![qorvo]

QPD1010

10W, 50V, DC – 4 GHz, GaN RF Transistor

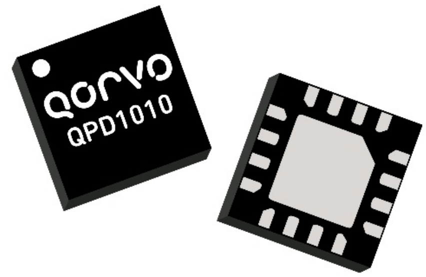
General Description

The Qorvo QPD1010 is a 10 W (P_{3dB}) discrete GaN on SiC HEMT which operates from DC to 4 GHz. The device is constructed with Qorvo's proven QGaN25HV process, which features advanced field plate techniques to optimize power and efficiency at high drain bias operating conditions. This optimization can potentially lower system costs in terms of fewer amplifier line-ups and lower thermal management costs.

The device is housed in an industry-standard 3 x 3 mm surface mount QFN package.

Lead-free and ROHS compliant

Evaluation boards are available upon request.

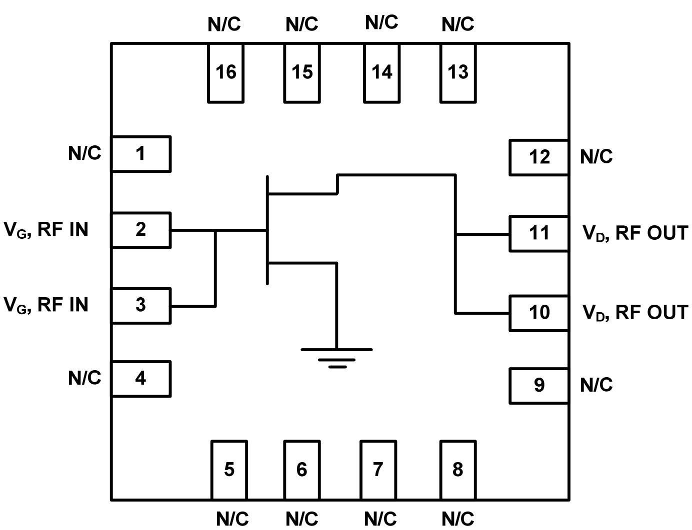


3 x 3 x 0.100 mm

Product Features

- Frequency: DC to 4 GHz
- Output Power (P_{3dB}): 11 W at 2 GHz
- Linear Gain: 24.7 dB at 2 GHz
- Typical PAE_{3dB}: 70% at 2 GHz
- Operating Voltage: 50 V
- Low thermal resistance package
- CW and Pulse capable
- 3 x 3 mm package

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.	ECCN	Description
QPD1010	EAR99	DC – 4 GHz RF Transistor
QPD1010-EVB1	EAR99	0.96 – 1.215 GHz EVB

Absolute Maximum Ratings[1]

Parameter	Rating	Units
Breakdown Voltage, BV_{DG}	+145	V
Gate Voltage Range, V_G	-7 - 0	V
Drain Current, I_D	1150	mA
Gate Current Range, I_G	See page 4.	mA
Power Dissipation, CW, P_{DISS}	12.8	W
RF Input Power at 2 GHz, CW, 50 Ω, T = 25 °C	+24	dBm
Channel Temperature, T_{CH}	275	°C
Mounting Temperature (30 Seconds)	320	°C
Storage Temperature	–40 to +150	°C

Notes:
1. Operation of this device outside the parameter ranges given above may cause permanent damage.

Recommended Operating Conditions[1]

Parameter	Min	Typ	Max	Units
Operating Temp. Range	–40	+25	+85	°C
Drain Voltage Range, V_D	+12	+50	+60	V
Drain Bias Current, I_{DQ}	–	18	–	mA
Drain Current, I_D	–	400	–	mA
Gate Voltage, V_G	–	–2.8	–	V
Channel Temperature (T_{CH})	–	–	250	°C
Power Dissipation, CW (P_D)[2]	–	–	11.4	W
Power Dissipation, Pulsed (P_D)[2, 3]	–	–	13.5	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. Back plane of package at 85 °C
3. Pulse Width = 128 uS, Duty Cycle = 10%

Pulsed Characterization – Load Pull Performance – Power Tuned

Parameters	Typical Values					Unit
Frequency, F	1	2	3	3.5	4	GHz
Linear Gain, G_{LIN}	26.4	24.7	21.4	20.7	19.8	dB
Output Power at 3dB compression point, P_{3dB}	40.9	40.4	41	40.7	40.4	dBm
Power-Added-Efficiency at 3dB compression point, PAE_{3dB}	69.4	63.2	64.7	59.5	53.9	%
Gain at 3dB compression point	23.4	21.7	18.4	17.7	16.8	dB

Notes:

1. Test conditions unless otherwise noted: V_D = +50 V, I_{DQ} = 18 mA, Temp = +25 °C

Pulsed Characterization – Load Pull Performance – Efficiency Tuned

Parameters	Typical Values					Unit
Frequency	1	2	3	3.5	4	GHz
Linear Gain, G_{LIN}	27.1	25.3	22.3	21.3	20.1	dB
Output Power at 3dB compression point, P_{3dB}	39.7	38.6	39.7	39.1	39.8	dBm
Power-Added-Efficiency at 3dB compression point, PAE_{3dB}	80.2	70.6	73.2	64.1	56.7	%
Gain at 3dB compression point, G_{3dB}	24.1	22.3	19.3	18.3	17.1	dB

Notes:

1. Test conditions unless otherwise noted: V_D = +50 V, I_{DQ} = 18 mA, Temp = +25 °C

RF Characterization – 0.96 – 1.215 GHz EVB Performance At 1.09 GHz[1]

Parameter	Min	Typ	Max	Units
Linear Gain, G_{LIN}	–	19.3	–	dB
Output Power at 3dB compression point, P_{3dB}	–	40.5	–	dBm
Drain Efficiency at 3dB compression point, $DEFF_{3dB}$	–	65.7	–	%
Gain at 3dB compression point, G_{3dB}	–	16.3	–	dB

Notes:

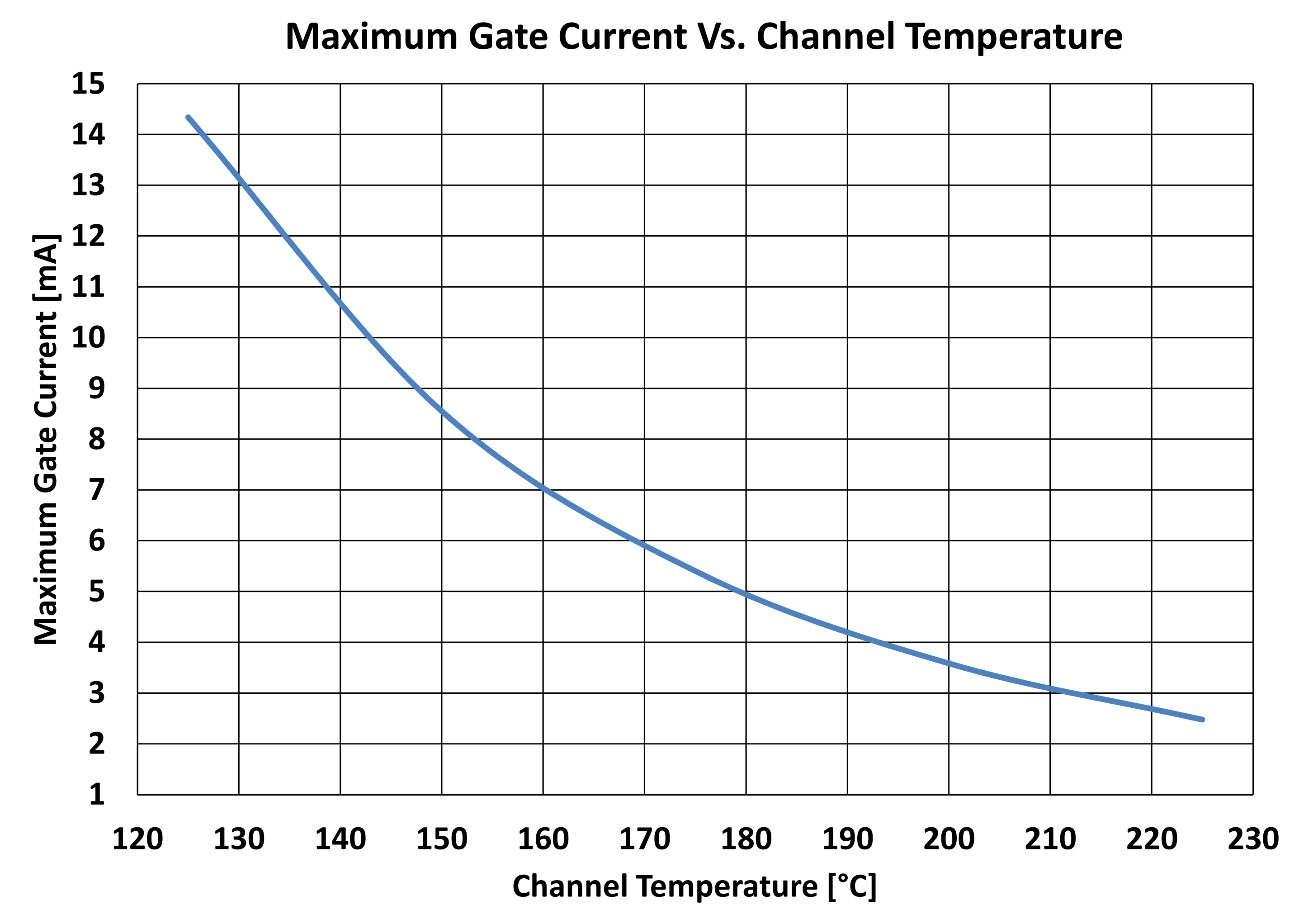
1. V_D = +50 V, I_{DQ} = 18 mA, Temp = +25 °C, Pulse Width = 128 uS, Duty Cycle = 10%

