QPA2597

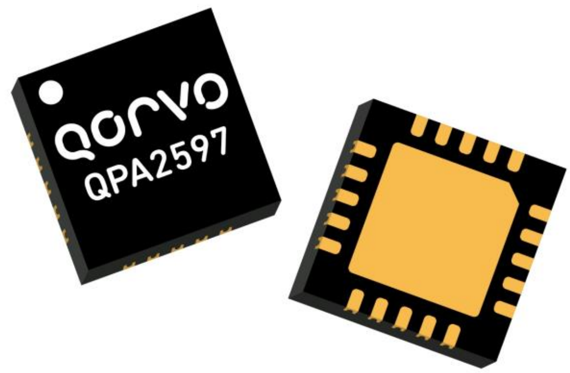
2.0 – 6.0 GHz GaN Driver Amplifier

Product Description

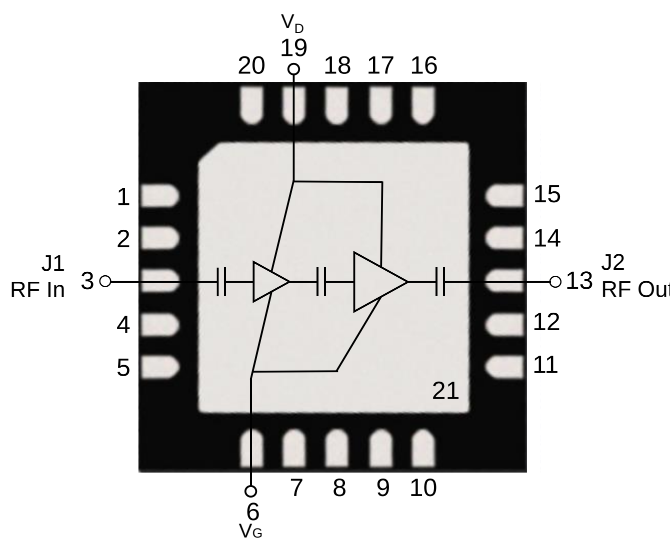
Qorvo's QPA2597 is a packaged driver amplifier using proven GaN on SiC technology. The QPA2597 operates from 2.0 to 6.0GHz and provides 32 dBm of output with 24 dB of small signal gain and 37 % power-added efficiency.

Using GaN MMIC technology and plastic packaging, the QPA2597 provides a low-cost driver solution that provides the added benefit of operating on the same voltage rail as the corresponding GaN HPA. It can also serve as the output power amplifier in lower power architectures.

The QPA2597 is offered in a 4x4 mm plastic overmold QFN. It is internally matched to 50 ohms and includes integrated DC blocking caps on both RF ports allowing for simple system integration.



Functional Block Diagram



Product Features

- Frequency Range: 2 – 6 GHz
- Small Signal Gain: 24 dB
- Power: 32 dBm
- PAE: 37 %
- IM3: -23 dBc
- Bias: V_D = 25 V, I_{DQ} = 50 mA
- 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

Applications

- Commercial & Military Radar
- Communications
- Electronic Warfare (EW)

Ordering Information

Part No.	Description
QPA2597	Driver Amplifier, Waffle Pack, Qty 50
QPA2597TR7	Tape and Reel, 7 ", Qty 250
QPA2597EVB	QPA2597 Evaluation Board, Qty 1

Recommended Operating Conditions

Parameter	Min	Typ.	Max	Units
Drain Voltage (V_D)		25		V
Drain Current (I_{DQ})		50		mA
Drain Current Under RF Drive (I_{D_DRIVE})		See Performance Plots		mA
Gate Voltage (V_G)		−2.4		V
Gate Current Under RF Drive (I_{G_DRIVE})		See Performance Plots		mA
Temperature (T_{BASE})	−40		+85	°C

Electrical performance is measured under conditions noted in the electrical specifications table. Specifications are not guaranteed over all recommended operating conditions.

Electrical Specifications

Parameter	Conditions	Min	Typ.	Max	Units
Operational Frequency Range		2		6	GHz
Output Power	P_{IN} = 18 dBm		32		dBm
Power Added Efficiency	P_{IN} = 18 dBm		37		%
Small Signal Gain			24		dB
Input Return Loss			-20		dB
Output Return Loss			-5		dB
IM3	P_{OUT} / Tone ≤ 24 dBm, Δf = 10 MHz		−23		dBc
Gate Leakage	VD = +10 V, VG = −3.7 V	-0.924	-0.05		mA
Gain Temperature Coefficient			-0.05		dB / °C
Output Power Temperature Coefficient			-0.009		dBm / °C

Test conditions unless otherwise noted: T_{BASE} = +25 °C, V_D = 25 V, Idq = 50mA, CW mode.

Absolute Maximum Ratings

Parameter	Range / Value	Notes
Drain Voltage (V_D)	+40 V	
Gate Voltage (V_G)	−5 to 0 V	
Drain Current (I_D)	400 mA	Electromigration
Gate Current (I_G)	10 mA	
Power Dissipation, 85 °C (P_{DISS})	5.4 W	50 ohms, CW, 85C
RF Input Power, CW, 50 Ω [1]	24 dBm	CW, 85C, 50ohm load, 24V
RF Input Power, CW, VSWR 3:1[1]	24 dBm	CW, 85C, 10:1 output VSWR, 24V
Channel Temperature (T_{CH})	+275 °C	85C package backside
Mounting Temperature	+260 °C	30 seconds maximum
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. Extended application of Absolute Maximum Rating conditions may reduce device reliability.

(1) V_D = 25V, I_{DQ} = 50mA, T_B = 85 °C

Thermal and Reliability Information

Parameter	Test Conditions	Value	Units
TX Channel Thermal Resistance (θ_{JC}) [1]	T_{base} = 85 °C, Vd = 25 V, Idq = 50 mA, P_{DISS} = 1.25 W, No RF (Quiescent or small signal applicsations)	12.8	ºC/W
TX Channel Temperature, T_{CH} (Under RF) [2,3]		101	°C
TX Channel Thermal Resistance (θ_{JC}) [1]	T_{base} = 85 °C, Vd = 25 V, Idq = 50 mA, CW, I_VD = 190.75 mA, Pin = 18 dBm, Pout = 32.41 dBm, Freq = 4.0 GHz (worst case) ,P_{DISS} = 3.09 W	13.6	ºC/W
TX Channel Temperature, T_{CH} (Under RF) [2,3]		127	°C

Notes:

1. Thermal resistance is referenced to the back of the package (T_{base} = 85 °C)
2. Channel temperature T_{CH} is IR scan equivalent temperature. Thermal resistance is calculated using this value. Additional information can be found in the Qorvo Applications Note “GaN Device TCHMAX Theta-JC and Reliability Estimates,” located here https://www.qorvo.com/products/d/da006480
3. Refer to the following document for transmit channel thermal properties:
   GaN Device Channel Temperature, Thermal Resistance, and Reliability Estimates

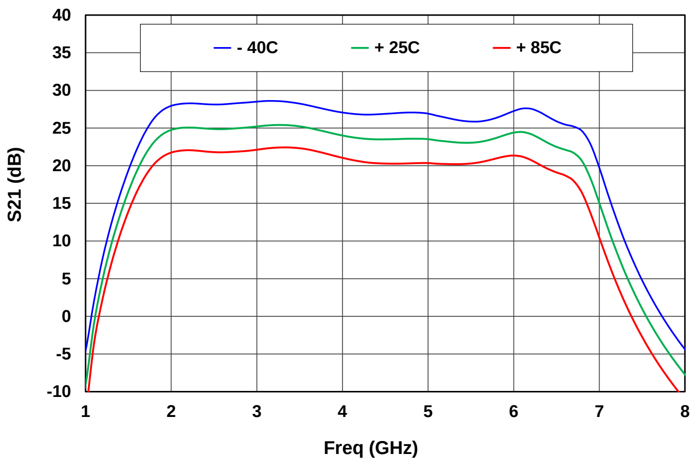
QPA2597

2.0 – 6.0 GHz GaN Driver Amplifier

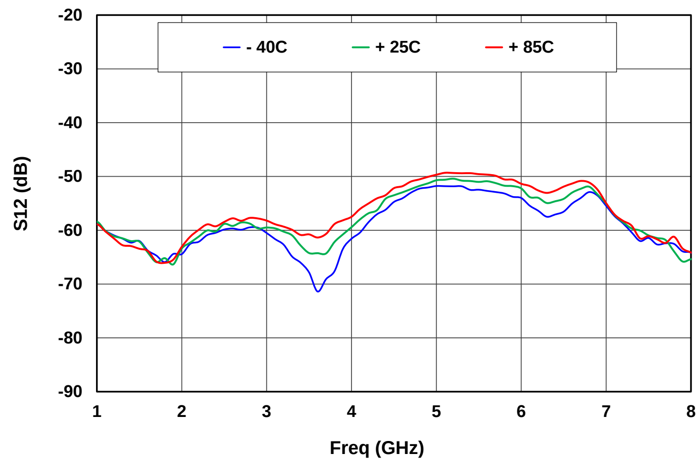
Performance Plots – Small Signal

Test Conditions unless otherwise stated: V_D = 25 V, I_{DQ} = 50 mA, Pin= - 25 dBm. T_{base} = 25 °C.

