QPA2237

0.03 – 2.5 GHz 10 W GaN Power Amplifier

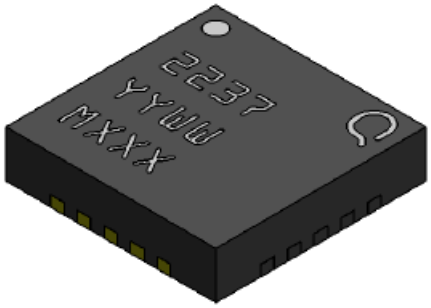
Product Description

Qorvo's QPA2237 is a wideband amplifier fabricated on Qorvo's production 0.25um GaN on SiC process. The QPA2237 operates from 0.03 – 2.5 GHz and provides 10W of saturated output power with 13 dB of large signal gain and 52% power-added efficiency.

The QPA2237 is available in a low-cost, surface-mount, 20 lead, 4x4 OVM QFN. It is ideally suited to support both radar and communication applications across defense and commercial markets as well as electronic warfare. The QPA2237 is fully matched to 50Ω at both RF ports allowing for simple system integration. DC blocks are required on both RF ports and the drain voltage must be injected through an off chip bias-tee on the RF output port.

Lead-free and RoHS compliant.

Evaluation boards are available upon request.



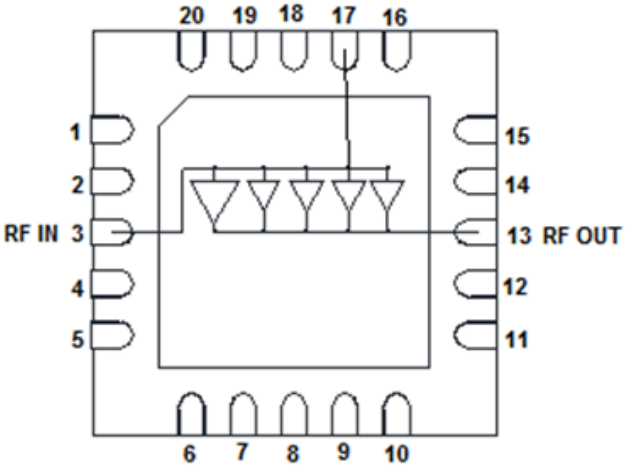
QFN 4x4 mm 20L

Product Features

- Frequency Range: 0.03 – 2.5 GHz
- P_{SAT}: 40 dBm at P_{IN} = 27 dBm
- PAE: 52%
- Large Signal Gain: 13 dB
- Small Signal Gain: 18.5 dB
- Input Return Loss: 9 dB
- Output Return Loss: 9.5 dB
- Bias: V_D = 32 V, I_{DQ} = 360 mA, V_G = -2.1 V Typical
- Wideband Flat Power
- Package Dimensions: 4.0 x 4.0 x 0.85 mm

Performance is typical across frequency. Please reference electrical specification table and data plots for more details.

Functional Block Diagram



Applications

- Commercial and military radar
- Communications
- Electronic Warfare

Ordering Information

Part No.	ECCN	Description
QPA2237	EAR99	0.03 – 2.5 GHz 10 W GaN Power Amplifier

Electrical Specifications

Test conditions unless otherwise noted: 25 °C, V_D = +32 V, I_{DQ} = 360 mA, V_G = -2.1 V Typical, CW.

Parameter		Min	Typ	Max	Units
Operational Frequency Range		0.03	–	2.5	GHz
Output Power @ P_{IN} = 27 dBm	Frequency = 0.05 GHz	39.5	40.5	–	dBm
	Frequency = 1.25 GHz	39.5	40.1	–	
	Frequency = 2.5 GHz	39.5	40.4	–	
Power Added Efficiency @ P_{IN} = 27 dBm	Frequency = 0.05 GHz	48	65	–	%
	Frequency = 1.25 GHz	48	48.5	–	
	Frequency = 2.5 GHz	48	57	–	
Small Signal Gain	Frequency = 0.05 GHz	–	22.5	–	dB
	Frequency = 1.25 GHz	–	20	–	
	Frequency = 2.5 GHz	–	19	–	
Input Return Loss	Frequency = 0.05 GHz	–	9	–	dB
	Frequency = 1.25 GHz	–	13	–	
	Frequency = 2.5 GHz	–	13	–	
Output Return Loss	Frequency = 0.05 GHz	–	10	–	dB
	Frequency = 1.25 GHz	–	11	–	
	Frequency = 2.5 GHz	–	16	–	
Small Signal Gain Temperature Coefficient		–	-0.017	–	dB/°C
Output Power Temperature Coefficient		–	-0.004	–	dBm/°C
Recommended Operating Voltage:		–	32	36	V

Recommended Operating Conditions

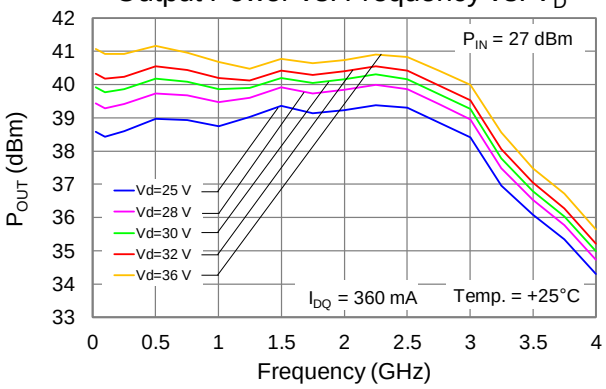
Parameter	Value / Range
Drain Voltage (V_D)	+32 V
Drain Current (I_{DQ})	360 mA
Gate Voltage (V_G)	−2.1 V (Typ.)
Temperature (T_{BASE})	−40 to 85 °C

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

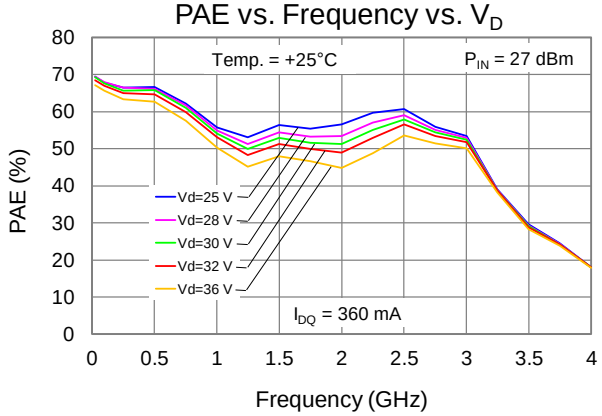
Performance Plots – Large Signal (CW)

The plots reflect performance measured with an external coaxial bias tee and DC blocks
(See application circuit on page 11)

