QPA2211

27.5 – 31 GHz 10 W GaN Power Amplifier

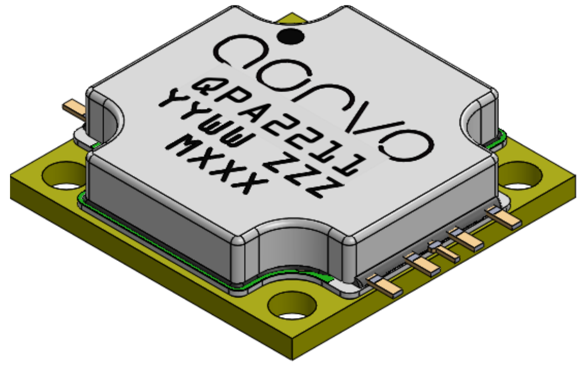
Product Description

Qorvo's QPA2211 is a Ka-band power amplifier fabricated on Qorvo's 0.15um GaN on SiC process (QGaN15). Operating from 27.5 to 31 GHz, it achieves 5 W linear power with lower than −25 dBc intermodulation distortion products and 24 dB small signal gain. Saturated output power is greater than 10 W with and associated power-added efficiency of 25%.

QPA2211 is packaged in a 10-lead 15 x 15 mm bolt-down package with a Cu base for superior thermal management. To simplify system integration, the QPA2211 is fully matched to 50 ohms with integrated DC blocking caps on both I/O ports.

QPA2211 is ideally suited to support satellite communications and 5G infrastructure.

Lead-free and RoHS compliant.

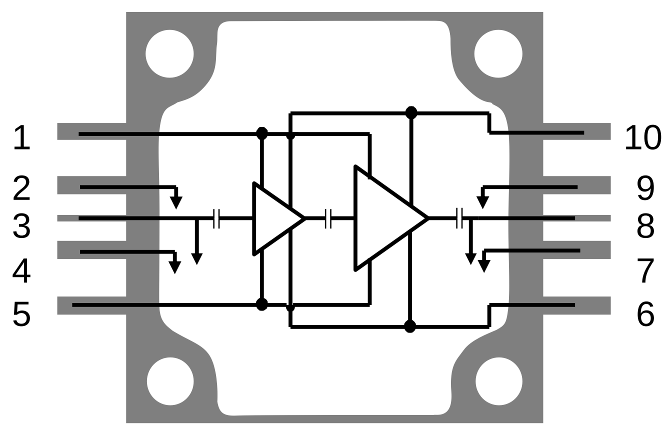


Product Features

- Frequency Range: 27.5 – 31 GHz
- P_{SAT} (P_{IN} = 24 dBm): 41 dBm
- PAE (P_{IN} = 24 dBm): 25 %
- Power Gain (P_{IN} = 24 dBm): 17 dB
- Small Signal Gain: 24 dB
- IMD3 (P_{OUT} = 34 dBm/tone): −25 dBc
- Bias: V_D = 22 V, I_{DQ} = 280 mA
- Package Dimensions: 15.2 x 15.2 x 3.5 mm
- Package base is pure Cu offering superior thermal management

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

Functional Block Diagram



Applications

- 5G Infrastructure
- Satellite Communications

Ordering Information

Part No.	Description
QPA2211	27.5 – 31 GHz 10 W GaN Power Amplifier
QPA2211EVB	Evaluation Board

Absolute Maximum Ratings

Parameter	Value / Range
Drain Voltage (V_D)	29.5 V
Gate Voltage Range (V_G)	−5 to 0 V
Drain Current (I_D)	5956 mA
Gate Current (I_G)	See plot page 17
Power Dissipation (P_{DISS}), 85°C	39.3 W
Input Power (P_{IN}), 50 Ω, V_D=22 V, I_{DQ}=280 mA, 85 °C	34 dBm
Input Power (P_{IN}), 3:1 VSWR, V_D=22 V, I_{DQ}=280 mA, 85 °C	34 dBm
Package Soldering 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 Operating Conditions

