QPD1006

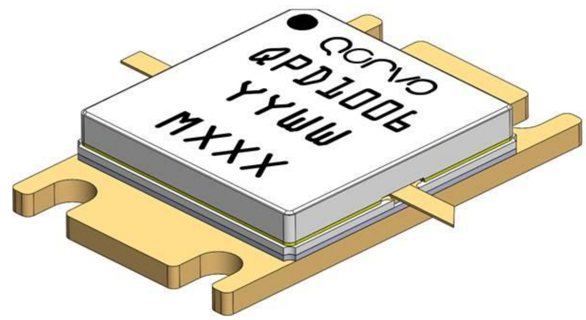
450W, 50V, 1.2 – 1.4 GHz, GaN RF IMFET

Product Overview

The QPD1006 is a 450 W (P_{3dB}) internally matched discrete GaN on SiC HEMT which operates from 1.2 to 1.4 GHz and 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 and civilian radar. The device can support pulsed and CW operations.

ROHS compliant.

Evaluation boards are available upon request.



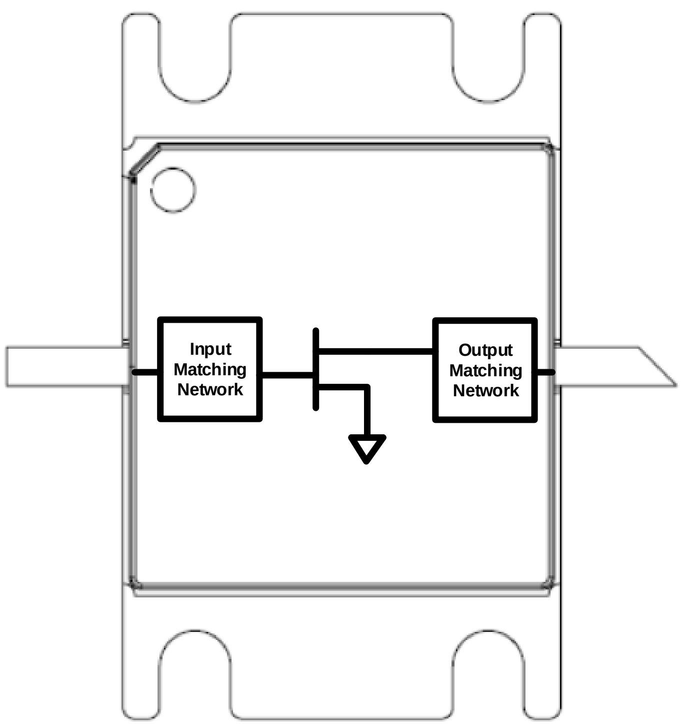
NI-50CW

Key Features

- Frequency: 1.2 to 1.4 GHz
- Output Power (P_{3dB})[1]: 313 W (CW), 468 W (Pulsed)
- Linear Gain[1]: 17.5 dB (CW), 17.8 dB (Pulsed)
- Typical $DEFF_{3dB}$[1]: 55% (CW), 62.2% (Pulsed)
- Operating Voltage: 45 V (CW), 50 V (Pulsed)
- Low thermal resistance package
- Pulse capable

  Note 1: @ 1.3 GHz, 25 °C

Functional Block Diagram



Applications

- Military radar
- Civilian radar

Part No.	Description
QPD1006	1.2 – 1.4 GHz RF IMFET
QPD1006EVB4	Evaluation Board

Absolute Maximum Ratings[1]

Parameter	Rating	Units
Breakdown Voltage, BV_{DG}	+145	V
Gate Voltage Range, V_G	-7 to +2	V
Drain Current	60	A
Gate Current Range, I_G	See page 4.	mA
Power Dissipation, 10% DC 1 mS PW, P_{DISS}	496	W
RF Input Power, 10% DC 1 mS PW, 1.3 GHz, T = 25 °C	+46	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]

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	–	14	–	A
Gate Voltage, V_G[4]	–	−2.7	–	V
Power Dissipation, Pulsed (P_D)[2, 3]	–	–	445	W
Power Dissipation, CW (P_D)[2]	–	–	299	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 = 300 uS, Duty Cycle = 30%.
4. To be adjusted to desired I_{DQ}.

RF Characterization – EVB CW Performance At 1.2 GHz[1]

Parameter	Min	Typ	Max	Units
Linear Gain, G_{LIN}	–	17.5	–	dB
Output Power at 3dB compression point, P_{3dB}	–	55.4	–	dBm
Drain Efficiency at 3dB compression point, $DEFF_{3dB}$	–	56.2	–	%
Gain at 3dB compression point, G_{3dB}	–	14.5	–	dB

Notes:
1. V_D = +45 V, I_{DQ} = 750 mA, T_A = 25 °C

RF Characterization – EVB CW Performance At 1.3 GHz[1]

Parameter	Min	Typ	Max	Units
Linear Gain, G_{LIN}	–	17.3	–	dB
Output Power at 3dB compression point, P_{3dB}	–	54.9	–	dBm
Drain Efficiency at 3dB compression point, $DEFF_{3dB}$	–	54.6	–	%
Gain at 3dB compression point, G_{3dB}	–	14.3	–	dB

Notes:
1. V_D = +45 V, I_{DQ} = 750 mA, T_A = 25 °C

RF Characterization – EVB CW Performance At 1.4 GHz[1]

Parameter	Min	Typ	Max	Units
Linear Gain, G_{LIN}	–	17.5	–	dB
Output Power at 3dB compression point, P_{3dB}	–	54.7	–	dBm
Drain Efficiency at 3dB compression point, $DEFF_{3dB}$	–	49.4	–	%
Gain at 3dB compression point, G_{3dB}	–	14.5	–	dB

Notes:
1. V_D = +45 V, I_{DQ} = 750 mA, T_A = 25 °C

RF Characterization – EVB Pulsed Performance At 1.2 GHz[1]

