QPD1017
450W, 50V, 3.1 – 3.5 GHz, GaN RF IMFET

Product Overview

The QPD1017 is a 450 W (P_{3dB}) internally matched discrete GaN on SiC HEMT which operates from 3.1 to 3.5 GHz on a 50V supply rail. The device is GaN IMFET fully matched to 50 Ω in an industry standard air cavity package and is ideally suited for military radar.

ROHS compliant.

Evaluation boards are available upon request.

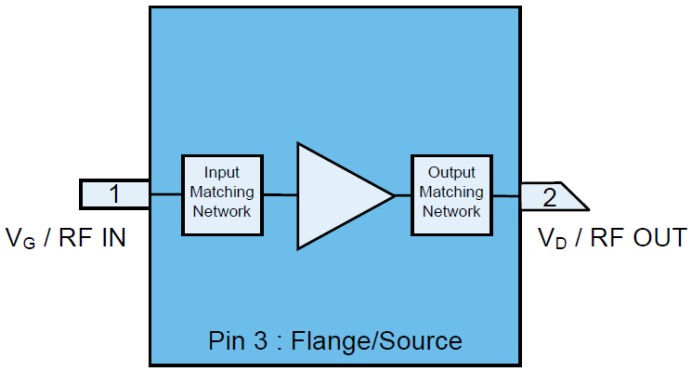
17.40 x 24.00 x 4.31 mm

Key Features[1]

- Frequency: 3.1 to 3.5 GHz
- Output Power (P_{3dB})[1]: 460 W
- Linear Gain[1]: 16.5 dB
- Typical DE_{3dB}[1]: 63%
- Typical PAE_{3dB}[1]: 60%
- Operating Voltage: 50 V
- Low thermal resistance package
- Pulse capable

Note 1: @ 3.3 GHz

Functional Block Diagram



Applications

- Military radar
- Civilian radar
- Test instrumentation

Ordering Information

Part No.	Description
QPD1017	3.1 – 3.5 GHz RF IMFET
QPD1017SB	3.1 – 3.5 GHz Sample
QPD1017PCB4B01	3.1 – 3.5 GHz EVB

Absolute Maximum Ratings[1]

Parameter	Rating	Units
Breakdown Voltage,BV_{DG}	+145	V
Gate Voltage Range, V_G	-7 to +2	V
Drain Current	20	A
Gate Current Range, I_G	See page 4.	mA
Power Dissipation, 10% DC 100 uS PW, P_D , T = 85°C	511	W
RF Input Power, 10% DC 100 uS PW, 3.3 GHz, T = 25°C	+49	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.

Recommended Operating Conditions[1, 2, 3, 4]

Parameter	Min	Typ	Max	Units
Operating Temp. Range	−40	+25	+85	°C
Drain Voltage Range, V_D	+28	+50	+55	V
Drain Bias Current, I_{DQ}	–	750	–	mA
Drain Current, I_D	–	15	–	A
Gate Voltage, V_G[4]	–	−2.8	–	V
Power Dissipation, Pulsed (P_D)[2, 3]	–	–	476	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. Pulse Width = 100 uS, Duty Cycle = 10%
4. To be adjusted to desired I_{DQ}

Pulsed Characterization – Load-Pull Performance – Power Tuned[1]

Parameters	Typical Values			Unit
Frequency, F	3.1	3.3	3.5	GHz
Linear Gain, G_{LIN}	14.8	15.7	15.5	dB
Output Power at 3dB compression point, P_{3dB}	57.9	57.8	57.6	dBm
Power-Added-Efficiency at 3dB compression point, PAE_{3dB}	57.5	56.4	54.7	%
Gain at 3dB compression point	11.8	12.7	12.5	dB

Notes:
1. Test conditions unless otherwise noted: V_D = 50 V, I_{DQ} = 750 mA, Temp = 25°C, 100 uS PW, 10% DC

Pulsed Characterization – Load-Pull Performance – Efficiency Tuned[1]

Parameters	Typical Values			Unit
Frequency, F	3.1	3.3	3.5	GHz
Linear Gain, G_{LIN}	15.8	16.8	16.8	dB
Output Power at 3dB compression point, P_{3dB}	56.1	56.2	55.9	dBm
Power-Added-Efficiency at 3dB compression point, PAE_{3dB}	68.0	66.0	65.0	%
Gain at 3dB compression point, G_{3dB}	12.8	13.8	13.8	dB

Notes:
1. Test conditions unless otherwise noted: V_D = 50 V, I_{DQ} = 750 mA, Temp = 25°C, 100 uS PW, 10% DC

RF Characterization – 3.1 – 3.5 GHz EVB Performance At 3.1 GHz[1]

Parameter	Min	Typ	Max	Units
Linear Gain, G_{LIN}	–	15.4	–	dB
Output Power at 3dB compression point, P_{3dB}	–	56.6	–	dBm
Power-Added Efficiency at 3dB compression point, PAE_{3dB}	–	57.1	–	%
Gain at 3dB compression point, G_{3dB}	–	12.4	–	dB

Notes:
1. V_D = 50 V, I_{DQ} = 750 mA, Temp = 25°C, 100 uS PW, 10% DC

RF Characterization – 3.1 – 3.5 GHz EVB Performance At 3.3 GHz[1]

Parameter	Min	Typ	Max	Units
Linear Gain, G_{LIN}	–	16.0	–	dB
Output Power at 3dB compression point, P_{3dB}	–	56.3	–	dBm
Power-Added Efficiency at 3dB compression point, PAE_{3dB}	–	54.6	–	%
Gain at 3dB compression point, G_{3dB}	–	13.0	–	dB

Notes:
1. V_D = 50 V, I_{DQ} = 750 mA, Temp = 25°C, 100 uS PW, 10% DC

RF Characterization – 3.1 – 3.5 GHz EVB Performance At 3.5 GHz[1]

Parameter	Min	Typ	Max	Units
Linear Gain, G_{LIN}	–	16.2	–	dB
Output Power at 3dB compression point, P_{3dB}	–	56.2	–	dBm
Power-Added Efficiency at 3dB compression point, PAE_{3dB}	–	54.1	–	%
Gain at 3dB compression point, G_{3dB}	–	13.2	–	dB