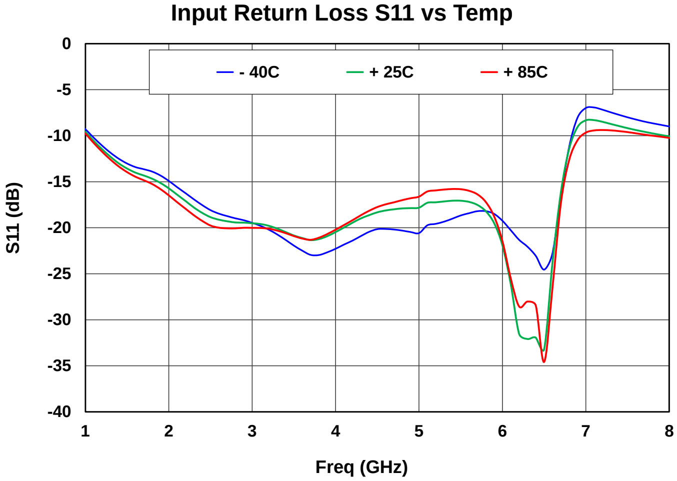
Gain S21 vs Temp



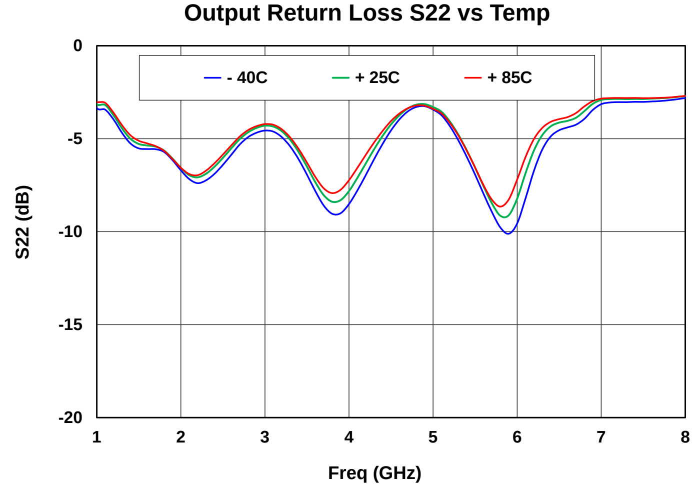
Reverse Isolation S12 vs Temp



Input Return Loss S11 vs Temp

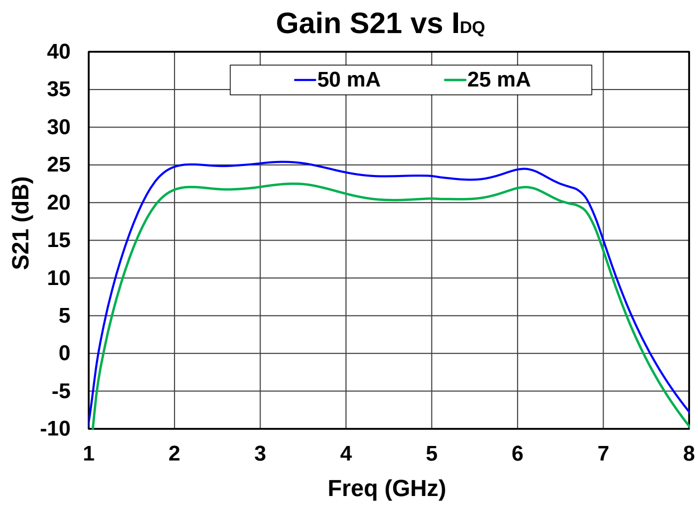


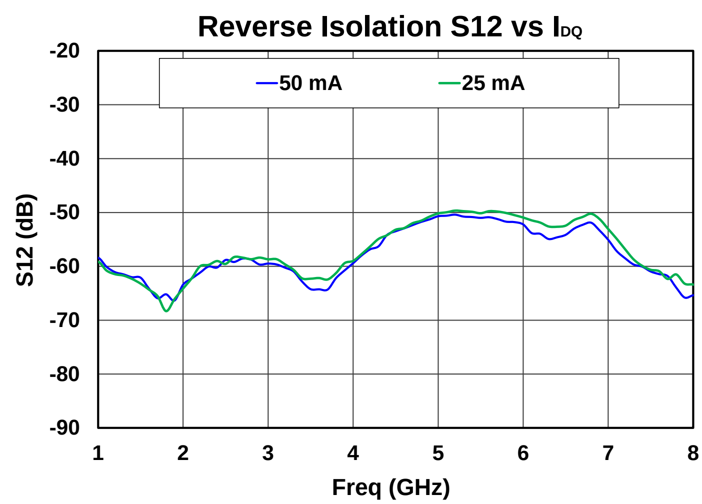
Output Return Loss S22 vs Temp

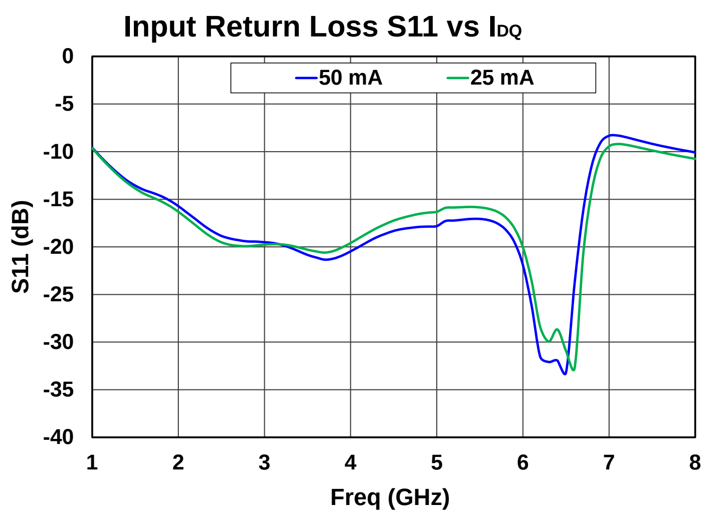


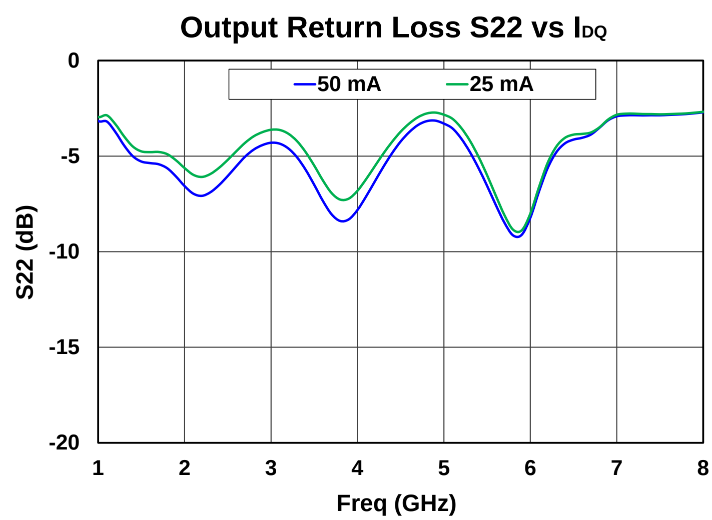
Performance Plots – Small Signal

Test Conditions unless otherwise stated: V_D = 25 V, I_{DQ} = 50 mA, Pin= - 25 dBm. T_{base} = 25 °C.



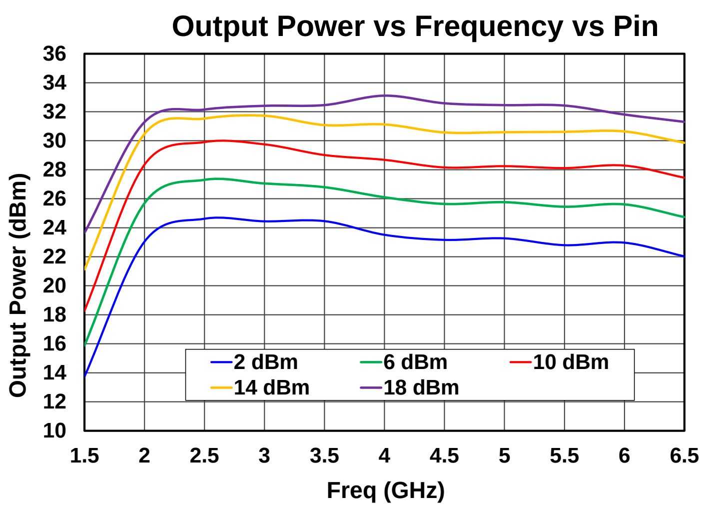


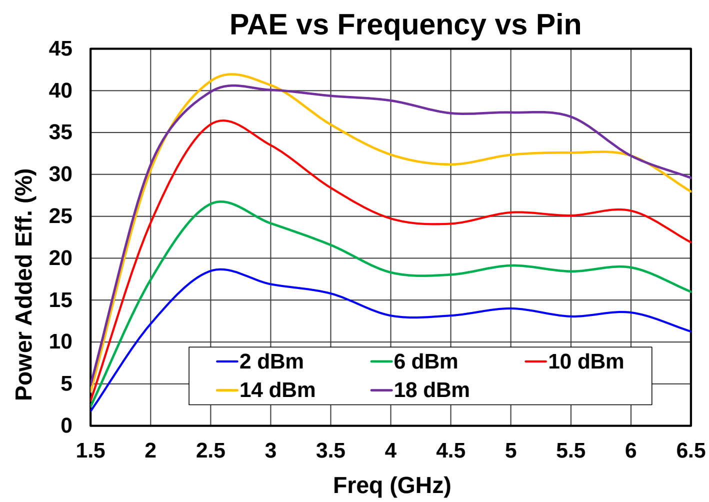


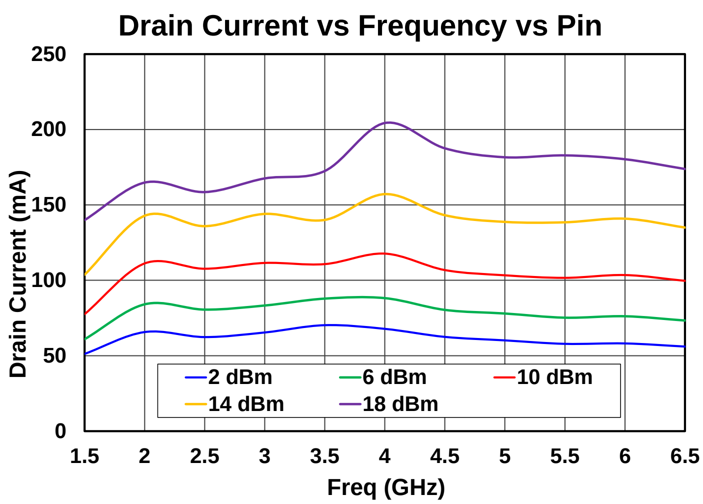


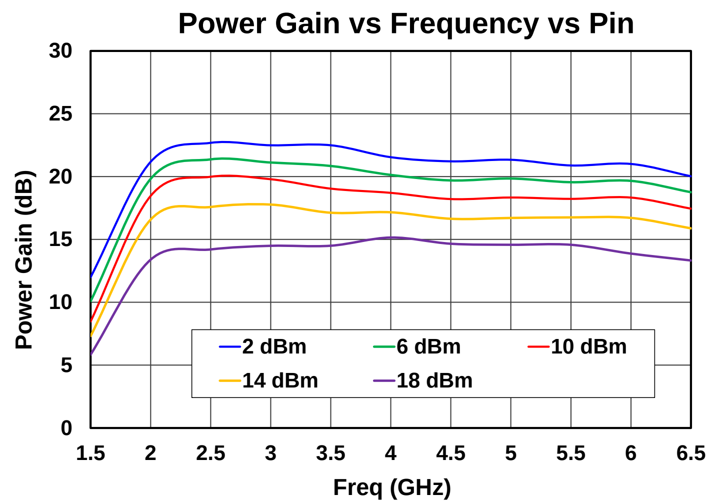
Performance Plots – Large Signal

Test Conditions unless otherwise stated: V_D = 25 V, I_{DQ} = 50 mA, CW mode, T_{base} = 25 °C.