RF Characterization – Mismatch Ruggedness at 1.1 GHz

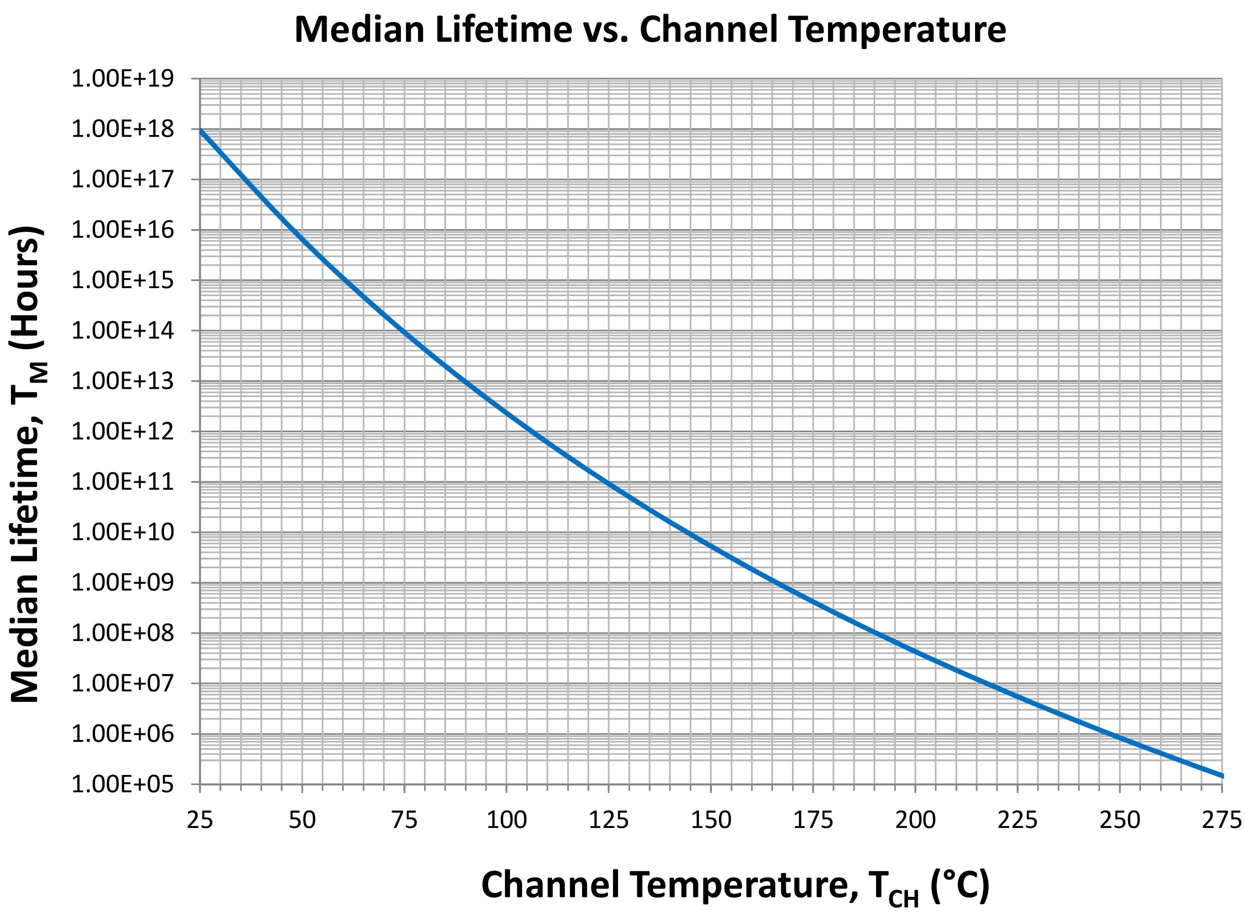
Symbol	Parameter	dB Compression	Typical
VSWR	Impedance Mismatch Ruggedness	3	10:1

Test conditions unless otherwise noted: T_A = 25 °C, V_D = 50 V, I_{DQ} = 18 mA
Driving input power is determined at pulsed compression under matched condition at EVB output connector.

Maximum Gate Current

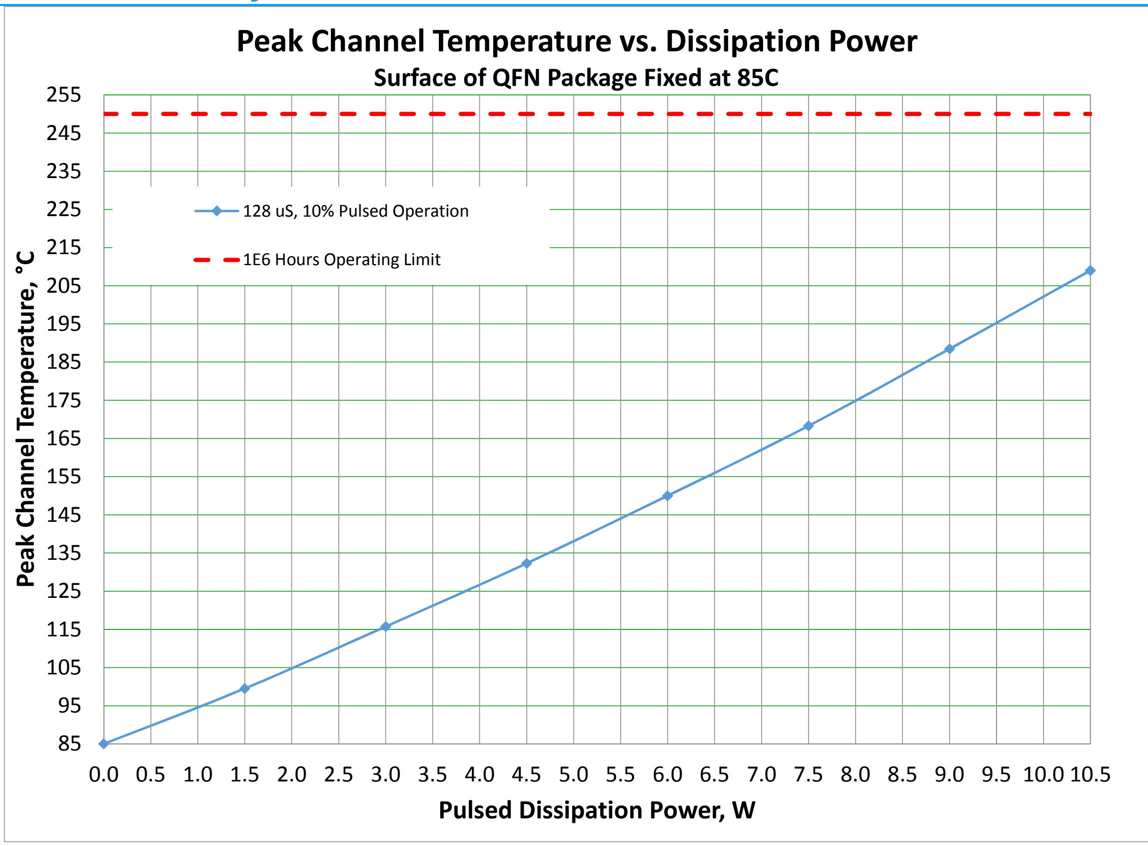


Median Lifetime[1]



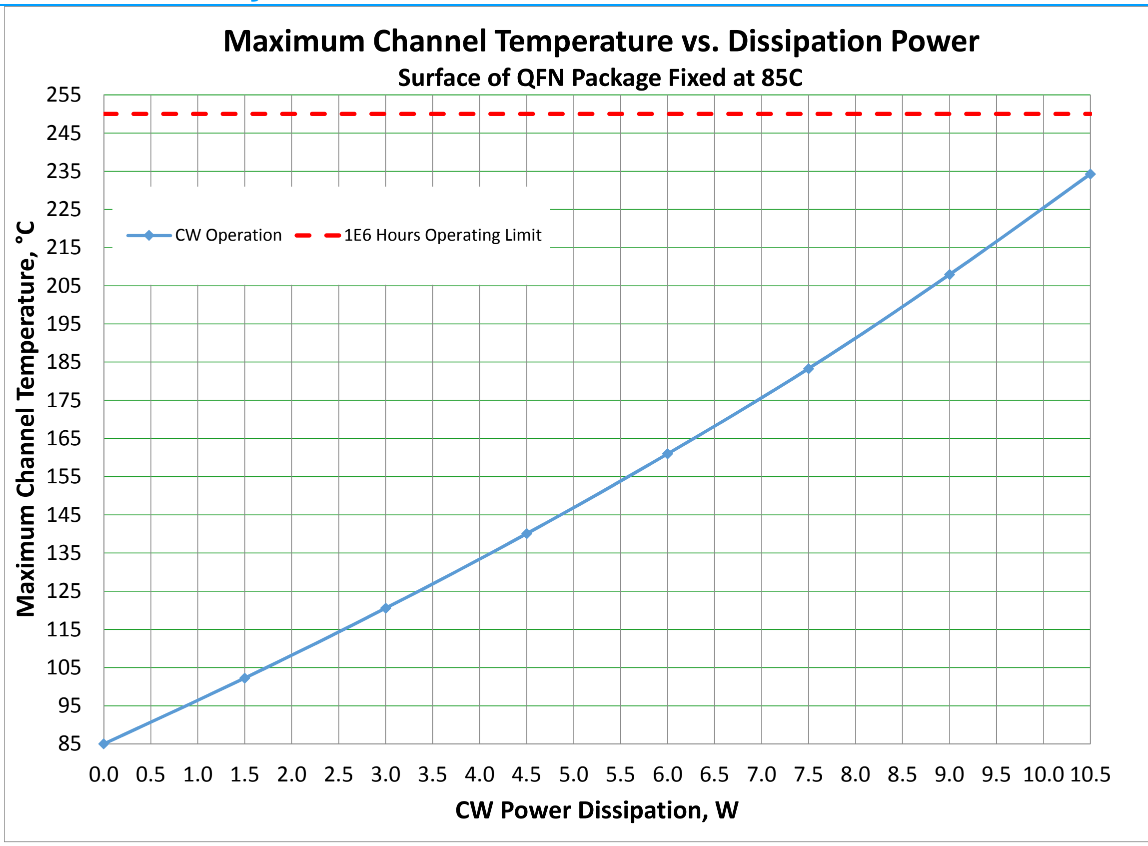
[1] For pulsed signals, average lifetime is average lifetime at maximum channel temperature divided by duty cycle.

