QPD1028

750 W, 65 V, 1.2 – 1.4 GHz, GaN RF Input-Matched Transistor

Product Overview

The Qorvo QPD1028 is a 750W (P_{3dB}) discrete GaN on SiC HEMT which operates from 1.2 to 1.4 GHz. Input pre-match within the package results in ease of external board match and saves board space. The device is in an industry standard air cavity package and is ideally suited for radar. The device can support both CW and pulsed operations.

Evaluation boards are available upon request.

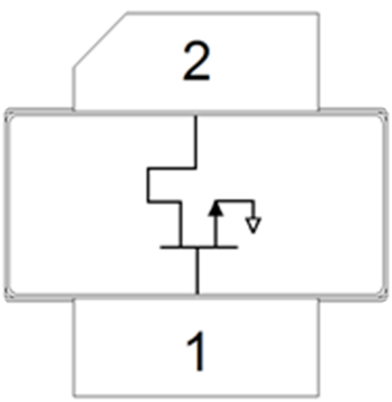
NI-780 Package

Key Features

- Frequency Range: 1.2 to 1.4 GHz
- Linear Gain[1]: 19.8 dB
- Output Power (P_{3dB})[1]: 838.5 W
- Drain Efficiency (P_{3dB})[1]: 67.3%
- Operating Voltage: 65 V
- CW and Pulse capable

Note 1: EVB Performance @ 1.3 GHz

Functional Block Diagram



Applications

- L-Band Radar

Ordering Information

Part Number	Description
QPD1028	1.2 – 1.4 GHz Transistor
QPD1028EVB	1.2 – 1.4 GHz Evaluation Board

Absolute Maximum Ratings[1]

Parameter	Rating	Units
Breakdown Voltage, BV_{DG}	225	V
Gate Voltage Range, V_G	-7 to +2	V
Drain Current, I_{DMAX}	71	A
Gate Current, I_G	79	mA
Power Dissipation, Pulsed, P_{DISS} [2]	605	W
RF Input Power, Pulsed, P_{IN} [3]	45.2	dBm
Operating Channel Temperature [4]	275	°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, Pulse Width = 100 µs, Duty Cycle = 10%
   Package base at 85 °C
3. Pulsed, Pulse Width = 100 µs, Duty Cycle = 10%
   T = 25 °C, 50 ohm load
4. Package base at 85 °C

Recommended Operating Conditions[1]

Parameter	Min	Typ	Max	Units
Operating Temp. Range	-40	+25	+85	°C
Drain Voltage Range, V_D	–	65	–	V
Drain Bias Current, I_{DQ}	–	750	–	mA
Drain Current, I_D [4]	–	19	–	A
Gate Voltage, V_G [3]	–	-2.7	–	V
Power Dissipation (P_D) [4]	–	–	400	W
Power Dissipation (P_D), CW [2]	–	–	238	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. CW operates at drain voltage of 50 V
3. To be adjusted to desired I_{DQ}
4. Pulsed, Pulse Width = 100 µs, Duty Cycle = 10%

Measured Load Pull Performance – 65V Power Tuned[1, 2]

Parameter	Typical Values			Units
Frequency	1.2	1.3	1.4	GHz
Output Power at 3 dB Gain Compression (P_{3dB})	59.5	59.6	59.4	dBm
Drain Efficiency at 3 dB Gain Compression (DE_{3dB})	62.7	63.6	63.6	%
Gain at 3 dB Compression (G_{3dB})	17.4	17.3	17.4	dB

Notes:
1. Test conditions unless otherwise noted: T_A = 25 °C, V_D = 65 V, I_{DQ} = 750 mA
2. Pulsed: Pulse Width = 100 µs, Duty Cycle = 10%.

Measured Load Pull Performance – 65V Efficiency Tuned[1, 2]

Parameter	Typical Values			Units
Frequency	1.2	1.3	1.4	GHz
Output Power at 3 dB Gain Compression (P_{3dB})	57.7	57.9	57.4	dBm
Drain Efficiency at 3 dB Gain Compression (DE_{3dB})	76.0	76.7	74.4	%
Gain at 3 dB Compression (G_{3dB})	19.4	19.1	19.0	dB

Notes:
1. Test conditions unless otherwise noted: T_A = 25 °C, V_D = 65 V, I_{DQ} = 750 mA
2. Pulsed: Pulse Width = 100 µs, Duty Cycle = 10%.

RF Characterization – 1.2 – 1.4 GHz EVB Performance at 1.3 GHz[1]

Parameter	Min	Typ	Max	Units
Linear Gain, G_{LIN}	–	19.8	–	dB
Output Power at 3dB compression point, P_{3dB}	–	59.2	–	dBm
Drain Efficiency at 3dB compression point, DE_{3dB}	–	67.3	–	%
Gain at 3dB compression point, G_{3dB}	–	16.8	–	dB
Gate Leakage, V_D = +10 V, V_G = -3.3 V	-40	–	–	mA

