QPD9300

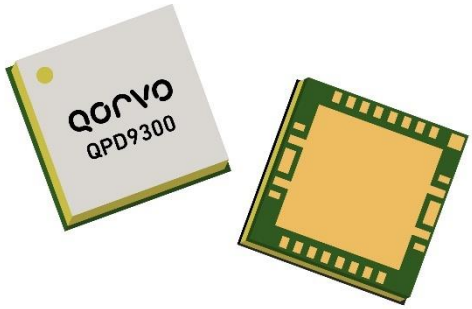
30 W, 28 V, 9.2 – 9.7 GHz, GaN RF IMFET

Product Overview

The QPD9300 is a 30 W (P_{3dB}) internally matched discrete GaN on SiC HEMT which operates from 9.2 to 9.7 GHz and a 28 V supply rail. The device is 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 linear operations.

ROHS compliant.

Evaluation boards are available upon request.

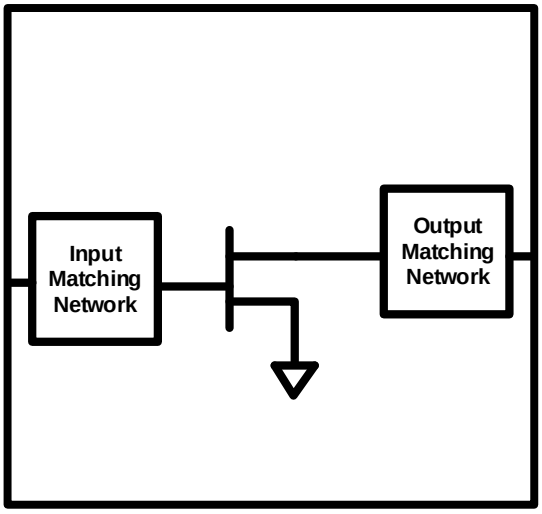


Key Features

- Frequency: 9.2 to 9.7 GHz
- Output Power (P_{OUT})[1]: 34.3 W
- Gain[1]: 9.1 dB
- Typical DEFF[1]: 48.6 %
- Operating Voltage: 28 V
- Low thermal resistance package
- Pulse capable

  Note 1: @ 9.4 GHz and 37 dBm EVB input power

Functional Block Diagram



Applications

- Marine radar
- Civilian radar

Part No.	Description
QPD9300EVB3	9 – 10 GHz EVB
QPD9300SR	QPD9300 short reel of 100 parts.
QPD9300TR7	QPD9300 7” reel of 500 parts.

Absolute Maximum Ratings[1]

Parameter	Rating	Units
Breakdown Voltage,BV_{DG}	+145	V
Gate Voltage Range, V_G	−7 to +2	V
Drain Current	11	A
Gate Current Range, I_G	See page 4.	mA
Power Dissipation, 10% DC 1 mS PW, P_{DISS}	78	W
RF Input Power, 10% DC 1 mS PW, 9.4 GHz, T = 25 °C	+43	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	+24	+28	+32	V
Drain Bias Current, I_{DQ}	–	240	–	mA
Drain Current, I_D	–	0.5	–	A
Gate Voltage, V_G[4]	–	−2.8	–	V
Power Dissipation, Pulsed (P_D)[2, 3]	–	–	62	W
Power Dissipation, CW (P_D)[2]	–	–	37	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 µS, Duty Cycle = 10%
4. To be adjusted to desired I_{DQ}

RF Characterization – 9 – 10 GHz EVB Performance At 9.4 GHz[1]

Parameter	Min	Typ	Max	Units
Gain, G	–	7.8	–	dB
Output Power, P_{OUT}	–	30.4	–	W
Drain Efficiency, DEFF	–	43.1	–	%

Notes:
1. EVB Input Power = 37 dBm, V_D = +28 V, I_{DQ} = 240 mA, Temp = +25 °C, Pulse Width = 100 µS, Duty Cycle = 10%.

RF Characterization – 9 – 10 GHz EVB Performance At 9.5 GHz[1]

Parameter	Min	Typ	Max	Units
Gain, G	–	7.6	–	dB
Output Power, P_{OUT}	–	29.2	–	W
Drain Efficiency, DEFF	–	41.8	–	%

Notes:
1. EVB Input Power = 37 dBm, V_D = +28 V, I_{DQ} = 240 mA, Temp = +25 °C, Pulse Width = 100 µS, Duty Cycle = 10%.

RF Characterization – 9 – 10 GHz EVB Performance At 9.6 GHz[1]

Parameter	Min	Typ	Max	Units
Gain, G	–	7.5	–	dB
Output Power, P_{OUT}	–	28.2	–	W
Drain Efficiency, DEFF	–	39.7	–	%

