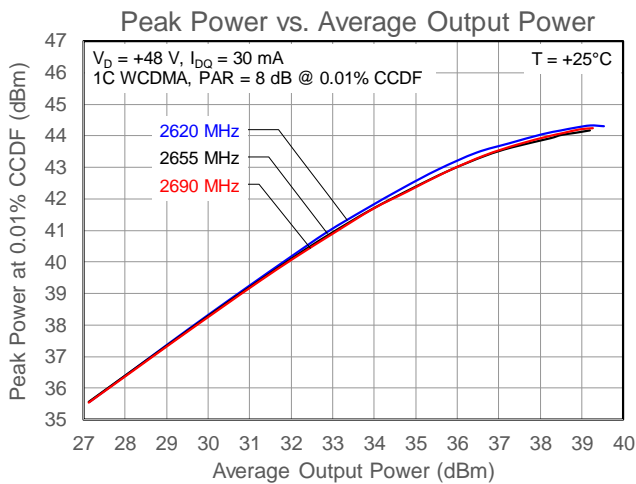
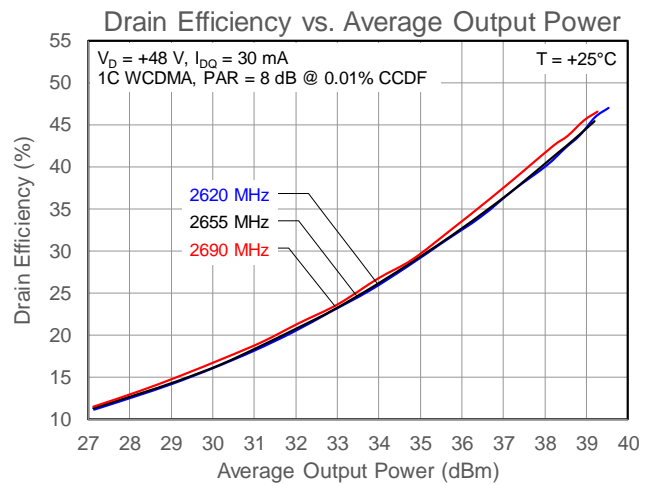
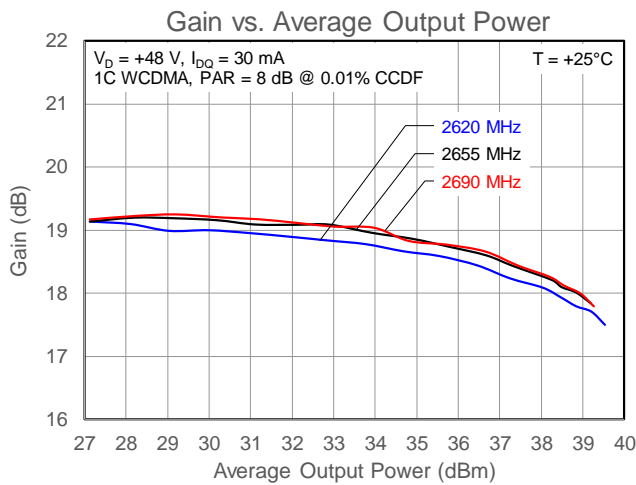
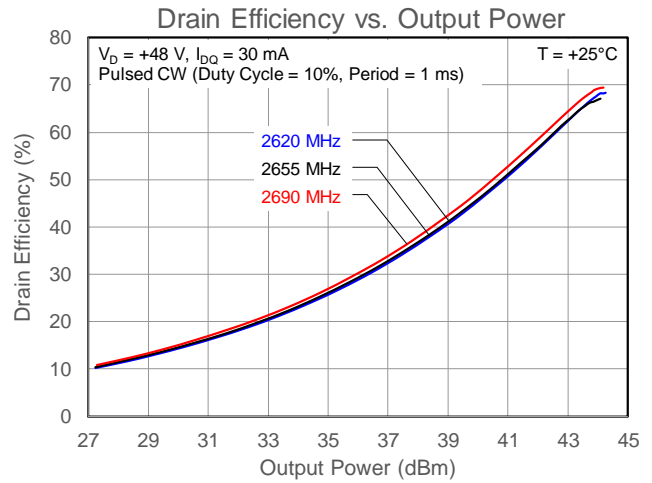
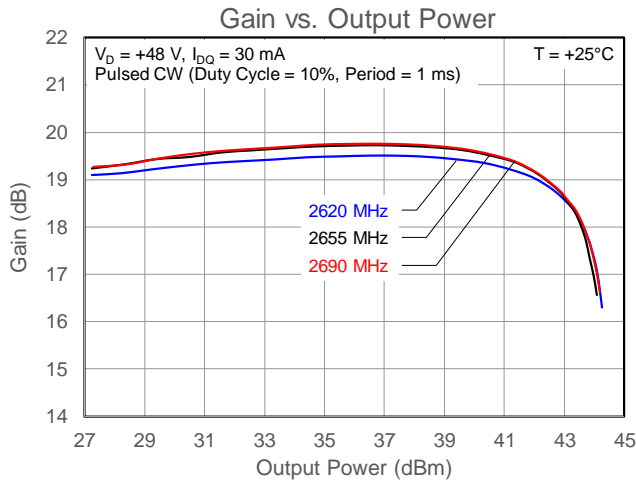
1. Thermal resistance is measured to package backside.
2. Refer to the following document: [GaN Device Channel Temperature, Thermal Resistance, and Reliability Estimates](#)