Thermal and Reliability Information - Pulsed



Parameter	Conditions	Values	Units
Thermal Resistance (θ_{JC})	85 ℃ Case 3 W Pdiss, 128 uS, 10%	10.2	℃/W
Maximum Channel Temperature (T_{CH})		116	℃
Median Lifetime (T_M)		2.9E12	Hrs
Thermal Resistance (θ_{JC})	85 ℃ Case 4.5 W Pdiss, 128 uS, 10%	10.5	℃/W
Maximum Channel Temperature (T_{CH})		132	℃
Median Lifetime (T_M)		4.1E11	Hrs
Thermal Resistance (θ_{JC})	85 ℃ Case 6 W Pdiss, 128 uS, 10%	10.8	℃/W
Maximum Channel Temperature (T_{CH})		150	℃
Median Lifetime (T_M)		5.3E10	Hrs
Thermal Resistance (θ_{JC})	85 ℃ Case 7.5 W Pdiss, 128 uS, 10%	11.1	℃/W
Maximum Channel Temperature (T_{CH})		168	℃
Median Lifetime (T_M)		8.5E9	Hrs
Thermal Resistance (θ_{JC})	85 ℃ Case 9 W Pdiss, 128 uS, 10%	11.5	℃/W
Maximum Channel Temperature (T_{CH})		188	℃
Median Lifetime (T_M)		1.3E9	Hrs
Thermal Resistance (θ_{JC})	85 ℃ Case 10.5 W Pdiss, 128 uS, 10%	11.8	℃/W
Maximum Channel Temperature (T_{CH})		209	℃
Median Lifetime (T_M)		2.1E8	Hrs

Thermal and Reliability Information - CW

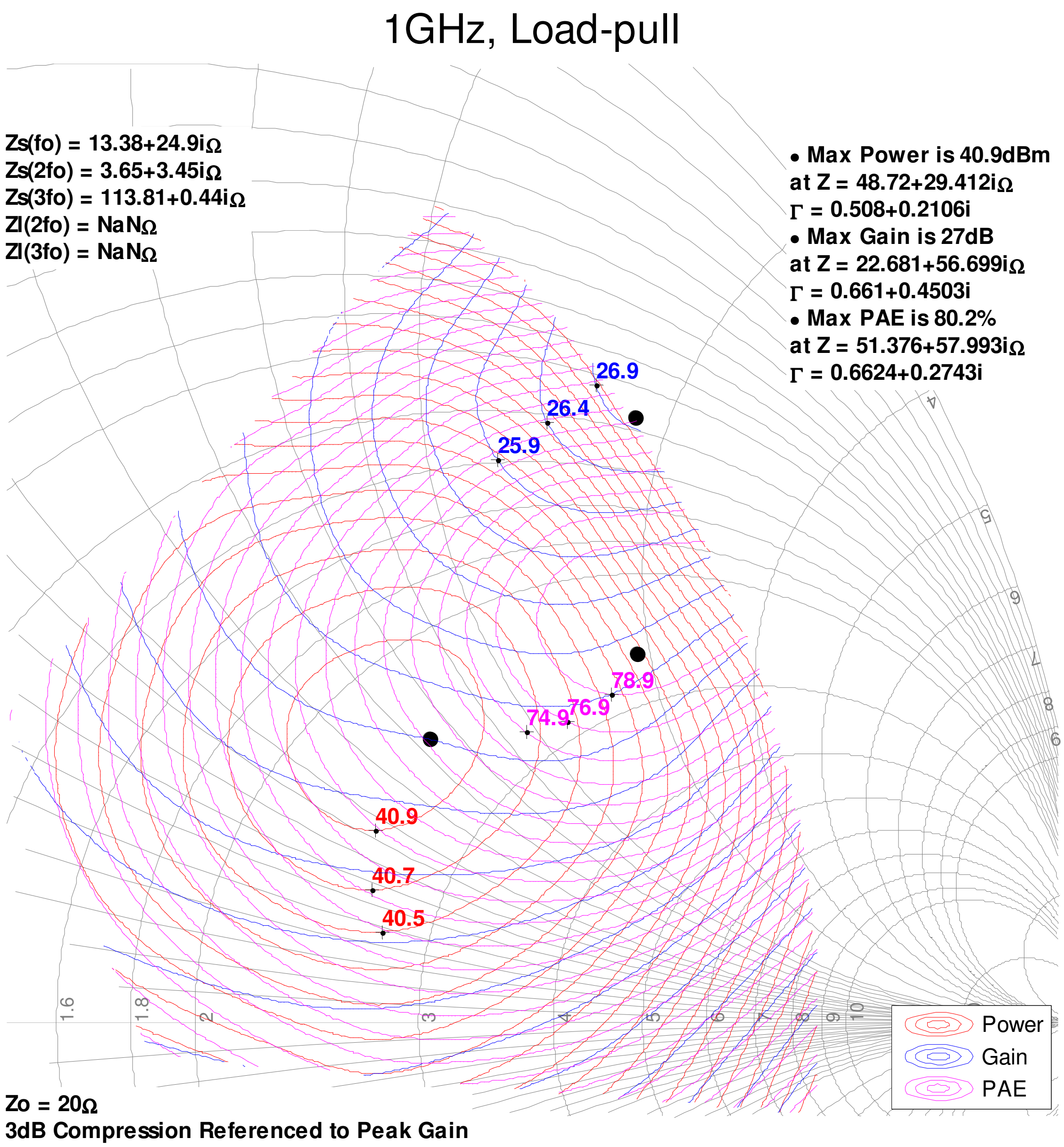


Parameter	Conditions	Values	Units
Thermal Resistance (θ_{JC})	85 °C Case 3 W Pdiss, CW	11.9	°C/W
Maximum Channel Temperature (T_{CH})		121	°C
Median Lifetime (T_M)		1.5E11	Hrs
Thermal Resistance (θ_{JC})	85 °C Case 4.5 W Pdiss, CW	12.2	°C/W
Maximum Channel Temperature (T_{CH})		140	°C
Median Lifetime (T_M)		1.7E10	Hrs
Thermal Resistance (θ_{JC})	85 °C Case 6.0 W Pdiss, CW	12.7	°C/W
Maximum Channel Temperature (T_{CH})		161	°C
Median Lifetime (T_M)		1.7E9	Hrs
Thermal Resistance (θ_{JC})	85 °C Case 7.5 W Pdiss, CW	13.1	°C/W
Maximum Channel Temperature (T_{CH})		183	°C
Median Lifetime (T_M)		2.0E8	Hrs
Thermal Resistance (θ_{JC})	85 °C Case 9.0 W Pdiss, CW	13.7	°C/W
Maximum Channel Temperature (T_{CH})		208	°C
Median Lifetime (T_M)		2.2E7	Hrs
Thermal Resistance (θ_{JC})	85 °C Case 10.5 W Pdiss, CW	14.2	°C/W
Maximum Channel Temperature (T_{CH})		234	°C
Median Lifetime (T_M)		2.8E6	Hrs

Load Pull Smith Charts[1, 2, 3]

Notes:

1. Vd = 50 V, I_{DQ} = 18 mA, Pulsed signal with 128 uS pulse width and 10 % duty cycle. Performance is at indicated input power.
2. See page 18 for load pull and source pull reference planes. 20-Ω load pull TRL fixtures are built with 20-mil RO4350B material.
3. NaN means the impedances are either undefined or varying in load-pull system.



Load Pull Smith Charts[1, 2, 3]

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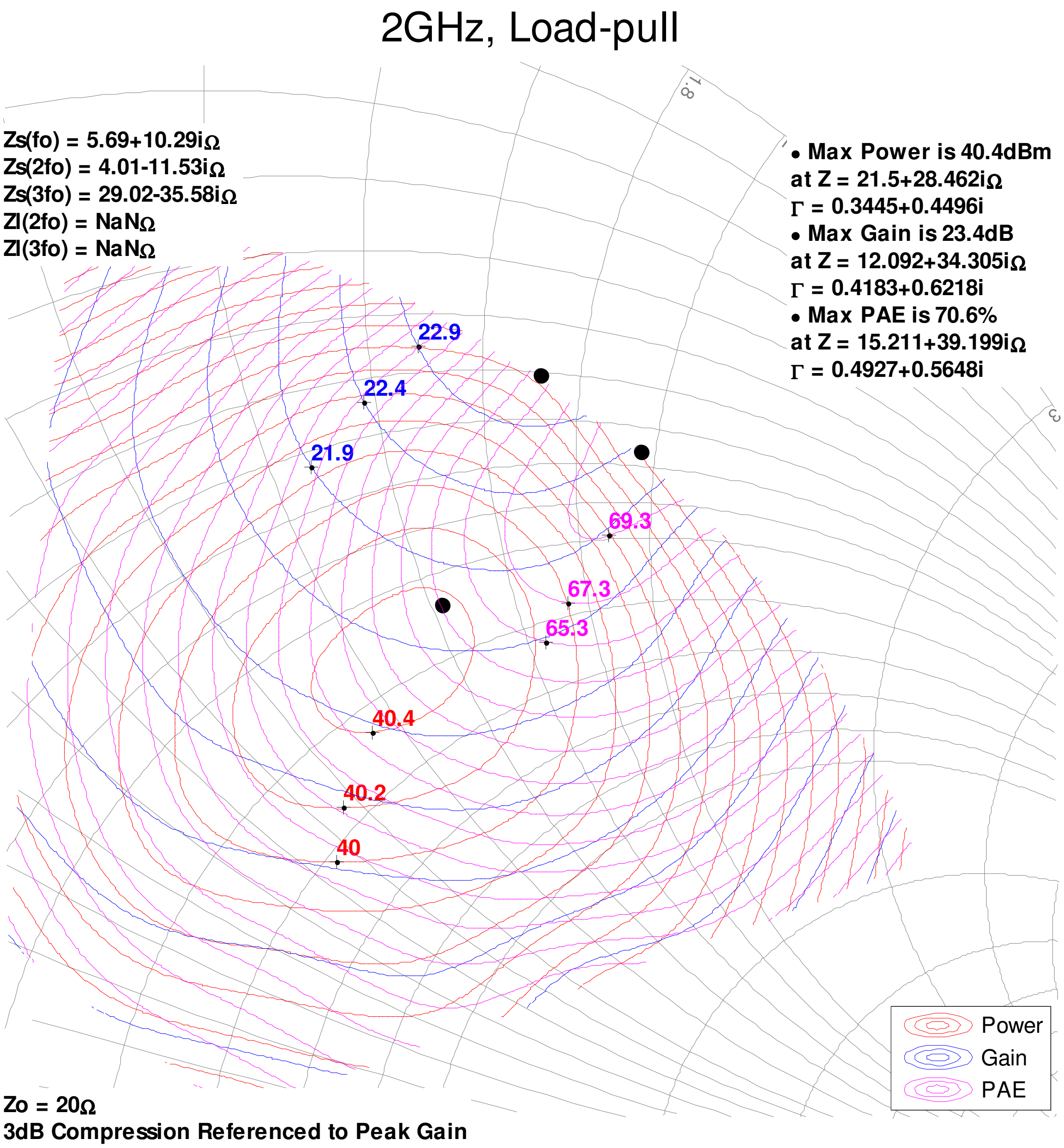

Load Pull Smith Charts[1, 2, 3]

