QPA2225

28 – 38 GHz 0.4 Watt GaN Driver Amplifier

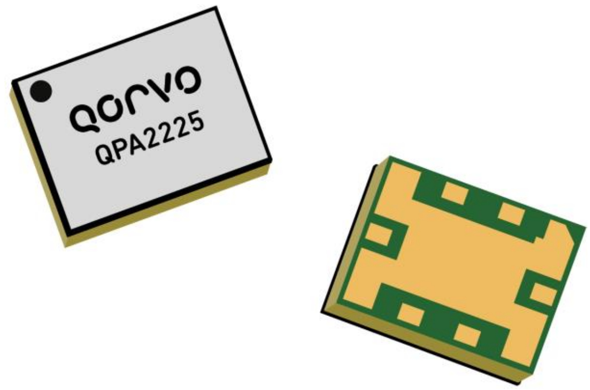
Product Overview

Qorvo's QPA2225 is a wide band driver amplifier fabricated on Qorvo's production 0.15 um GaN on SiC process (QGaN15). Covering 28 – 38 GHz, the QPA2225 provides > 0.4 W of saturated output power with >22 dB of small-signal gain.

The QPA2225 dimensions are 4 x 3 x 2 mm. It can support a variety of operating conditions to best support system requirements. With good thermal properties, it can support a range of bias voltages.

The QPA2225 has DC blocking capacitors on both RF ports, which are matched to 50 ohms.

The QPA2225 is ideal for supporting communications and radar applications in both commercial and military markets.

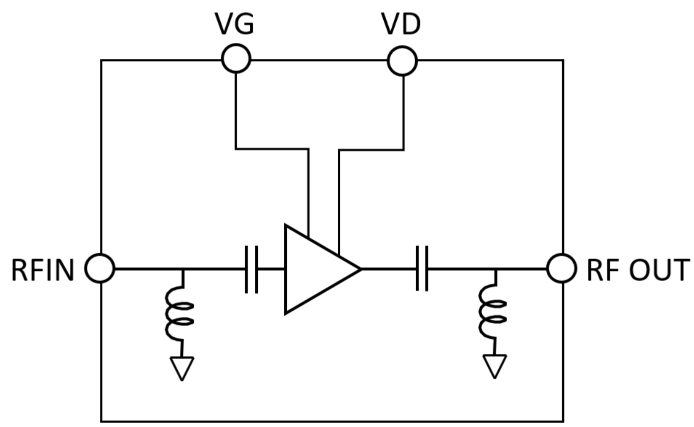


Key Features

- Frequency Range: 28 – 40 GHz
- Power (Pin = 14 dBm): 26 dBm
- Large Signal Gain (Pin = 14 dBm): 12 dB
- Small Signal Gain: 22 dB
- IM3 (Pout / Tone = 20 dBm): - 20 dBc
- Bias: VD = +20 V, IDQ = 64 mA, VG = - 2.5 V typ.
- Package Dimensions: 4 x 3 x 2 mm

Performance is typical across frequency. Refer to electrical specification table and data plots for more details.

Functional Block Diagram



Applications

- Wide Band Communications
- Radar
- Satellite Communications
- Electronic Warfare

Ordering Information

Part No.	Description
QPA2225	QPA2225 Waffle Pack, Qty 50
QPA2225TR7	Tape & Reel, 7" reel, Qty 250
QPA2225EVB	Evaluation Board, Qty 1

Absolute Maximum Ratings

Parameter	Min Value	Max Value	Units
Drain Voltage (VD)	-	29.5	V
Gate Voltage Range (VG)	-5	0	V
Drain Current (ID)	-	516	mA
Gate Current (IG)	-	24	mA
Input Power (Pin), CW, 85 °C	-	18	dBm
Input Power (Pin), CW, 3:1 VSWR, 85 °C	-	18	dBm
Mounting Temperature	-	260	ºC
Storage Temperature	-55	150	ºC

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.

Recommended Operating Conditions

Parameter	Min	Typ.	Max	Units
Drain Voltage (VD)		20	22	V
Drain Current, (IDQ)		64		mA
Gate Voltage (VG, typical, can be adjusted)		−2.5		V
Ambient Temperature Range	−40		+85	ºC

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

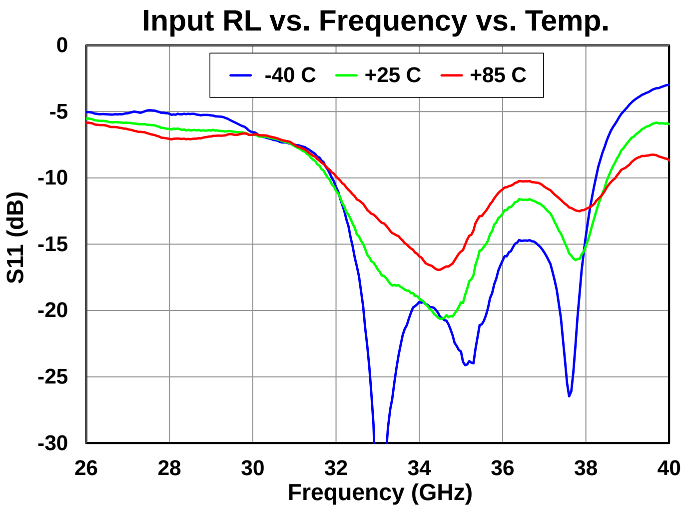
Electrical Specifications

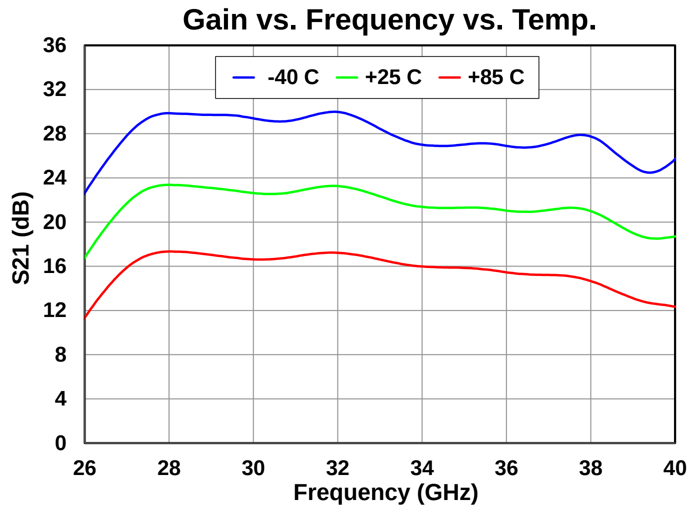
Parameter	Conditions (1)	Min	Typ.	Max	Units
Operational Frequency Range		28		38	GHz
Small Signal Gain			22		dB
Input Return Loss			8		dB
Output Return Loss			8		dB
Output Power at Saturation	P_{IN} = 14 dBm, CW		26		dBm
Large Signal Gain	P_{IN} = 14 dBm, CW		12		dB
Power Added Efficiency	P_{IN} = 14 dBm, CW		10		%
3^{RD} Intermodulation Products	P_{OUT}/Tone = 20 dBm; Δf = 100 MHz		-20		dBc
Gate Leakage	VD = 10V, VG = - 4.0 V	-0.7			mA
Gain Temperature Coefficient			-0.08		dB/ºC

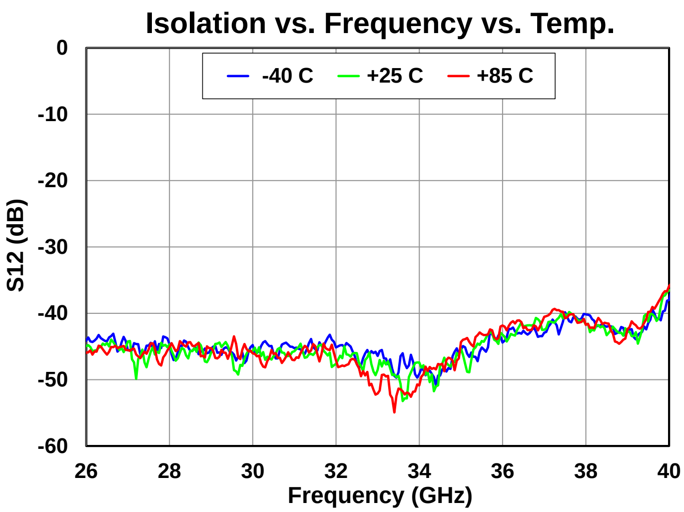
1. Nominal bias, data de-embedded of fixture losses.