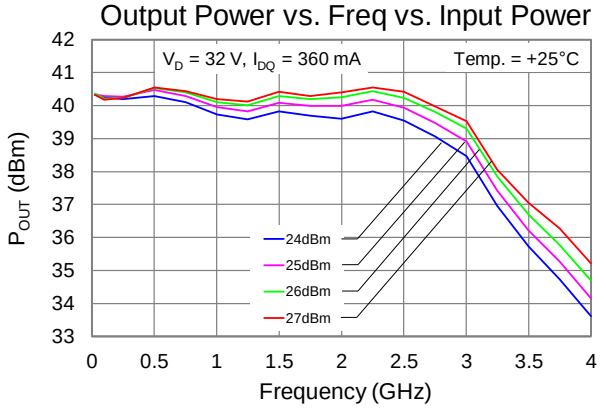
Output Power vs. Frequency vs. V_D



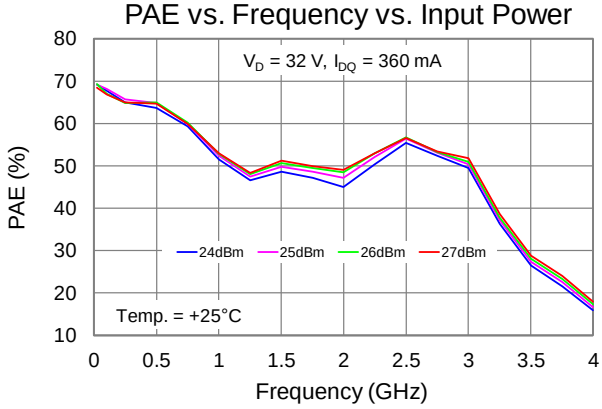
PAE vs. Frequency vs. V_D



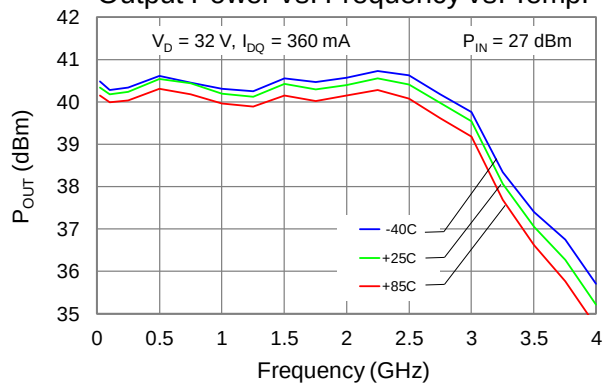
Output Power vs. Freq vs. Input Power



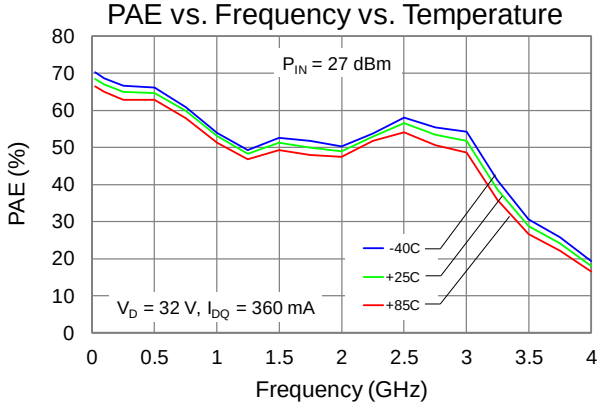
PAE vs. Frequency vs. Input Power



Output Power vs. Frequency vs. Temp.



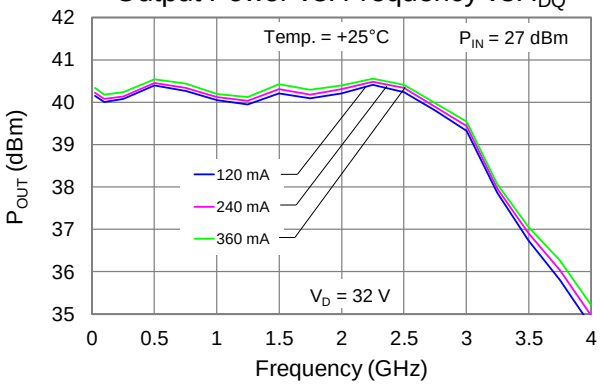
PAE vs. Frequency vs. Temperature



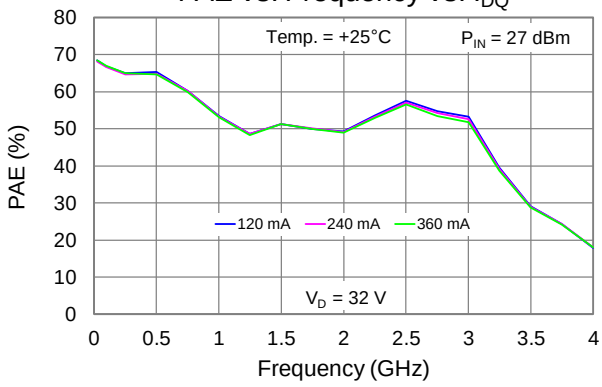
Performance Plots – Large Signal (CW)

The plots reflect performance measured with an external coaxial bias tee and DC blocks
(See application circuit on page 11)

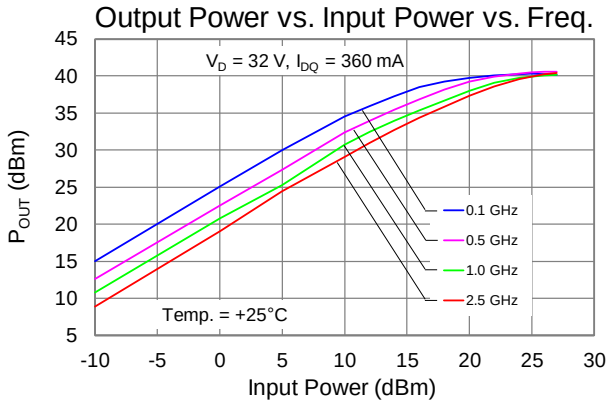
Output Power vs. Frequency vs. I_{DQ}



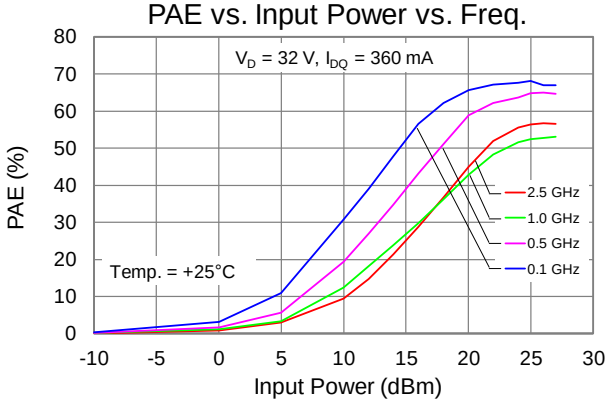
PAE vs. Frequency vs. I_{DQ}



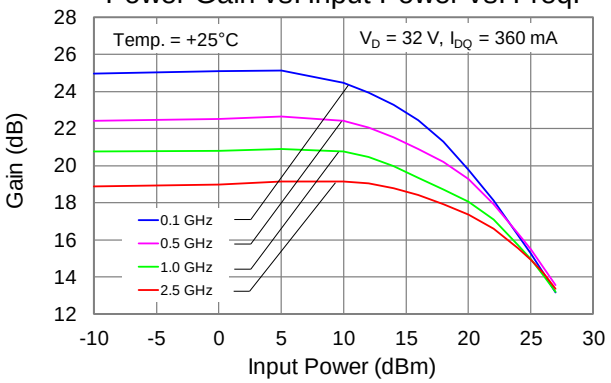
Output Power vs. Input Power vs. Freq.



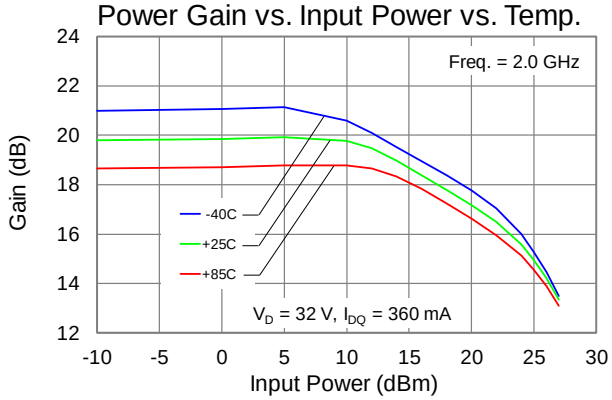
PAE vs. Input Power vs. Freq.



Power Gain vs. Input Power vs. Freq.

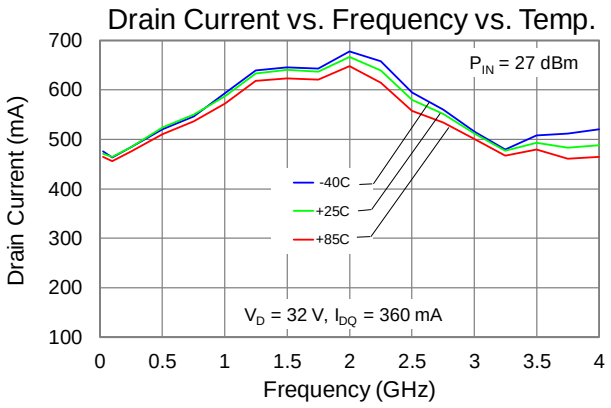


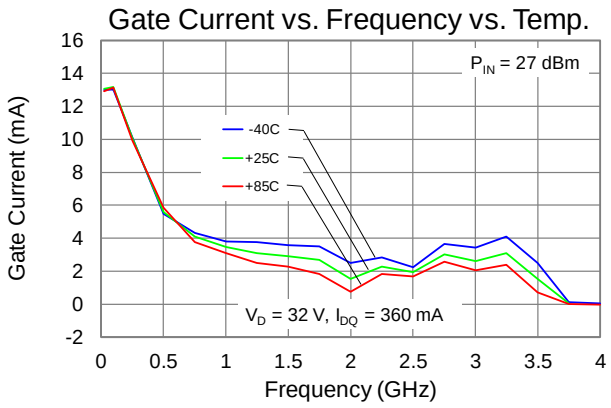
Power Gain vs. Input Power vs. Temp.