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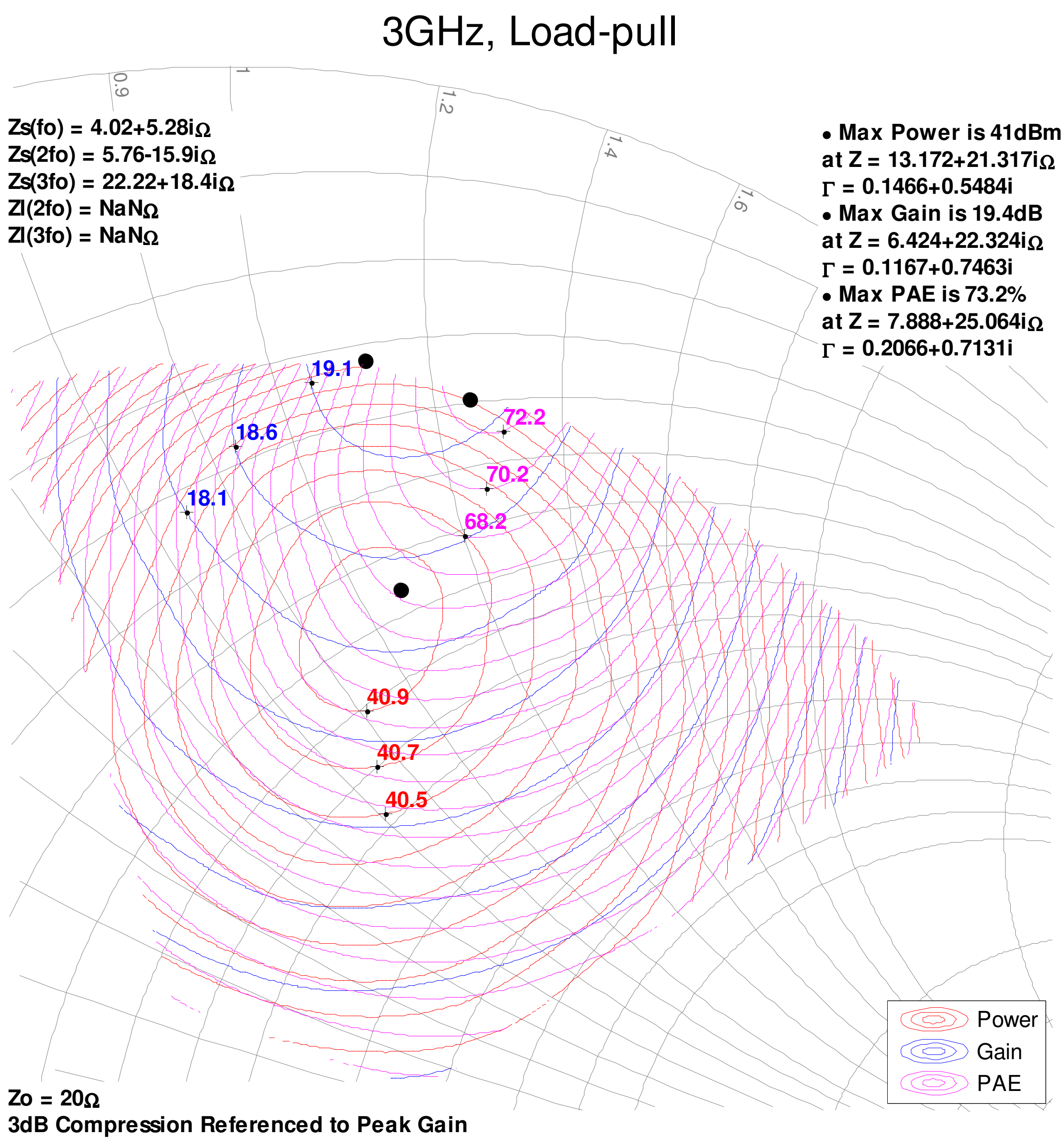

Load Pull Smith Charts[1, 2, 3]

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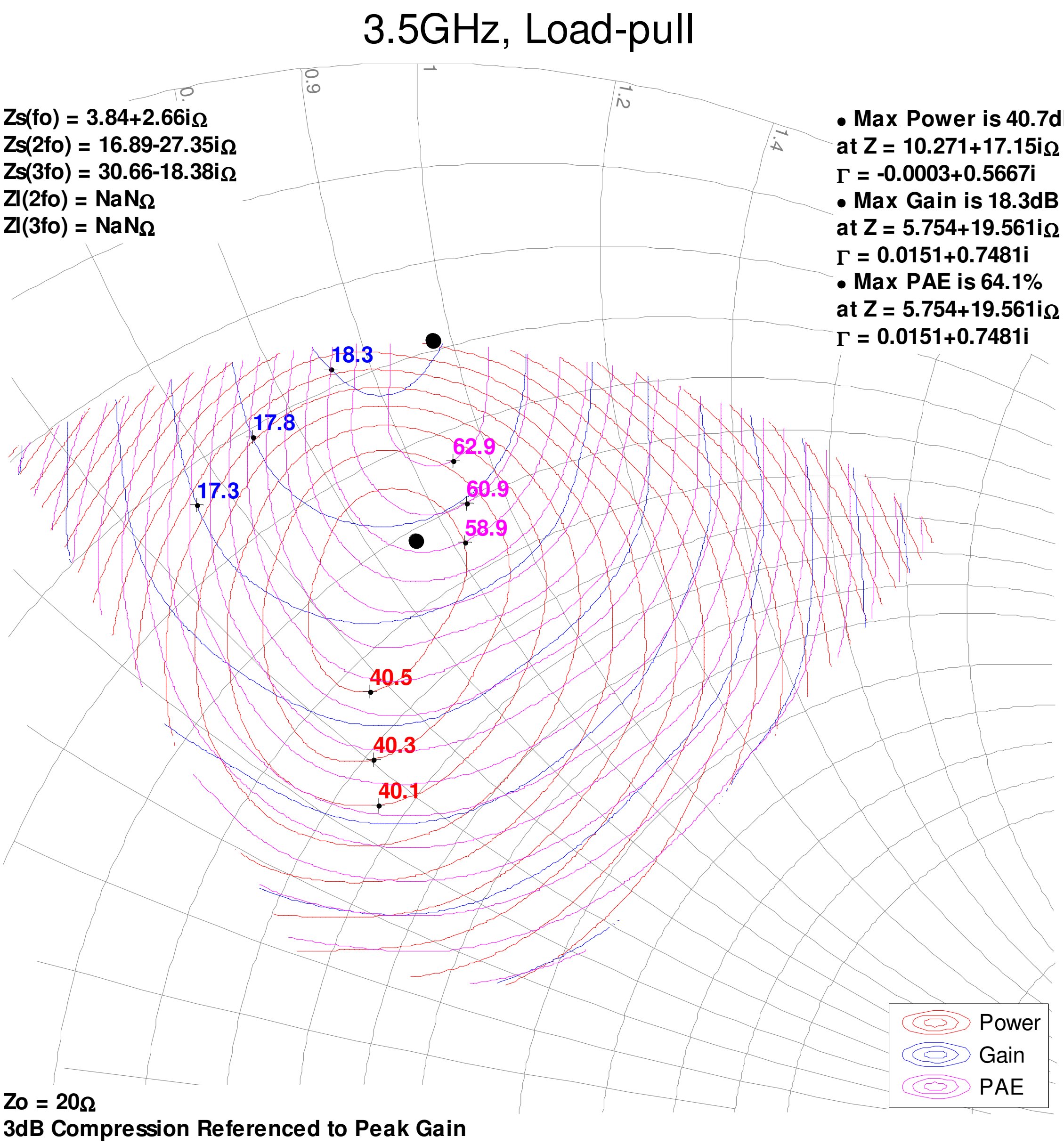

Load Pull Smith Charts[1, 2, 3]

