TGF2929-HM

100W, 28V, DC – 3.5 GHz, GaN RF Power Transistor

General Description

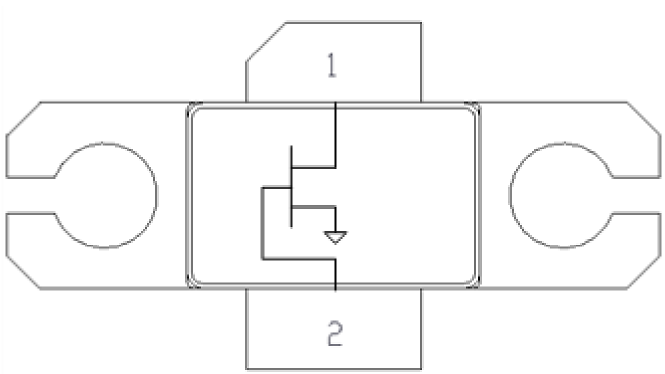
The Qorvo TGF2929-HM is a 100 W (P_{3dB}) discrete GaN on SiC HEMT which operates from DC to 3.5 GHz. The device is constructed with Qorvo's proven QGaN25HV process, which features advanced field plate techniques to optimize power and efficiency at high drain bias operating conditions. This optimization can potentially lower system costs in terms of fewer amplifier line-ups and lower thermal management costs.

Hermetic package

Lead-free and ROHS compliant

Evaluation boards are available upon request.

Functional Block Diagram



Product Features

- Frequency: DC to 3.5 GHz
- Output Power (P_{3dB})[1]: 132 W
- Linear Gain[1]: 17.4 dB
- Typical $DEFF_{3dB}$[1]: 74.9% at
- Operating Voltage: 28 V
- Low thermal resistance package
- CW and Pulse capable

Note 1: @ 2 GHz

Applications

- Space radar
- Satcomm
- Military radar
- Civilian radar
- Land mobile and military radio communications
- Test instrumentation
- Wideband or narrowband amplifiers
- Jammers

Ordering info

Part No.	Description
TGF2929-HM	DC – 3.5 GHz packaged part
TGF2929-HM EVB01	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	12	A
Gate Current Range, I_G	See page 4.	mA
Power Dissipation, CW, T = 85°C, P_{DISS}	110	W
RF Input Power, CW, T = 25 °C	+42	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	+12	+28	+50	V
Drain Bias Current, I_{DQ}	–	260	–	mA
Peak Drain Current, I_D[3]	–	7.2	–	A
Gate Voltage, V_G[4]	–	−2.7	–	V
Power Dissipation, CW (P_D)[2]	–	–	98	W
Power Dissipation, Pulsed (P_D)[2, 3]	–	–	140	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 = 20%
4. To be adjusted to desired I_{DQ}

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

Parameters	Typical Values				Unit
Frequency, F	1	2	3	3.5	GHz
Linear Gain, G_{LIN}	21.7	17.4	14.7	15.6	dB
Output Power at 3dB compression point, P_{3dB}	50.9	51.2	50.9	50.8	dBm
Drain Efficiency at 3dB compression point, $DEFF_{3dB}$	69.4	68.1	59.7	58.5	%
Gain at 3dB compression point	18.7	14.4	11.7	12.6	dB

Notes:
1. V_D = +28 V, I_D = 260 mA, Temp = +25 °C, Pulse Width = 100 uS, Duty Cycle = 20%

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

Parameters	Typical Values				Unit
Frequency	1	2	3	3.5	GHz
Linear Gain, G_{LIN}	23.3	18.6	16.0	17	dB
Output Power at 3dB compression point, P_{3dB}	50.1	49.5	49.9	49.1	dBm
Drain Efficiency at 3dB compression point, $DEFF_{3dB}$	79.2	74.9	67.4	63.1	%
Gain at 3dB compression point, G_{3dB}	20.3	15.6	13.0	14	dB

Notes:
1. V_D = +28 V, I_D = 260 mA, Temp = +25 °C, Pulse Width = 100 uS, Duty Cycle = 20%

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

Parameter	Min	Typ	Max	Units
Linear Gain, G_{LIN}	–	13.9	–	dB
Output Power at 3dB compression point, P_{3dB}	–	50.5	–	dBm
Power-Added-Efficiency at 3dB compression point, PAE_{3dB}	–	54	–	%
Gain at 3dB compression point, G_{3dB}	–	10.9	–	dB

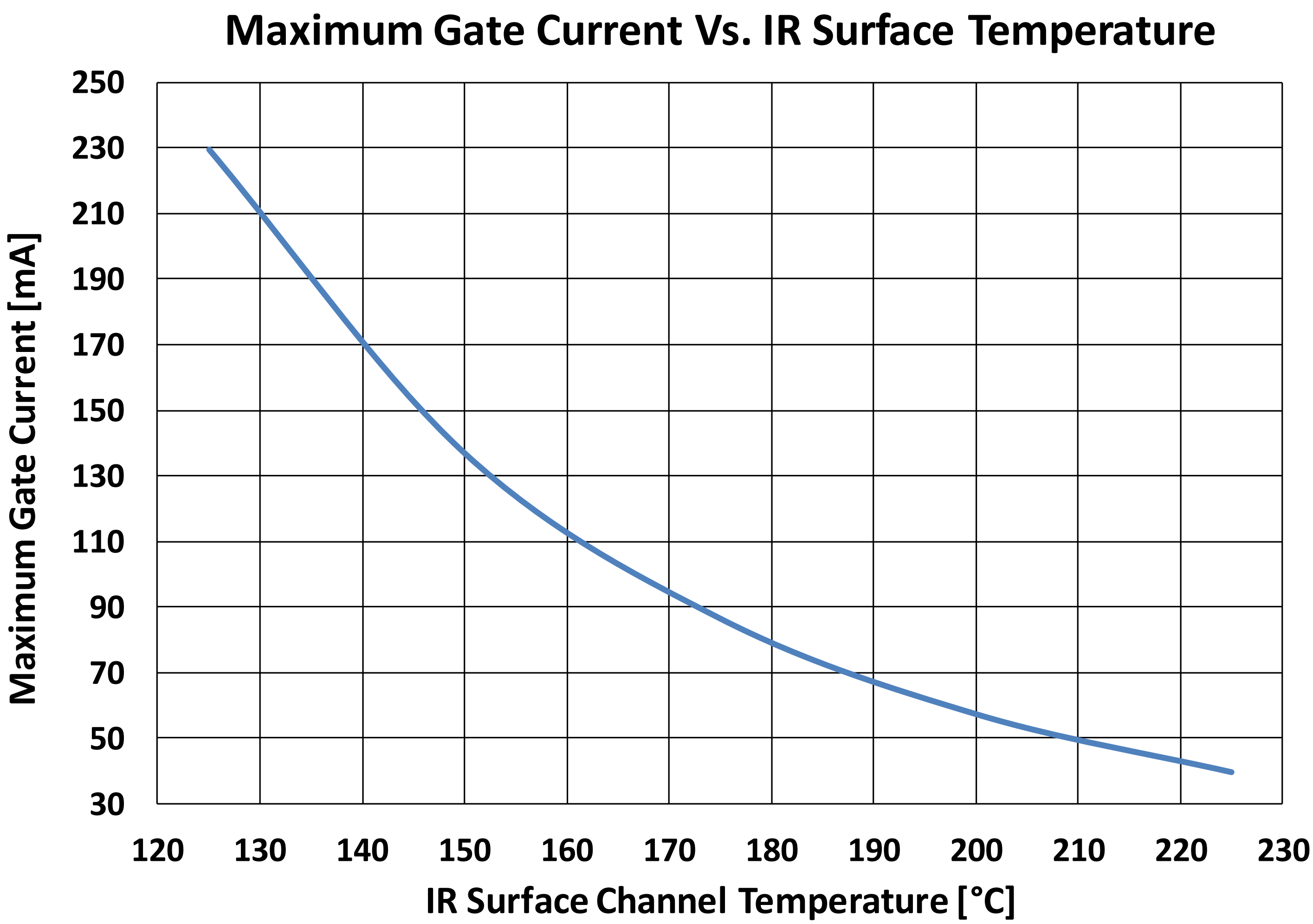
Notes:
1. V_D = +28 V, I_D = 260 mA, Temp = +25 °C, Pulse Width = 100 uS, Duty Cycle = 20%