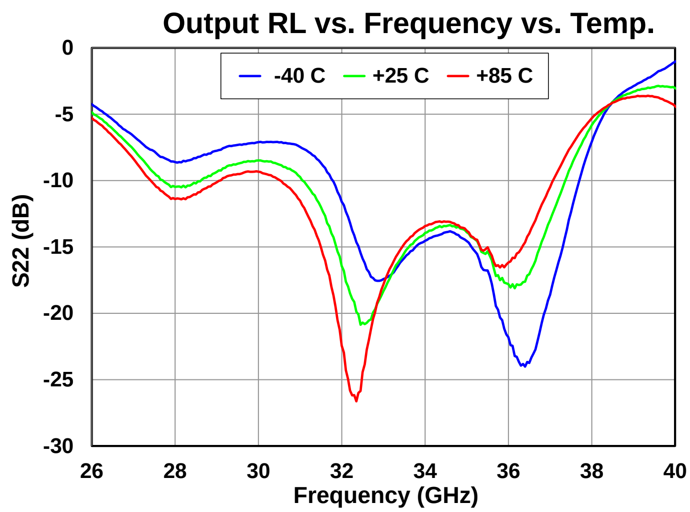
Performance Plots – Small Signal

Test conditions unless otherwise noted: VD = 20 V, IDQ = 64 mA, +25 ºC





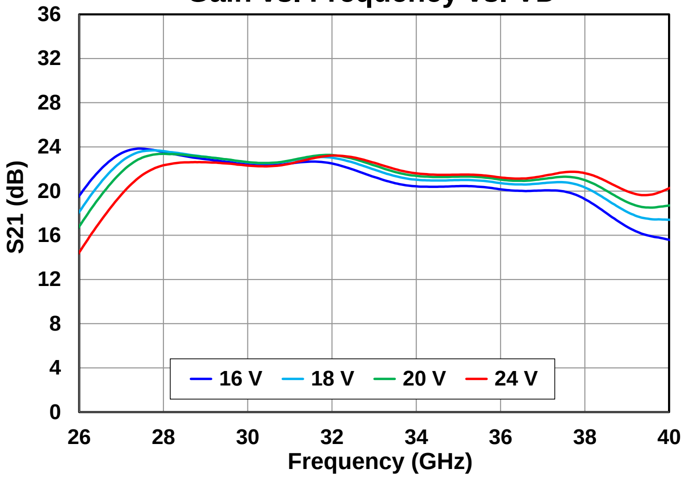




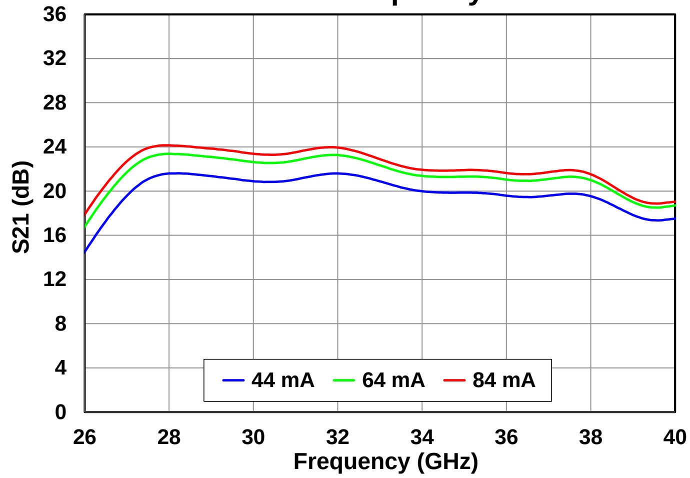
Performance Plots – Small Signal

Test conditions unless otherwise noted: VD = 20 V, IDQ = 64 mA, +25 ºC

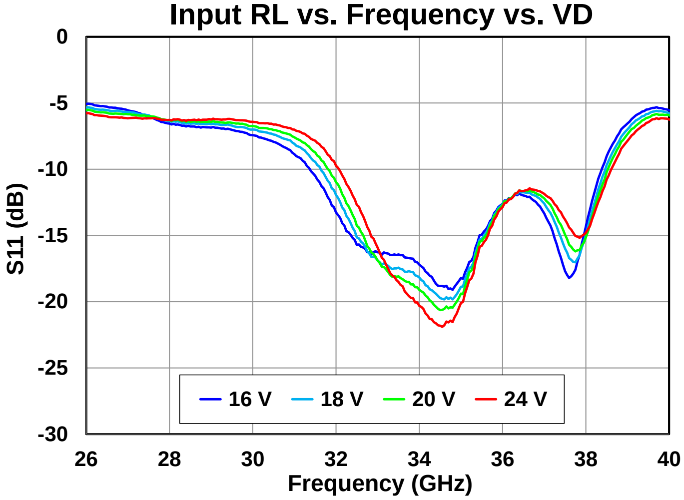
Gain vs. Frequency vs. VD



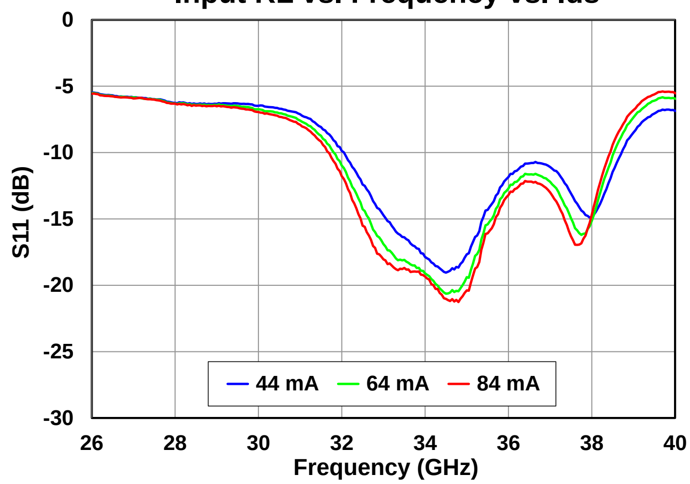
Gain vs. Frequency vs. Ids



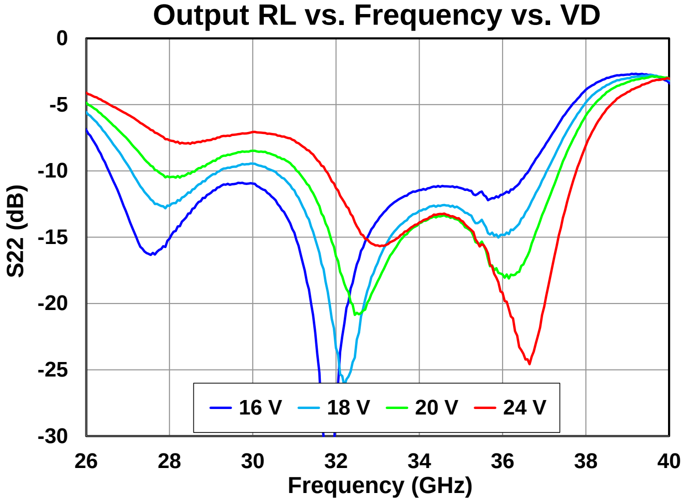
Input RL vs. Frequency vs. VD



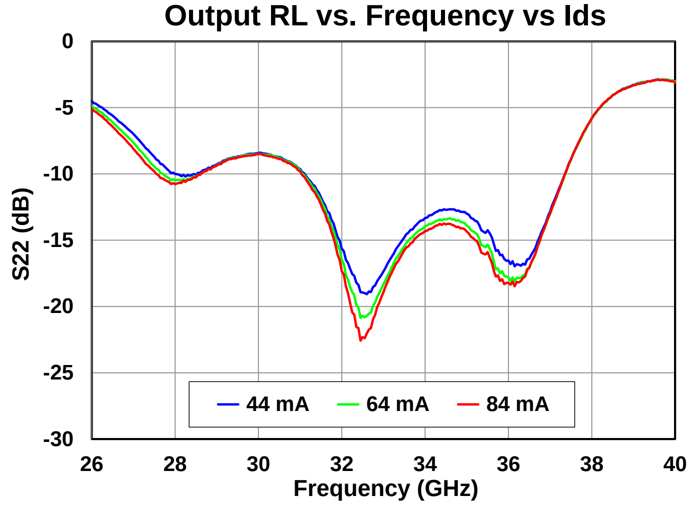
Input RL vs. Frequency vs. Ids



Output RL vs. Frequency vs. VD

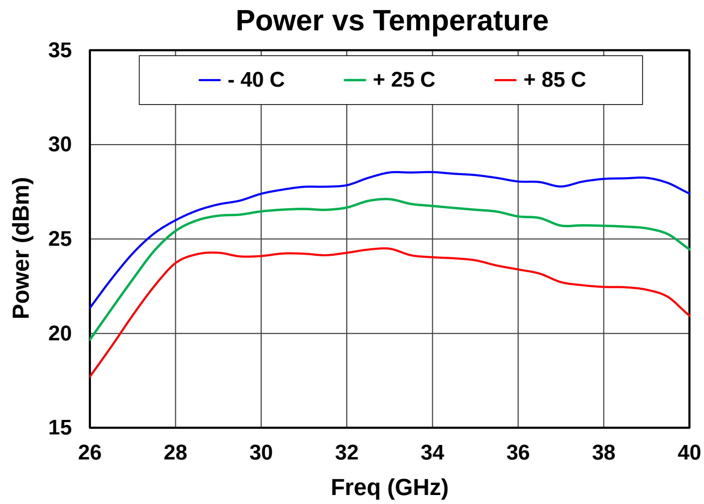


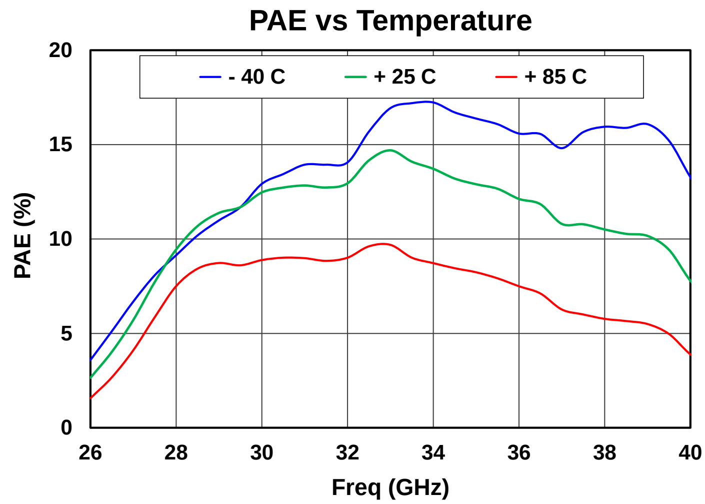
Output RL vs. Frequency vs Ids

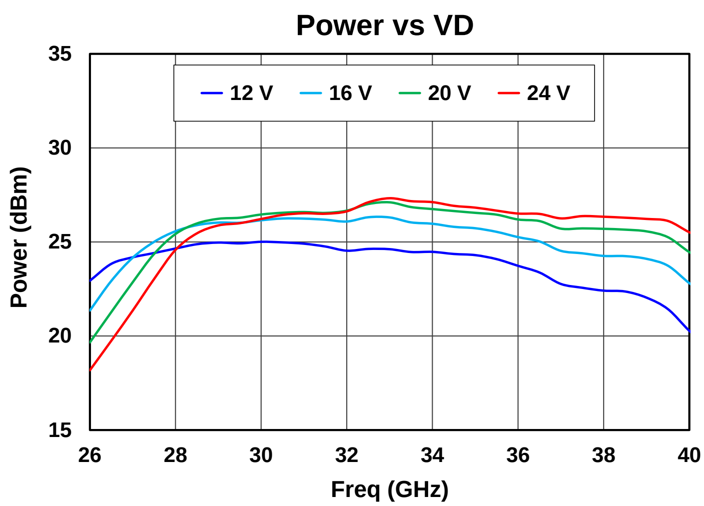


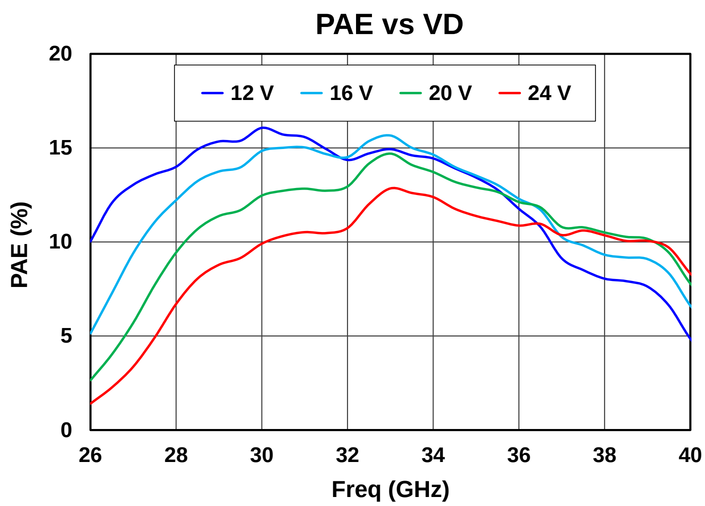
Performance Plots – Large Signal (CW)

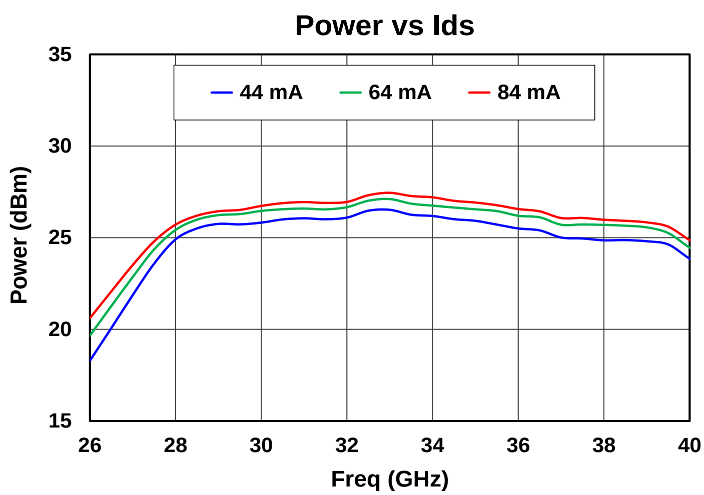
Test conditions unless otherwise noted: VD = 20 V, IDQ = 64 mA, Pin = +14dBm, +25 ºC

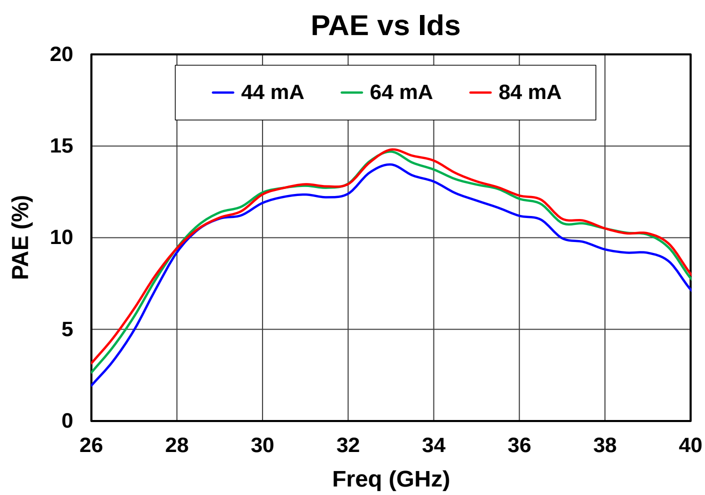








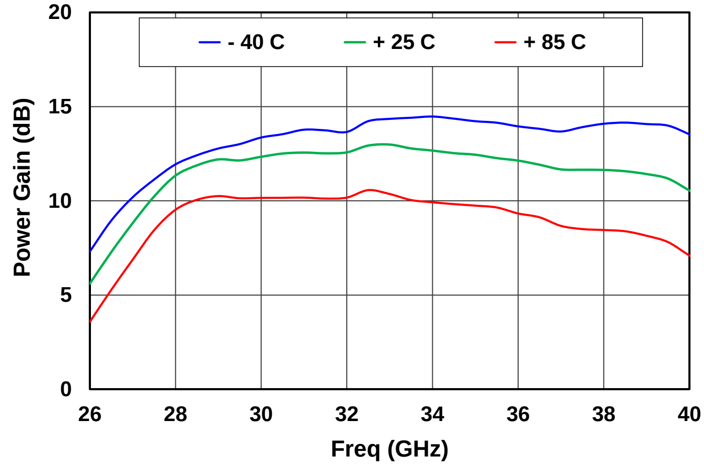




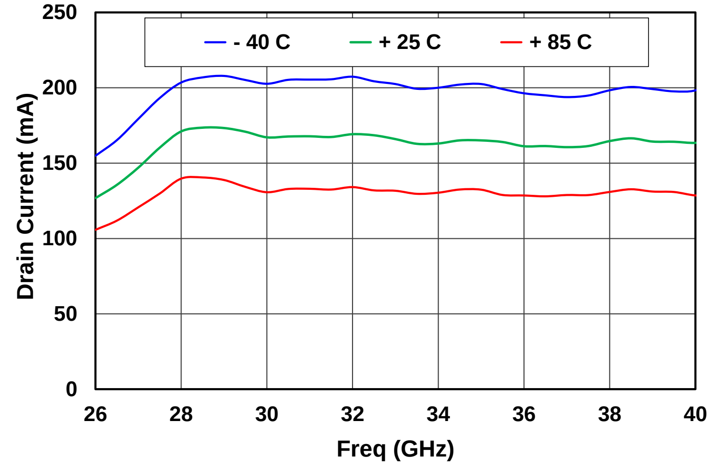
Performance Plots – Large Signal (CW)

Test conditions unless otherwise noted: VD = 20 V, IDQ = 64 mA, Pin = +14dBm, +25 ºC

