QPD1035L

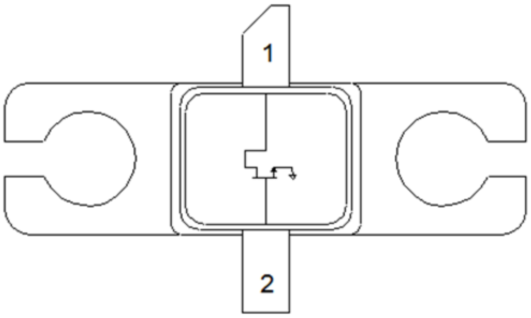
40 W, 50 V, DC – 6 GHz, GaN RF Power Transistor

Product Overview

The QPD1035L is a 40W (P_{3dB}) discrete GaN on SiC HEMT which operates from DC to 6 GHz on a 50V supply rail. The device has an input pre-match and is ideally suitable for broadband amplifier application for pulsed and CW operations.

Lead free and RoHS compliant.

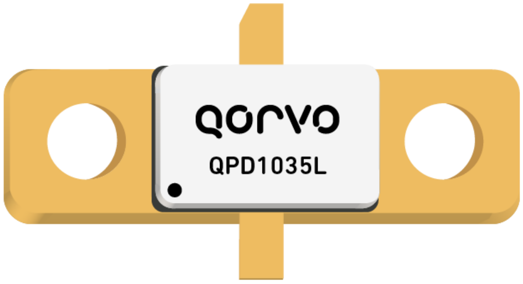
Functional Block Diagram



QPD1035LEVB0-50V Performance

Freq.(GHz)	P_{3dB} (W)	G_{3dB} (dB)	DE_{3dB} (%)
5.40	46.8	11.5	50.0
5.65	42.3	12.0	48.1
5.90	37.5	12.6	46.3

Typical performance summary of 100us pulse width and 10% duty cycle for 25°C at the bottom of baseplate



Key Features

- Operating Frequency Range: DC – 6 GHz
- Operating Voltage: 50 V
- Output Power (P_{3dB}) = 42.3 W (1)
- Gain (P_{3dB}) = 12.0 dB (1)
- Drain Efficiency (P_{3dB}) = 48.1 % (1)
- Low thermal resistance package

Note 1:
Typical P3dB Performance of 100 us pulse width, 10% duty cycle at 5.65 GHz

Applications

- Military Radar
- Civilian Radar
- Professional and military radio communications
- Test instrumentation
- Wideband or narrowband amplifiers
- Jammers

Ordering Information

Part No.	Description
QPD1035L	30W, DC – 6GHz, Flanged
QPD1035LEVB0-50V	QPD1035L 5.4 – 5.9 GHz 50V EVB

Absolute Maximum Ratings

Parameter	Rating
Drain Voltage (V_D)	+145 V
Gate Voltage Range (V_G)	−7 to +2 V
Drain Current (I_D)	7 A
Gate Current (I_G)	10.5 mA
RF Input Power, Pulsed CW	38.2 dBm
Operating Channel Temperature, (Backside Package at 85°C)	275°C
Storage Temperature	−65 to +150°C

Exceeding any one or a combination of the Absolute Maximum Rating conditions may cause permanent damage to the device. Extended application of Absolute Maximum Rating conditions to the device may reduce device reliability.

Recommended Operating Conditions[1]

Parameter	Min	Typ	Max	Units
Operating Temperature	-40	+25	+85	°C
Drain Voltage (V_D)	–	+50	–	V
Drain Bias Current (I_{DQ})	–	65	–	mA
Gate Voltage (V_G)	–	-2.5	–	V
Drain Current (I_D)	–	2.1	–	A
Power Dissipation (P_{DISS})	–	–	50.4	W

Electrical specifications are measured at specified test conditions. Specifications are not guaranteed over all recommended operating conditions.

1. Pulsed, 100 us Pulse Width, 10% Duty Cycle, 25°C

Measured Load Pull Performance – 50V Power Tuned [1, 2]

Parameter		Typical Values			Units
Frequency, F	4.0	5.4	5.9	6.0	GHz
Output Power at 3dB compression, P_{3dB}	47.1	46.6	46.5	46.6	dBm
Drain Efficiency at 3dB compression, $DEff_{3dB}$	48.2	46.3	45.4	45.5	%
Gain at 3dB compression, G_{3dB}	11.5	13.1	13.1	12.3	dB

Notes:

1. Test conditions unless otherwise noted: T_A = 25 °C, V_D = 50 V, I_{DQ} = 65 mA
2. Pulsed, 100 us Pulse Width, 10% Duty Cycle.

Measured Load Pull Performance – 50V Efficiency Tuned [1, 2]

Parameter		Typical Values			Units
Frequency, F	4.0	5.4	5.9	6.0	GHz
Output Power at 3dB compression, P_{3dB}	46.1	45.8	45.6	45.8	dBm
Drain Efficiency at 3dB compression, $DEff_{3dB}$	59.3	52.9	52.6	52.4	%
Gain at 3dB compression, G_{3dB}	13.3	15.3	15.1	14.0	dB

Notes:

1. Test conditions unless otherwise noted: T_A = 25 °C, V_D = 50 V, I_{DQ} = 65 mA
2. Pulsed, 100 us Pulse Width, 10% Duty Cycle.

RF Characterization – 5.4 – 5.9 GHz EVB Performance at 5.65 GHz

Parameter	Min	Typ	Max	Units
Linear Gain, GLIN	12.0	15.0	22.0	dB
Output Power at 3dB compression point, P3dB	45.0	46.3	49.0	dBm
Drain Efficiency at 3dB compression point, DEFF3dB	40.0	48.1	65.0	%
Gain at 3dB compression point, G3dB	9.0	12.0	18.0	dB
Gate Leakage V_D = +50V, V_G = -6V	-7.2	–	0.1	mA

Notes:

Test conditions unless otherwise noted: V_D = +50 V, I_{DQ} = 65 mA, T_A = +25°C, 100 µs Pulse Width, 10% Duty Cycle in a 5.4 to 5.9 GHz Evaluation Board.

RF Characterization – Mismatch Ruggedness at 5.65 GHz [1, 2, 3]

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

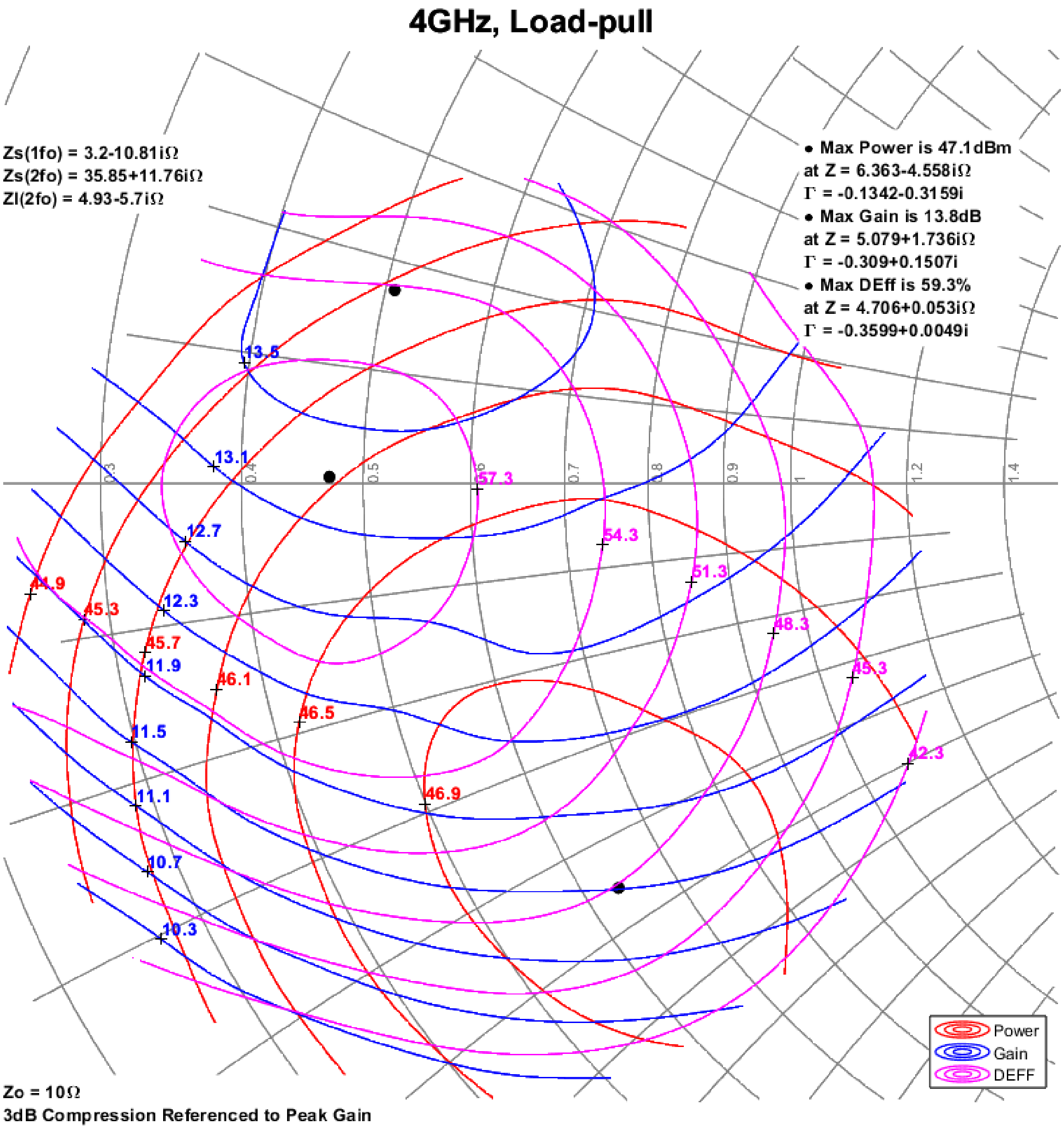
Notes:

1. Test conditions unless otherwise noted: V_D = 50 V, I_{DQ} = 65 mA, T_A = +25 °C
2. Input drive power is determined at pulsed 3dB compression under matched condition at EVB output connector
3. Pulse Width = 100us, Duty cycle = 10%

Measured Load-Pull Smith Charts at 50V [1]

Notes:

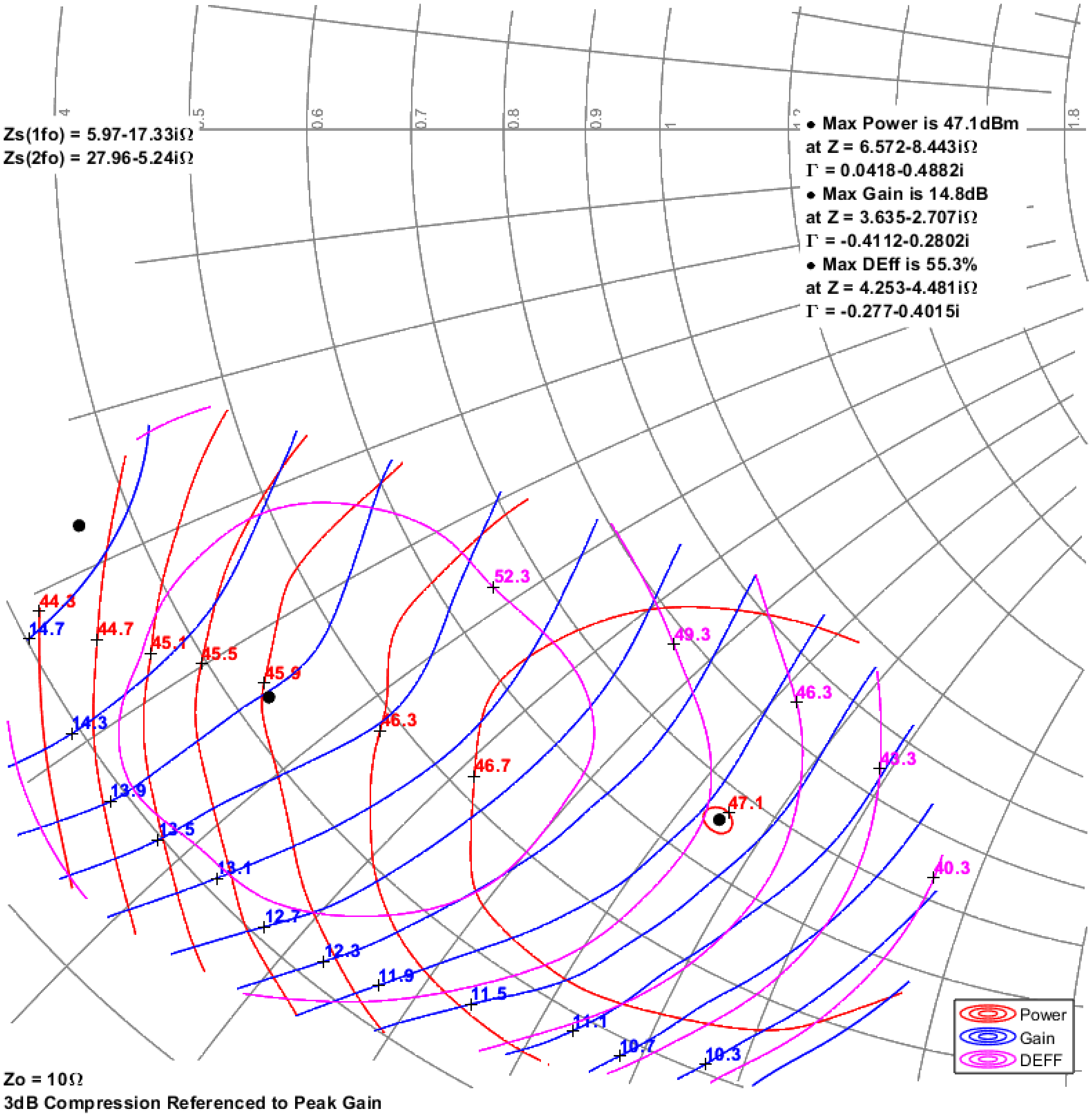
1. Test Conditions: V_D = 50 V, I_{DQ} = 65 mA, 100 us Pulse Width, 10% Duty Cycle, Temp = 25°C.



Measured Load-Pull Smith Charts at 50V [1]

Notes:

2. Test Conditions: V_D = 50 V, I_{DQ} = 65 mA, 100 us Pulse Width, 10% Duty Cycle, Temp = 25°C.



5GHz, Load-pull

Zs(1fo) = 5.97-17.33iΩ
Zs(2fo) = 27.96-5.24iΩ

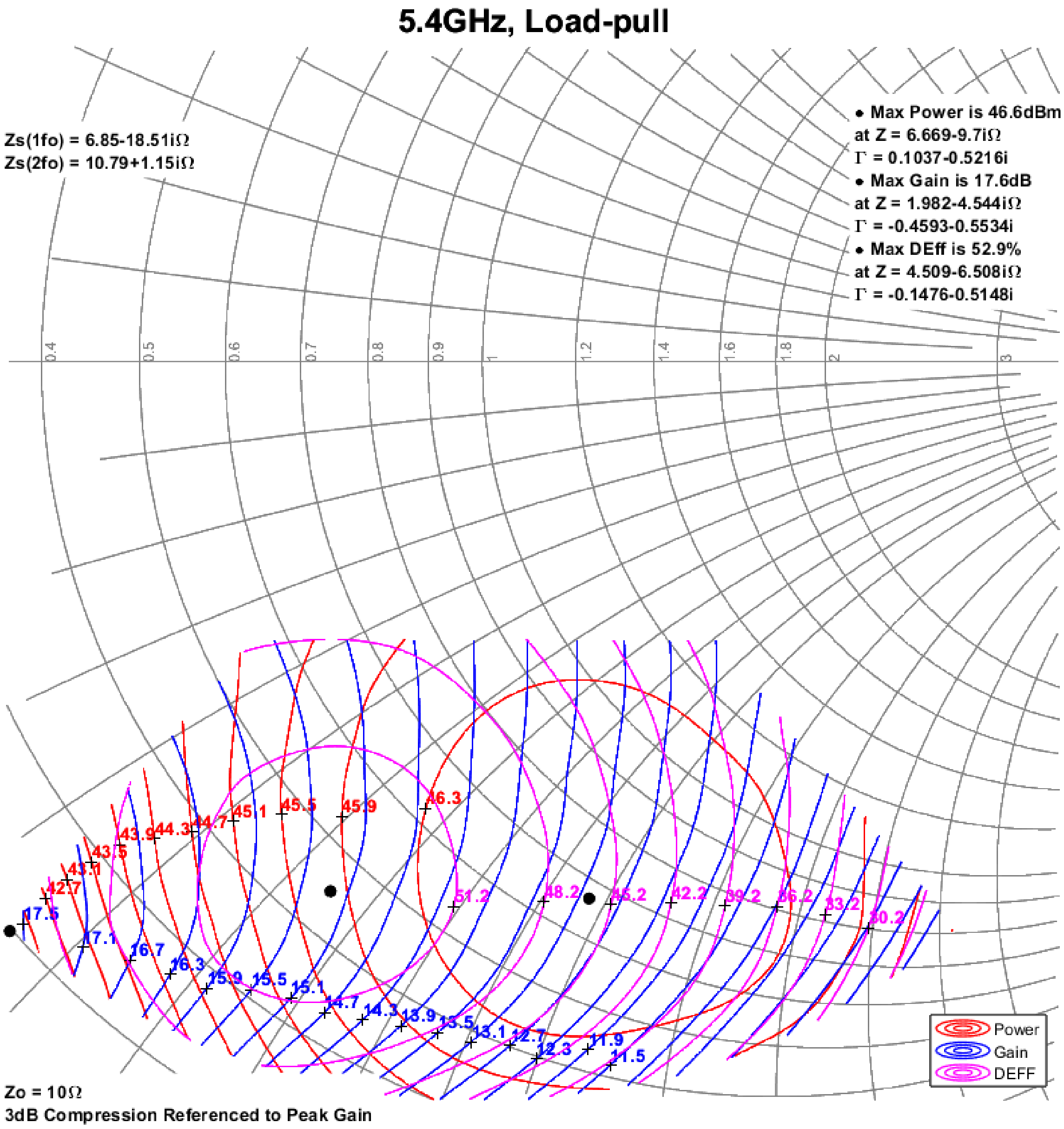
• Max Power is 47.1dBm
at Z = 6.572-8.443iΩ
Γ = 0.0418-0.4882i
• Max Gain is 14.8dB
at Z = 3.635-2.707iΩ
Γ = -0.4112-0.2802i
• Max DEff is 55.3%
at Z = 4.253-4.481iΩ
Γ = -0.277-0.4015i