Notes:
1. Vd = 50 V, I_{DQ} = 18 mA, Pulsed signal with 128 uS pulse width and 10 % duty cycle. Performance is at indicated input power.
2. See page 18 for load pull and source pull reference planes. 20-Ω load pull TRL fixtures are built with 20-mil RO4350B material.
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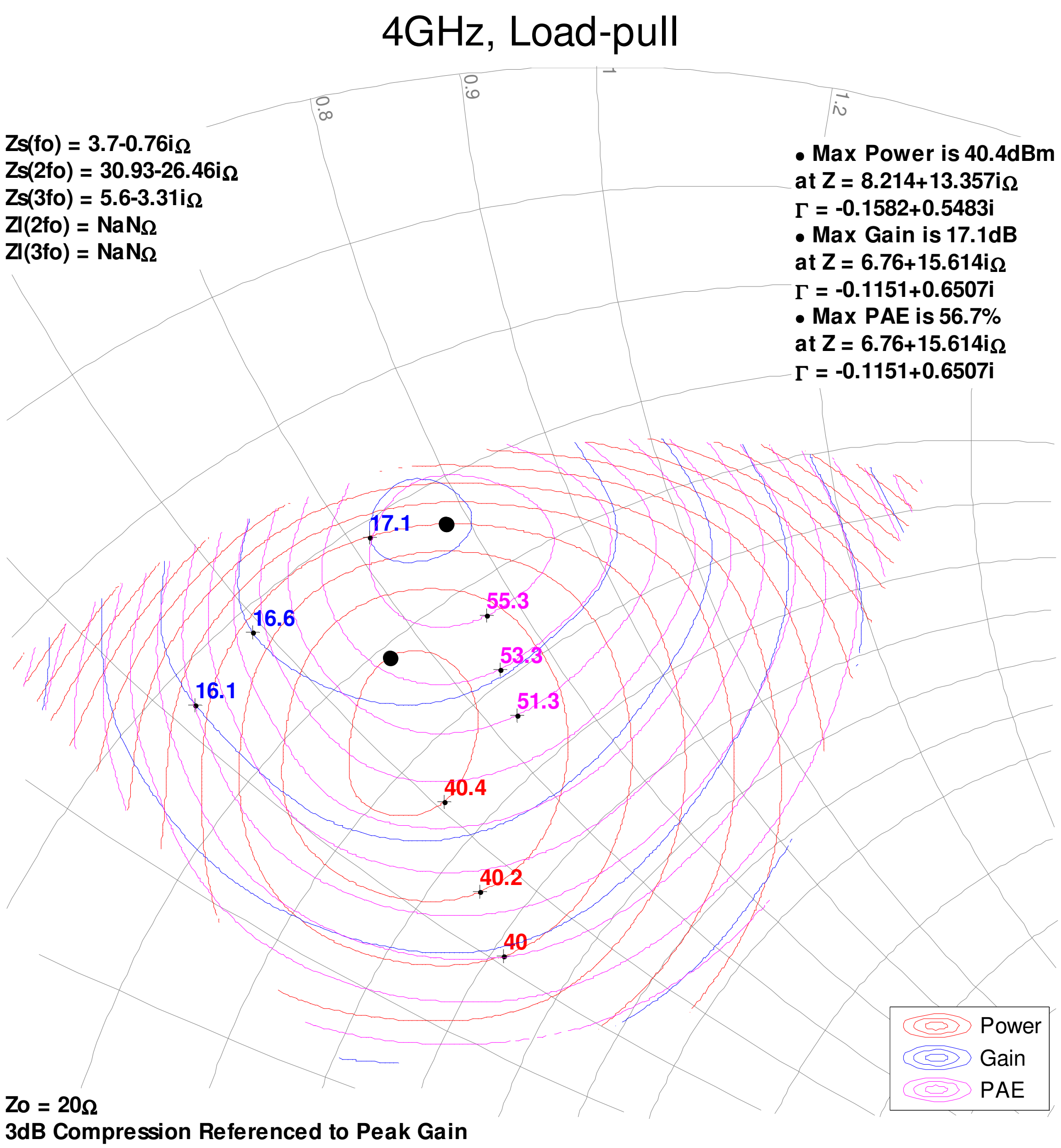
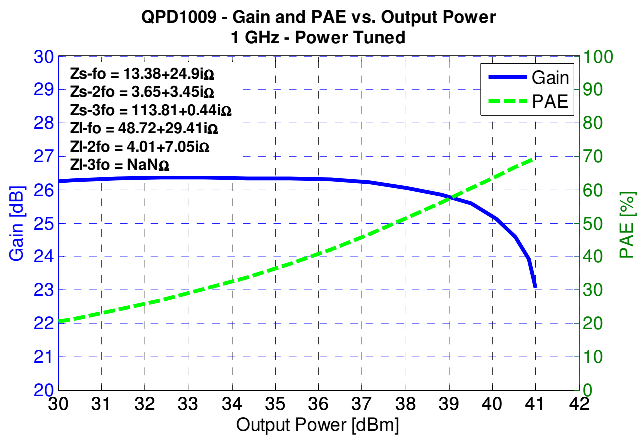
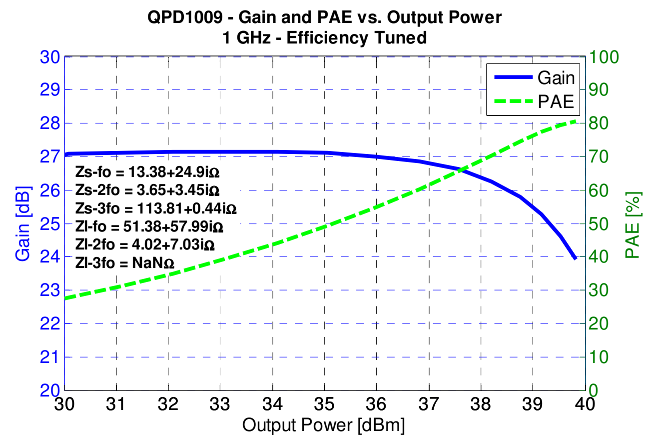


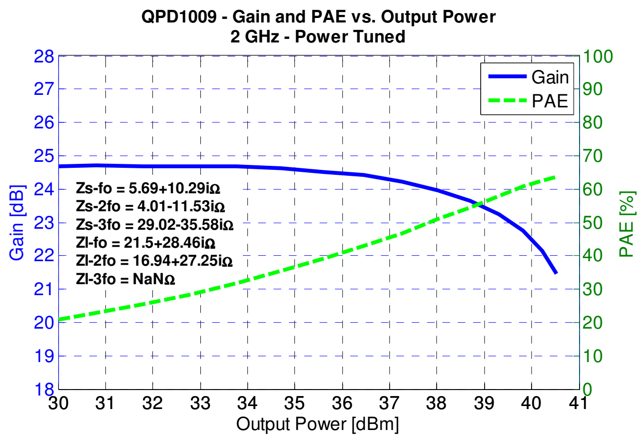
Typical Performance – Load Pull Drive-up

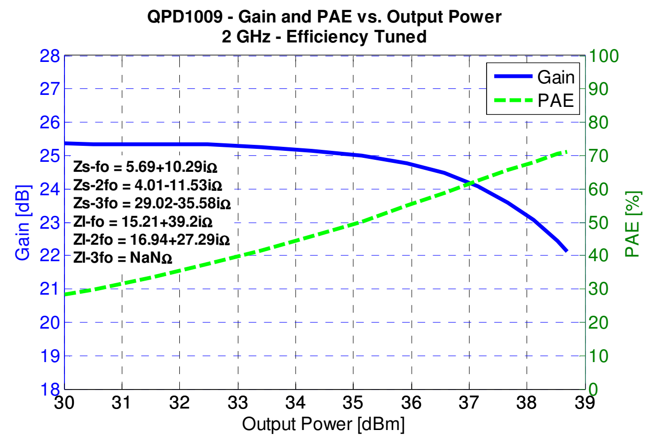
Notes:

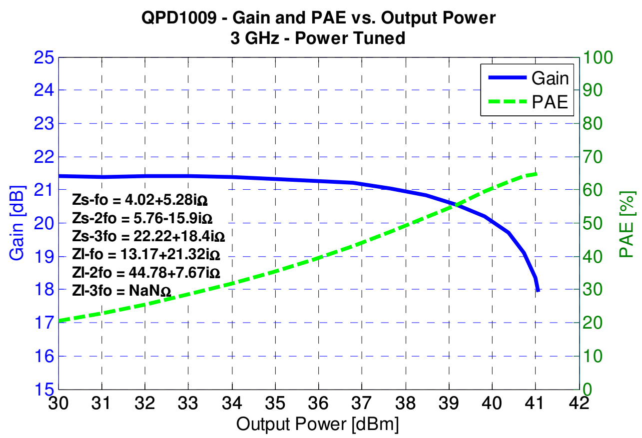
1. Pulsed signal with 128 uS pulse width and 10 % duty cycle, Vd = 50 V, I_{DQ} = 18 mA
2. See page 18 for load pull and source pull reference planes where the performance was measured.

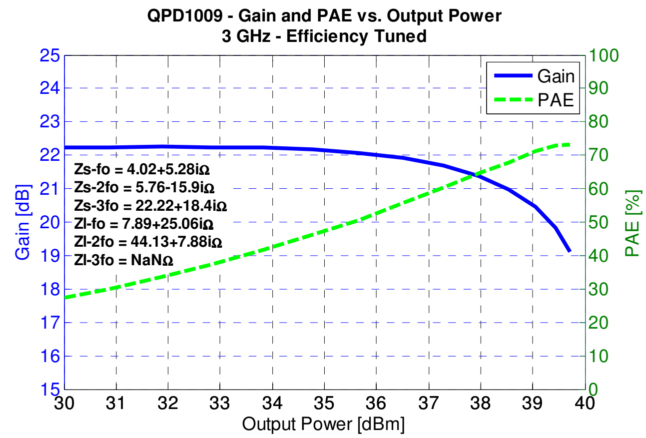






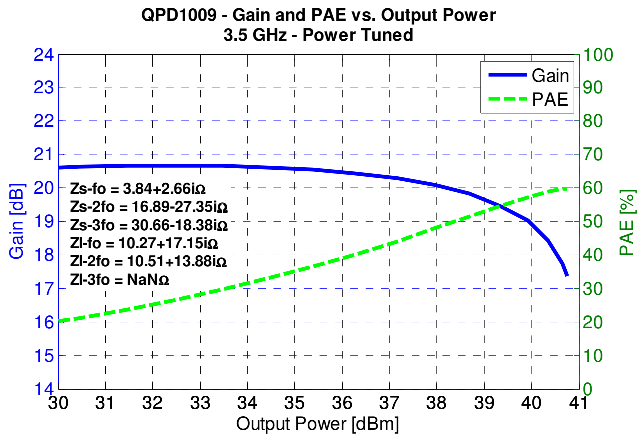


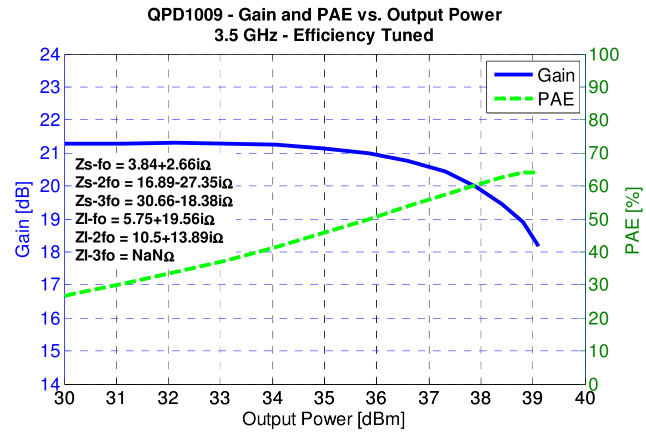


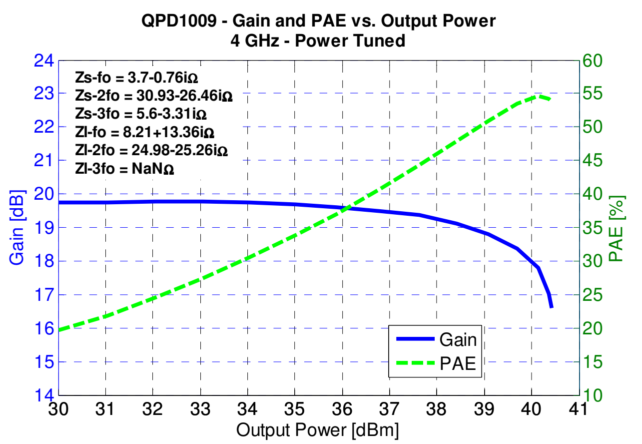


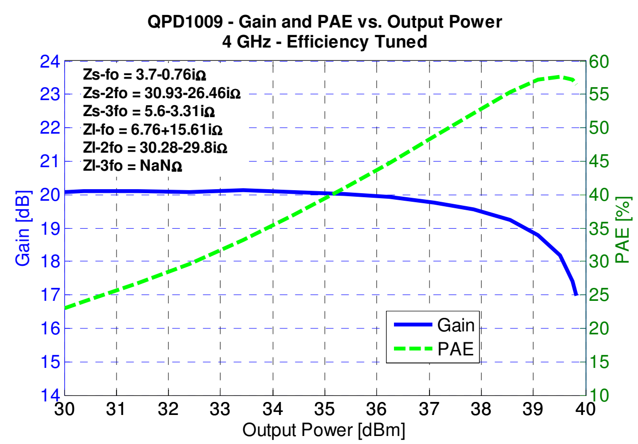
Typical Performance – Load Pull Drive-up

Notes:
3. Pulsed signal with 128 uS pulse width and 10 % duty cycle, Vd = 50 V, I_{DQ} = 18 mA
4. See page 18 for load pull and source pull reference planes where the performance was measured.