RF Characterization – Mismatch Ruggedness at 3.3 GHz

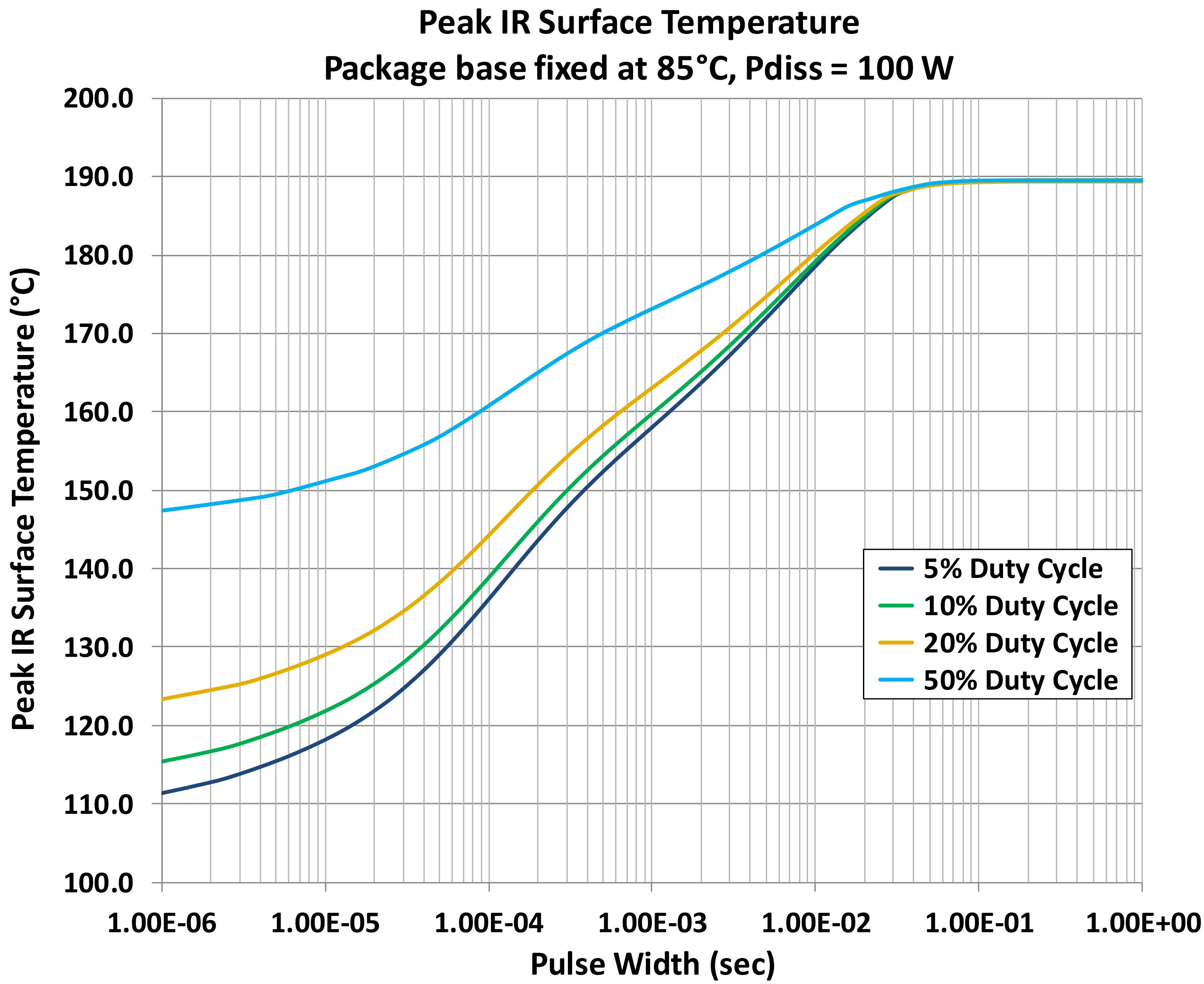
Symbol	Parameter	dB Compression	Typical
VSWR	Impedance Mismatch Ruggedness	3	10:1

Test conditions unless otherwise noted: T_A = 25 °C, V_D = 28 V, I_{DQ} = 260 mA, Pulse Width = 100 uS, Duty Cycle = 20%, Driving input power is determined at pulsed compression under matched condition at EVB output connector.

Maximum Gate Current



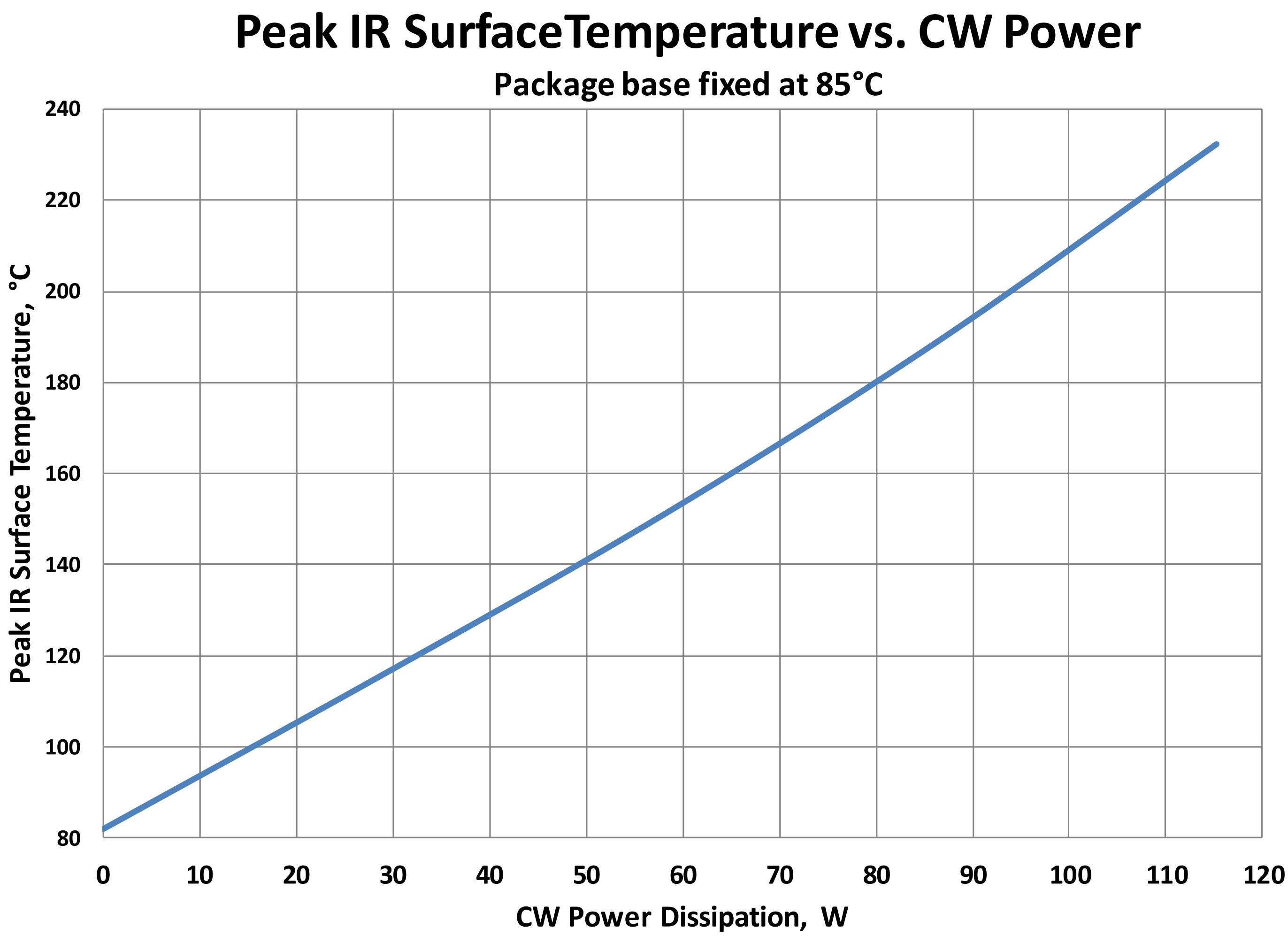
Thermal and Reliability Information – Pulsed