Parameter	Value / Range
Drain Voltage (V_D)	22 V
Drain Current (I_{DQ})	280 mA
Temperature Range	−40 to +85 °C

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

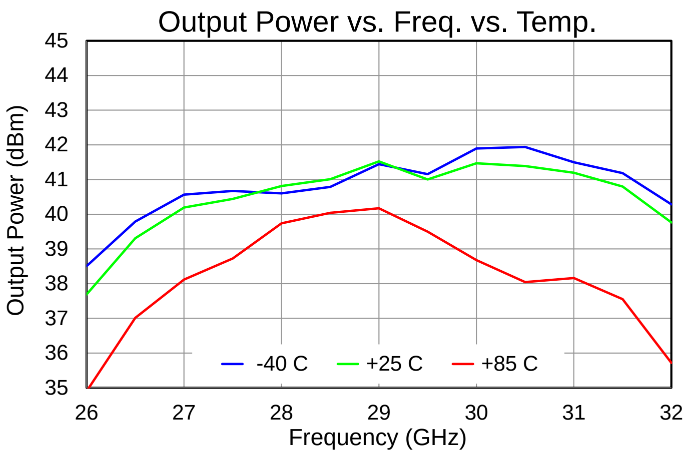
Electrical Specifications

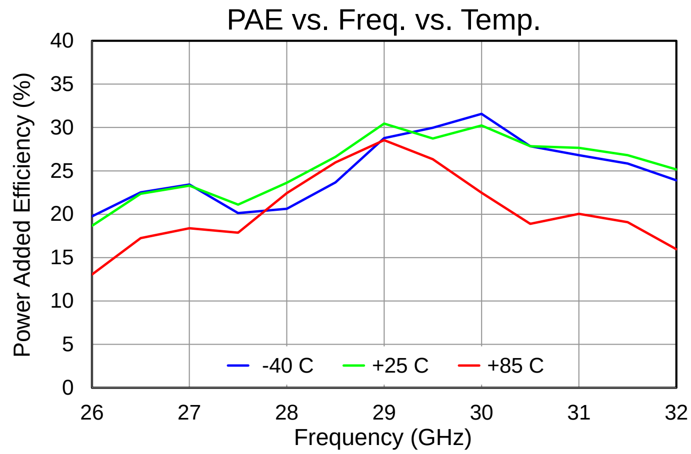
Parameter		Min	Typ	Max	Units
Operational Frequency		27		31	GHz
Output Power (P_{IN}=24 dBm)	27.5 GHz 29 GHz 31 GHz		40.4 41.5 41.2		dBm dBm dBm
Power Added Efficiency (P_{IN}=24 dBm)	27.5 GHz 29 GHz 31 GHz		20.6 30.5 27.7		% % %
Small Signal Gain	27.5 GHz 29 GHz 31 GHz		26.5 25.7 23.7		dB dB dB
Input Return Loss	27.5 GHz 29 GHz 31 GHz		16 13 18		dB dB dB
Output Return Loss	27.5 GHz 29 GHz 31 GHz		3 15 12		dB dB dB
IMD3 (P_{OUT}/Tone = 34 dBm, 10 MHz tone spacing)	28 GHz 29 GHz 31 GHz		−19 −26 −26		dBc dBc dBc
P_{OUT} Temp. Coeff. (85 °C to 25 °C, P_{IN} = 24 dBm))			−0.033		dB/°C
Sm. Sig. Gain Temp. Coefficient (85 °C to −40 °C)			−0.110		dB/°C
Gate Leakage (V_D = 10 V, V_G = −3.7)		−9.25			mA

