# QPD1011

## 30 – 1200 MHz, 50 V, 7 W GaN RF Input-Matched Transistor

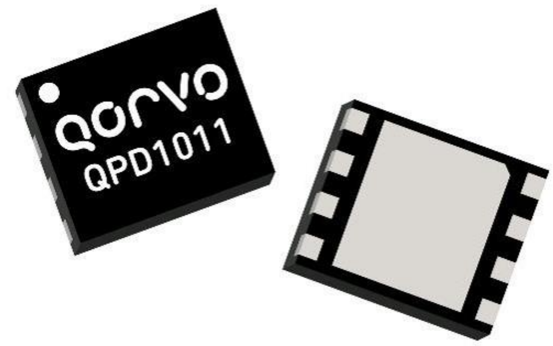
## Product Overview

The Qorvo QPD1011 is a 7W ($P_{3dB}$), 50Ω-input matched discrete GaN on SiC HEMT which operates from 30 MHz to 1.2 GHz. The integrated input matching network enables wideband gain and power performance, while the output can be matched on board to optimize power and efficiency for any region within the band.

The device is housed in a 5 x 6 mm leadless SMT package that saves real estate of already space-constrained handheld radios.

Lead-free and ROHS compliant.

Evaluation boards are available upon request.



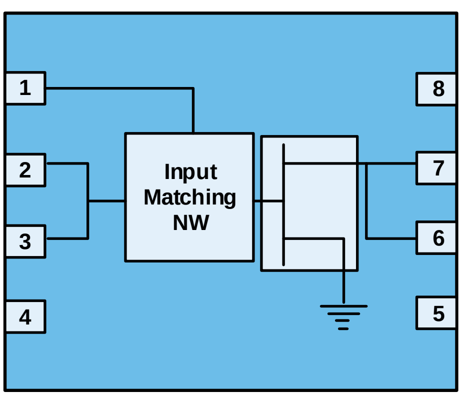

5 x 6 x 0.85 mm Package

## Key Features

- Frequency: 30 to 1200 MHz
- Output Power ($P_{3dB}$)[1]: 8.7 W
- Linear Gain[1]: 21 dB
- Typical $PAE_{3dB}$[1]: 60 %
- Operating Voltage: 50 V
- CW and Pulse capable

Note 1: @ 1 GHz Load Pull

## Functional Block Diagram




## Applications

- Military radar
- Civilian radar
- Land mobile and military radio communications
- Test instrumentation
- Wideband or narrowband amplifiers
- Jammers

## Ordering info

| Part No. | Description |
|---|---|
| QPD1011EVB01 | 30 – 1000 MHz EVB |
| QPD1011S2 | Pack of 2 QPD1011 |
| QPD1011SQ | Pack of 25 QPD1011 |
| QPD1011SR | Pack of 100 QPD1011 |

## Absolute Maximum Ratings[1]

| Parameter | Rating | Units |
|---|---|---|
| Breakdown Voltage, $BV_{DG}$ | +145 | V |
| Gate Voltage Range, $V_G$ | -7 to +2 | V |
| Drain Current, $I_{DMAX}$ | 1.46 | A |
| Gate Current Range, $I_G$ | See page 17. | mA |
| Power Dissipation, $P_{DISS}$ | 14.7[2] | W |
| RF Input Power, Pulsed, 1.3 GHz, T = 25 °C[2] | +27 | dBm |
| Mounting Temperature (30 Seconds) | 320 | °C |
| Storage Temperature | −65 to +150 | °C |

Notes:
1. Operation of this device outside the parameter ranges given above may cause permanent damage.
2. Pulsed, 100 uS PW, 10% DC

## Recommended Operating Conditions[1]

| Parameter | Min | Typ | Max | Units |
|---|---|---|---|---|
| Operating Temp. Range | −40 | +25 | +85 | °C |
| Drain Voltage Range, $V_D$ | +32 | +50 | +55 | V |
| Drain Bias Current, $I_{DQ}$ | | 20 | | mA |
| Drain Current, $I_D$[4] | – | 300 | – | mA |
| Gate Voltage, $V_G$[3] | – | −2.8 | – | V |
| Power Dissipation ($P_D$)[2,4] | – | – | 13 | W |
| Power Dissipation ($P_D$), CW[2] | – | – | 10 | W |

Notes:
1. Electrical performance is measured under conditions noted in the electrical specifications table. Specifications are not guaranteed over all recommended operating conditions.
2. Package base at 85 °C
3. To be adjusted to desired $I_{DQ}$
4. Pulsed, 100 uS PW, 10% DC

## Measured Load Pull Performance – Power Tuned[1, 2]

| Parameter | Typical Values | | | | Units |
|---|---|---|---|---|---|
| Frequency, F | 0.6 | 0.8 | 1.0 | 1.2 | GHz |
| Drain Voltage, $V_D$ | 50 | 50 | 50 | 50 | V |
| Drain Bias Current, $I_{DQ}$ | 20 | 20 | 20 | 20 | mA |
| Output Power at 3dB compression, $P_{3dB}$ | 39.7 | 39.4 | 39.4 | 39.1 | dBm |
| Power Added Efficiency at 3dB compression, $PAE_{3dB}$ | 59.4 | 58.7 | 49.3 | 49.1 | % |
| Gain at 3dB compression, $G_{3dB}$ | 15.7 | 18 | 18.3 | 16.6 | dB |

Notes:
1. Pulsed, 100 uS Pulse Width, 10% Duty Cycle
2. Characteristic Impedance Zo = 33.4 Ω.

## Measured Load Pull Performance – Efficiency Tuned[1, 2]

| Parameter | Typical Values | | | | Units |
|---|---|---|---|---|---|
| Frequency, F | 0.6 | 0.8 | 1.0 | 1.2 | GHz |
| Drain Voltage, $V_D$ | 50 | 50 | 50 | 50 | V |
| Drain Bias Current, $I_{DQ}$ | 20 | 20 | 20 | 20 | mA |
| Output Power at 3dB compression, $P_{3dB}$ | 37.7 | 38.4 | 37.3 | 37.4 | dBm |
| Power Added Efficiency at 3dB compression, $PAE_{3dB}$ | 71.6 | 64.1 | 60.1 | 55.4 | % |
| Gain at 3dB compression, $G_{3dB}$ | 17.9 | 19.2 | 19.5 | 19.1 | dB |

Notes:
1. Pulsed, 100 uS Pulse Width, 10% Duty Cycle
2. Characteristic Impedance Zo = 33.4 Ω.

## 50 – 1000 MHz EVB 500 MHz Performance[1]

| Parameter | Min | Typ | Max | Units |
|---|---|---|---|---|
| Linear Gain, $G_{LIN}$ | – | 17.8 | – | dB |
| Output Power at 3dB compression point, P3dB | – | 7.2 | – | W |
| Drain Efficiency at 3dB compression point, DEFF3dB | – | 52.6 | – | % |
| Gain at 3dB compression point, G3dB | – | 14.8 | – | dB |

1. $V_D$ = +50 V, $I_{DQ}$ = 20 mA, Temp = +25 °C, CW

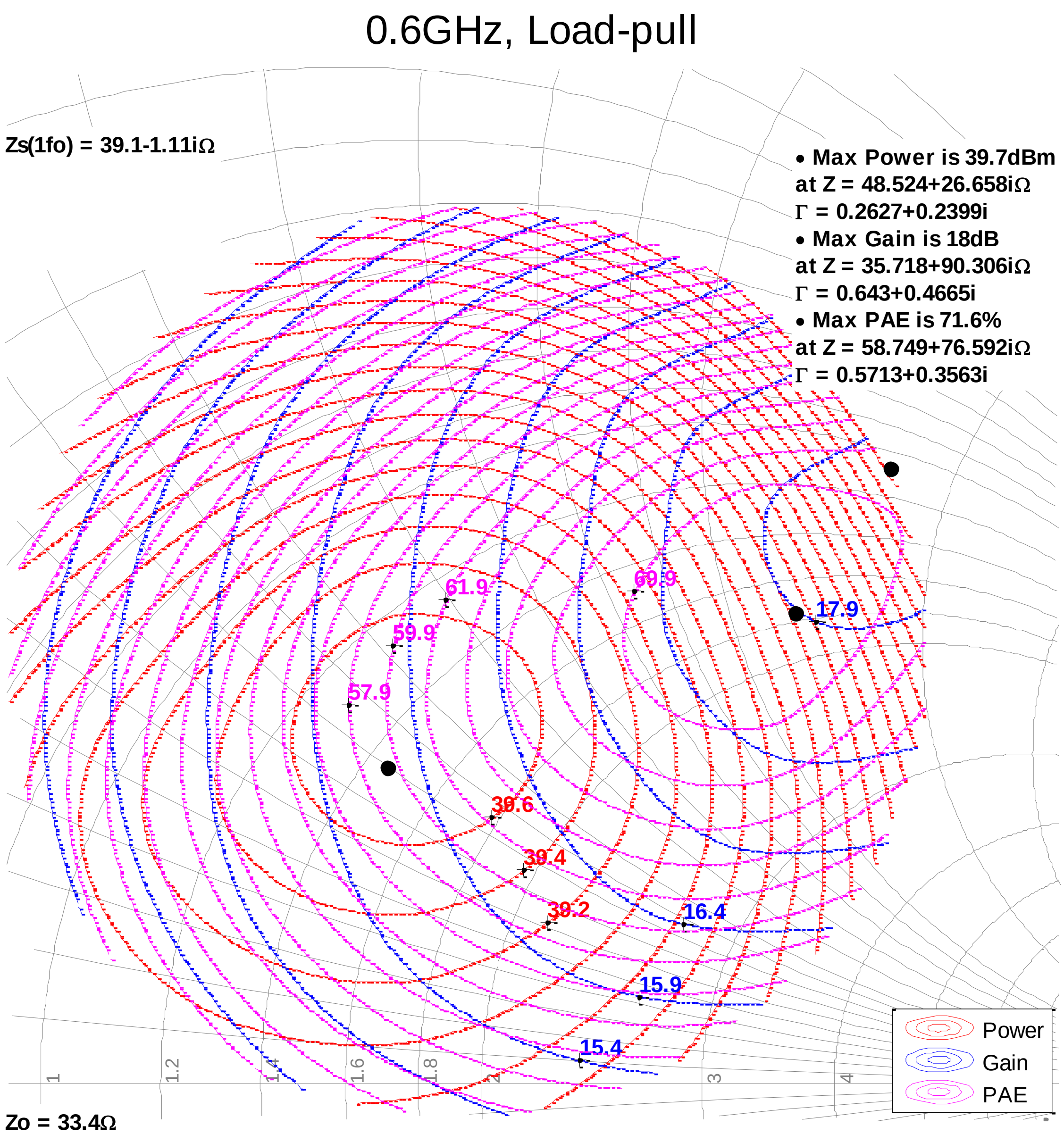
## RF Characterization – Mismatch Ruggedness at 1000 MHz[1]

| Symbol | Parameter | Input Drive Level | Typical |
|---|---|---|---|
| VSWR | Impedance Mismatch Ruggedness | 23 dBm | 10:1 |

1. Test conditions unless otherwise noted: $T_A$ = 25 °C, $V_D$ = 50 V, $I_{DQ}$ = 20 mA, CW

## Measured Load-Pull Smith Charts[1, 2]

Notes:
1. Test Conditions: $V_D$ = 50 V, $I_{DQ}$ = 20 mA, 100 uS Pulse Width, 10% Duty Cycle
2. See page 18 for load pull reference planes where the performance was measured.