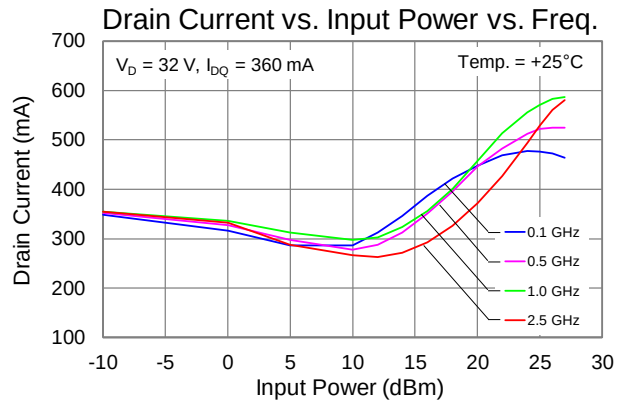


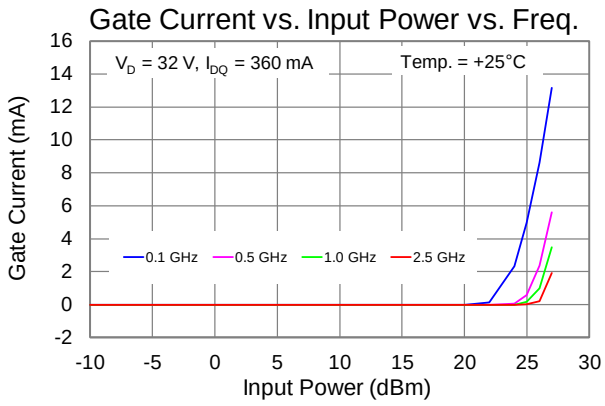
Performance Plots – Large Signal (CW)

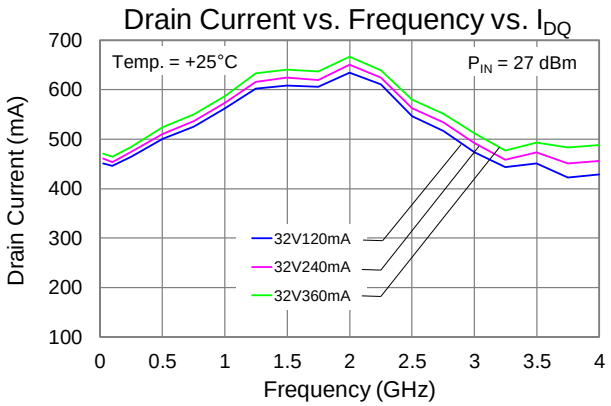
The plots reflect performance measured with an external coaxial bias tee and DC blocks
(See application circuit on page 11)

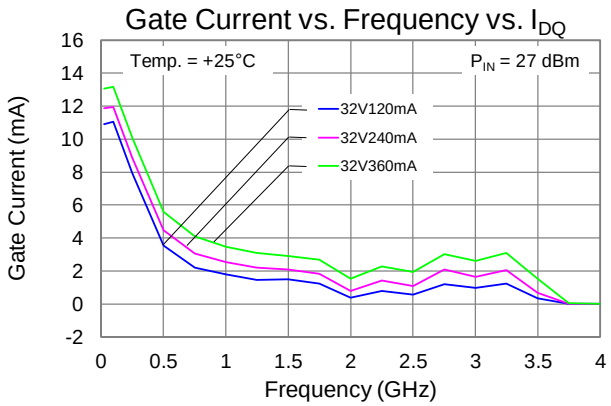








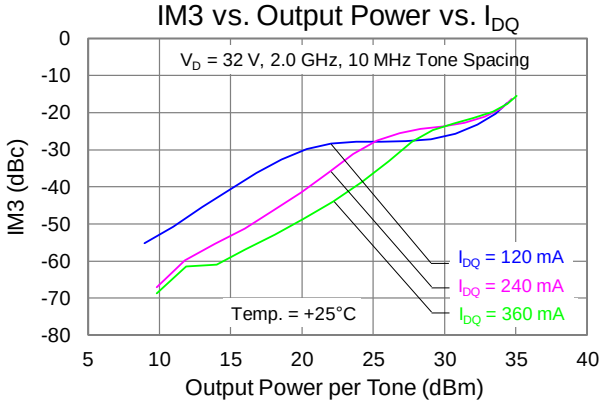




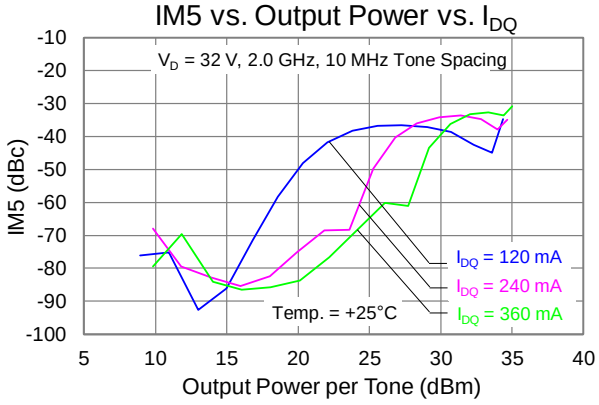
Performance Plots – Linearity

The plots reflect performance measured with an external coaxial bias tee and DC blocks
(See application circuit on page 11)