Zo = 10Ω
3dB Compression Referenced to Peak Gain

Measured Load-Pull Smith Charts at 50V [1]

Notes:

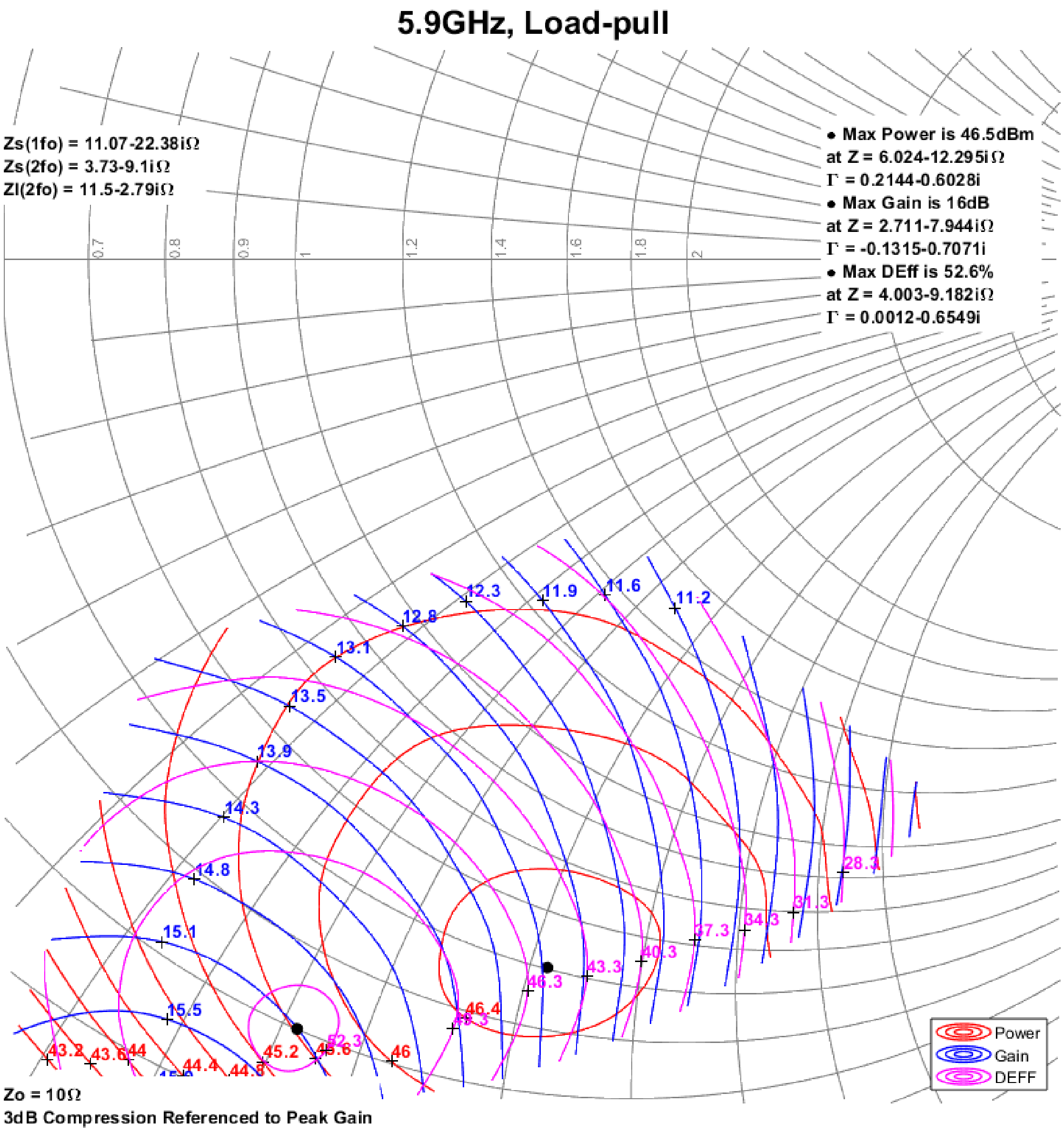
1. Test Conditions: V_D = 50 V, I_{DQ} = 65 mA, 100 us Pulse Width, 10% Duty Cycle, Temp = 25°C.



Measured Load-Pull Smith Charts at 50V [1]

Notes:

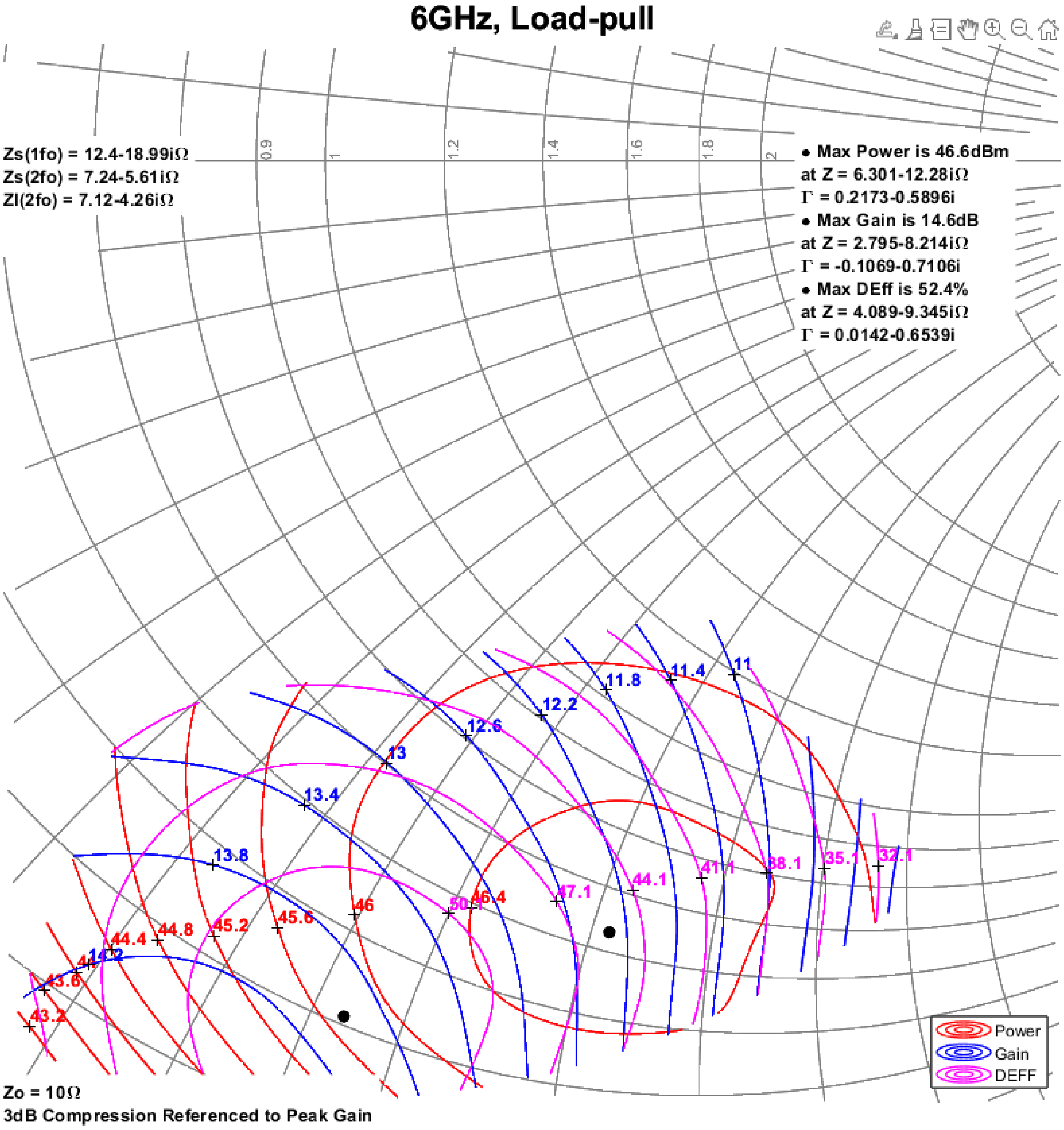
1. Test Conditions: V_D = 50 V, I_{DQ} = 65 mA, 100 us Pulse Width, 10% Duty Cycle, Temp = 25°C.