Parameter[1]	Conditions	Values	Units
Thermal Resistance, IR (θ_{JC})	85 °C back side temperature	0.73	°C/W
Peak IR Surface Temperature (T_{CH})	100 W Pdiss, 1 mS PW, 5% DC	158	°C
Thermal Resistance, IR (θ_{JC})	85 °C back side temperature	0.75	°C/W
Peak IR Surface Temperature (T_{CH})	100 W Pdiss, 1 mS PW, 10% DC	160	°C
Thermal Resistance, IR (θ_{JC})	85 °C back side temperature	0.78	°C/W
Peak IR Surface Temperature (T_{CH})	100 W Pdiss, 1 mS PW, 20% DC	163	°C
Thermal Resistance, IR (θ_{JC})	85 °C back side temperature	0.88	°C/W
Peak IR Surface Temperature (T_{CH})	100 W Pdiss, 1 mS PW, 50% DC	173	°C

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

Thermal and Reliability Information – CW



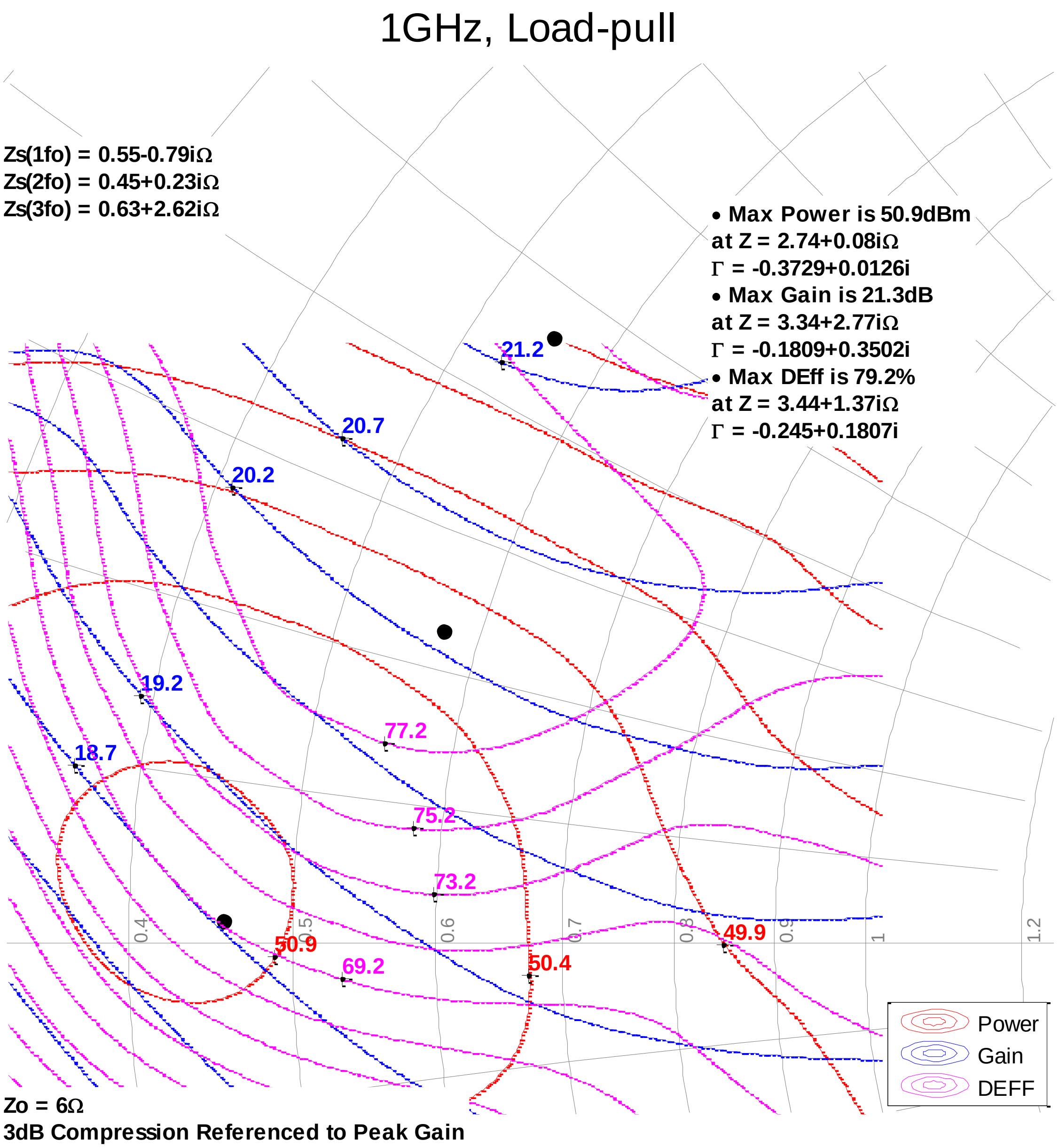
Parameter[1]	Conditions	Values	Units
Thermal Resistance, IR (θ_{JC})	85 °C back side temperature	1.08	°C/W
Peak IR Surface Temperature (T_{CH})	28.8 W Pdiss	116	°C
Thermal Resistance, IR (θ_{JC})	85 °C back side temperature	1.15	°C/W
Peak IR Surface Temperature (T_{CH})	57.6 W Pdiss	151	°C
Thermal Resistance, IR (θ_{JC})	85 °C back side temperature	1.20	°C/W
Peak IR Surface Temperature (T_{CH})	86.4 W Pdiss	189	°C
Thermal Resistance, IR (θ_{JC})	85 °C back side temperature	1.28	°C/W
Peak IR Surface Temperature (T_{CH})	115.2 W Pdiss	232	°C

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

Load Pull Smith Charts[1, 2, 3]

Notes:

1. 28 V, 260 mA, Pulsed signal with 100 uS pulse width and 20 % duty cycle. Performance is at indicated input power.
2. See page 15 for load pull and source pull reference planes. 6-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]

Notes:

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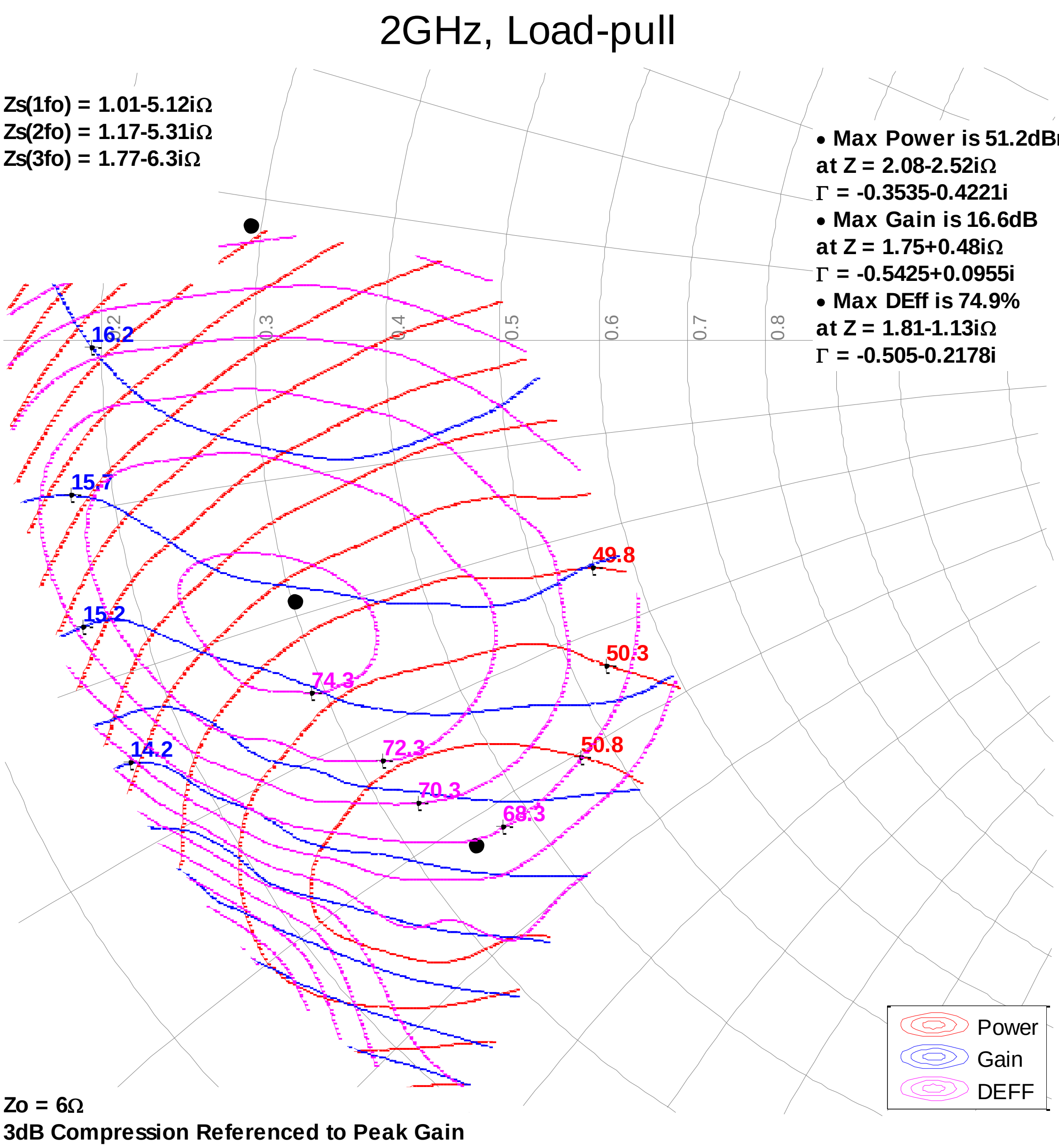

