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.

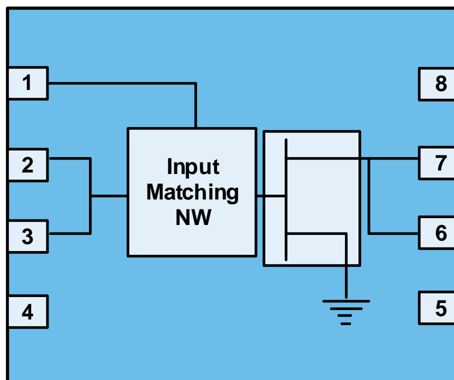
5 x 6 x 0.85 mm Package

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

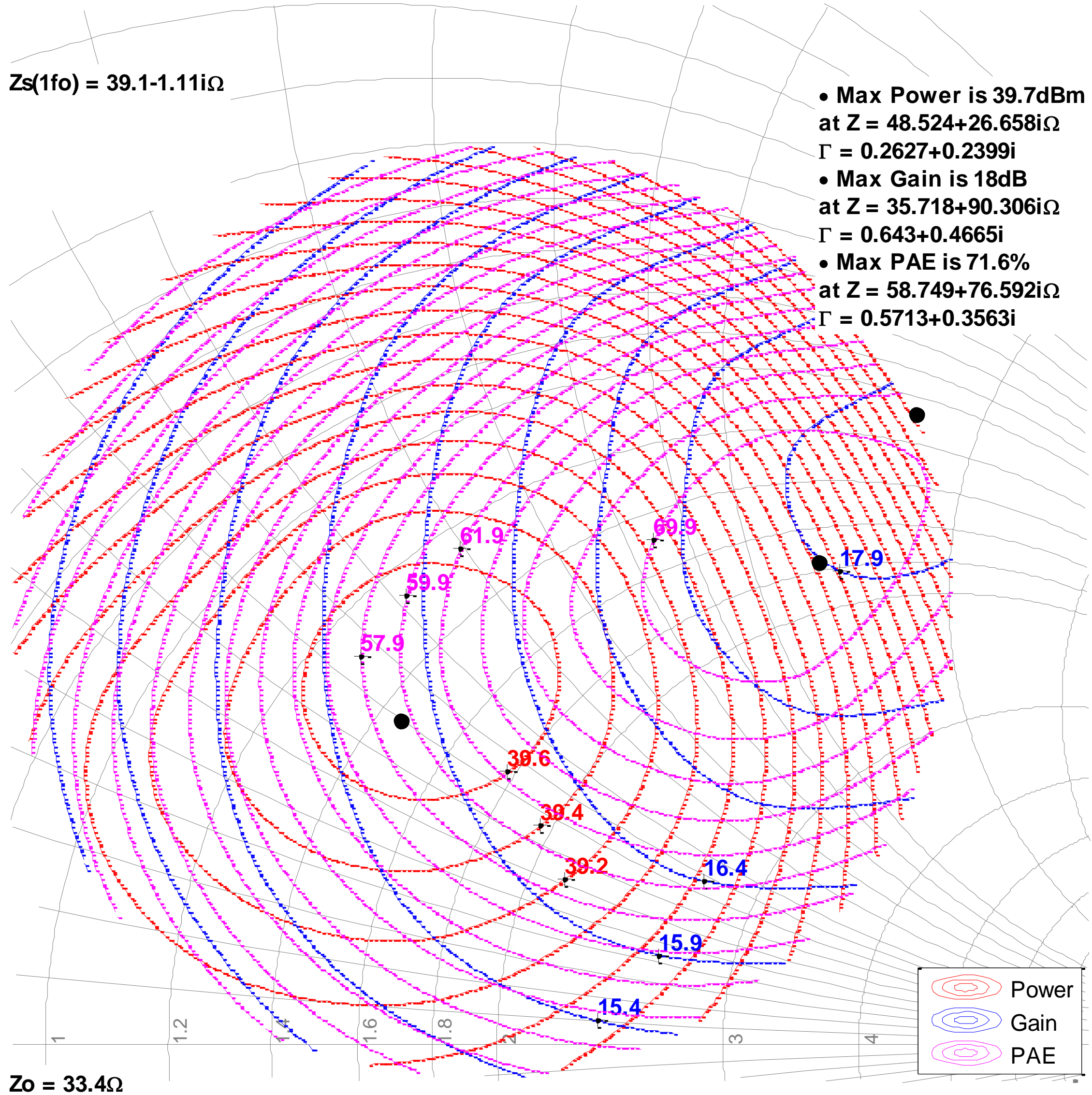
RF Characterization – Mismatch Ruggedness at 1000 MHz[1]

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]

Notes:
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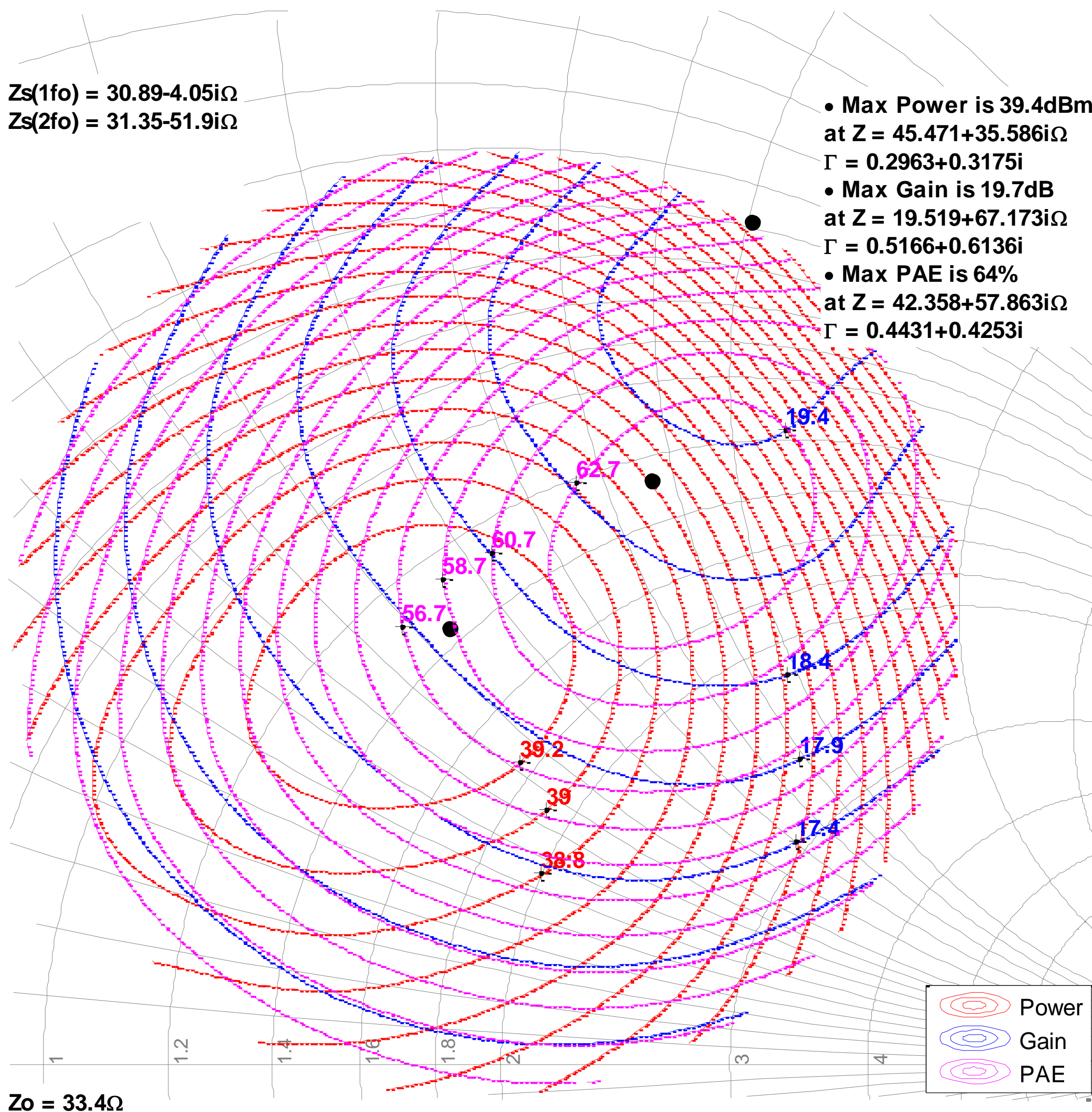