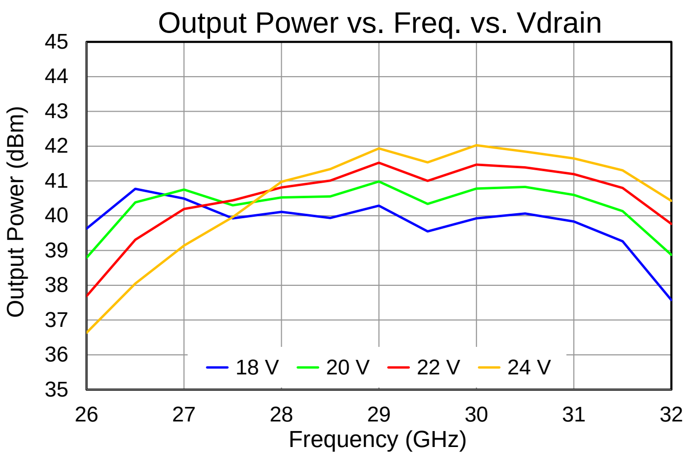
Test conditions, unless otherwise noted: T = 25 °C, V_D = 22 V, I_{DQ} = 280 mA

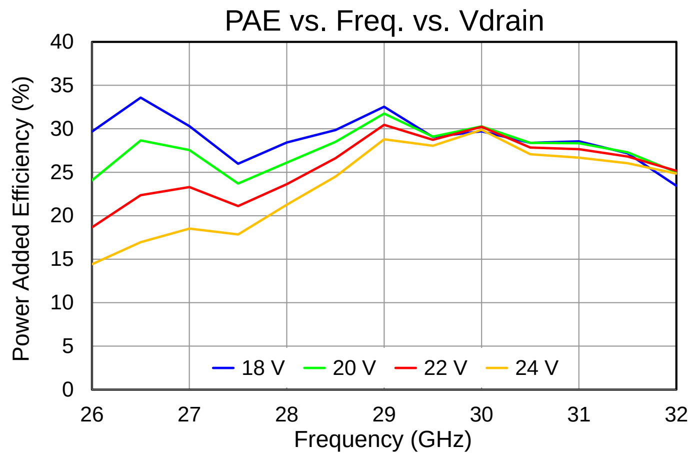
Performance Plots – Large Signal

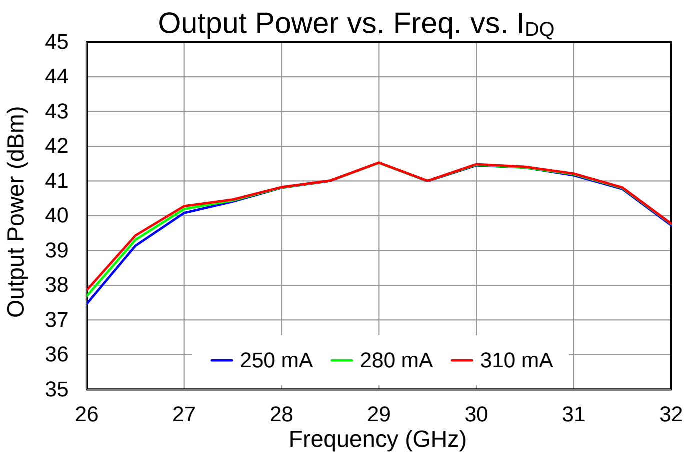
Test conditions, unless otherwise noted: V_D = 22 V, I_{DQ} = 280 mA, T = 25 °C, P_{IN} = 24 dBm