Load Pull Smith Charts[1, 2, 3]

Notes:

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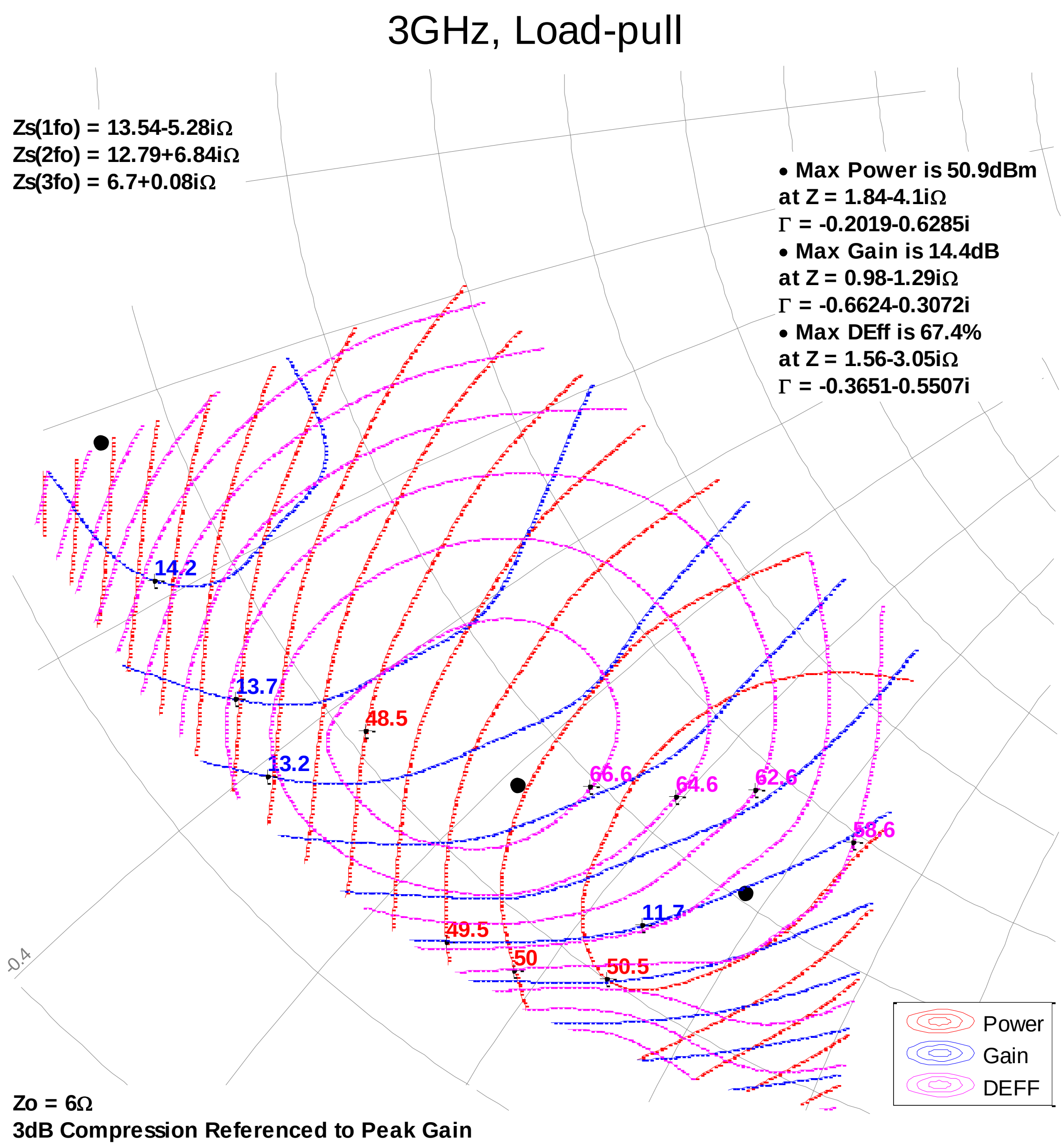
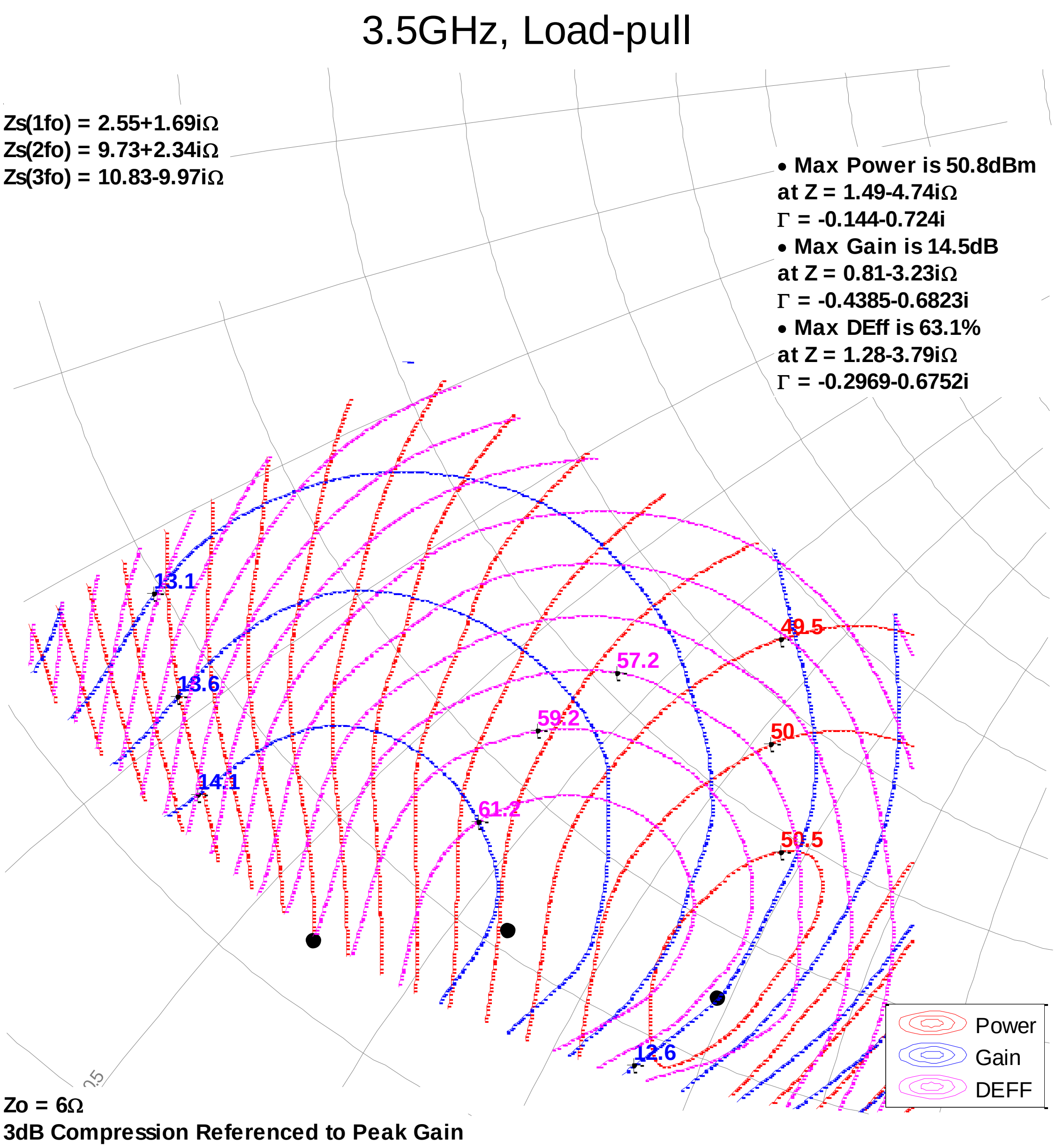