Measured Load-Pull Smith Charts[1, 2]

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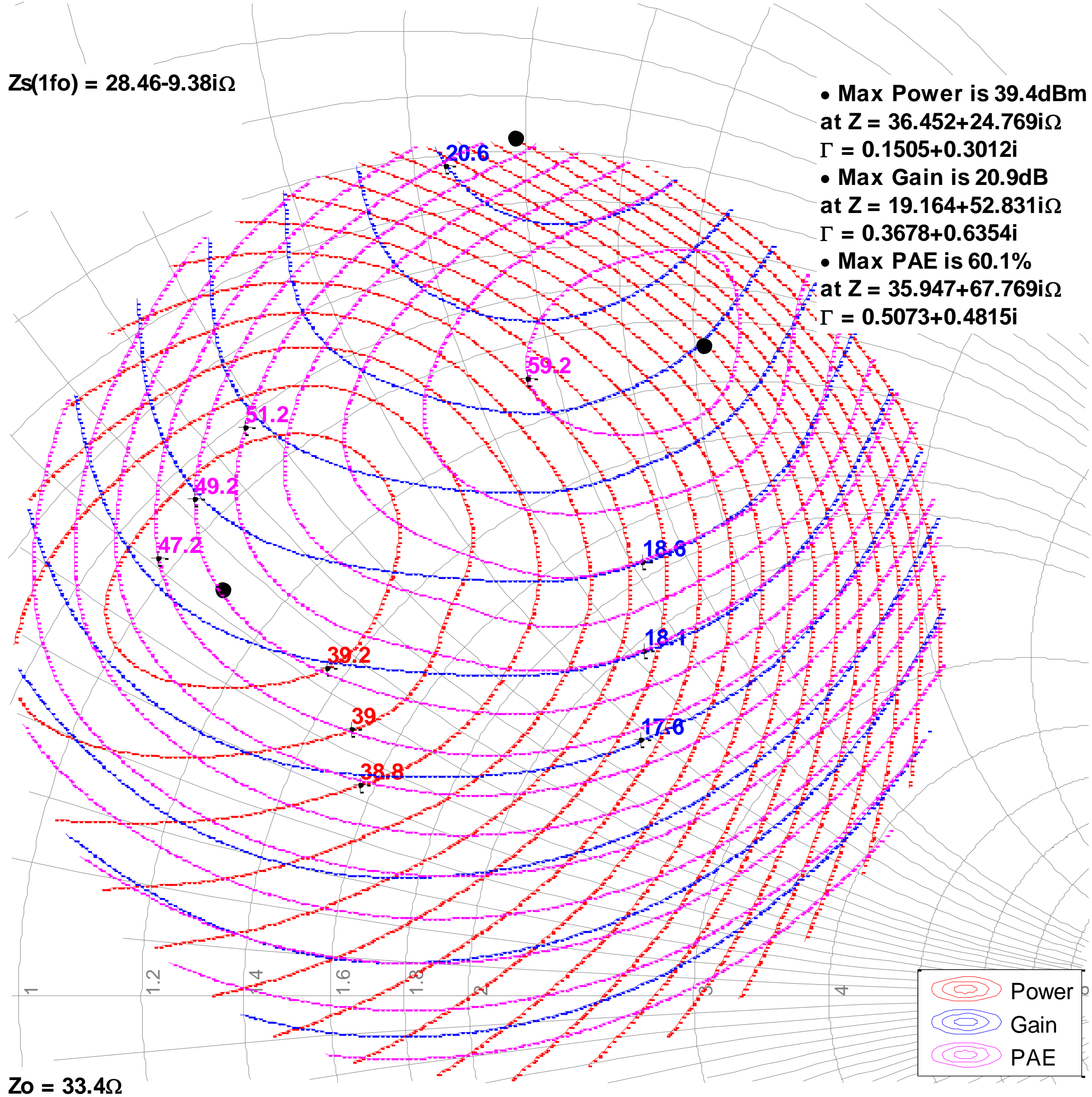

Measured Load-Pull Smith Charts[1, 2]

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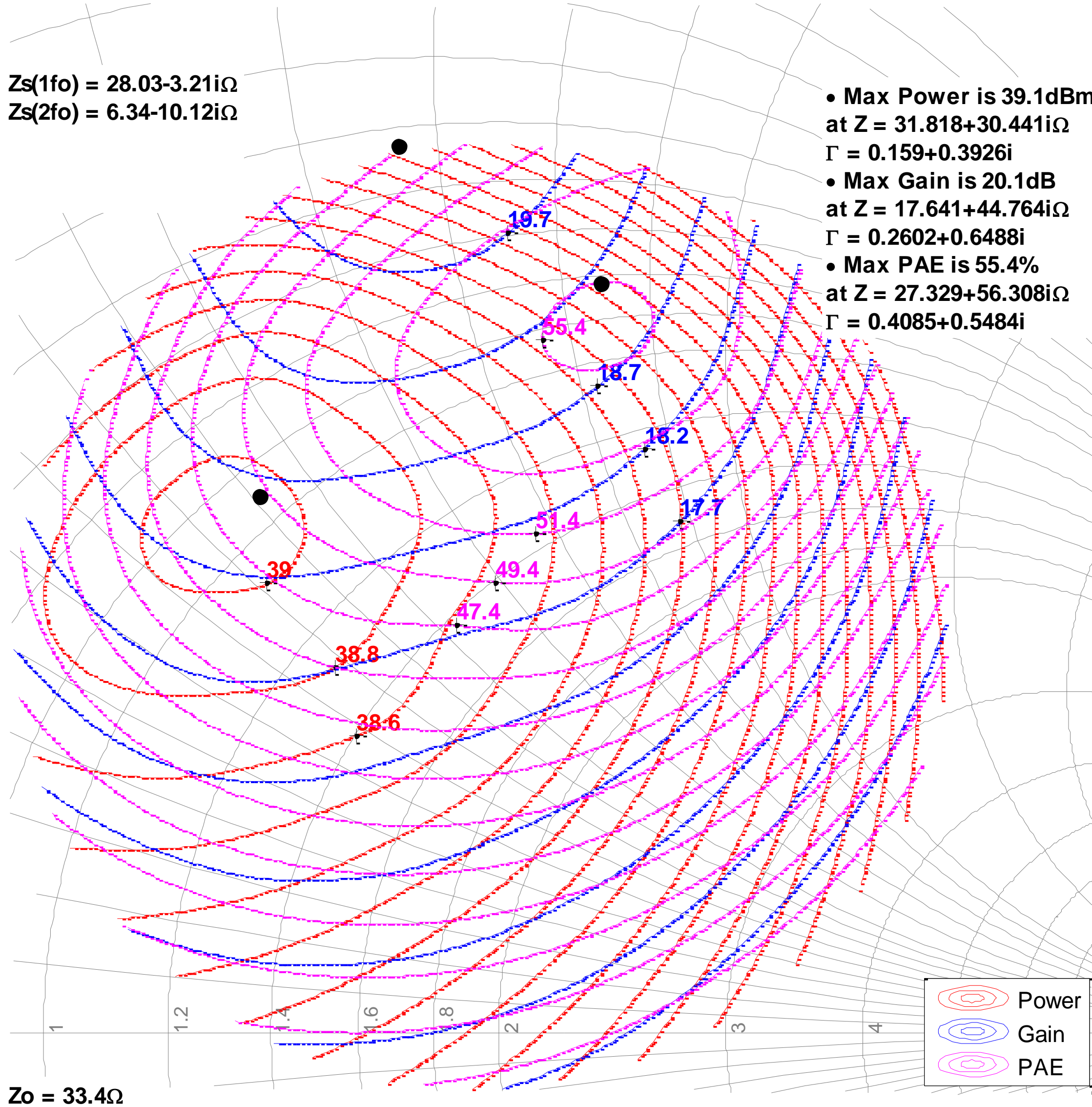
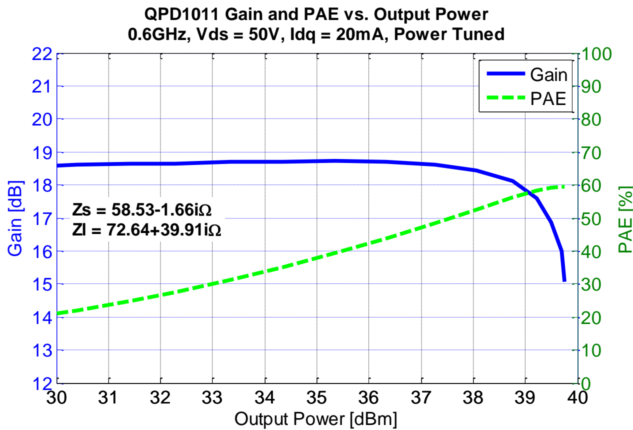
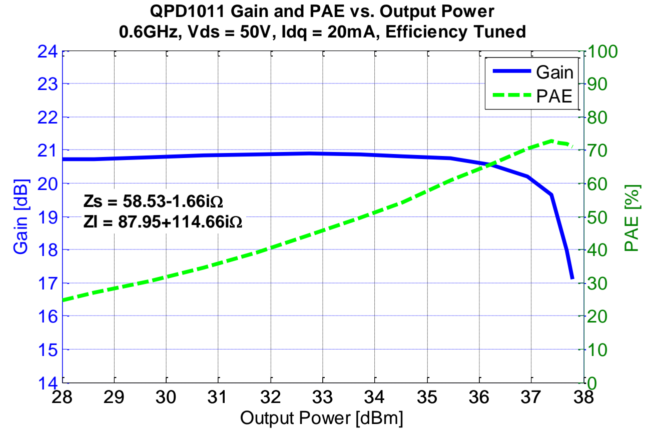
2. See page 18 for load pull reference planes where the performance was measured.