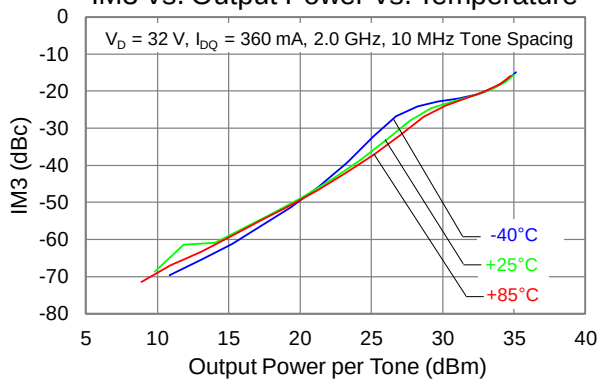
IM3 vs. Output Power vs. I_{DQ}



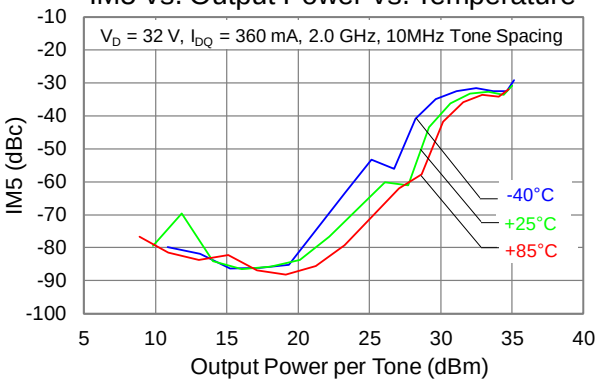
IM5 vs. Output Power vs. I_{DQ}



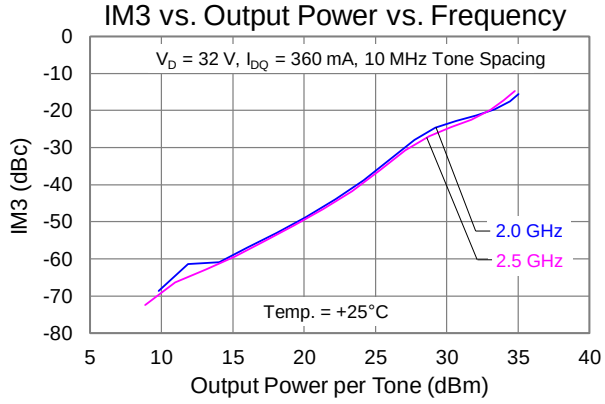
IM3 vs. Output Power vs. Temperature



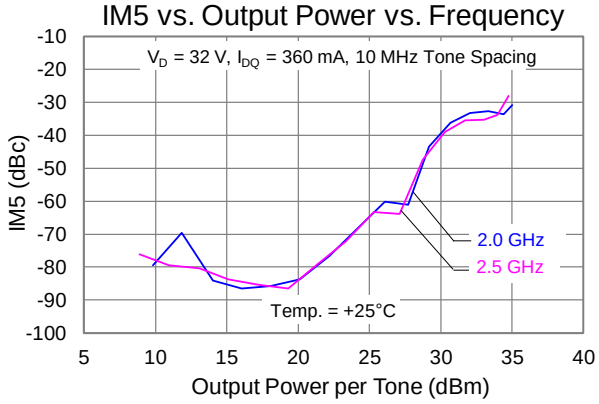
IM5 vs. Output Power vs. Temperature



IM3 vs. Output Power vs. Frequency



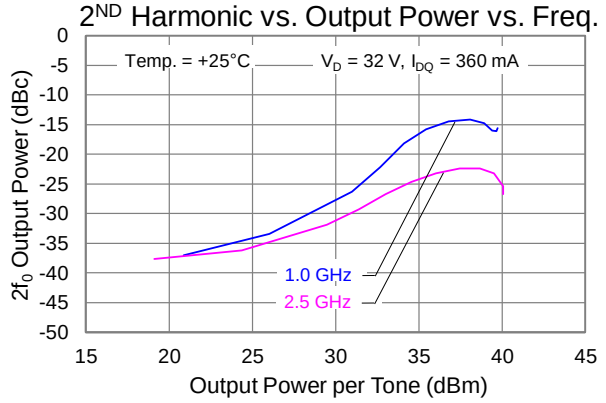
IM5 vs. Output Power vs. Frequency



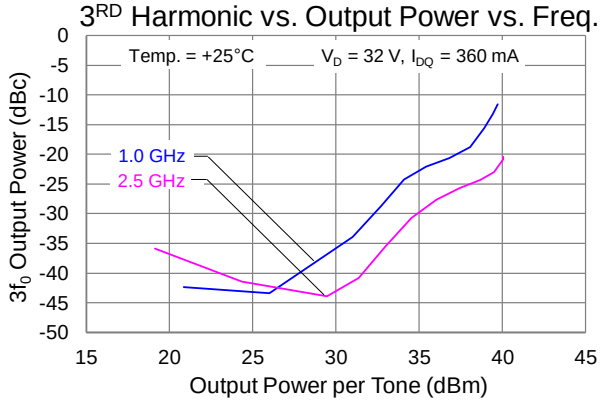
Performance Plots – Linearity

The plots reflect performance measured with an external coaxial bias tee and DC blocks
(See application circuit on page 11)

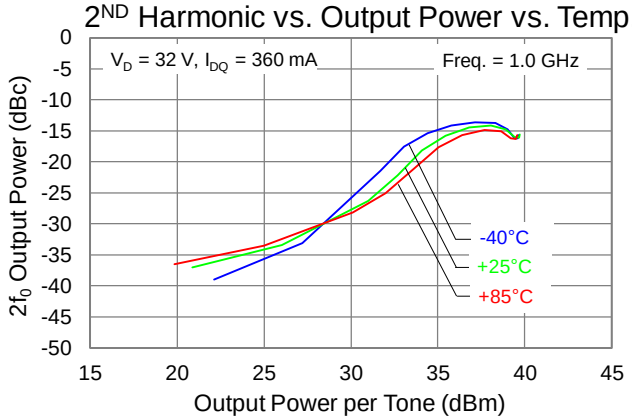
2ND Harmonic vs. Output Power vs. Freq.



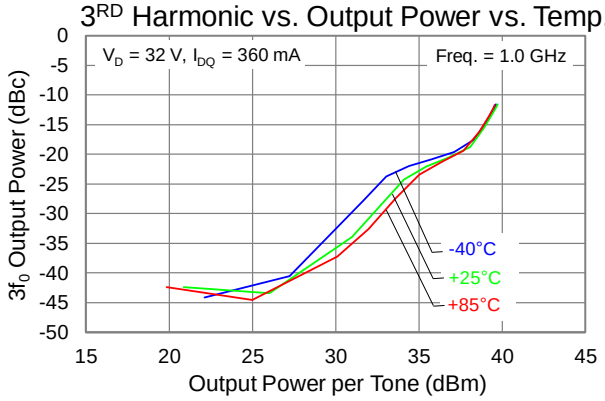
3RD Harmonic vs. Output Power vs. Freq.



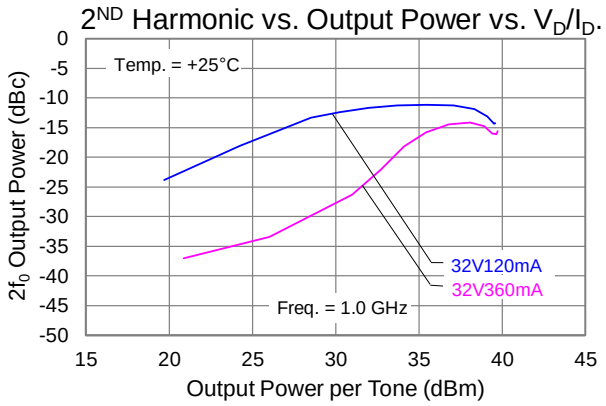
2ND Harmonic vs. Output Power vs. Temp.



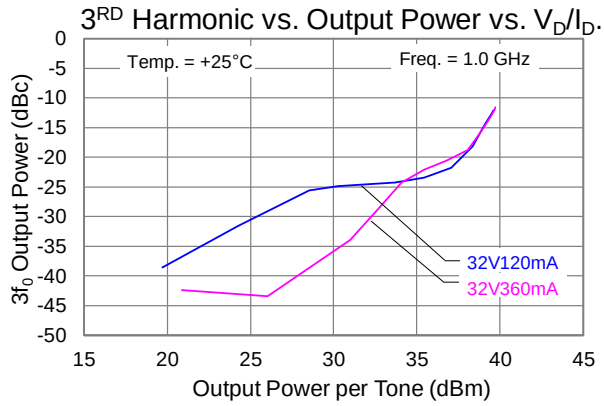
3RD Harmonic vs. Output Power vs. Temp.



2ND Harmonic vs. Output Power vs. V_D/I_D.



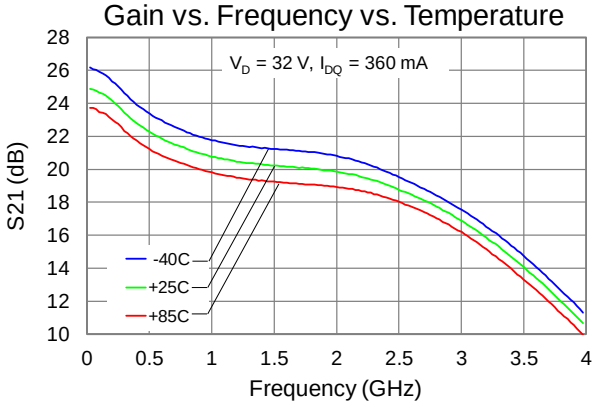
3RD Harmonic vs. Output Power vs. V_D/I_D.



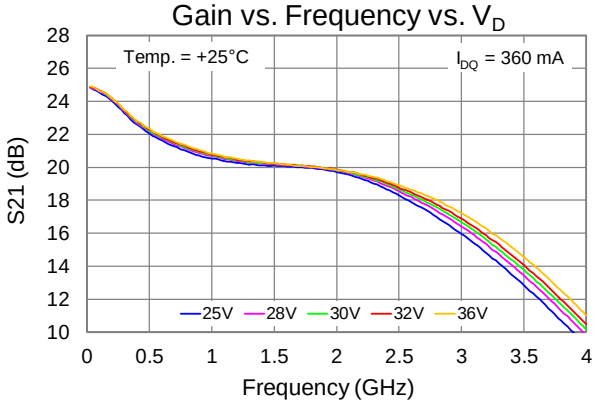
Performance Plots – Small Signal

The plots reflect performance measured with an external coaxial bias tee and DC blocks
(See application circuit on page 11)