## Measured Load-Pull Smith Charts[1, 2]

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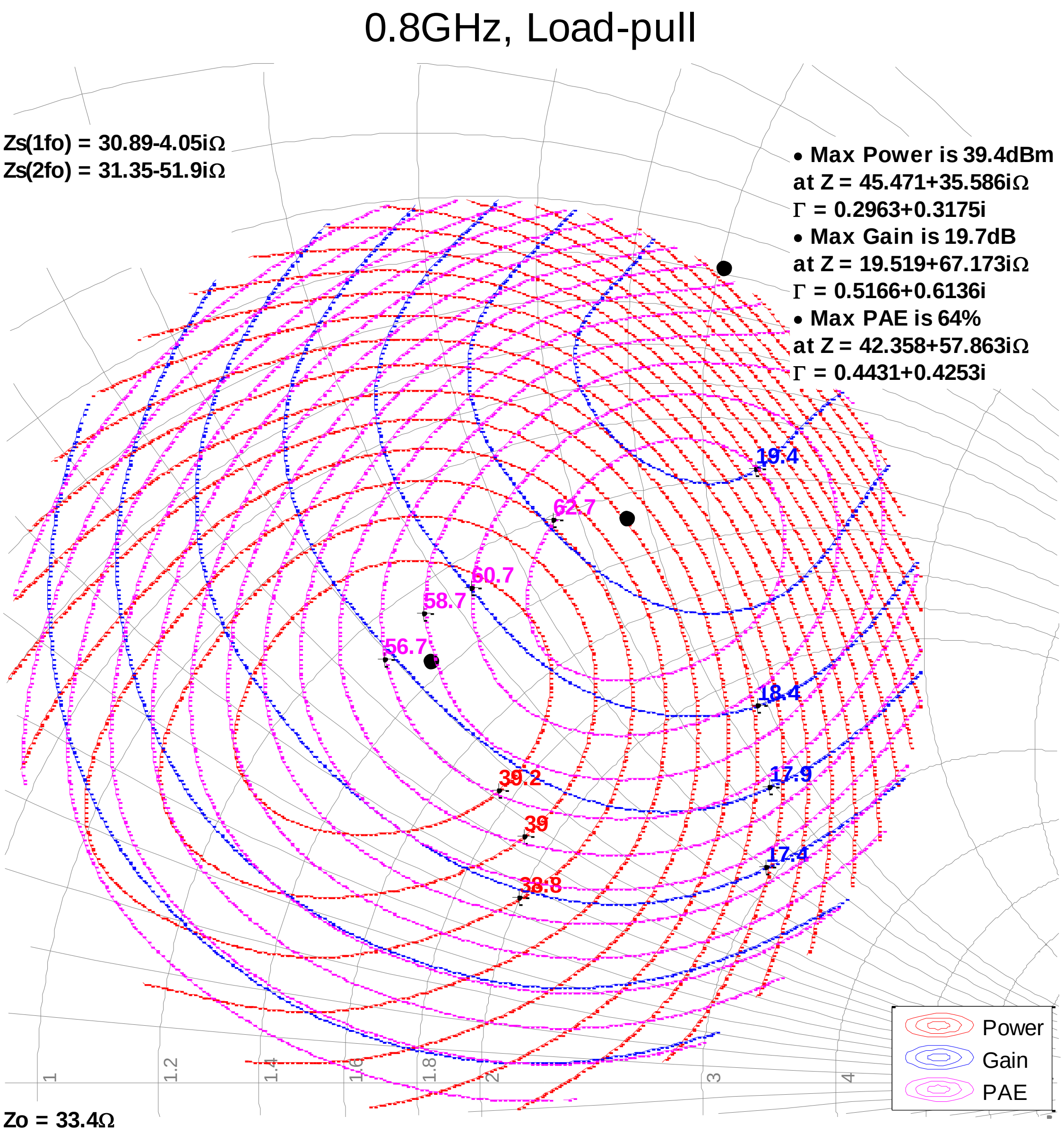

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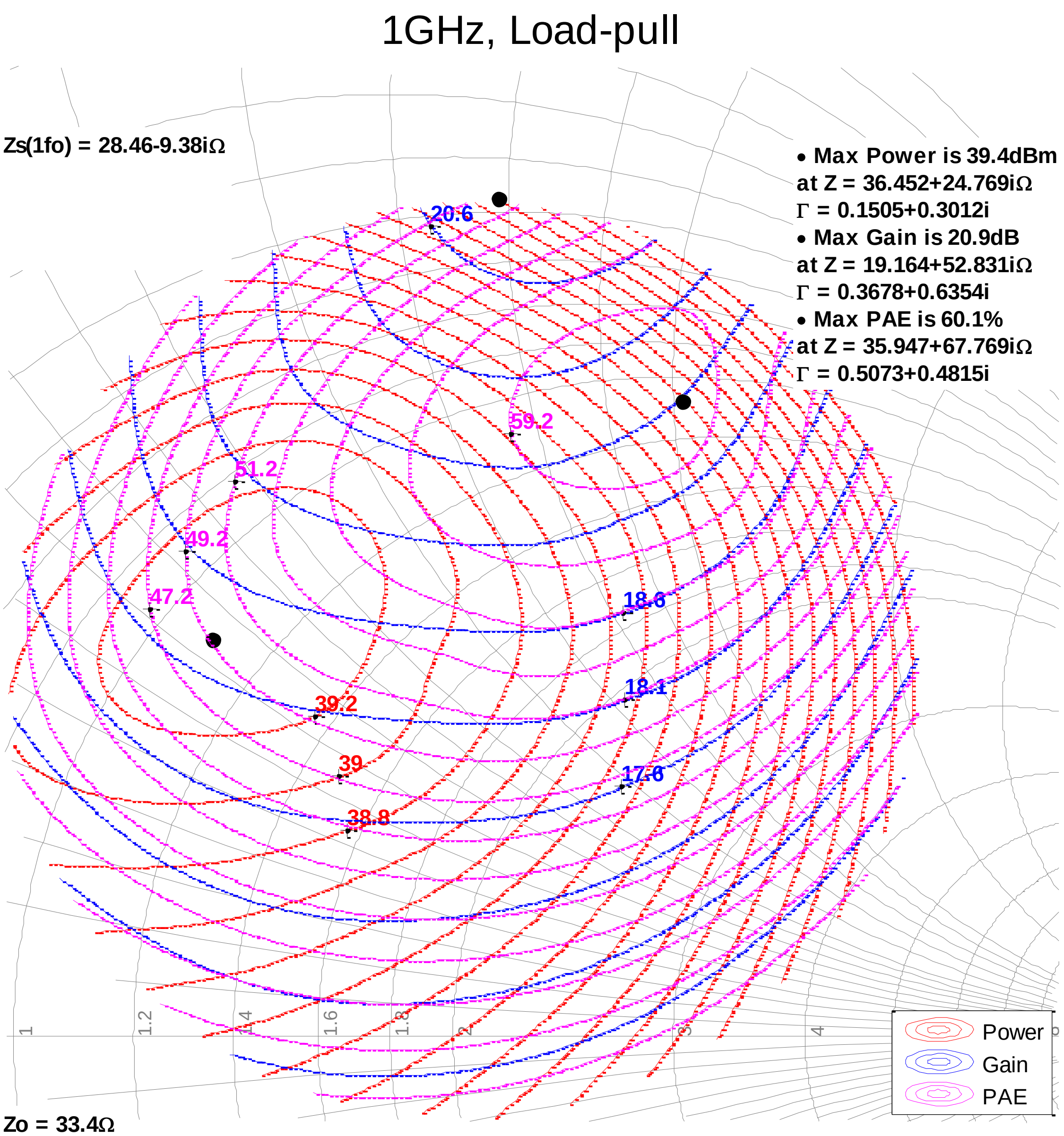