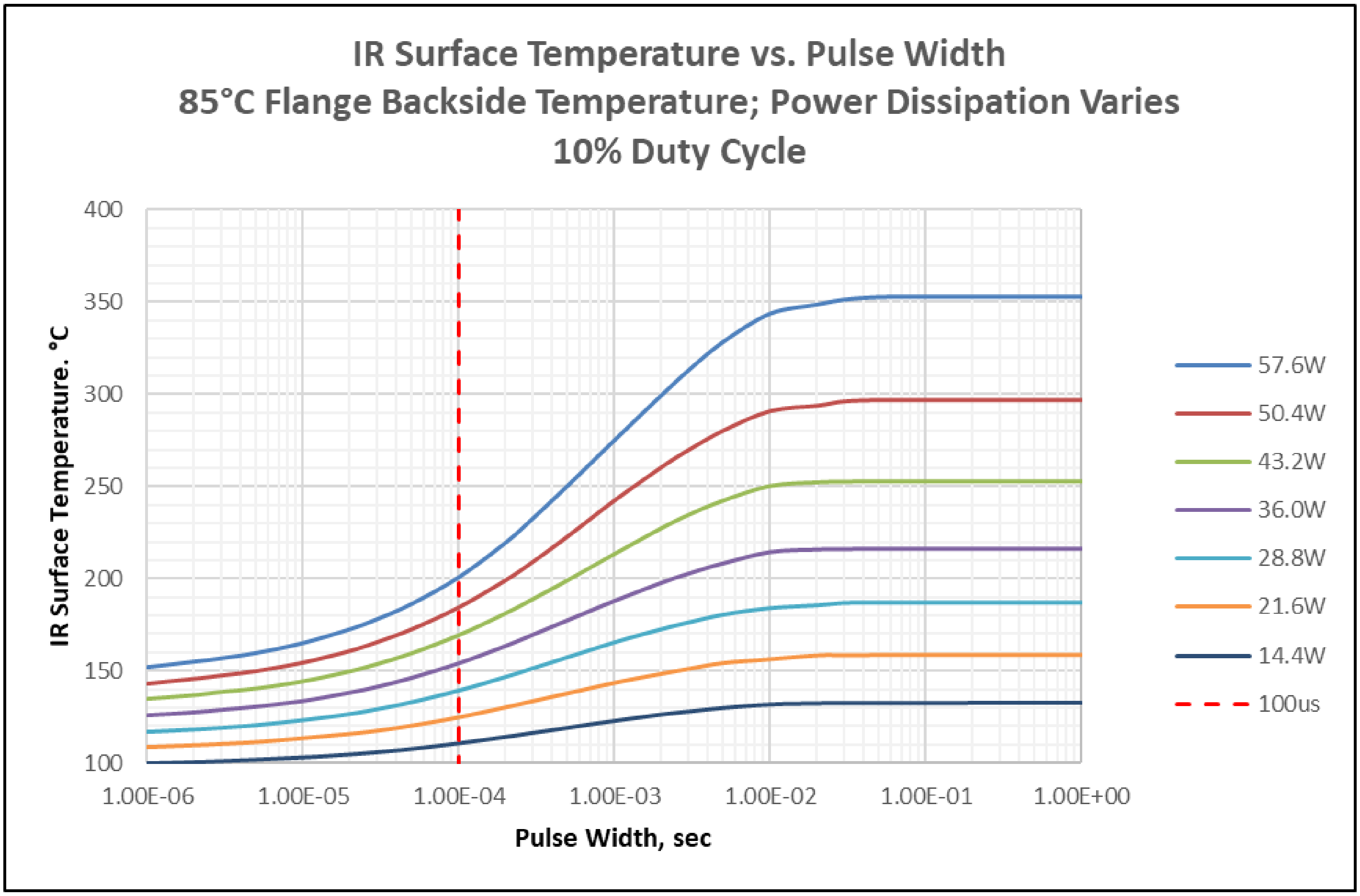
Measured Load-Pull Smith Charts at 50V [1]

Notes:

2. Test Conditions: V_D = 50 V, I_{DQ} = 65 mA, 100 us Pulse Width, 10% Duty Cycle, Temp = 25°C.



Thermal and Reliability Information – Pulsed [1]

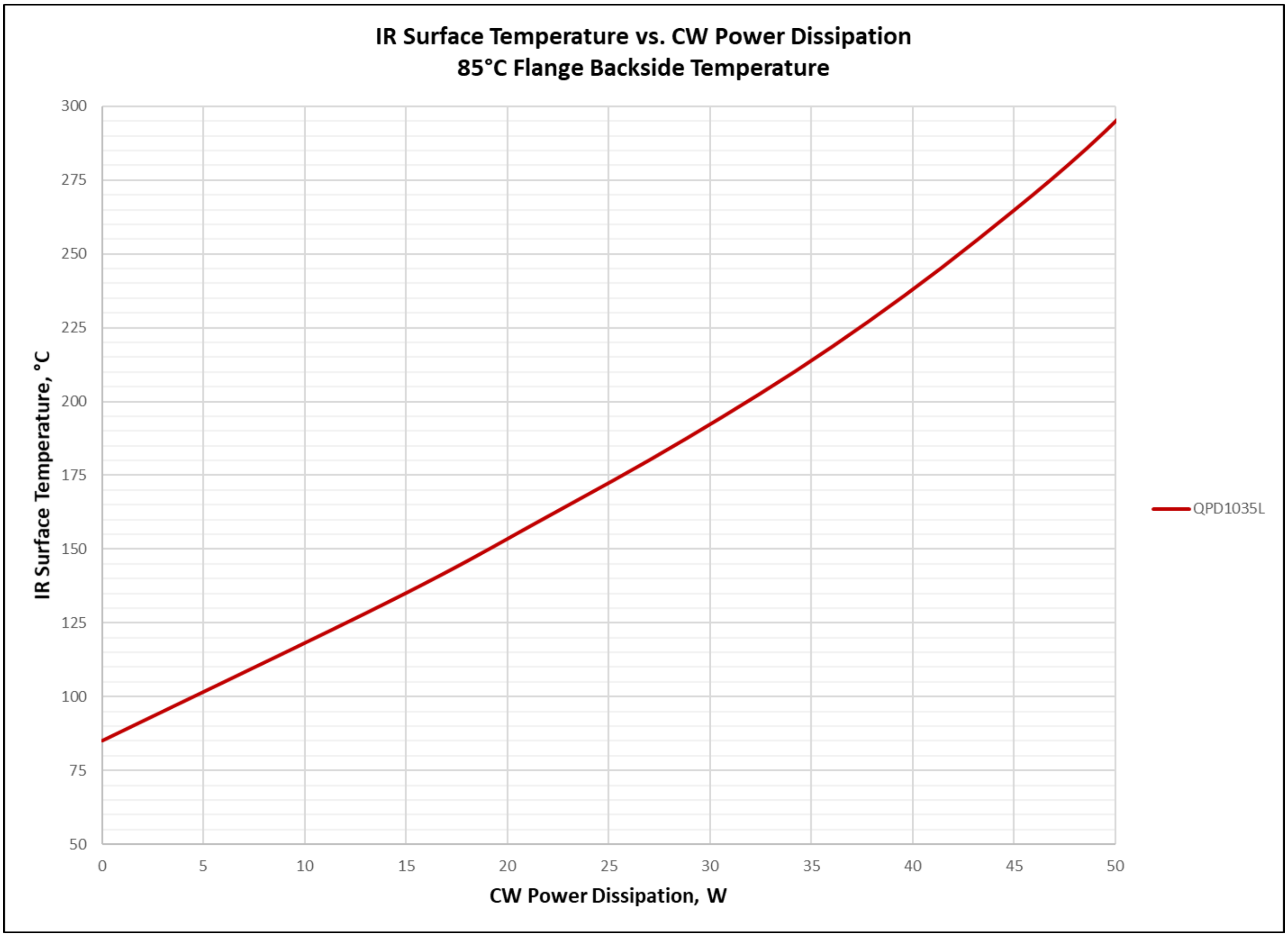


Parameter	Conditions	Values	Units
Thermal Resistance, IR[1] (θ_{JC})	85 °C Case backside Temperature Pdiss = 50.4 W, Pulse: 100 us PW, 10% DC	1.98	°C/W
Peak IR Surface Temperature[1] (T_{ch})		184.6	°C