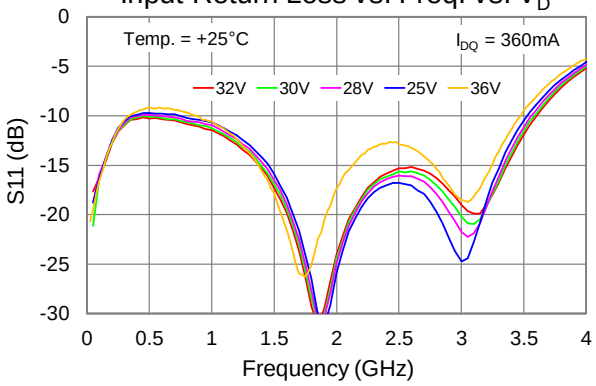
Gain vs. Frequency vs. Temperature



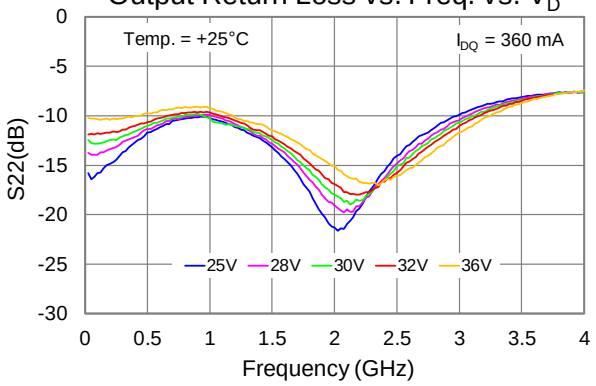
Gain vs. Frequency vs. V_D



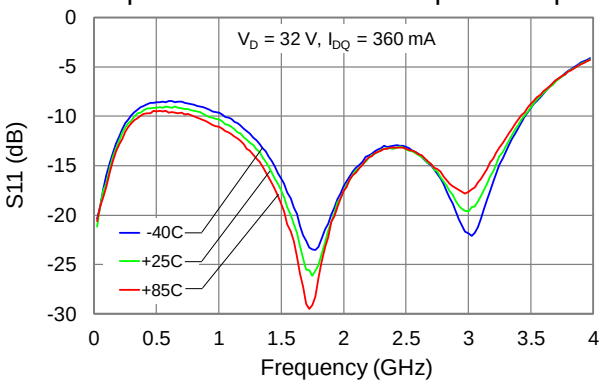
Input Return Loss vs. Freq. vs. V_D



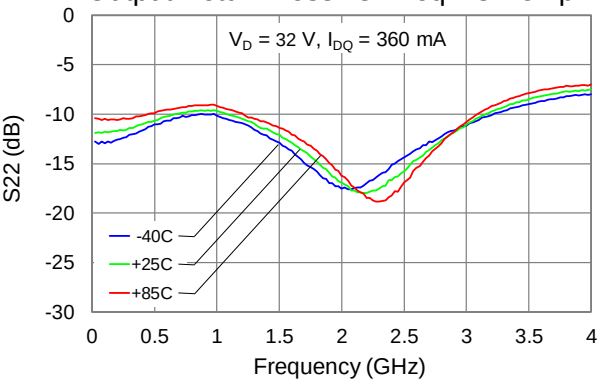
Output Return Loss vs. Freq. vs. V_D



Input Return Loss vs. Freq. vs. Temp.



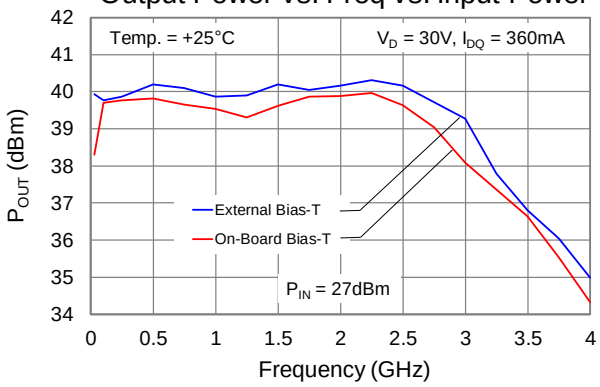
Output Return Loss vs. Freq. vs. Temp.



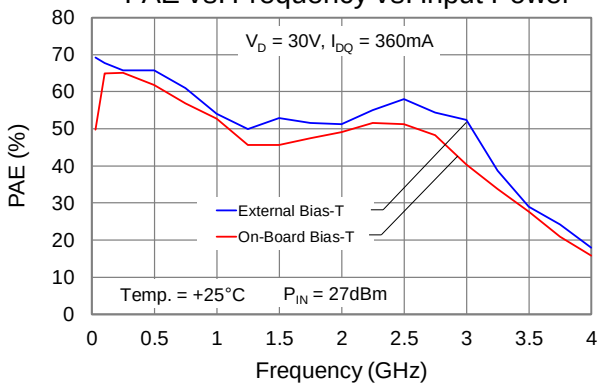
Performance Plots – Large Signal (CW), On-board vs. External Coaxial Bias-T

The plots reflect performance measured with an external coaxial bias tee and DC blocks
(See application circuit on page 11 and 13)

Output Power vs. Freq vs. Input Power



PAE vs. Frequency vs. Input Power



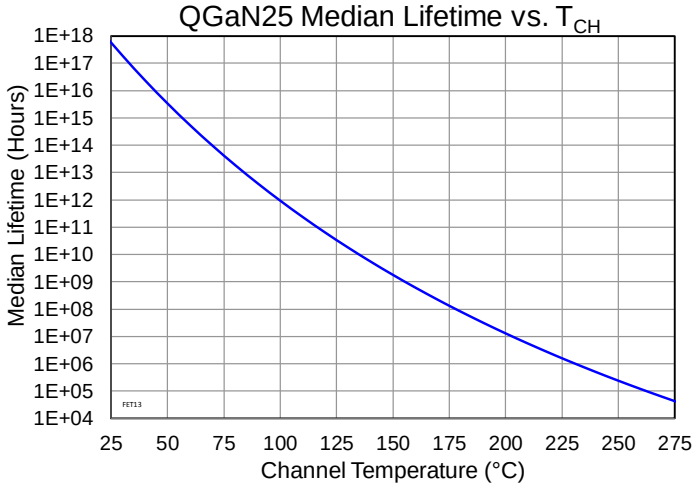
Thermal and Reliability Information

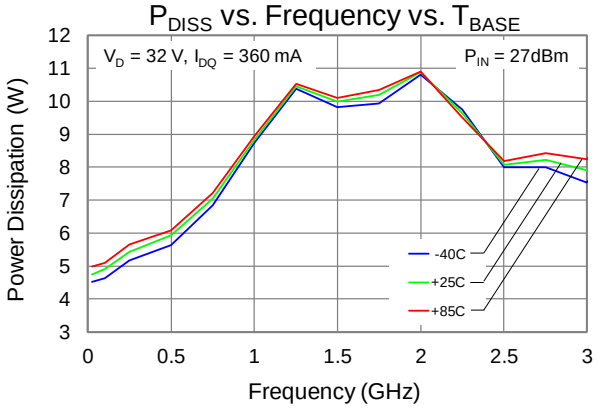
Parameter	Test Conditions	Value	Units
Thermal Resistance (θ_{JC}) (1)	T_{BASE} = 85 °C, V_D = +32 V (CW) At Freq = 2.0 GHz, P_{IN} = 27 dBm: I_{DQ} = 360 mA, I_{D_Drive} = 648 mA P_{OUT} = 40 dBm, P_{DISS} = 10.9 W	8.1	°C/W
Channel Temperature (T_{CH}) (Under RF drive)		173	°C
Median Lifetime (T_M)		1.58 E+8	Hrs

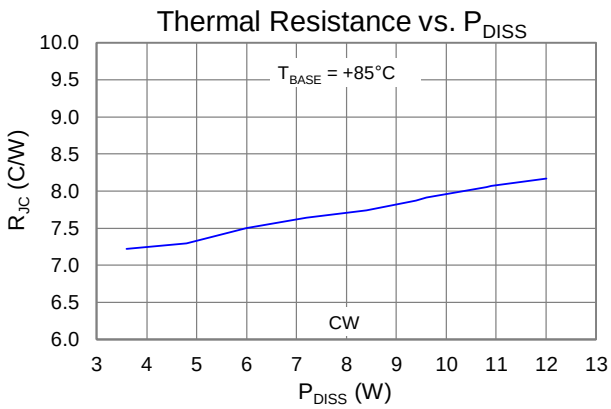
Notes:
1. Thermal resistance measured to back of package.