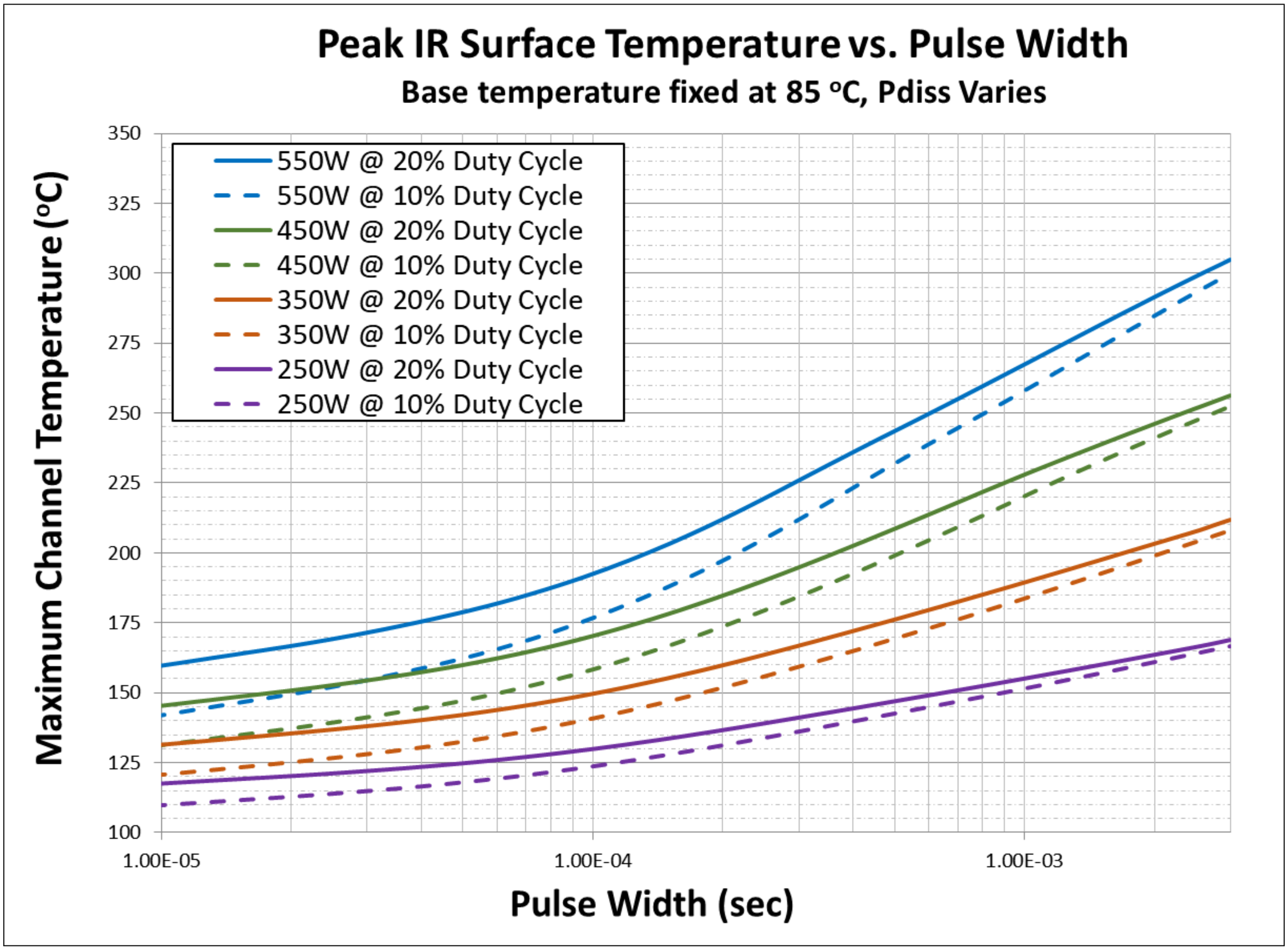
Notes:
1. V_D = +65V, I_{DQ} = 750 mA, Temp = +25 °C, Pulse Width = 100 µs, Duty Cycle = 10%

RF Characterization – Mismatch Ruggedness at 1.2, 1.3, 1.4 GHz[1, 2, 3]

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

Notes:
1. Test conditions unless otherwise noted: T_A = +25 °C, V_D = +65 V, I_{DQ} = 750 mA
2. Input drive power is determined at pulsed 3dB compression under matched condition at EVB output connector
3. Pulse Width = 100 µs, Duty Cycle = 10%

Thermal Information[1]

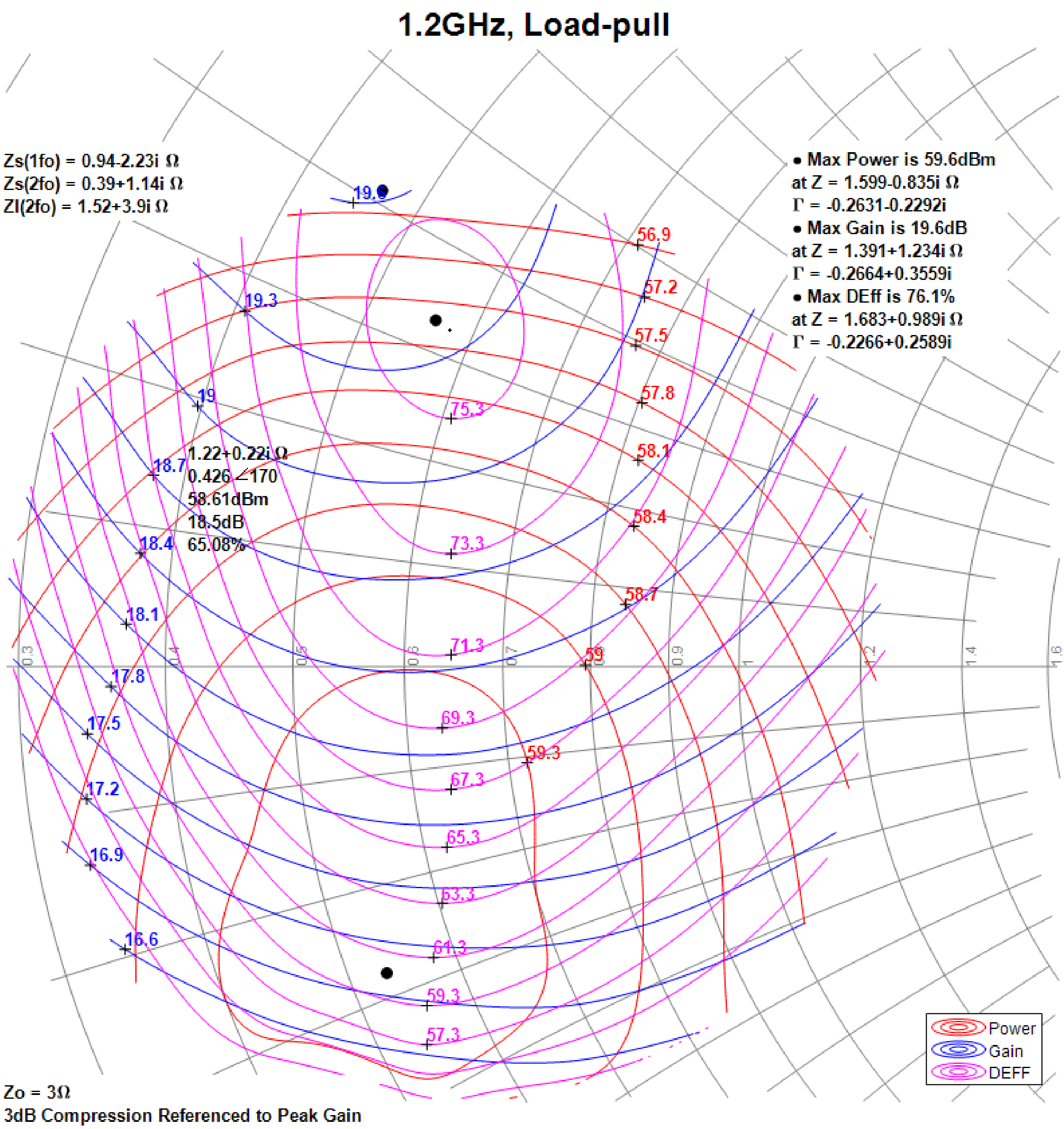


Parameter	Test Conditions	Values	Units
Thermal Resistance, IR (θ_{JC})	P_{DISS} = 350 W, Pulse Width = 300 µs Duty Cycle = 10%, T_{CASE} = 85 °C	0.21	°C/W
Channel Temperature, IR (T_{CH})		160	°C