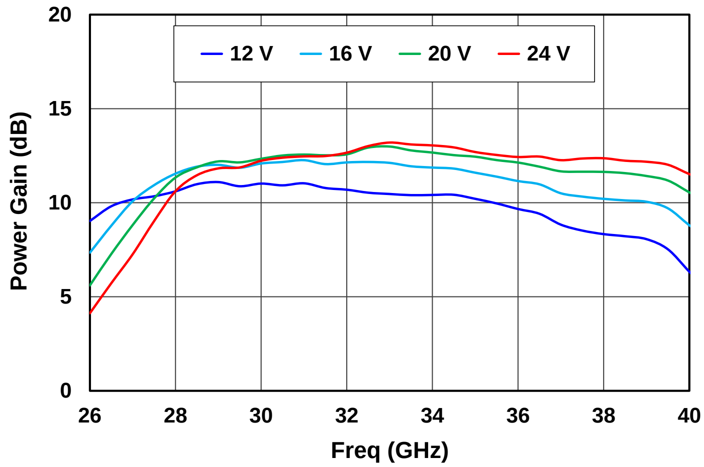
Power Gain vs Temperature



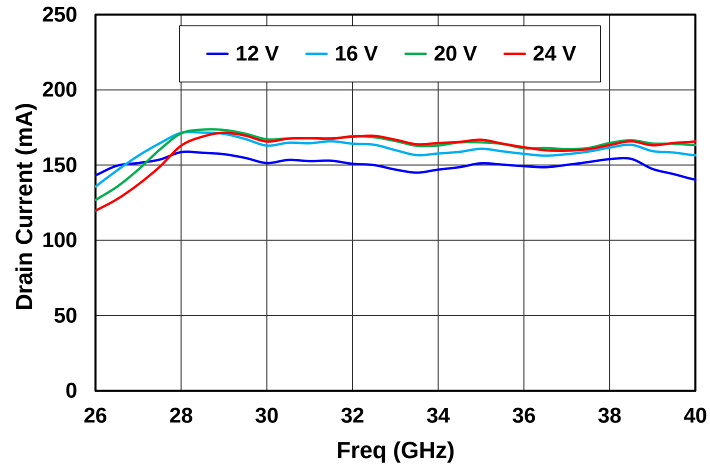
Drain Current vs Temperature



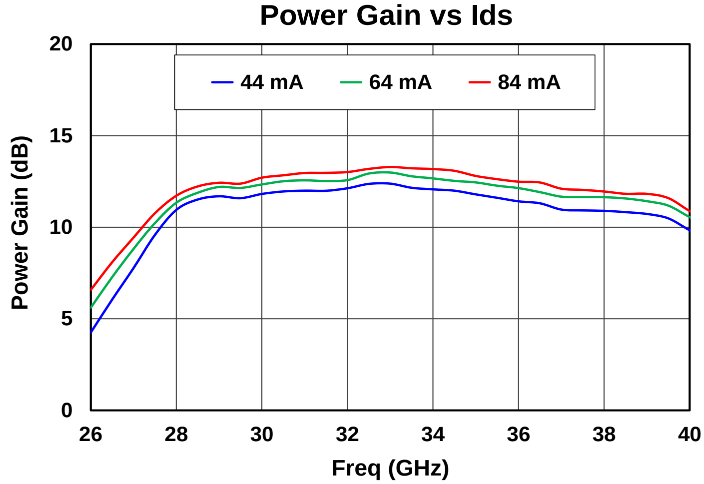
Power Gain vs VD



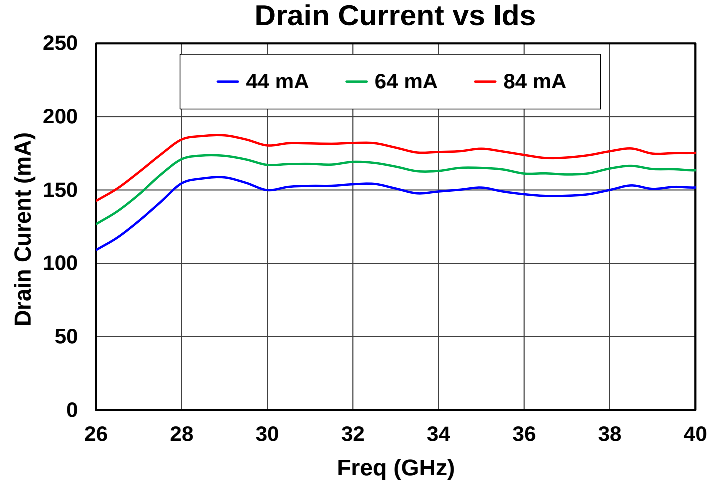
Drain Current vs VD



Power Gain vs Ids

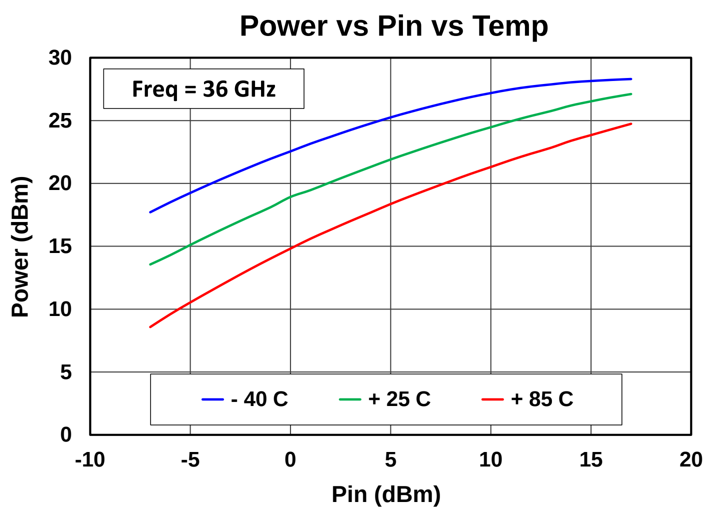


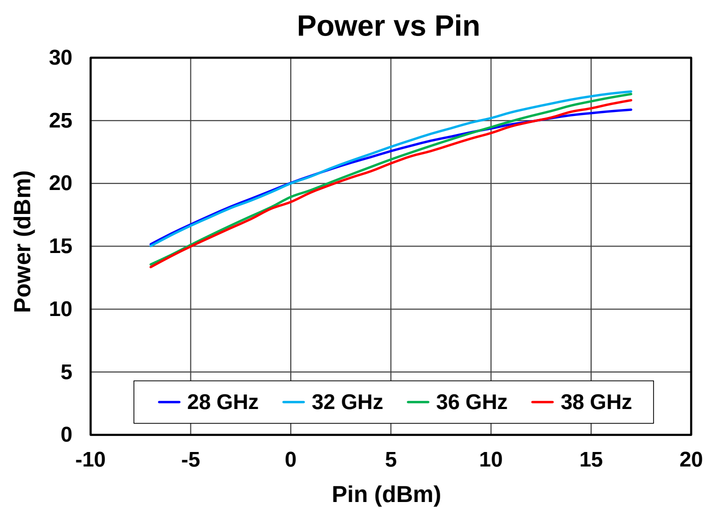
Drain Current vs Ids

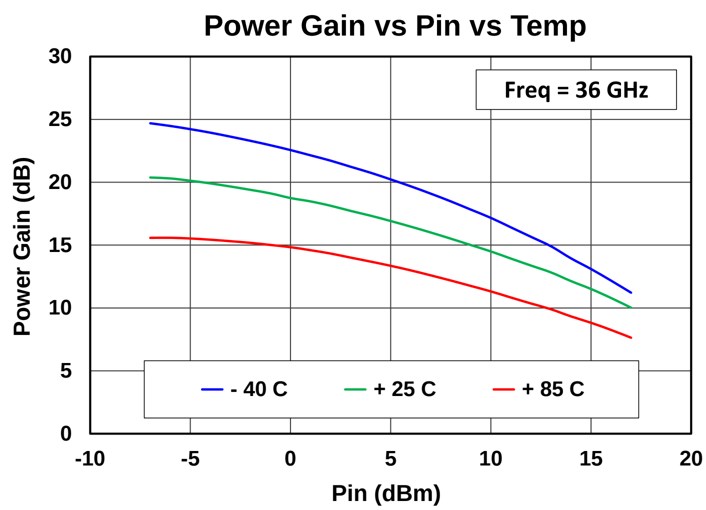


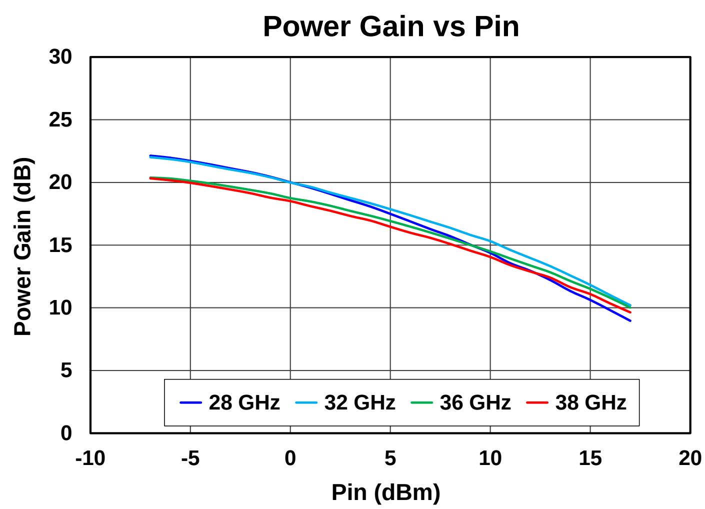
Performance Plots – Large Signal (CW)

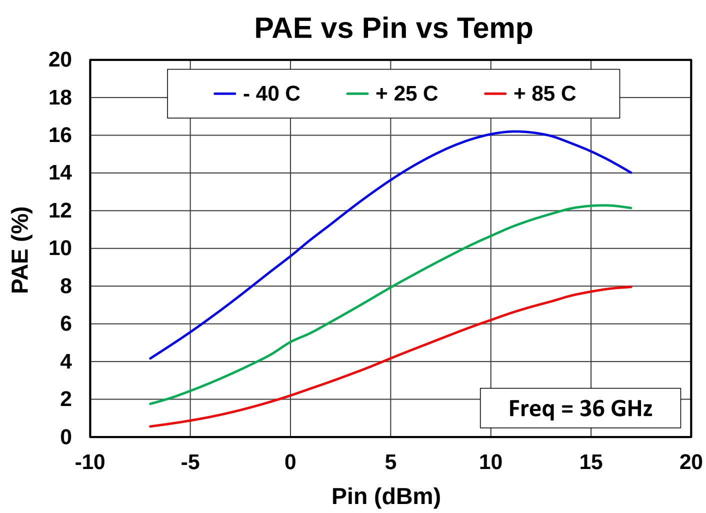
Test conditions unless otherwise noted: VD = 20 V, IDQ = 64 mA, +25 ºC

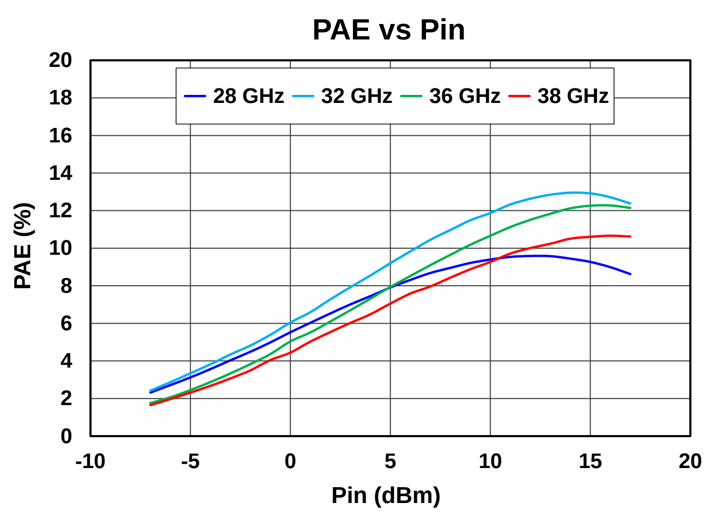








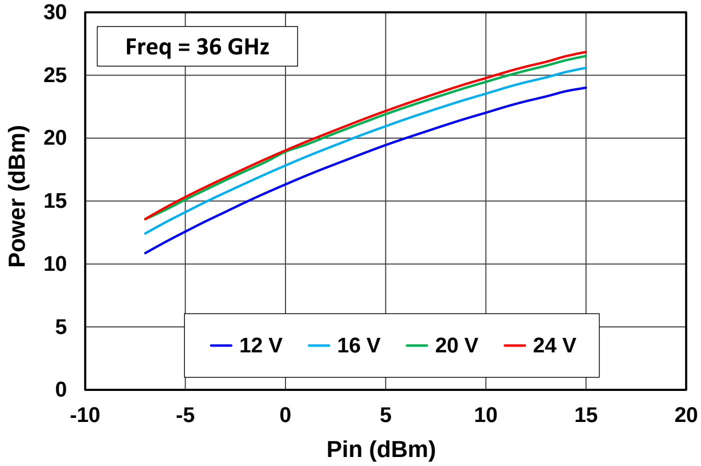




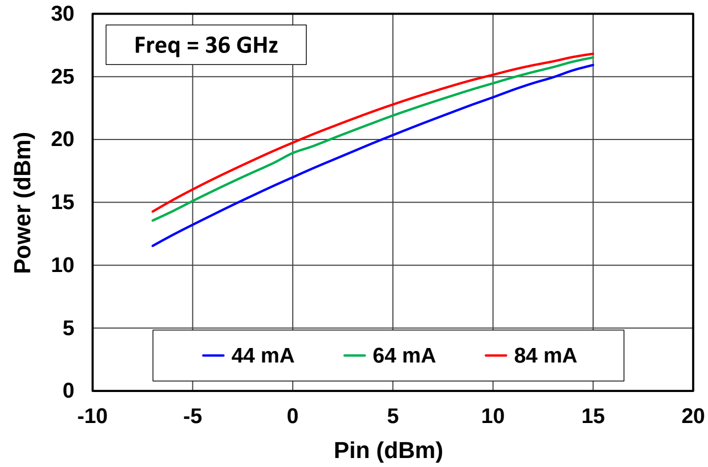
Performance Plots – Large Signal (CW)