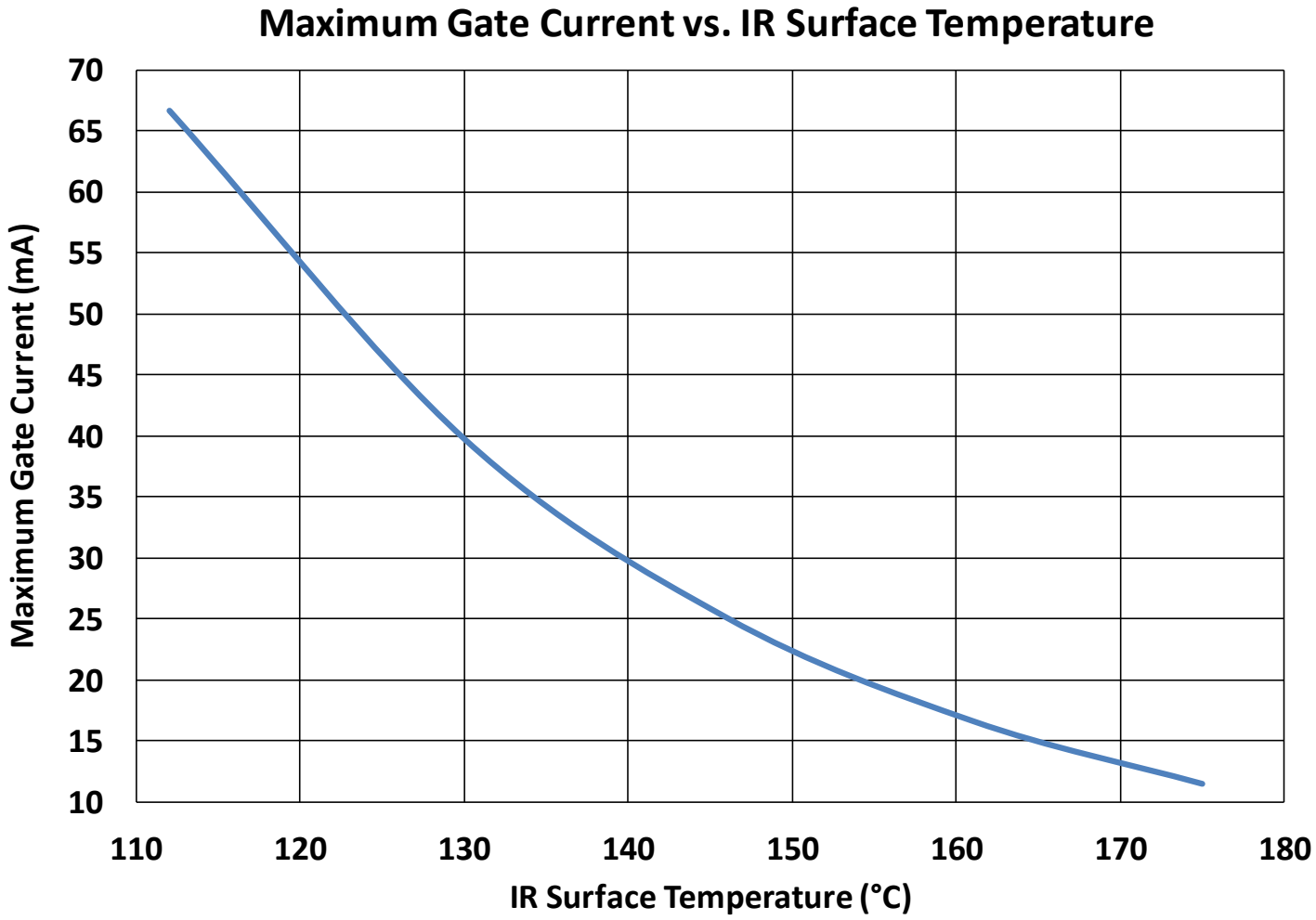
Notes:
1. EVB Input Power = 37 dBm, V_D = +28 V, I_{DQ} = 240 mA, Temp = +25 °C, Pulse Width = 100 µS, Duty Cycle = 10%.

RF Characterization – Mismatch Ruggedness at 9.3 - 9.6 GHz[1, 2]

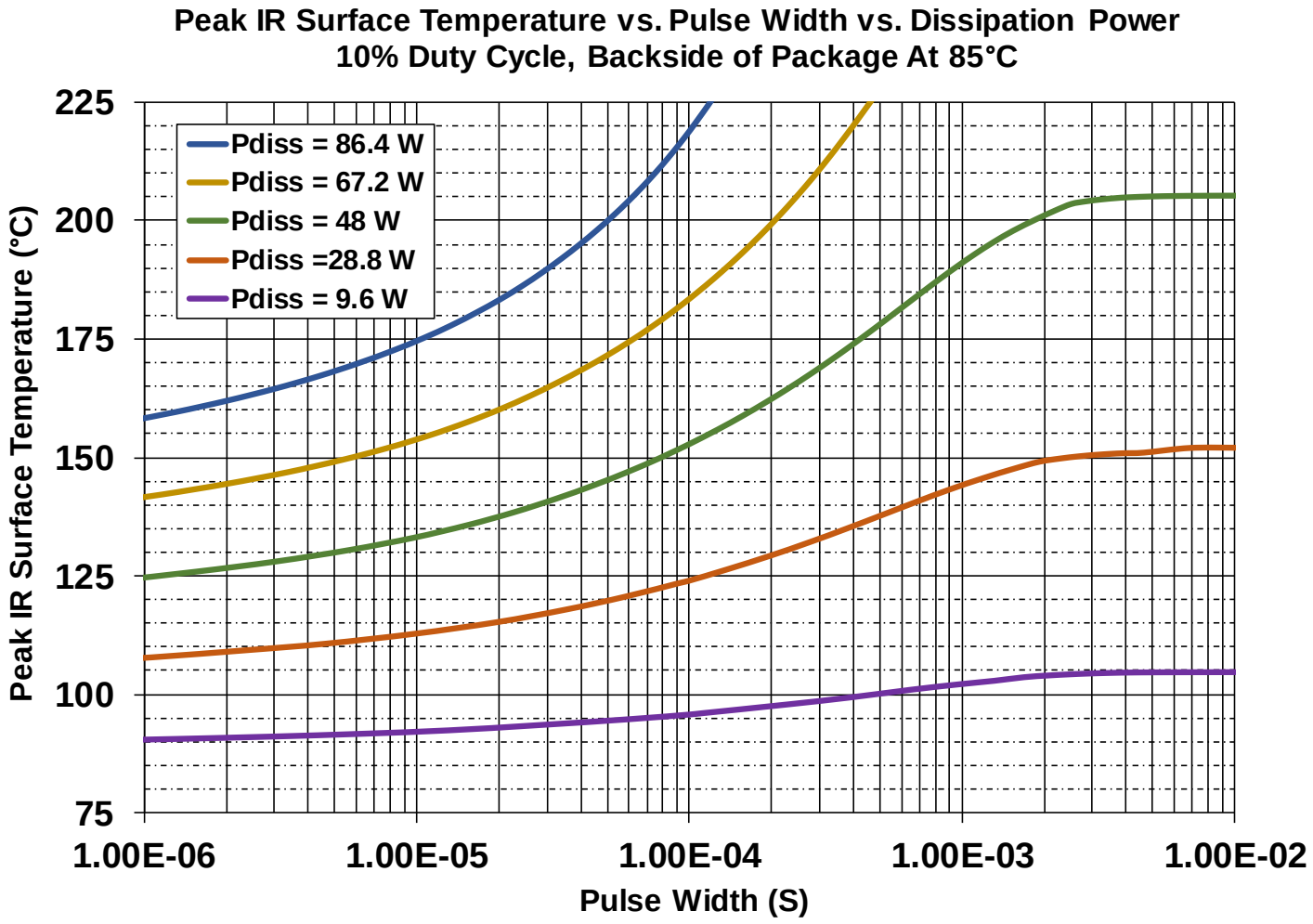
Symbol	Parameter	Typical
VSWR	Impedance Mismatch Ruggedness	3:1