Median Lifetime

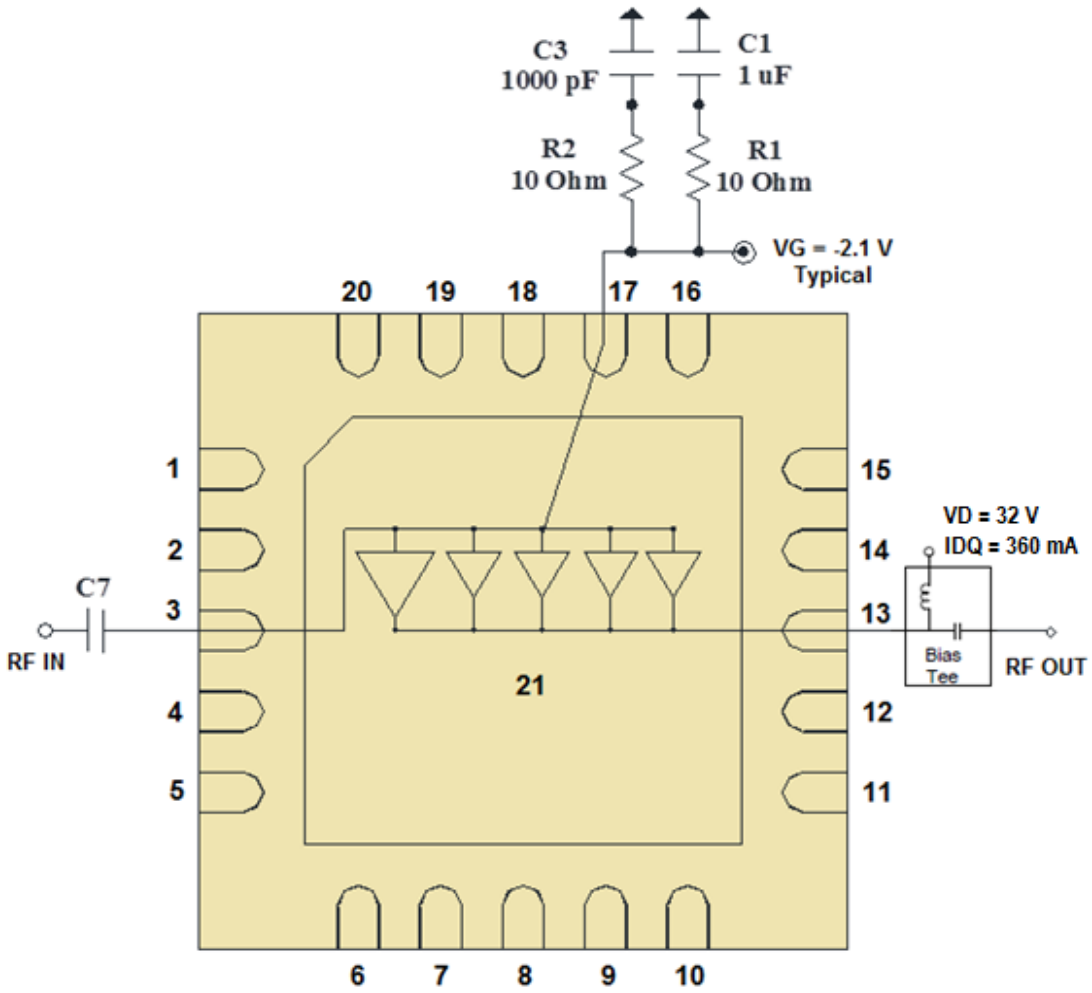
Test Conditions: V_D = +40 V; Failure Criteria = 10 % reduction in I_{D_MAX} during DC Life Testing







Application Circuit (Coaxial input DC block and Coaxial Output Bias-T)



Notes:

1. Coaxial input DC block (C7) is used for input port (RF In.)
2. External wide bandwidth Bias-Tee is used for output port (RF Out). V_D is applied through the output Bias-Tee.

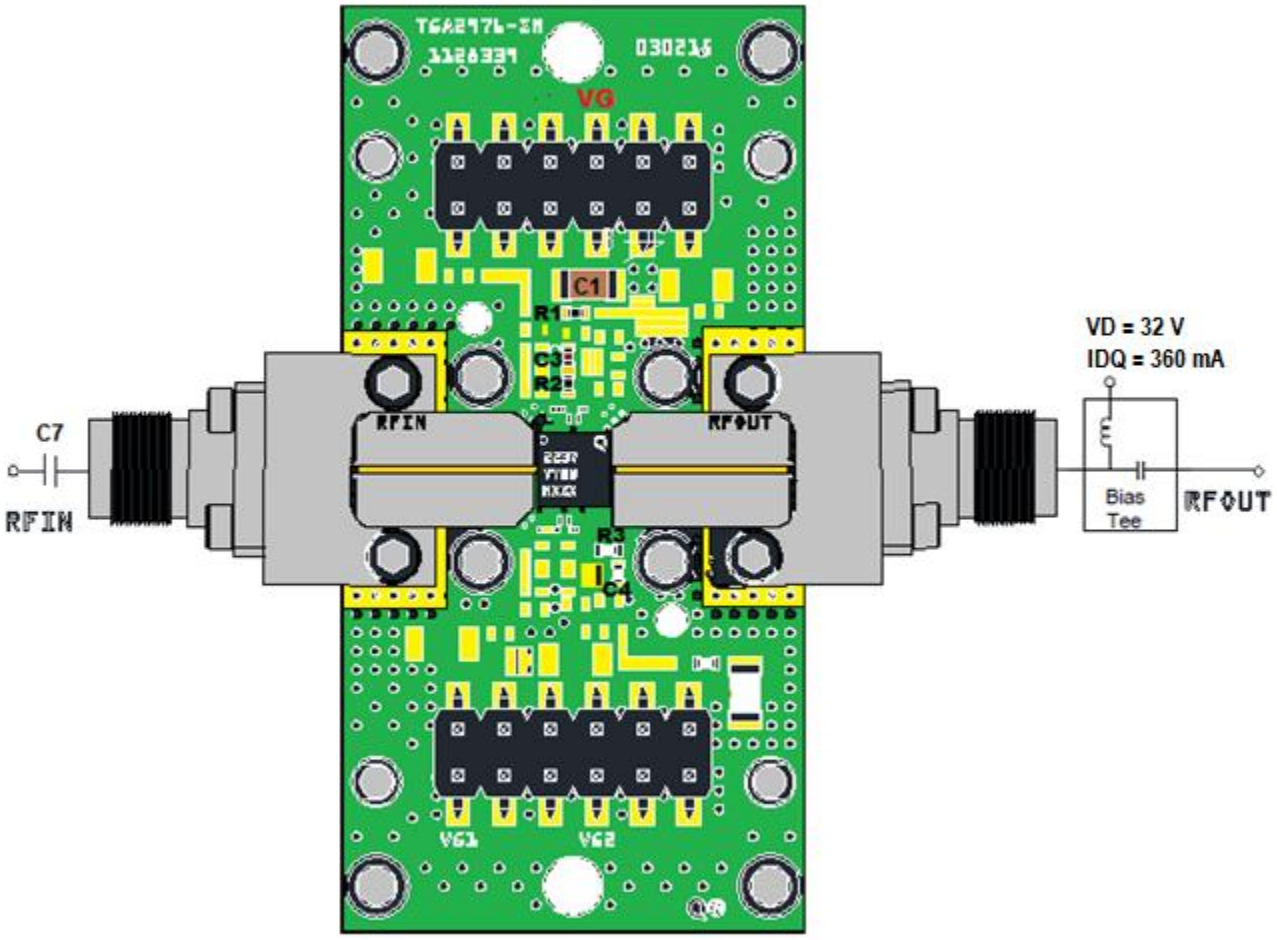
Bias Up Procedure

1. Set I_D limit to 700mA, I_G limit to 15mA
2. Set V_G to -5.0V
3. Set V_D +32V
4. Adjust V_G more positive until I_{DQ} = 360mA (V_G ~ -2.1V Typical)
5. Apply RF signal

Bias Down Procedure

1. Turn off RF signal
2. Reduce V_G to -5.0V. Ensure I_{DQ} ~ 0mA
3. Set V_D to 0V
4. Turn off V_D supply
5. Turn off V_G supply