Notes:
1. Refer to the following document: GaN Device Channel Temperature, Thermal Resistance, and Reliability Estimates

Load Pull Contours[1, 2]

Notes:
1. Test Conditions: V_D = 65 V, I_{DQ} = 750 mA, Pulse Width = 100 µs, Duty Cycle = 10%, Temperature = 25 °C.
2. The performance shown below is for only half of the device out of the two independent amplification paths.



Load Pull Contours[1, 2]

Notes:

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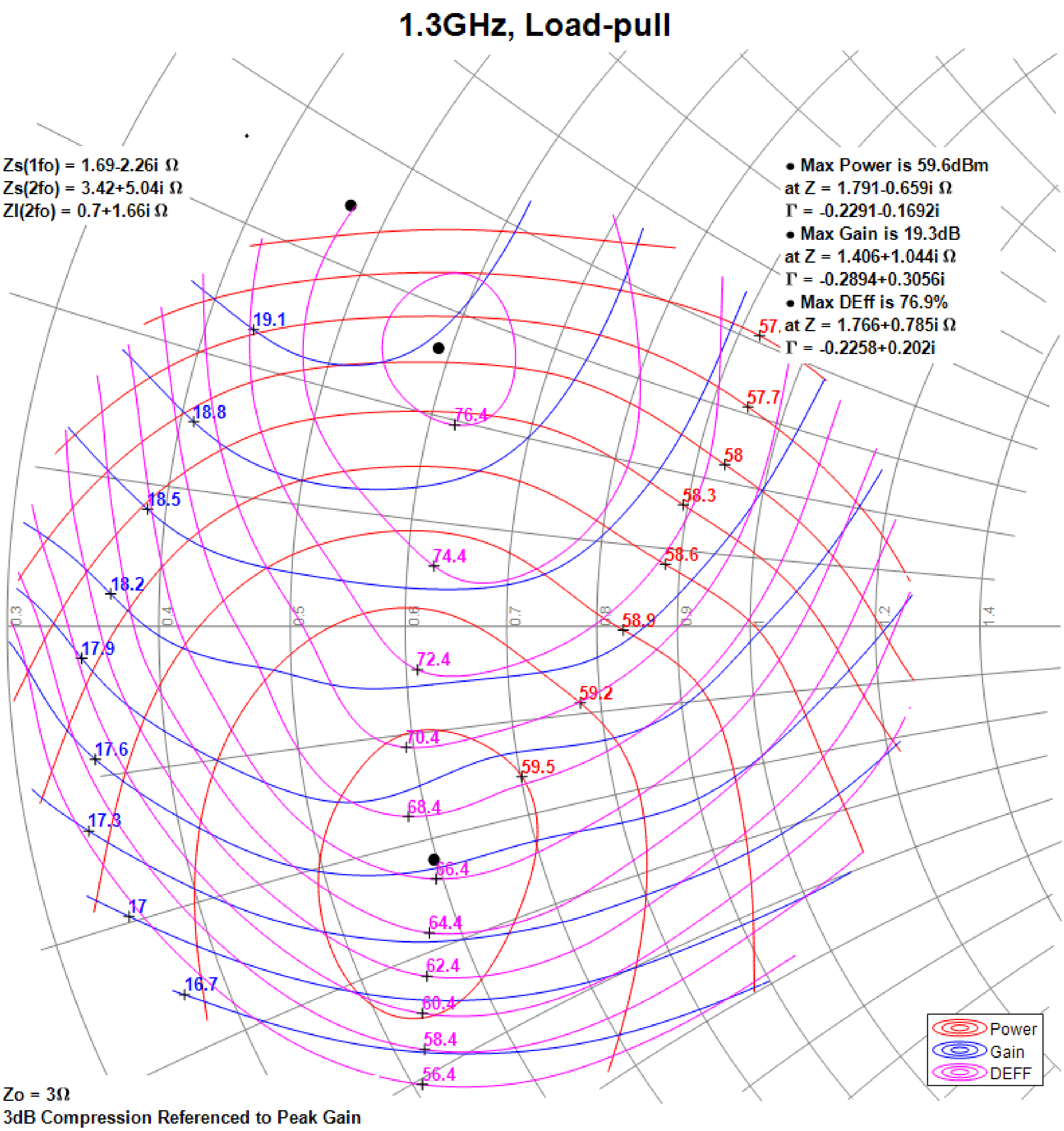

Load Pull Contours[1, 2]

Notes:

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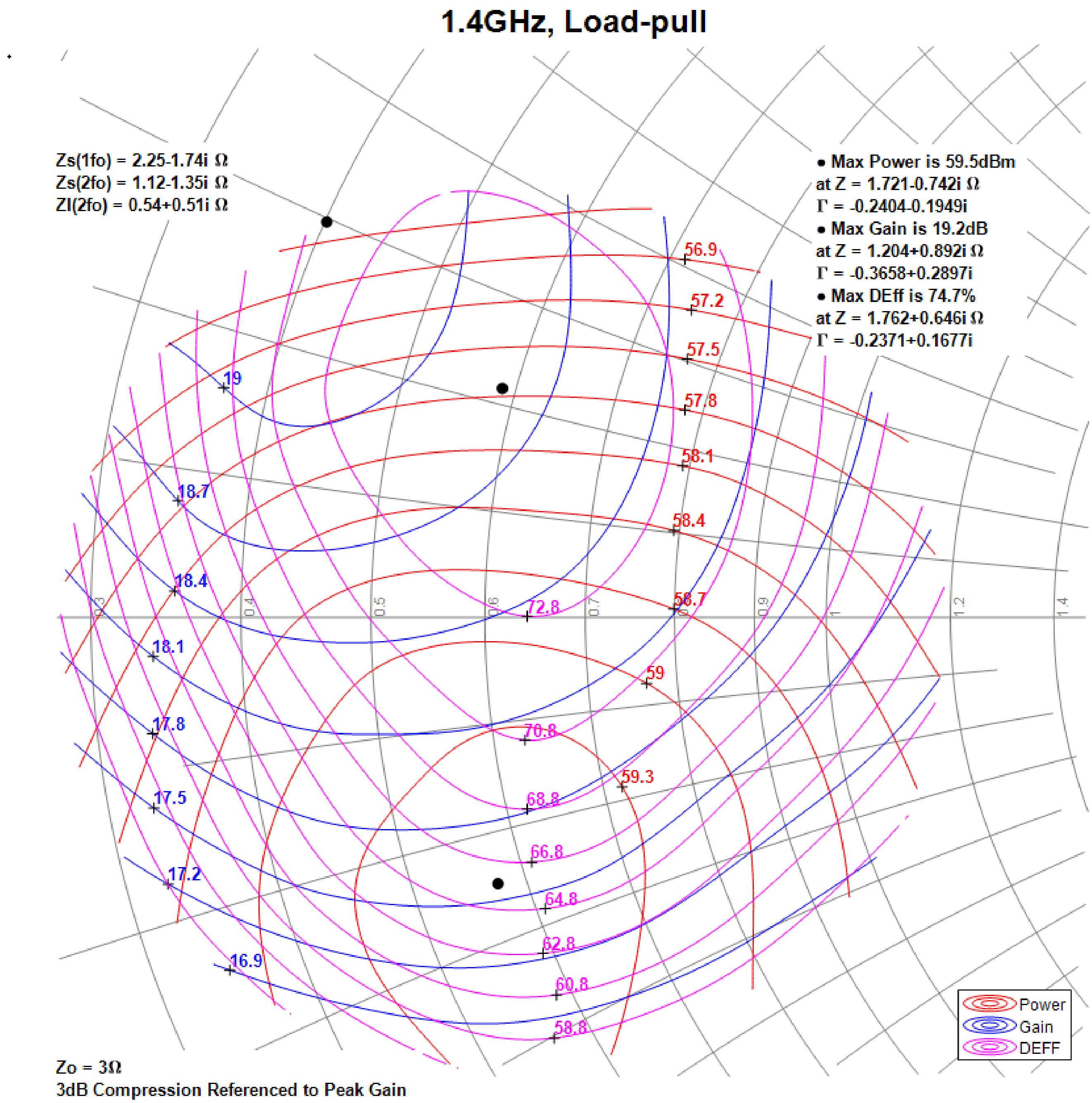
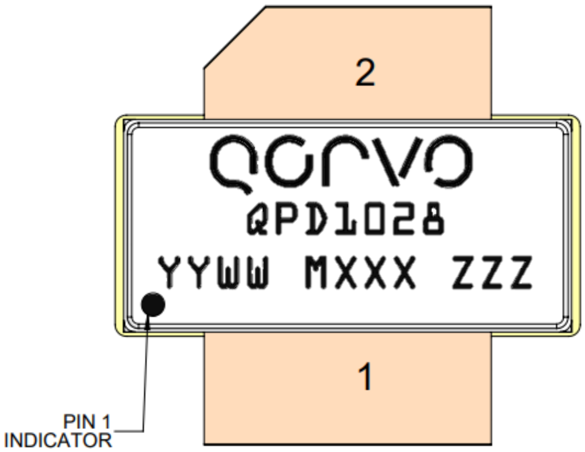
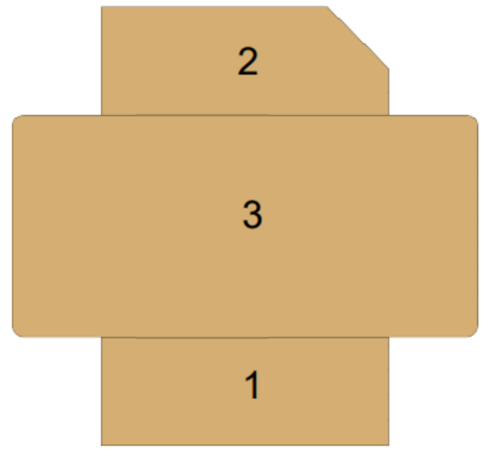
2. The performance shown below is for only half of the device out of the two independent amplification paths.



Pin Configuration and Description[1]

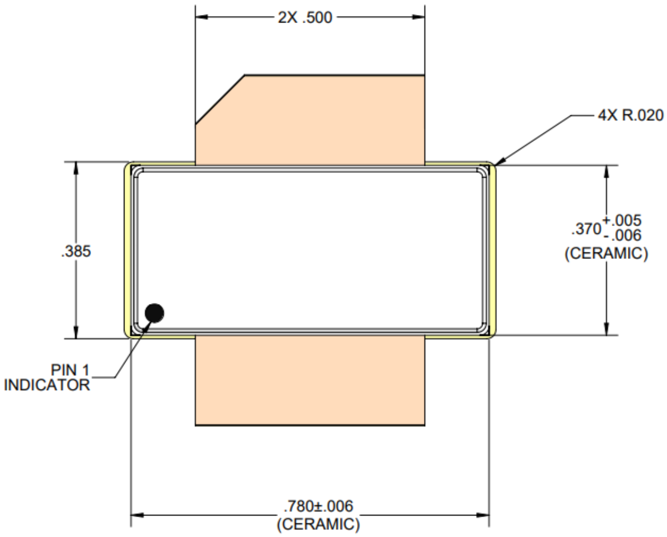


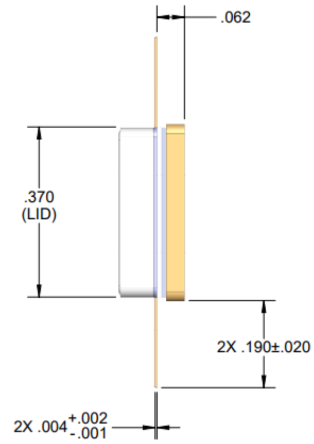


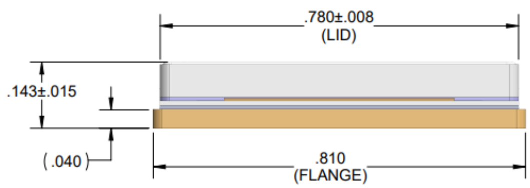
Note:
1. The QPD1028 will be marked with the "QPD1028" designator and a lot code marked below the part designator. The "YY" represents the last two digits of the calendar year the part was manufactured, the "WW" is the work week of the assembly lot start, the "MXXX" is the Batch ID, and the "ZZZ" is the serial number that is unique for all parts.