Notes:
1. Test conditions unless otherwise noted: T_A = +25 °C, V_D = 28 V, I_{DQ} = 240 mA, 1 mS PW, 10% DC
2. Driving input power is 43 dBm under matched condition at EVB input connector.

Maximum Gate Current



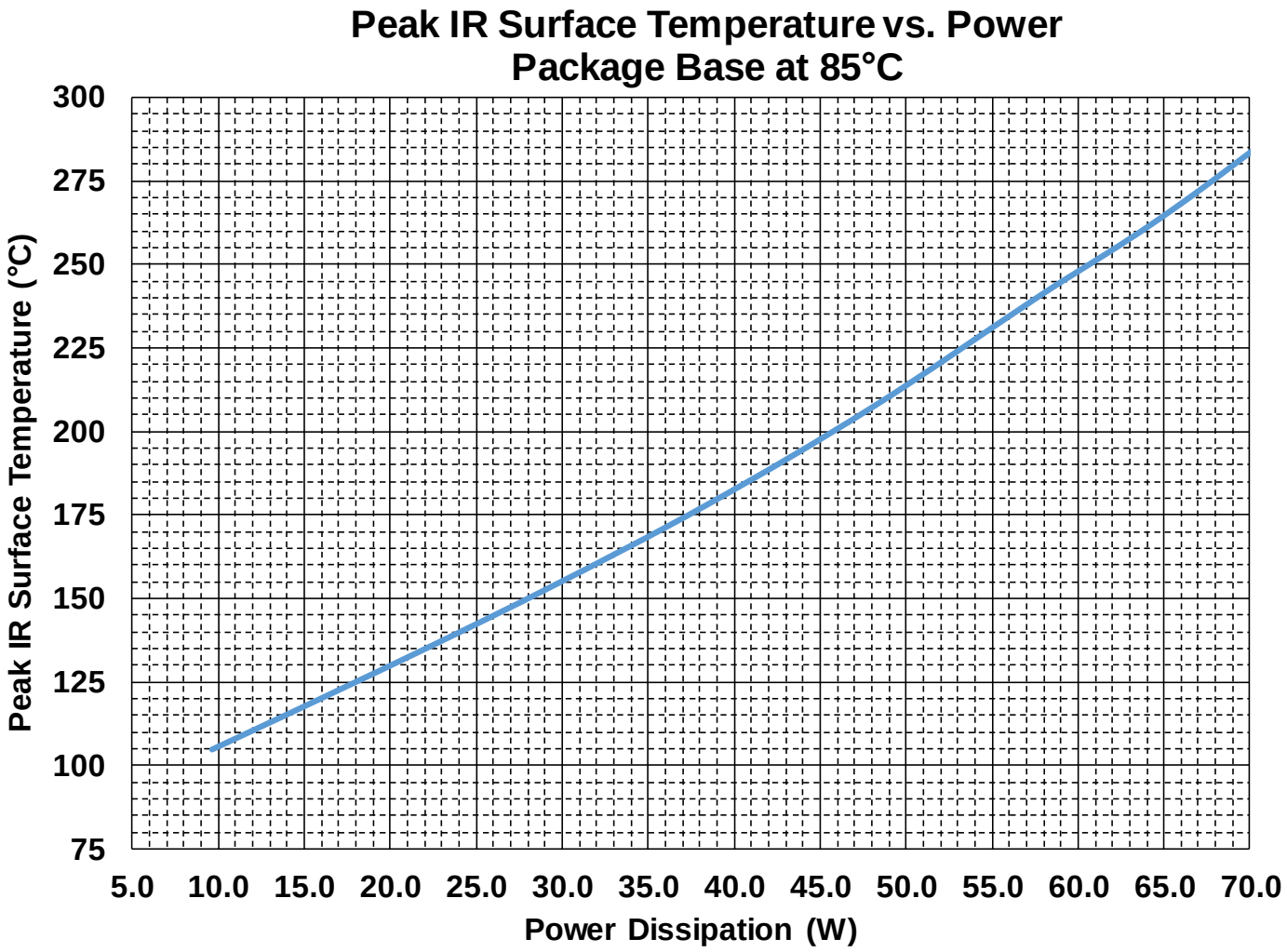
Thermal and Reliability Information – Pulsed[1]