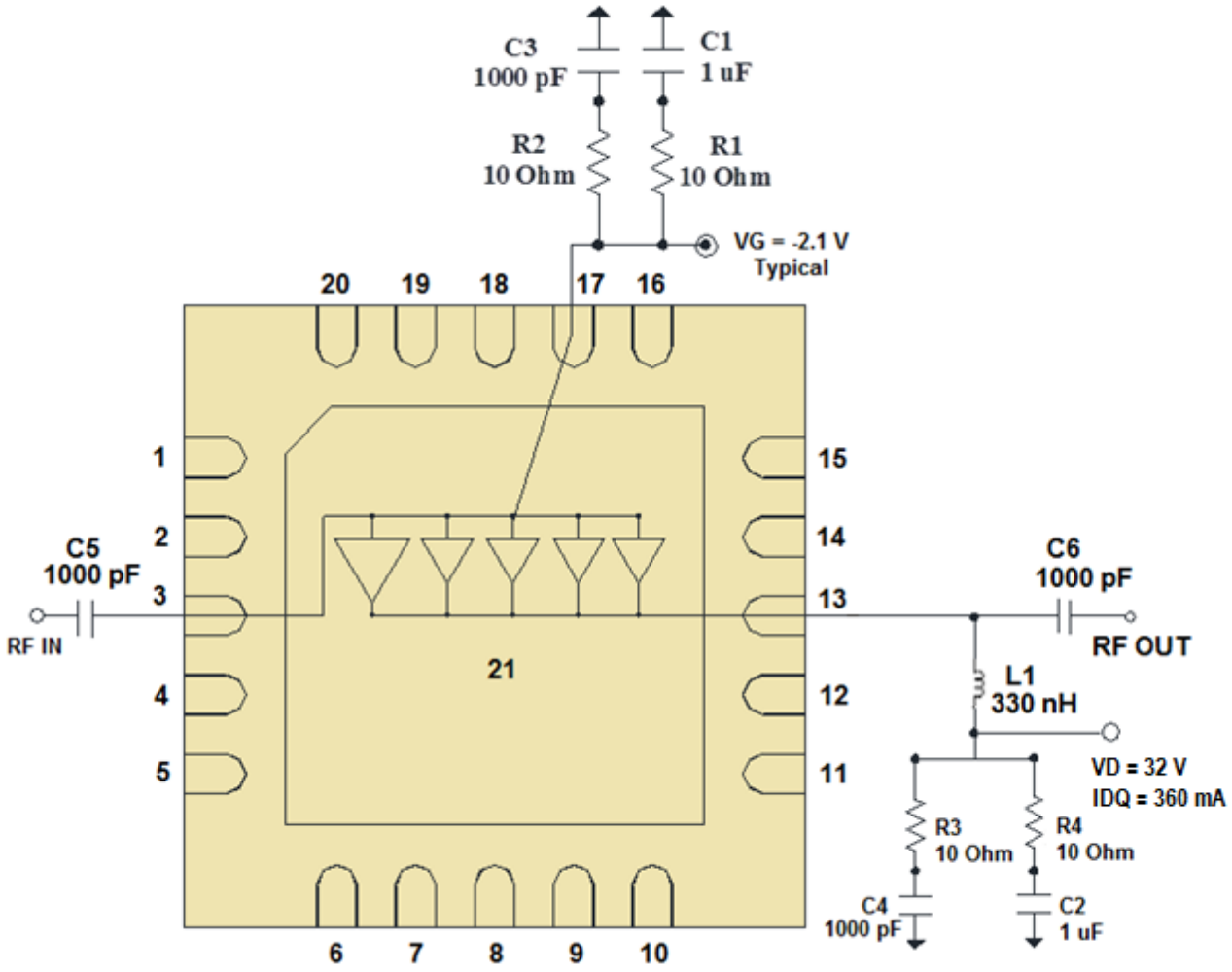
Evaluation Board (EVB) Layout Assembly
(Coaxial input DC block and Coaxial Output Bias-T Option)



Bill of Materials

Reference Des.	Value	Description	Manuf.	Part Number
C1	1 uF	Cap, 1206, 50V, 5%, X7R	Various	–
C3	1000 pF	Cap, 0402, 100V, 10%, X7R	Various	–
C7		DC Block	Various	–
R1 – R2	10Ω	Res, 0402, 5%, SMD	Various	–

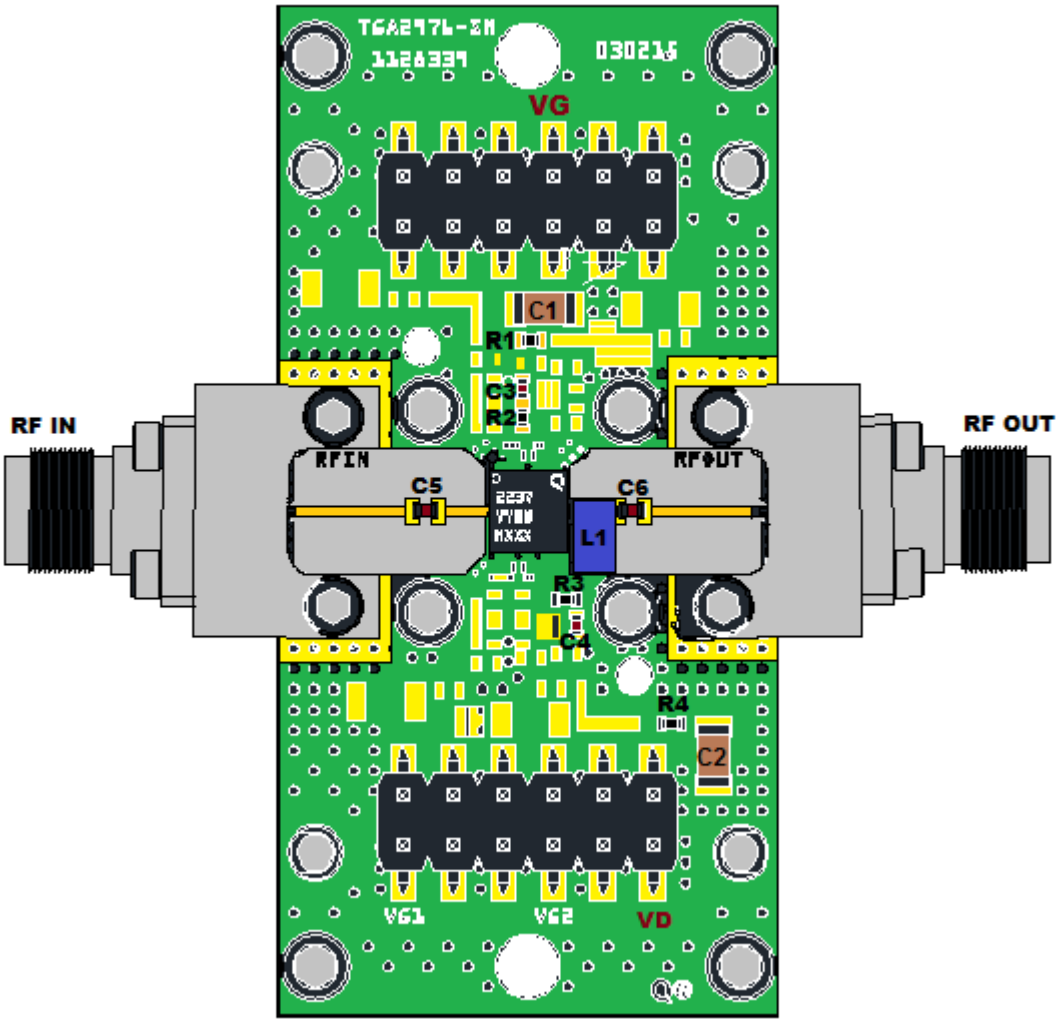
Application Circuit (Option with board-level DC blocks and Output Bias-T)



Notes:

1. Performance of the DUT with surface-mount DC blocks and bias tee components may be degraded relative to the coaxial option. These components should be optimized for the desired operational bandwidth.

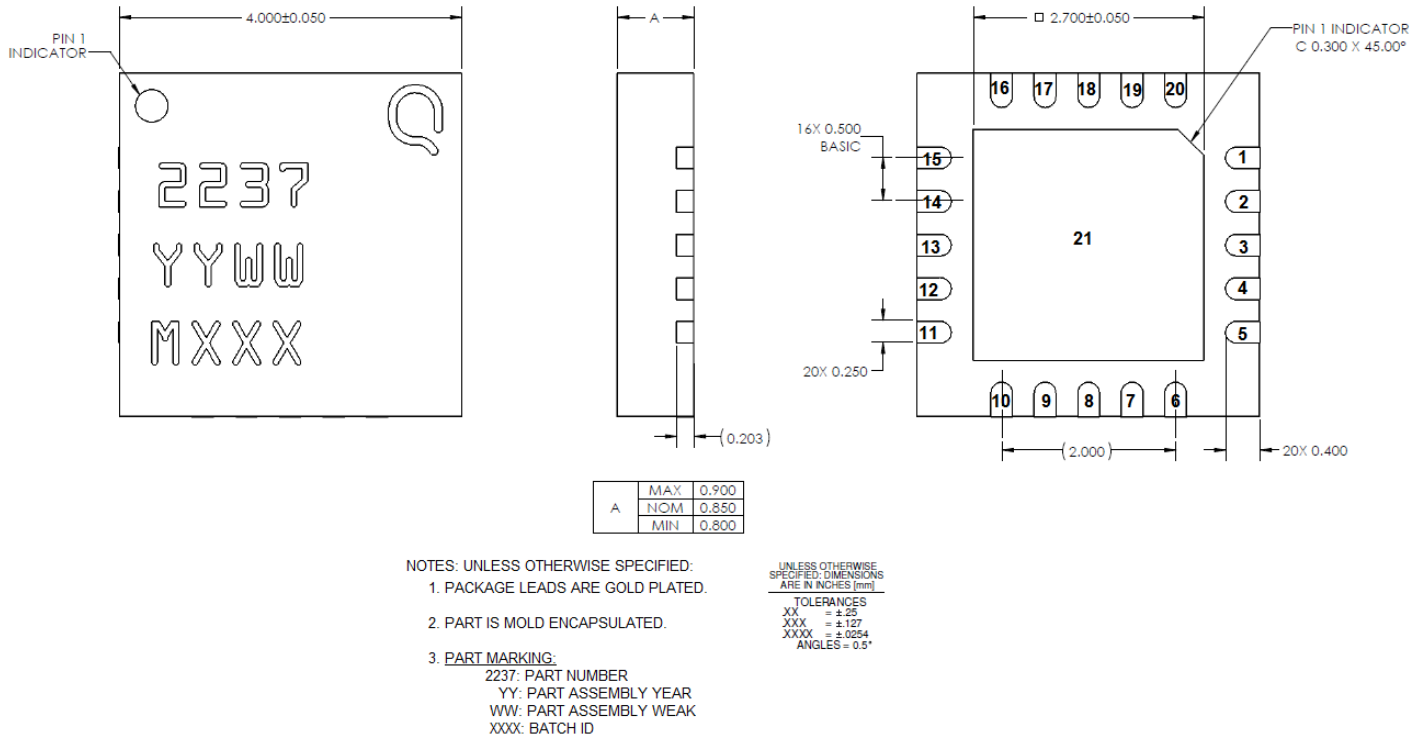
Evaluation Board (EVB) Layout Assembly
(With On-Board DC Blocks and Output Bias-T Option)