Parameter	Min	Typ	Max	Units
Linear Gain, G_{LIN}	–	17.8	–	dB
Output Power at 3dB compression point, P_{3dB}	–	57.1	–	dBm
Drain Efficiency at 3dB compression point, $DEFF_{3dB}$	–	62.8	–	%
Gain at 3dB compression point, G_{3dB}	–	14.8	–	dB

Notes:
2. V_D = +50 V, I_{DQ} = 750 mA, T_A = +25 °C, PW = 300 uS, DC = 30%

RF Characterization – EVB Pulsed Performance At 1.3 GHz[1]

Parameter	Min	Typ	Max	Units
Linear Gain, G_{LIN}	–	17.8	–	dB
Output Power at 3dB compression point, P_{3dB}	–	56.7	–	dBm
Drain Efficiency at 3dB compression point, $DEFF_{3dB}$	–	62.0	–	%
Gain at 3dB compression point, G_{3dB}	–	14.8	–	dB

Notes:
1. V_D = +50 V, I_{DQ} = 750 mA, T_A = +25 °C, PW = 300 uS, DC = 30%

RF Characterization – EVB Pulsed Performance At 1.4 GHz[1]

Parameter	Min	Typ	Max	Units
Linear Gain, G_{LIN}	–	17.8	–	dB
Output Power at 3dB compression point, P_{3dB}	–	57.1	–	dBm
Drain Efficiency at 3dB compression point, $DEFF_{3dB}$	–	59.6	–	%
Gain at 3dB compression point, G_{3dB}	–	14.8	–	dB

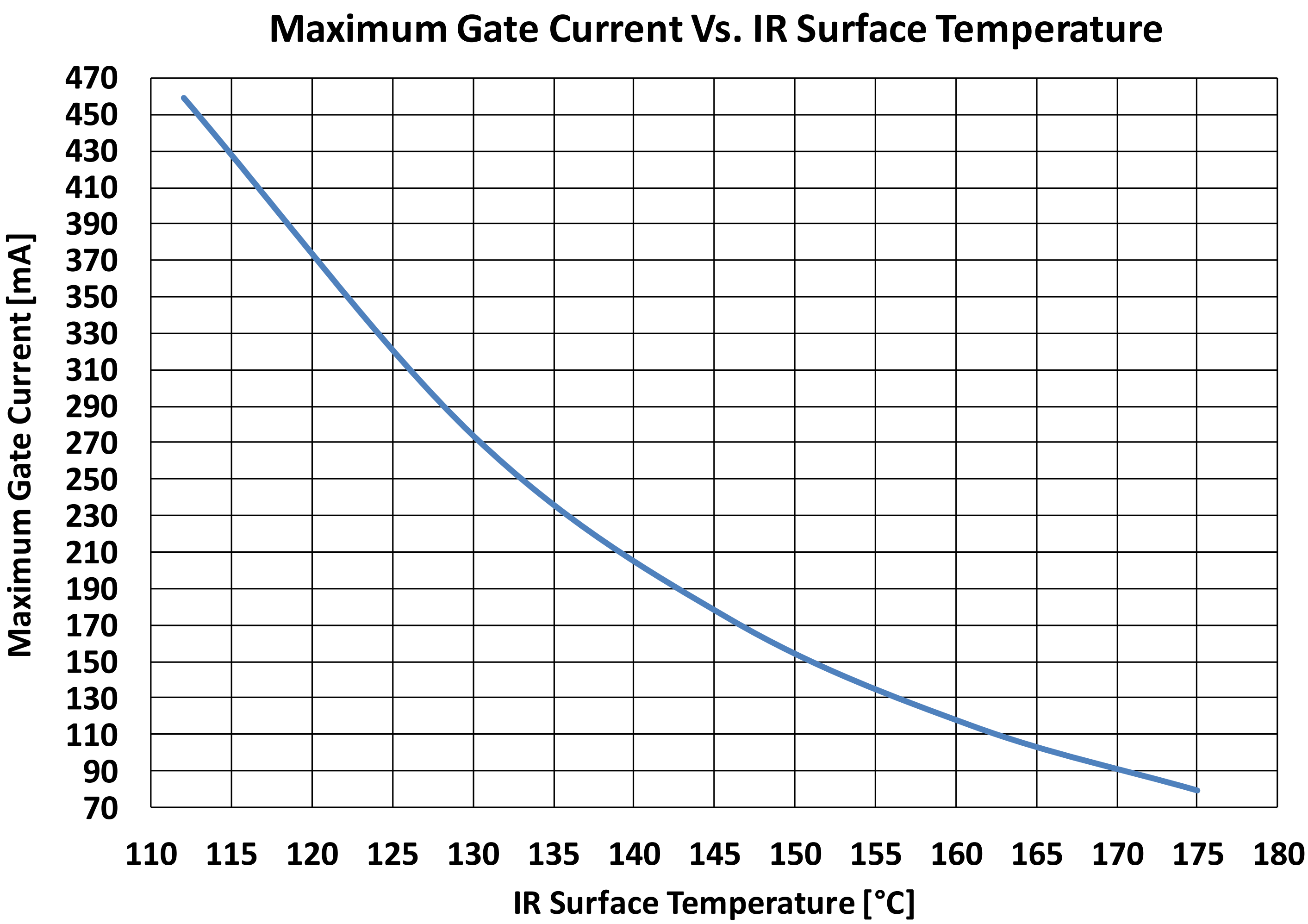
Notes:
1. V_D = +50 V, I_{DQ} = 750 mA, T_A = +25 °C, PW = 300 uS, DC = 30%

RF Characterization – Mismatch Ruggedness at 1.3 GHz[1]