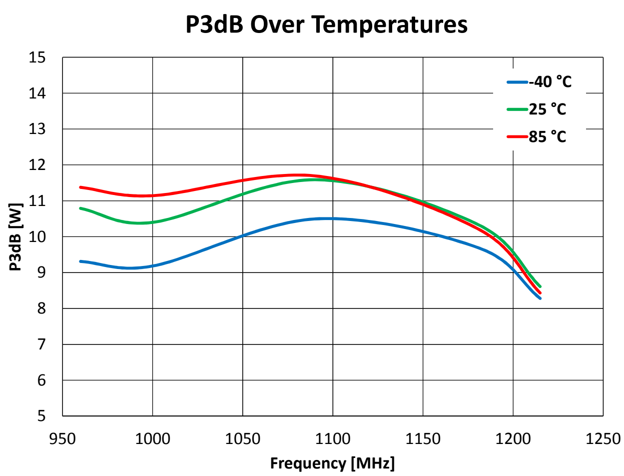


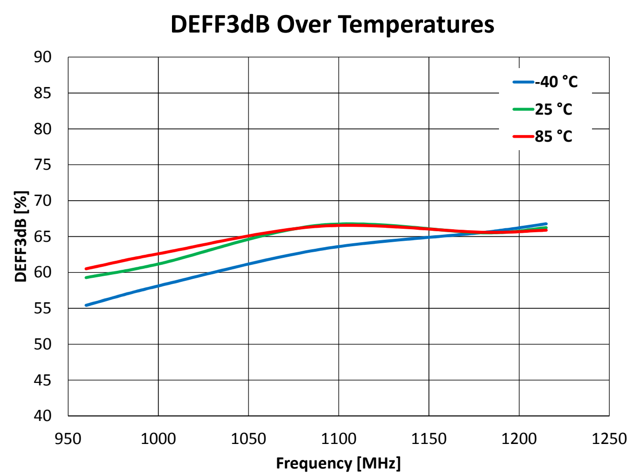


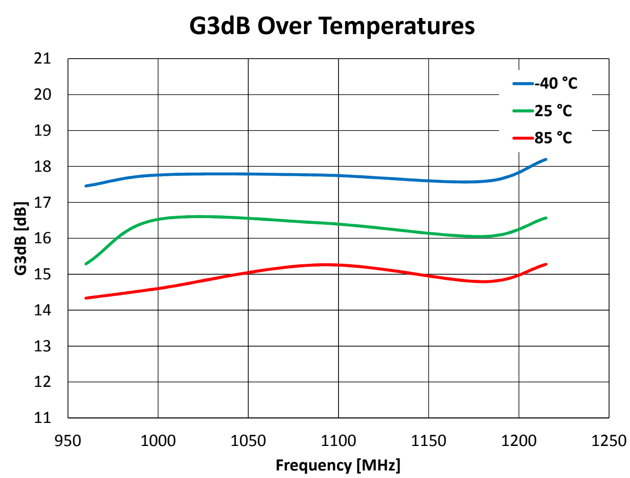


Power Driveup Performance Over Temperatures Of 0.96 – 1.2 GHz EVB[1]

[1] Vd = 50 V, I_{DQ} = 18 mA, Pulse Width = 128 uS, Duty Cycle = 10 %

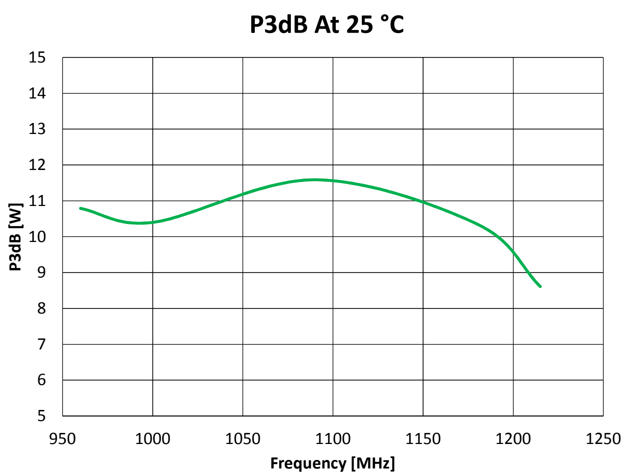


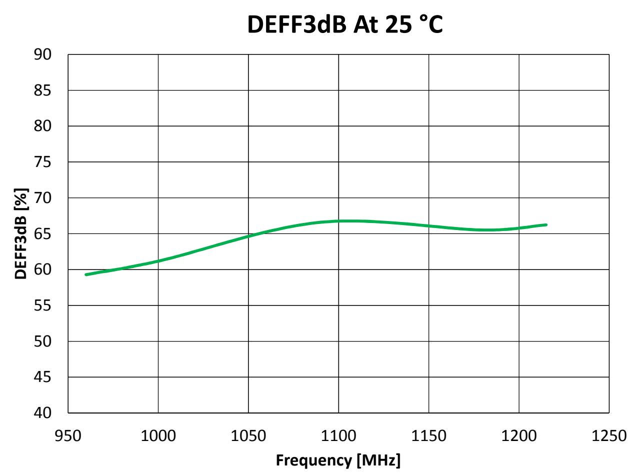


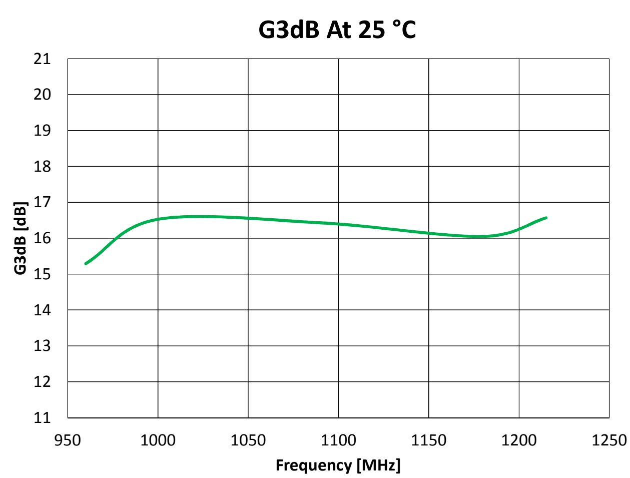


Power Driveup Performance At 25 °C Of 0.96 – 1.2 GHz EVB[1]

[1] Vd = 50 V, I_{DQ} = 18 mA, Pulse Width = 128 uS, Duty Cycle = 10 %

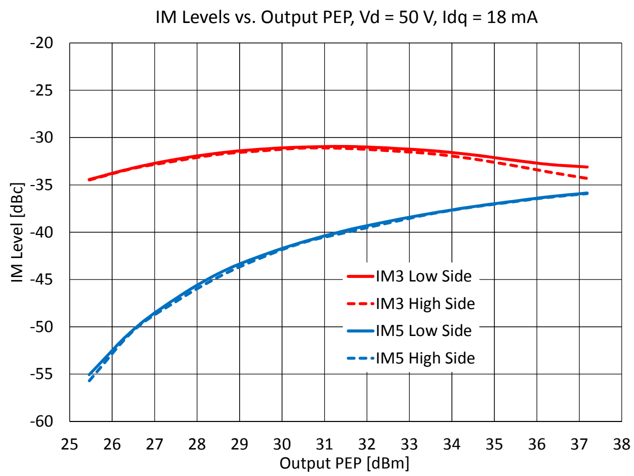


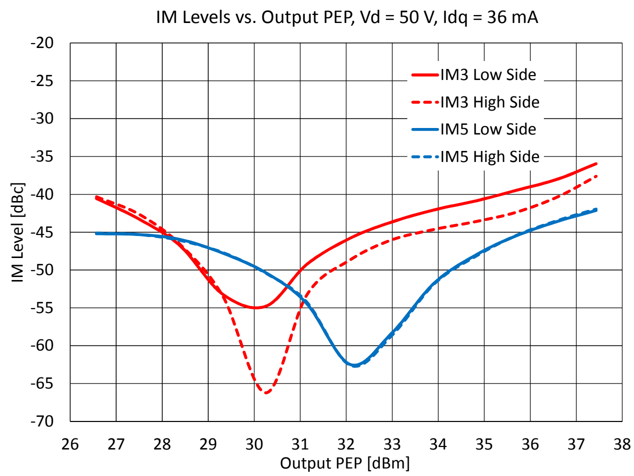




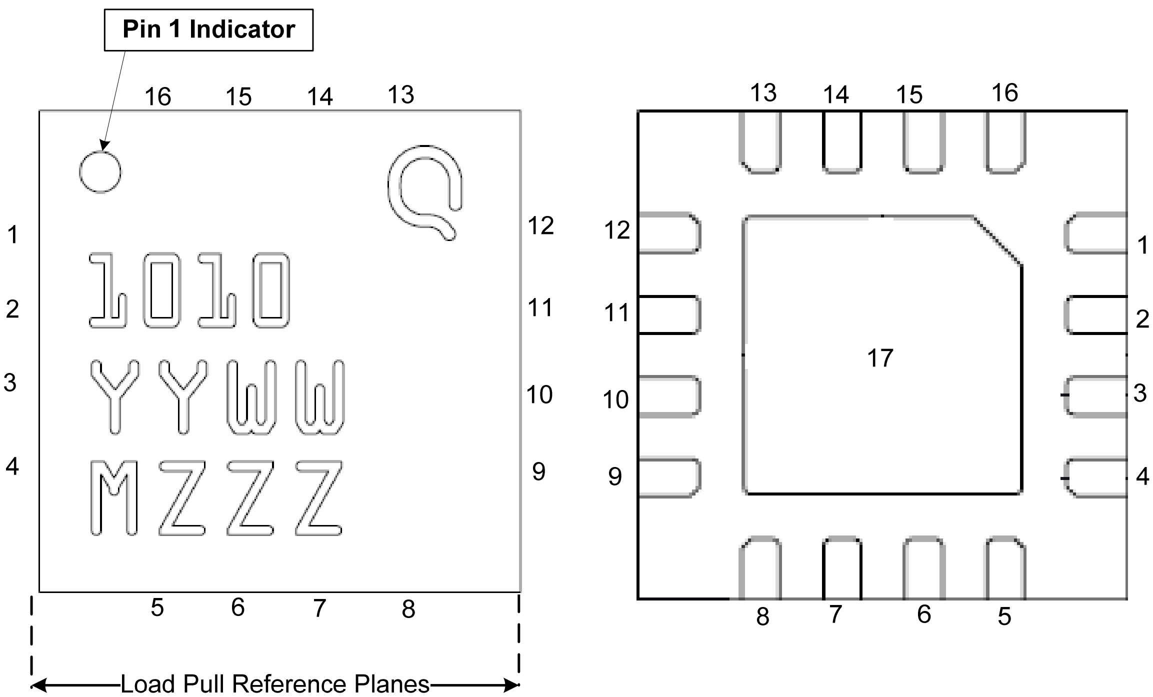
Two-Tone Performance At 25 °C Of 0.96 – 1.2 GHz EVB[1]