Load Pull Smith Charts[1, 2, 3]

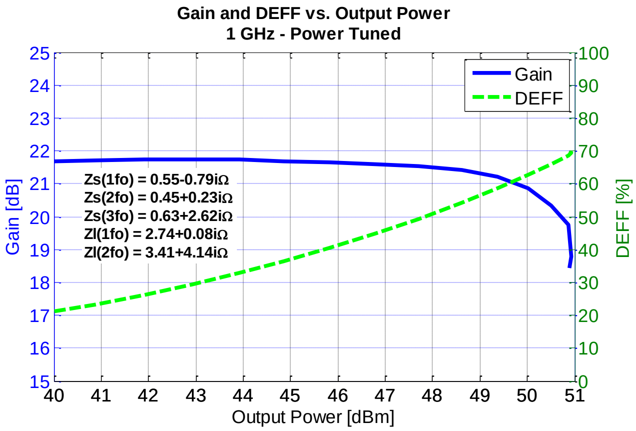
Notes:

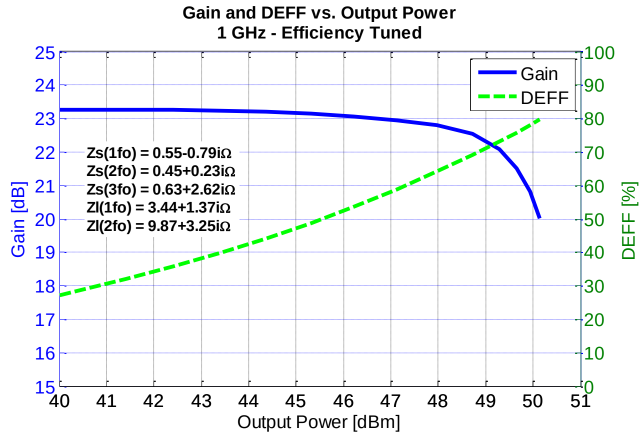
1. 28 V, 260 mA, Pulsed signal with 100 uS pulse width and 20 % duty cycle. Performance is at indicated input power.
2. See page 15 for load pull and source pull reference planes. 6-Ω load pull TRL fixtures are built with 20-mil RO4350B material.
3. NaN means the impedances are either undefined or varying in load-pull system.

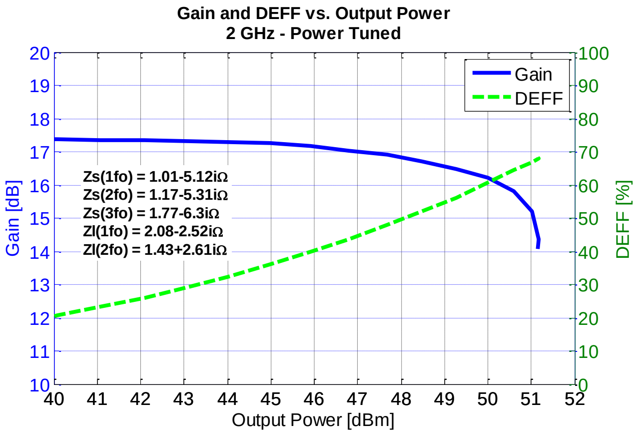


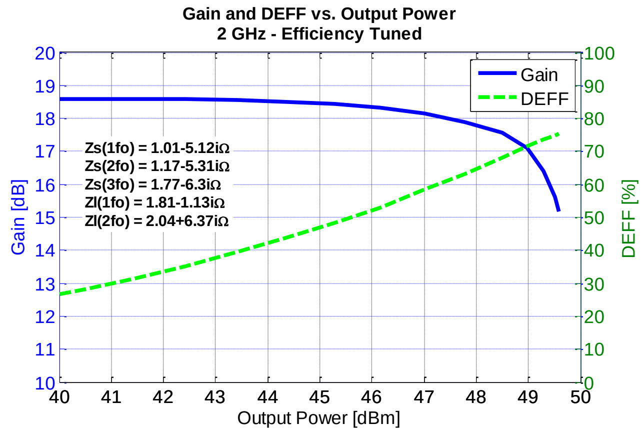
Typical Performance – Load Pull Drive-up[1, 2]

Notes:
1. Pulsed signal with 100 uS pulse width and 20 % duty cycle, Vd = 28 V, Idq = 260 mA
2. See page 15 for load pull and source pull reference planes where the performance was measured.





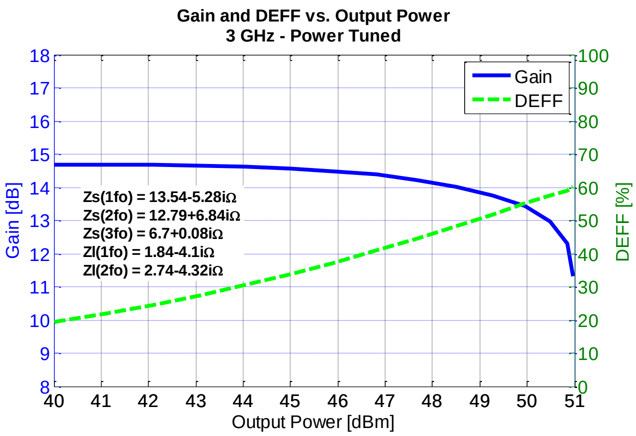


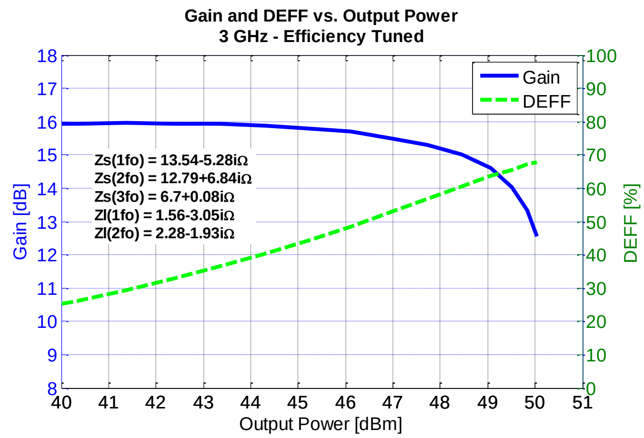


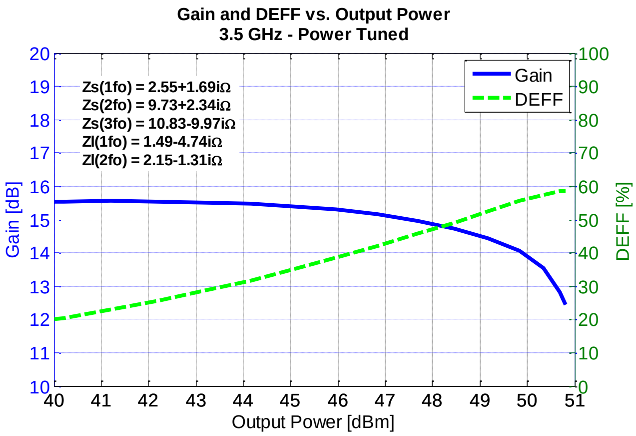
Typical Performance – Load Pull Drive-up[1, 2]

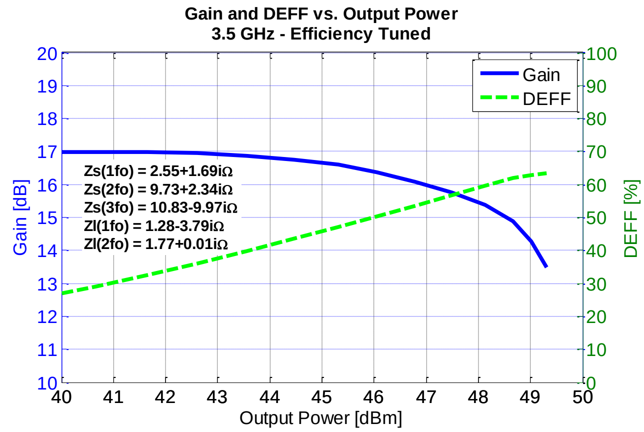
Notes:

1. Pulsed signal with 100 uS pulse width and 20 % duty cycle, Vd = 28 V, Idq = 260 mA
2. See page 15 for load pull and source pull reference planes where the performance was measured.