## Measured Load-Pull Smith Charts[1, 2]

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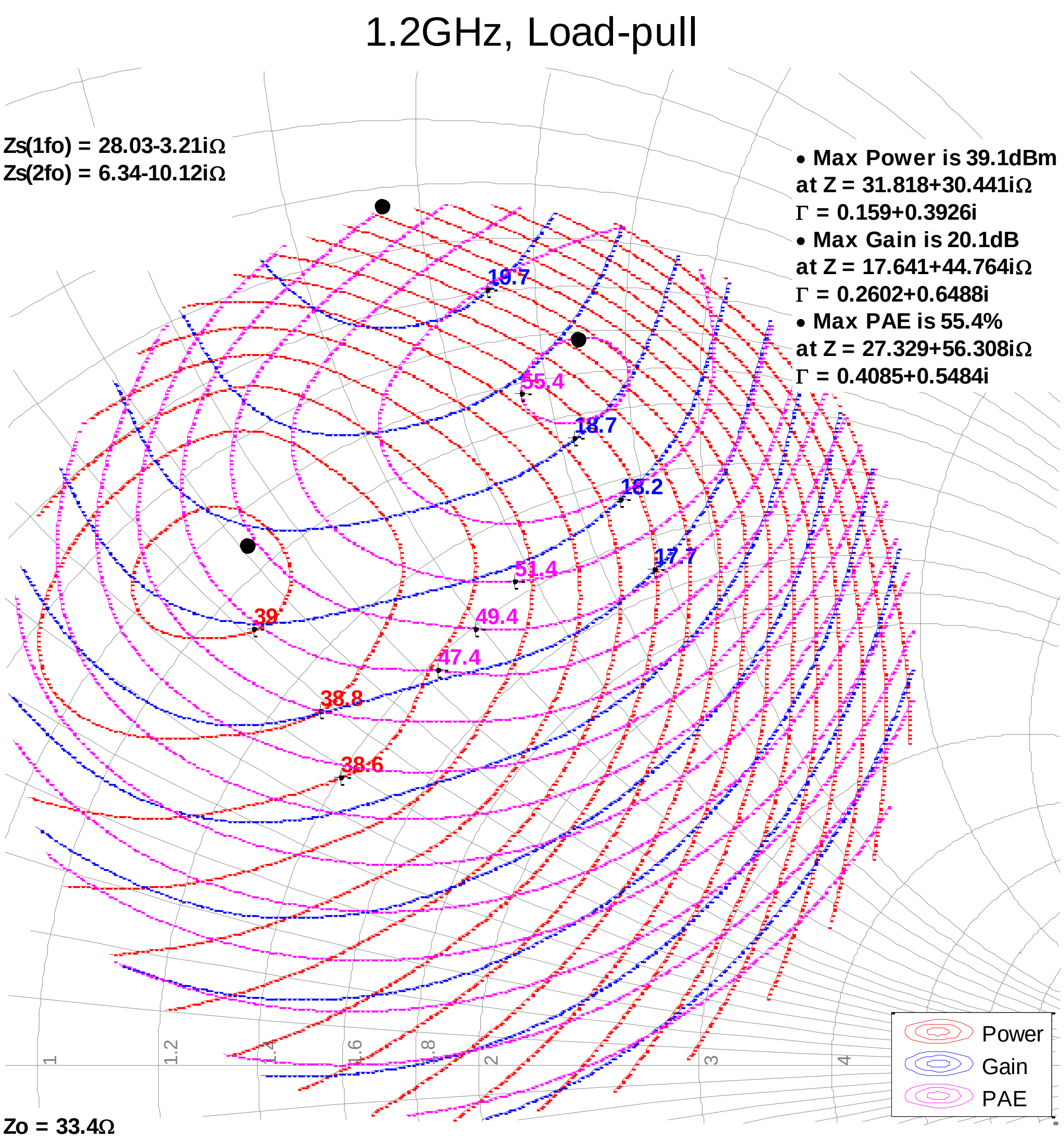
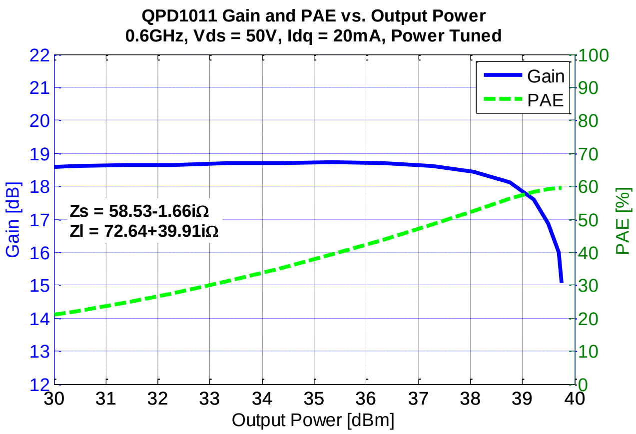
2. See page 18 for load pull reference planes where the performance was measured.

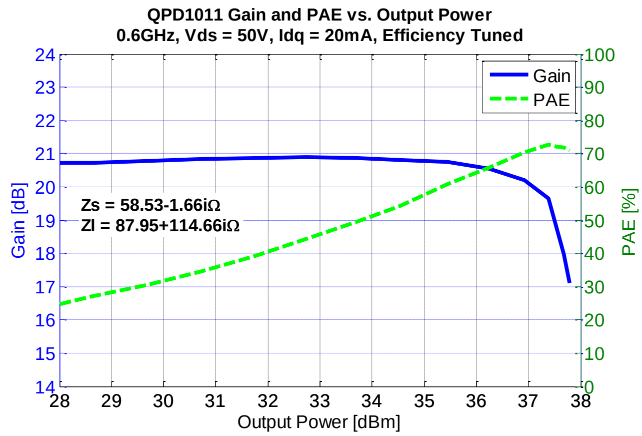


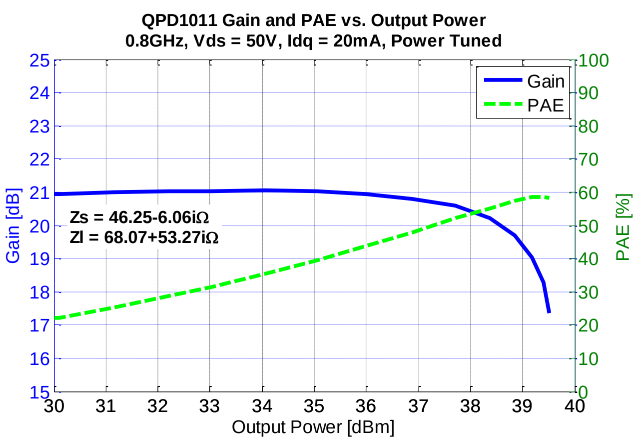
## Typical Measured Performance – Load-Pull Drive-up[1, 2]

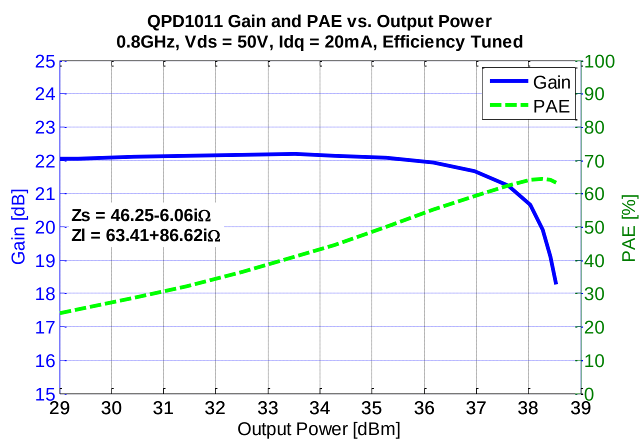
Notes:

1. Test Conditions: $V_D$ = 50 V, $I_{DQ}$ = 20 mA, 100 uS Pulse Width, 10% Duty Cycle
2. See page 18 for load-pull and source-pull reference planes where the performance was measured.



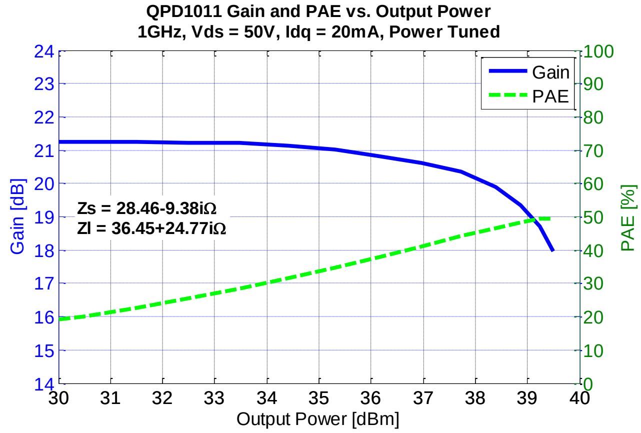



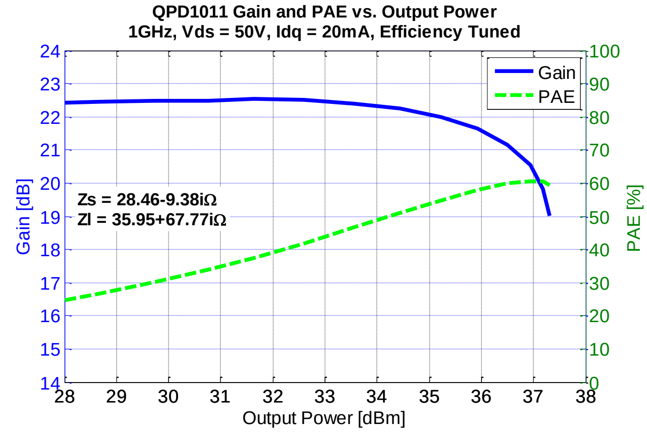



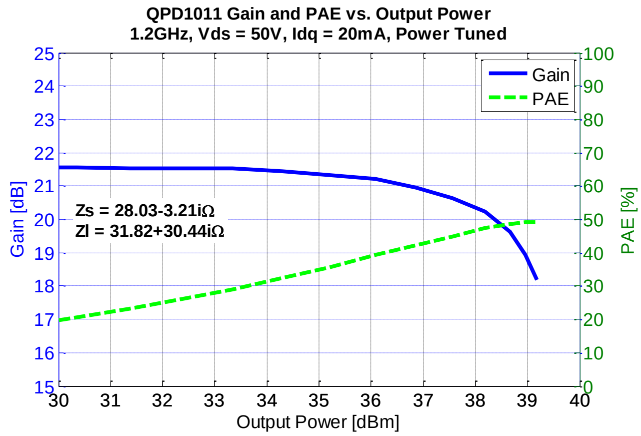
## Typical Measured Performance – Load-Pull Drive-up[1, 2]

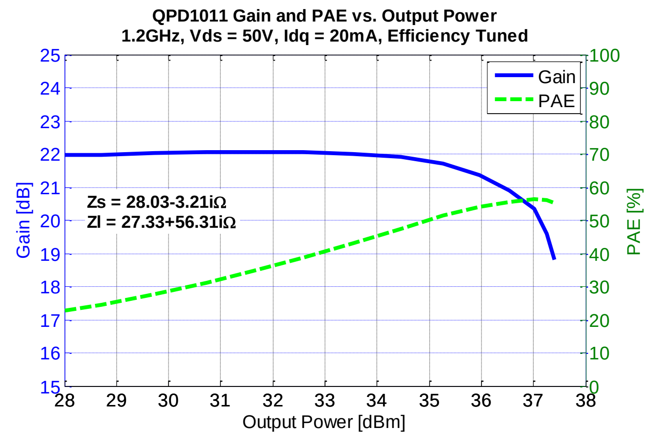
Notes:

1. C Test Conditions: $V_D$ = 50 V, $I_{DQ}$ = 20 mA, 100 uS Pulse Width, 10% Duty Cycle
2. See page 18 for load-pull and source-pull reference planes where the performance was measured.