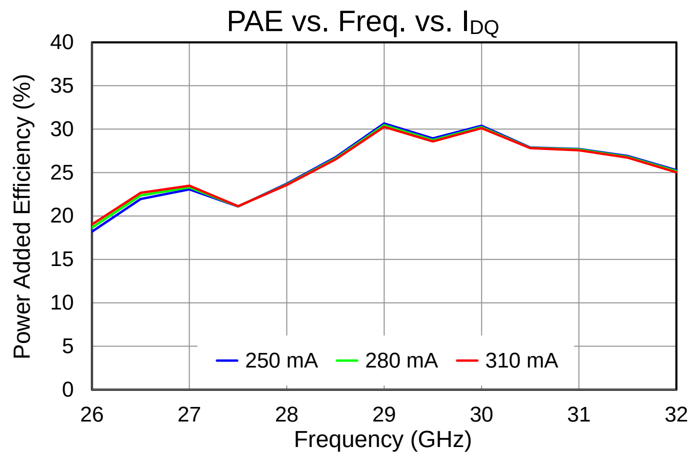






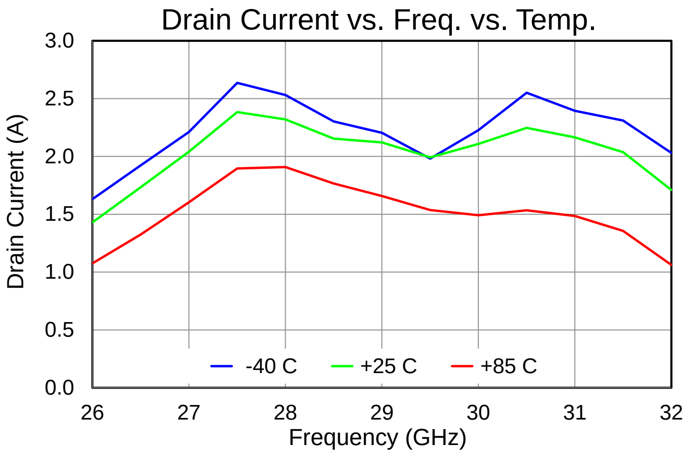


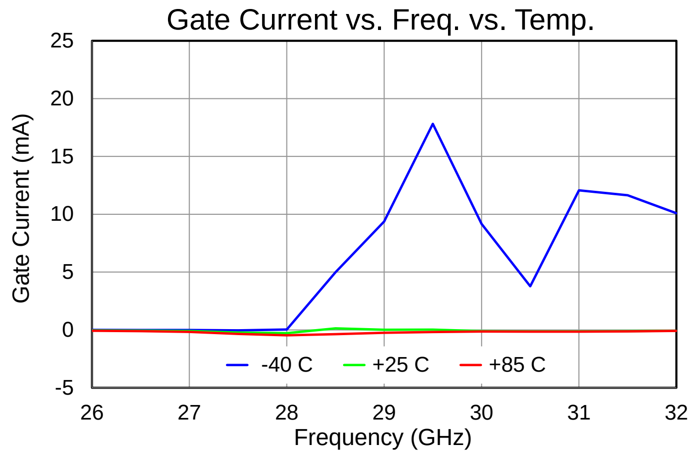


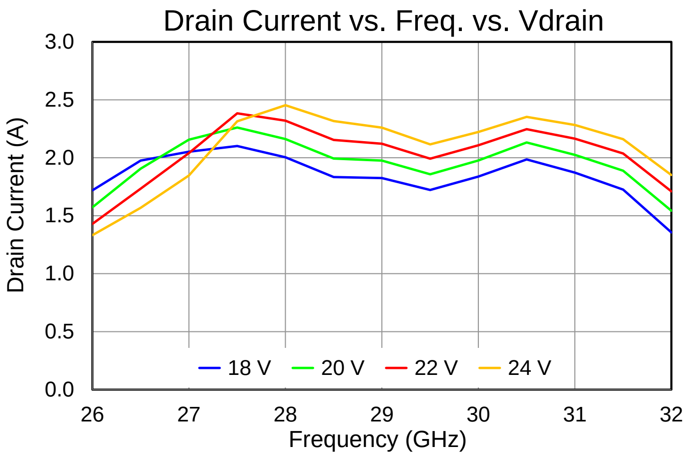