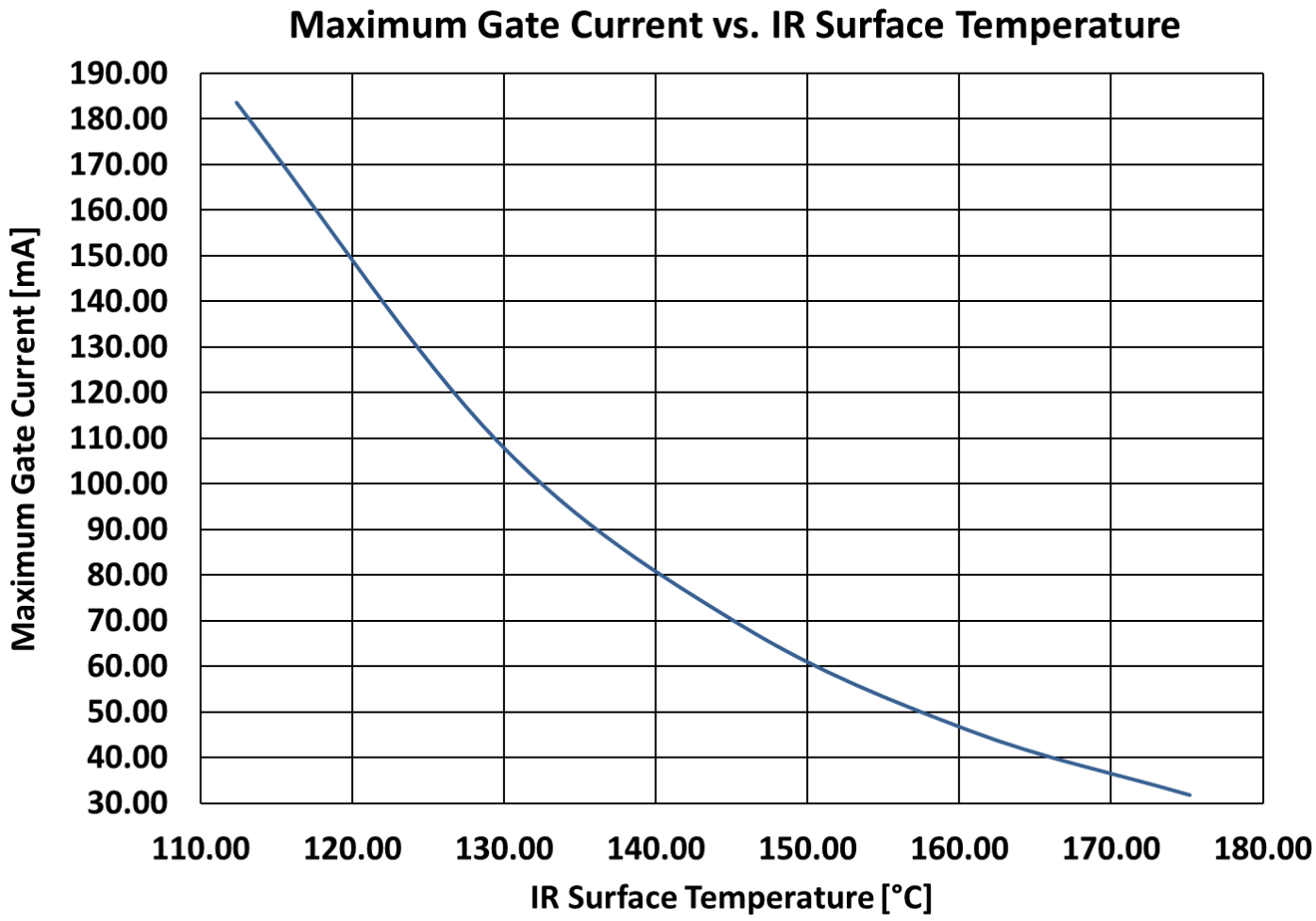
Notes:
1. V_D = 50 V, I_{DQ} = 750 mA, Temp = 25°C, 100 uS PW, 10% DC

RF Characterization – Mismatch Ruggedness at 3.1, 3.3 & 3.5 GHz[1, 2, 3]

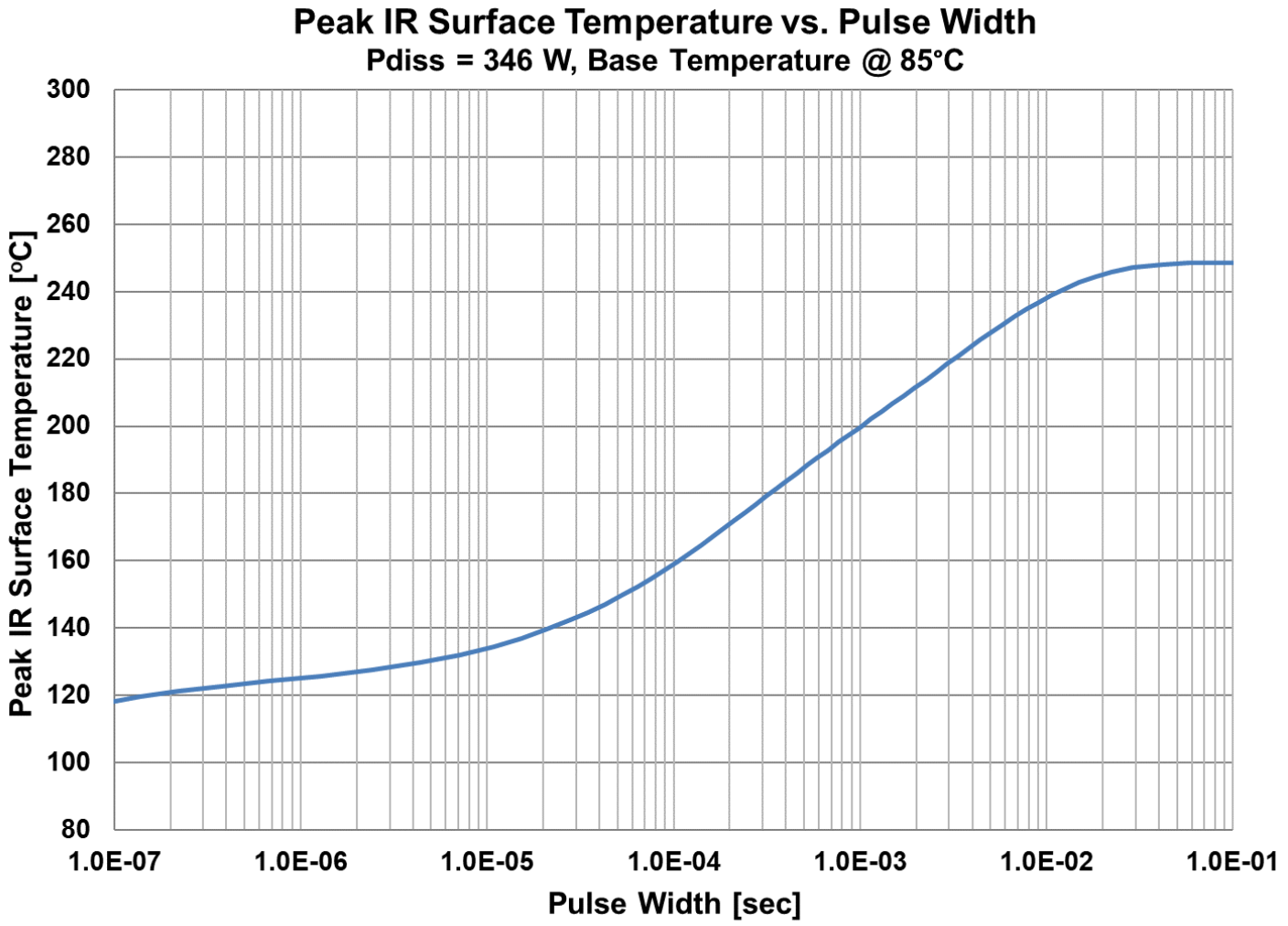
Symbol	Parameter	dB Compression	Typical
VSWR	Impedance Mismatch Ruggedness	3	10:1

Notes:
1. Test conditions unless otherwise noted: T_A = 25°C, V_D = 50 V, I_{DQ} = 750 mA, 100 uS PW, 10% DC.
2. Driving input power is determined at pulsed compression under matched condition at EVB output connector.
3. No spur detected down to the noise floor of Spectrum Analyzer from 1 – 15GHz at T_A = -40°C.