Pin Number	Label	Description
1	RF IN / V_G	Gate
2	RF OUT / V_D	Drain
3	Source	Source / Ground/ Backside of part

Mechanical Drawing[1-7]

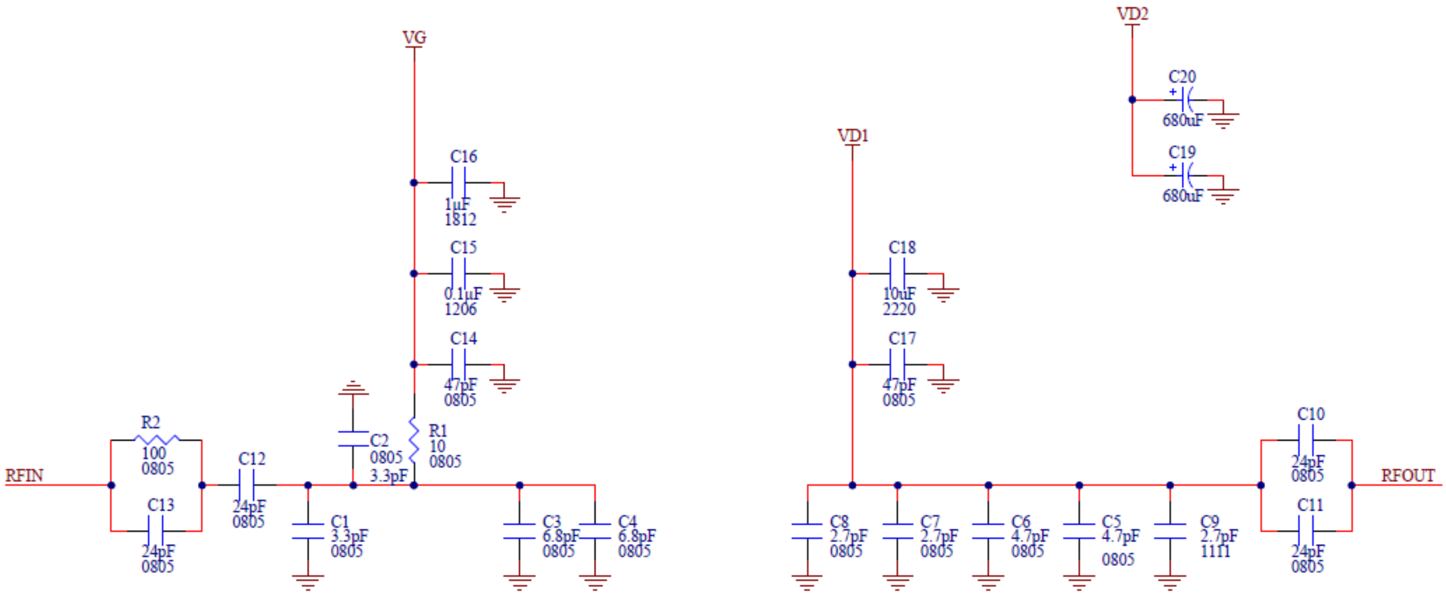






Note:
1. All dimensions are in inches.
2. Dimension tolerance is ± 0.005 inches, unless noted otherwise.
3. Material:
   Package Base: Ceramic/Metal
   Package Lid: Ceramic
4. Package exposed metallization is gold plated.
5. Part is epoxy sealed.
6. Parts meet industry NI780 footprint.
7. Body dimensions do not include lid shift or epoxy run out which can be up to 0.020 inches per side.