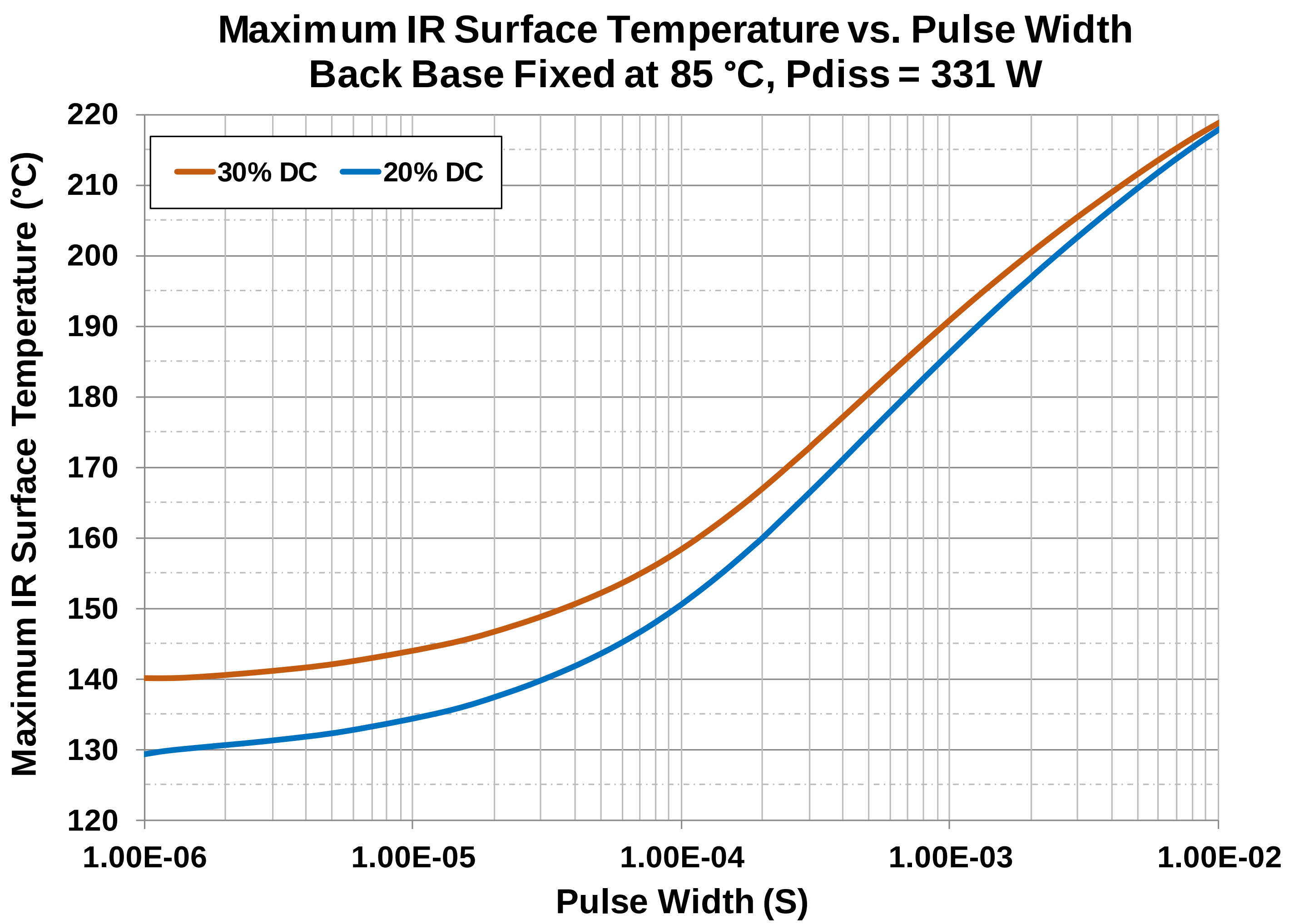
Symbol	Parameter	dB Compression	Typical
VSWR	Impedance Mismatch Ruggedness	3	10:1

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.