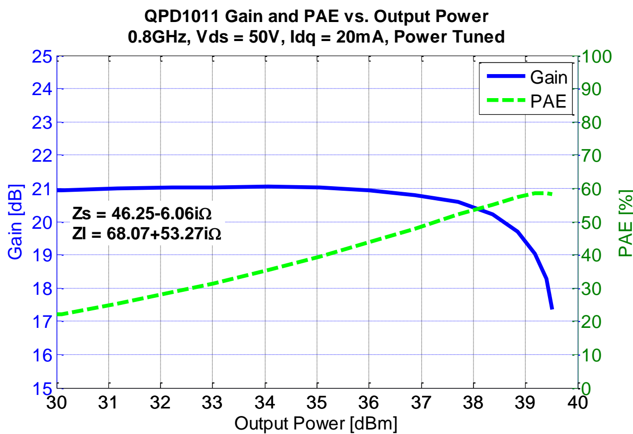


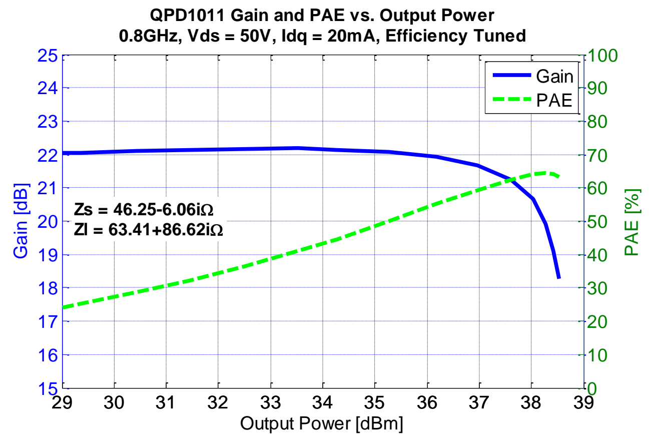
Typical Measured Performance – Load-Pull Drive-up[1, 2]

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.



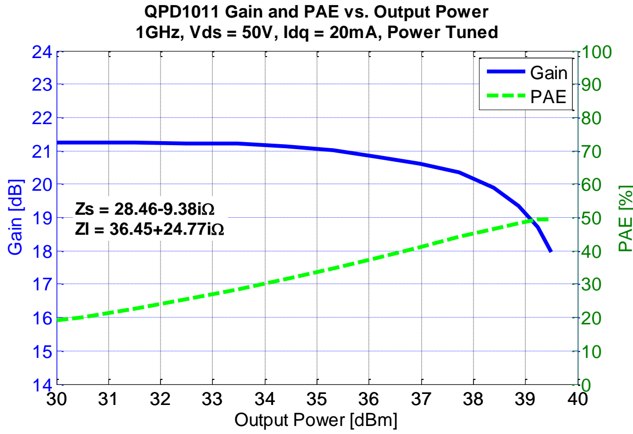


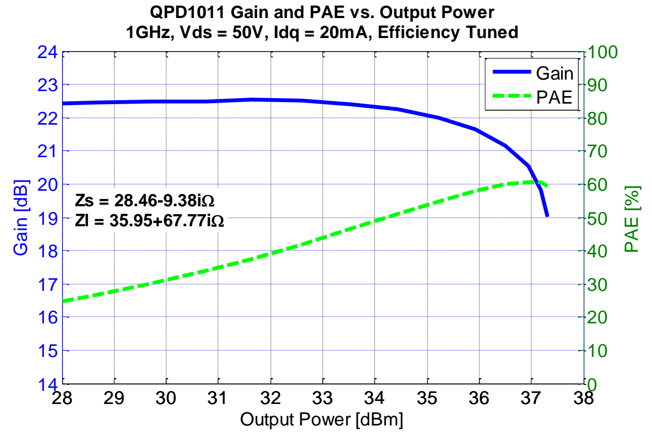


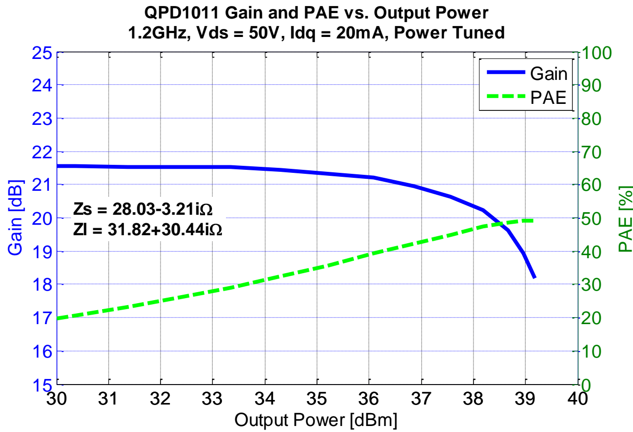


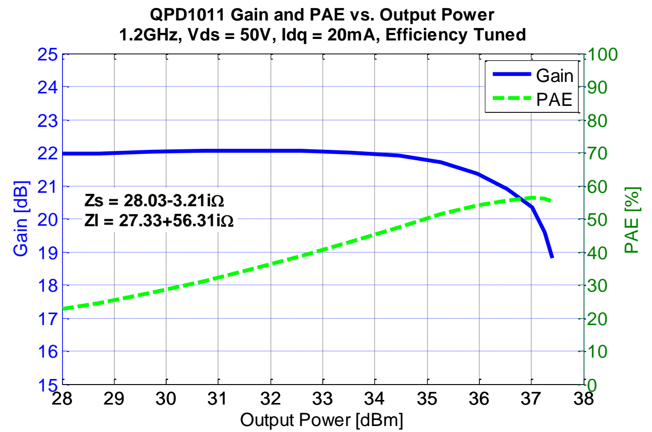
Typical Measured Performance – Load-Pull Drive-up[1, 2]

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.