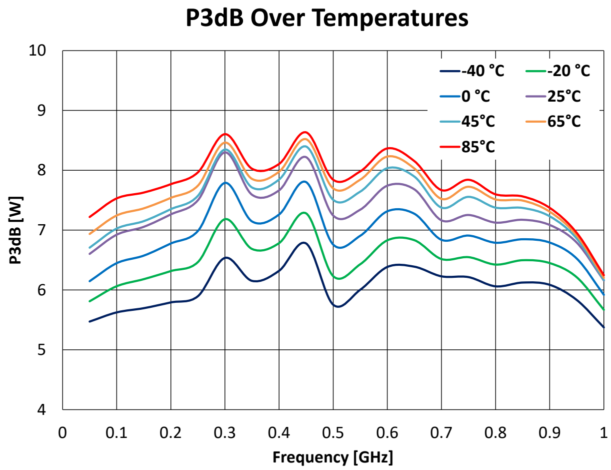



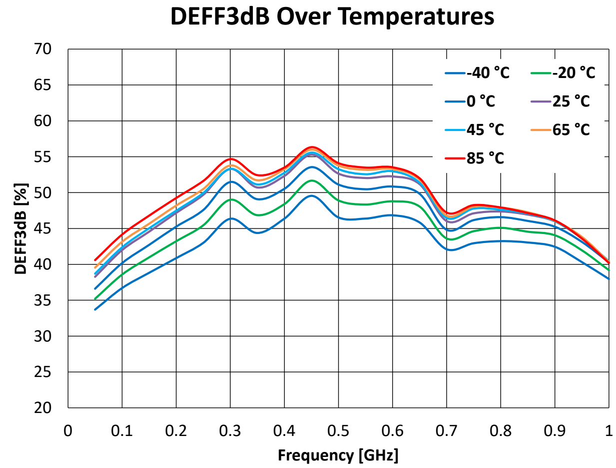



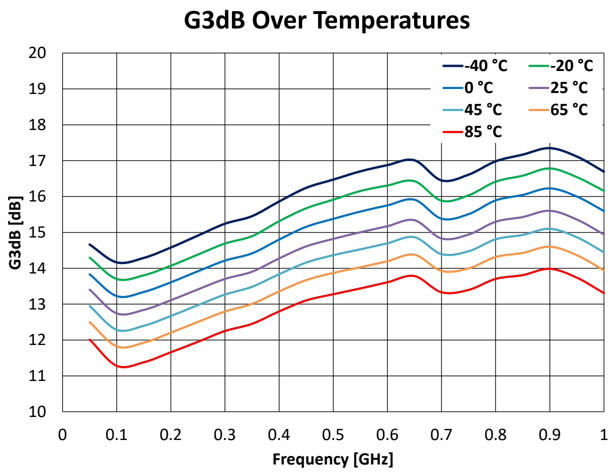



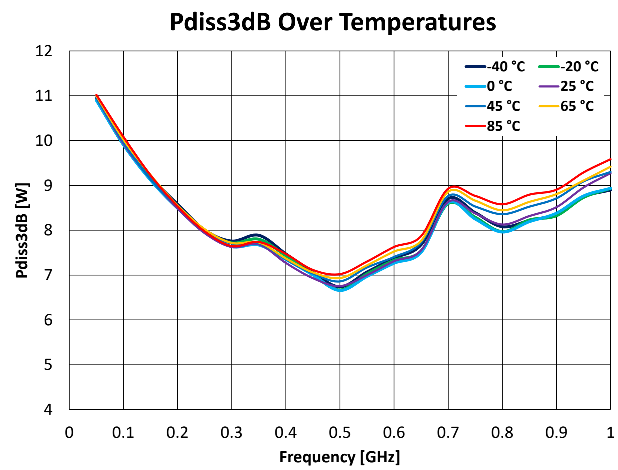
## Power Driveup Performance Over Temperatures Of 50 – 1000 MHz EVB[1, 2]

Notes:
1. Test Conditions: $V_D$ = 50 V, $I_{DQ}$ = 20 mA, CW
2. The dissipation power is calculated at EVB level. The device dissipation power is lower due to input and output matching network losses.



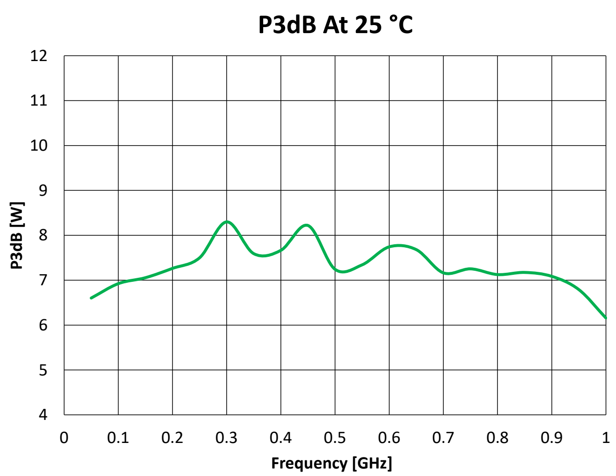



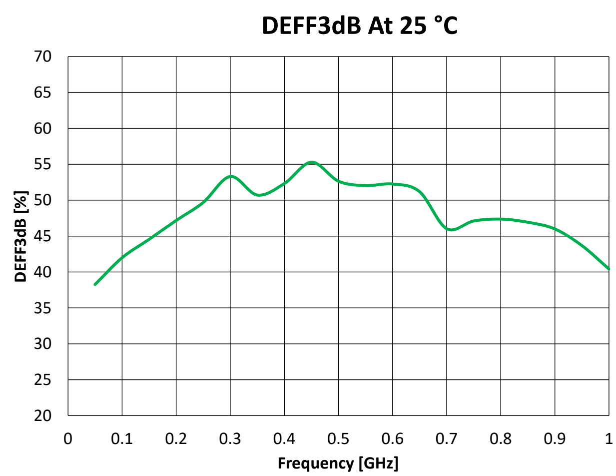



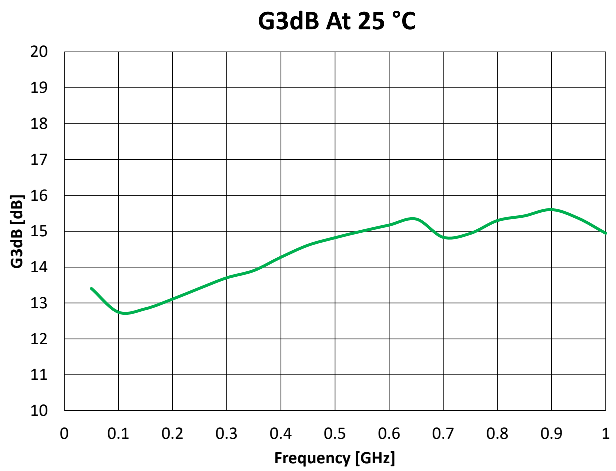



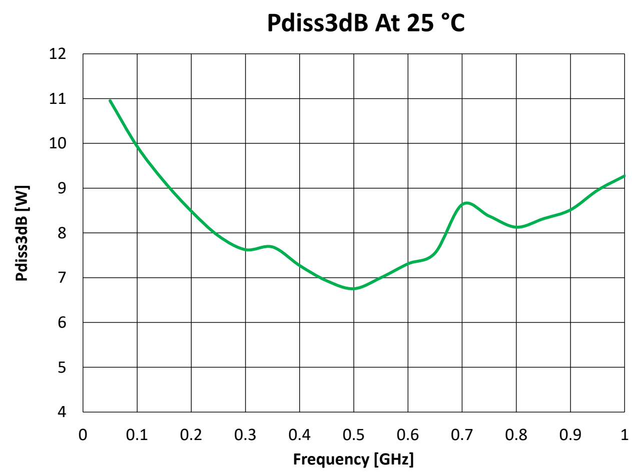
## Power Driveup Performance At 25°C Of 50 – 1000 MHz EVB[1, 2]

Notes:
1. Test Conditions: $V_D$ = 50 V, $I_{DQ}$ = 20 mA, CW
2. The dissipation power is calculated at EVB level. The device dissipation power is lower due to input and output matching network losses.



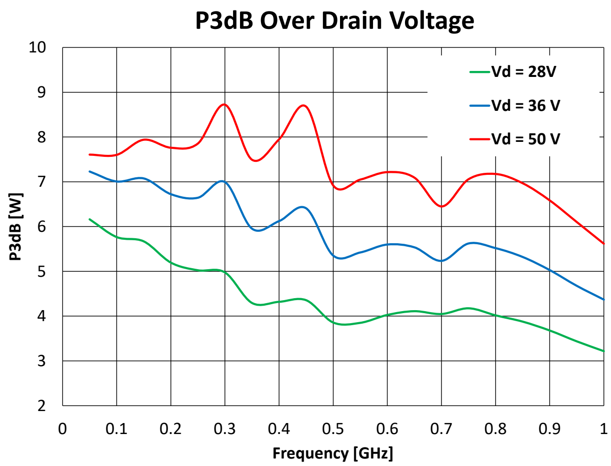



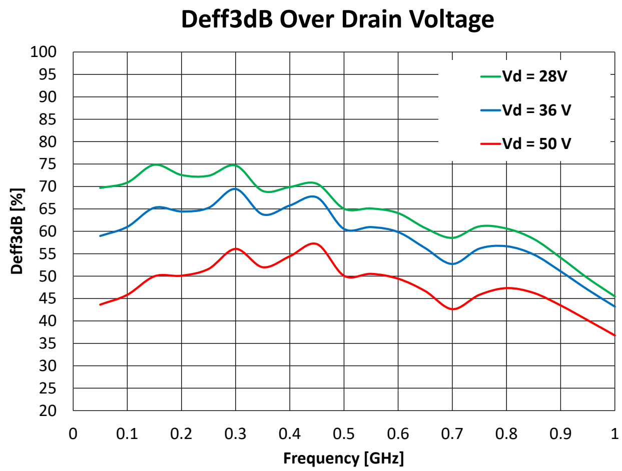



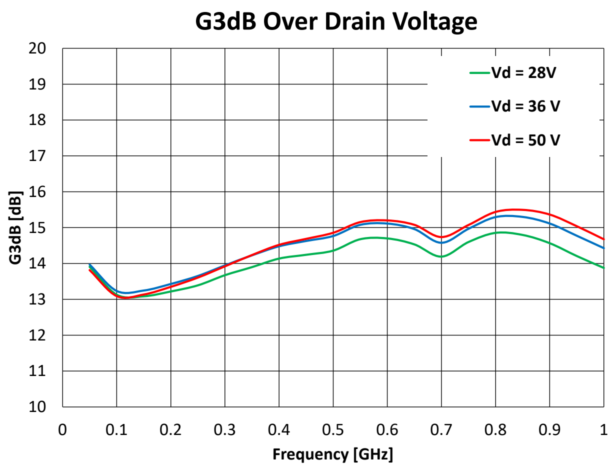
## Power Driveup Performance At 25°C Over Drain Voltage Of 50 – 1000 MHz EVB[1, 2]

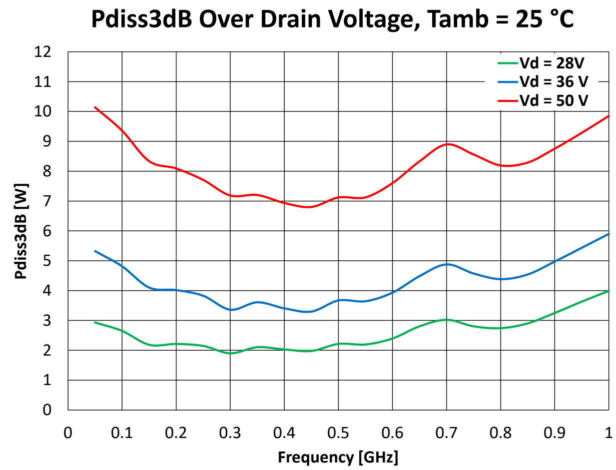
Notes:

1. Test Conditions: $I_{DQ}$ = 20 mA, CW
2. The dissipation power limit is conservative because it is specified at DUT only without accounting for the loss of the output matching network..