Notes:

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

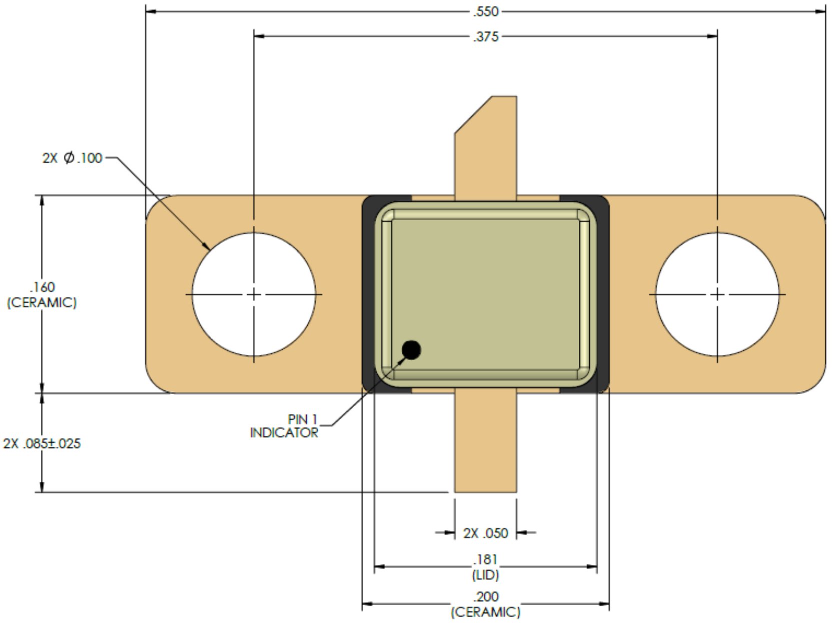
Thermal and Reliability Information – CW [1]

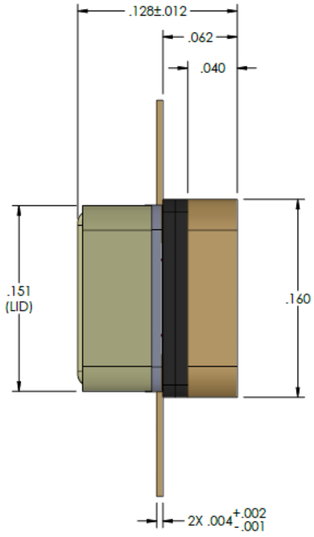


Parameter	Conditions	Values	Units
Thermal Resistance, IR[1] (θ_{JC})	85 °C Case backside Temperature Pdiss = 36 W, CW	3.71	°C/W
Peak IR Surface Temperature[1] (T_{ch})		218.5	°C

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

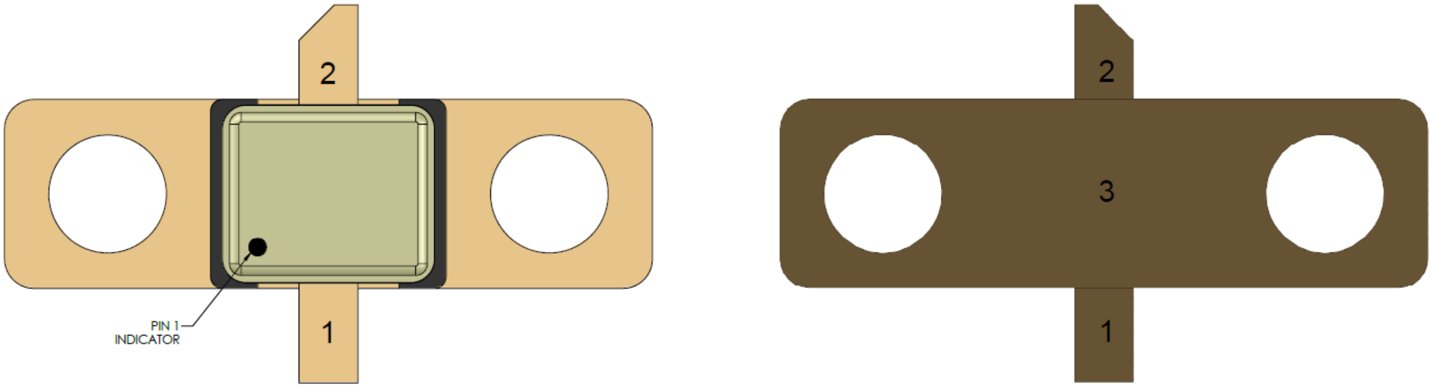
Package Dimensions[1-6]





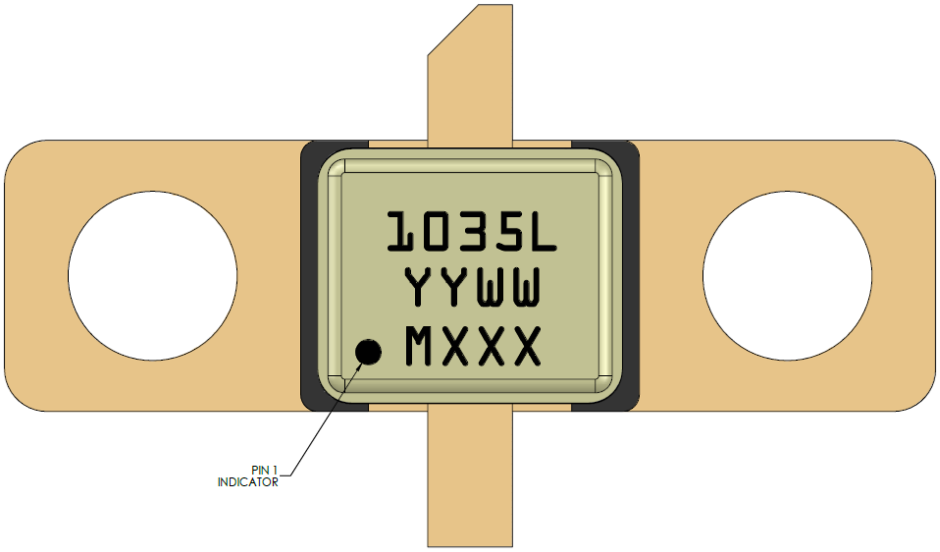
Notes:
1. Material:
   Package Base: Ceramic/Metal
   Package Lid: Ceramic
2. Dimensions tolerance is ± 0.005 inches, unless noted otherwise.
3. Package exposed metallization is gold plated.
4. Part is epoxy sealed.
5. Part meets industry NI200 footprint.
6. Body dimensions do not include lid shift or epoxy run out which can be up to 20 mils per side.

Pin Configuration



PIN ASSIGNMENT TABLE	
PIN NO.	DEFINITION
1	RF IN
2	RF OUT
3	SOURCE

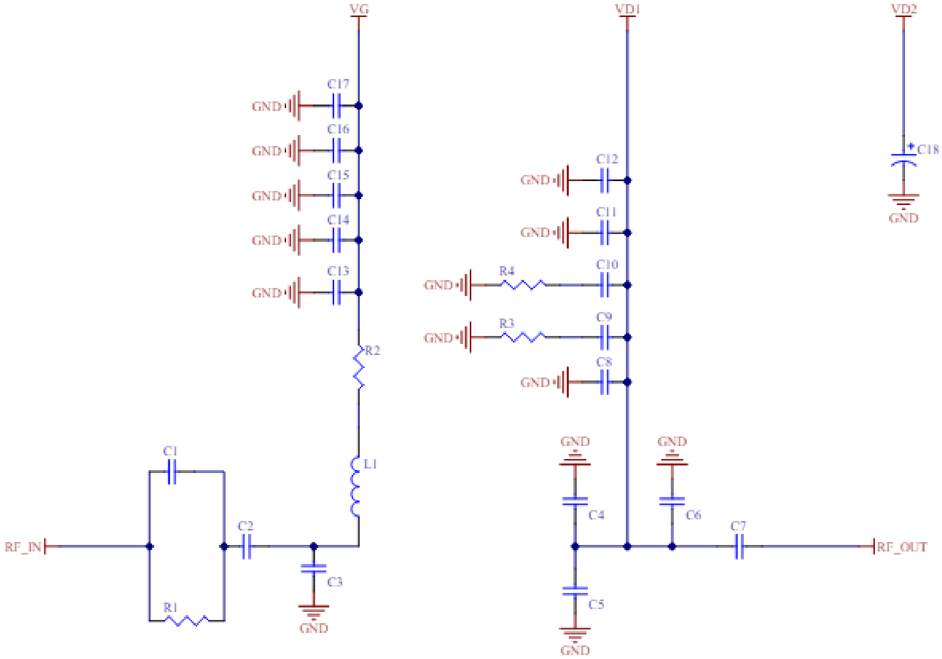
Marking Diagram[1]



Note:

1. The QPD1035L will be marked with the “1035L” 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 week number of the assembly lot start, and the “MXXX” is the batch ID for all parts within one assembly lot.