Bill of Materials for On-Board Bias-Tee

Reference Des.	Value	Description	Manuf.	Part Number
C1, C2	1 uF	Cap, 1206, 50V, 5%, X7R	Various	–
C3 – C6	1000 pF	Cap, 0402, 100V, 10%, X7R	Various	–
L1	330 nH	Ind, 1206, 850mA, 5%	Various	–
R1 – R4	10Ω	Res, 0402, 5%, SMD	Various	–

Mechanical Information



A	MAX	0.900
	NOM	0.850
	MIN	0.800

NOTES: UNLESS OTHERWISE SPECIFIED:

1. PACKAGE LEADS ARE GOLD PLATED.
2. PART IS MOLD ENCAPSULATED.
3. PART MARKING:
   2237: PART NUMBER
   YY: PART ASSEMBLY YEAR
   WW: PART ASSEMBLY WEAK
   XXXX: BATCH ID

UNLESS OTHERWISE SPECIFIED: DIMENSIONS ARE IN INCHES [mm]
TOLERANCES
XX = ±.25
XXX = ±.127
XXXX = ±.0254
ANGLES = 0.5°

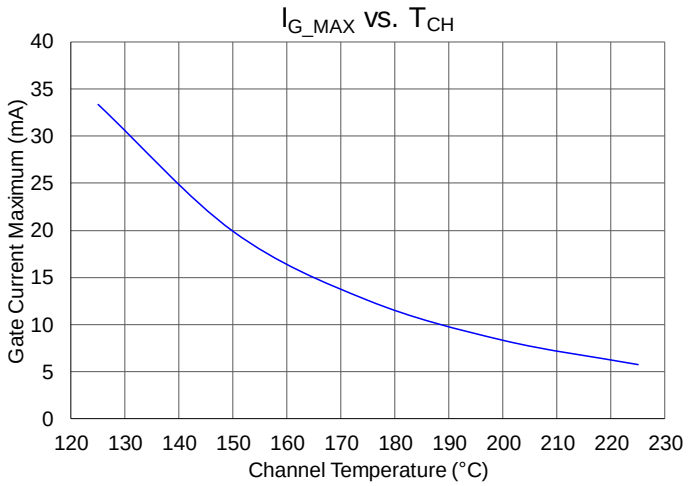
Pin Description

Pin No.	Symbol	Description
1, 2, 4 – 12, 14 – 16, 18 – 20	N/C	No connection
3	RF IN	Input; matched to 50 Ω.
13	RF OUT/V_D	Output; matched to 50 Ω.
17	V_G	GATE voltage; bias network is required; see recommended Application Information on page 11
21	GND	Ground Paddle. Multiple vias should be employed to minimize inductance and thermal resistance.

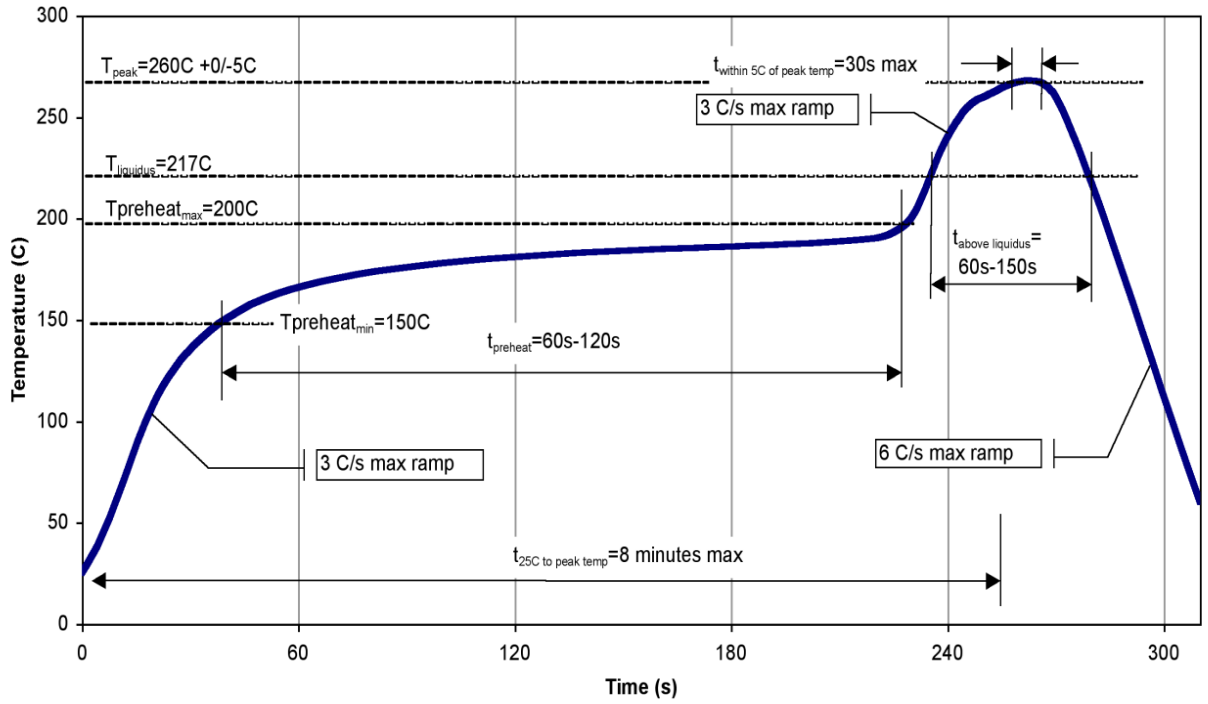
Absolute Maximum Ratings

Parameter	Value / Range
Drain Voltage (V_D)	40 V
Gate Voltage Range (V_G)	-8 to 0 V
Drain Current (I_D)	1.2 A
Gate Current (I_G)	See I_{G_Max} plot
Power Dissipation (P_{DISS}), 85°C	19 W
Input Power (P_{IN}), CW, 50 Ω, 85°C	33 dBm
Input Power (P_{IN}), CW, VSWR 3:1, V_D = 32V, 85°C	33 dBm
Max VSWR, CW, P_{IN} = 27dBm, V_D = 32V, 85°C (Load)	10:1
Channel Temperature (T_{CH})	275°C
Mounting Temperature (30 Seconds)	260°C
Storage Temperature	-55 to 150°C

Operation of this device outside the parameter ranges given above may cause permanent damage. These are stress ratings only, and functional operation of the device at these conditions is not implied.



Recommended Soldering Temperature Profile



Handling Precautions

Parameter	Rating	Standard
ESD – Human Body Model (HBM)	Class 3A	JEDEC Standard JESD22-A114
ESD – Charge Device Model (CDM)	Class C3	JESD22-C101
MSL – Moisture Sensitivity Level	Level 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.

RoHS Compliance

This product is compliant with the 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
- Qorvo Green

Contact Information

For the latest specifications, additional product information, worldwide sales and distribution locations:

Tel: **1-844-890-8163**

Web: **www.qorvo.com**

Email: **customer.support@qorvo.com**

For technical questions and application information: **Email:** **appsupport@qorvo.com**

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