Parameter	Conditions	Values	Units
Thermal Resistance, IR (θ_{JC})	85 °C Case 9.6 W Pdiss, 100 uS PW, 10% DC	1.15	°C/W
Peak IR Surface Temperature (T_{CH})		96	°C
Thermal Resistance, IR (θ_{JC})	85 °C Case 28.8 W Pdiss, 100 uS PW, 10% DC	1.35	°C/W
Peak IR Surface Temperature (T_{CH})		124	°C
Thermal Resistance, IR (θ_{JC})	85 °C Case 48 W Pdiss, 100 uS PW, 10% DC	1.42	°C/W
Peak IR Surface Temperature (T_{CH})		153	°C
Thermal Resistance, IR (θ_{JC})	85 °C Case 67.2 W Pdiss, 100 uS PW, 10% DC	1.46	°C/W
Peak IR Surface Temperature (T_{CH})		183	°C
Thermal Resistance, IR (θ_{JC})	85 °C Case 86.4 W Pdiss, 100 uS PW, 10% DC	1.54	°C/W
Peak IR Surface Temperature (T_{CH})		218	°C

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

Thermal and Reliability Information – CW[1]



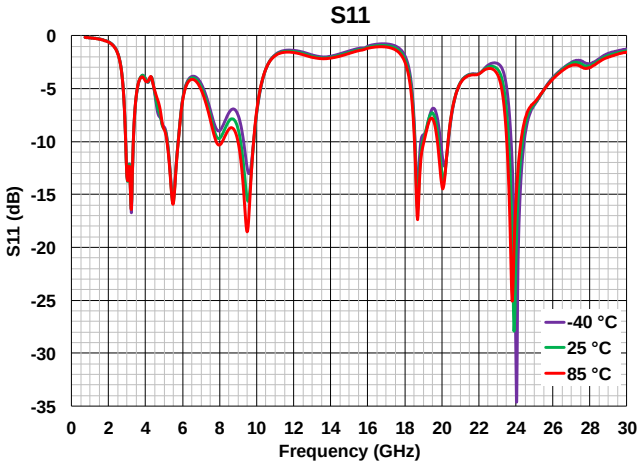
Parameter	Conditions	Values	Units
Thermal Resistance, IR (θ_{JC})	85 °C Case 19.2 W Pdiss, CW	2.24	°C/W
Peak IR Surface Temperature (T_{CH})		128	°C
Thermal Resistance, IR (θ_{JC})	85 °C Case 28.8 W Pdiss, CW	2.33	°C/W
Peak IR Surface Temperature (T_{CH})		152	°C
Thermal Resistance, IR (θ_{JC})	85 °C Case 38.4 W Pdiss, CW	2.42	°C/W
Peak IR Surface Temperature (T_{CH})		178	°C
Thermal Resistance, IR (θ_{JC})	85 °C Case 48 W Pdiss, CW	2.54	°C/W
Peak IR Surface Temperature (T_{CH})		207	°C
Thermal Resistance, IR (θ_{JC})	85 °C Case 57.6 W Pdiss, CW	2.69	°C/W
Peak IR Surface Temperature (T_{CH})		240	°C

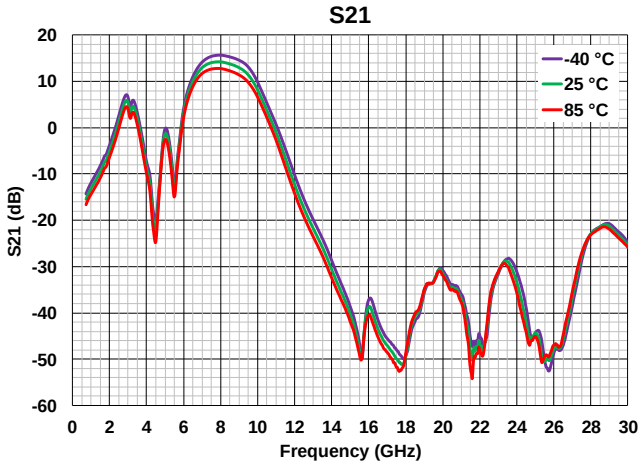
[1]Refer to the following document GaN Device Channel Temperature, Thermal Resistance, and Reliability Estimates

S-Parameters Over Temperatures Of 9 – 10 GHz EVB[1]

Notes:

1. V_D = 28 V, I_{DQ} = 240 mA.





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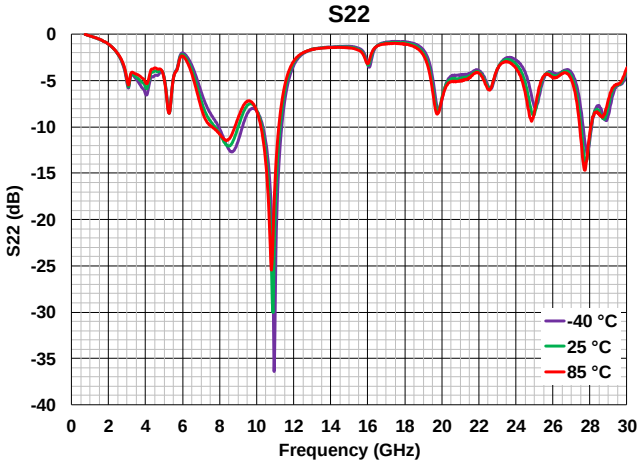
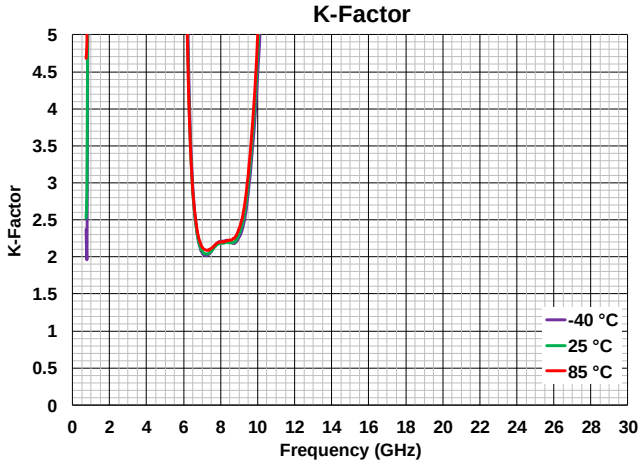
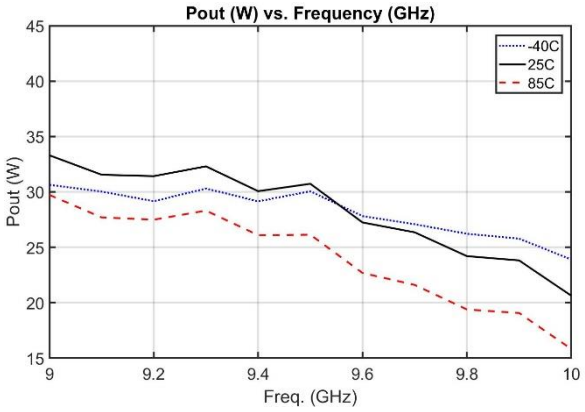


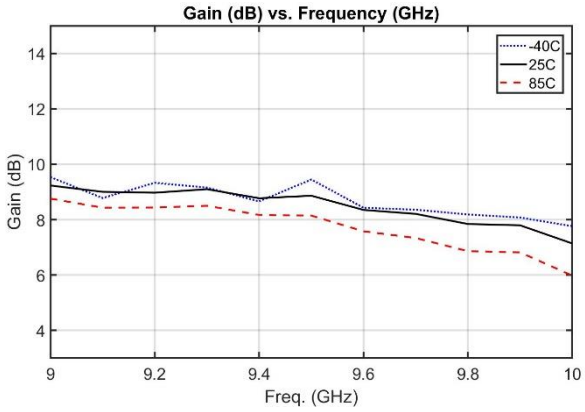


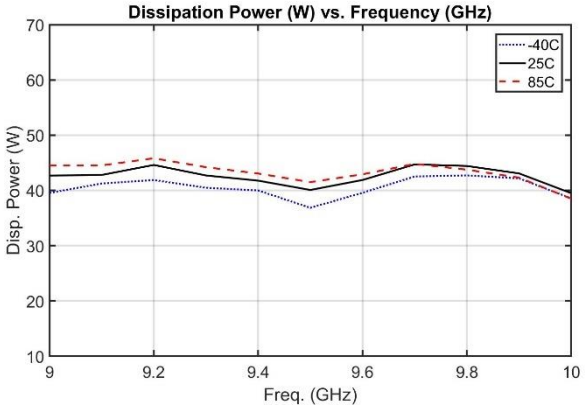
Power Performance Over Temperatures Of 9 – 10 GHz EVB[1, 2]

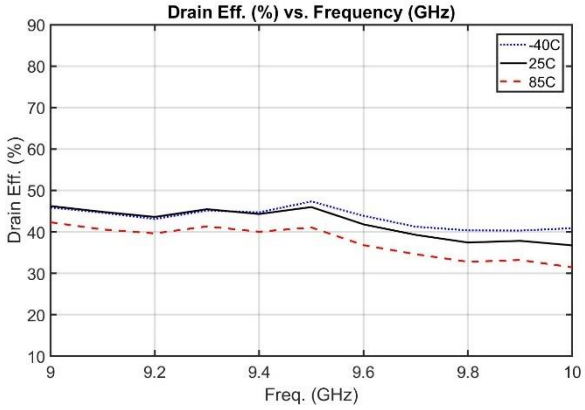
Notes:

1. At QPD9300 Package.
2. EVB Input Power = 37 dBm, V_D = 28 V, I_{DQ} = 240 mA, 100 µS PW, 10% DC.





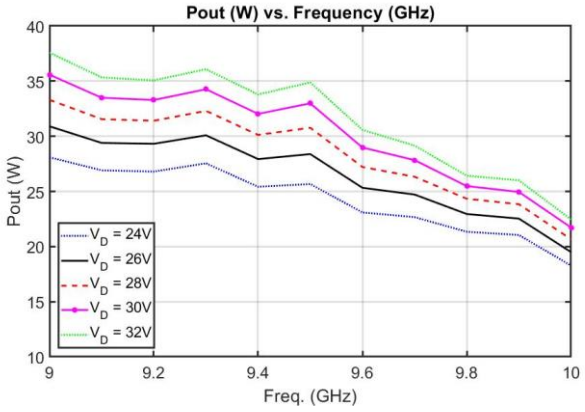


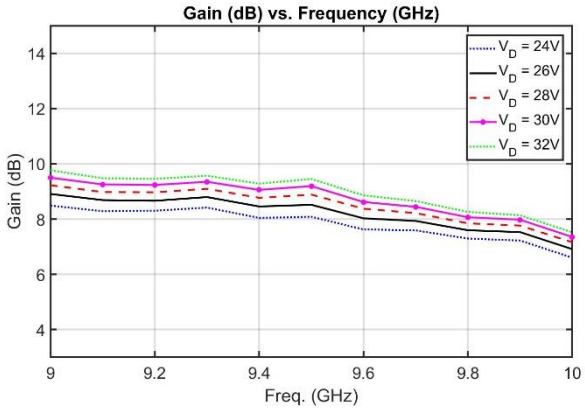


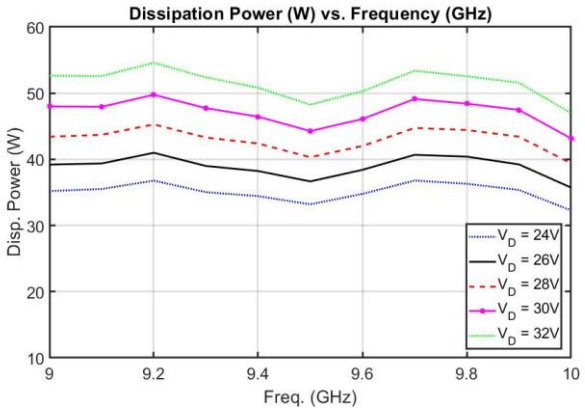
Power Performance Over Temperatures and V_D Of 9 – 10 GHz EVB[1, 2]

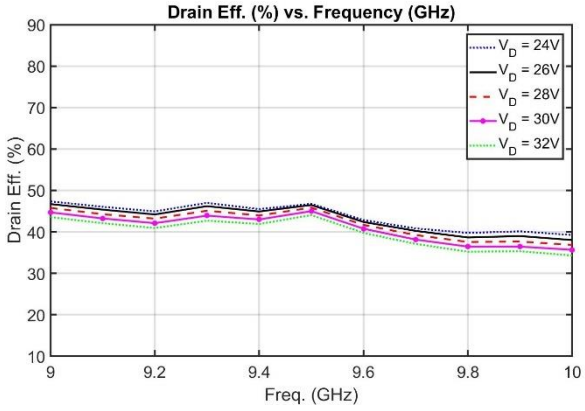
Notes:

1. At QPD9300 Package.
2. EVB Input Power = 37 dBm, I_{DQ} = 240 mA, 100 µS PW, 10% DC

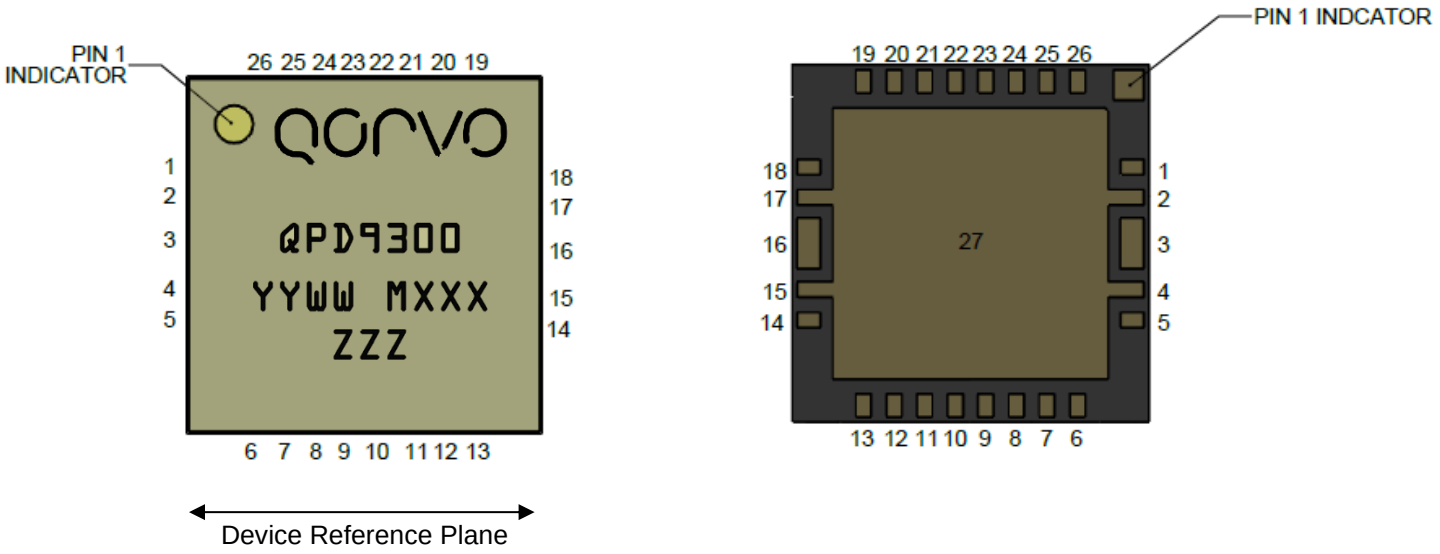








Pin Configuration and Description, and Package Marking[1]



Notes:

1. The QPD9300 will be marked with the “QPD9300” 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

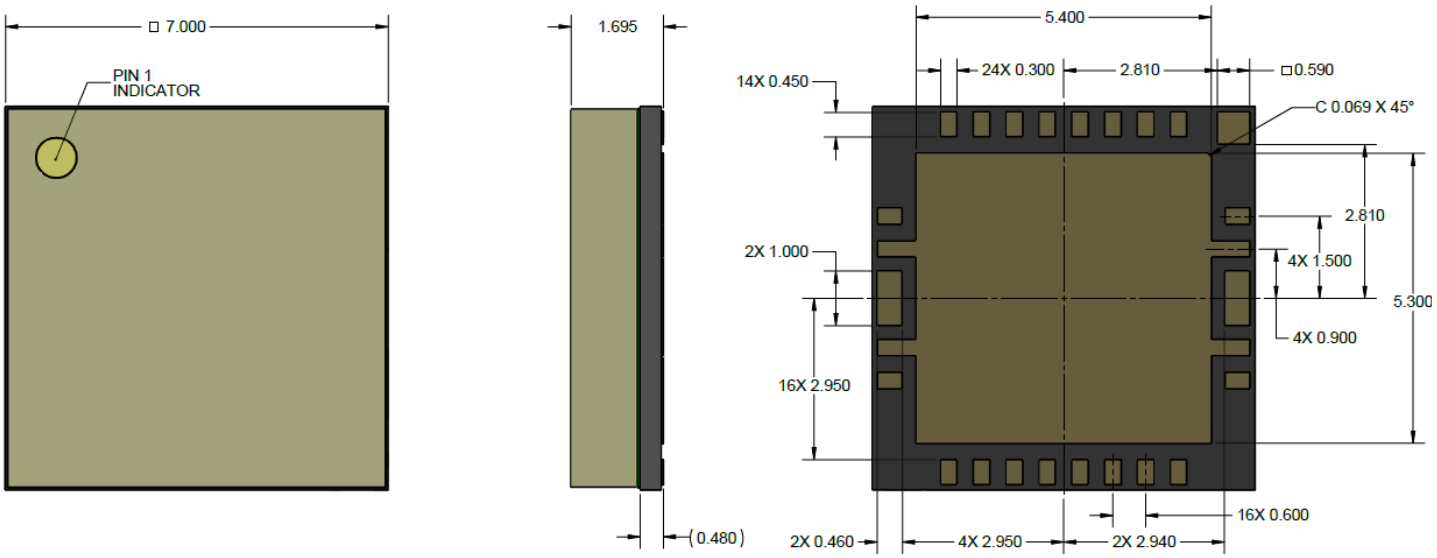
Pin Description

Pin	Symbol	Description
3	V_G / RF IN	Gate voltage / RF Input
16	V_D / RF OUT	Drain voltage / RF Output
1, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 18, 19, 20, 21, 22, 23, 24, 25, 26	N/C	No Connection[1]
2, 4, 15, 17, 27	GND	Package Base

[1] To be grounded in board layout.

start, the “MXXX” is the batch ID, ZZZ is unique for all parts within one assembly lot.

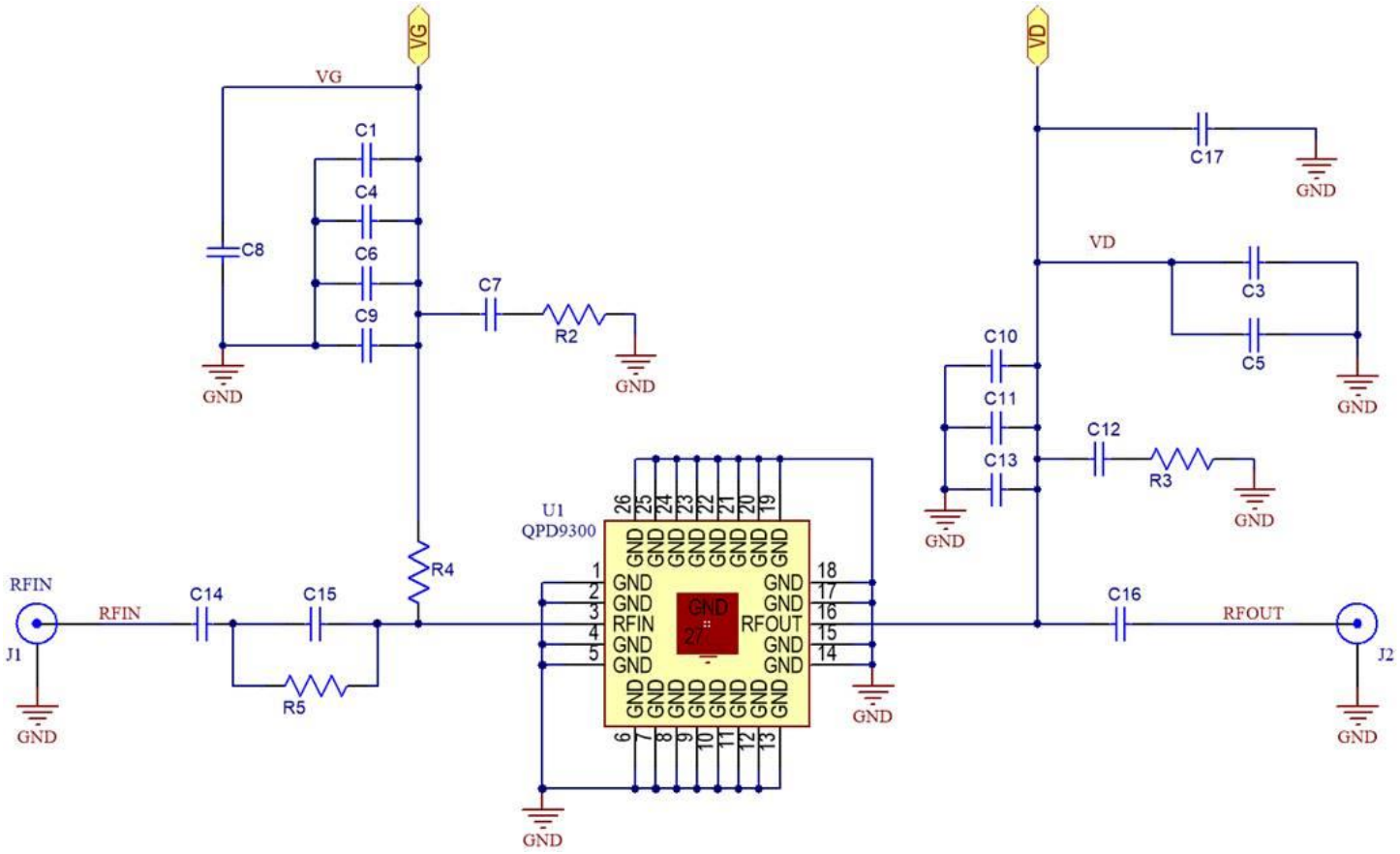
Package Dimensions[1, 2, 3, 4, 5]