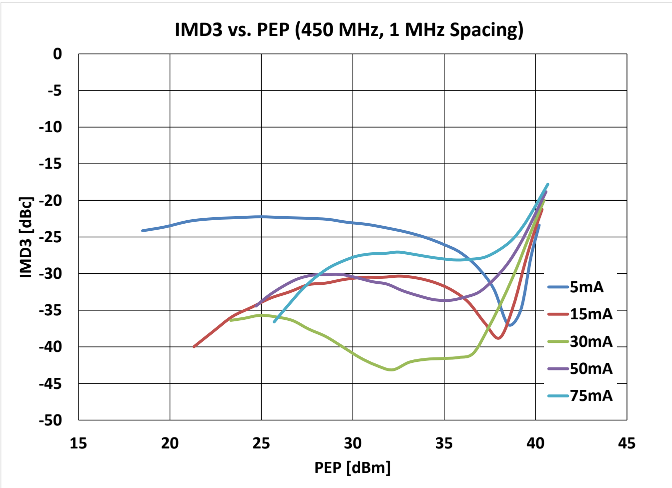



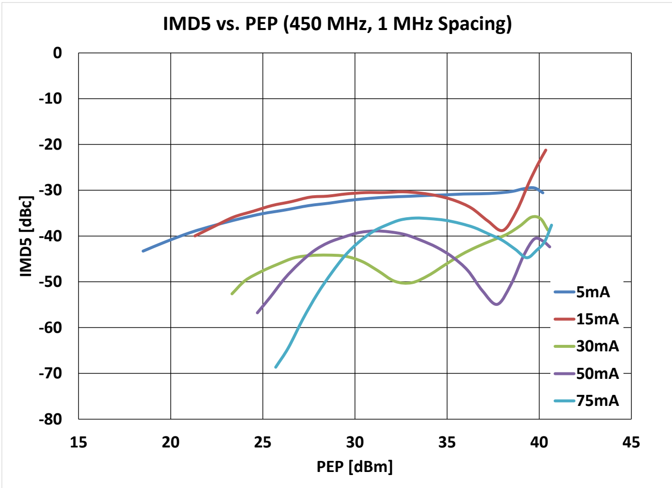



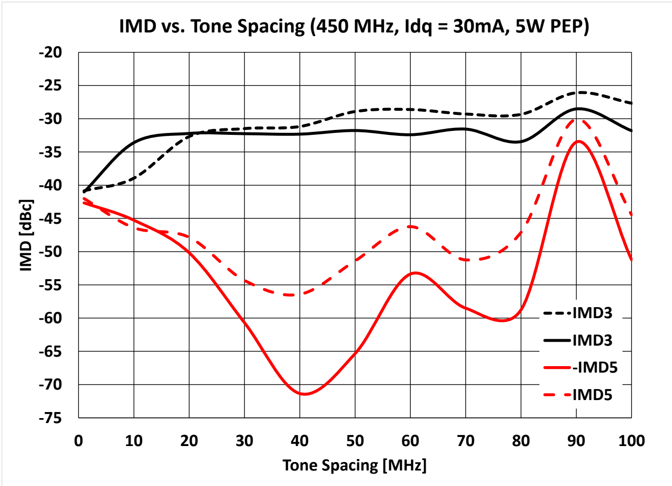



## 2-Tone Performance At 25°C Of 50 – 1000 MHz EVB[1]

Notes:
1. Test Conditions: $I_{DQ}$ = 20 mA, CW

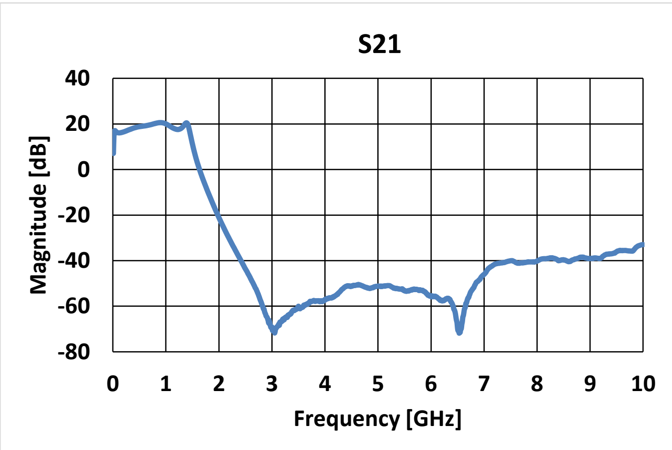


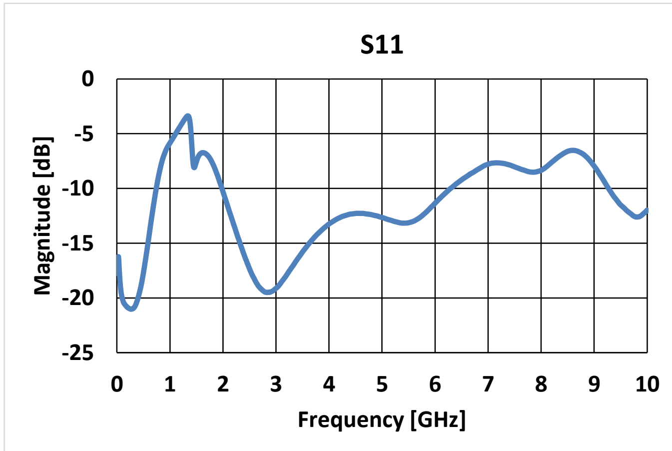



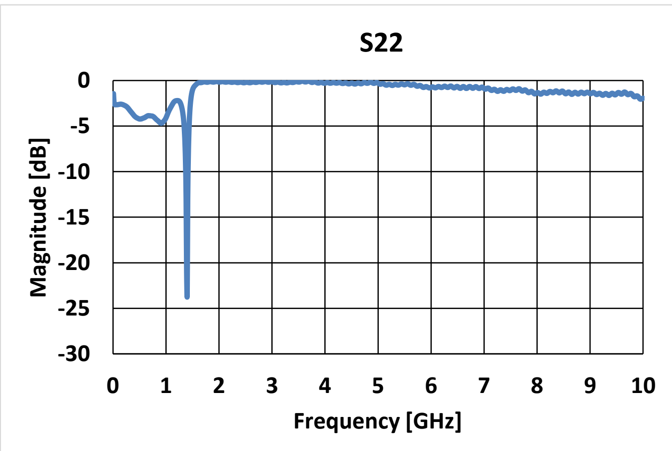



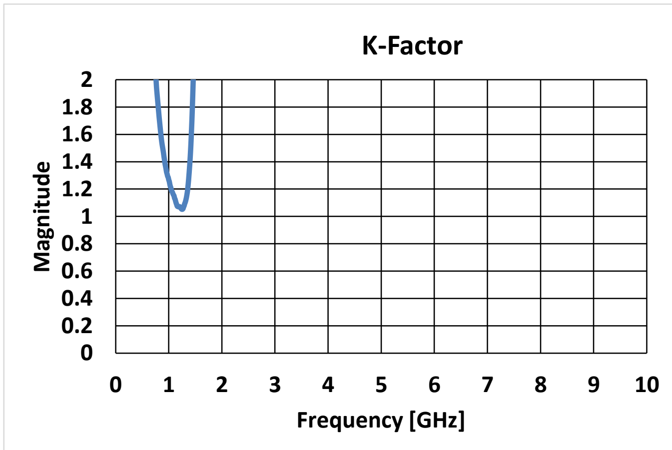
## S-Parameters At -40°C Of 50 – 1000 MHz EVB[1, 2]

Notes:
1. Test Conditions: $V_D$ = 50 V, $I_{DQ}$ = 20 mA
2. K-factor > 1 indicates unconditional stability