[1] Center Frequency = 1.09 GHz, Tone Separation = 1 MHz





Pin Layout [1]

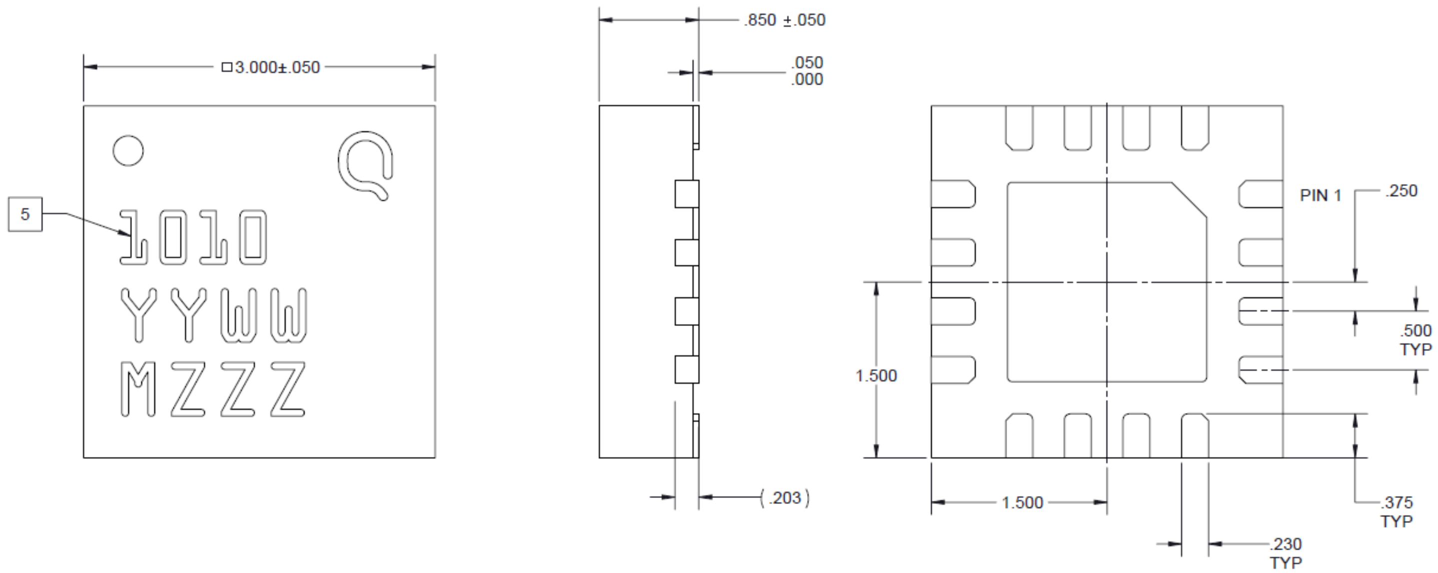


Notes:
1. The QPD1010 will be marked with the "1010" designator and a lot code marked below the part designator. The "YY" represents the last two digits of the calendar year the part was manufactured, the "WW" is the work week of the assembly lot start, the "MXXX" is the production lot number, and the "ZZZ" is an auto-generated serial number.

Pin Description

Pin	Symbol	Description
2, 3	VG / RF IN	Gate voltage / RF Input
10, 11	VD / RF OUT	Drain voltage / RF Output
1, 4, 5 – 9, 12 - 16	NC	Not Connected
17	Back Plane	Source to be connected to ground

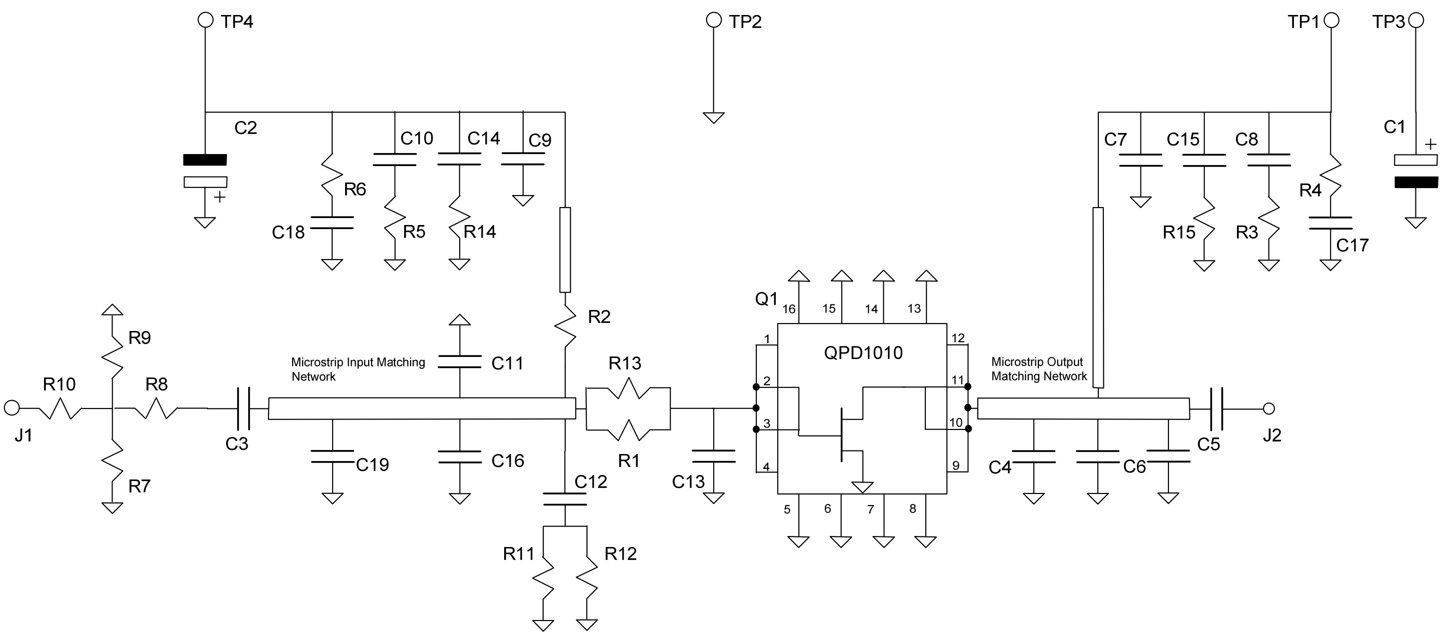
Mechanical Drawing



Notes:

1. All dimensions are in inches. Otherwise noted, the tolerance is ±0.005 inches.

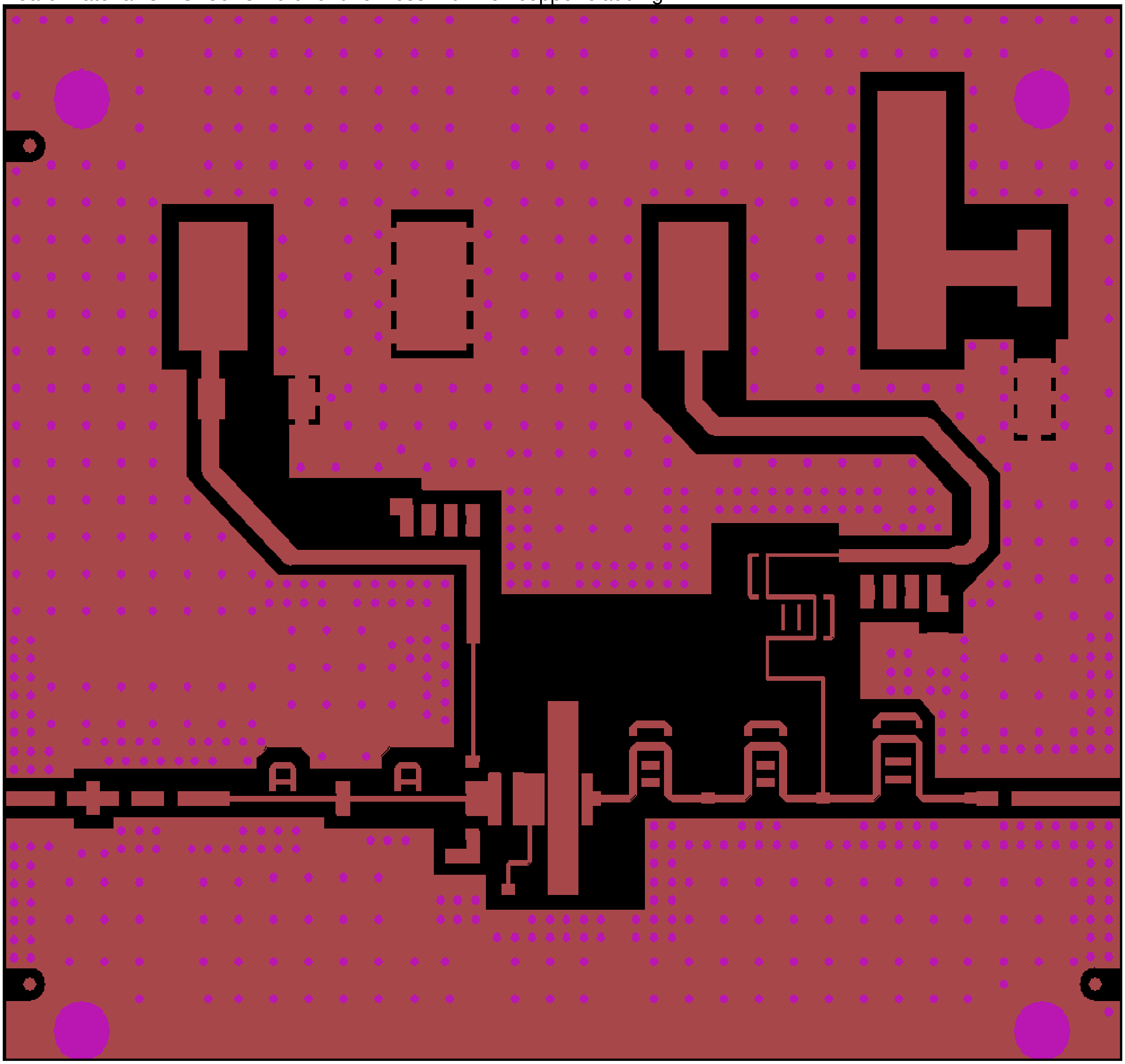
Schematic – 0.96 – 1.215 GHz EVB



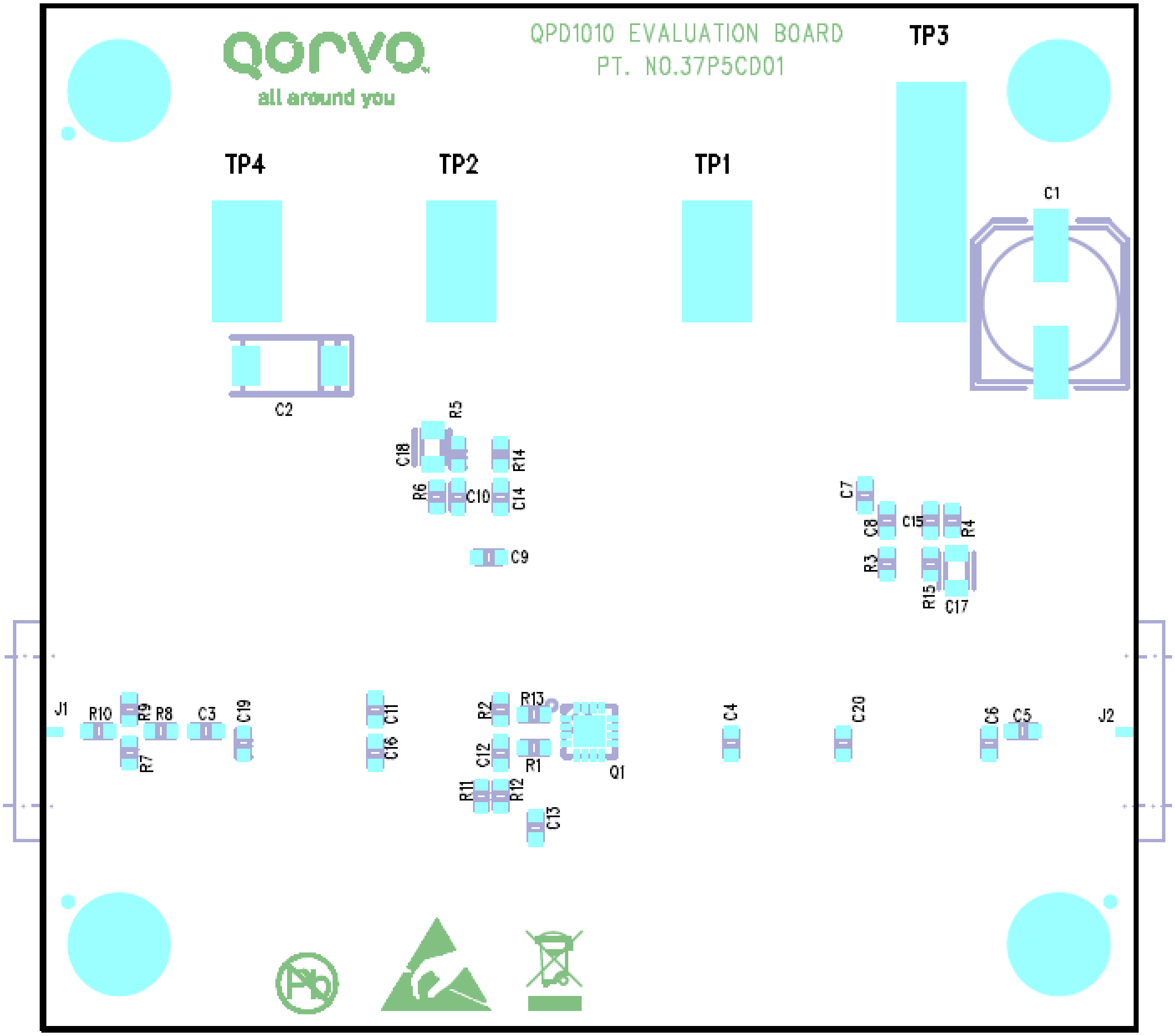
Bias-up Procedure	Bias-down Procedure
1. Set V_G to -4 V.	1. Turn off RF signal.
2. Set ID current limit to 30 mA.	2. Turn off VD
3. Apply 50 V VD.	3. Wait 2 seconds to allow drain capacitor to discharge
4. Slowly adjust VG until ID is set to 26 mA.	4. Turn off VG
5. Set ID current limit to 1 A	
6. Apply RF.	

PCB Layout – 0.96 – 1.215 GHz EVB

Board material is RO4362G2 0.020" thickness with 1 oz copper cladding.



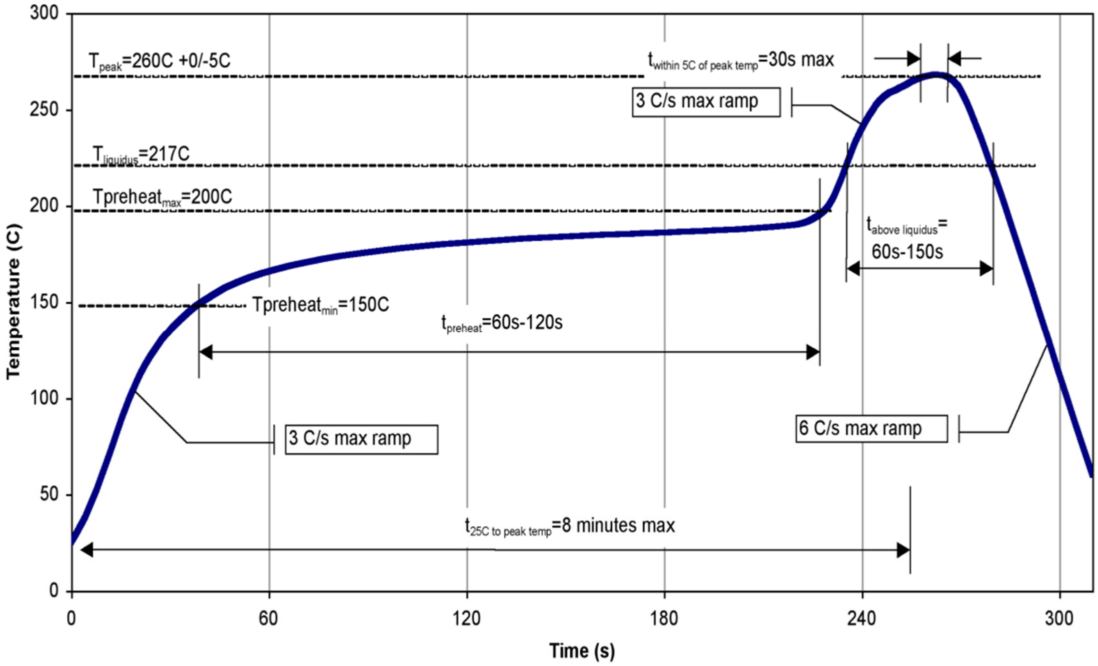
Component Placement – 0.96 – 1.215 GHz EVB



Bill Of material - 0.96 – 1.215 GHz EVB

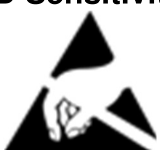
Ref Des	Value	Description	Manufacturer	Part Number
C14, 15	82 pF	C0G 100V 5% 0603 Capacitor	AVX	06031A820JAT2A
C8 - 10	1 nF	X7R 100V 5% 0603 Capacitor	AVX	06031C102JAT2A
C17 - 18	100 nF	X7R 100V 5% 0805 Capacitor	AVX	08051C104JAT2A
C4	0.5 pF	RF NPO 250VDC ± 0.05 pF Capacitor	ATC	ATC600S0R5AT250X
C13	1.0 pF	RF NPO 250VDC ± 0.05 pF Capacitor	ATC	ATC600S1R0AT250X
C6	3.3 pF	RF NPO 250VDC ± 0.05 pF Capacitor	ATC	ATC600S3R3AT250X
C16, 19	6.2 pF	RF NPO 250VDC ± 0.1 pF Capacitor	ATC	ATC600S6R2BT250X
C11, 20	6.8 pF	RF NPO 250VDC ± 0.1 pF Capacitor	ATC	ATC600S6R8BT250X
C3, 5, 7, 9, 12	56 pF	RF NPO 250VDC 1% Capacitor	ATC	ATC600S5650FT250X
C1	33 uF	80V SVP Capacitor	Panasonic	EEEFK1K330P
C2	10 uF	16V Tantalum Capacitor	AVX	TPSC106KR0500
J1 - 2		SMA Panel Mount 4-hole Jack	Gigalane	PSF-S00-000
R4, 6	1 Ohm	0603 1% Thick Film Resistor	ANY	
R2, 8, 10	5.1 Ohm	0603 1% Thick Film Resistor	ANY	
R1, 13, 14, 15	7.5 Ohm	0603 1% Thick Film Resistor	ANY	
R3, 5	33 Ohm	0603 1% Thick Film Resistor	ANY	
R11, 12	240 Ohm	0603 1% Thick Film Resistor	ANY	
R7, 9	430 Ohm	0603 1% Thick Film Resistor	ANY	

Recommended Solder Temperature Profile



Product Compliance Information

ESD Sensitivity Ratings



Caution! ESD Sensitive Device

ESD Rating

ESD Rating:	TBD
Value:	TBD
Test:	Human Body Model (HBM)
Standard:	JEDEC Standard JESD22-A114

MSL Rating

MSL Rating:	TBD
Test:	260 °C convection reflow
Standard:	JEDEC Standard IPC/JEDEC J-STD-020

Solderability

Compatible with lead free soldering processes, 260 °C maximum reflow temperature.

Package lead plating: NiAu

The use of no-clean solder to avoid washing after soldering is recommended.

This part is compliant with EU 2002/95/EC RoHS directive (Restrictions on the Use of Certain Hazardous Substances in Electrical and Electronic Equipment).

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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Стандарт
Электрон
Связь

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