Notes:

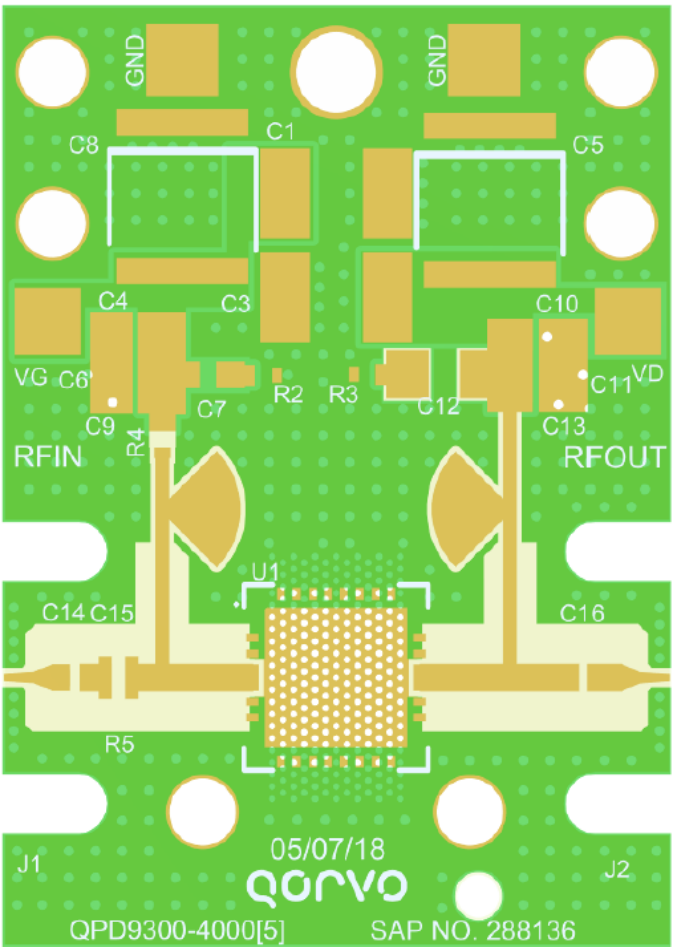
1. Dimension unit is mm.
2. Unless otherwise noted, dimension tolerance is ±0.127 mm.
3. Material:
   Package Base: Laminate
   Package Lid: Laminate
4. Package exposed metallization is gold plated.
5. Part is epoxy sealed.

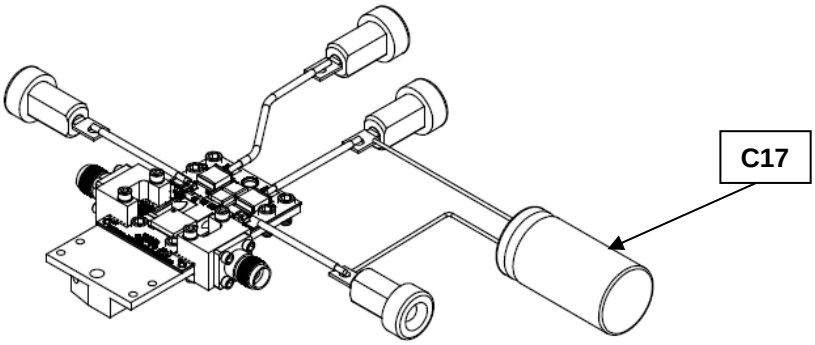
Schematic – 9 – 10 GHz EVB



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 250 mA	2. Turn off V_D
3. Apply 28 V V_D	3. Wait 2 seconds to allow drain capacitor to discharge
4. Slowly adjust V_G until I_D is set to 240 mA	4. Turn off V_G
5. Set I_D current limit to 0.6 A	
6. Apply RF	

Layout - 9 – 10 GHz EVB[1]





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

Bill Of material – 9 – 10 GHz EVB

Ref Des	Value	Qty	Manufacturer	Part Number
C4, C10	10000 pF, 100 V	2	AVX	08051C103KAZ2A
C1, C3	1 uF, 100 V	2	AVX	18121C105KAT2A
C6, C11	100 pF, 250 V	2	AVX	UQCSVA101JAT2A\500
C9, C13	1.8 pF, 200 V	2	AVX	UQCL2A1R8BAT2A\500
C14, C15, C16	1.0 pF, 200 V	3	AVX	UQCL2A1R0BAT2A\500
C5, C8	10 uF, 100 V	2	Murata	22201C106MAT2A
C17	220 uF, 100 V	1	Nichicon	UVY2A221MHD1TO
R4	10 Ω	1	Panasonic	ERJ-2GEJ100X
R5	1 kΩ	1	Panasonic	ERJ-PA2J102X
J1, J2	Connector	2	Southwest Microwave	1092-01A-5
C7, C12, R2, R3	Do Not Place			

Recommended Solder Temperature Profile