Test conditions unless otherwise noted: VD = 20 V, IDQ = 64 mA, +25 ºC

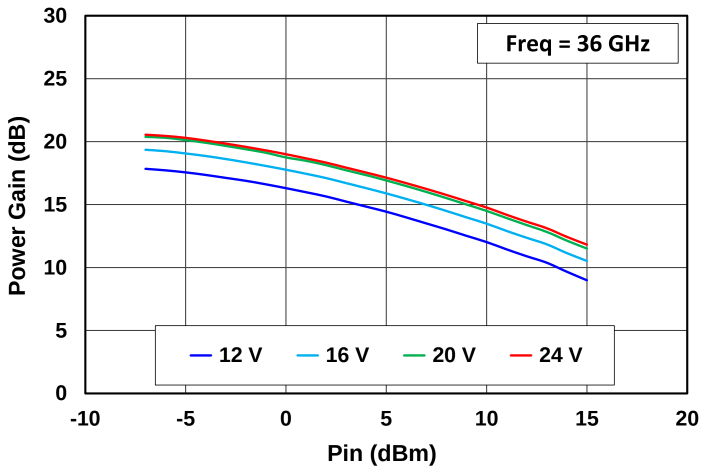
Power vs Pin vs VD



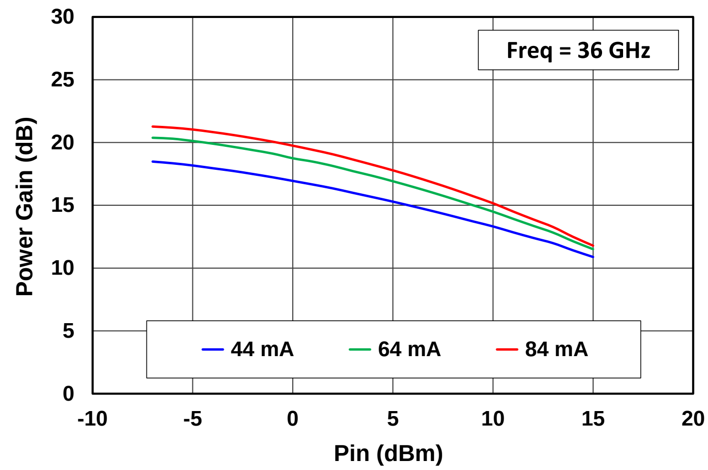
Power vs Pin vs Ids



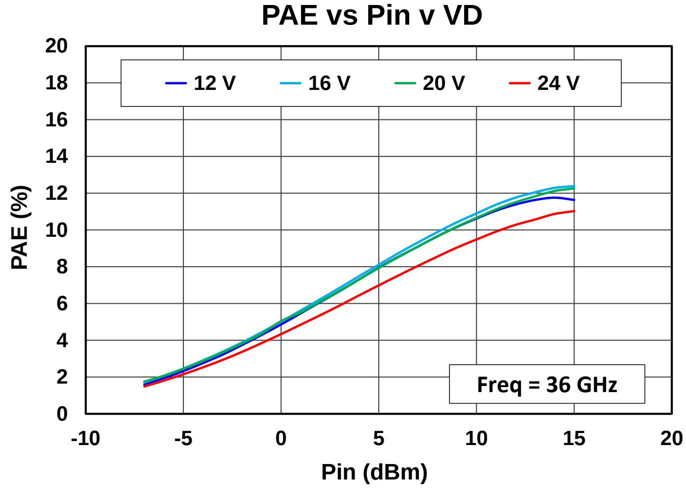
Power Gain vs Pin vs VD



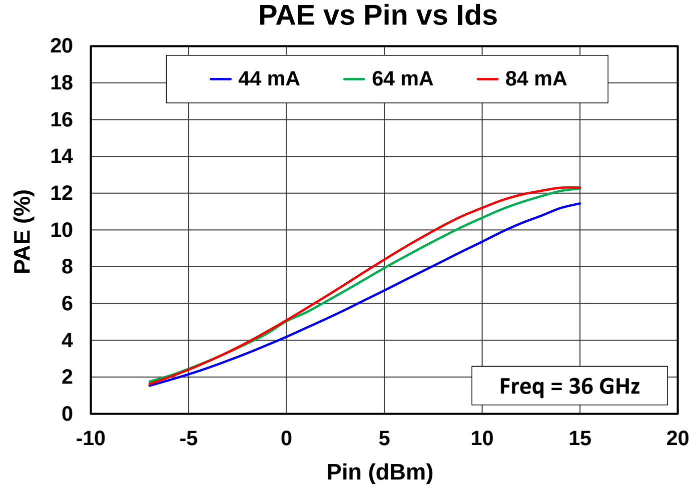
Power Gain vs Pin vs Ids



PAE vs Pin v VD

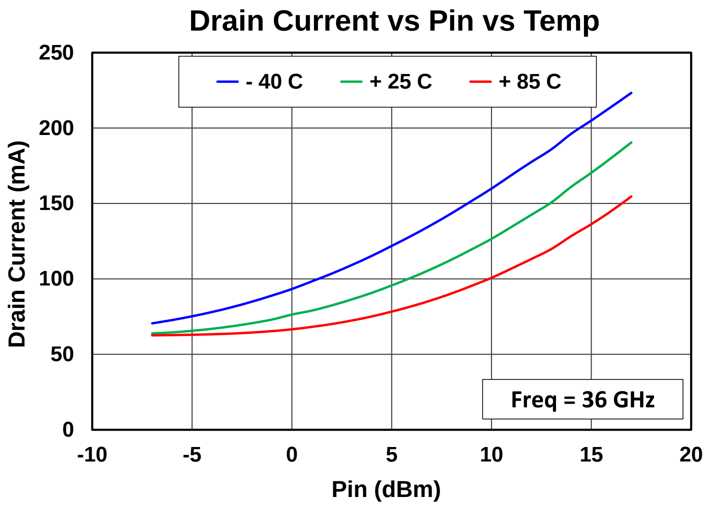


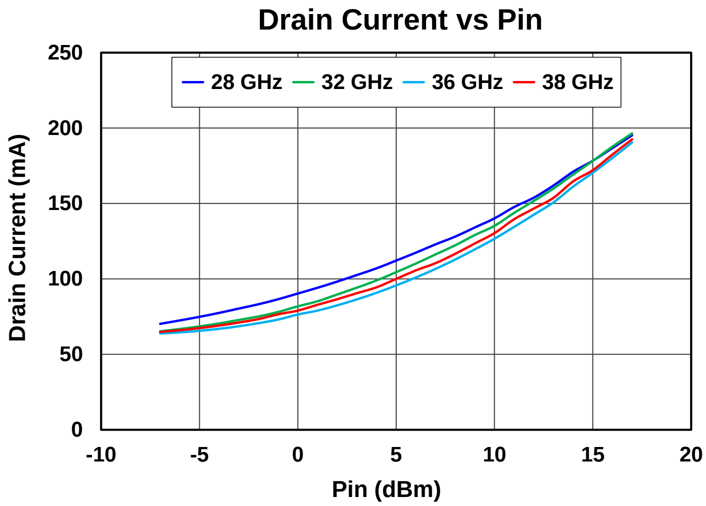
PAE vs Pin vs Ids

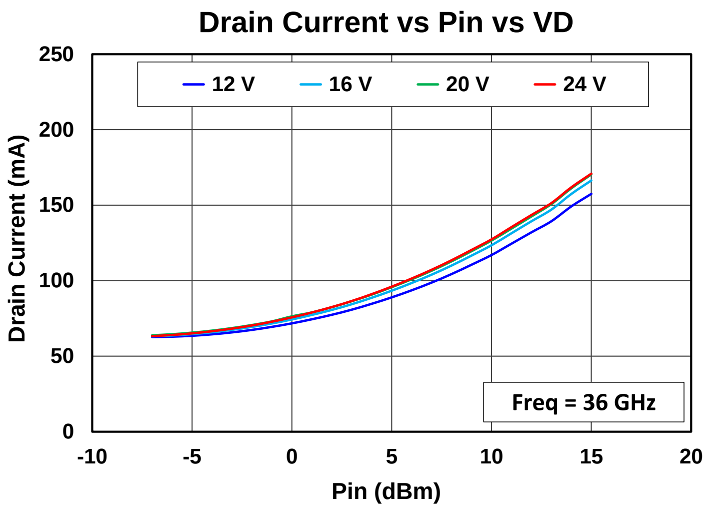


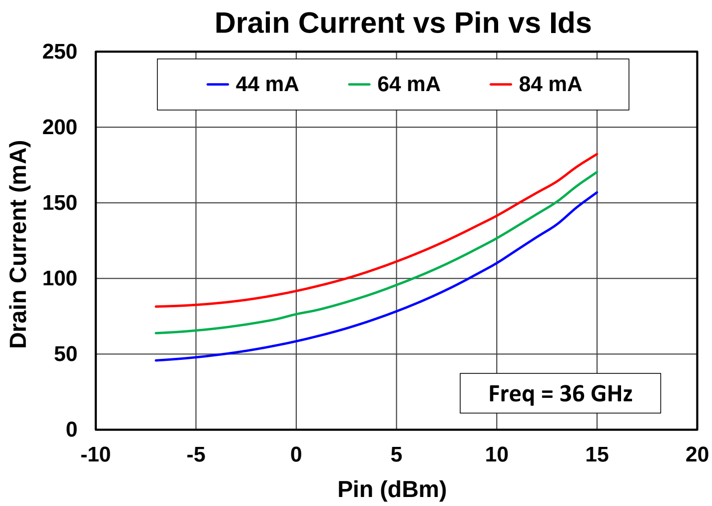
Performance Plots – Large Signal (CW)

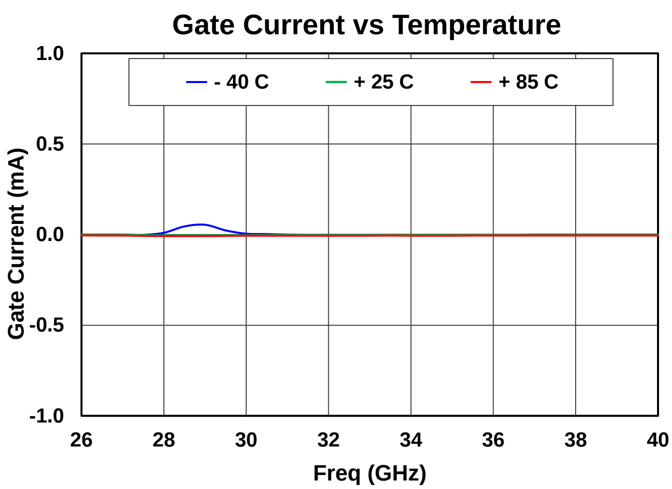
Test conditions unless otherwise noted: VD = 20 V, IDQ = 64 mA, Pin = +14dBm, +25 ºC





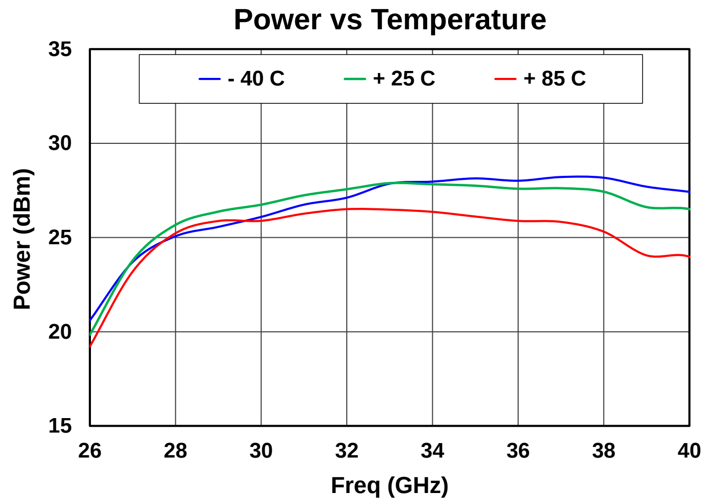


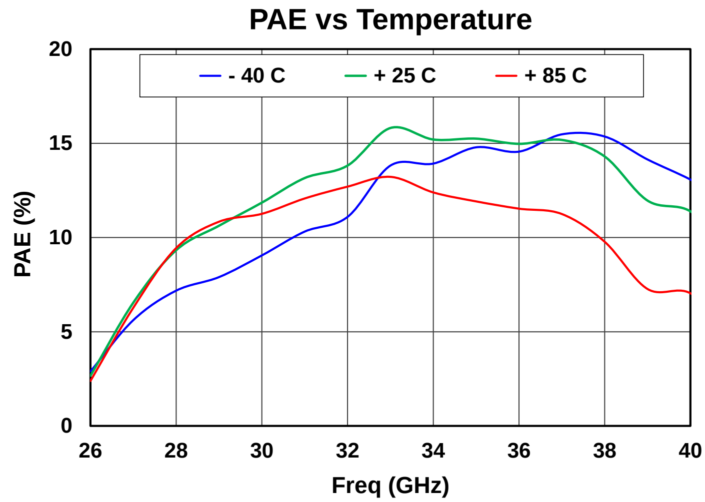


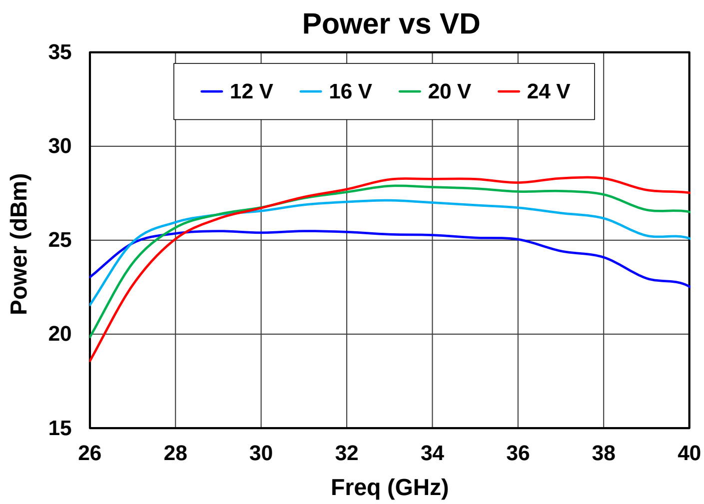


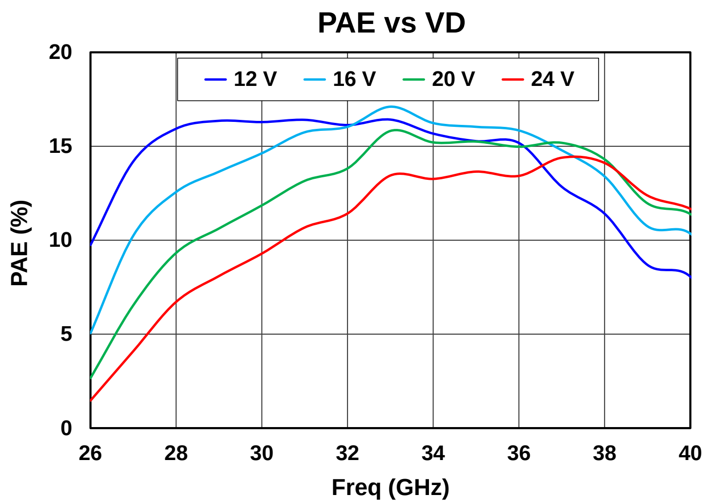
Performance Plots – Large Signal (Pulsed)