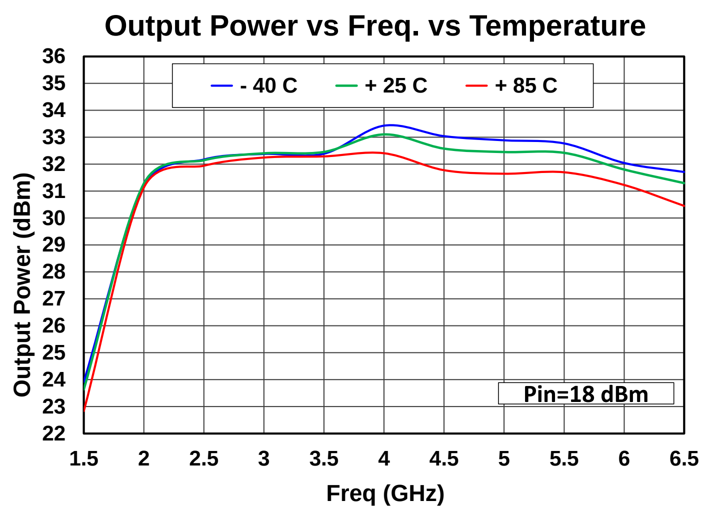


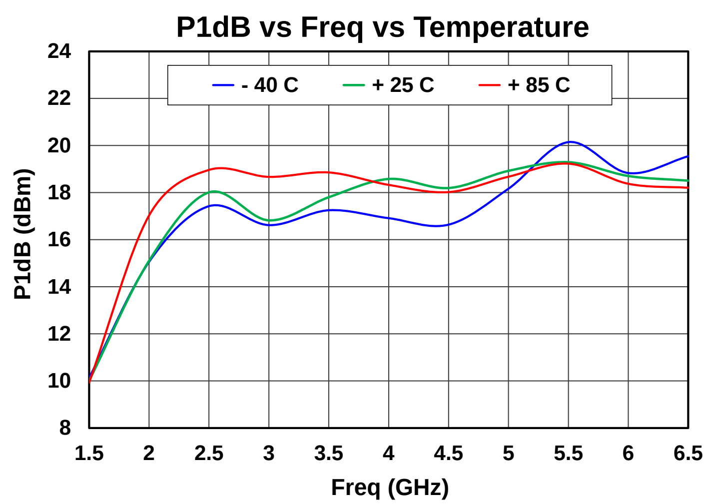


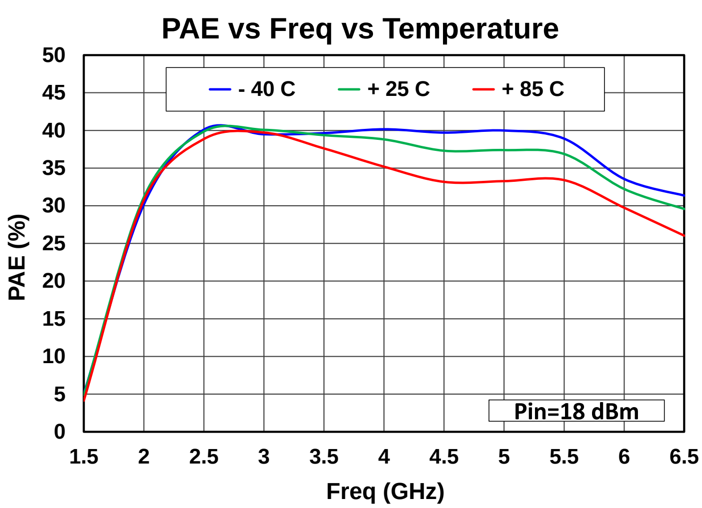


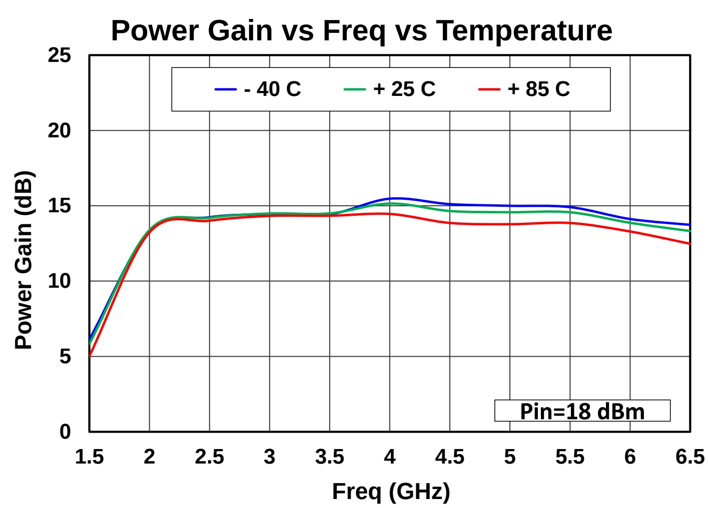
Performance Plots – Large Signal

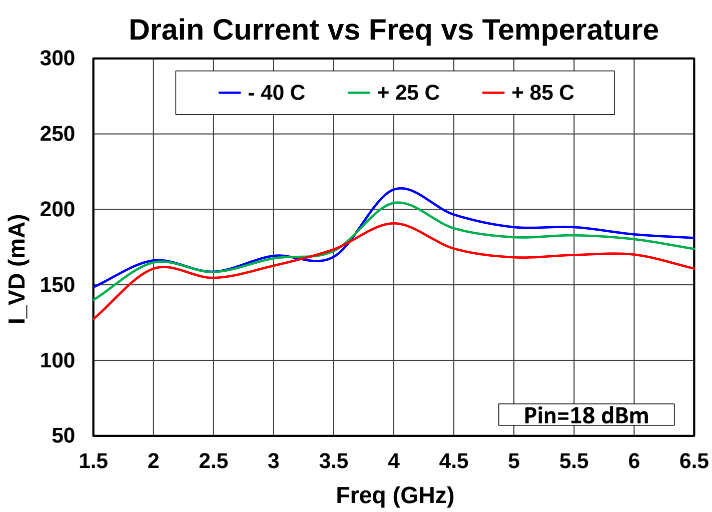
Test Conditions unless otherwise stated: V_D = 25 V, I_{DQ} = 50 mA, CW mode, T_{base} = 25 °C.