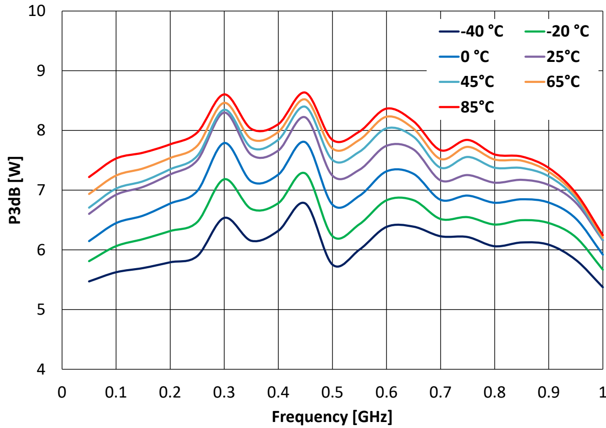


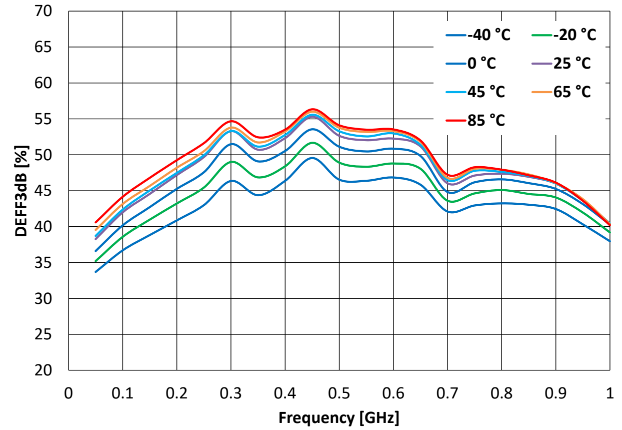


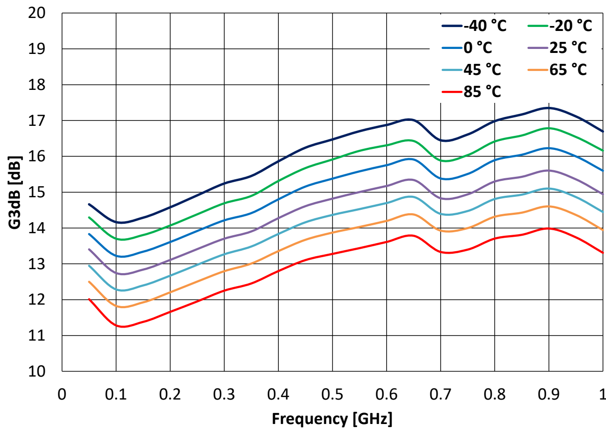


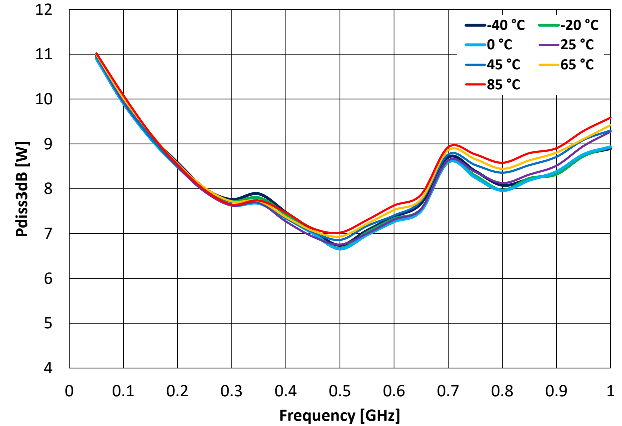
Power Driveup Performance Over Temperatures Of 50 – 1000 MHz EVB[1, 2]

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.



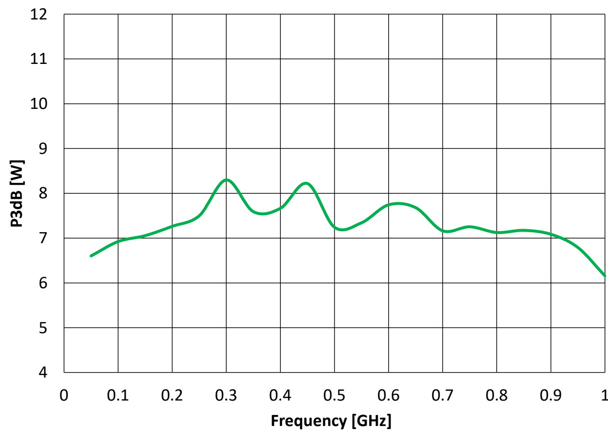


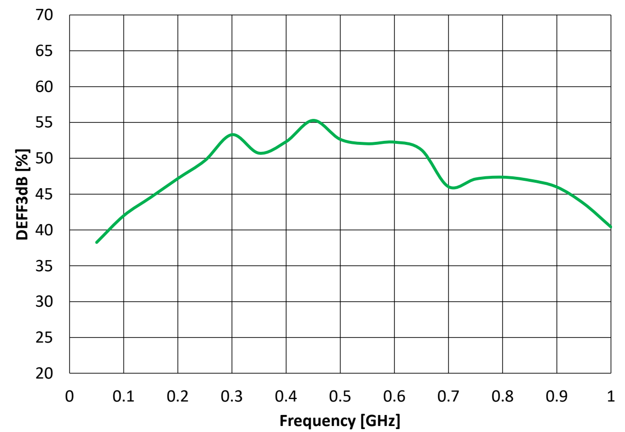


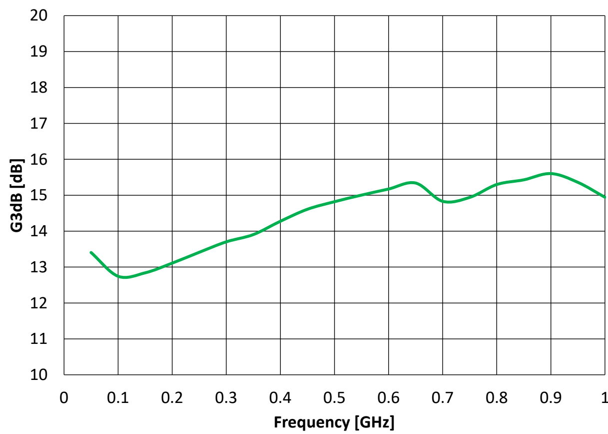


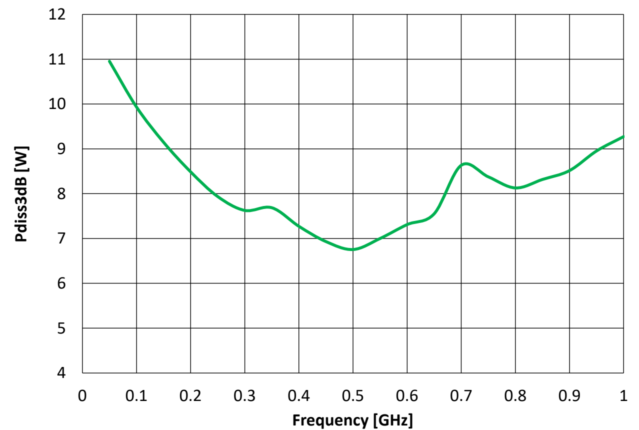
Power Driveup Performance At 25°C Of 50 – 1000 MHz EVB[1, 2]

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.