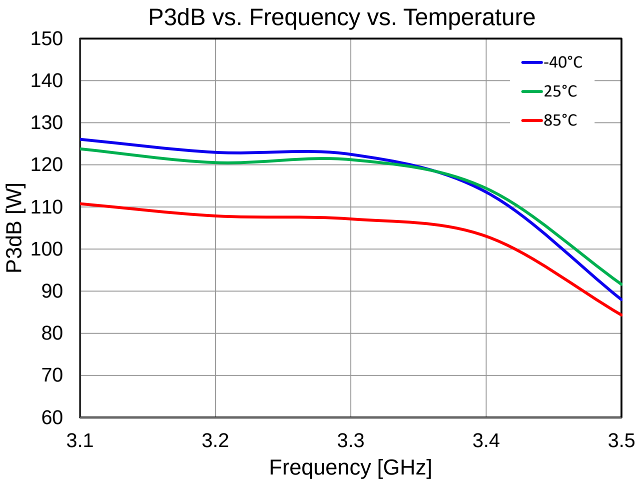


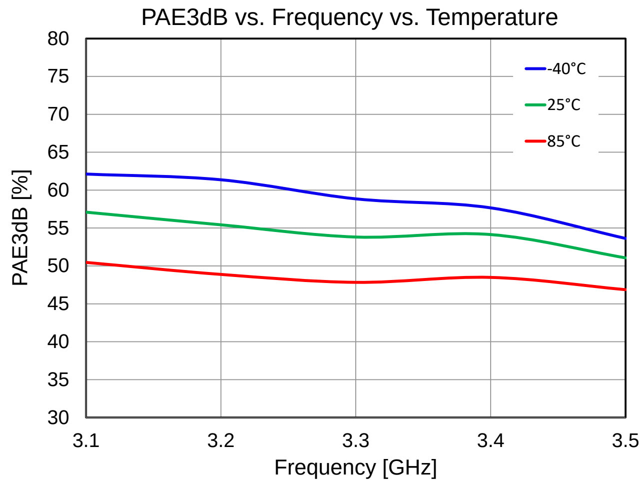


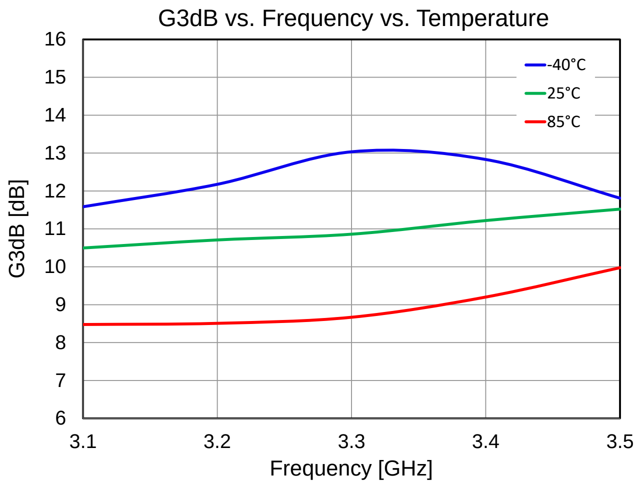


Power Driveup Performance Over Temperatures Of 3.1 – 3.5 GHz EVB[1]

[1] Vd = 28 V, Idq = 260 mA, Pulse Width = 100 uS, Duty Cycle = 20 %

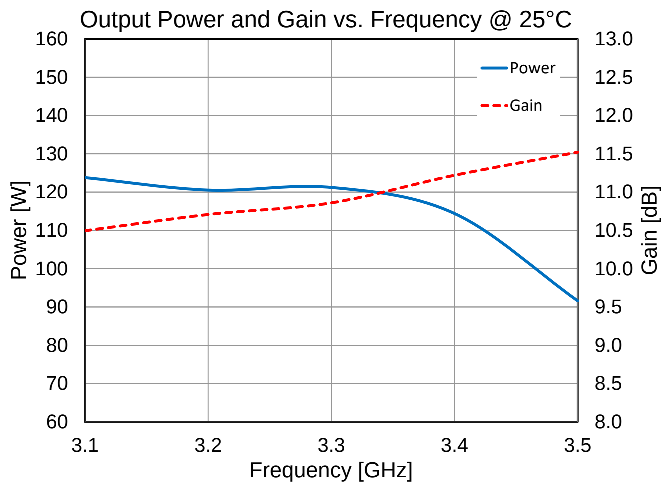


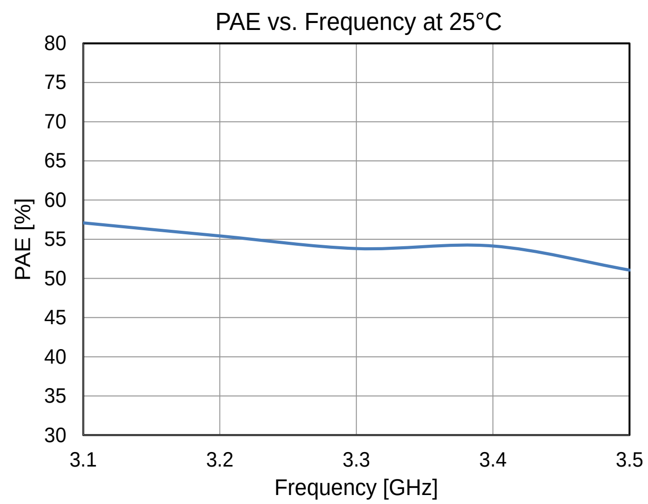




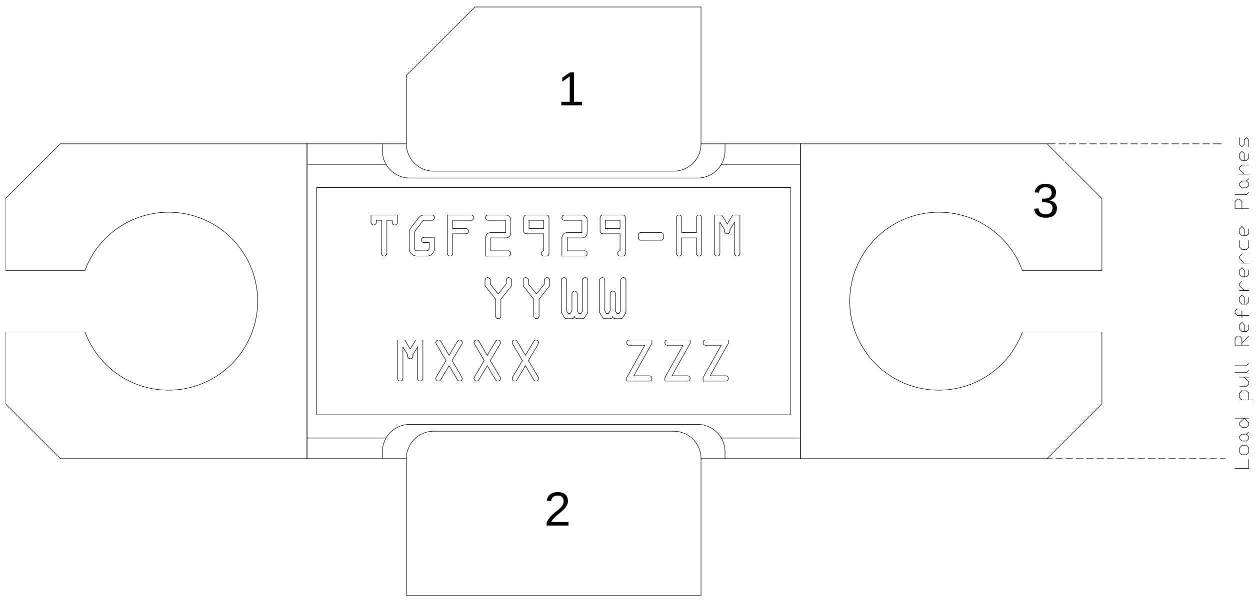
Power Driveup Performance At 25 °C Of 3.1 – 3.5 GHz EVB[1]