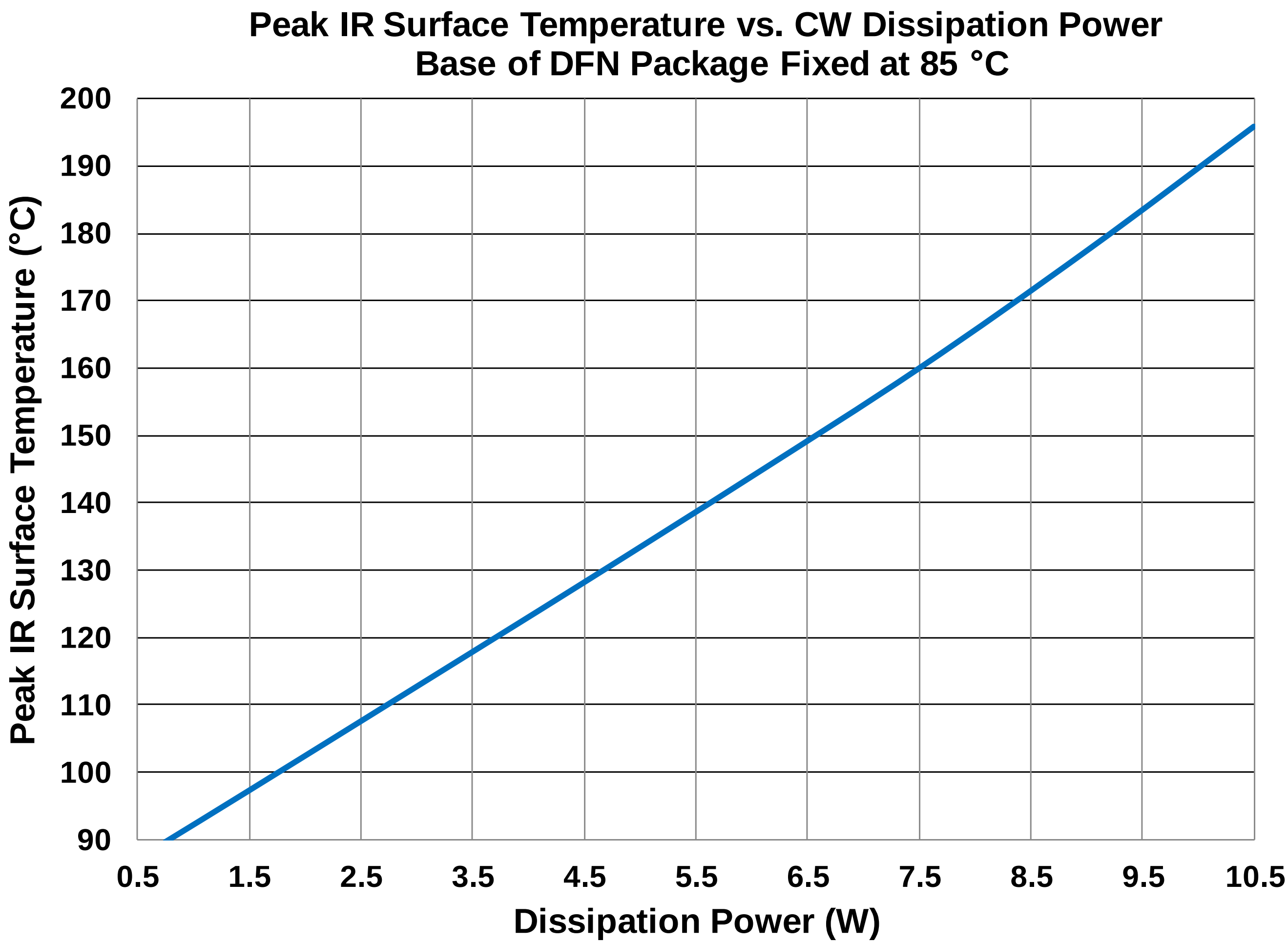


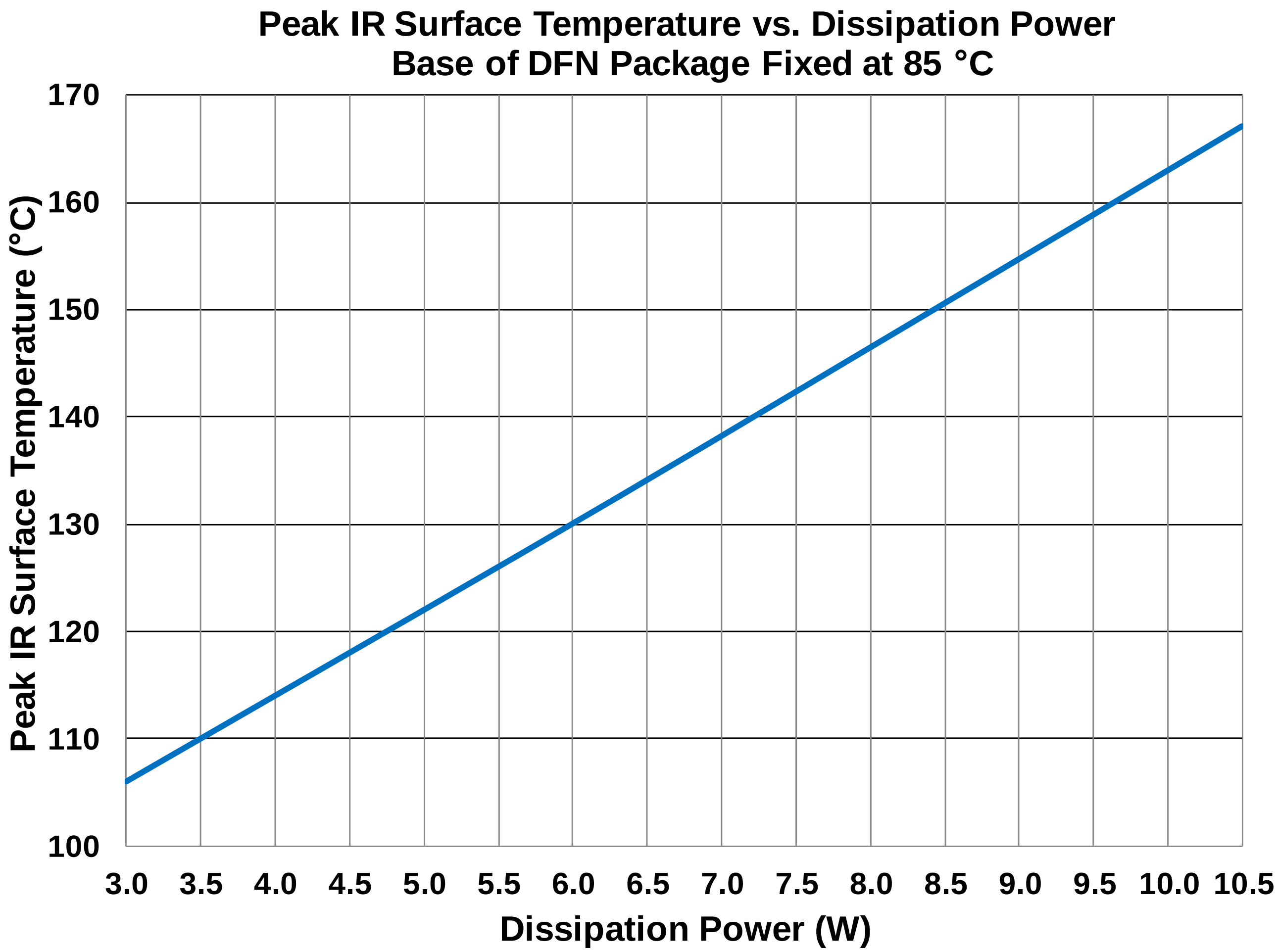
## Thermal and Reliability Information - CW




| Parameter | Conditions | Values | Units |
|---|---|---|---|
| Thermal Resistance, IR[1] ($\theta_{JC}$) | 85 °C Case<br>10.5 W Pdiss, CW | 10.6 | °C/W |
| Peak IR Surface Temperature[1] ($T_{CH}$) | | 196 | °C |
| Thermal Resistance, IR[1] ($\theta_{JC}$) | 85 °C Case<br>9.0 W Pdiss, CW | 10.2 | °C/W |
| Peak IR Surface Temperature[1] ($T_{CH}$) | | 177 | °C |
| Thermal Resistance, IR[1] ($\theta_{JC}$) | 85 °C Case<br>7.5 W Pdiss, CW | 10.0 | °C/W |
| Peak IR Surface Temperature[1] ($T_{CH}$) | | 160 | °C |
| Thermal Resistance, IR[1] ($\theta_{JC}$) | 85 °C Case<br>6.0 W Pdiss, CW | 9.8 | °C/W |
| Peak IR Surface Temperature[1] ($T_{CH}$) | | 144 | °C |
| Thermal Resistance, IR[1] ($\theta_{JC}$) | 85 °C Case<br>4.5 W Pdiss, CW | 9.6 | °C/W |
| Peak IR Surface Temperature[1] ($T_{CH}$) | | 128 | °C |

[1]Refer to the following document GaN Device Channel Temperature, Thermal Resistance, and Reliability Estimates

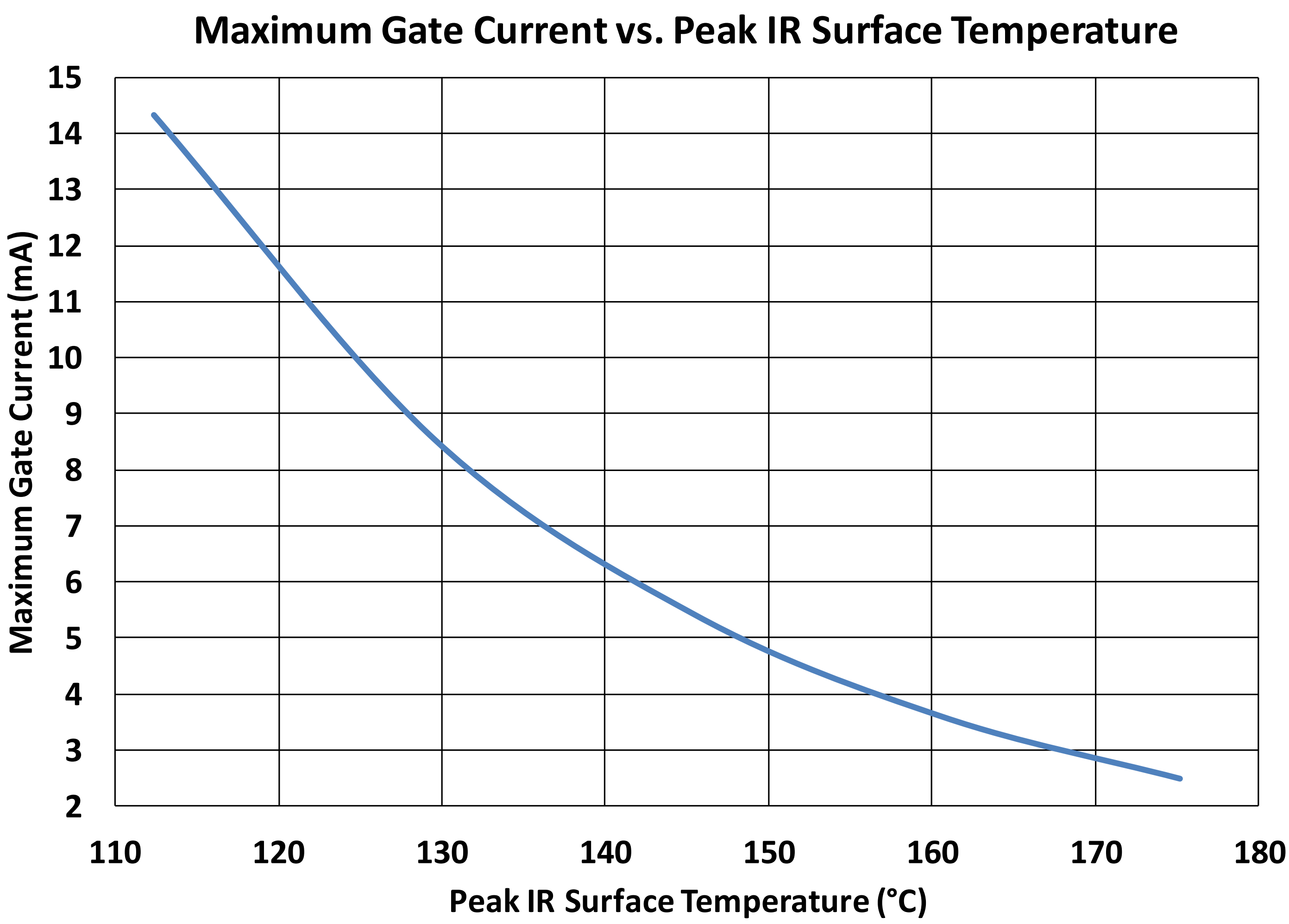
## Thermal and Reliability Information - Pulsed