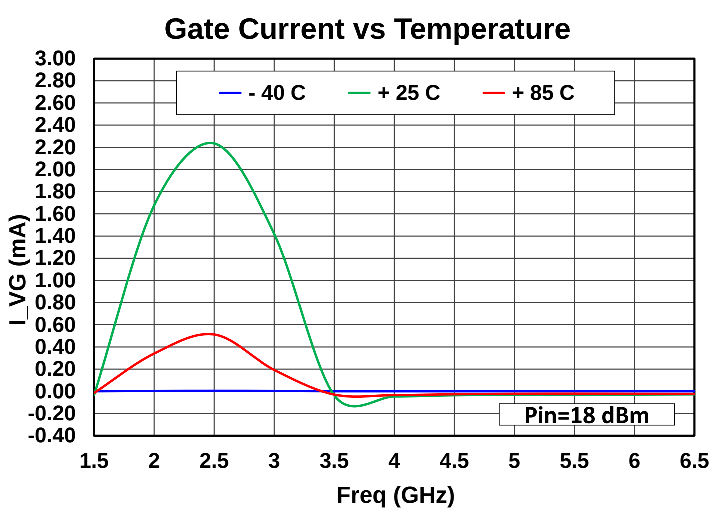






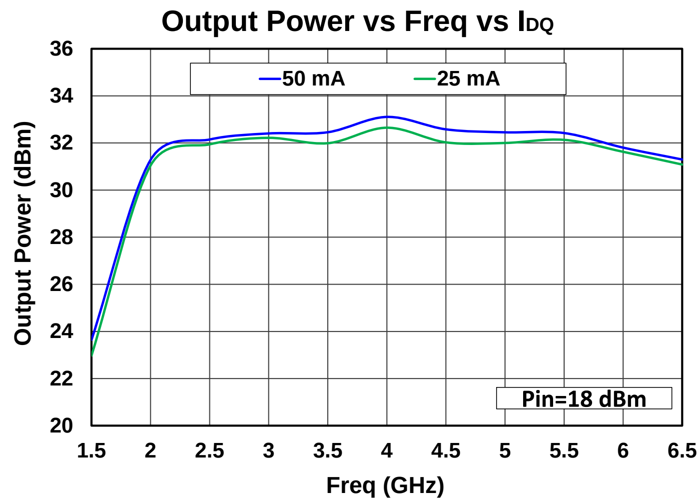


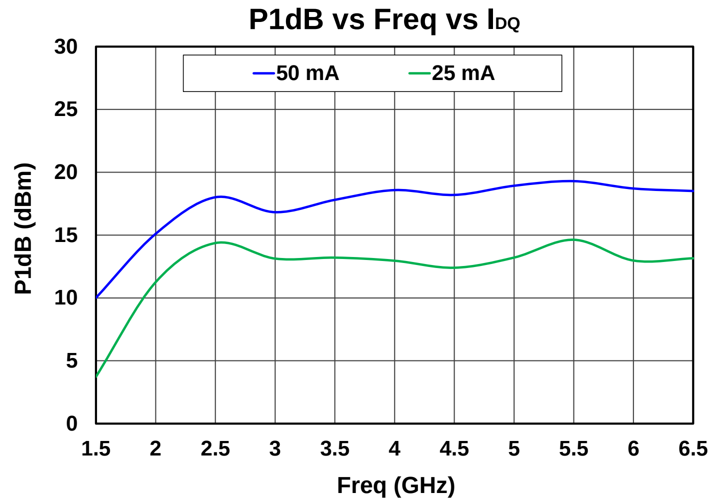


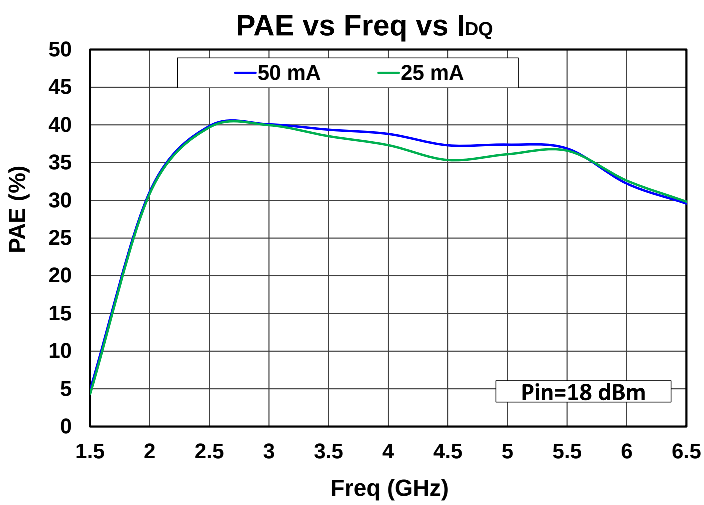


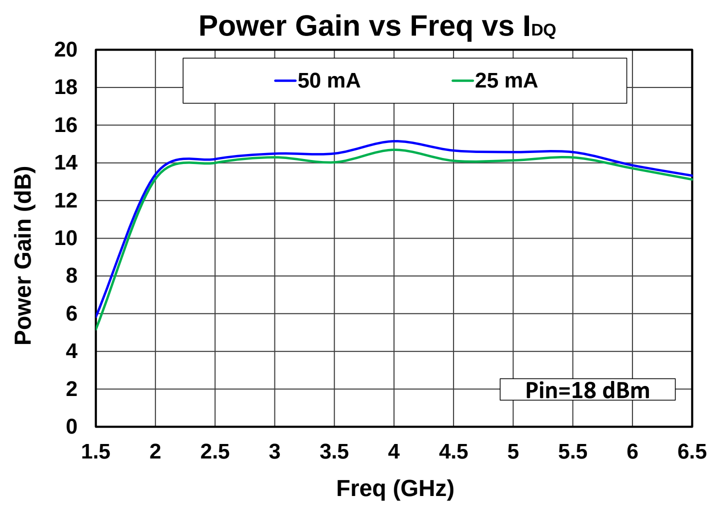
Performance Plots – Large Signal

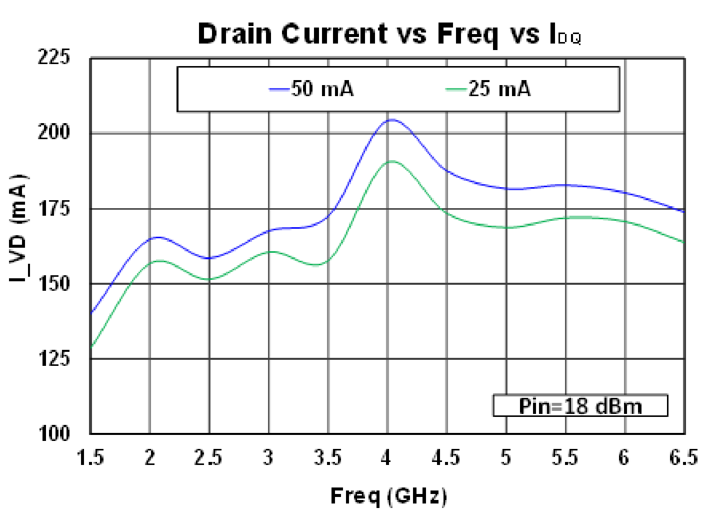
Test Conditions unless otherwise stated: V_D = 25 V, I_{DQ} = 50 mA, CW mode, T_{base} = 25 °C.

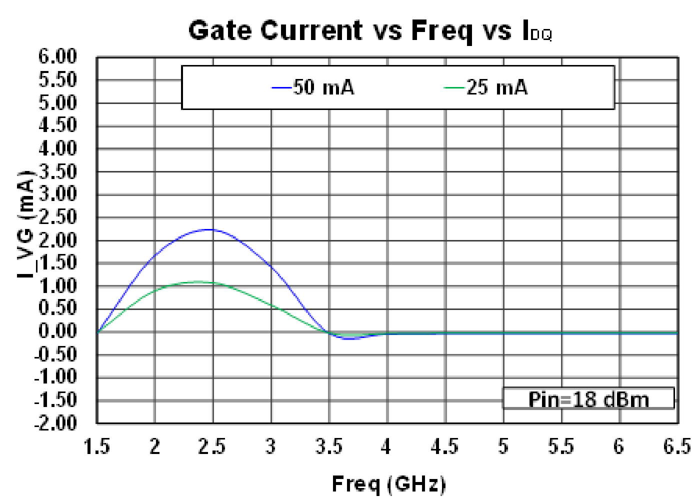






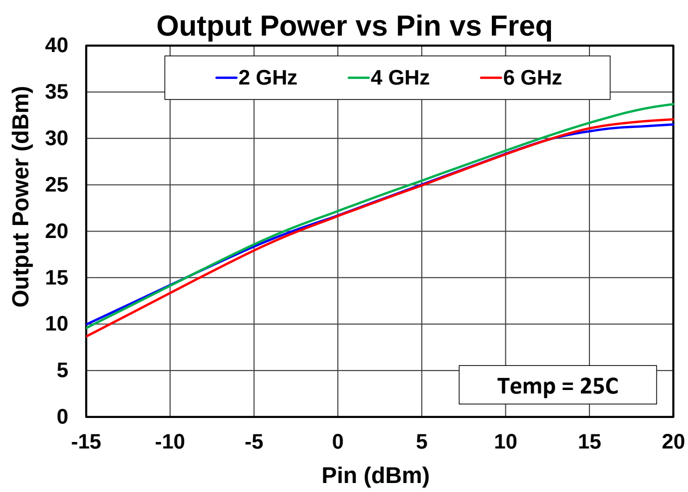


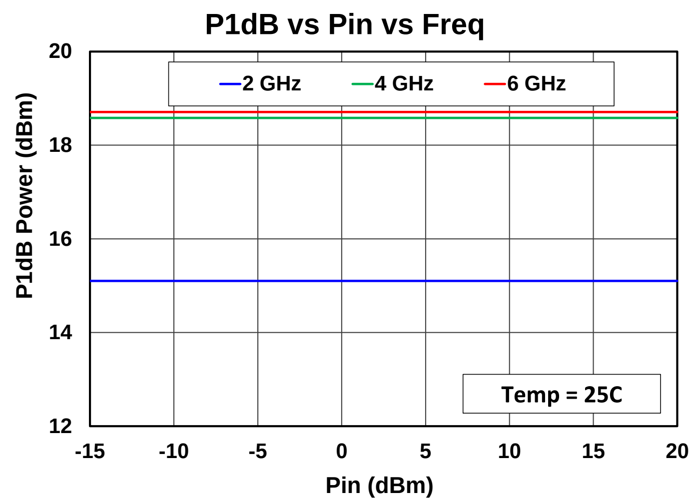


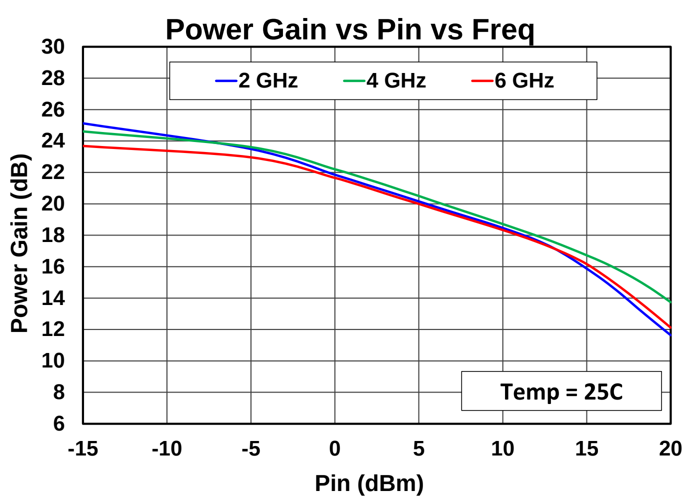


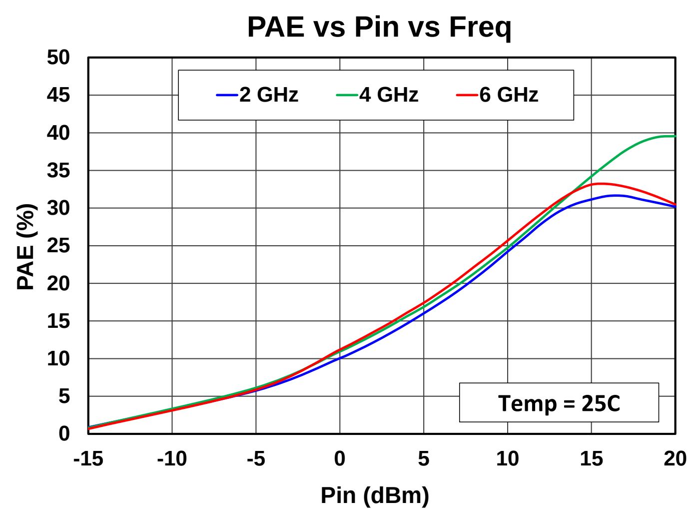
Performance Plots – Large Signal

Test Conditions unless otherwise stated: V_D = 25 V, I_{DQ} = 50 mA, CW mode, T_{base} = 25 °C.