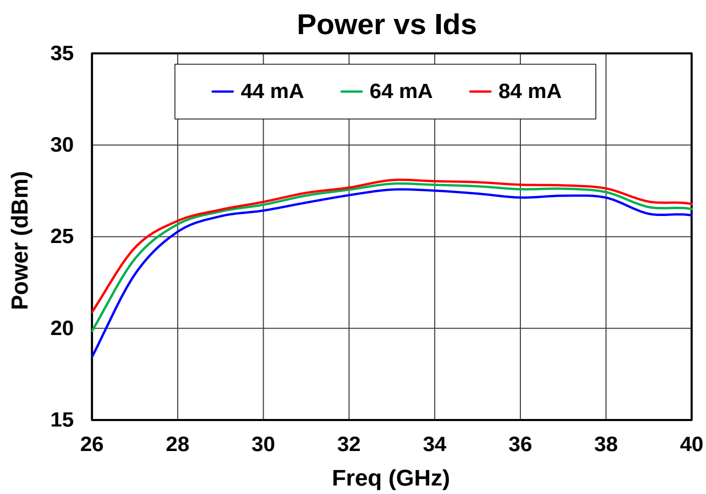
Test conditions unless otherwise noted: VD = 20 V, IDQ = 64 mA, PW = 100 µs, DC = 10%, Pin= +14dBm, +25 ºC

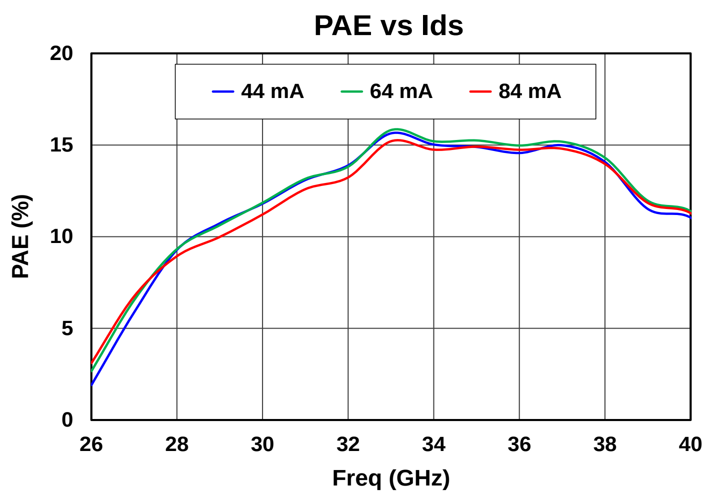








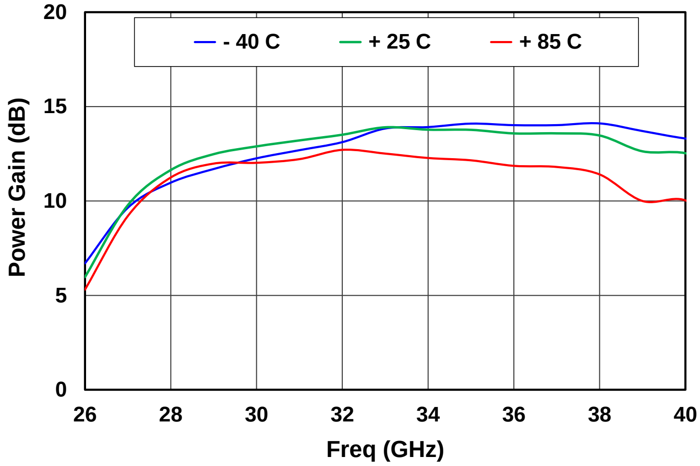




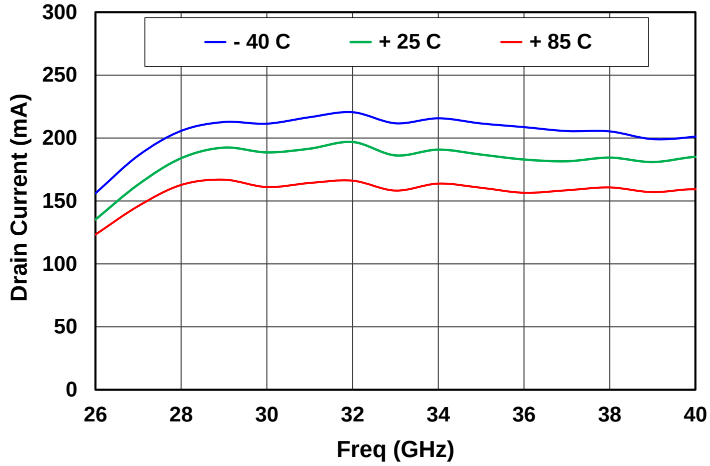
Performance Plots – Large Signal (Pulsed)

Test conditions unless otherwise noted: VD = 20 V, IDQ = 64 mA, PW = 100 µs, DC = 10%, Pin = +14dBm, +25 ºC

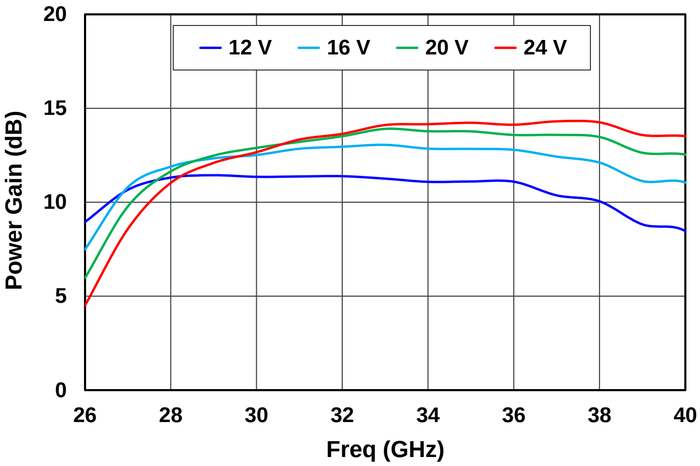
Power Gaain vs Temperature



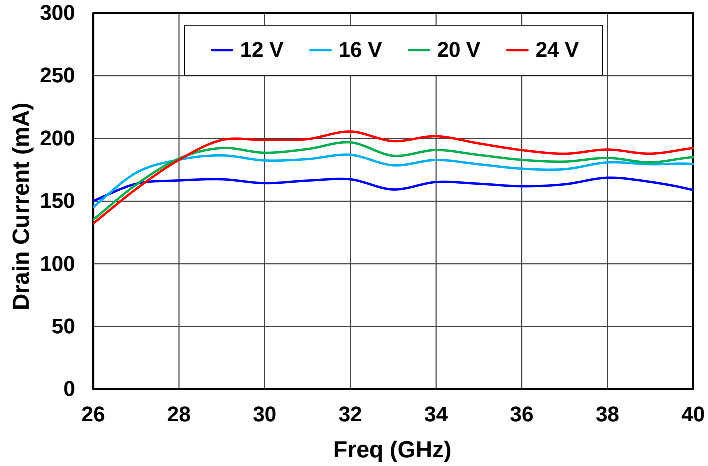
Drain Current vs Temperature



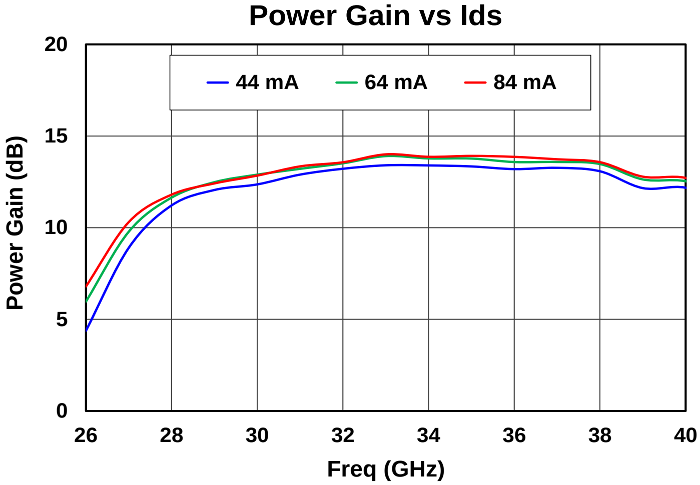
Power Gain vs VD



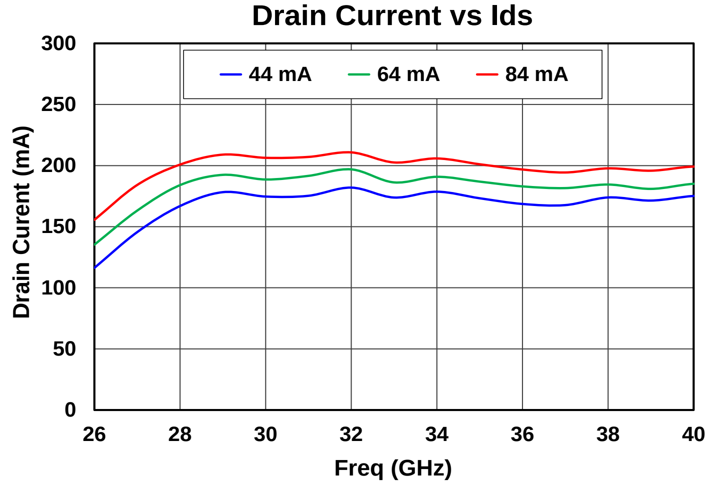
Drain Current vs VD



Power Gain vs Ids

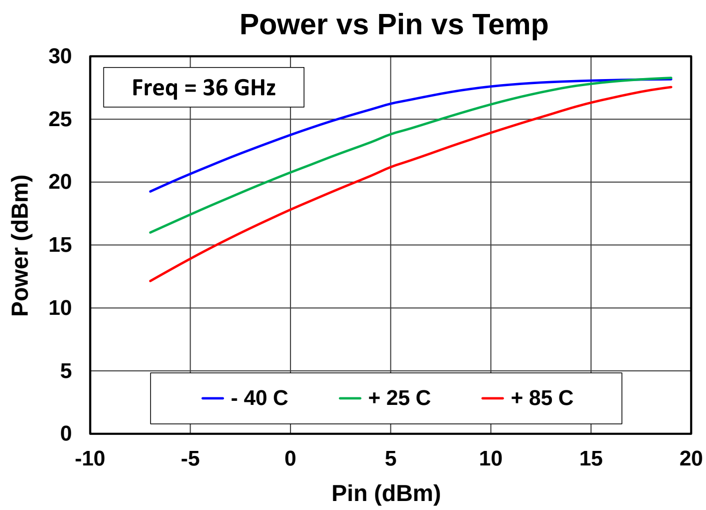


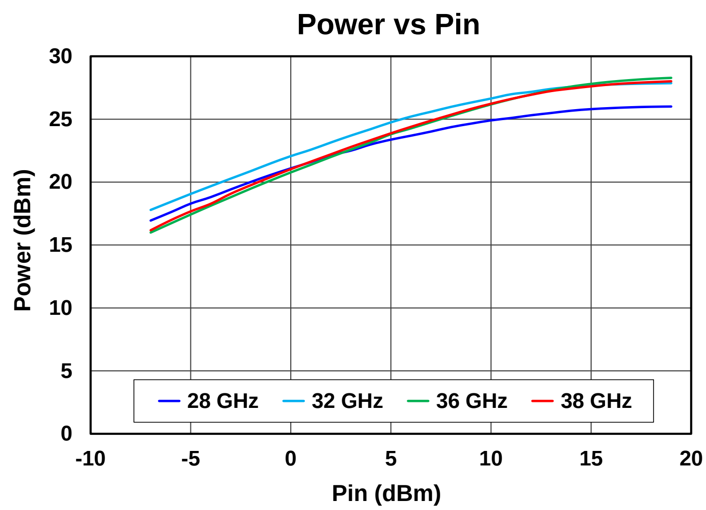
Drain Current vs Ids

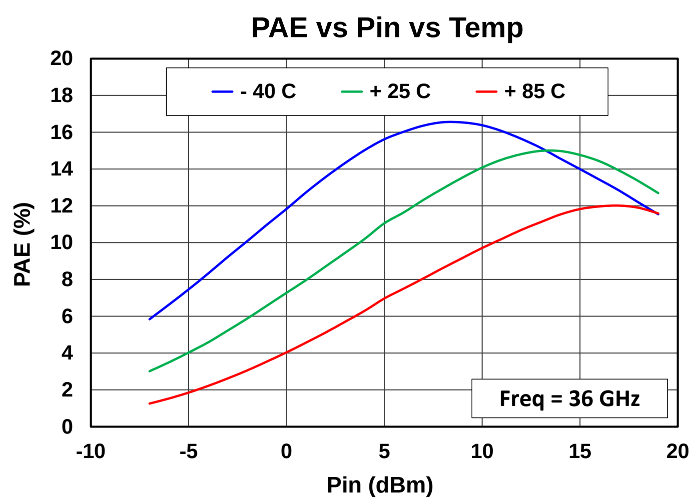


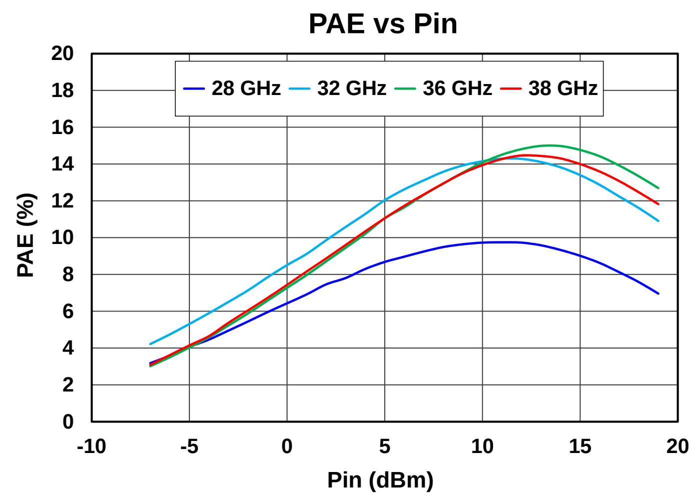
Performance Plots – Large Signal (Pulsed)