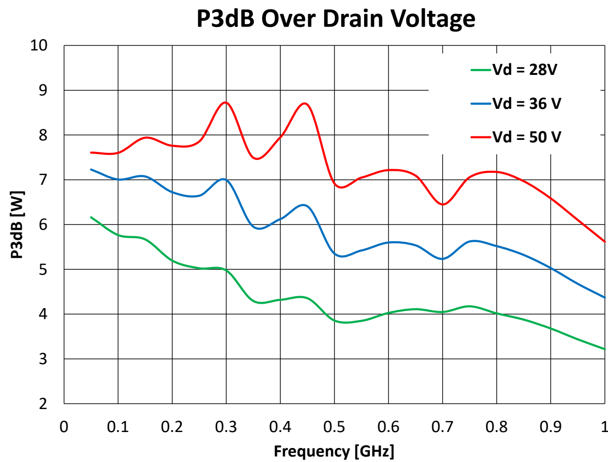


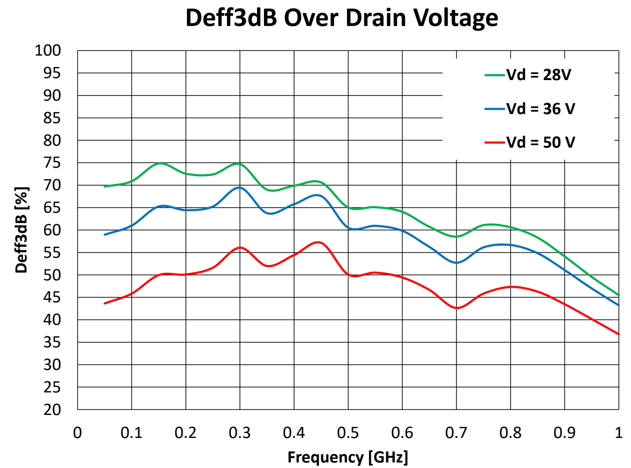


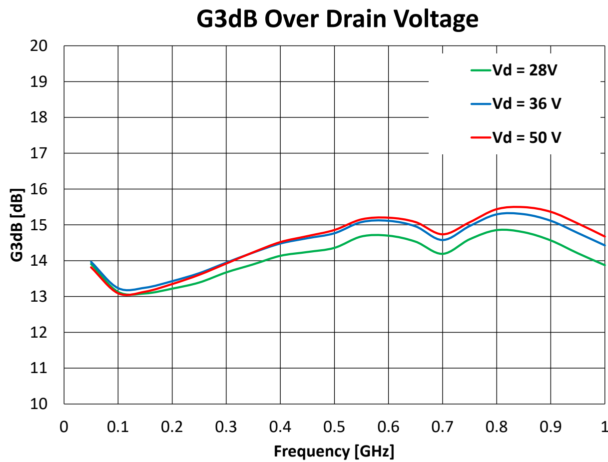
Power Driveup Performance At 25°C Over Drain Voltage Of 50 – 1000 MHz EVB[1, 2]

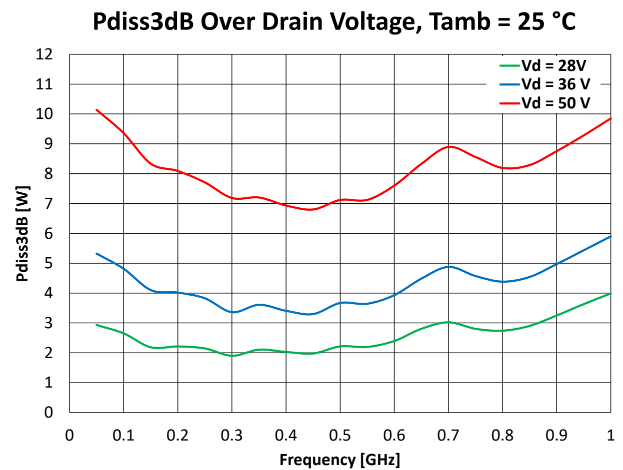
Notes:

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..



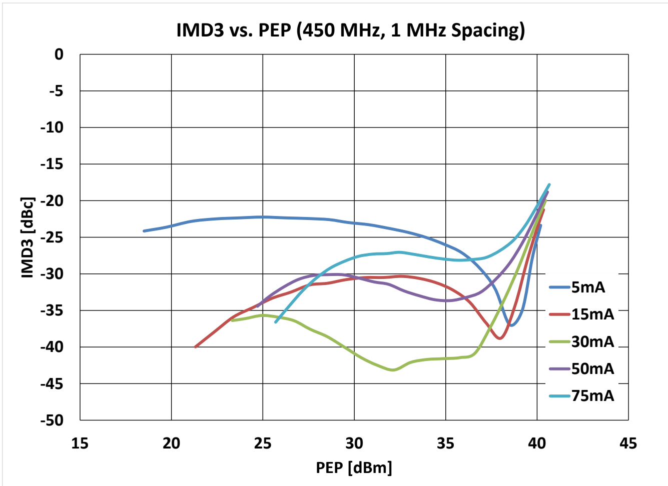


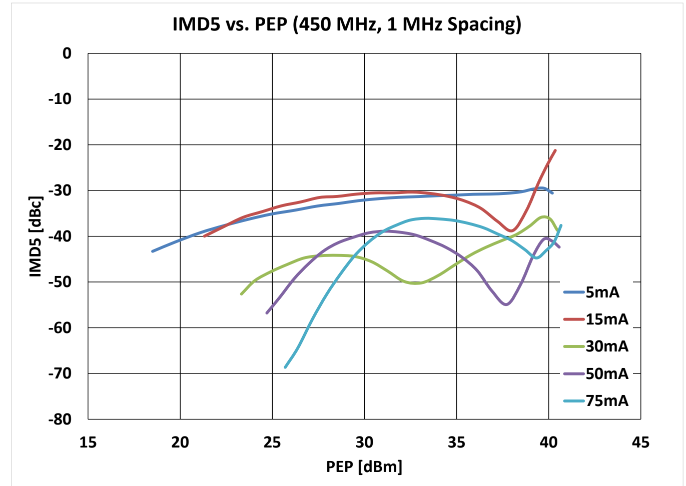


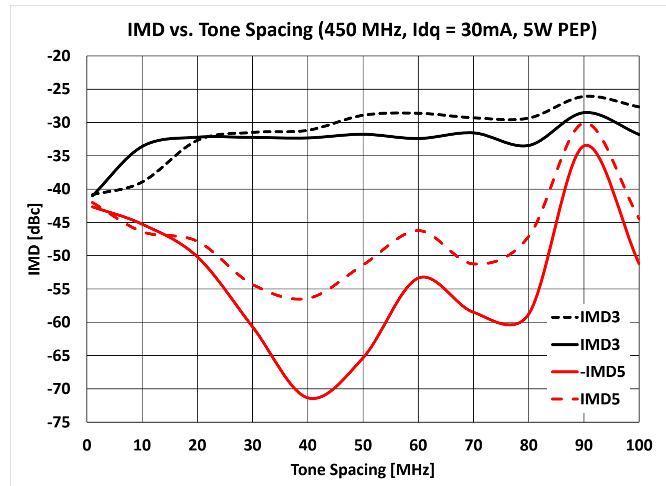


2-Tone Performance At 25°C Of 50 – 1000 MHz EVB[1]