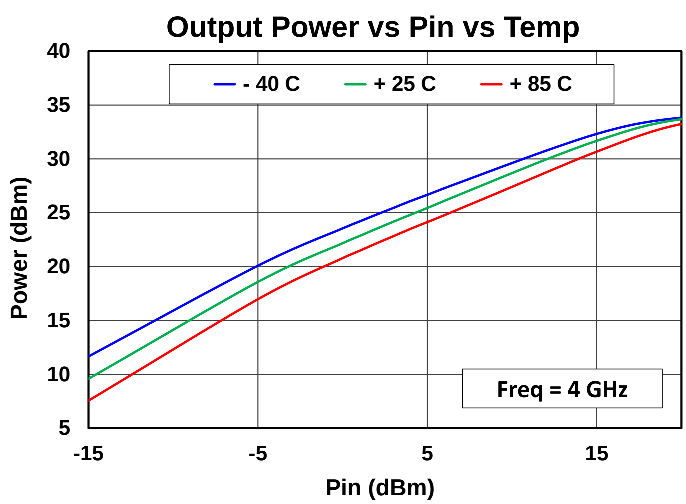


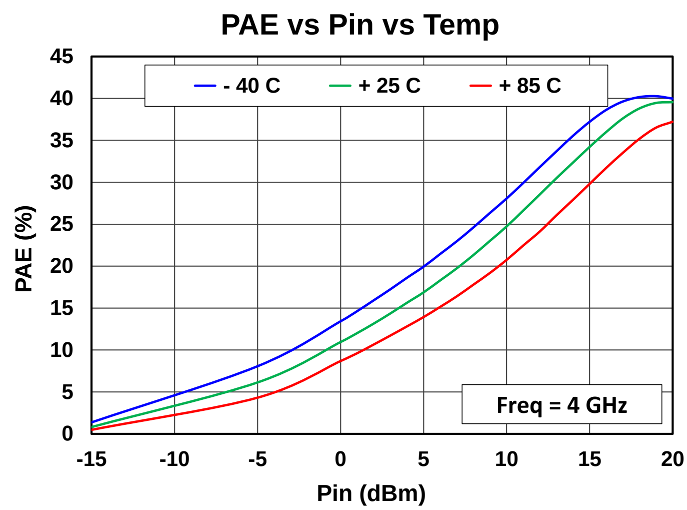


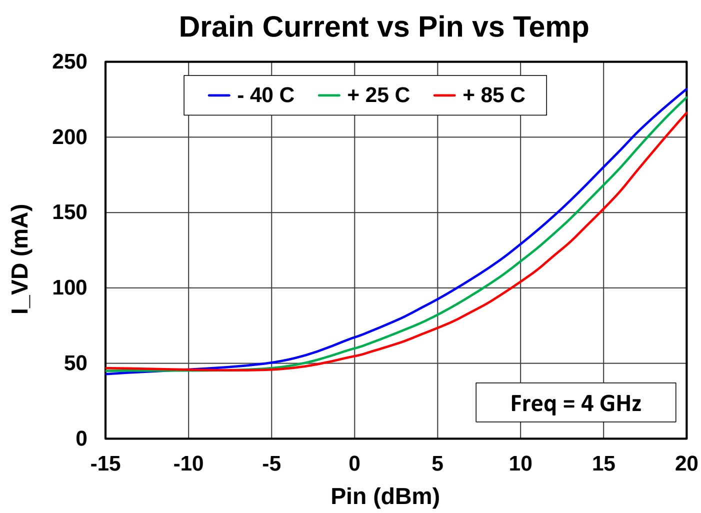


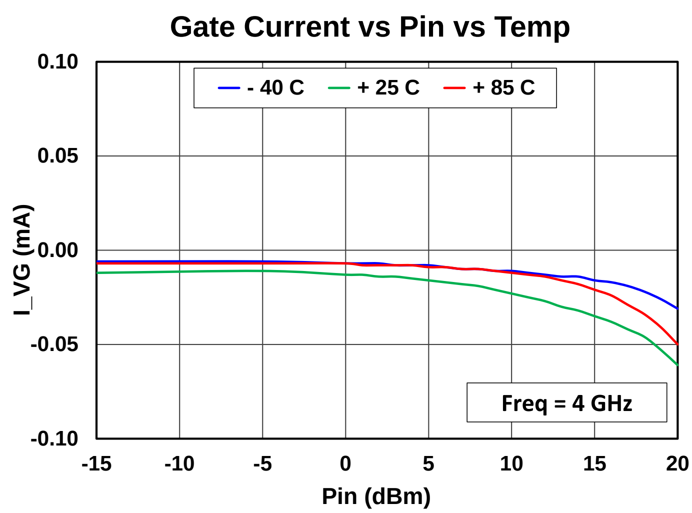
Performance Plots – Large Signal

Test Conditions unless otherwise stated: V_D = 25 V, I_{DQ} = 50 mA, CW mode, T_{base} = 25 °C.



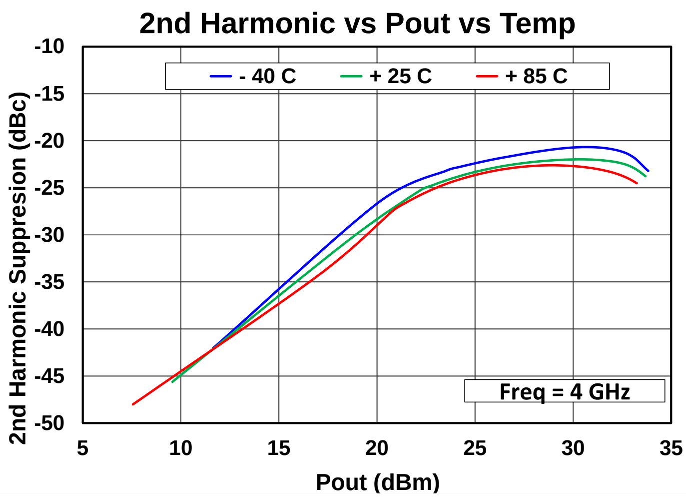


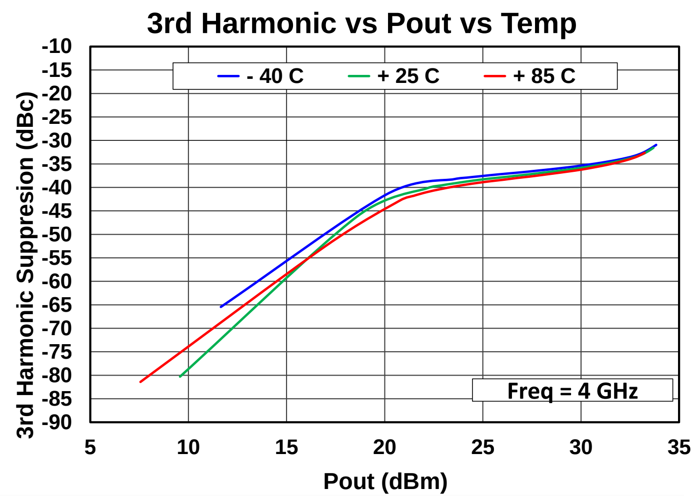


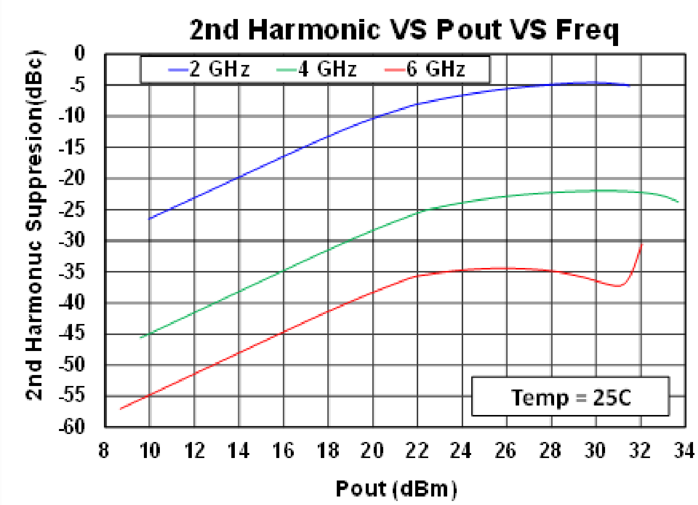


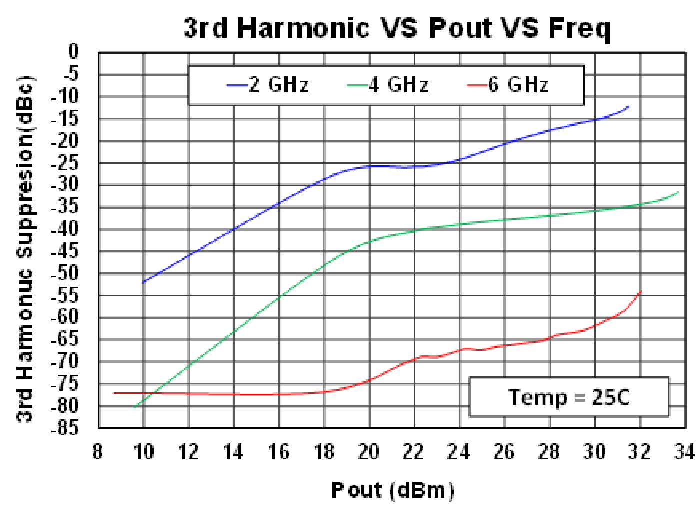
Performance Plots – Harmonics

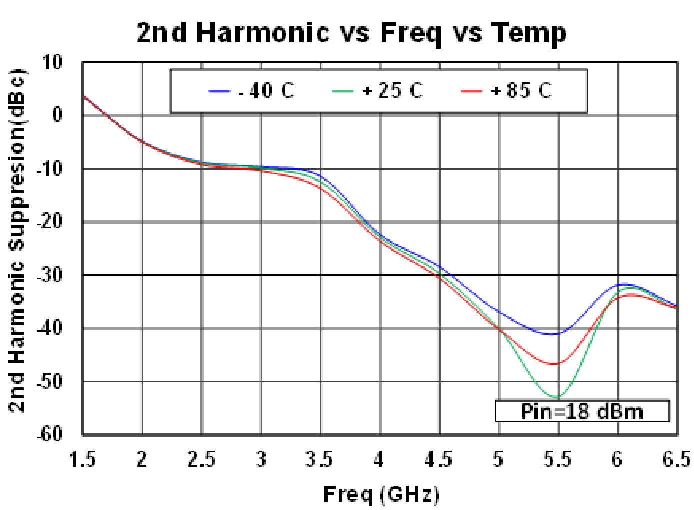
Test Conditions unless otherwise stated: V_D = 25 V, I_{DQ} = 50 mA, CW mode, T_{base} = 25 °C.