Maximum Gate Current



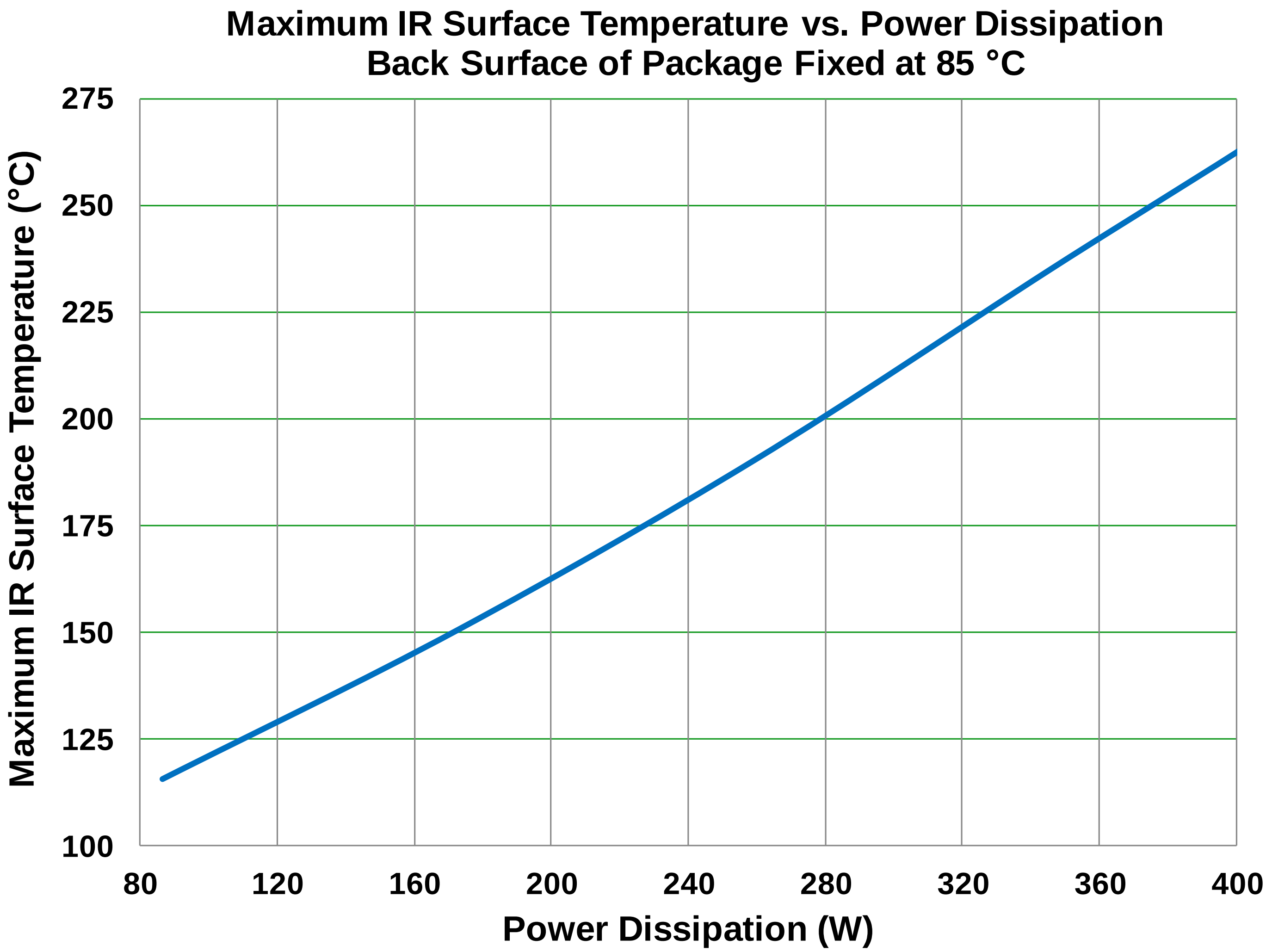
Thermal and Reliability Information – Pulsed



Parameter	Conditions	Values	Units
Thermal Resistance, IR[1] (θ_{JC})	85 °C back side temperature	0.23	°C/W
Peak IR Surface Temperature[1] (T_{CH})	331 W Pdiss, 200 uS PW, 20% DC	160	°C
Thermal Resistance, IR[1] (θ_{JC})	85 °C back side temperature	0.27	°C/W
Peak IR Surface Temperature[1] (T_{CH})	331 W Pdiss, 300 uS PW, 30% DC	173	°C

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

Thermal and Reliability Information – CW



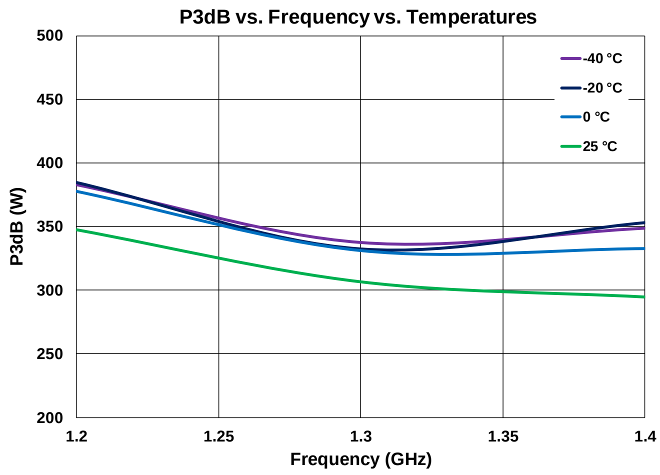
Parameter	Conditions	Values	Units
Thermal Resistance, IR[1] (θ_{JC})	85 °C back side temperature	0.35	°C/W
Peak IR Surface Temperature[1] (T_{CH})	86.4 W Pdiss, CW	116	°C
Thermal Resistance, IR[1] (θ_{JC})	85 °C back side temperature	0.38	°C/W
Peak IR Surface Temperature[1] (T_{CH})	177.8 W Pdiss, CW	151	°C
Thermal Resistance, IR[1] (θ_{JC})	85 °C back side temperature	0.41	°C/W
Peak IR Surface Temperature[1] (T_{CH})	259.2 W Pdiss, CW	190	°C
Thermal Resistance, IR[1] (θ_{JC})	85 °C back side temperature	0.43	°C/W
Peak IR Surface Temperature[1] (T_{CH})	345.6 W Pdiss, CW	235	°C

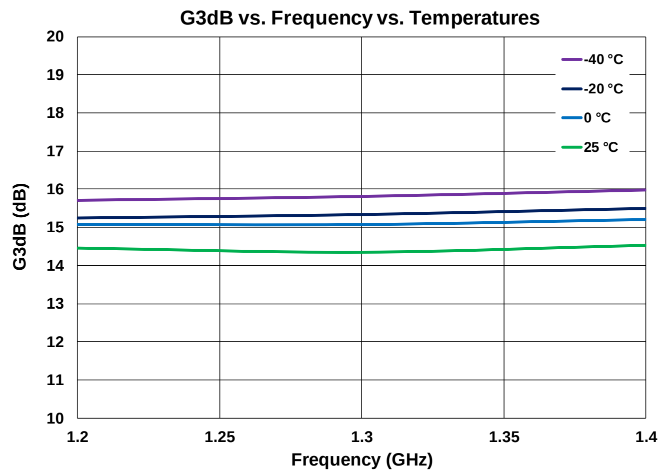
[1] Refer to the following document GaN Device Channel Temperature, Thermal Resistance, and Reliability Estimates