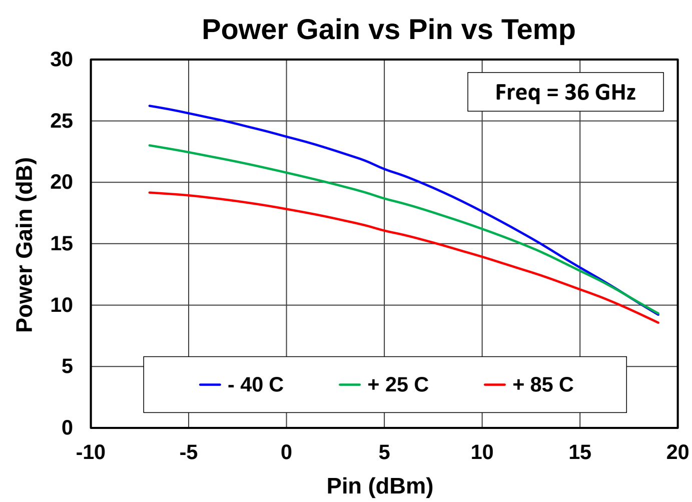
Test conditions unless otherwise noted: VD = 20 V, IDQ = 64 mA, PW = 100 µs, DC = 10%, Pin = +14dBm, +25 ºC

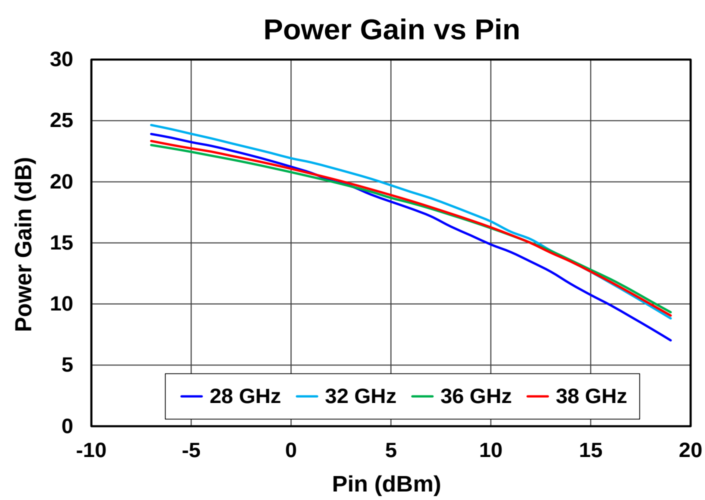








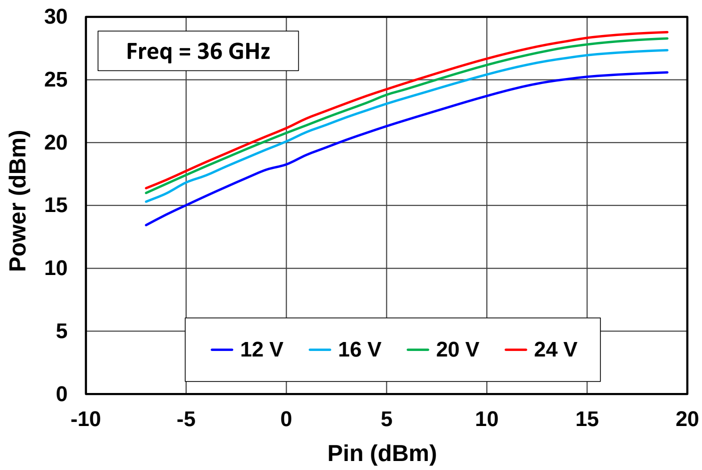




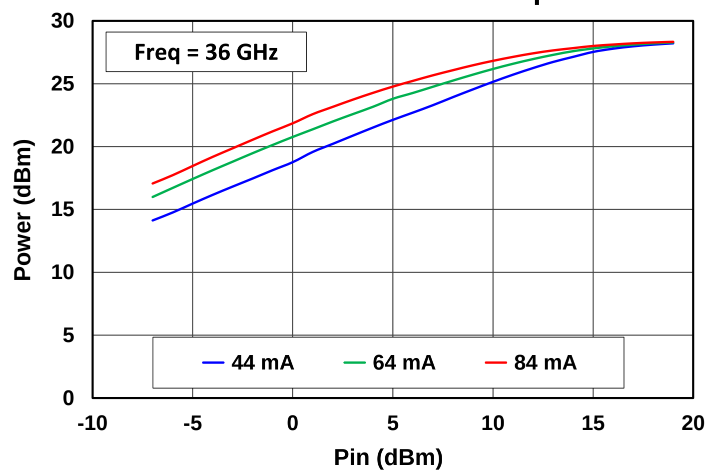
Performance Plots – Large Signal (Pulsed)

Test conditions unless otherwise noted: VD = 20 V, IDQ = 64 mA, PW = 100 µs, DC = 10%, Pin = +14dBm, +25 ºC

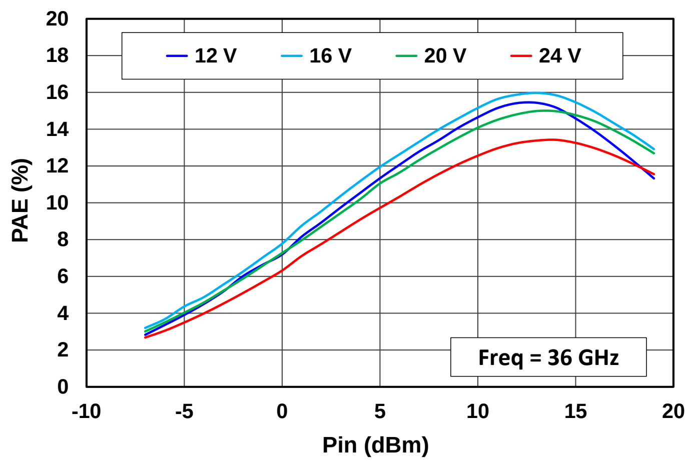
Power vs Pin vs VD



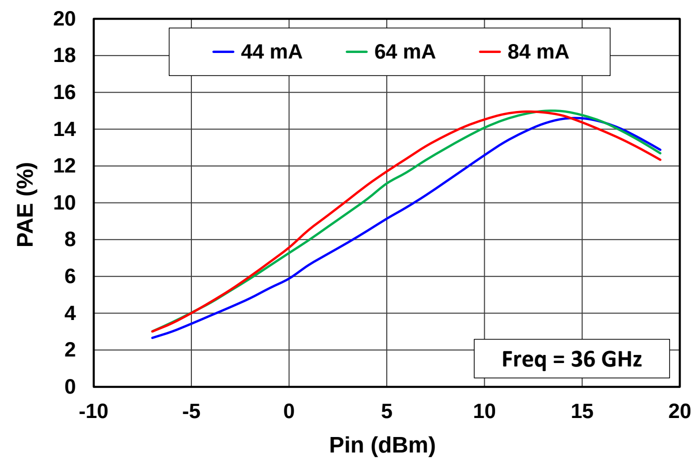
Power vs Pin vs Temp



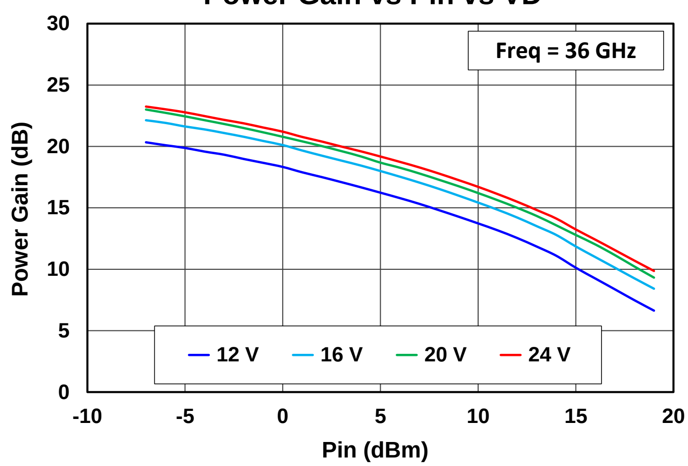
PAE vs Pin vs VD



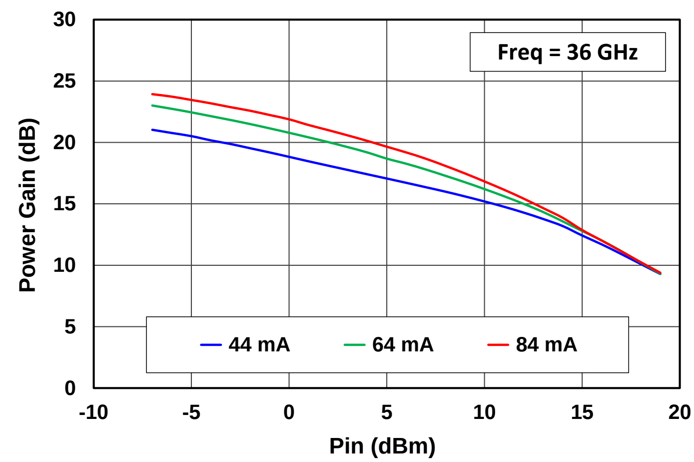
PAE vs Pin vs Ids



Power Gain vs Pin vs VD

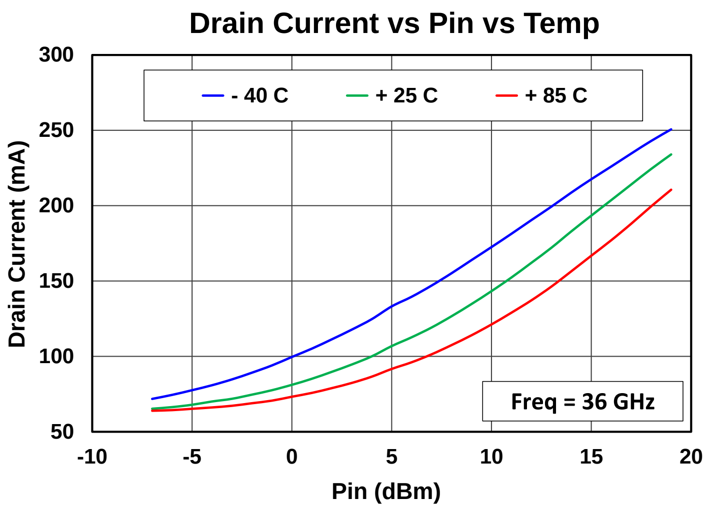


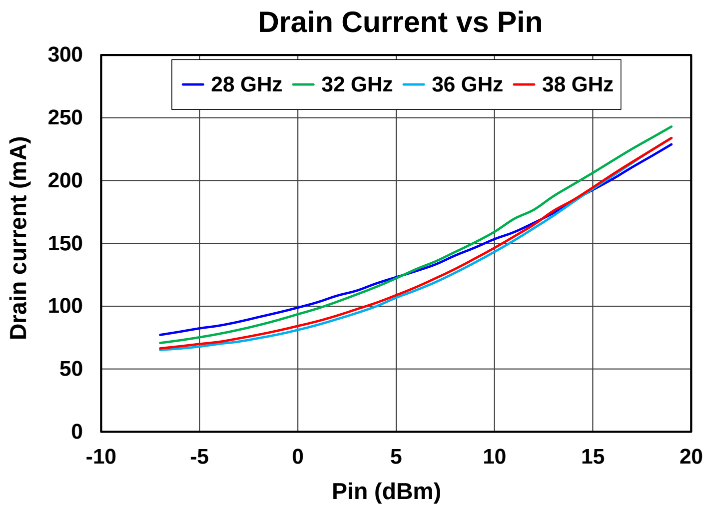
Power Gain vs Pin vs Ids

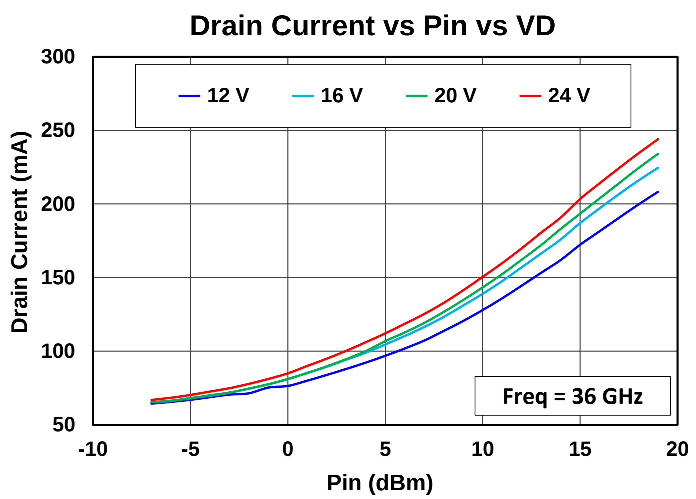


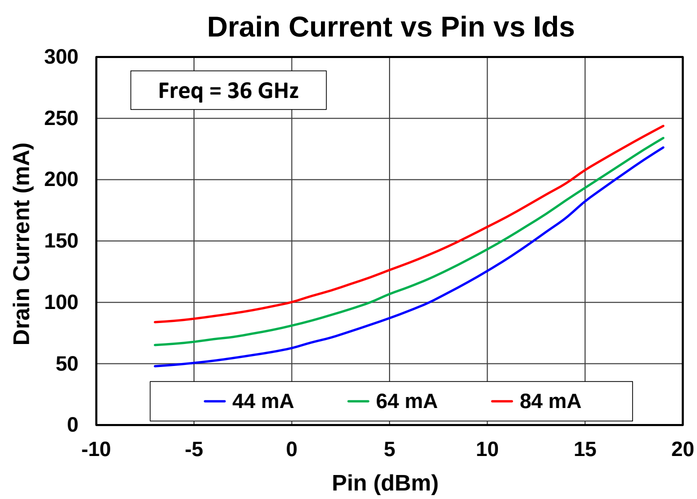
Performance Plots – Large Signal (Pulsed)