| Parameter | Conditions | Values | Units |
|---|---|---|---|
| Thermal Resistance, IR[1] ($\theta_{JC}$) | 85 °C Case | 7.8 | °C/W |
| Peak IR Surface Temperature[1] ($T_{CH}$) | 10.5 W Pdiss, 100 uS PW, 10% DC | 167 | °C |
| Thermal Resistance, IR[1] ($\theta_{JC}$) | 85 °C Case | 7.7 | °C/W |
| Peak IR Surface Temperature[1] ($T_{CH}$) | 8.3 W Pdiss, 100 uS PW, 10% DC | 149 | °C |
| Thermal Resistance, IR[1] ($\theta_{JC}$) | 85 °C Case | 7.5 | °C/W |
| Peak IR Surface Temperature[1] ($T_{CH}$) | 6.0 W Pdiss, 100 uS PW, 10% DC | 130 | °C |
| Thermal Resistance, IR[1] ($\theta_{JC}$) | 85 °C Case | 7.0 | °C/W |
| Peak IR Surface Temperature[1] ($T_{CH}$) | 3.0 W Pdiss, 100 uS PW, 10% DC | 106 | °C |

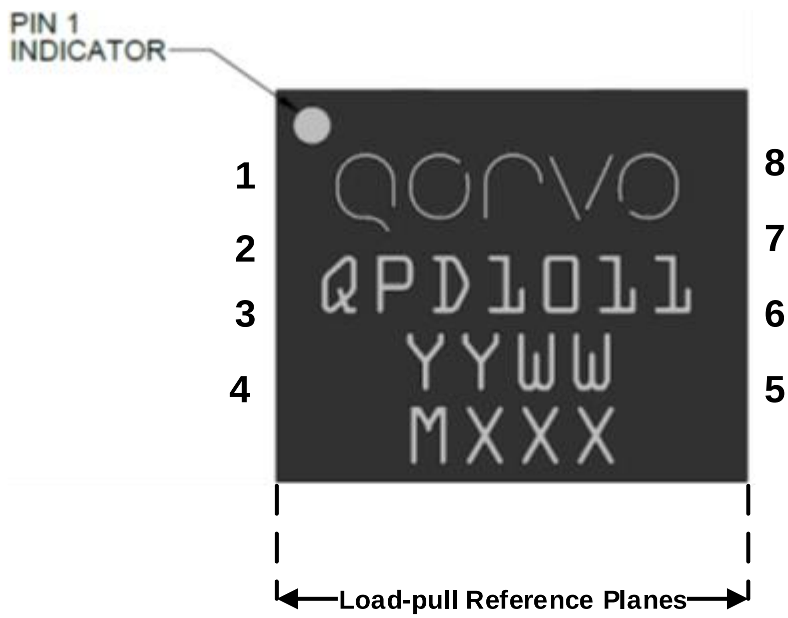
[1]Refer to the following document GaN Device Channel Temperature, Thermal Resistance, and Reliability Estimates

## Maximum Gate Current



## Pin Configuration and Description[1]

Note 1: The QPD1011 will be marked with the “QPD1011” designator and a lot code marked below the part designator. The “YY” represents the last two digits of the calendar year the part was manufactured, the “WW” is the work week of the assembly lot start, the MXXX” is the production lot number.

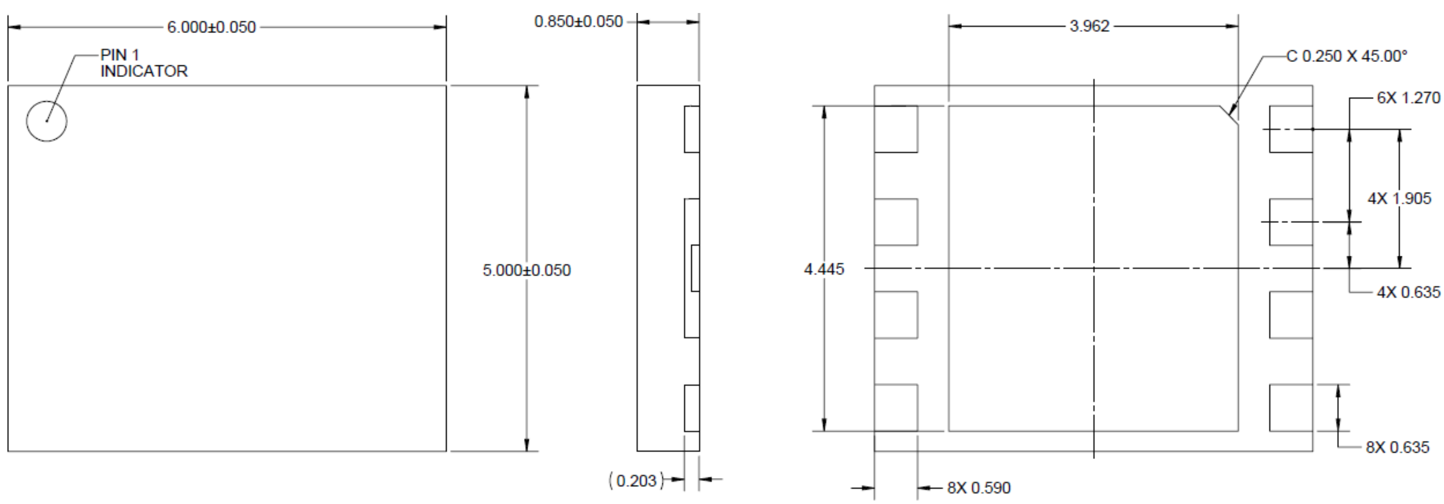



| Pin | Symbol | Description |
|---|---|---|
| 1 | $V_G$ | Gate Voltage |
| 2, 3 | RF INPUT | Gate |
| 6, 7 | RF OUTPUT / $V_D$ | Drain |
| 4, 5, 8 | NC | No connection |
| 9 | Source | Source / Ground / Backside of part |

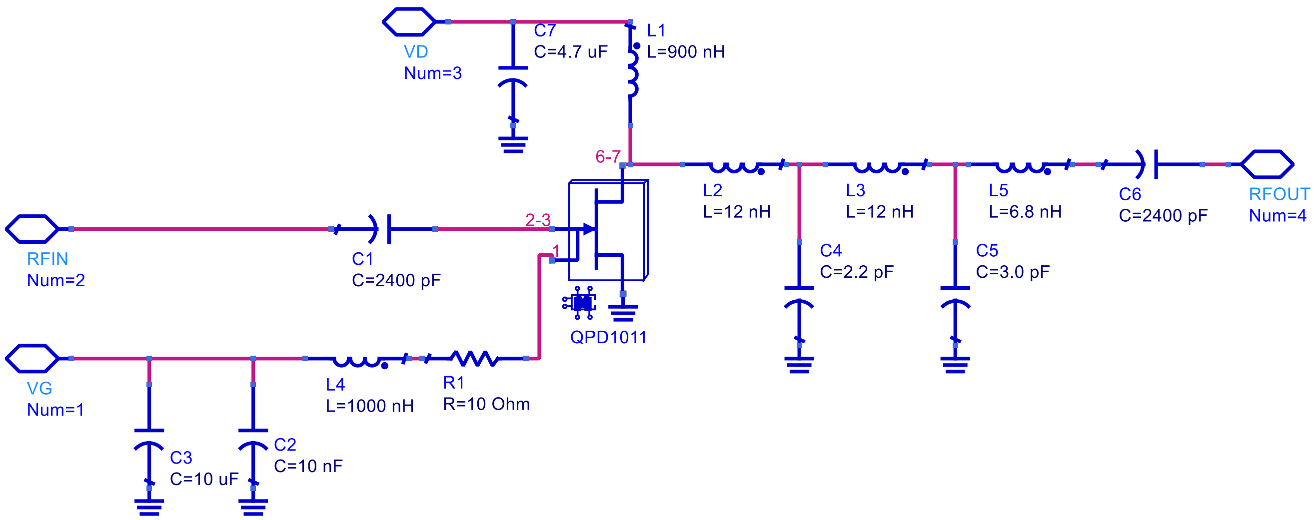
## Mechanical Drawing[1, 2, 3, 4]

Note

1. Dimensions are in mm.
2. Dimension tolerance is ± 0.1 mm, unless noted otherwise.
3. Package leads are gold plated.
4. Part is mold encapsulated.