[1] Vd = 28 V, Idq = 260 mA, Pulse Width = 100 uS, Duty Cycle = 20 %





Pin Layout [1]

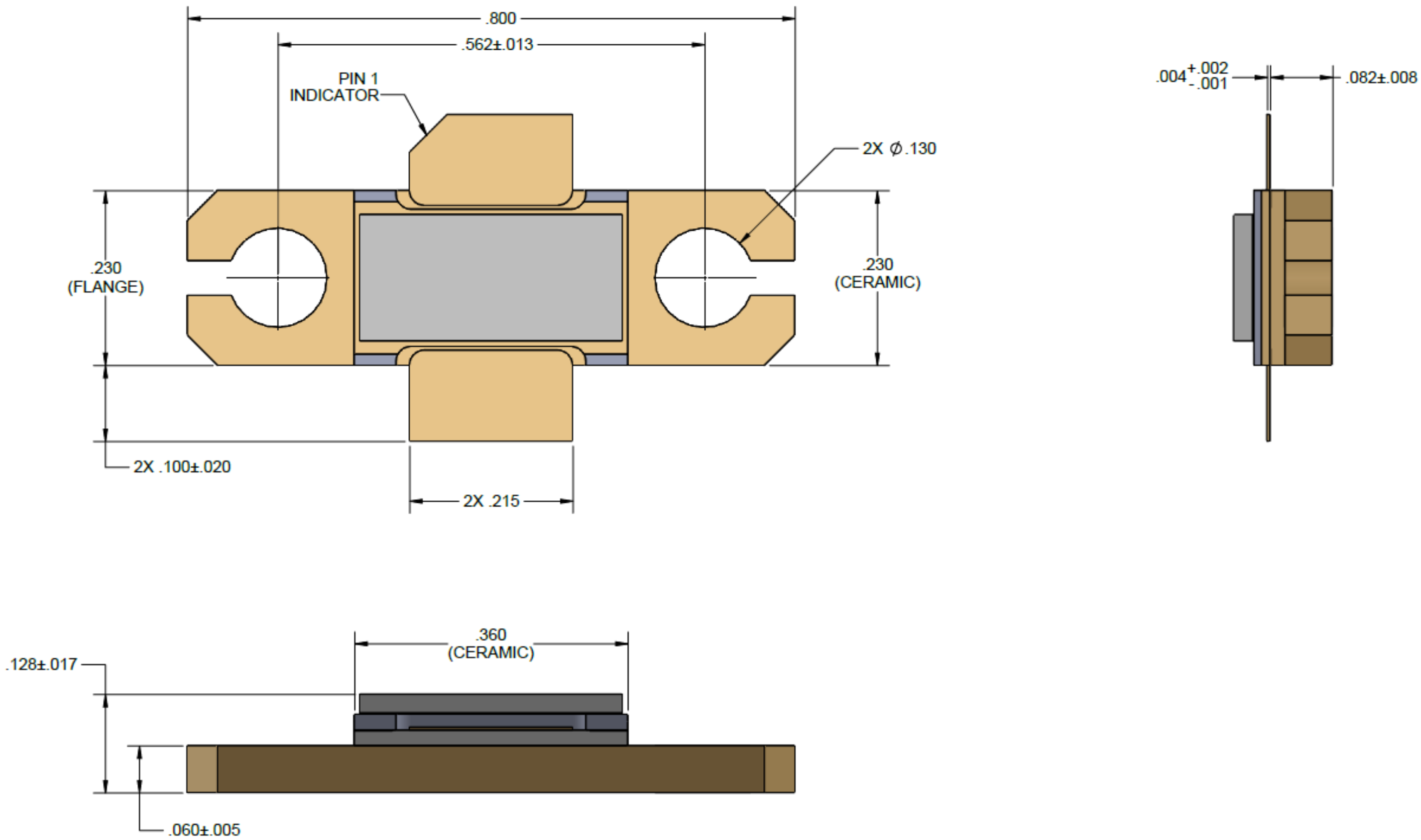


Notes:
1. The TGF2929-HM will be marked with the "TGF2929HM" designator and a lot code marked below the part designator. The "YY" represents the last two digits of the calendar year the part was manufactured, the "WW" is the work week of the assembly lot start, the "MXXX" is the production lot number, and the "ZZZ" is an auto-generated serial number.

Pin Description

Pin	Symbol	Description
1	VD / RF OUT	Gate voltage / RF Input
2	VG / RF IN	Drain voltage / RF Output
3	Flange	Source to be connected to ground

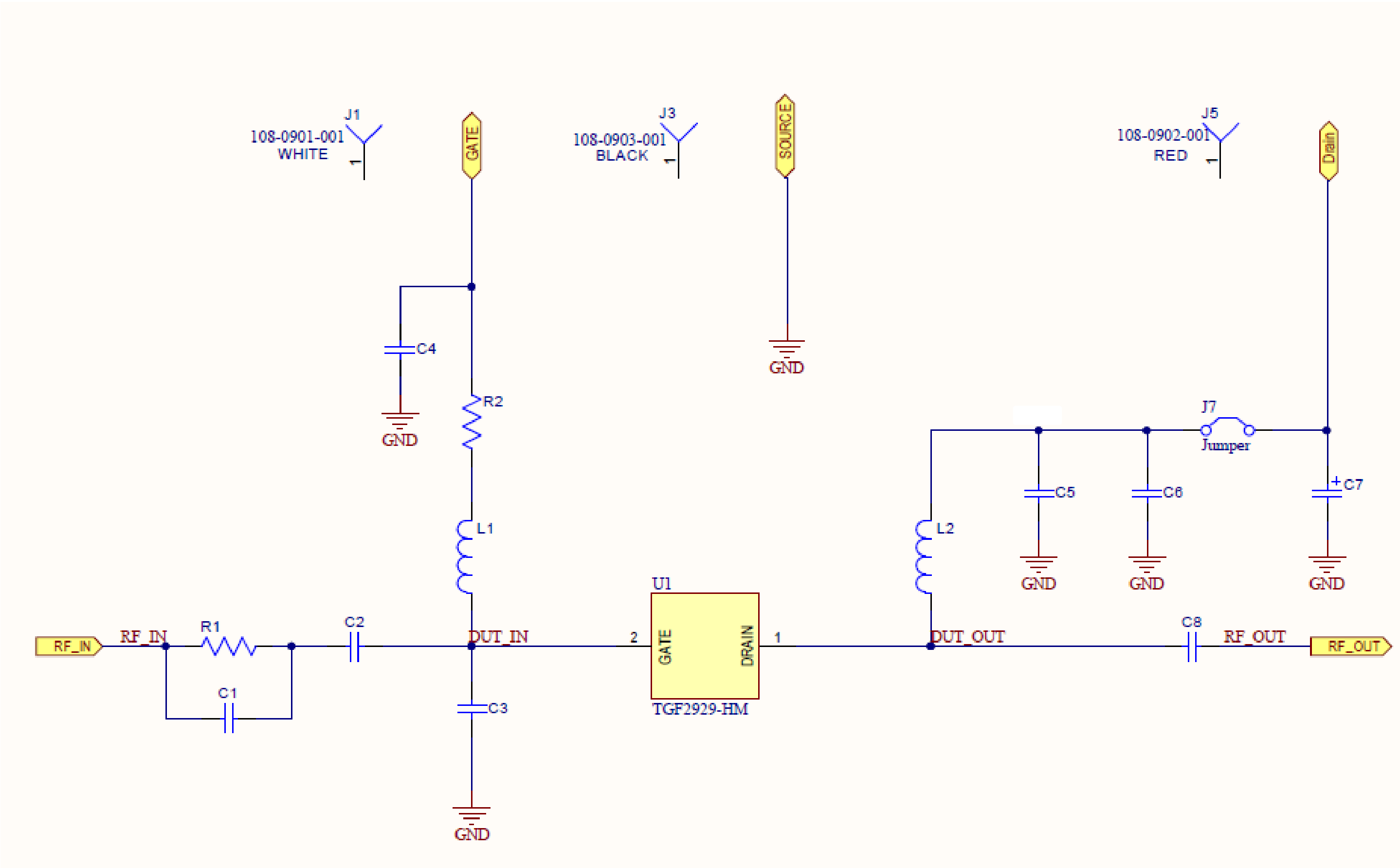
Mechanical Drawing[1, 2, 3, 4, 5]



Notes:

1. All dimensions are in inches. Otherwise noted, the tolerance is ±0.005 inches.
2. Material:
   Package base: Metal
   Ringframe: ceramic
   Package lid: ceramic
3. Package exposed metal base and leads are gold plated.
4. Lid is attached to package with solder.
5. Parts meet industry NI360 footprint.