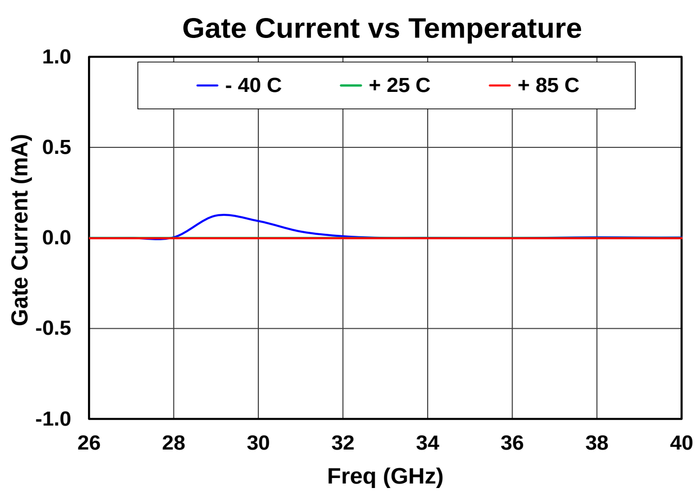
Test conditions unless otherwise noted: VD = 20 V, IDQ = 64 mA, PW = 100 µs, DC = 10%, Pin = +14dBm, +25 ºC





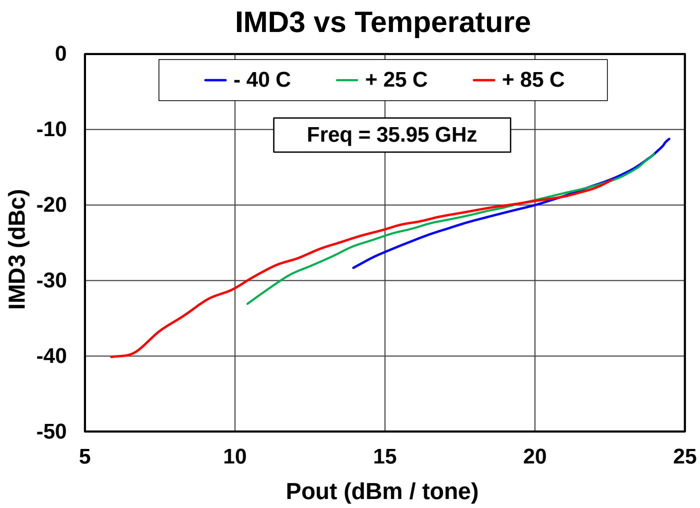


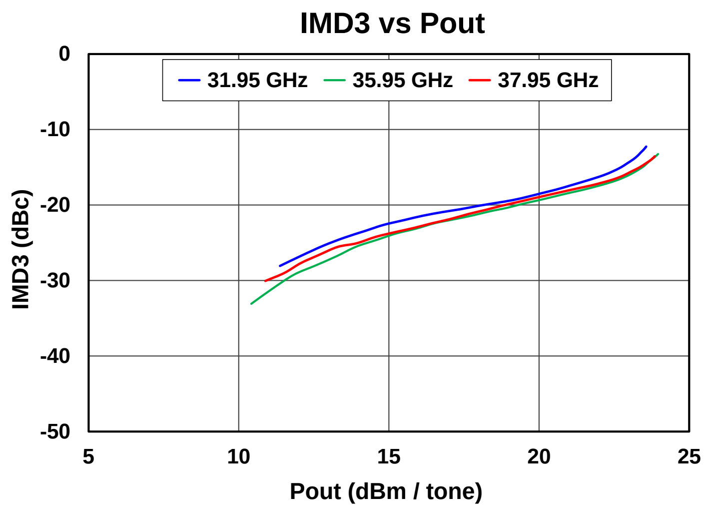


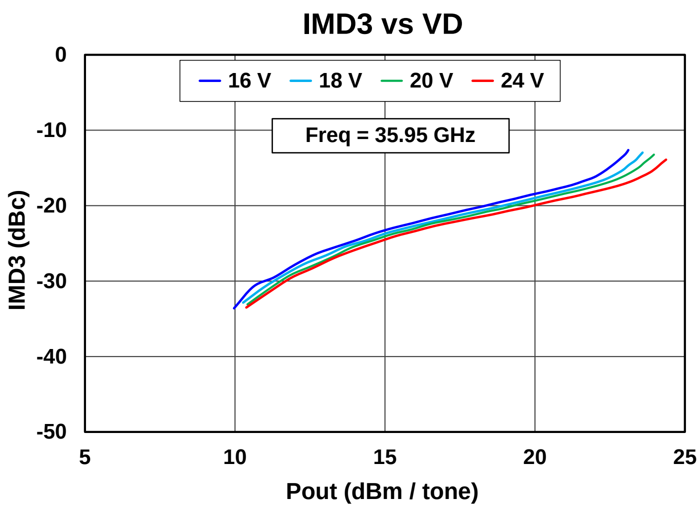


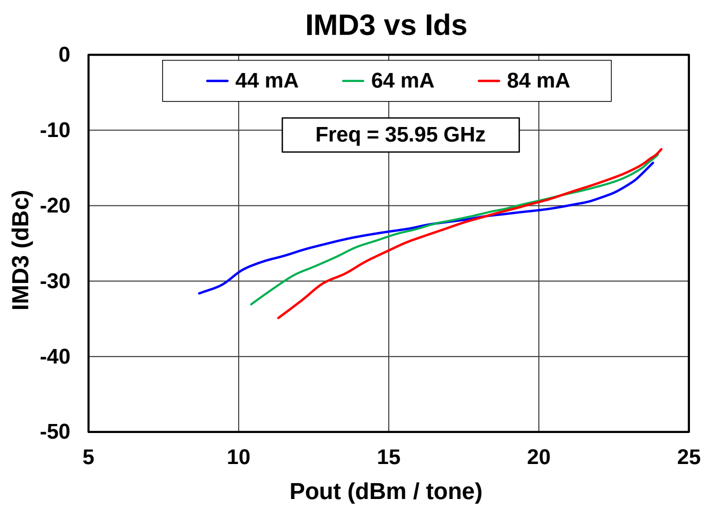
Performance Plots – Linearity

Test conditions unless otherwise noted: VD = 20 V, IDQ = 64 mA, Tone Spacing = 100 MHz, +25 ºC



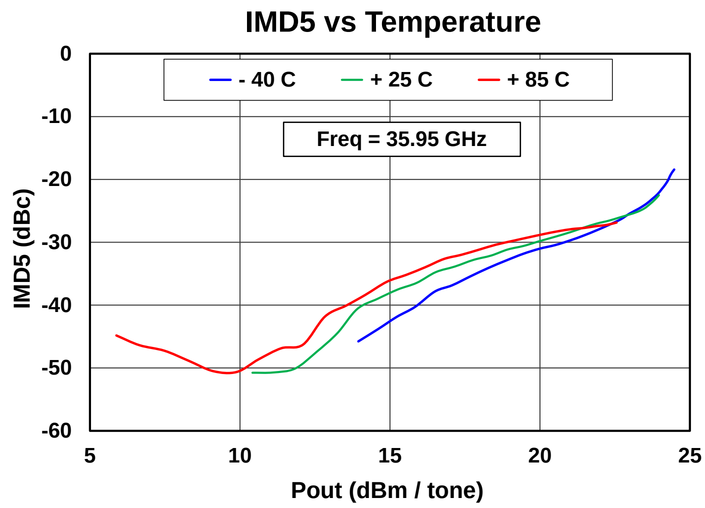


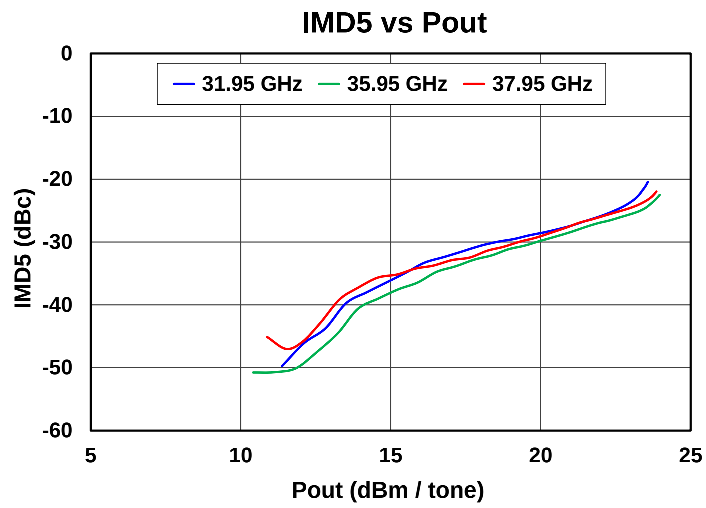


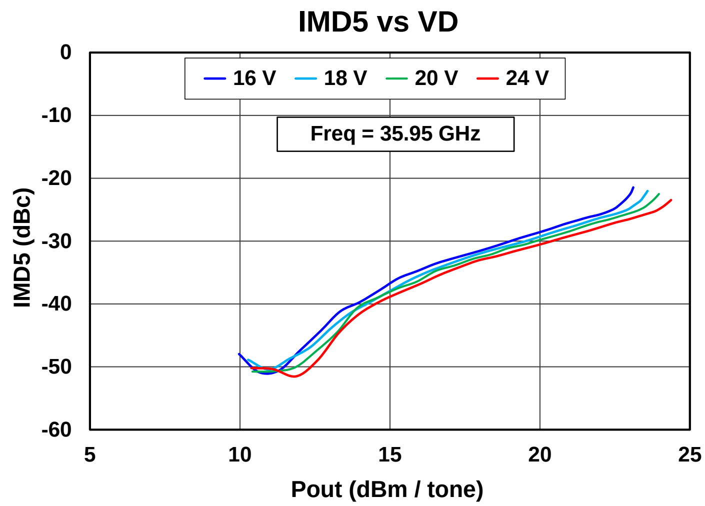


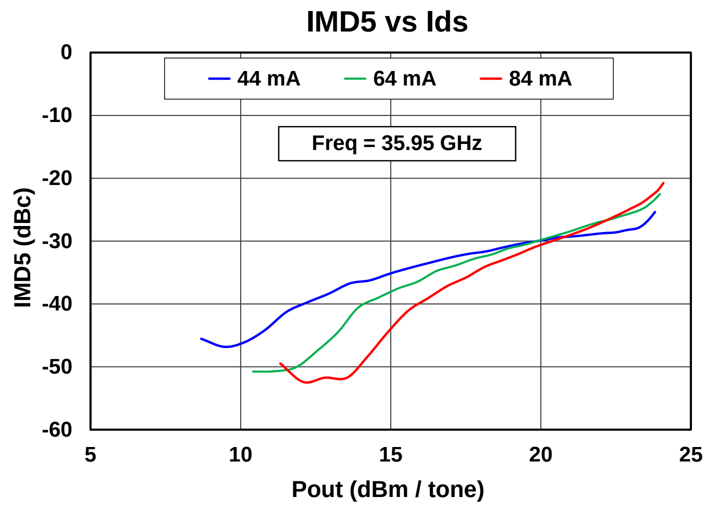
Performance Plots – Linearity

Test conditions unless otherwise noted: VD = 20 V, IDQ = 64 mA, Tone Spacing = 100 MHz, +25 ºC









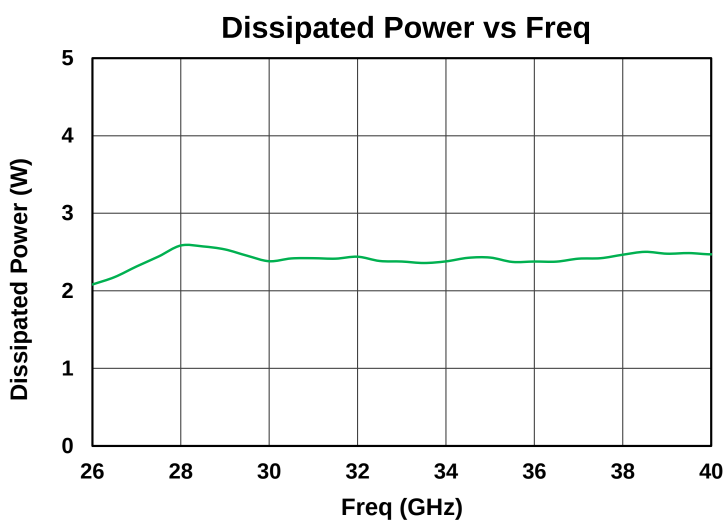
Thermal and Reliability Information

Parameter	Test Conditions	Value	Units
Thermal Resistance (θ_{JC}) (1)	T_{base} = 85 ºC, VD = 20 V, IDQ = 64 mA PDiss = 1.28 W No RF (quiescent DC operation)	21.95	ºC/W
Channel Temperature, T_{CH} (No RF) (2)		113.1	°C
Thermal Resistance (θ_{JC}) (1)	T_{base} = 85 ºC, VD = 20 V, IDQ = 64 mA Freq = 28 GHz, I_{D_Drive} = 139.7 mA, Pin = 14 dBm Pout = 23.73 dBm, PDiss = 2.59 W	23.17	ºC/W
Channel Temperature, T_{CH} (Under RF) (2)		145.0	°C