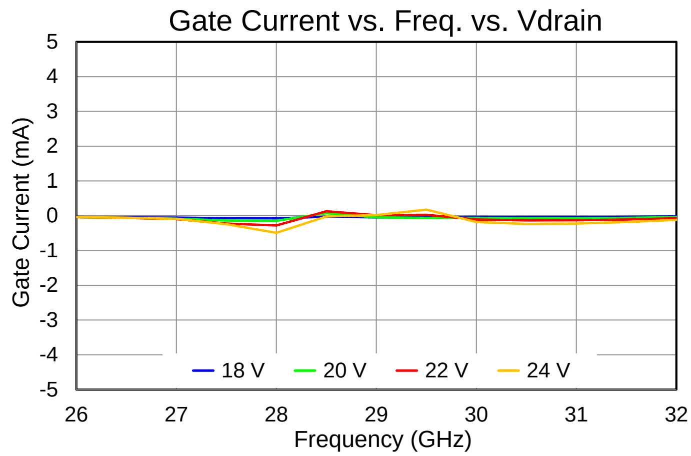
Performance Plots – Large Signal

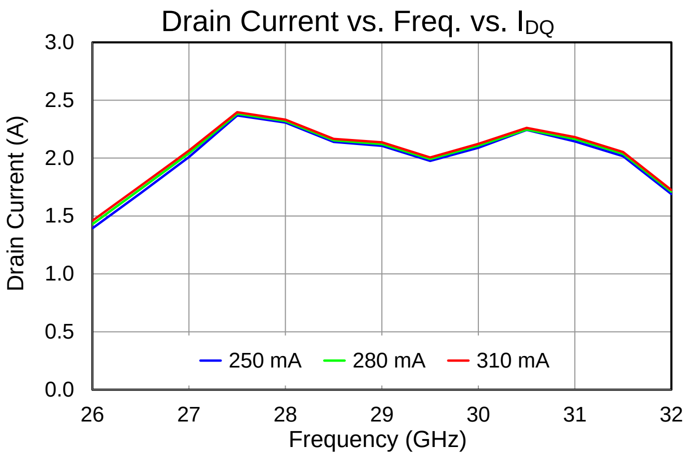
Test conditions, unless otherwise noted: V_D = 22 V, I_{DQ} = 280 mA, T = 25 °C, P_{IN} = 24 dBm