5.4 – 5.9 GHz 50V Application Circuit - Schematic



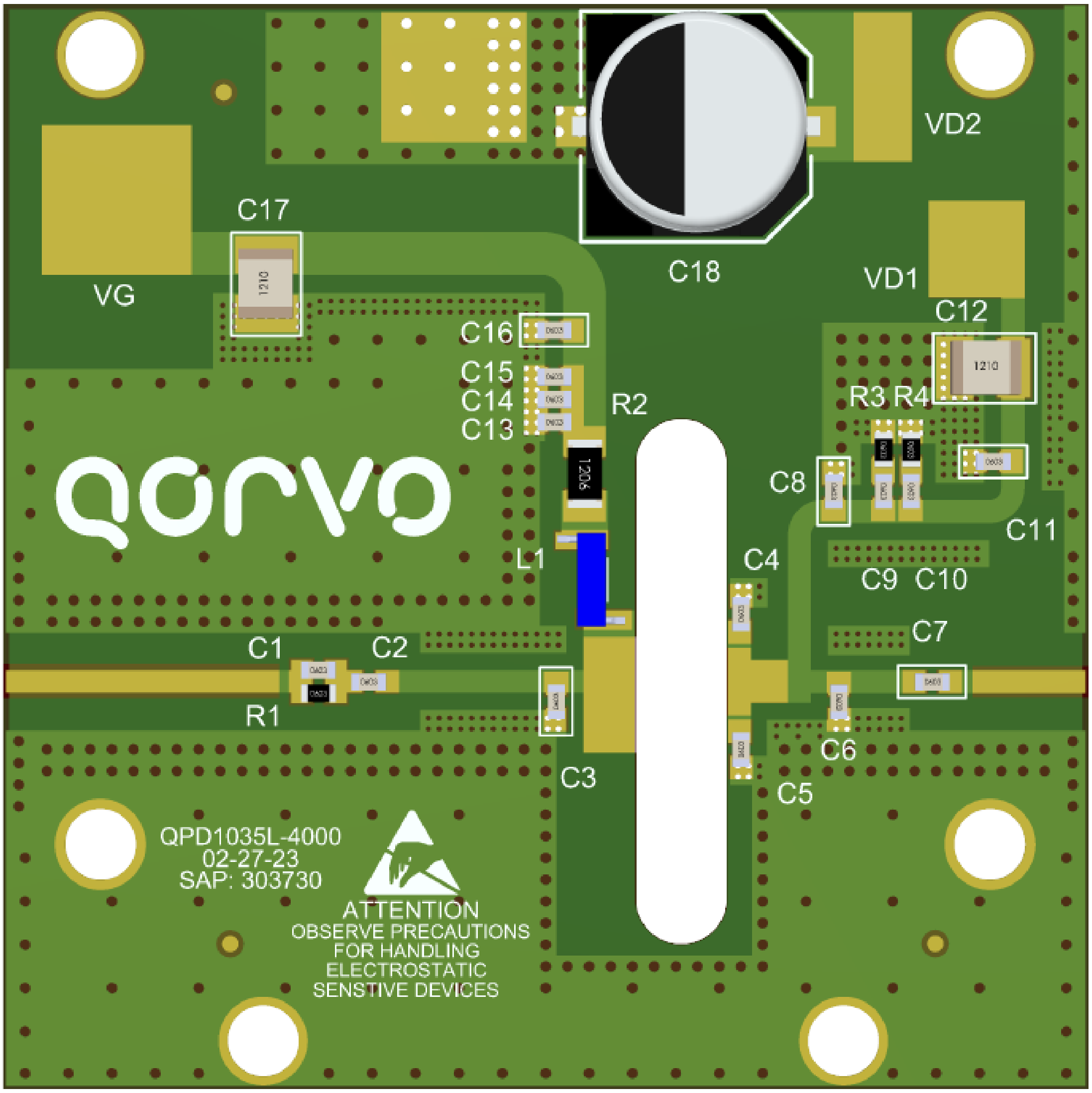
Biasing Procedure

Bias On	Bias Off
1. Turn ON V_G to −5 V. 2. Turn ON V_D to +50 V. 3. Slowly adjust V_G until I_D = 65 mA. (Typically, V_G = −2.8 V.) 4. Turn ON RF.	1. Turn OFF RF. 2. Adjust V_G to −5 V. 3. Turn OFF V_D. 4. Wait two (2) seconds to allow drain capacitors to discharge. 5. Turn OFF V_G.

5.4 – 5.9 GHz 50V Application Circuit – EVB Assembly [1]

Notes:

1. PCB material is RO4350 0.020” thick, 1 oz. copper cladding on top and bottom layer.



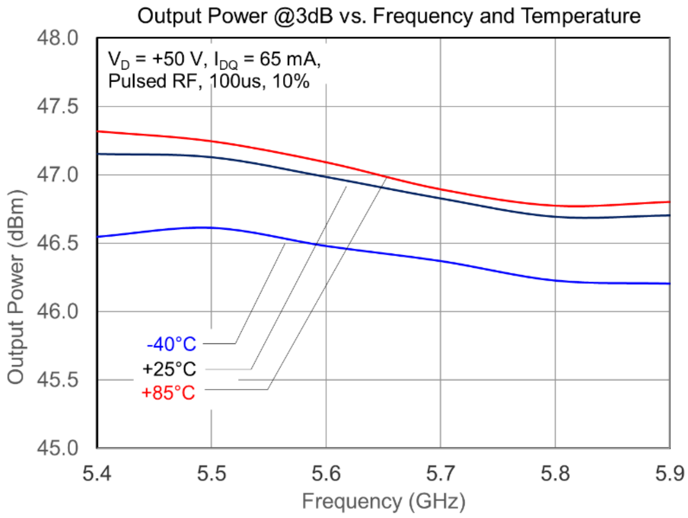
5.4 – 5.9 GHz 50V Application Circuit EVB – Bill of Material

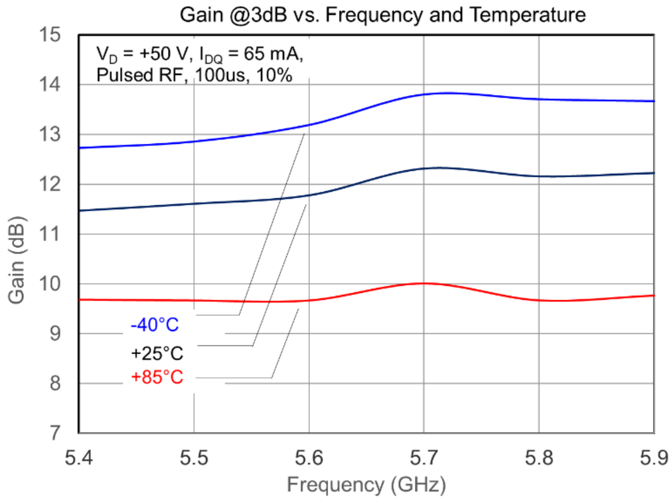
Ref Des	Qty	Description	Mfg Name	Mfg Part #
U1	1	30W, DC – 6GHz, Flanged	Qorvo	QPD1035L.E2
C1, C2, C7, C8, C13	5	CAP, 3.0pF, +/-0.1pF, 250V, 0603	AVX	600S3R0BT250XT
C3	1	CAP, 0.3pF, +/-0.1pF, 250V, 0603	AVX	600S0R30BT250XT
C4, C5, C6	3	CAP, 0.4pF, +/-0.1pF, 250V, 0603	AVX	600S0R4BT250XT
C9	1	CAP, 6.8pF, +/-0.1pF, 250V, 0603	AVX	600S6R8BT250XT
C10, C14	2	CAP, 220pF, 5%, 100V, 0603	AVX	06031C221JAT2A
C11, C15	2	CAP, 2200pF, 5%, 200V, 0603	Kemet	C0603C222J2GACAUTO
C12, C17	2	CAP, 1uF, 20%, 100V, 1210	Murata	GRM32ER72A105MA01L
C16	1	CAP, 0.022uF, 10%, 100V, 0603	TDK	CGA3E2X7R2A223K080AA
C18	1	CAP, 220uF, 20%, 50V, ALUM	Panasonic	EEEFK1H221P
L1	1	IND, 8.8nH, 2%, 1.6A, WW	Coilcraft	1606-8GLB
R1	1	RES, 150 Ohm, 1%, 1/10W, 0603	Kamaya	RMC1/16K1500FTP
R2	1	RES, 10 Ohm, 1%, 1/4W, 1206	Panasonic	ERJ-8ENF10R0V
R3, R4	2	RES, 5.6 Ohm, 1%, 1/10W, 0603	Panasonic	ERJ-3GEYJ5R6V