Maximum Gate Current



Thermal and Reliability Information – Pulsed[1]



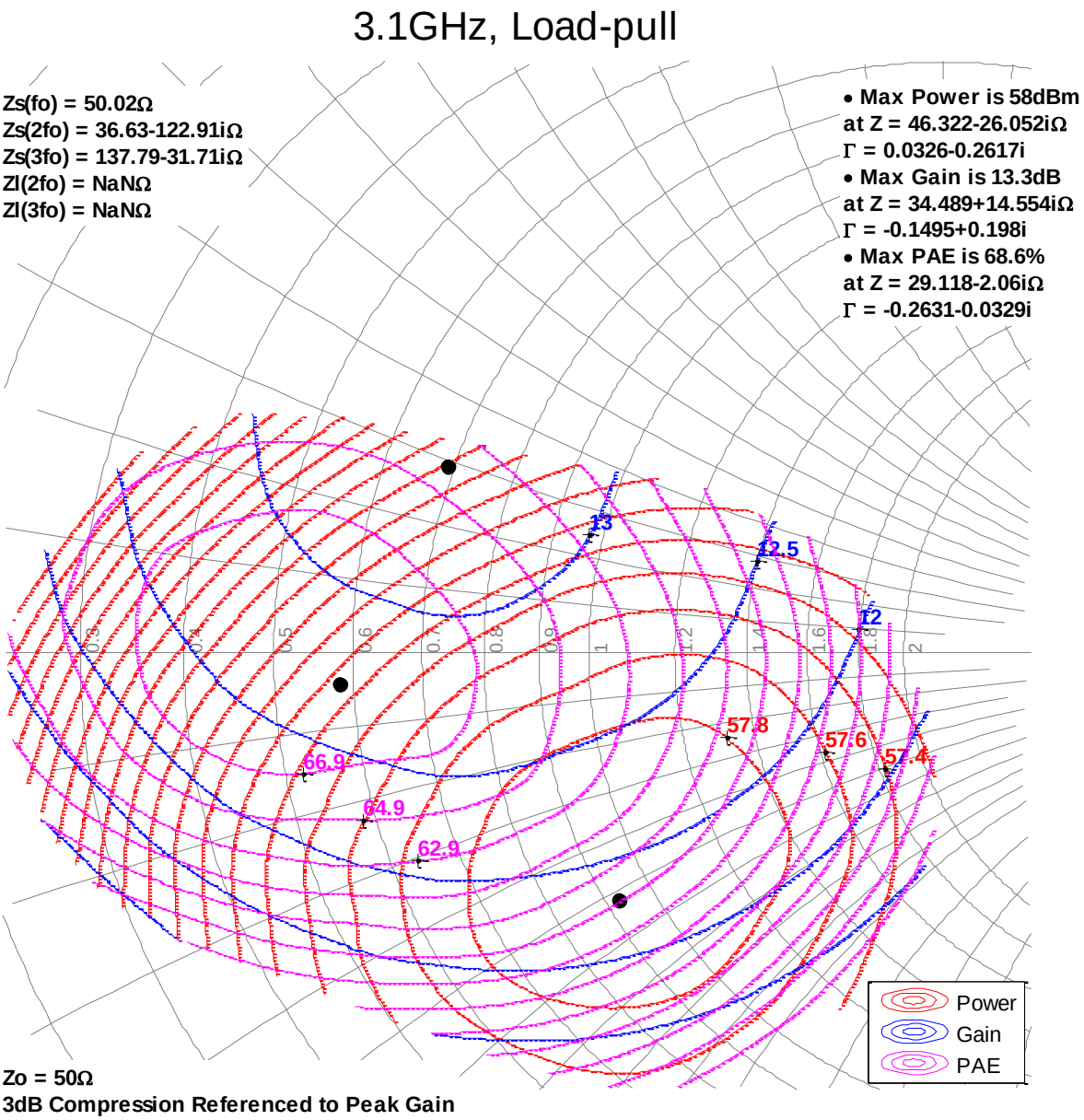
Parameter	Conditions	Values	Units
Thermal Resistance, IR[1] (θ_{JC})	85°C back side temperature	0.33	°C/W
Peak IR Surface Temperature[1] (T_{CH})	346 W Pdiss, 1 mS PW, 10% DC	200	°C

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

Load-Pull Smith Charts[1, 2, 3]

Notes:

1. V_D = 50 V, I_{DQ} = 750 mA, 100 uS PW, 10% DC pulsed. Performance is at 3dB gain compression referenced to peak gain.
2. See page 12 for load-pull and source-pull reference planes. 50-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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1. V_D = 50 V, I_{DQ} = 750 mA, 100 uS PW, 10% DC pulsed. Performance is at 3dB gain compression referenced to peak gain.
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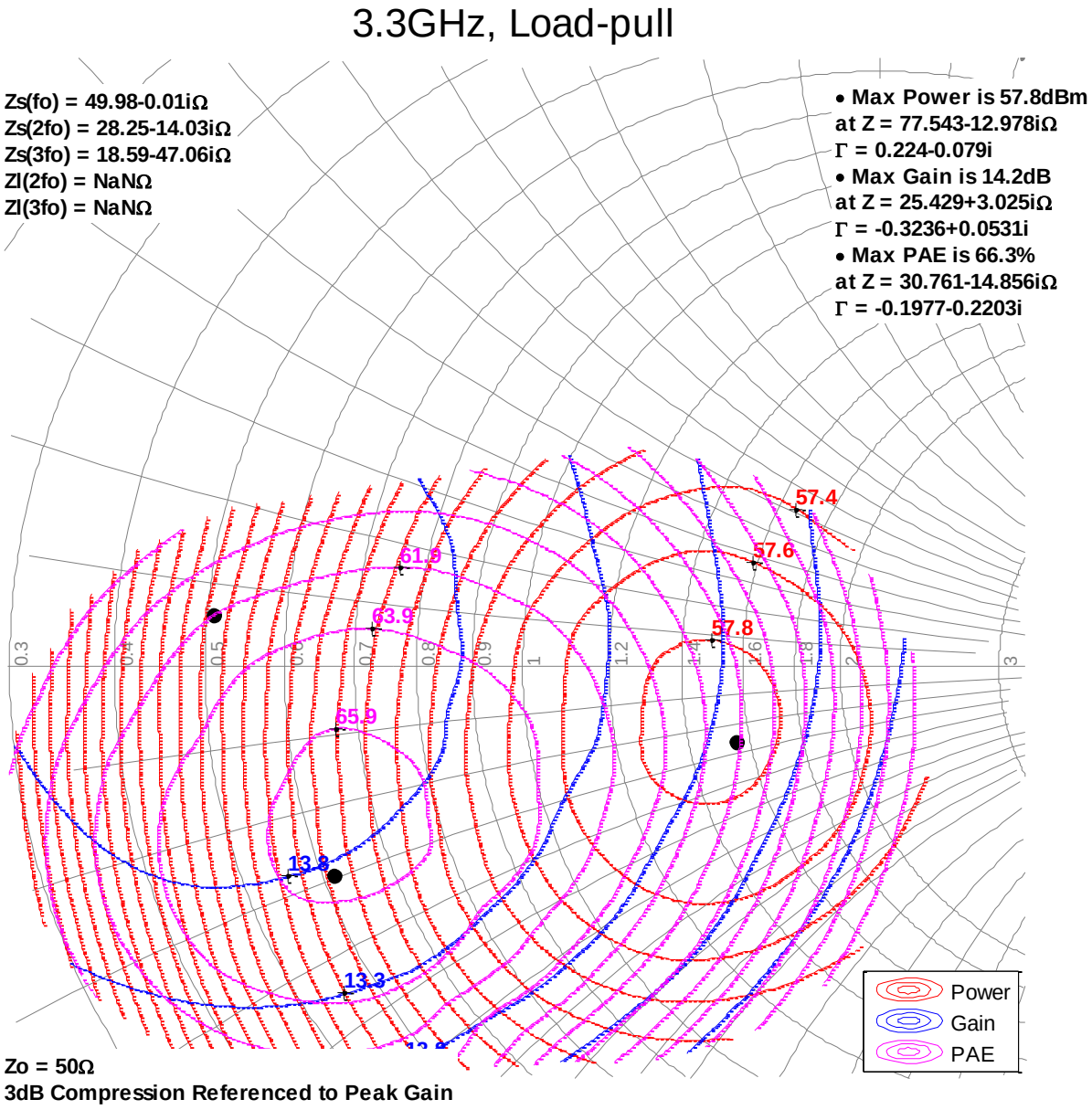

Load-Pull Smith Charts[1, 2, 3]