1.2 – 1.4 GHz Application Circuit - Schematic

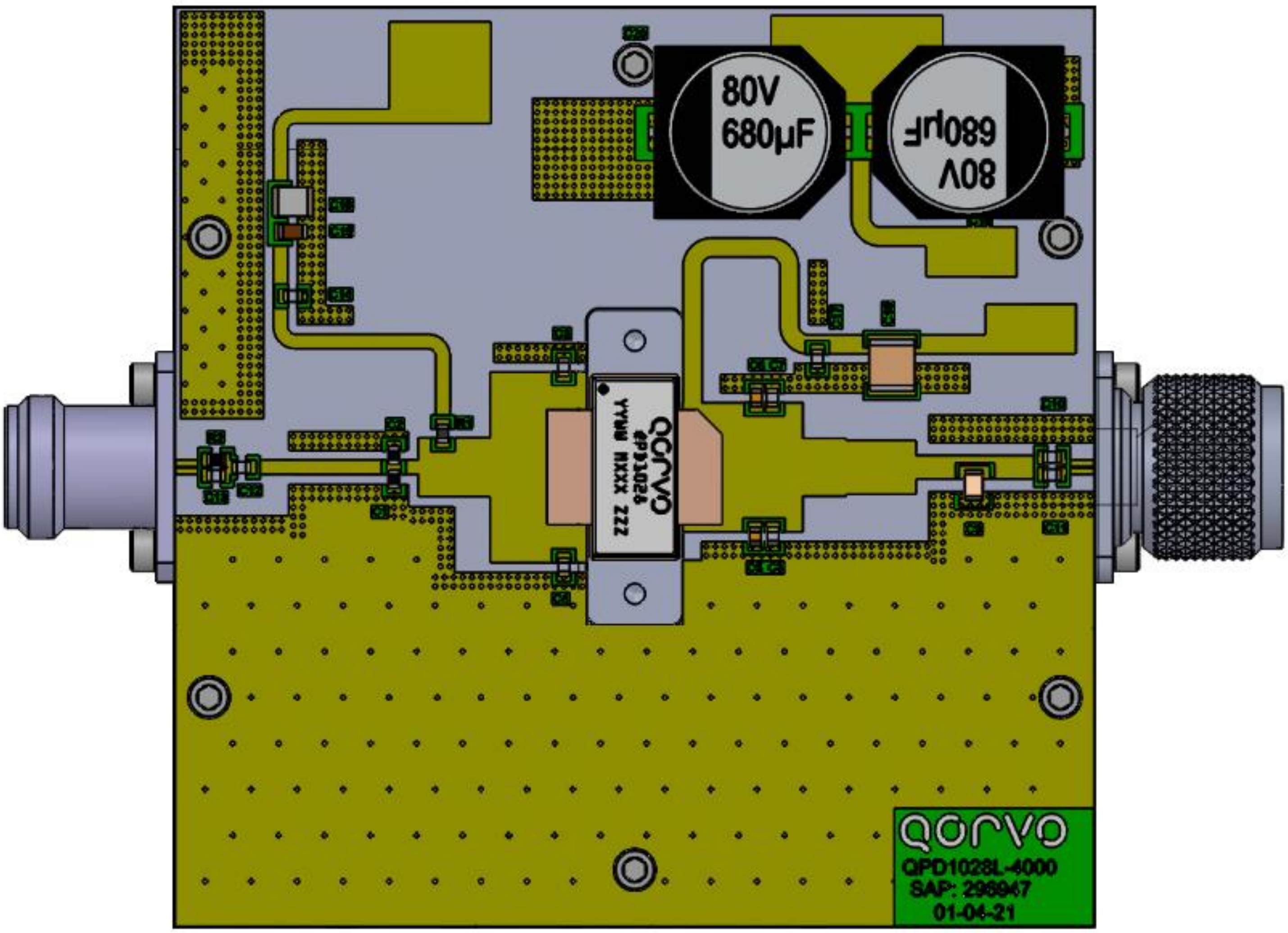


Biasing Procedure

Bias On	Bias Off
1. Turn ON V_G to −5 V.	1. Turn OFF RF.
2. Turn ON V_D to +65 V.	2. Adjust V_G to −5 V.
3. Slowly adjust V_G until I_D = 750 mA.	3. Turn OFF V_D.
(Typically, V_G = -2.8 V)	4. Wait two (2) seconds to allow drain capacitors to discharge.
4. Turn ON RF.	5. Turn OFF V_G.

1.2 – 1.4 GHz Application Circuit – EVB Assembly[1, 2]

Notes:
1. PCB material is RO4350B 0.030" thick, 2 oz. copper each side.
2. EVB is rated for pulsed operation only.

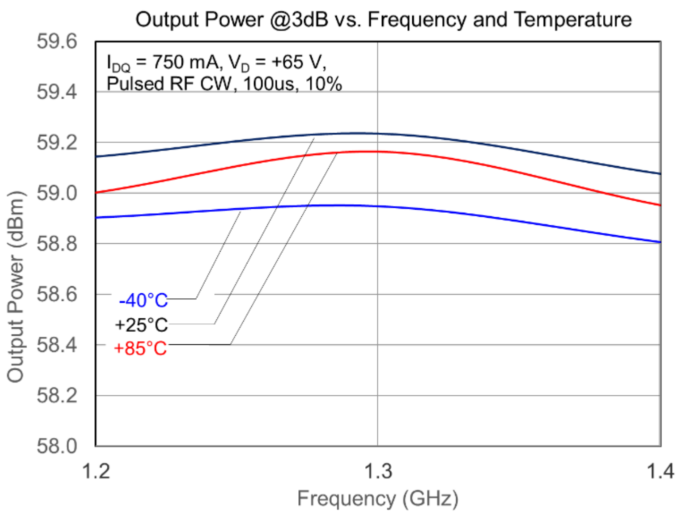


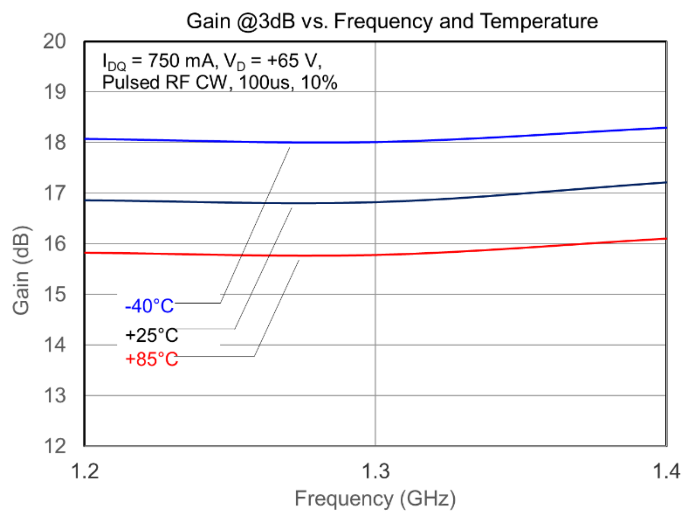
1.2 – 1.4 GHz Application Circuit EVB – Bill of Material

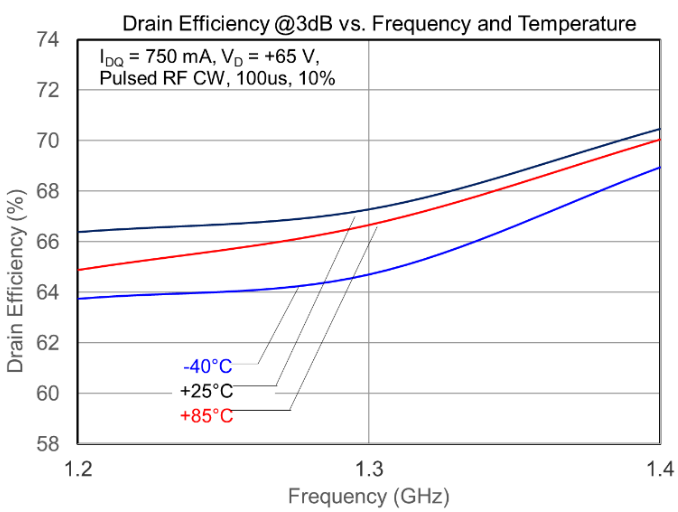
Ref Des	Qty	Description	Mfg Name	Mfg Part #
U1	1	750W, 65V, Pre-matched, 1.2-1.4GHz	Qorvo	QPD1028
C1, C2	2	CAP, 3.3pF, 0.1pF, 250V, C0G, 0805	American Technical Ceramics	600F3R3BT250XT
C3, C4	2	CAP, 6.8pF, ± 0.1pF, 250V, C0G, 0805	American Technical Ceramics	600F6R8BTT250XT
C5, C6	2	CAP, 4.7pF, 0.1pF, 250V, C0G, 0805	American Technical Ceramics	600F4R7BT250XT
C7, C8	2	CAP, 2.7pF, 0.1pF, 250V, C0G, 0805	American Technical Ceramics	600F2R7BT250XT
C9	1	CAP, 2.7pF, ±0.1pF, 500V, C0G, ATC-B	American Technical Ceramics	800B2R7BT500X
C10, C11. C12, C13	4	CAP, 24pF, 1%, 250V, C0G, 0805	American Technical Ceramics	600F240FT250XT
C14. C17	2	CAP, 47pF, 5%, 250V, HI-Q, 0805	American Technical Ceramics	600F470JT250XT
C15	1	CAP, 0.1uF, 10%, 100V, X7R, 1206	AVX Corporation	12061C104K4T2A
C16	1	CAP, 1uF, 10%, 100V, STD, 1812	AVX Corporation	18121C105KAT2A
C18	1	CAP, 10uF, 20%, 100V, X7S, 2220	TDK Singapore LTD	C5750X7S2A106M230KB
C19, C20	2	CAP, 680uF, ±20%, 80V, Alum Cap, SMD	Vishay Americas, Inc	MAL215099708E3
R1	1	RES, 10 OHM, 1%, 1/8W, 0805	Panasonic Industrial	ERJ-6ENF10R0V
R2	1	RES, 100 OHM, 5%, 1/8w, 0805	Kamaya, Inc	RMC1/10-101JTP
RFOUT	1	CONN, N, RECP ST PANEL FLG MNT	HUBER+SUHNER, Inc.	23_N-50-0-33/133_NE
RFIN	1	CONN, COAXIAL, 11 GHz, N-FLANGE, FEMALE	HUBER+SUHNER, Inc.	23_N-50-0-33/133_NE