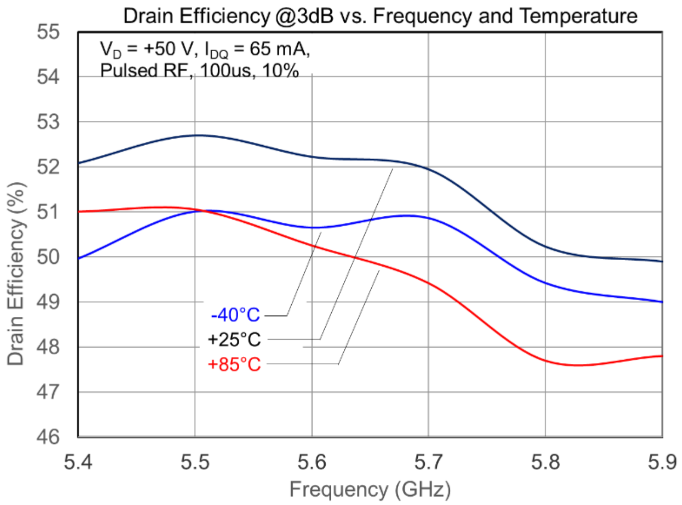
P3dB Performance over Temperature of 5.4 – 5.9 GHz EVB [1]

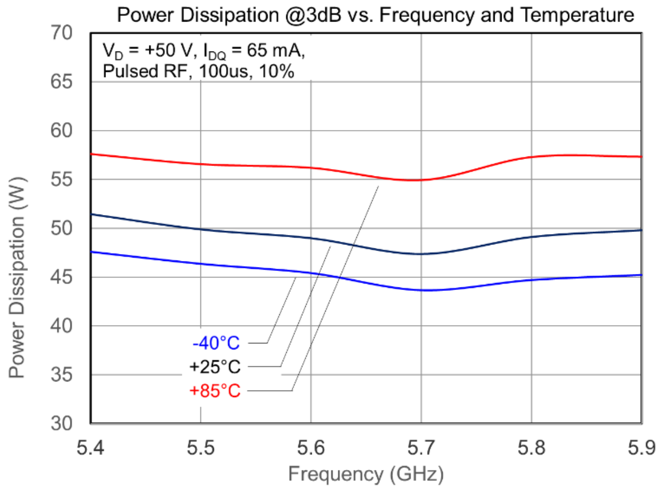
Notes:

1. Test Conditions: V_D = 50 V, I_{DQ} = 65 mA, 100 us Pulse Width, 10% Duty Cycle.


Output Power @3dB vs. Frequency and Temperature


Gain @3dB vs. Frequency and Temperature

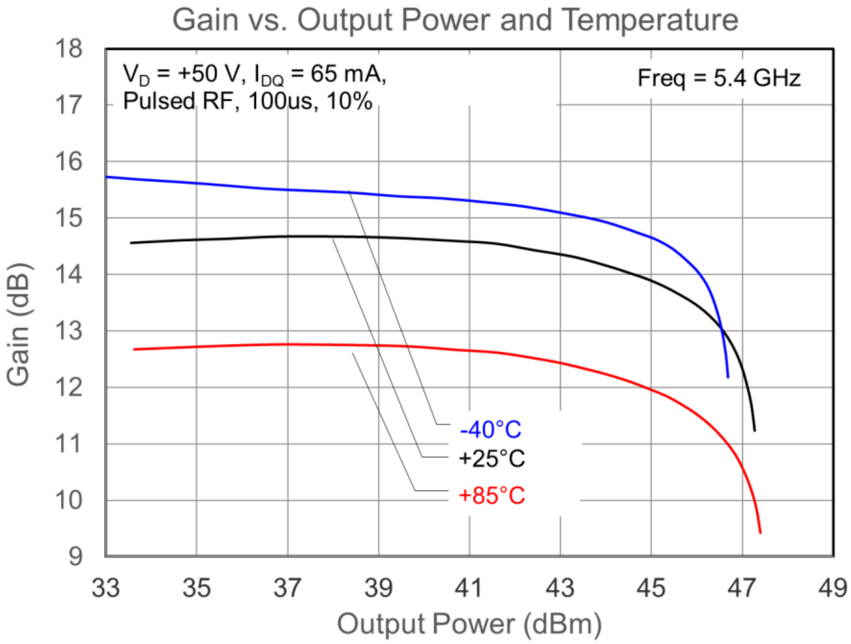

Drain Efficiency @3dB vs. Frequency and Temperature

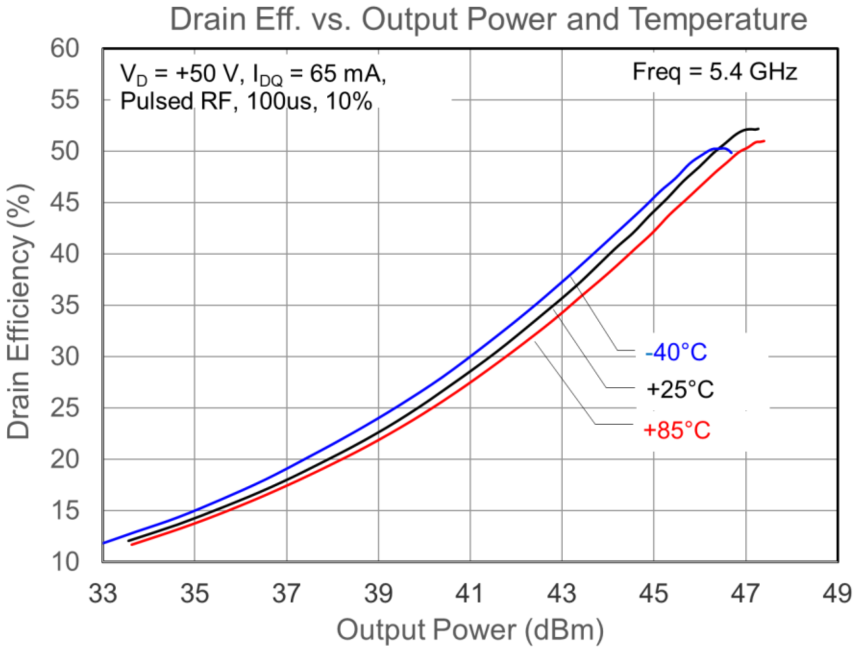

Power Dissipation @3dB vs. Frequency and Temperature

Power Drive-up Performance over Temperatures at 5.4 GHz [1]

Notes:

1. Test Conditions: V_D = 50 V, I_{DQ} = 65 mA, 100 us Pulse Width, 10% Duty Cycle.

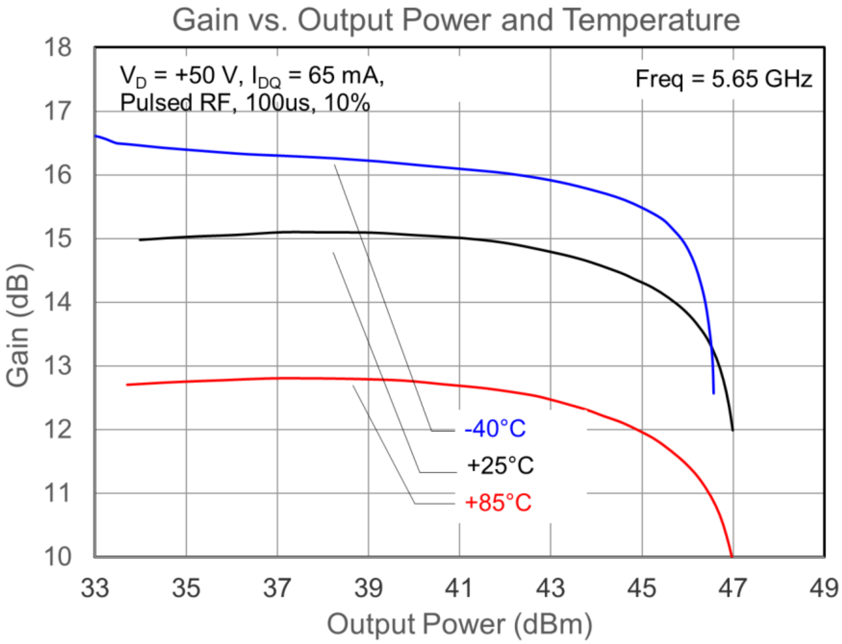


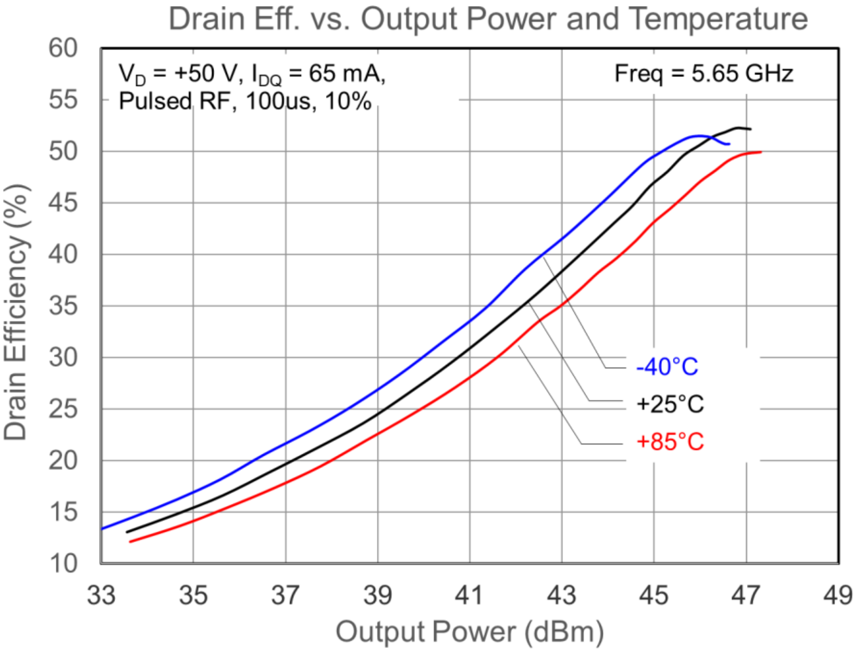


Power Drive-up Performance over Temperatures at 5.65 GHz [1]

Notes:

1. Test Conditions: V_D = 50 V, I_{DQ} = 65 mA, 100 us Pulse Width, 10% Duty Cycle.

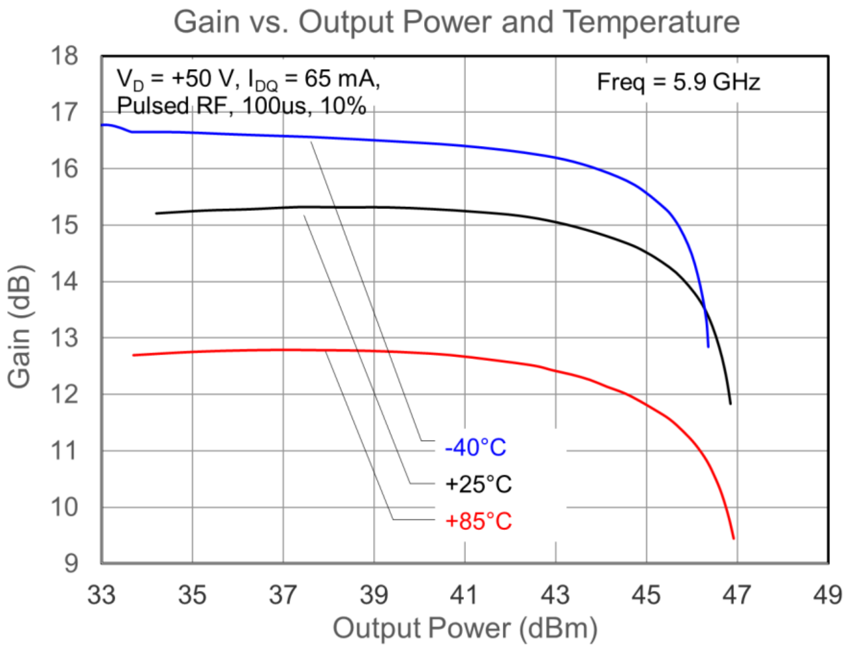


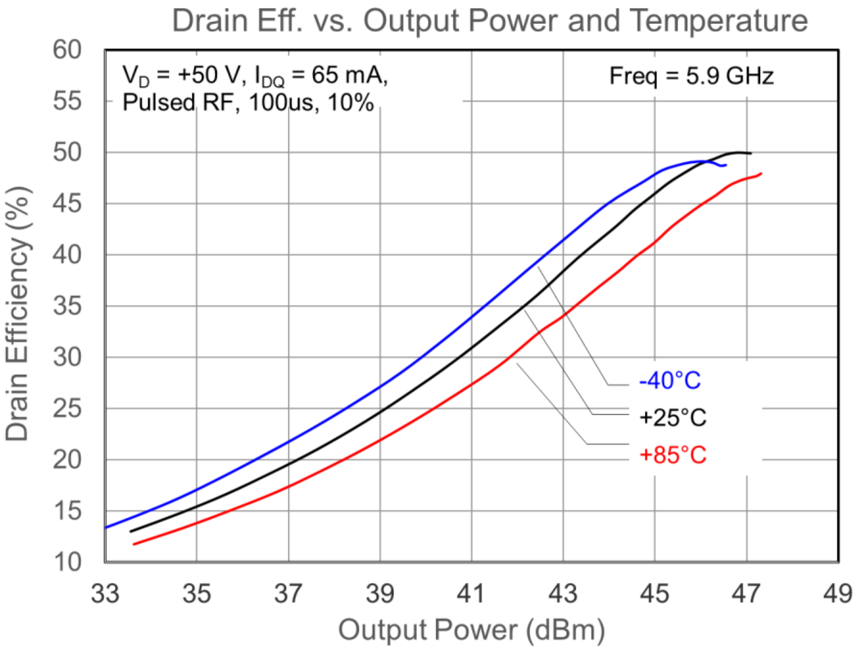


Power Drive-up Performance over Temperatures at 5.9 GHz [1]

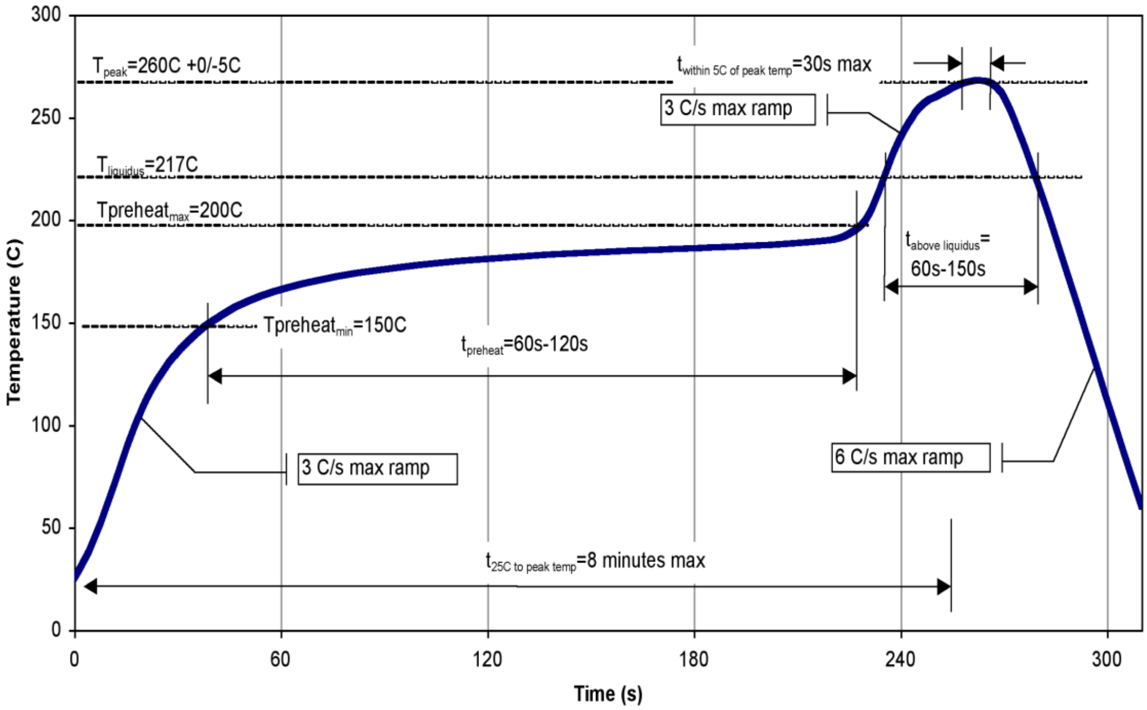
Notes:

1. Test Conditions: V_D = 50 V, I_{DQ} = 65 mA, 100 us Pulse Width, 10% Duty Cycle.





Recommended Solder Temperature Profile



Handling Precautions

Parameter	Rating	Standard
ESD – Human Body Model (HBM)	Class 0B (125V)	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.
Solder profiles available upon request.
The use of no-clean solder to avoid washing after soldering is recommended.

Contact plating: NiAu. Minimum Au thickness is 60 µinches.

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:

- 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:

Web: www.qorvo.com **Tel: 1-844-890-8163**

Email: customer.support@qorvo.com

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