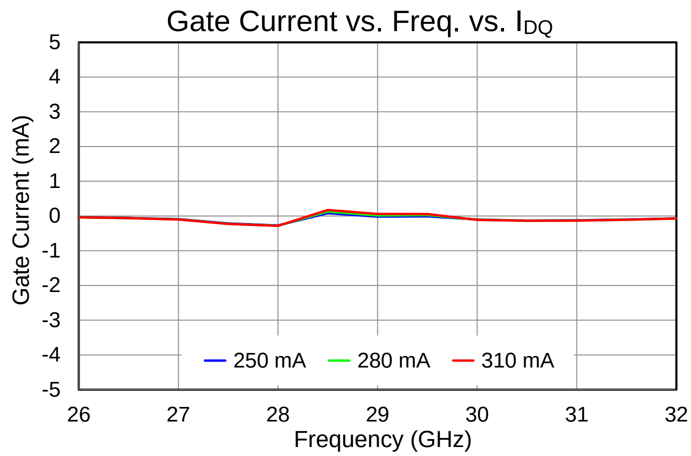






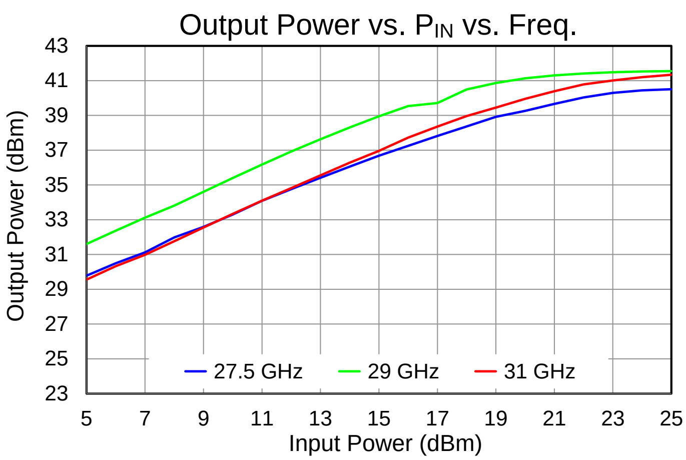


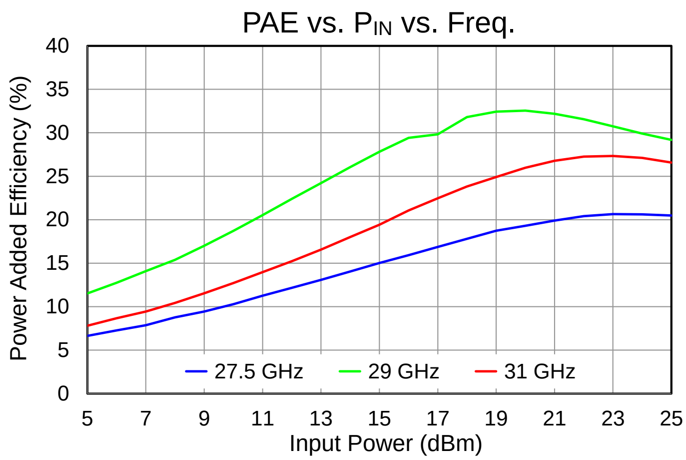


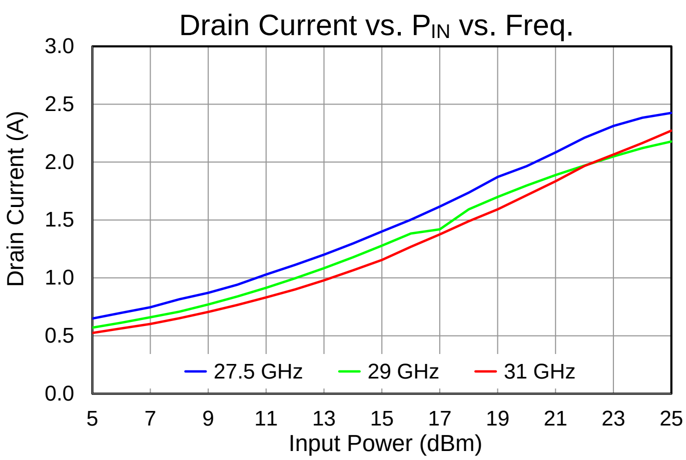


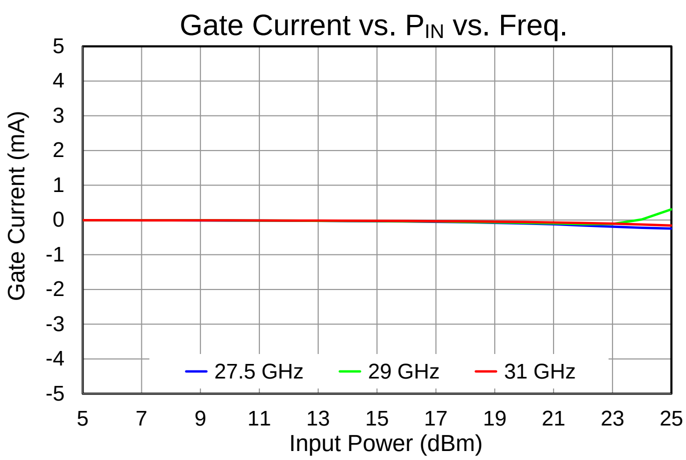
Performance Plots – Large Signal