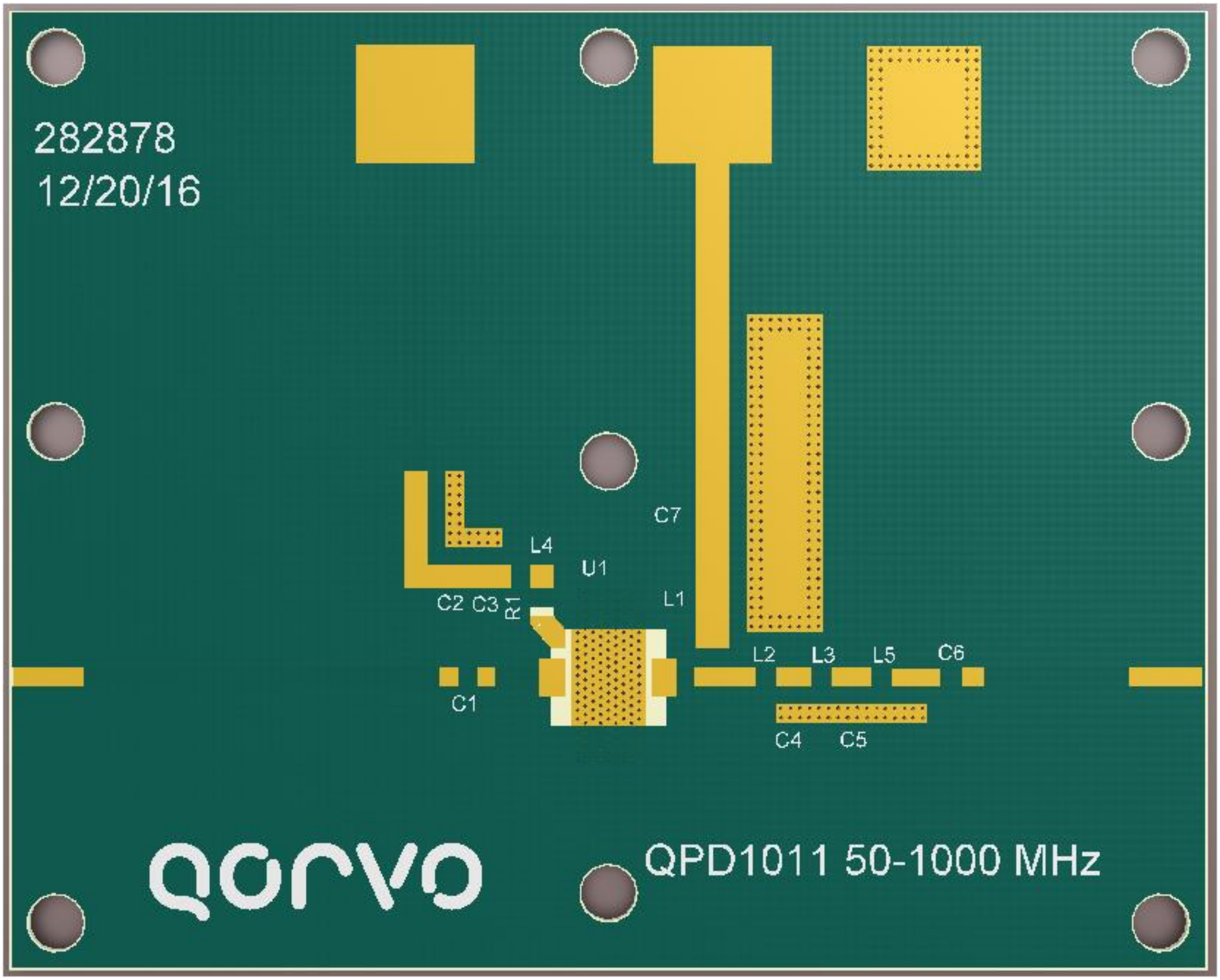
## 50 – 1000 MHz Application Circuit - Schematic




| Bias-up Procedure | Bias-down Procedure |
|---|---|
| 1. Set $V_G$ to -3.5 V. | 1. Turn off RF signal. |
| 2. Set $I_D$ current limit to 30 mA. | 2. Turn off $V_D$ |
| 3. Apply 50 V $V_D$. | 3. Wait 2 seconds to allow drain capacitor to discharge |
| 4. Slowly adjust $V_G$ until $I_D$ is set to 20 mA. | 4. Turn off $V_G$ |
| 5. Set $I_D$ current limit to 500 mA (CW operation) | |
| 6. Apply RF. | |

## 50 – 1000 MHz Application Circuit - Layout

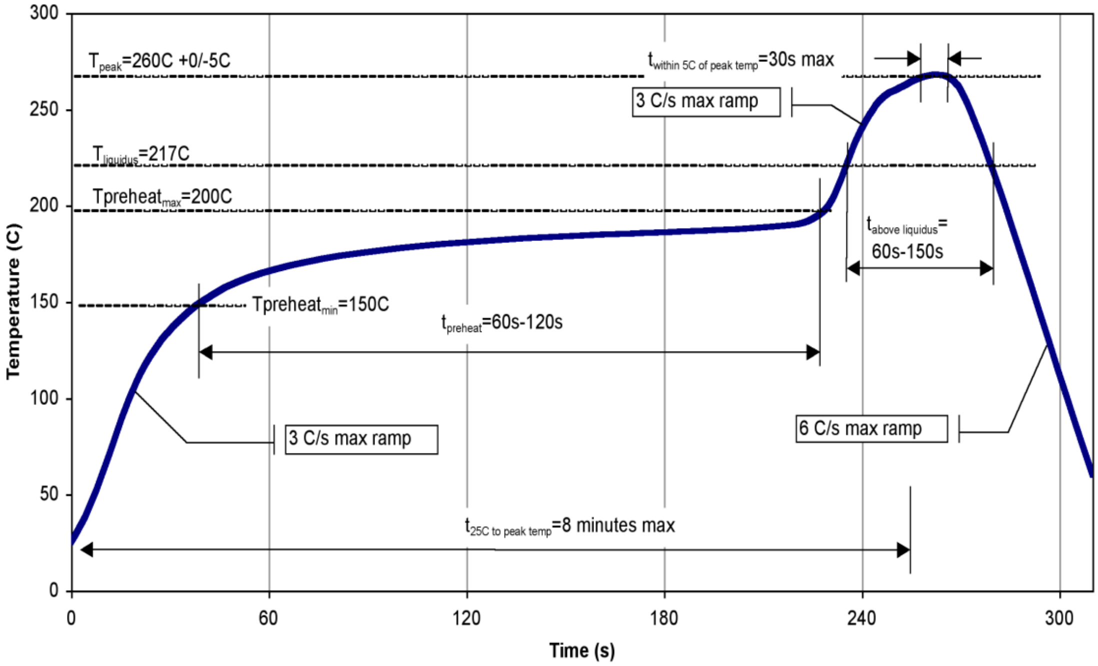
Board material is RO4350B 0.020” thickness with 2oz copper cladding. Overall EVB size is 3.98” x 3.98”.



## 50 – 1000 MHz Application Circuit - Bill Of material

| Description | Ref. Des. | Manufacturer | Part Number |
|---|---|---|---|
| CAP, SMT 0603 10nF | C2 | AVX Corporation | 0603YC103KAT2A |
| CAP, CER, SMD 10UF, 10%, 10V, 0805, X7R | C3 | Murata | GRM21BR71A106KE51L |
| CAP MLCC 2400PF TC +/-15% 50V, 0805 | C1, C6 | | C08BL242X-5UN-X0T |
| CAP CER 4.7UF 100V 10% X7R 2220 | C7 | Murata | GRM55ER72A475KA01L |
| CAP, 2.2pF, +/-0.1pF, 250V, Hi-Q, 0603 | C4 | American Technical Ceramics | 600S2R2BT250T |
| CAP, 3.0pF, +/-0.1pF, 250V, HI-Q, 0603 | C5 | American Technical Ceramics | 600S3R0BT250XT |
| RES 10 OHM 1/10W +-5% 0603 | R1 | TTI Inc. | CRCW060310R0JNEA |
| IND 1000nH 0603 2% | L4 | Coilcraft Inc. | 0603LS-102XGLC |
| IND 900nH 1008 5% | L1 | Coilcraft Inc. | 1008AF-901XJLC |
| IND, 6.8nH, 5%, W/W, 0603 | L5 | Coilcraft Inc. | 0603HC-6N8XJLW |
| IND, 12nH, 5%, 0603, HC | L2, L3 | Coilcraft Inc. | 0603HC-12NXGLW |

## Recommended Solder Temperature Profile



## Handling Precautions

| Parameter | Rating | Standard |
|---|---|---|
| ESD – Human Body Model (HBM) | Class 1A, 250 V | ANSI/ESD/JEDEC JS-001 |
| ESD – Charged Device Model (CDM) | 750 V | ANSI/ESD/JEDEC JS-002 |
| MSL – Moisture Sensitivity Level | Level 3 | JESD 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.

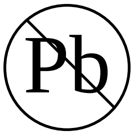
Contact plating: NiPdAu

## 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, and information about Qorvo:

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For technical questions and application information: **Email:** info-products@qorvo.com

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# OCEAN CHIPS
## Океан Электроники
### Поставка электронных компонентов

Компания «Океан Электроники» предлагает заключение долгосрочных отношений при поставках импортных электронных компонентов на взаимовыгодных условиях!

Наши преимущества:

- Поставка оригинальных импортных электронных компонентов напрямую с производств Америки, Европы и Азии, а так же с крупнейших складов мира;
- Широкая линейка поставок активных и пассивных импортных электронных компонентов (более 30 млн. наименований);
- Поставка сложных, дефицитных, либо снятых с производства позиций;
- Оперативные сроки поставки под заказ (от 5 рабочих дней);
- Экспресс доставка в любую точку России;
- Помощь Конструкторского Отдела и консультации квалифицированных инженеров;
- Техническая поддержка проекта, помощь в подборе аналогов, поставка прототипов;
- Поставка электронных компонентов под контролем ВП;
- Система менеджмента качества сертифицирована по Международному стандарту ISO 9001;
- При необходимости вся продукция военного и аэрокосмического назначения проходит испытания и сертификацию в лаборатории (по согласованию с заказчиком);
- Поставка специализированных компонентов военного и аэрокосмического уровня качества (Xilinx, Altera, Analog Devices, Intersil, Interpoint, Microsemi, Actel, Aeroflex, Peregrine, VPT, Syfer, Eurofarad, Texas Instruments, MS Kennedy, Miteq, Cobham, E2V, MA-COM, Hittite, Mini-Circuits, General Dynamics и др.);

Компания «Океан Электроники» является официальным дистрибьютором и эксклюзивным представителем в России одного из крупнейших производителей разъемов военного и аэрокосмического назначения **«JONHON»**, а так же официальным дистрибьютором и эксклюзивным представителем в России производителя высокотехнологичных и надежных решений для передачи СВЧ сигналов **«FORSTAR»**.

**«JONHON»** (основан в 1970 г.)

Разъемы специального, военного и аэрокосмического назначения:

(Применяются в военной, авиационной, аэрокосмической, морской, железнодорожной, горно- и нефтедобывающей отраслях промышленности)

**«FORSTAR»** (основан в 1998 г.)

ВЧ соединители, коаксиальные кабели, кабельные сборки и микроволновые компоненты:

(Применяются в телекоммуникациях гражданского и специального назначения, в средствах связи, РЛС, а так же военной, авиационной и аэрокосмической отраслях промышленности).

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