QPD0020EVB02 Layout – 2.62 – 2.69 GHz Reference Design



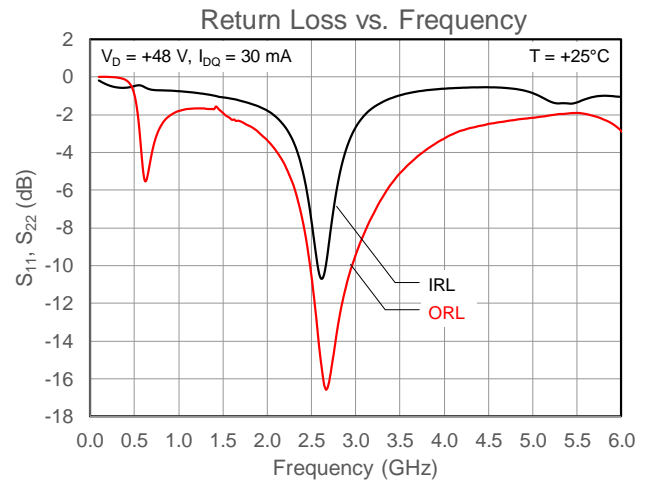
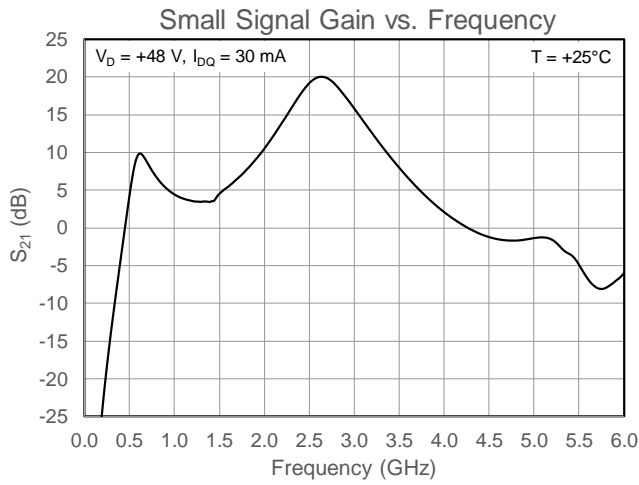
QPD0020EVB02 Bill of Materials

| Reference Des. | Value | Description | Manuf. | Part Number |
|----------------|--------|---|------------------|---------------------|
| C1, C2 | 3 pF | Capacitor, 3 pF, ±0.1pF, 250 V, C0G, 0805 | ATC | 600F3R0BT250XT |
| C3 | 2 pF | Capacitor, 2 pF, ±0.1 pF, 250 V, C0G, 0805 | ATC | 600F2R0BT250XT |
| C4, C7 | 10 pF | Capacitor, 10 pF, ±1%, 250 V, C0G, 0805 | ATC | 600F100FT250XT |
| C5, C6 | 4.7 µF | Capacitor, 4.7 µF, ±20%, 50 V, X5R, 0805 | Murata | GRT21BR61H475ME13L |
| C8, C9 | 10 µF | Capacitor, 10 µF, ±20%, 50 V, STD, 2220 | TDK | C5750X7R1H106K230KB |
| C10 | 220 µF | Capacitor, 220 µF, ±20%, 50 V, Electrolytic | United Chemi-Con | EMVY500ADA221MJA0G |
| R1 | 47 Ω | Resistor, 47 Ω, ±5%, 1/10 W, 0805 | Panasonic | ERJ-6GEYJ470 |
| R2 | 20 Ω | Resistor, 20 Ω, ±5%, 1/10 W, 0805 | Panasonic | ERJ-6GEYJ200 |
| U1 | – | 35 W, 48 V, DC – 6 GHz, GaN RF Transistor | Qorvo | QPD0020 |

QPD0020EVB02 Performance Plots


Test conditions unless otherwise noted: $V_D = +48\text{ V}$, $I_{DQ} = 30\text{ mA}$, $T = +25^\circ\text{C}$, pulsed CW signal (10% duty cycle, 1 ms period) on a 2620 – 2690 MHz reference design fixture.