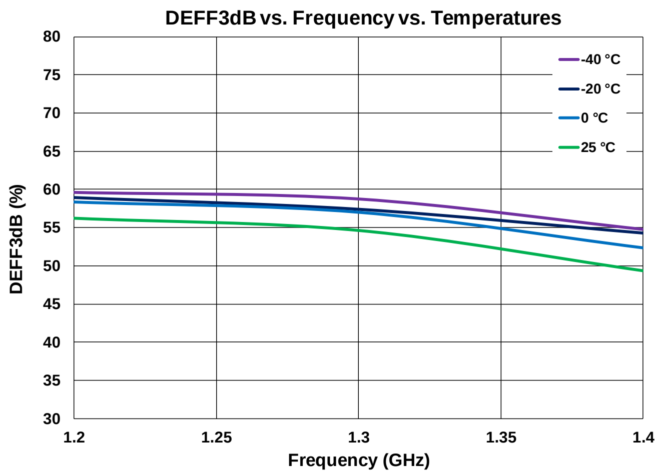
CW Power Drive-up Performance Over Temperatures Of 1.2 – 1.4 GHz EVB[1]

Notes:

1. V_D = 45 V, I_{DQ} = 750 mA.



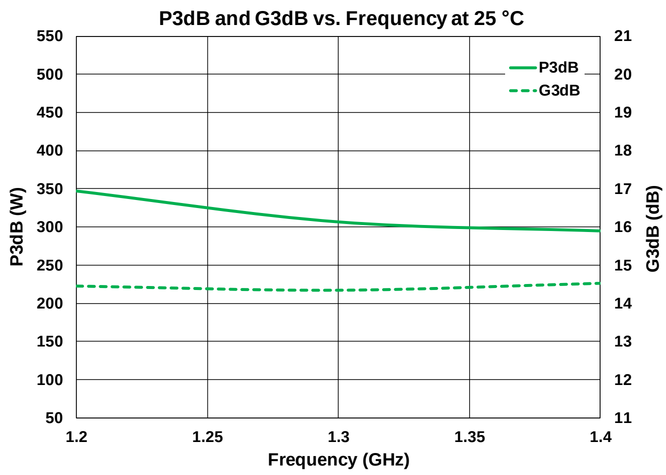


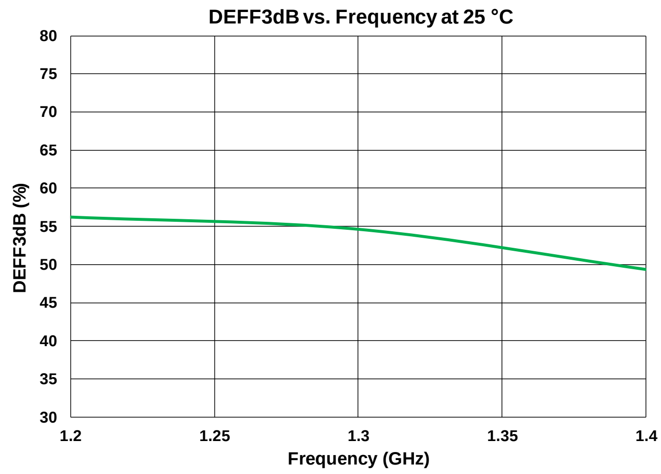


CW Power Drive-up Performance At 25 °C Of 1.2 – 1.4 GHz EVB[1]

Notes:

1. V_D = 45 V, I_{DQ} = 750 mA.

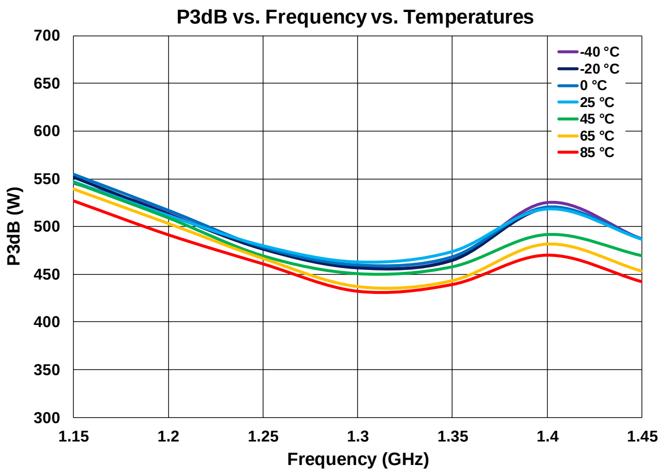


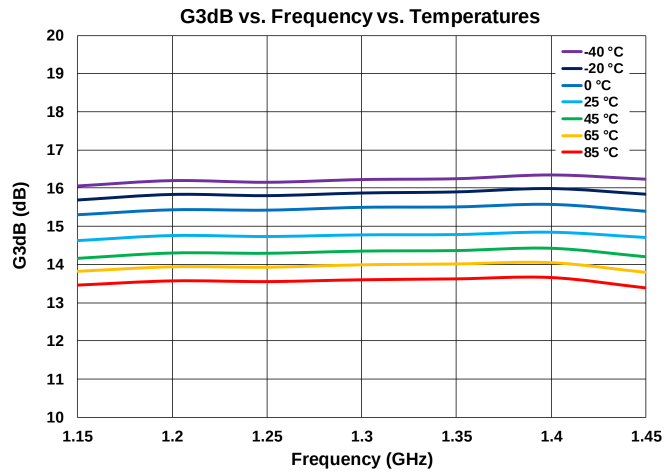


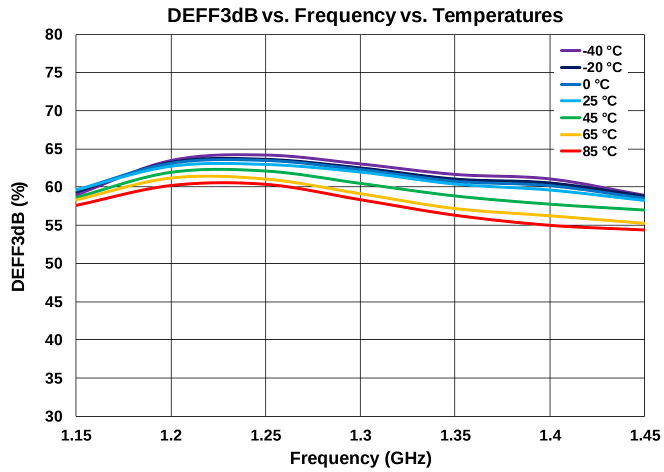
Pulsed Power Drive-up Performance Over Temperatures Of 1.2 – 1.4 GHz EVB[1]