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

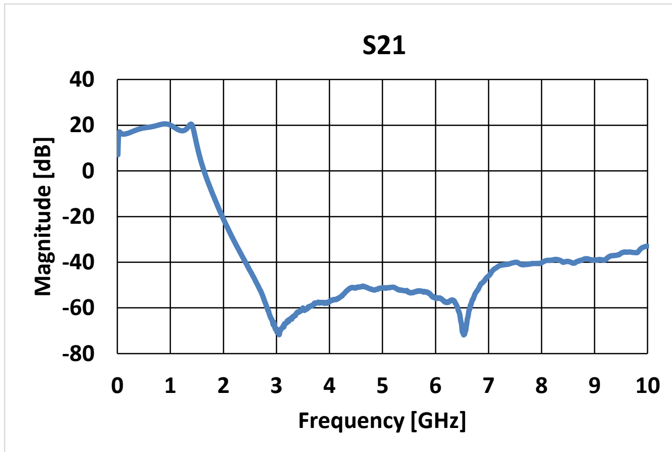


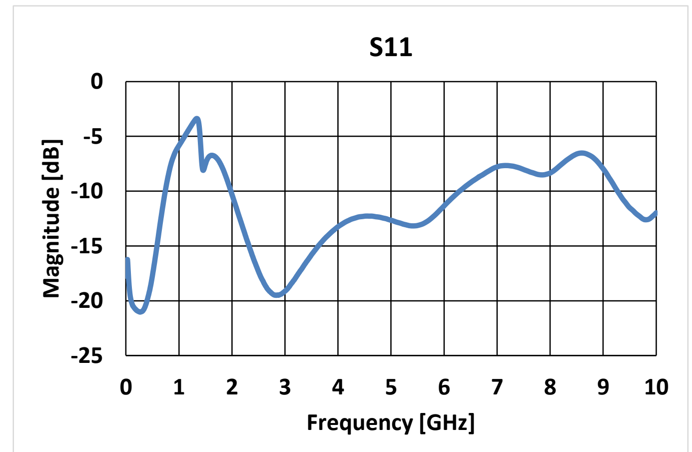


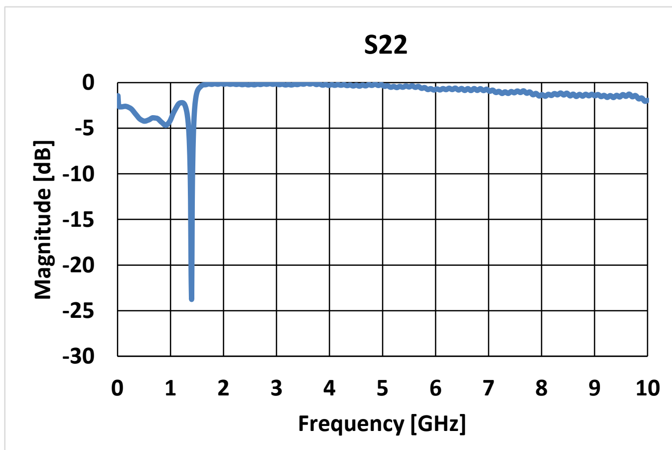


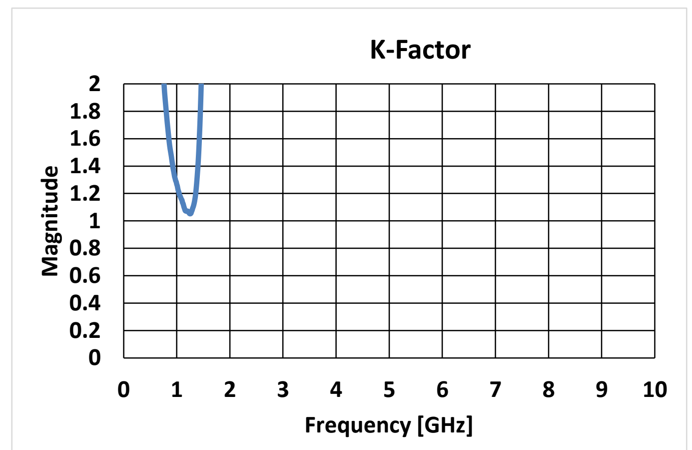
S-Parameters At -40°C Of 50 – 1000 MHz EVB[1, 2]

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

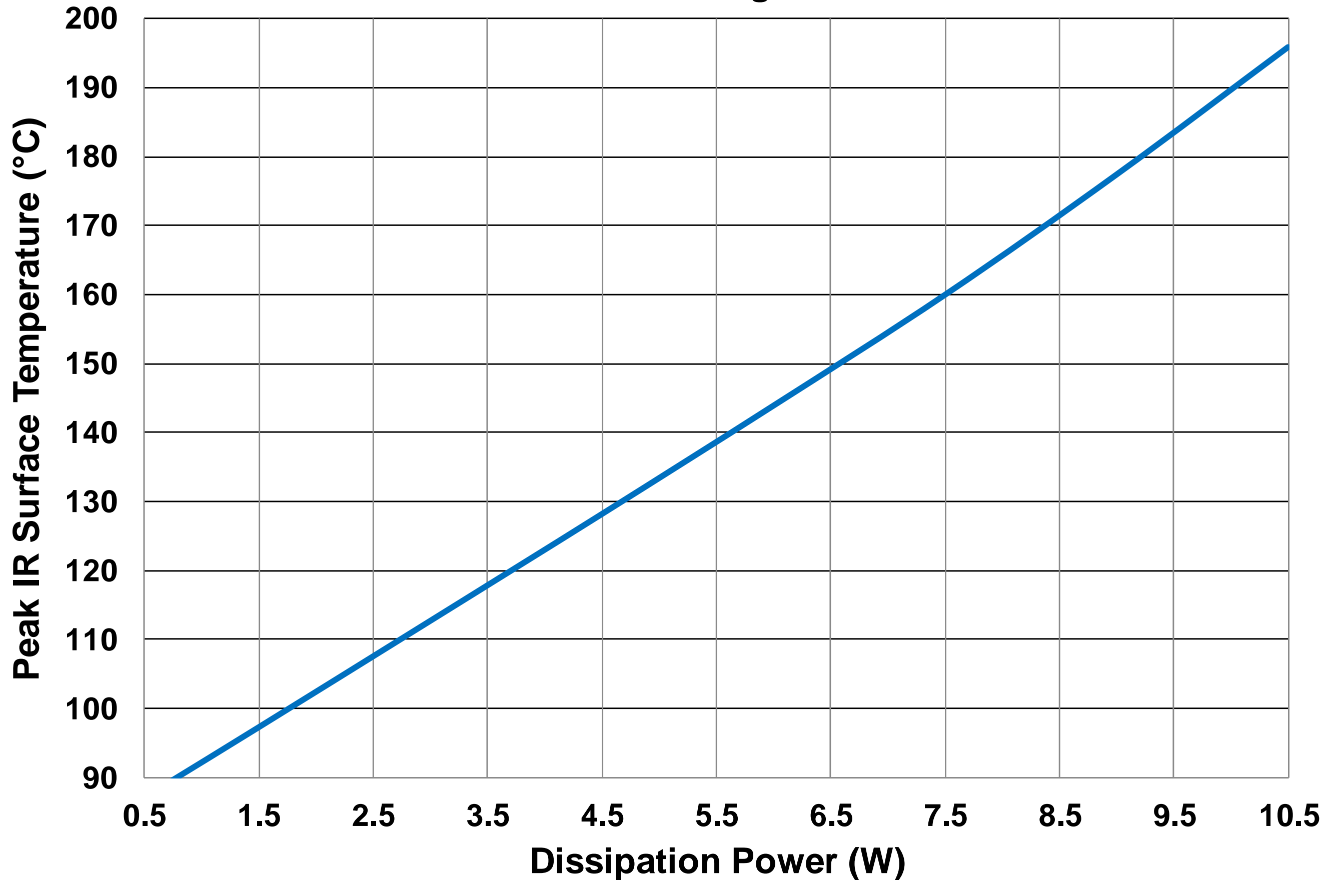








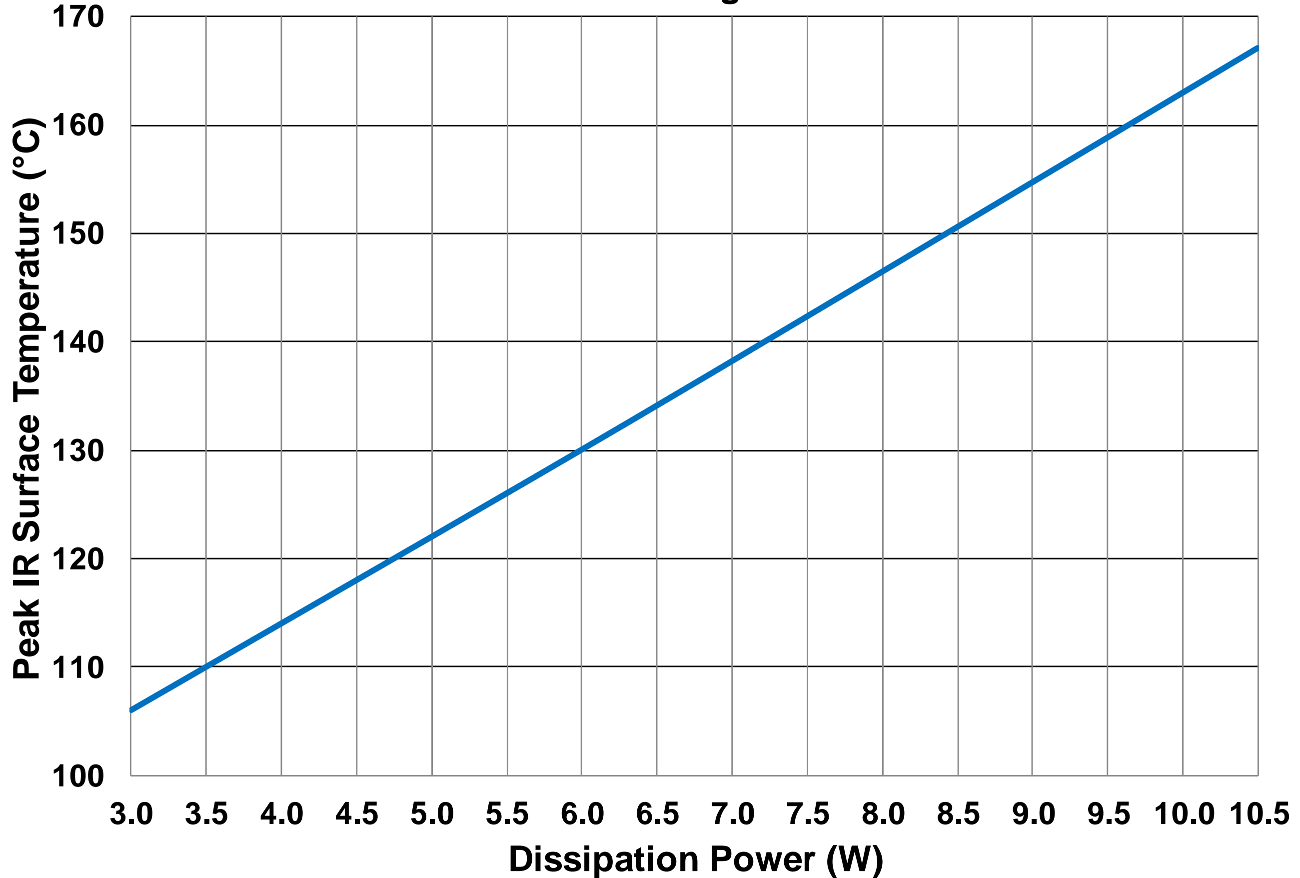
Thermal and Reliability Information - CW