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1. V_D = 50 V, I_{DQ} = 750 mA, 100 uS PW, 10% DC pulsed. Performance is at 3dB gain compression referenced to peak gain.
2. See page 12 for load-pull and source-pull reference planes. 50-Ω load-pull TRL fixtures are built with 20-mil RO4350B material.
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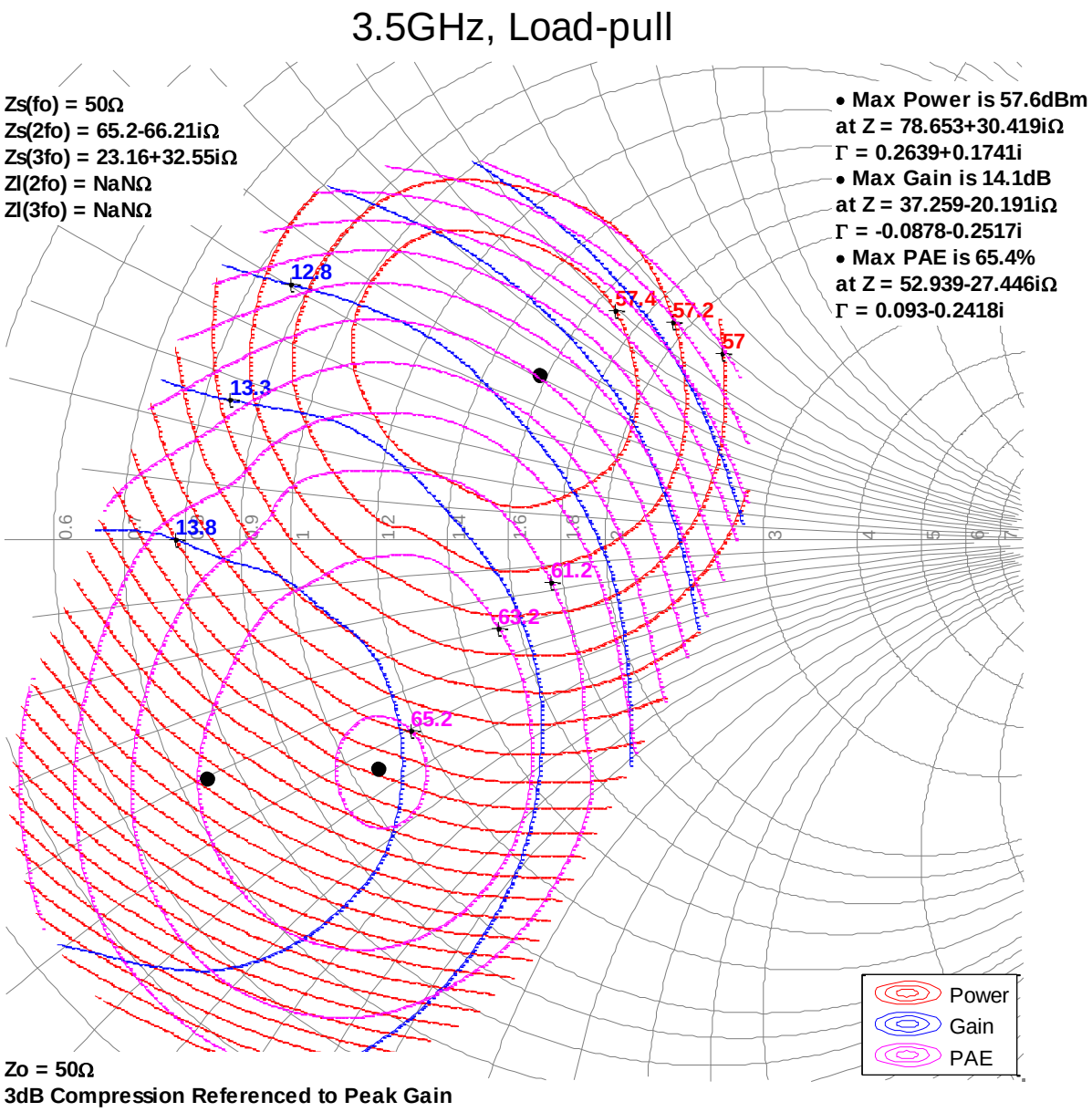
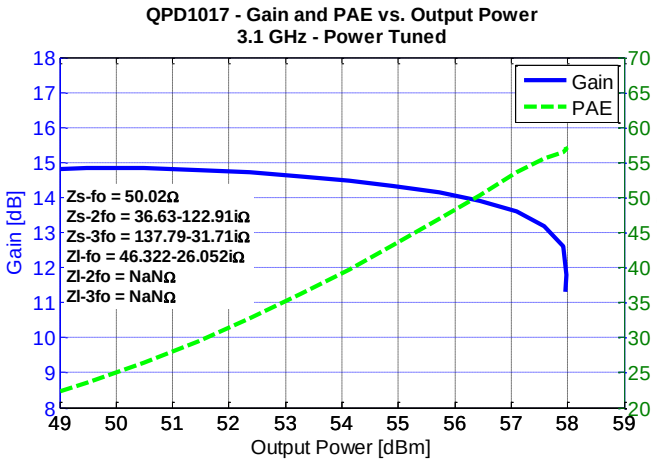
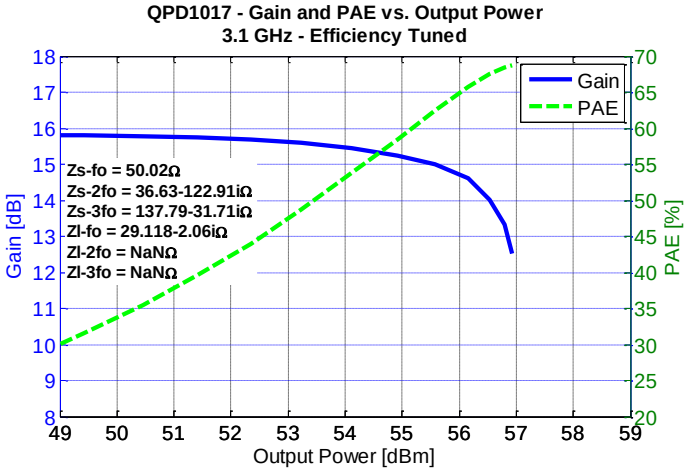


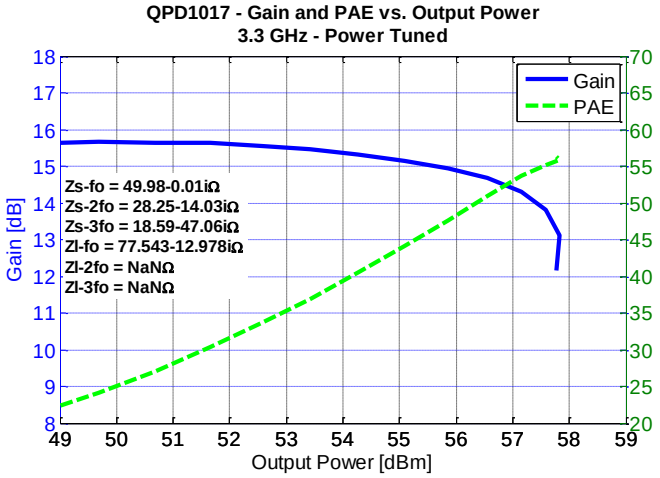
Typical Performance – Load-Pull Drive-up[1, 2]

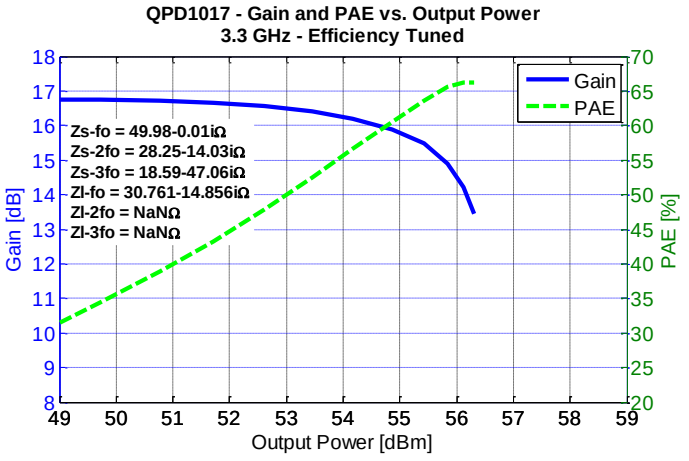
Notes:

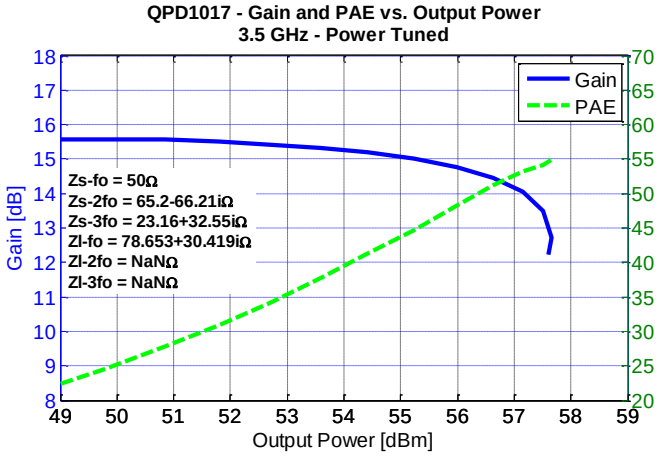
1. 100 uS PW, 10% DC pulsed signal, V_D = 50 V, I_{DQ} = 750 mA, T_A = 25°C.
2. See page 12 for load-pull and source-pull reference planes where the performance was measured.

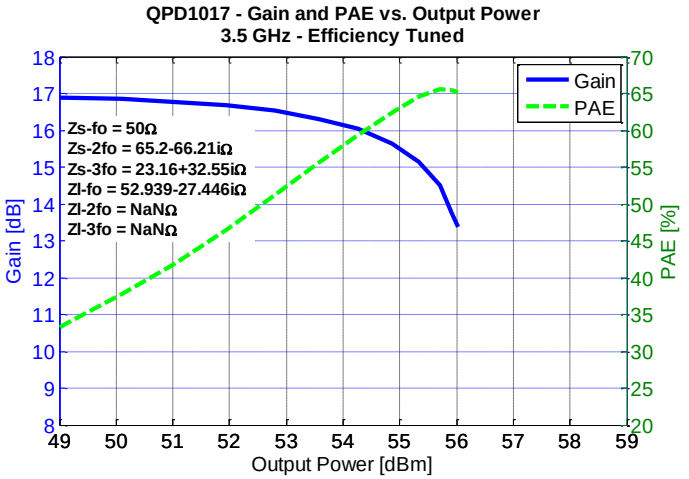






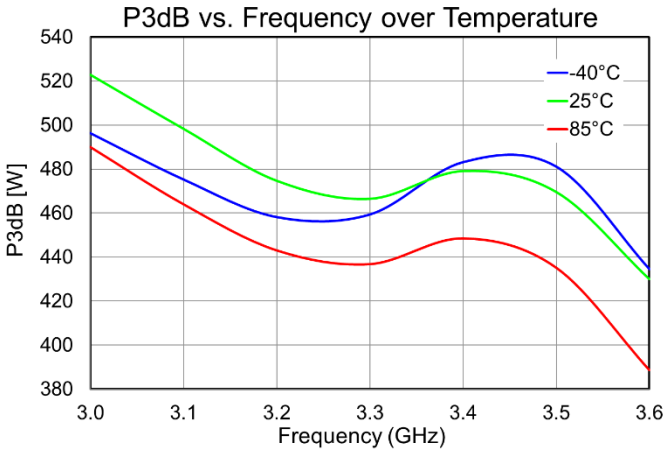


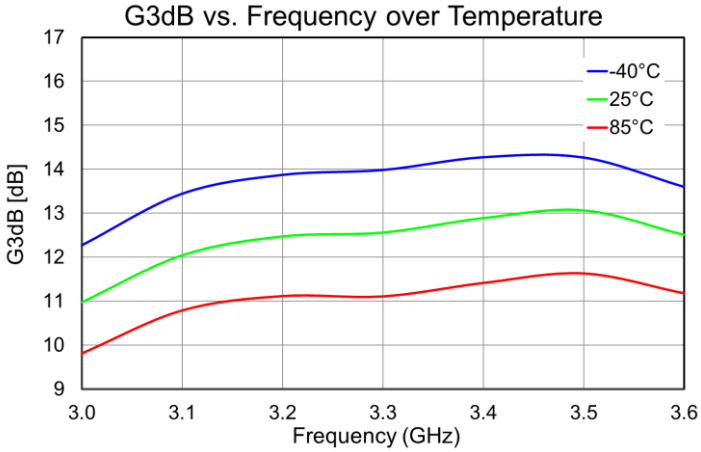


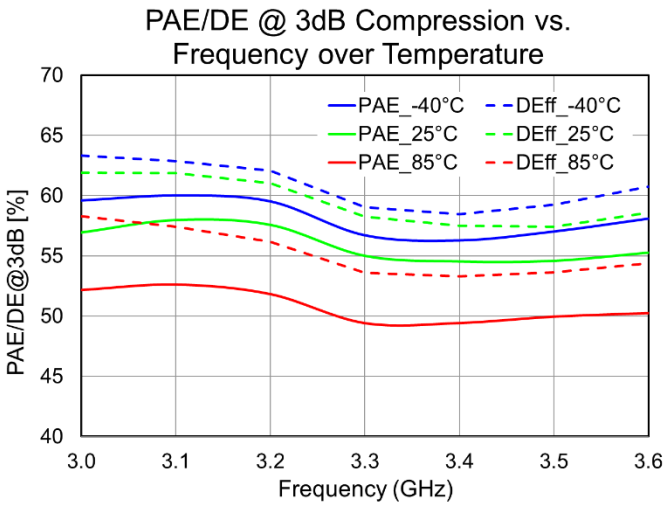


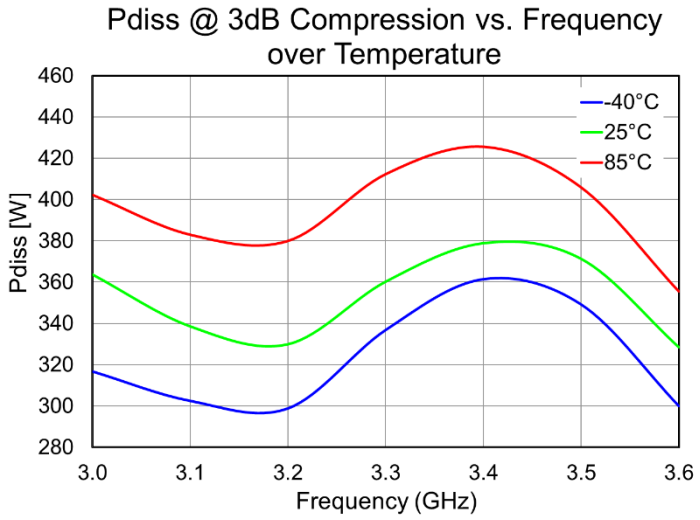
Power Drive-up Performance Over Temperatures Of 3.1 – 3.5 GHz EVB[1, 2]

Notes:
1. V_D = 50 V, I_{DQ} = 750 mA, 100 uS PW, 10% DC.
2. Performance shown is at EVB connectors reference plane.