Notes:

1. V_D = 50 V, I_{DQ} = 750 mA, PW = 300 uS, DC = 30%.



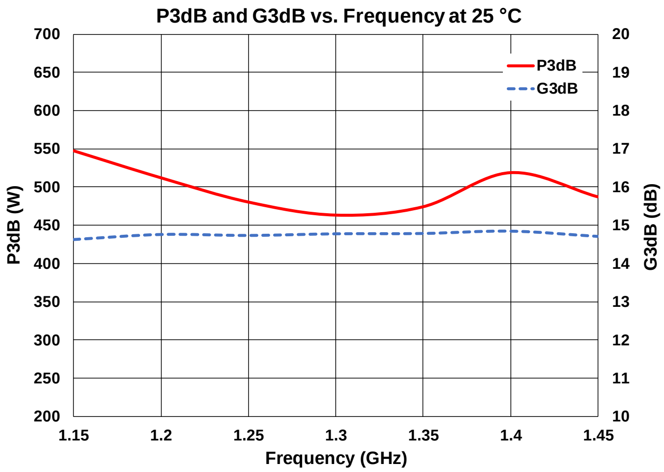


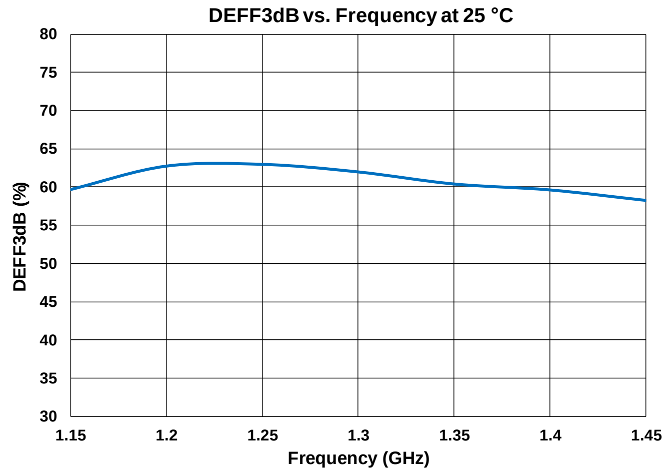


Power Drive-up Performance At 25 °C Of 1.2 – 1.4 GHz EVB[1]

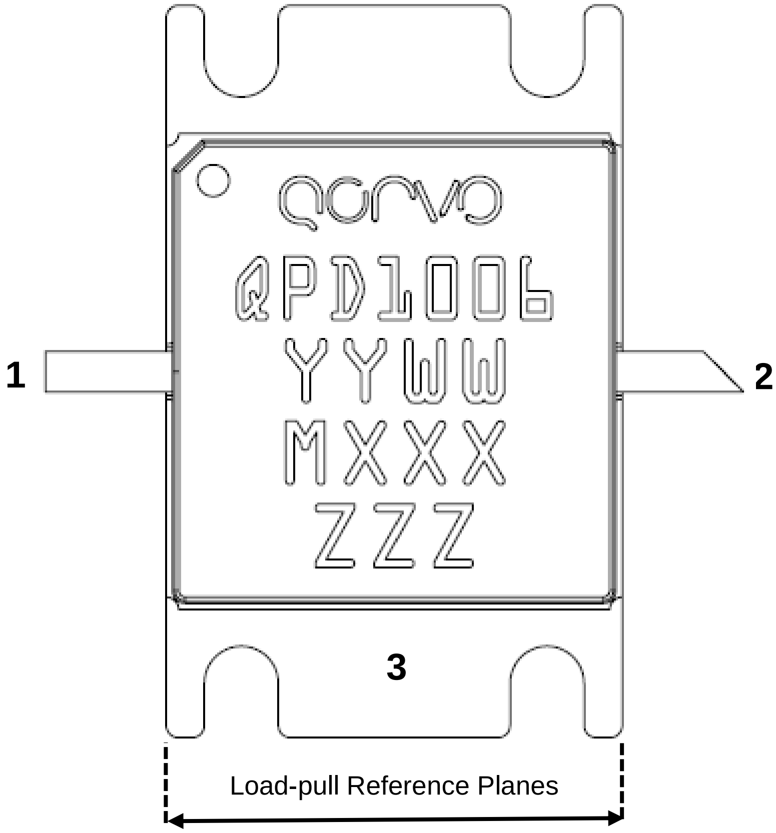
Notes:

1. V_D = 50 V, I_{DQ} = 750 mA, PW = 300 uS, DC = 30%.





Pin Configuration and Description, and Package Marking[1]