Test conditions, unless otherwise noted: V_D = 22 V, I_{DQ} = 280 mA, T = 25 °C



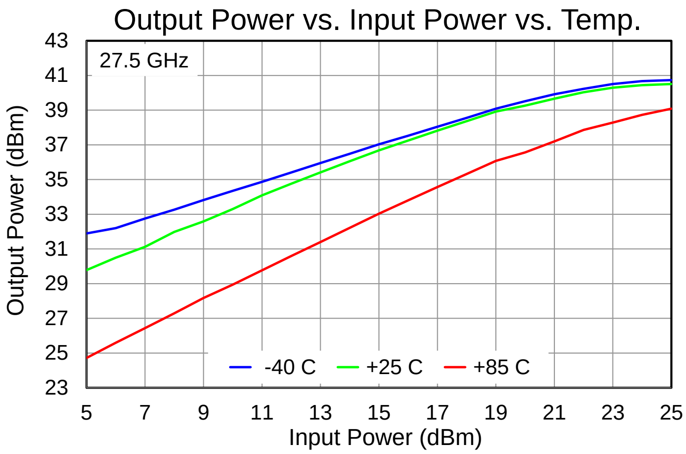


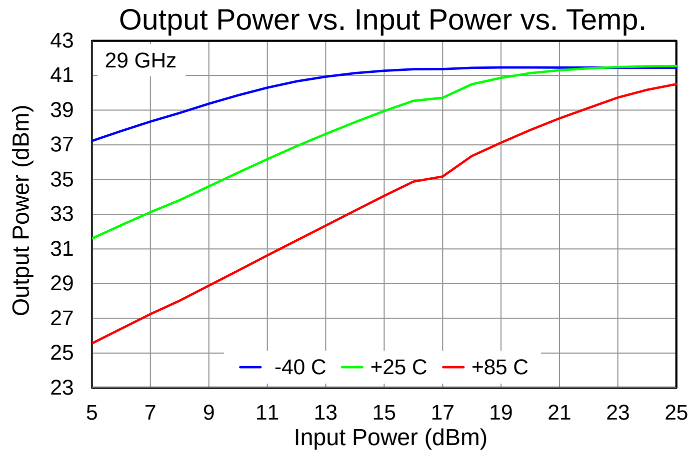


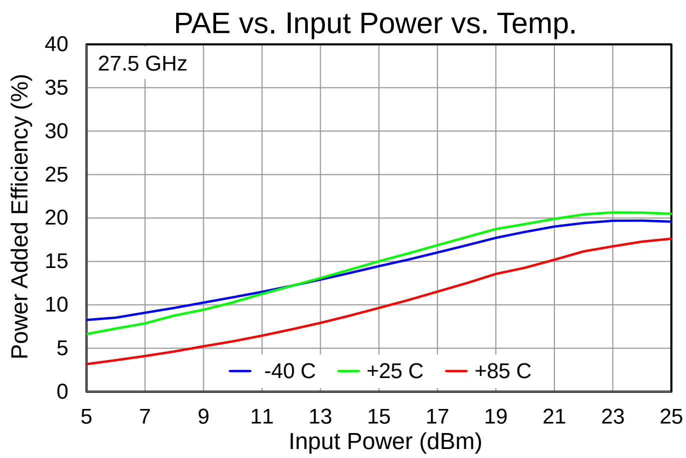


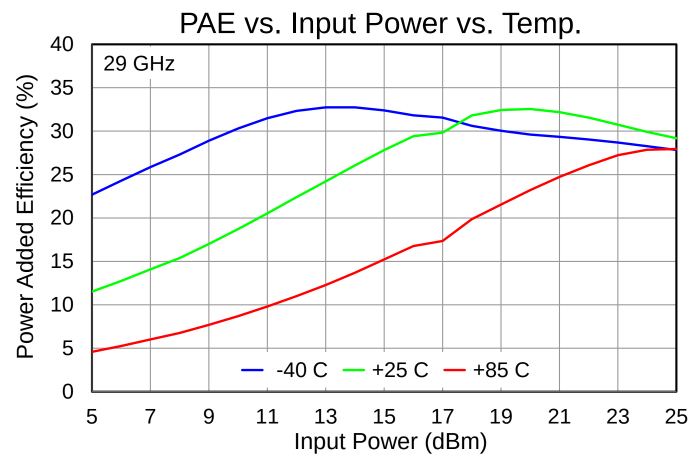
Performance Plots – Large Signal