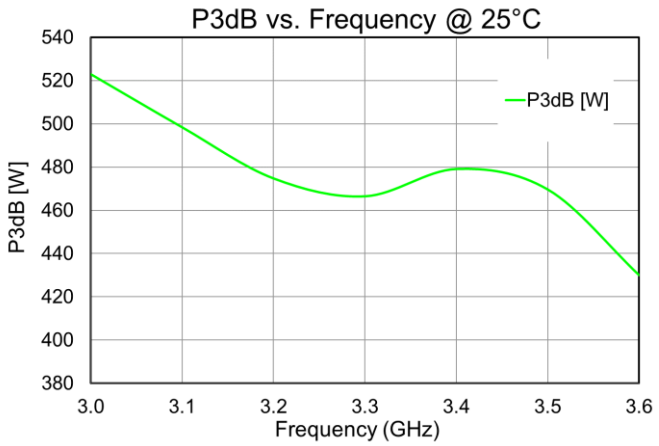


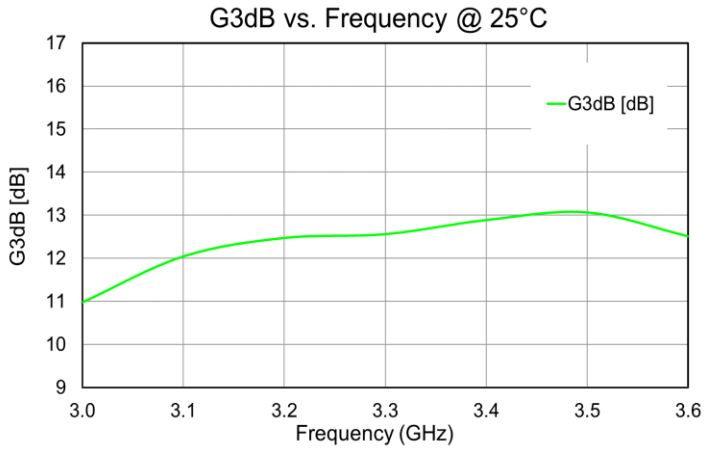


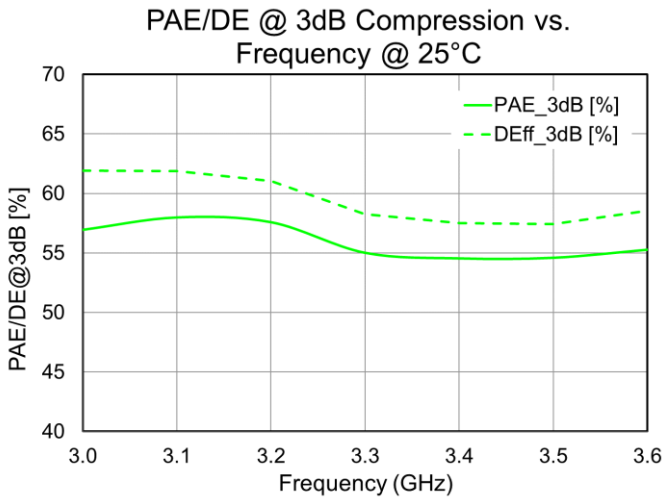
Power Drive-up Performance At 25°C Of 3.1 – 3.5 GHz EVB[1, 2]

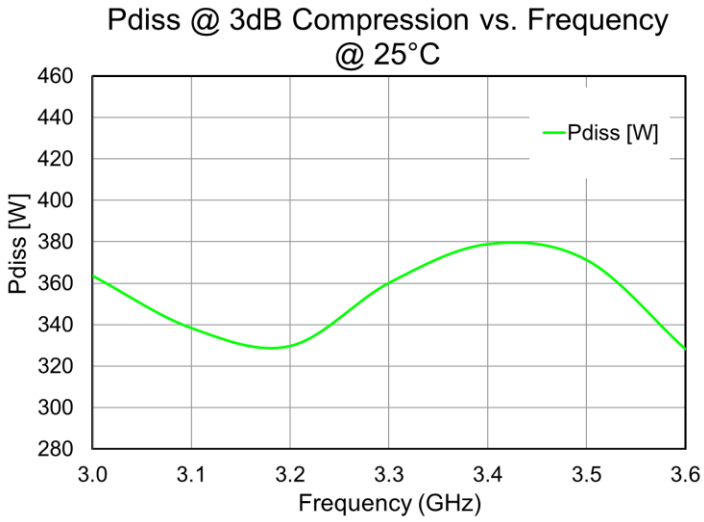
Notes:

1. V_D = 50 V, I_{DQ} = 750 mA, 100 uS PW, 10% DC, T_A = 25°C.
2. Performance shown is at EVB connectors reference plane.

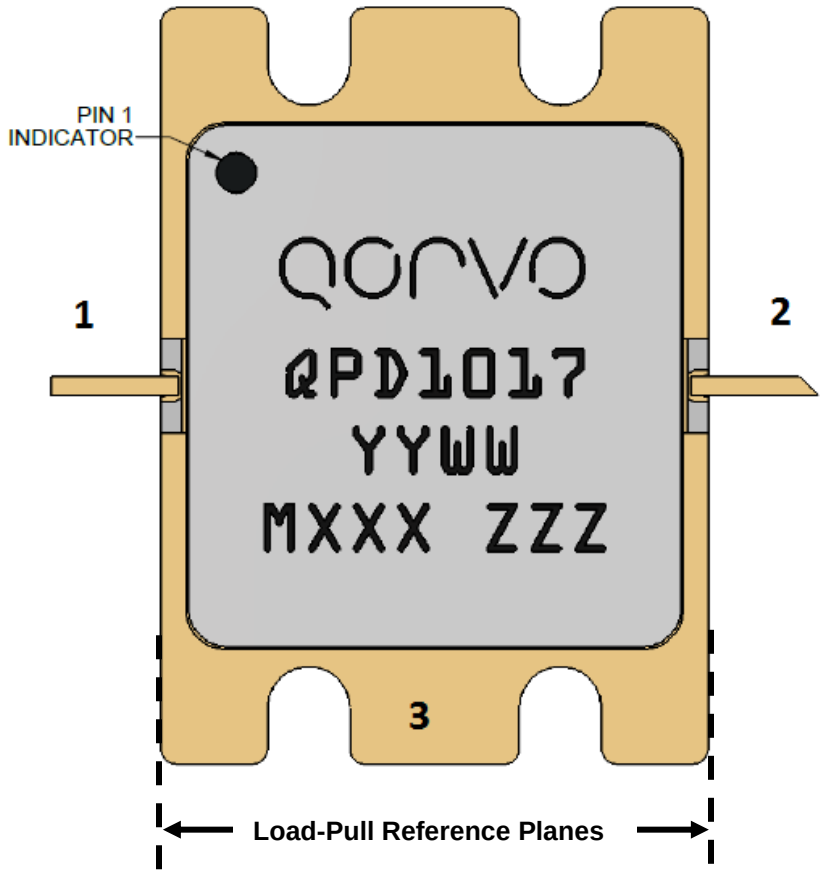








Pin Configuration, Marking and Description[1]