QPD0020EVB02 Performance Plots



Test conditions unless otherwise noted: $V_D = +48\text{ V}$, $I_{DQ} = 30\text{ mA}$, $T = +25^\circ\text{C}$, pulsed CW signal (10% duty cycle, 1 ms period) on a 2620 – 2690 MHz reference design fixture.

Power-Matched Load Pull Performance

| Frequency (MHz) | Source Impedance (Ω) | Load Impedance (Ω) | P3dB (dBm) | Drain Efficiency (%) | G3dB (dB) |
|-----------------|-------------------------------|-----------------------------|------------|----------------------|-----------|
| 2500 | 2.87 + j1.08 | 14.06 + j5.73 | 45.3 | 62.5 | 18.5 |
| 2600 | 2.86 + j1.07 | 13.72 + j7.59 | 45.3 | 67.6 | 18.5 |
| 2700 | 4.10 + j0.01 | 14.16 + j7.51 | 45.4 | 68.2 | 17.5 |

Test conditions unless otherwise noted: $V_D = +48$ V, $I_{DQ} = 30$ mA, $T = +25^\circ\text{C}$, pulsed CW (20% duty cycle, 100 μs width).

Efficiency-Matched Load Pull Performance

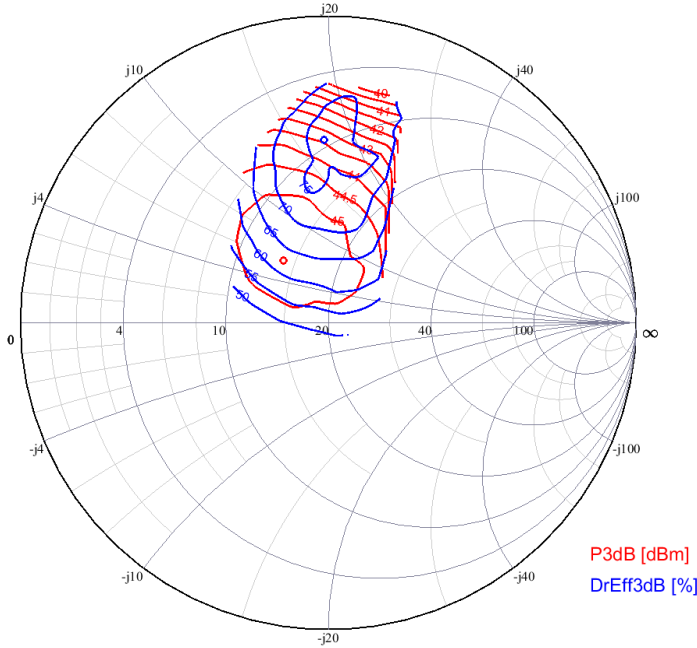
| Frequency (MHz) | Source Impedance (Ω) | Load Impedance (Ω) | P3dB (dBm) | Drain Efficiency (%) | G3dB (dB) |
|-----------------|-------------------------------|-----------------------------|------------|----------------------|-----------|
| 2500 | 2.87 + j1.08 | 9.32 + j17.22 | 43.4 | 78.3 | 20.4 |
| 2600 | 2.86 + j1.07 | 10.41 + j15.61 | 43.8 | 76.8 | 19.6 |
| 2700 | 4.10 + j0.01 | 8.59 + j16.46 | 43.1 | 77.8 | 18.8 |

Test conditions unless otherwise noted: $V_D = +48$ V, $I_{DQ} = 30$ mA, $T = +25^\circ\text{C}$, pulsed CW (20% duty cycle, 100 μs width).