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

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

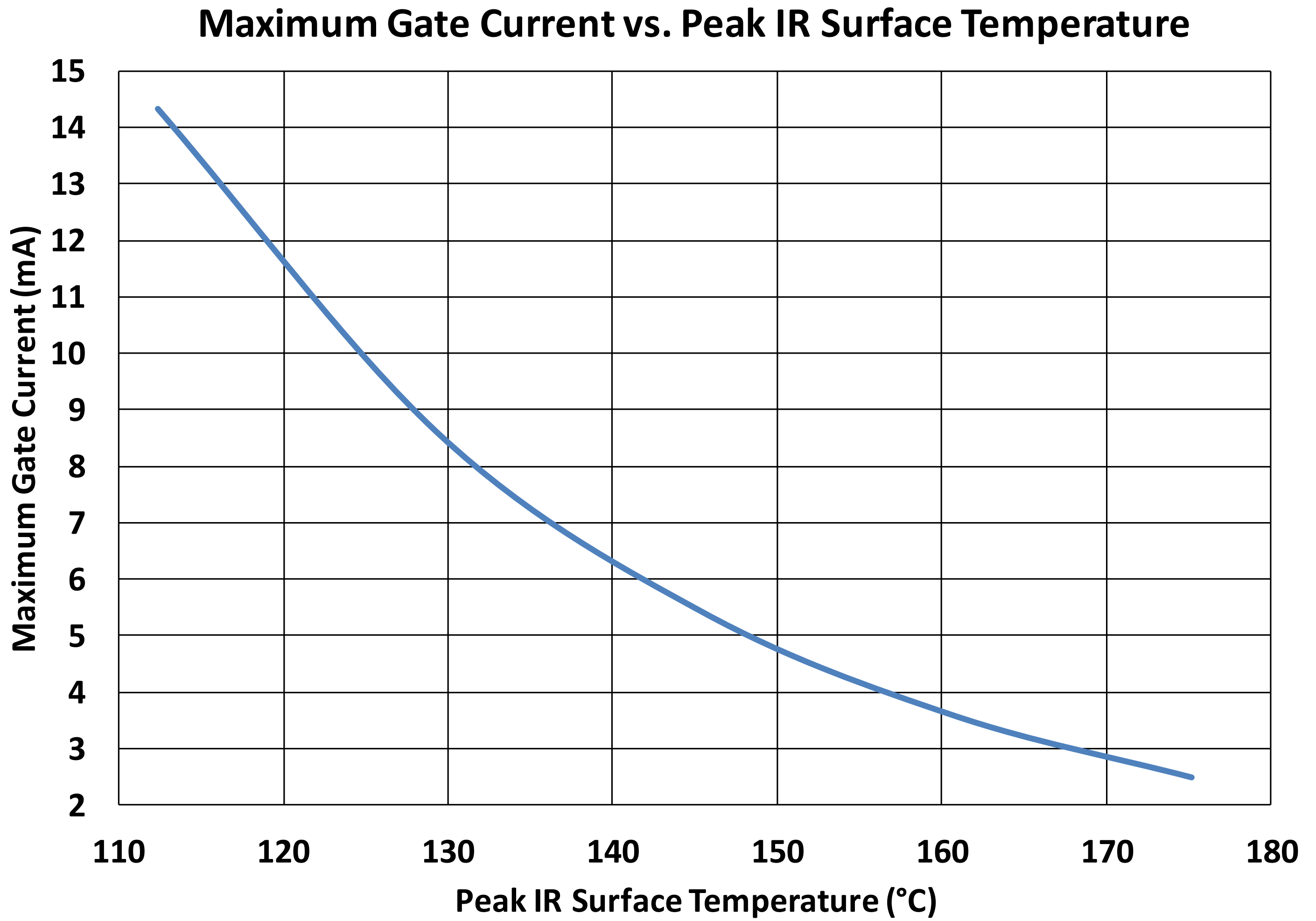
Thermal and Reliability Information - Pulsed



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

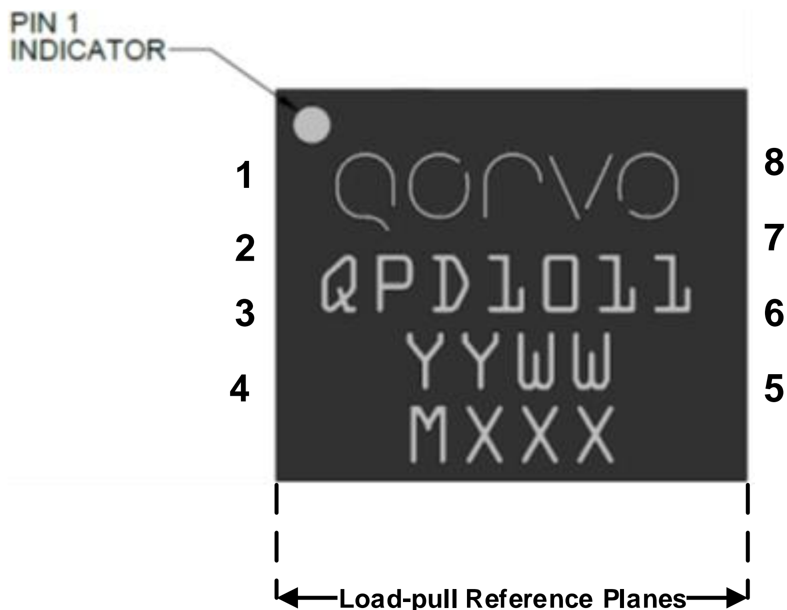
[1]Refer to the following document GaN Device Channel Temperature, Thermal Resistance, and Reliability Estimates

Maximum Gate Current



Pin Configuration and Description[1]