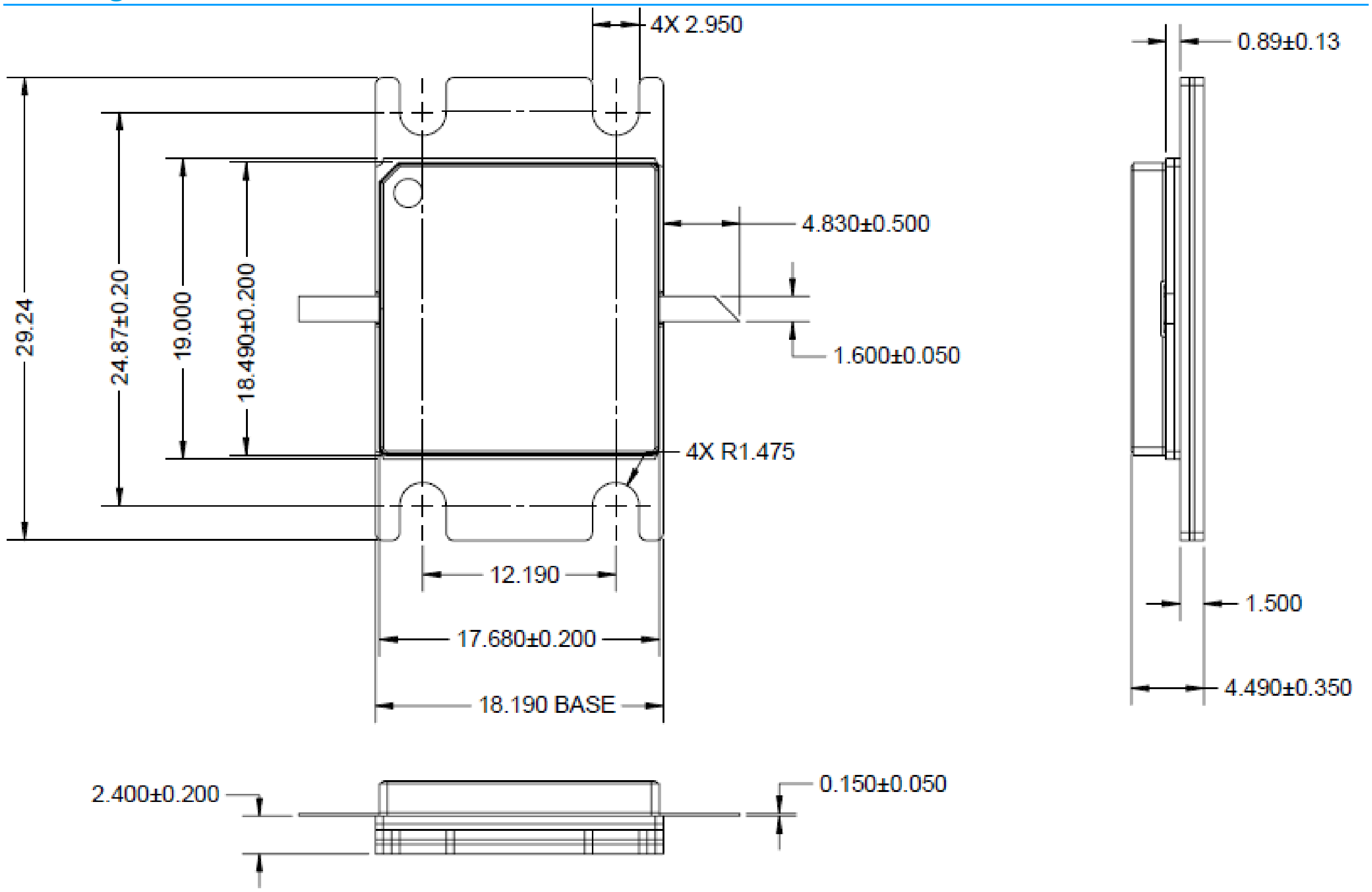


Notes:
1. The QPD1006 will be marked with the “1006” designator and a lot code marked below the part designator. The “YY” represents the last two digits of the calendar year the part was manufactured, the “WW” is the work week of the assembly lot start, the “MXXX” is the production lot number. “ZZZ” is the unique serial number.

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

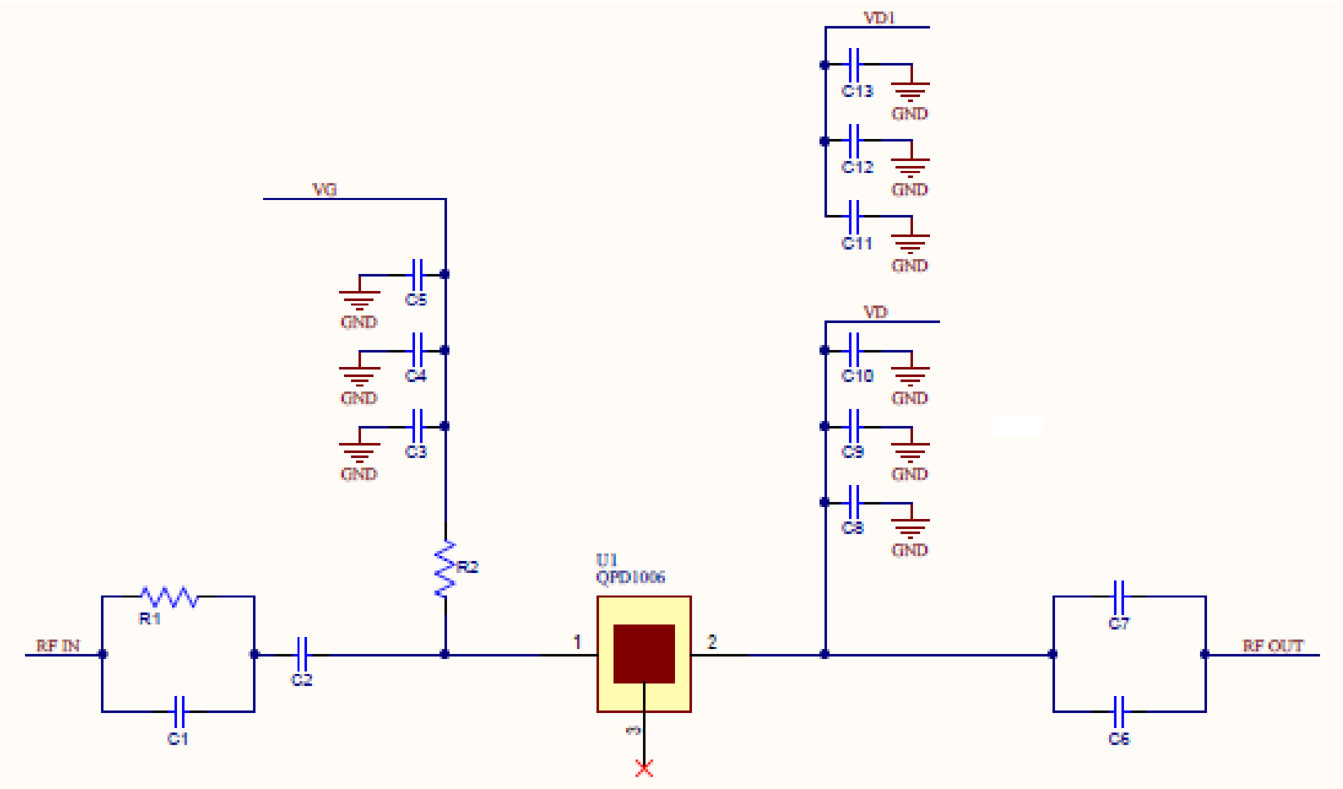
Package Dimensions[1, 2, 3]