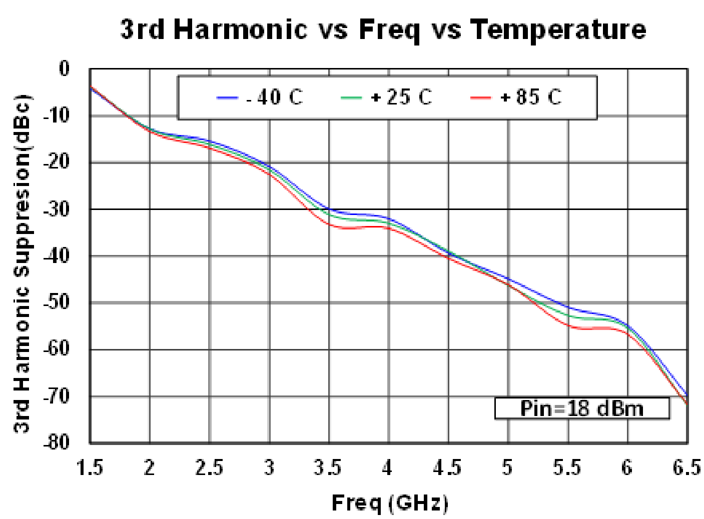








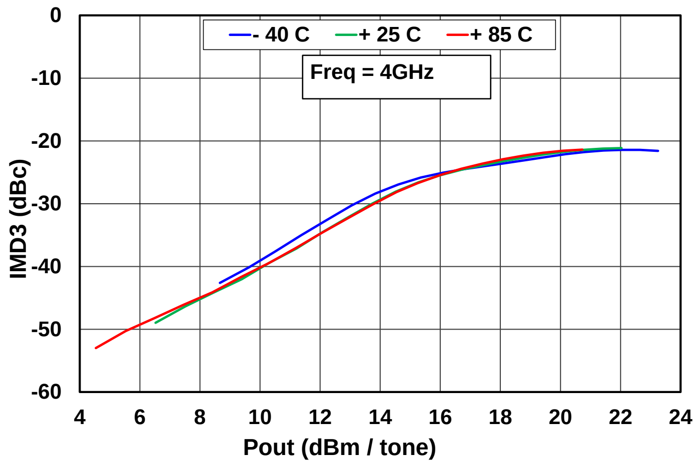




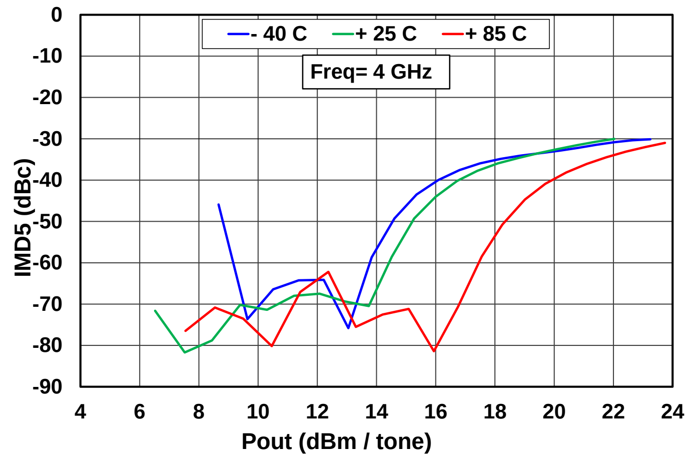
Performance Plots – Linearity

Test Conditions unless otherwise stated: V_D = 25 V, I_{DQ} = 50 mA, CW mode, Tone spacing=10MHz, Tbase = 25 °C.