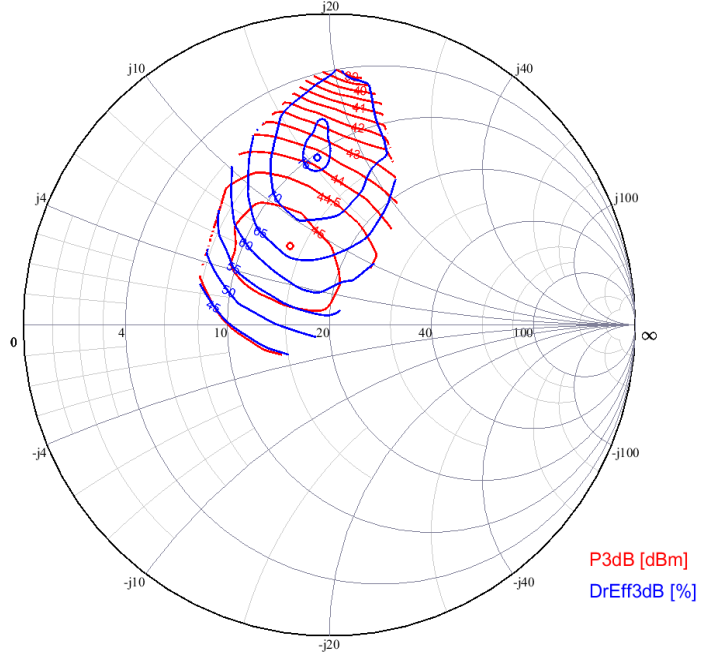
Load Pull Contours

Test Conditions unless otherwise noted: $V_D = +48\text{ V}$, $I_{DQ} = 30\text{ mA}$, $T = +25^\circ\text{C}$, pulsed CW (20% duty cycle, 100 μs width).