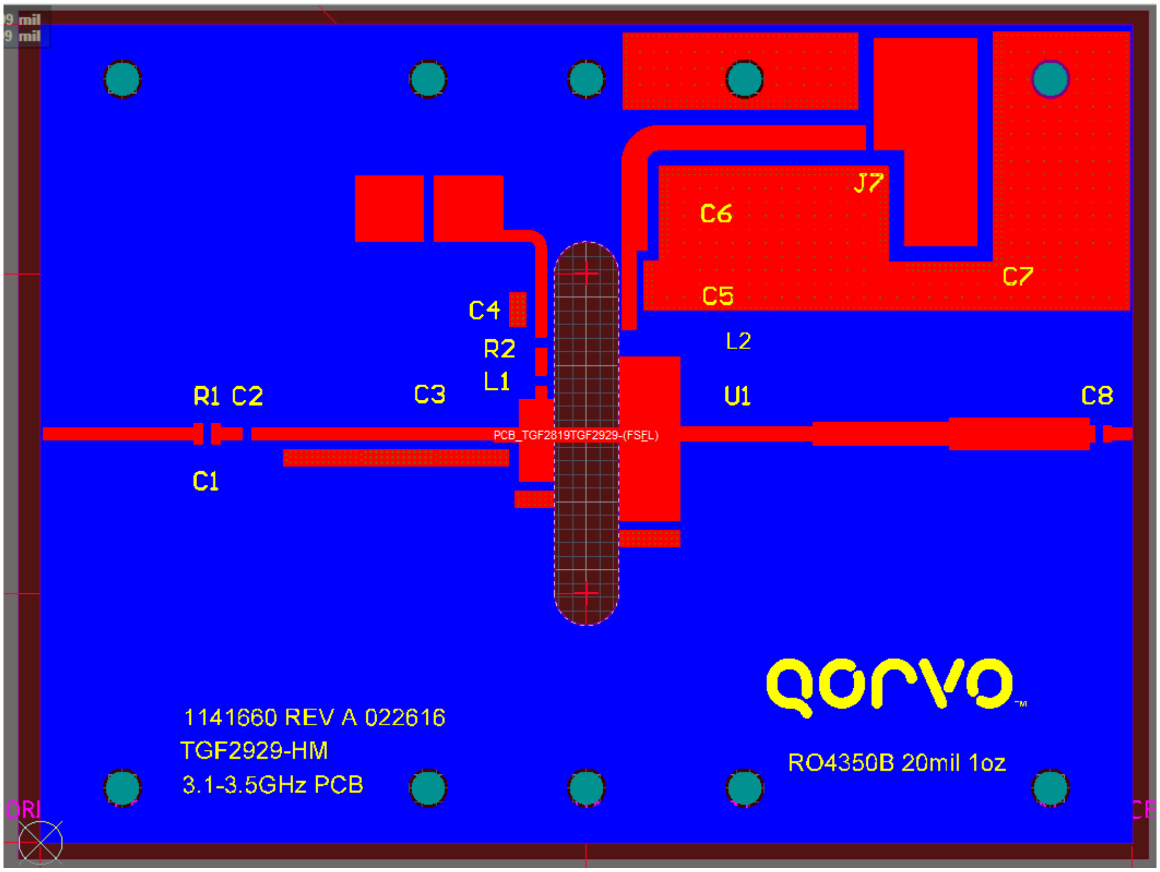
Schematic Of 3.1 – 3.5 GHz EVB



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 300 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 260 mA.	4. Turn off V_G
5. Set I_D current limit to 7 A	
6. Apply RF.	

PCB Layout Of 3.1 – 3.5 GHz EVB

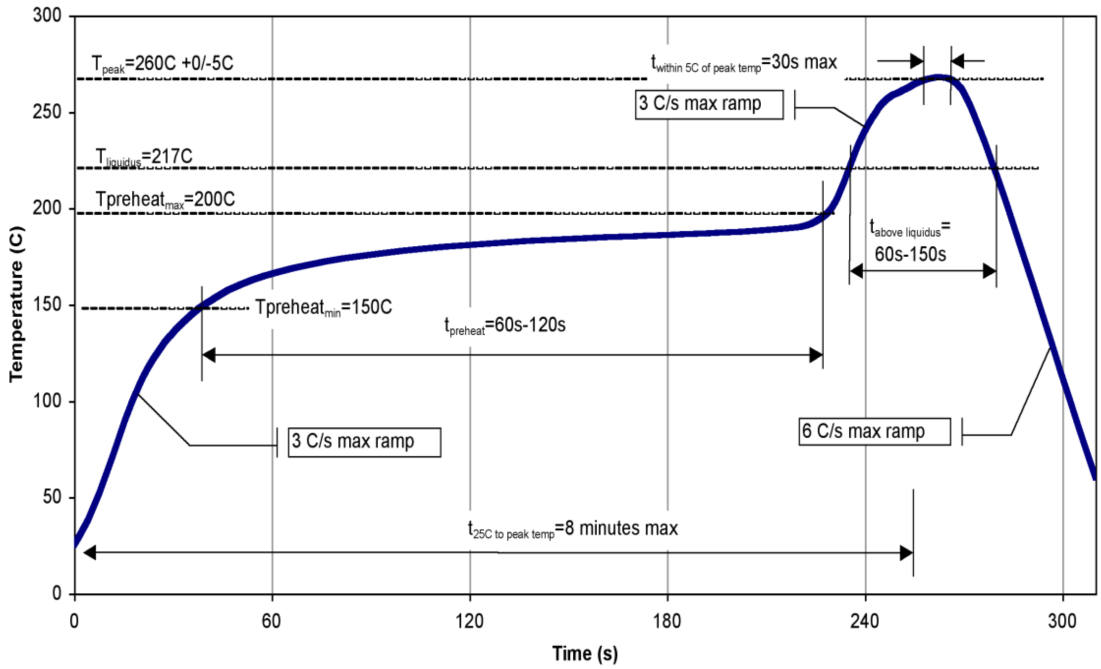
Board material is RO4350B 0.02” thickness with 1 oz copper cladding.



Bill Of material Of 3.1 – 3.5 GHz EVB

Ref Des	Value	Description	Manufacturer	Part Number
R1	1 kΩ	0603 Resistor	Vishay/Dale	CRCW0603102RJNEA
C1, C2	5.6 pF	RF NPO 250VDC ± 0.1 pF Capacitor	ATC	600S5R6BT
C3	1.2 pF	RF NPO 250VDC ± 0.1 pF Capacitor	ATC	600S1R2BT
L1	22 nH	Inductor	Coilcraft	0805CS-220X-LB
R2	20 Ω	0603 Resistor	Vishay/Dale	CRCW060320R0JNEA
C4	10 uF	Ceramic Capacitor	Murata	C1632X5R0J106M130AC
L2	12.5 nH	Inductor	Coilcraft	A04T_L
C5	2400 pF	Ceramic Capacitor	Murata	C08BL242X-5UN-X0T
C6	1000 pF	Ceramic Capacitor	ATC	800B102JT50XT
C7	220 uF	Electrolytic Capacitor	United Chemi-Con	EMVY500ADA221MJA0G
C8	15 pF	RF NPO 250VDC 5% Capacitor	ATC	600S150JT250XT

Recommended Solder Temperature Profile



Handling Precautions

Parameter	Rating	Standard
ESD – Human Body Model (HBM)	1A 700 V	JESD22-A114
ESD – Charged Device Model (CDM)	TBD	IPC/JEDED 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.

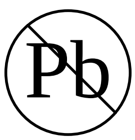
Package lead plating is NiAu. Au thickness is 60 microinches.

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**

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

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