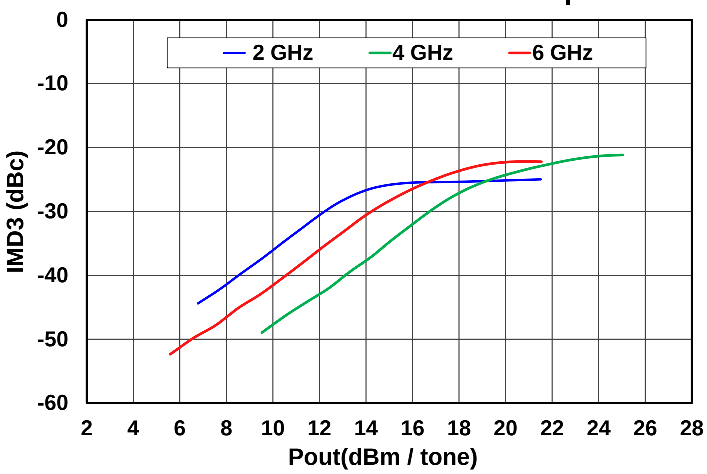
IMD3 vs Pout/Tone vs Temp



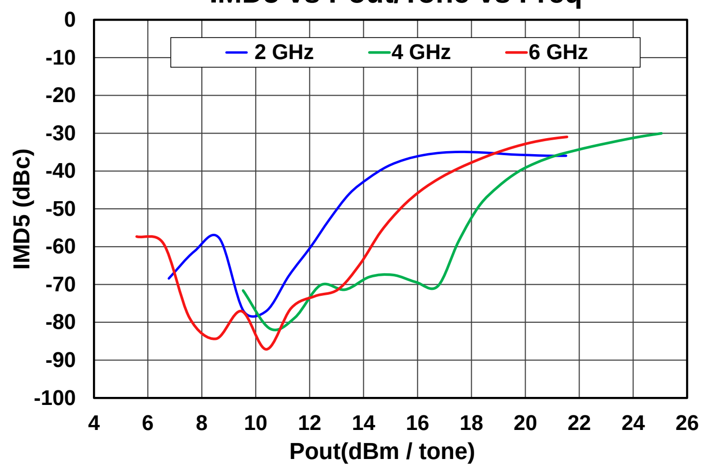
IMD5 vs Pout/Tone vs Temp



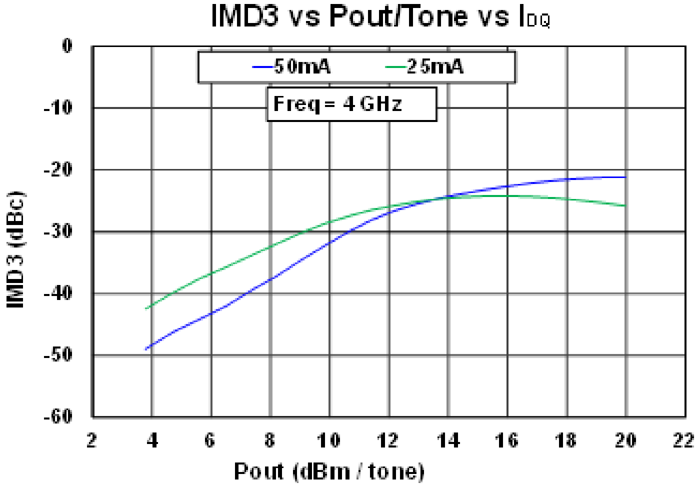
IMD3 vs Pout/Tone vs Freq



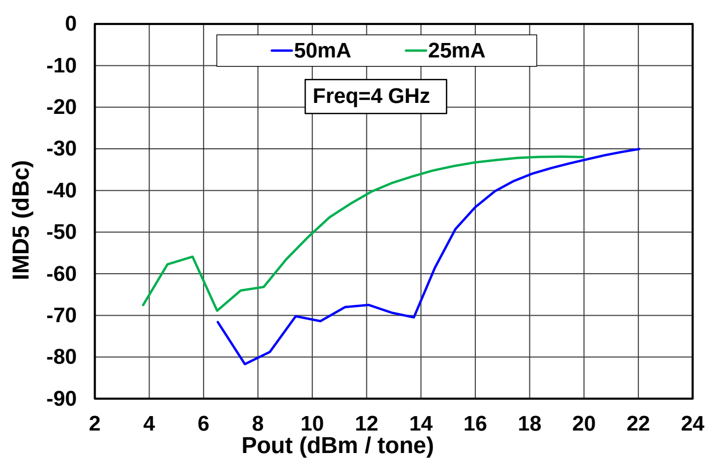
IMD5 vs Pout/Tone vs Freq



IMD3 vs Pout/Tone vs I_{DQ}

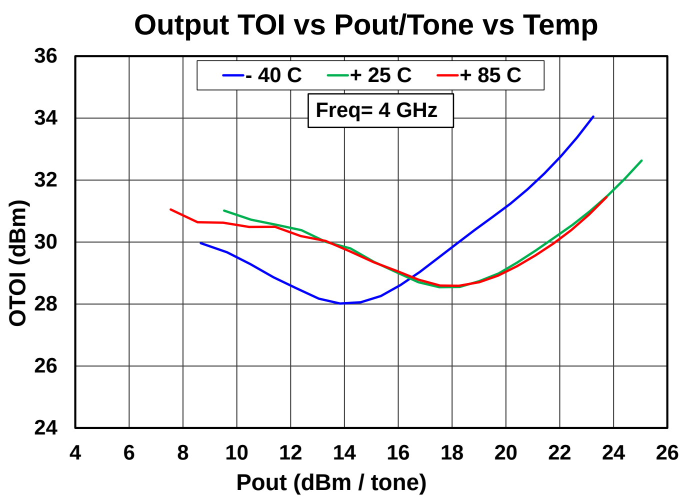


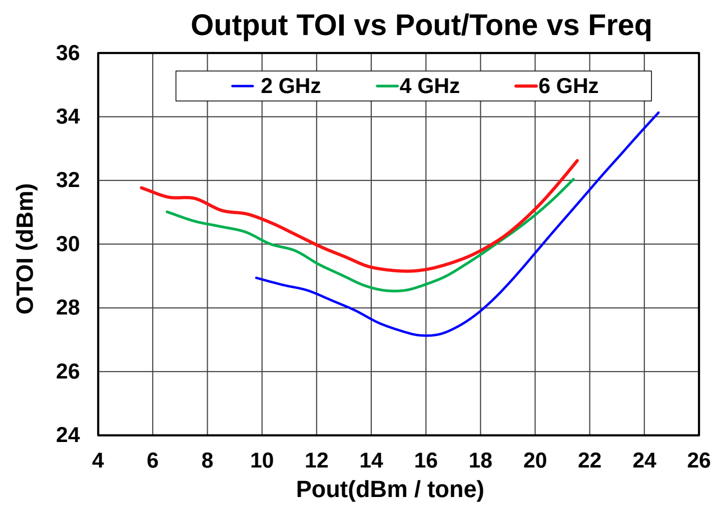
IMD5 vs Pout/Tone vs I_{DQ}

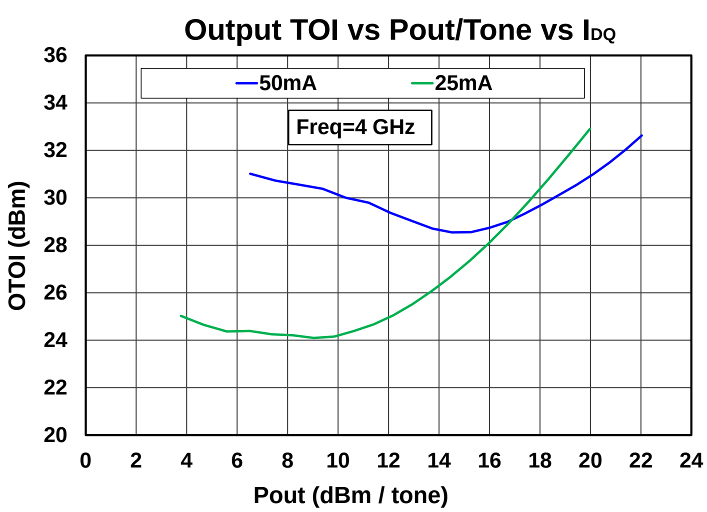


Performance Plots – Linearity

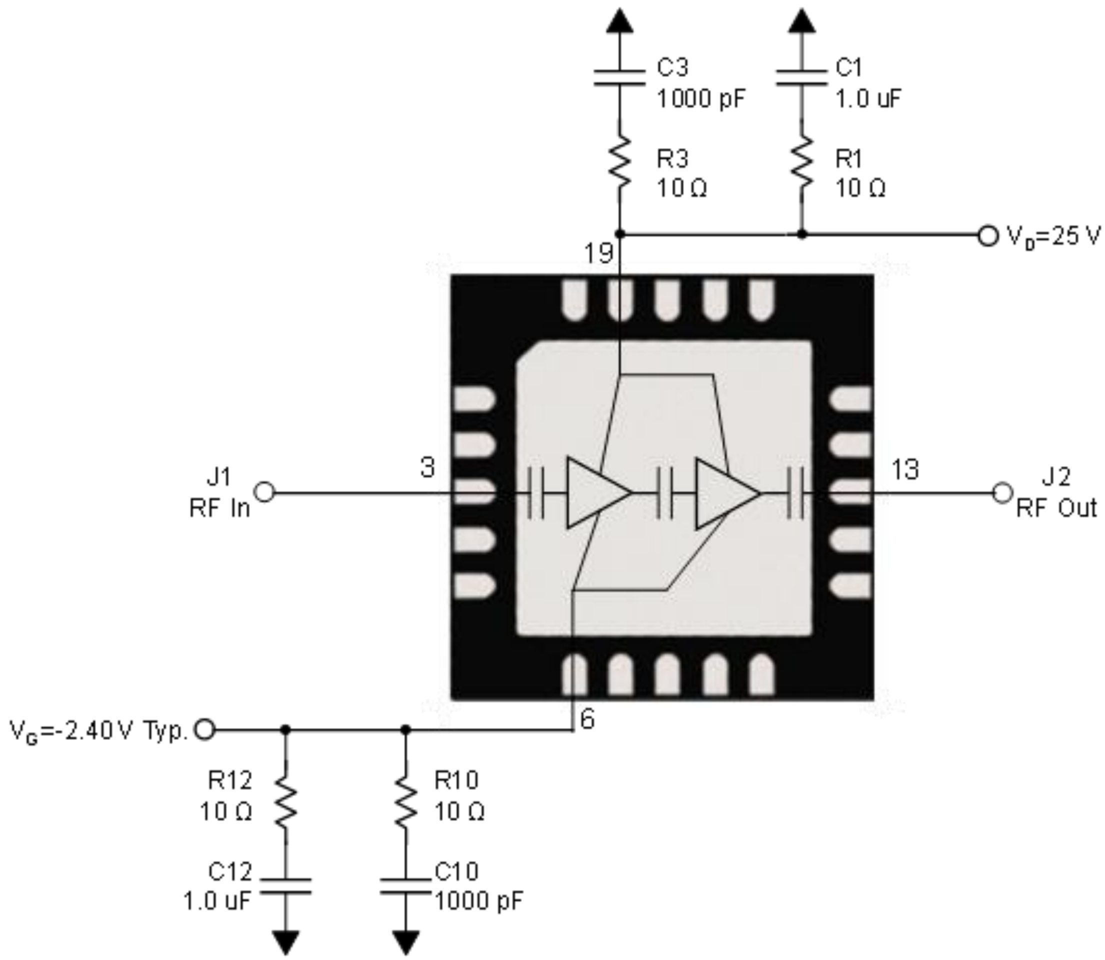
Test Conditions unless otherwise stated: V_D = 25 V, I_{DQ} = 50 mA, CW mode, Tone spacing=10MHz, Tbase = 25 °C.







Application Circuit



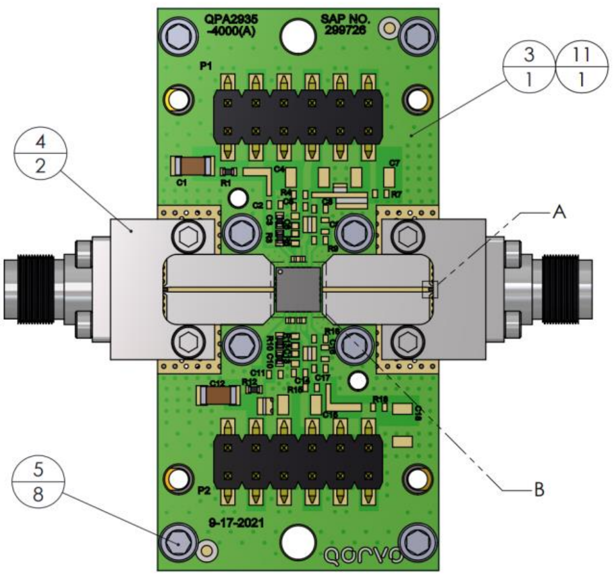
Bias Up Procedure

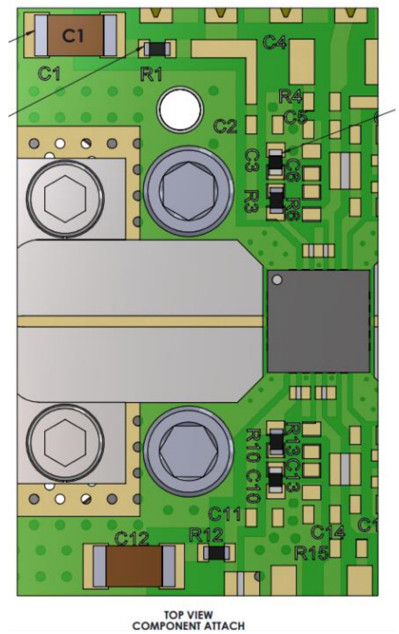
1. Set I_D limit to 400 mA, I_G limit to 10 mA
2. Set V_G to -5.0 V
3. Set V_D +25 V
4. Adjust V_G more positively until I_{DQ} = 50 mA.
5. Apply RF signal

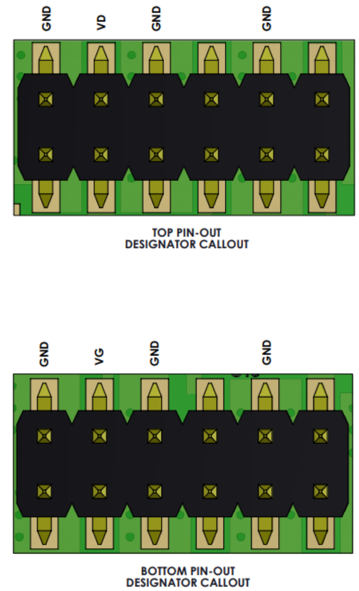
Bias Down Procedure

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

Evaluation Board Layout







RF Layer is 0.008” thick Rogers Corp. RO4003C, ε_r = 3.38. Metal layers are 0.5 oz. copper. The microstrip line at the connector interface is optimized for the Southwest Microwave end launch connector 1092-01A-5.

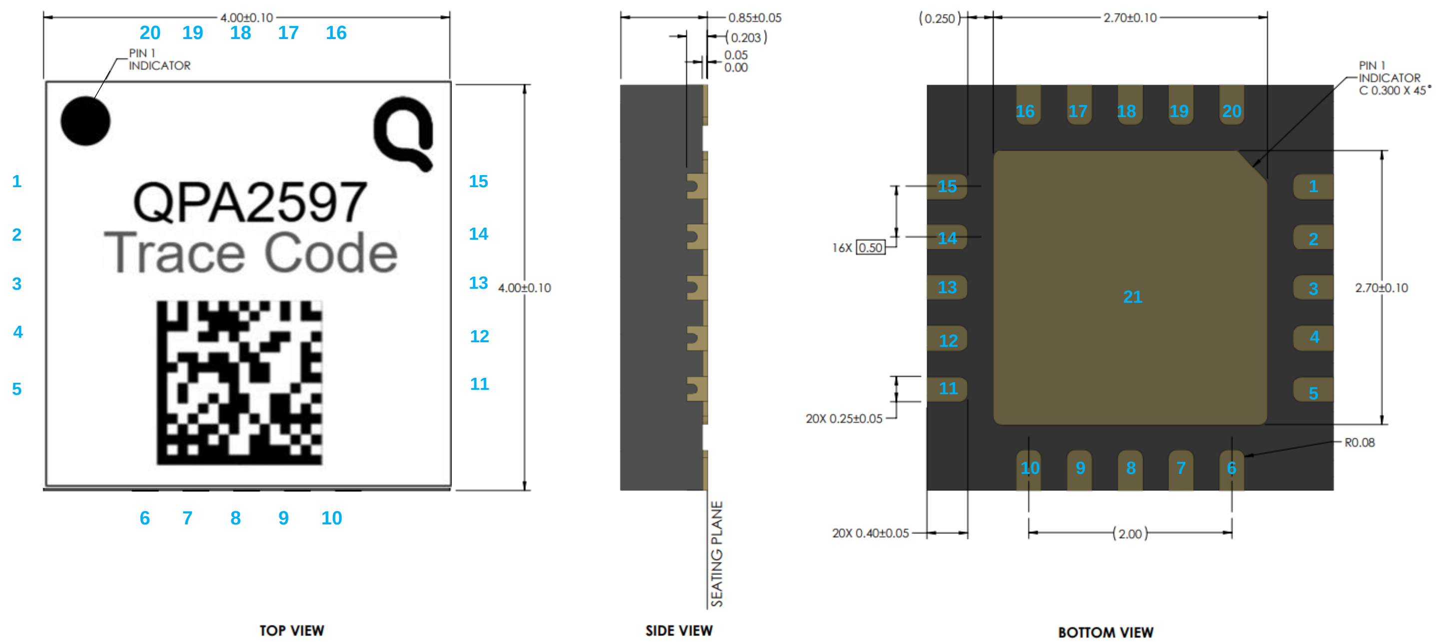
The pad pattern shown has been developed and tested for optimized assembly at Qorvo. The PCB land pattern has been developed to accommodate lead tolerances. Since processes vary from company to company, careful process development is recommended

Multiple vias should be employed under the package center paddle to minimize inductance resistance.