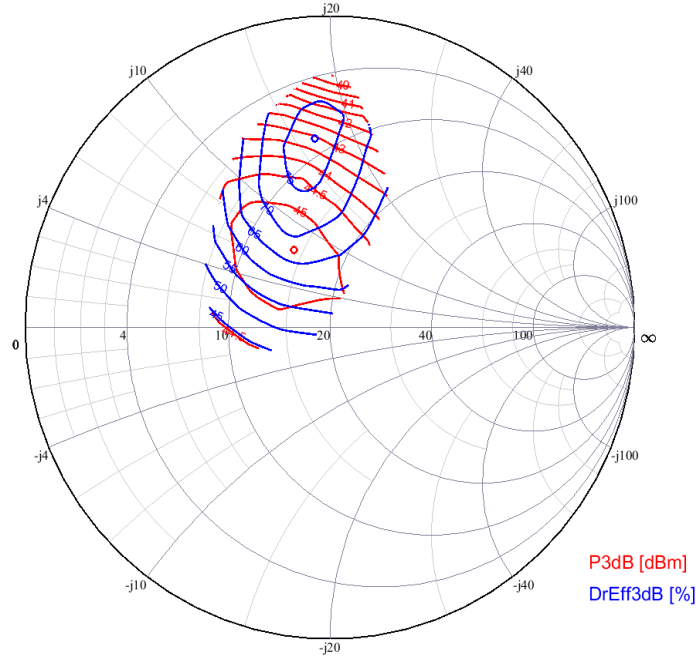
Load Pull at 2500 MHz



Load Pull at 2600 MHz

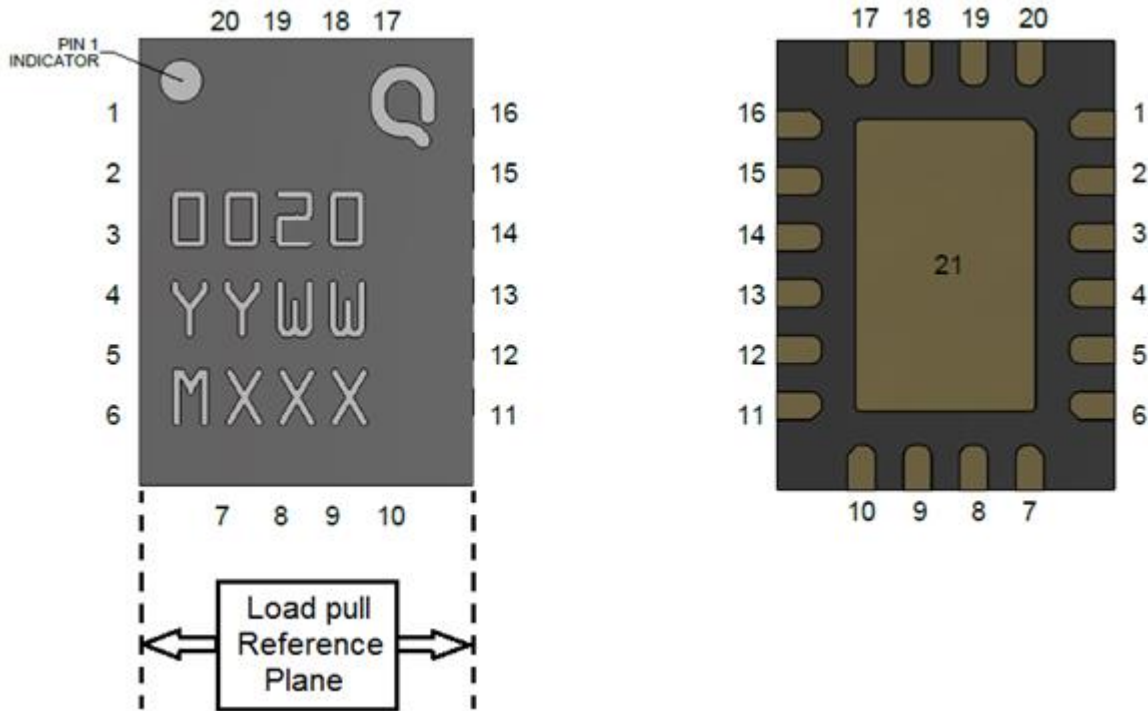


Load Pull at 2700 MHz



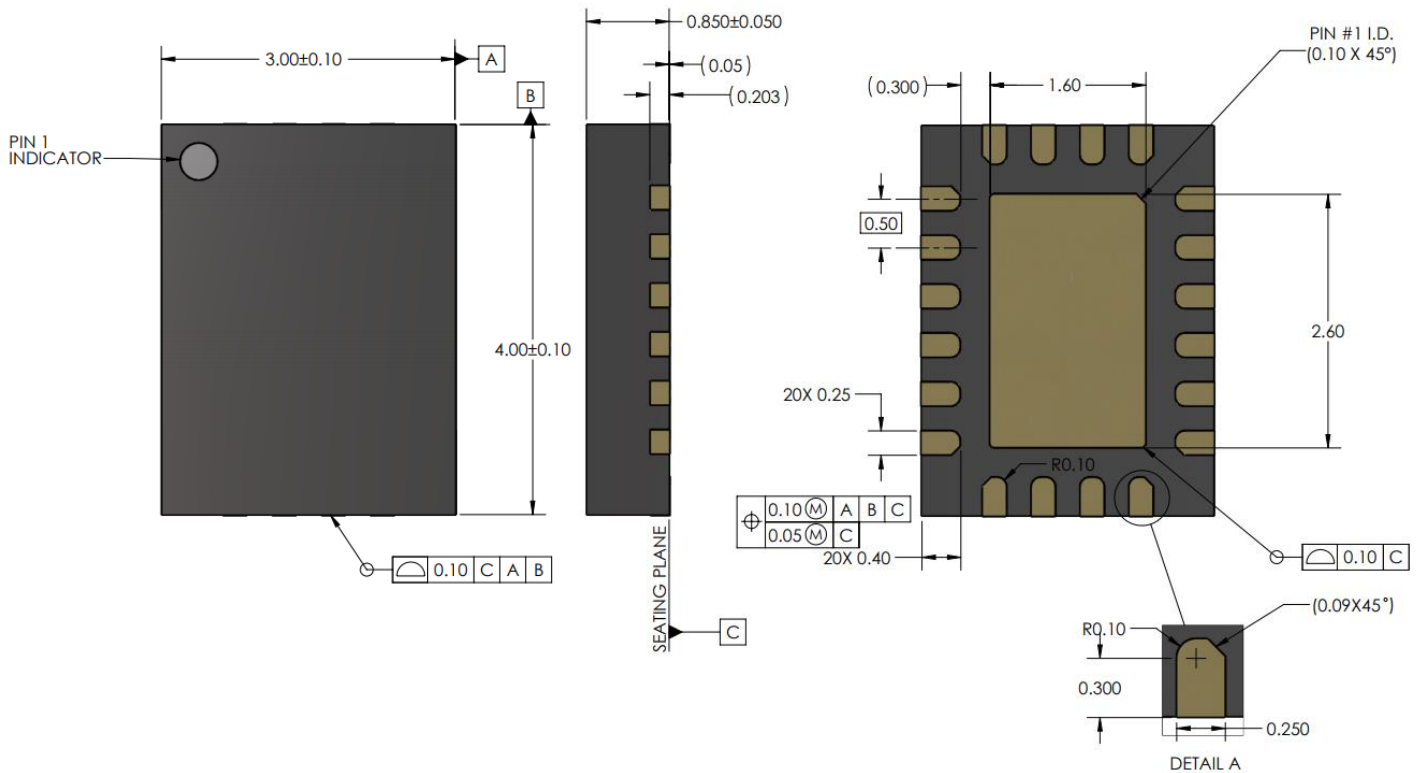
Package Marking and Pin Configuration

Marking: Qorvo Logo
 Part Number – 0020
 Date Code – YYWW
 Production Lot Number - MXXX