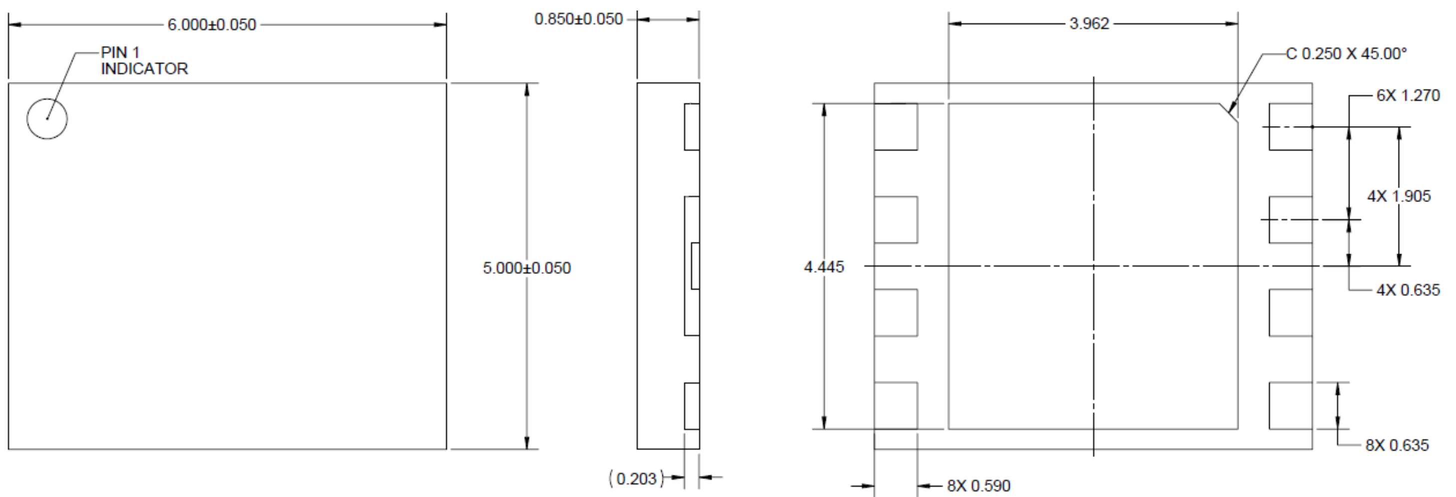
Note 1: The QPD1011 will be marked with the “QPD1011” designator and a lot code marked below the part designator. The “YY” represents the last two digits of the calendar year the part was manufactured, the “WW” is the work week of the assembly lot start, the MXXX” is the production lot number.



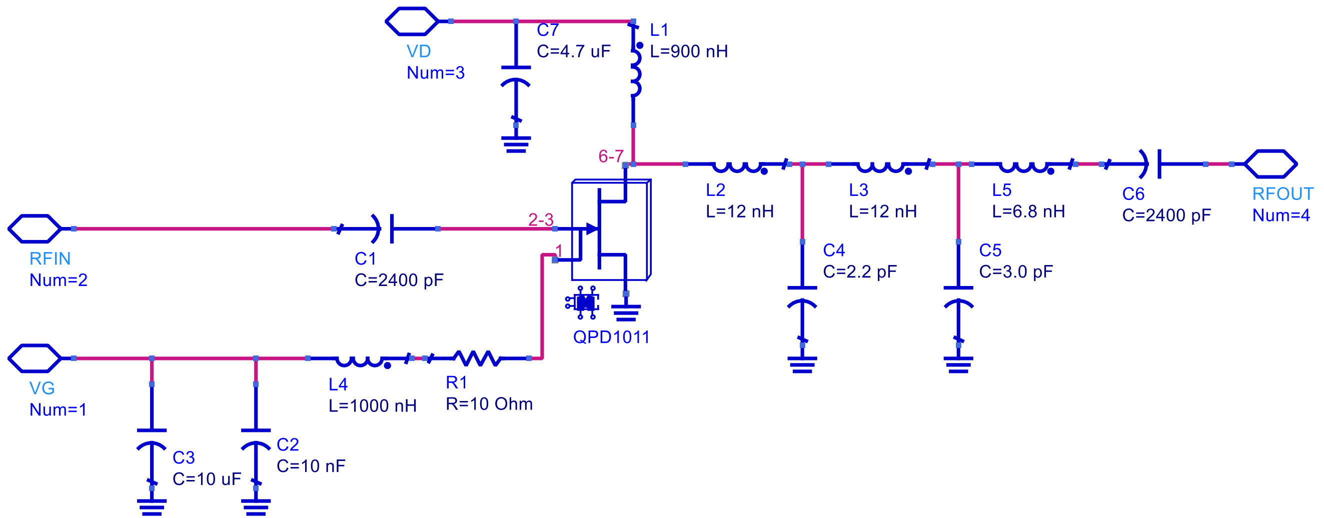
Pin	Symbol	Description
1	V_G	Gate Voltage
2, 3	RF INPUT	Gate
6, 7	RF OUTPUT / V_D	Drain
4, 5, 8	NC	No connection
9	Source	Source / Ground / Backside of part

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.



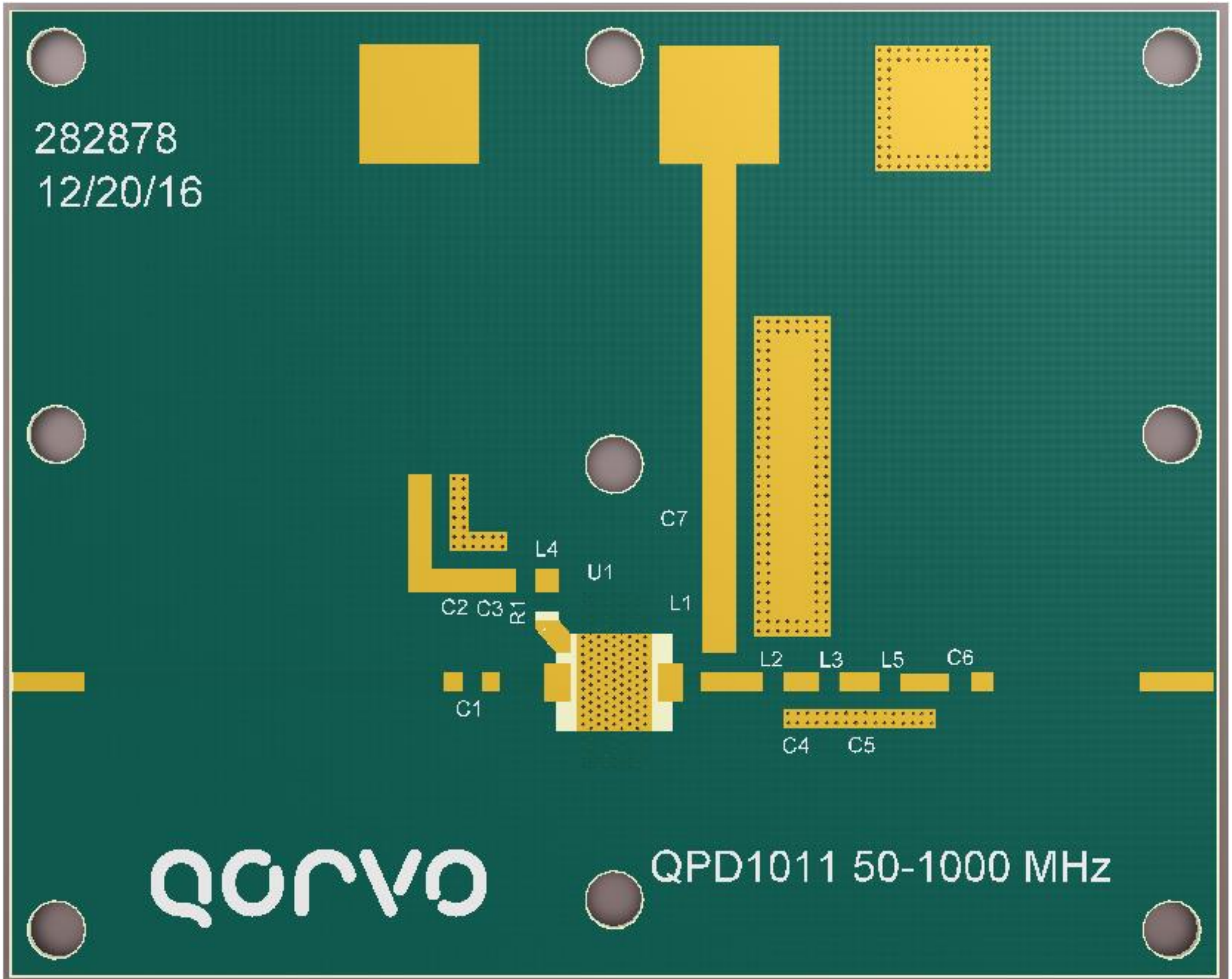
50 – 1000 MHz Application Circuit - Schematic



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