Bill of Materials

Reference Des.	Value	Description	Manuf.	Part Number
C1, C12	1 uF, 50 V, 5 %	CAP X5R 1206	Various	–
C3, C10	1000 pF, 100 V, 10 %	CAP X7R 0402	Various	–
R1, R12, R3, R10	10 Ohm, 5 %, 1/10 W	RES 0402 case	Various	–

Mechanical Information, Pin Configuration and Description



Dimensions in mm, package is mold encapsulated with gold plated leads. General tolerance. xx = +/- 0.05, .xxx = +/-0.025

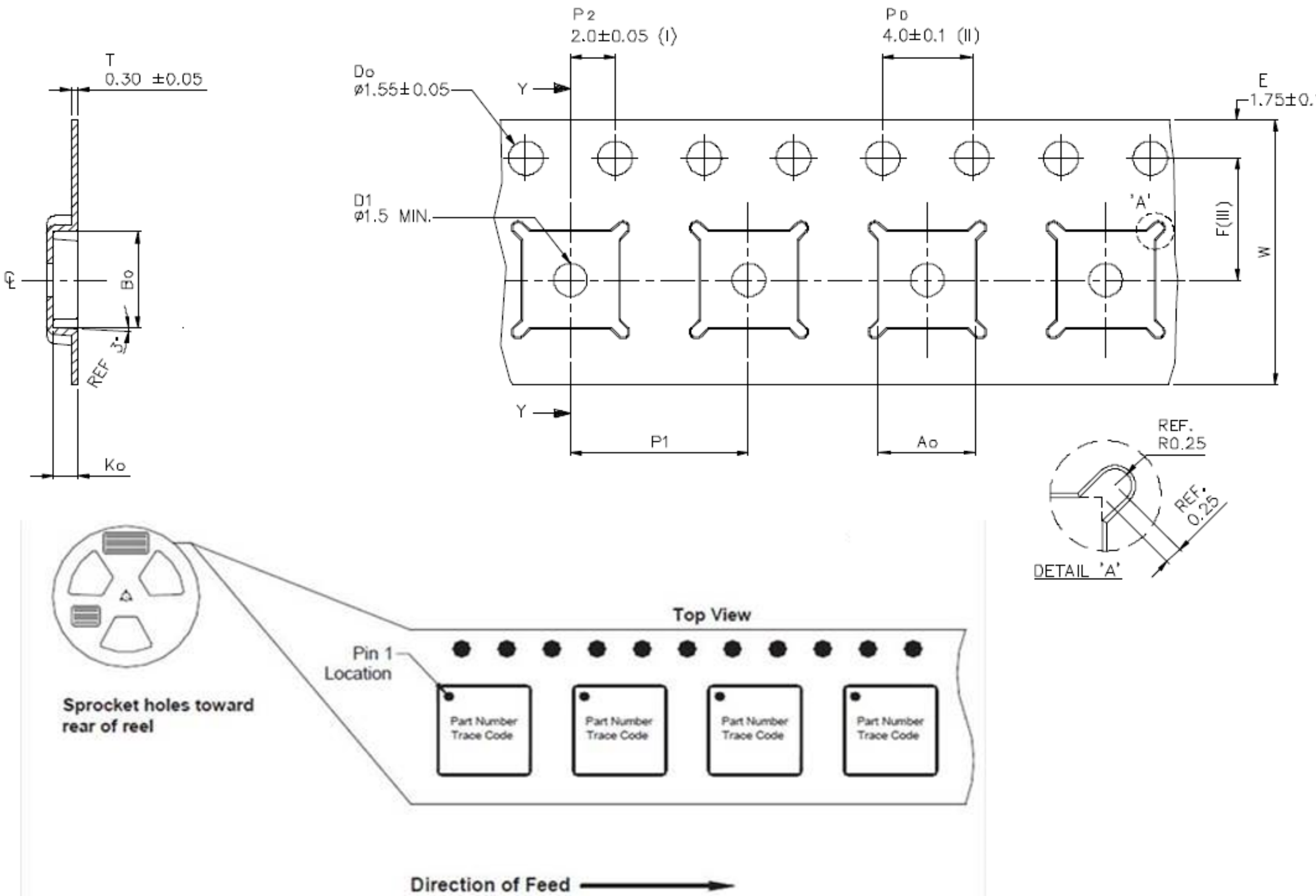
Part Marking: 2597: Part Number, YY = Part Assembly Year, WW = Part Assembly Week, MXXX = Batch ID

Pin No.	Label	Description
1-2, 4-5, 7-12, 14-18, 20	GND	Connected to ground paddle (21); recommend grounding on PCB for improved package isolation.
3	RF Input	RF input, matched to 50 Ω, DC blocked
6	V_G	Gate voltage. Bias network required
13	RF Output	RF output, matched to 50 Ω, DC blocked
19	V_D	Drain voltage. Bias network required.
21	Slug (GND)	Backside paddle. Multiple vias should be employed to minimize inductance and thermal resistance. Copper-filled vias recommended for best thermal performance.

Tape and Reel Information

Standard T/R size = 250 pieces on a 7” reel.

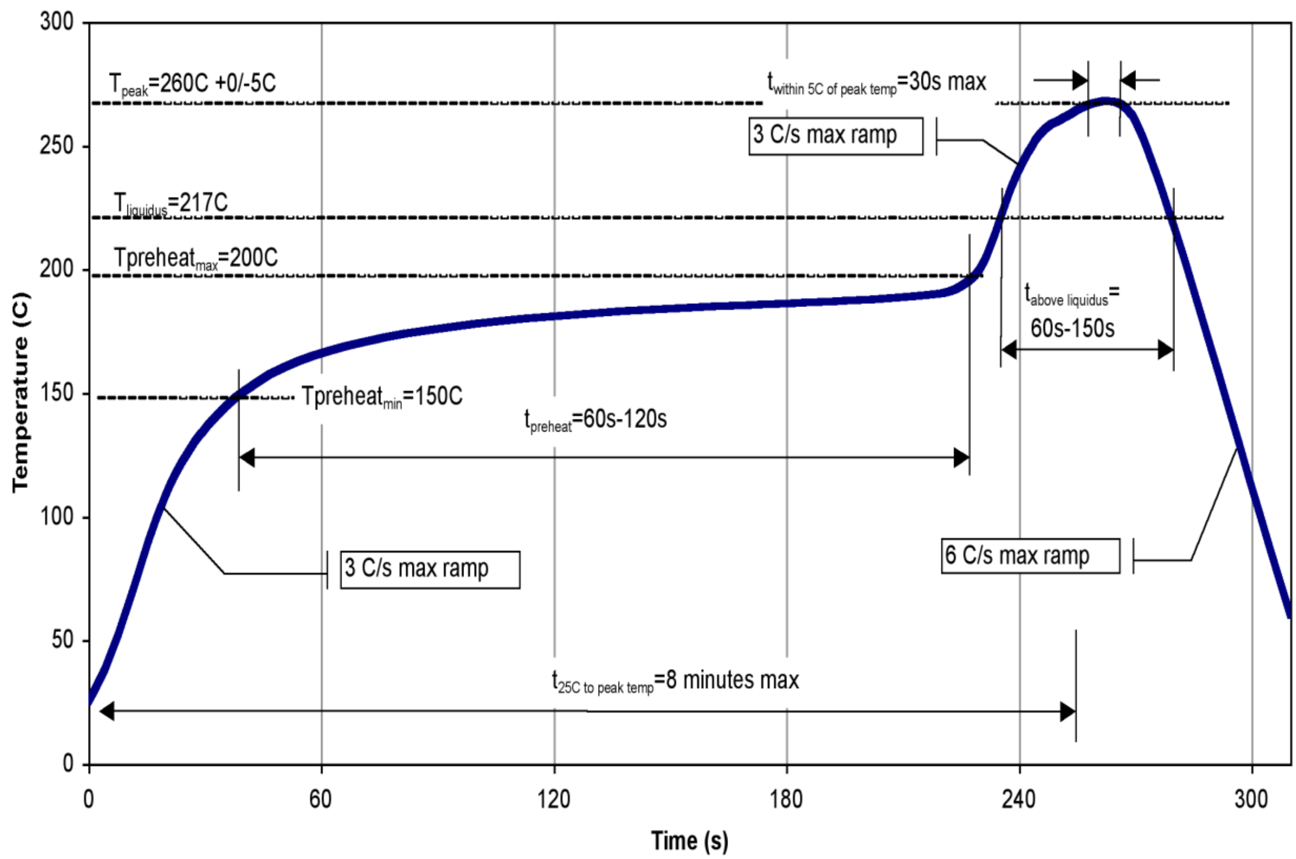
Material		Cavity (mm)				Distance Between Centerline (mm)		Carrier Tape (mm)	Cover Carrier (mm)
Vendor	Vendor P/N	Length (A0)	Width (B0)	Depth (K0)	Pitch (P1)	Length direction (P2)	Width Direction (F)	Width (W)	Width (W)
C-Pack	QFN0400 X 0400D	4.35	4.35	1.1	8.0	2.00	5.50	12.0	9.20



Solderability

1. Compatible with the latest version of J-STD-020, Lead-free solder, 260 °C peak reflow temperature.

Recommended Soldering Temperature Profile



Handling Precautions

Parameter	Rating	Standard
ESD – Human Body Model (HBM)	TBD	ESDA / JEDEC JS-001-2012
ESD – Charge Device Model (CDM)	TBD	JESD22-C101
MSL – 260 °C Convection Reflow	TBD	JEDEC standard IPC/JEDEC-J-STD-020

Caution!
ESD-Sensitive Device

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 ($C_{15}H_{12}Br_{4}0_{2}$) Free
- SVHC Free
- PFOS Free

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**

Important Notice

The information contained herein is believed to be reliable; however, Qorvo makes no warranties regarding the information contained herein and assumes no responsibility or liability whatsoever for the use of the information contained herein. All information contained herein is subject to change without notice. Customers should obtain and verify the latest relevant information before placing orders for Qorvo products. The information contained herein or any use of such information does not grant, explicitly or implicitly, to any party any patent rights, licenses, or any other intellectual property rights, whether with regard to such information itself or anything described by such information. **THIS INFORMATION DOES NOT CONSTITUTE A WARRANTY WITH RESPECT TO THE PRODUCTS DESCRIBED HEREIN, AND QORVO HEREBY DISCLAIMS ANY AND ALL WARRANTIES WITH RESPECT TO SUCH PRODUCTS WHETHER EXPRESS OR IMPLIED BY LAW, COURSE OF DEALING, COURSE OF PERFORMANCE, USAGE OF TRADE OR OTHERWISE, INCLUDING THE IMPLIED WARRANTIES OF MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE.**

Without limiting the generality of the foregoing, Qorvo products are not warranted or authorized for use as critical components in medical, life-saving, or life-sustaining applications, or other applications where a failure would reasonably be expected to cause severe personal injury or death.