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

Package Dimensions



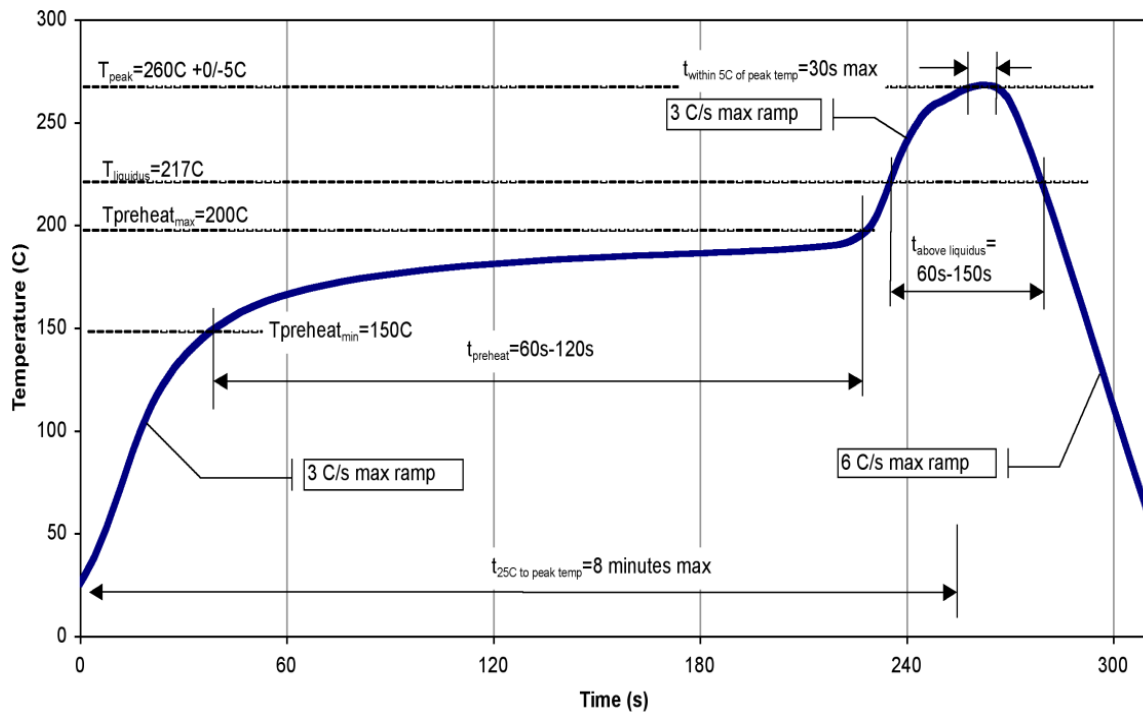
Notes:

1. All dimensions are in millimeters. Angles are in degrees.
2. General tolerance is ± 0.25 .
3. Part is overmold encapsulated.
4. Contact plating is NiPdAu. Au thickness is 0.00254 to 0.01501 μm .

Bias Procedure

| Bias-Up Procedure | Bias-Down Procedure |
|---|--|
| 1. Set V_G to -4 V. | 1. Turn off RF signal. |
| 2. Apply $+48$ V V_D . | 2. Turn off V_D . |
| 3. Slowly adjust V_G until I_D is set to 30 mA. | 3. Wait two (2) seconds to allow drain capacitor to discharge. |
| 4. Apply RF. | 4. Turn off V_G . |

Recommended Solder Temperature Profile



Handling Precautions

| Parameter | Rating | Standard |
|----------------------------------|--------|---------------------------------|
| ESD – Human Body Model (HBM) | TBD | ANSI/ESDA/JEDEC Standard JS-001 |
| ESD – Charged Device Model (CDM) | TBD | ANSI/ESDA/JEDEC Standard JS-002 |
| MSL – Moisture Sensitivity Level | TBD | IPC/JEDEC Standard J-STD-020 |



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

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Email: customer.support@qorvo.com

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