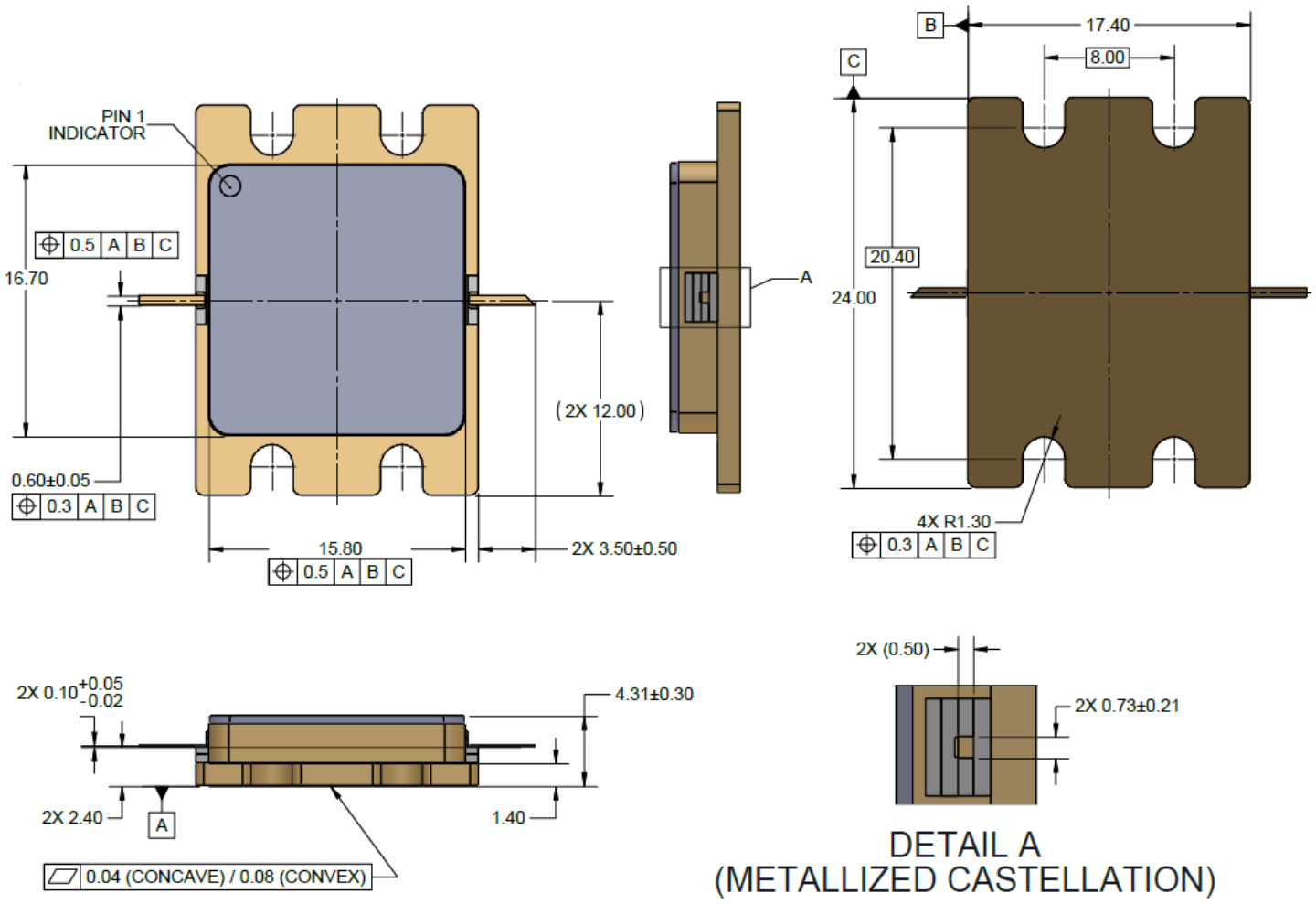


Pin Description

Pin	Symbol	Description
1	V_G / RF IN	Gate voltage / RF Input
2	V_D / RF OUT	Drain voltage / RF Output
3	GND	Package base / Ground

Notes:
1. The QPD1017 will be marked with the “QPD1017” 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.

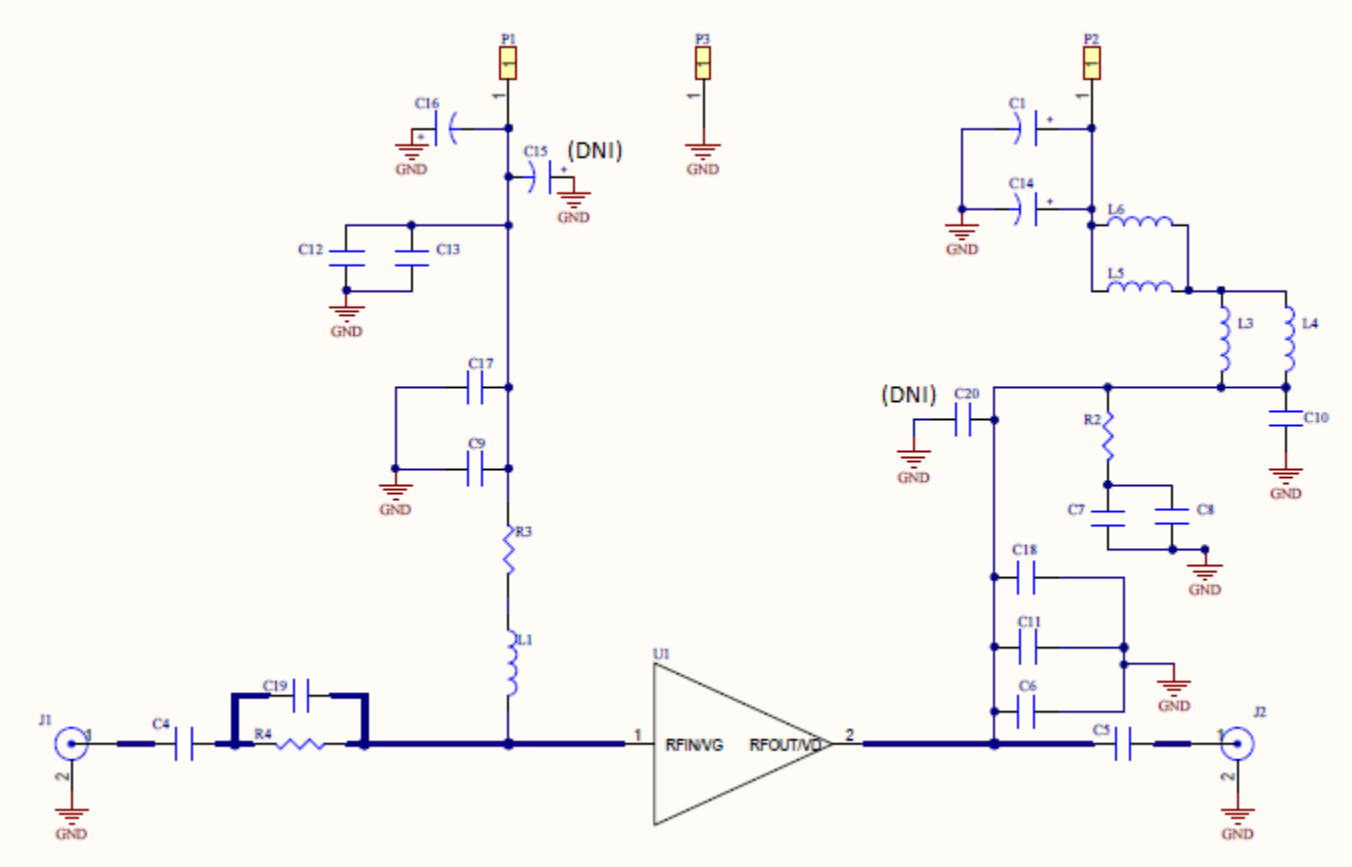
Package Dimensions[1, 2, 3, 4]



Notes:

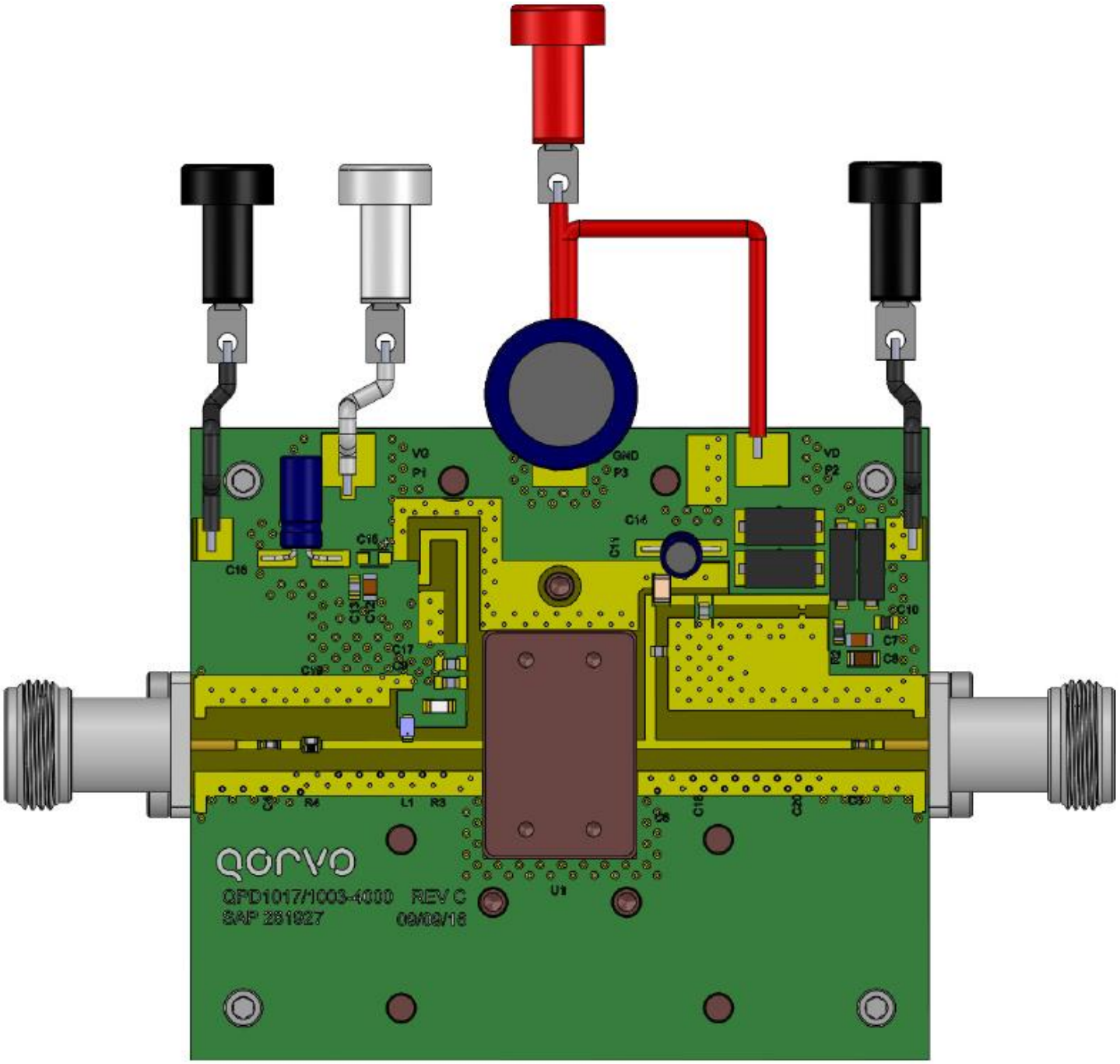
1. All dimensions are in mm. otherwise noted, the tolerance is ±0.15 mm.
2. Package is an all metal design with ceramic lid and feed thru's.
3. Package is epoxy sealed.
4. For instruction to mount the part, please refer to application note "RF565 Package Mounting, Mechanical Mounting and PCB Considerations".

Schematic – 3.1 – 3.5 GHz EVB



Bias-up Procedure	Bias-down Procedure
1. Set V_G to -6 V.	1. Turn off RF signal.
2. Set I_D current limit to 1000 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 750 mA.	4. Turn off V_G
5. Set I_D current limit to 2 A	
6. Apply RF.	

PCB Assembly – 3.1 – 3.5 GHz EVB[1]

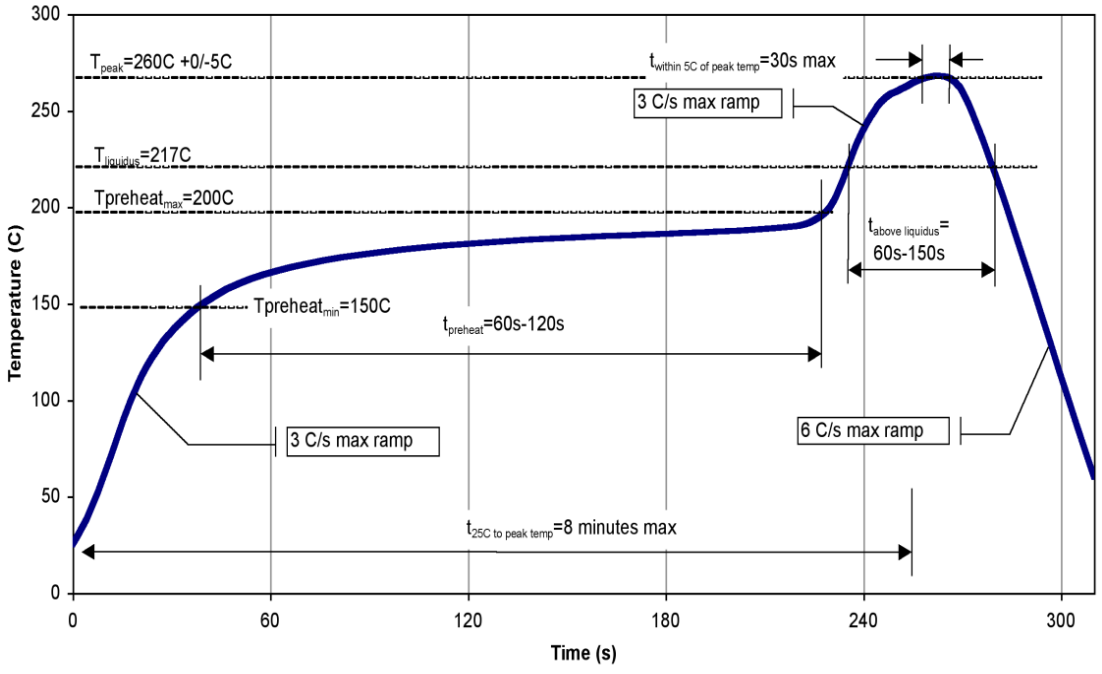


Notes:
1. PCB Material: RO4350B, 20 mil thickness, 1 oz copper cladding

Bill Of material – 3.1 – 3.5 GHz EVB

Ref Des	Value	Qty	Manufacturer	Part Number
C1	680 uF	1	Panasonic	EEU-FC2A681
C4, C19	10 pF	2	ATC	ATC600S100JW250XT
C5	15 pF	1	ATC	ATC600S150FT250XT
C6, C9	10 pF	2	ATC	ATC600F100BT250XT
C7, C12	10000 pF	2	Panasonic	ECJ-2VB2A103K
C8	0.1 uF	1	Panasonic	ECJ-3YB2A104K
C10	100 pF	1	ATC	ATC800A101JT250X
C11	0.1 uF	1	Murata	GRM32NR72A104KA01L
C13	0.1 uF	1	Panasonic	ECJ-2YB1H104K
C14, C16	10 uF	2	Panasonic	ECA-2AM100
C17, C18	10000 pF	2	Samsung	CL31B103KGFNNNE
R2	51 Ohm	1	Panasonic	ERJ-6GEYJ510
R3	10 Ohm	1	Panasonic	ERJ-8GEYJ100V
R4	1 kOhm	1	Vishay	CRCW06031K00FKTA
L1	22 nH	1	Coilcraft	0805HT-22NTJLB
L3, L4	75 Ohm	2	Steward	35F0121-1SR-10
L5, L6	115 Ohm	2	Steward	28F0181-1SR-10

Recommended Solder Temperature Profile



Handling Precautions

Parameter	Rating	Standard
ESD – Human Body Model (HBM)	Class 2	ANSI / ESDA / JEDEC JS-001
ESD – Charged Device Model (CDM)	Class C3	ANSI / ESDA / JEDEC JS-002
MSL – Moisture Sensitivity Level	MSL 3	IPC / JEDEC 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: Ni/Au Au thickness is 1.0 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:

- 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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Email: customer.support@qorvo.com

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

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