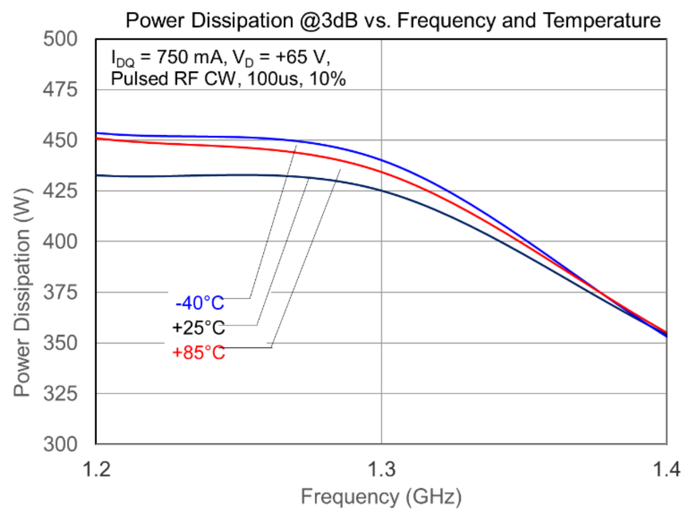
P3dB Performance over Temperature of 1.2 – 1.4 GHz EVB[1]

Notes:
1. Test Conditions: V_D = 65 V, I_{DQ} = 750 mA, Pulse Width = 100 μs, Duty Cycle = 10%.



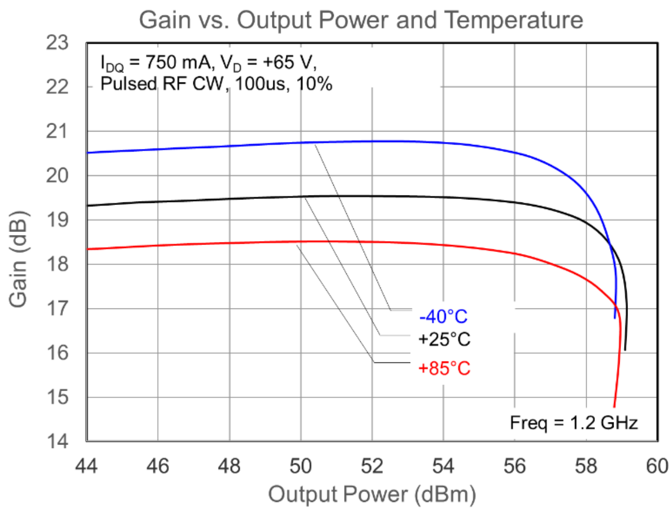


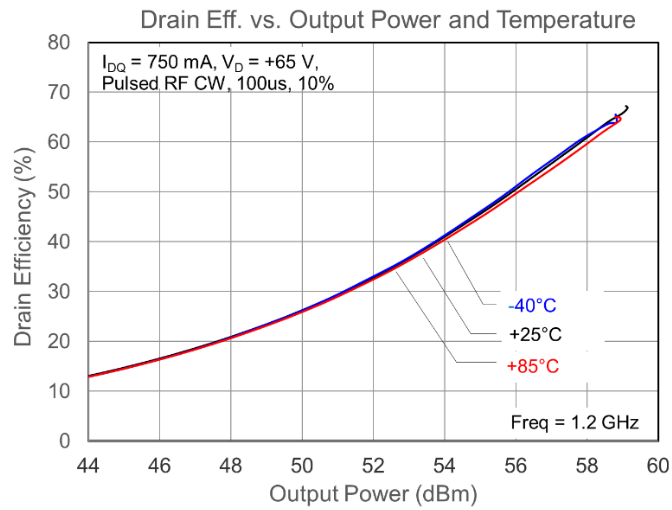


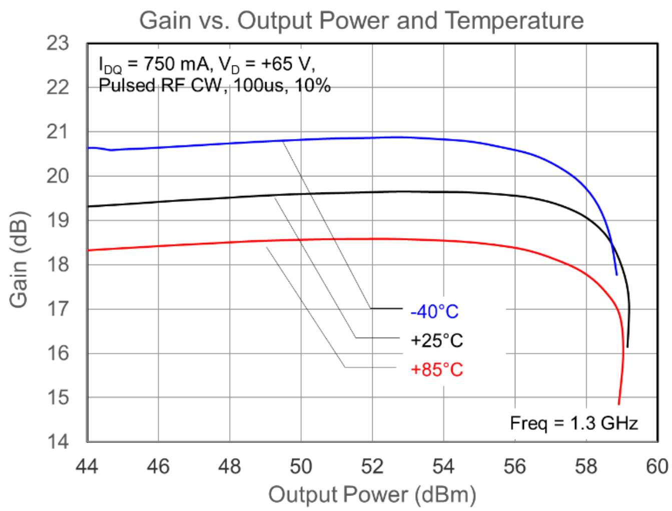


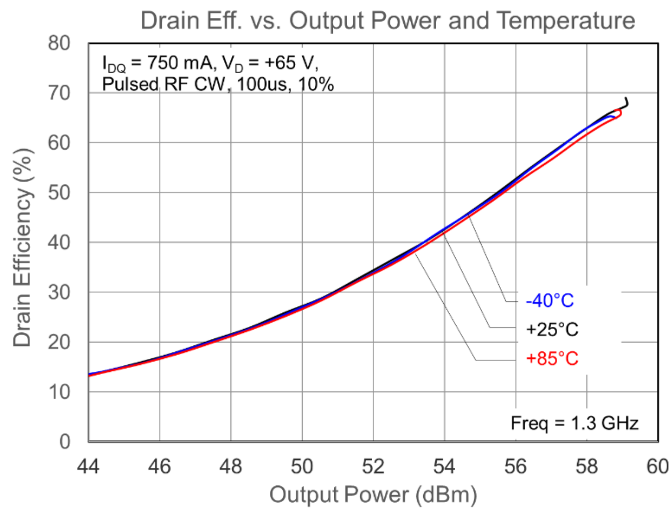
Power Drive-up Performance over Temperatures of 1.2 – 1.4 GHz EVB[1]