Notes:

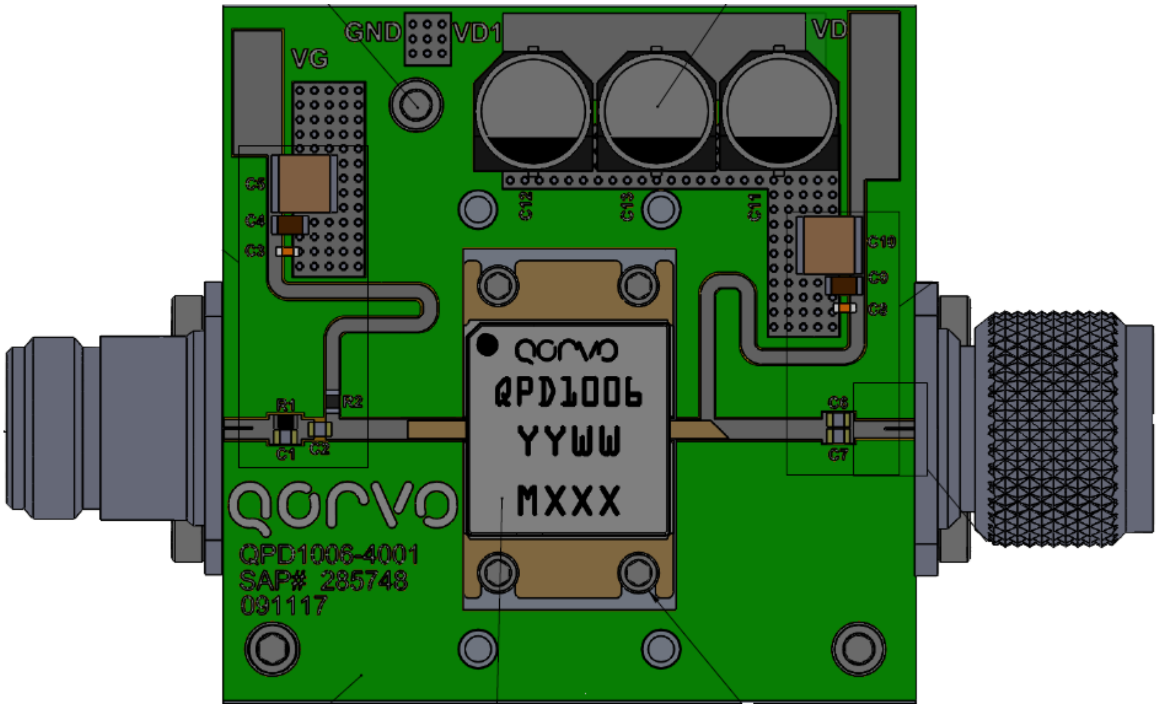
1. Unless otherwise noted, the tolerance is ±0.15 mm.
2. For instruction to mount the part, please refer to application note "RF565 Package Mounting, Mechanical Mounting and PCB Considerations."
3. Material:
   Package Base: Metal
   Package Lid: Ceramic
4. Package exposed metallization is gold plated.
5. Part is epoxy sealed.
6. Body dimensions do not include lid shift or epoxy run out which can be up to 0.5 mm per side.

Schematic – 1.2 – 1.4 GHz EVB



Bias-up Procedure	Bias-down Procedure
1. Set V_G to -4 V.	1. Turn off RF signal.
2. Set I_D current limit to 800 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 7 A	
6. Apply RF.	

1.2 – 1.4 GHz EVB [1, 2]



Notes:
1. PCB Material: RO4350B, 20 mil thickness, 1 oz copper cladding
2. For good pulsed operation, an additional 3300 uF, 100 V electrolytic capacitor is required on the drain supply line.

Bill Of material – 1.2 – 1.4 GHz Pulsed or CW EVB

Ref Des	Value	Qty	Manufacturer	Part Number
C1, C2, C6, C7	33 pF	4	ATC	600F330JT250XT
C4, C9	0.1 uF	2	TDK	C3216X7R2A104K160AA
C3, C8	240 pF	2	AVX	UQCFVA241JAT2A\500
C11, C12, C13	220 uF	3	United Chemicon	EMVY500ADA221MJA03
C5, C10	10 uF	2	TDK	C5750X7S2A106M230KB
R1	100 Ohm	1	Kamaya, Inc	RMC1/10-101JTP
R2	10 Ohm	1	Vishay	CRCW080510R0JNTA

Recommended Solder Temperature Profile