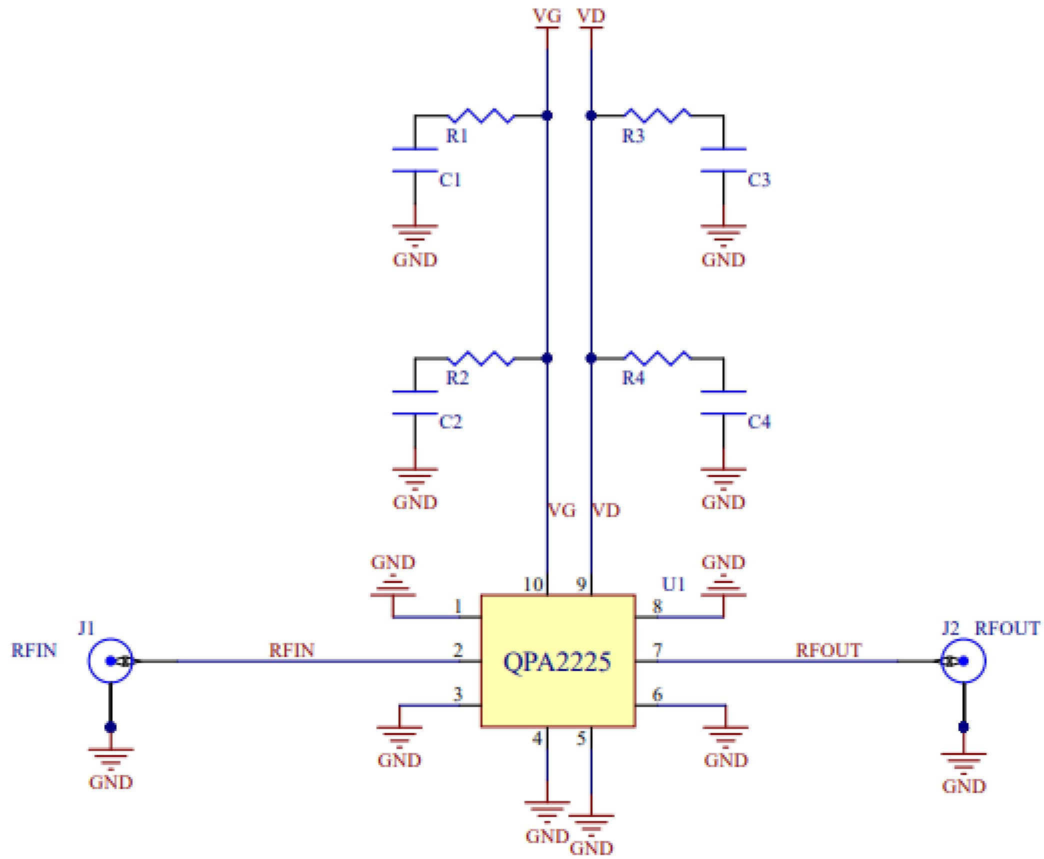
Notes:
1. Thermal resistance referenced to the back side of package
2. Refer to the following document: GaN Device Channel Temperature, Thermal Resistance, and Reliability Estimates

Power Dissipation

Test conditions, unless otherwise noted: CW, VD = 20 V, IDQ = 64 mA, Pin = +14dBm, +85 ºC



Application Circuit



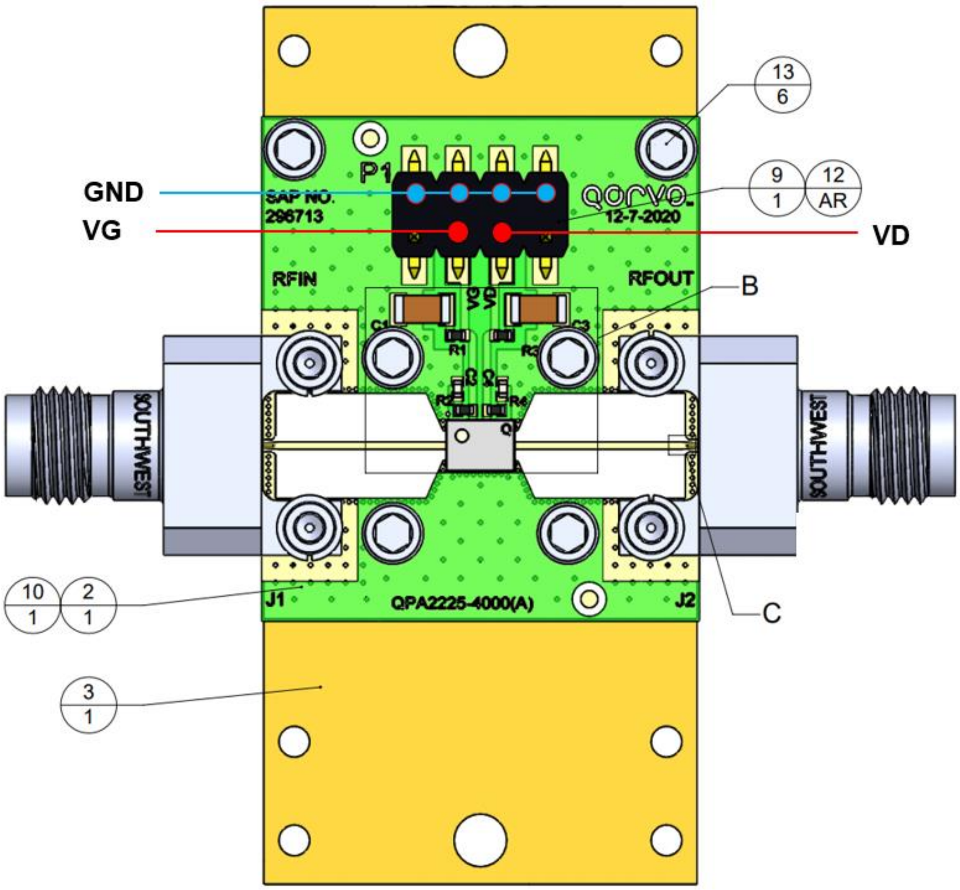
Bias-Up Procedure

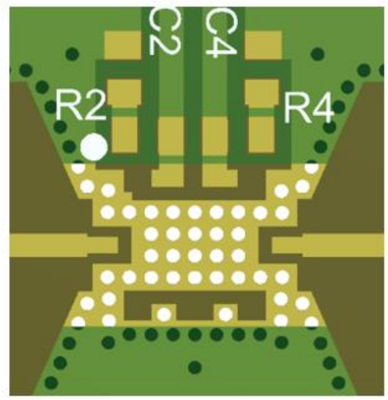
1. Set drain current limit to 500 mA, gate limit to 10 mA
2. Set VG to −4.0 V
3. Set VD to +20 V
4. Adjust VG more positive until IDQ ≈ 64 mA
5. Apply RF signal

Bias-Down Procedure

1. Turn off RF signal
2. Reduce VG to −4.0 V. Ensure IDQ ~ 0 mA
4. Set VD to 0 V
4. Turn off VD supply
5. Turn off VG supply

Evaluation Board and Assembly



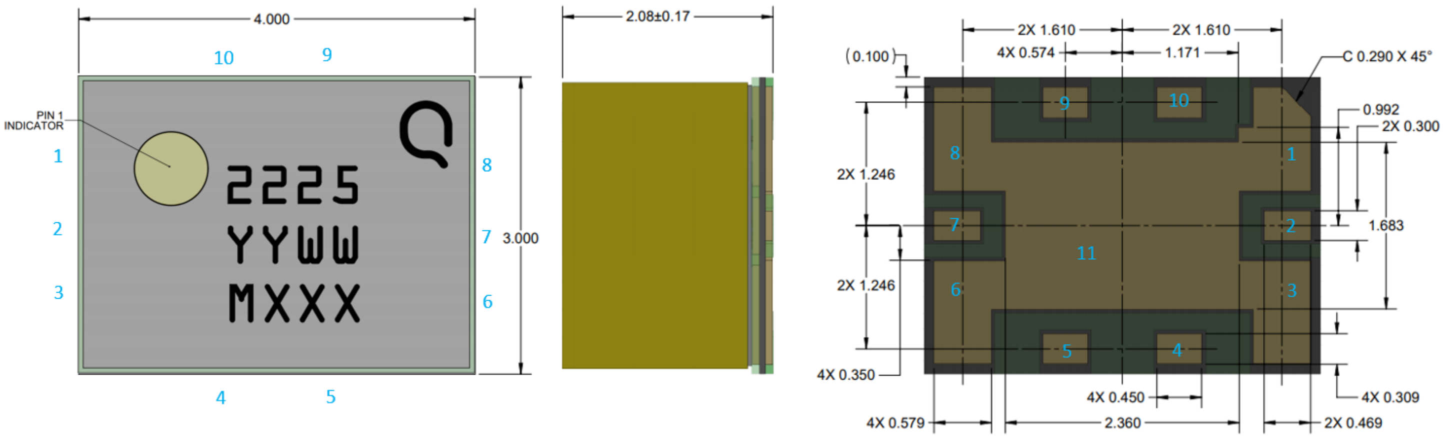


Mounting pad details

RF Layer is 0.008” thick Rogers Corp. RO4003C (ε_r = 3.35). 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.

Ref. Des.	Component	Value	Manuf.	Part Number
C1, C3	10 uF	CAP, 10 uF, 20%, 50 V, 20%, X5R, 1206	Various	
C2, C4	0.01 uF	CAP, 0.01 uF, 10%, 50 V, X7R, 0402	Various	
R1	5.1 Ω	RES, 5.1 OHM, 5%, 50 V, 0402	Various	
R2, R3, R4	0 Ω	RES, 0 OHM, JMPR, 0402	Various	
J1, J2	RF Connectors	CONN, 2.92mm, End Launch	Southwest Microwave	1092-01A-5

Mechanical Drawing & Pad Description

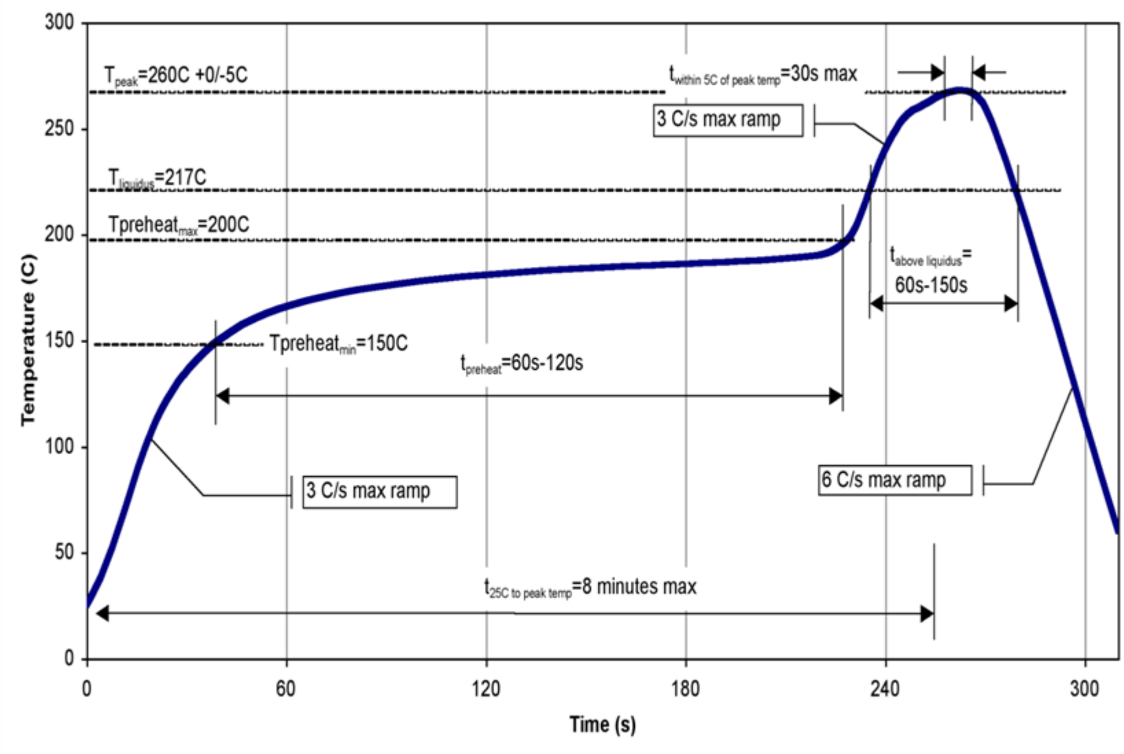


Dimensions in mm
Package is air cavity and non-hermetic, NiAu gold plated leads with minimum gold thickness of 0.1 um
Part Marking: QPA2225 = Part Number, YY = Part Assembly Year, WW = Part Assembly Week, MXXX = Batch ID

Pin Number	Label	Description
1, 3, 6, 8	GND	Ground
2	RFIN	RF input, DC grounded
4, 5	N/C	No internal connections, however need to be grounded
7	RFOUT	RF output, DC grounded
9	VD	Amplifier drain supply
10	VG	Amplifier gate control
11	GND	Bottom pad, ground

Solderability and Recommended Soldering Temperature Profile

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



Handling Precautions

Parameter	Rating	Standard
ESD – Human Body Model (HBM)	0B	ESDA / JEDEC JS-001-2017
ESD – Charged Device Model (CDM)	C3	ESDA / JEDEC JS-002-2014
MSL – Convection Reflow 260 °C	MSL5a	JEDEC standard IPC/JEDEC J-STD-020

Caution!
ESD-Sensitive Device

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
- Antimony Free
- TBBP-A ($C_{15}H_{12}Br_{4}0_{2}$) 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

Important Notice

The information contained in this Data Sheet and any associated documents ("Data Sheet Information") is believed to be reliable; however, Qorvo makes no warranties regarding the Data Sheet Information and assumes no responsibility or liability whatsoever for the use of said information. All Data Sheet Information is subject to change without notice. Customers should obtain and verify the latest relevant Data Sheet Information before placing orders for Qorvo® products. Data Sheet Information or the use thereof does not grant, explicitly, implicitly or otherwise any rights or licenses to any third party with respect to patents or any other intellectual property whether with regard to such Data Sheet Information itself or anything described by such information.

DATA SHEET 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. Applications described in the Data Sheet Information are for illustrative purposes only. Customers are responsible for validating that a particular product described in the Data Sheet Information is suitable for use in a particular application.