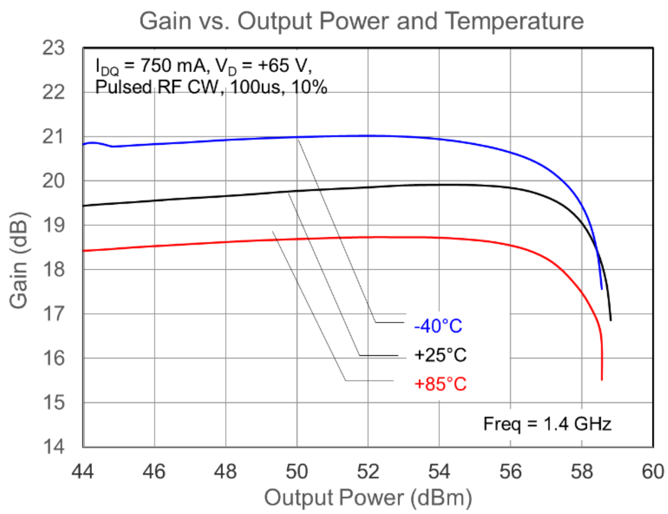
Notes:
1. Test Conditions: V_D = 65 V, I_{DQ} = 750 mA, Pulse Width = 100 µs, Duty Cycle = 10%.

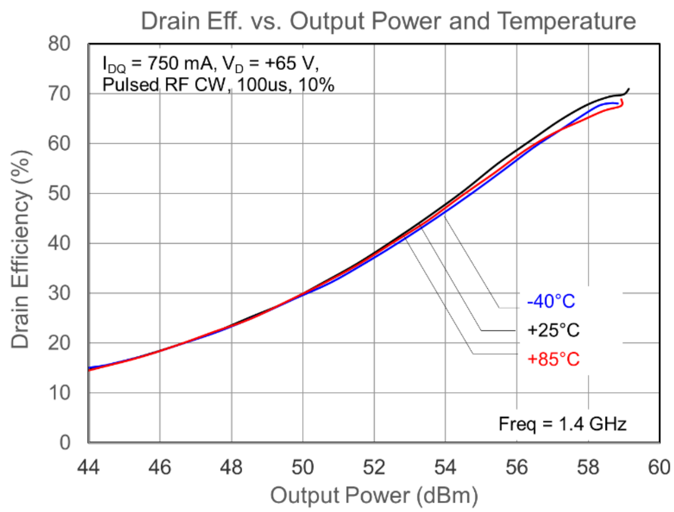




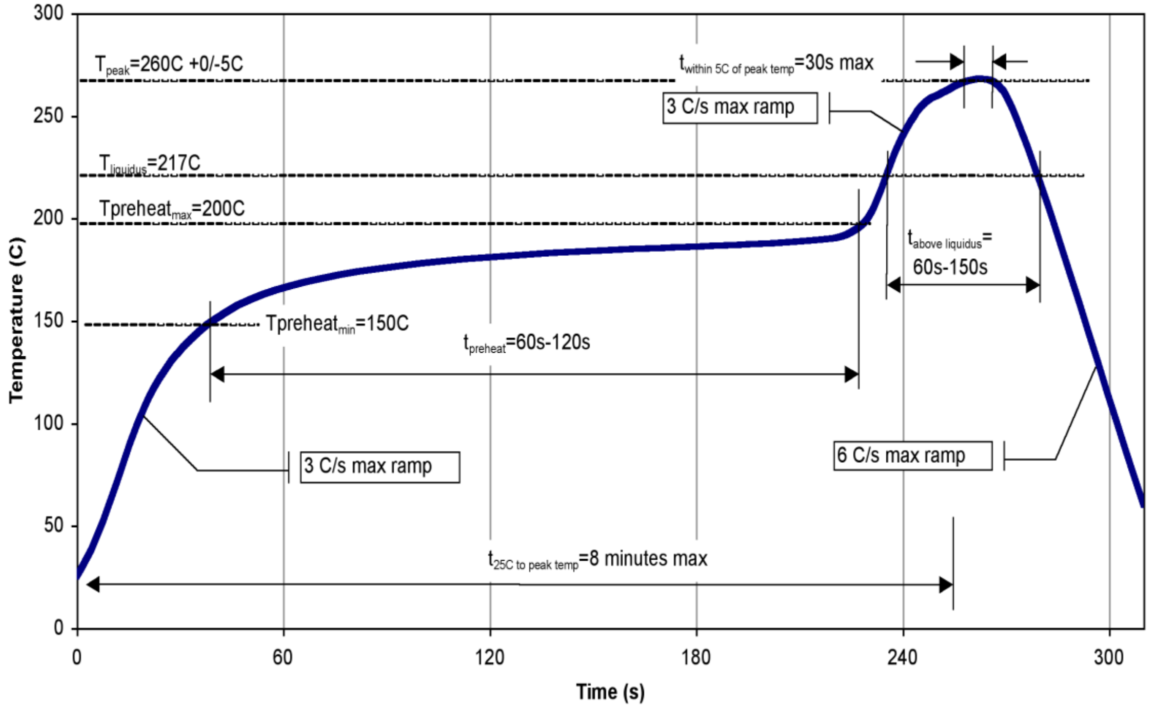








Recommended Solder Temperature Profile



Handling Precautions

Parameter	Rating	Standard
ESD – Human Body Model (HBM)	Class 1A (250 V)	ANSI/ESDA/JEDEC Standard JS-001
ESD – Charged Device Model (CDM)	Class C3 (1000V)	ANSI/ESDA/JEDEC Standard JS-002
MSL – Moisture Sensitivity Level	MSL3	IPC/JEDEC Standard 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.

Package lead plating is NiAu. Au thickness is 60 micro inches minimum.

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:

- 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:

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Email: customer.support@qorvo.com

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