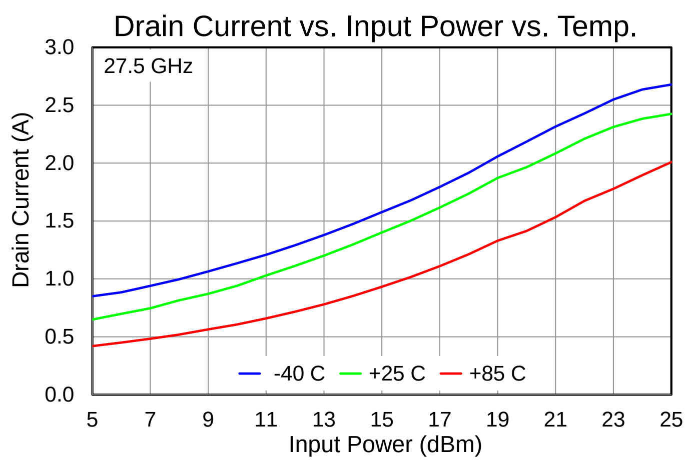
Test conditions, unless otherwise noted: V_D = 22 V, I_{DQ} = 280 mA, T = 25 °C

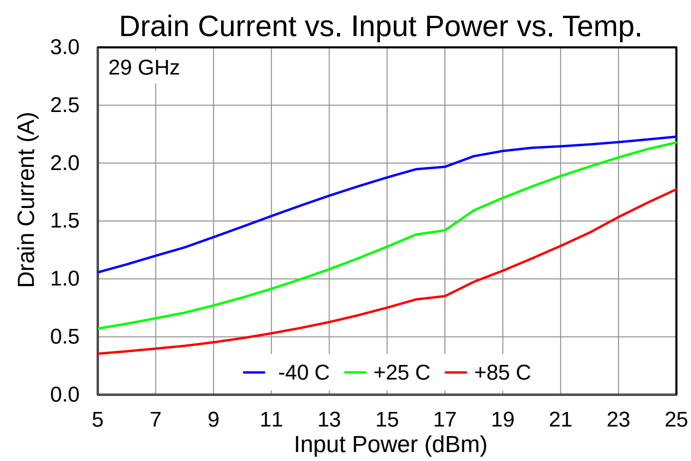






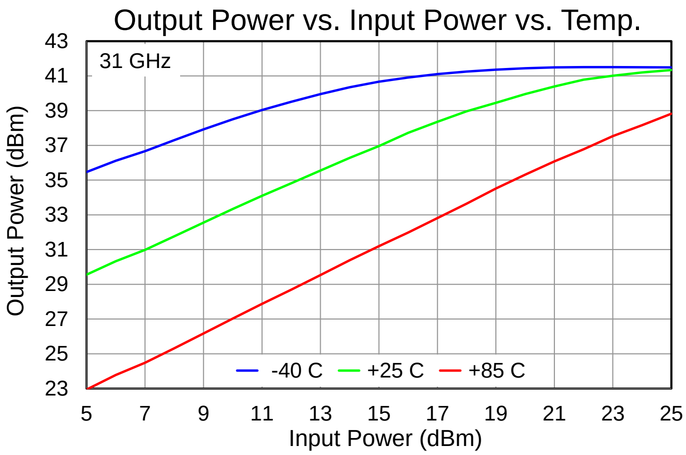


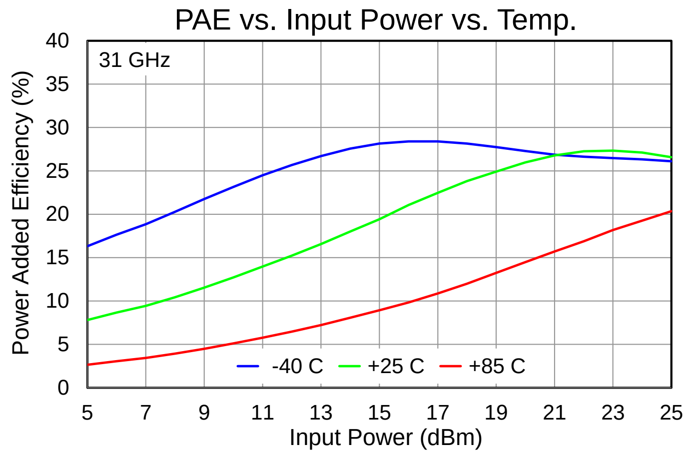


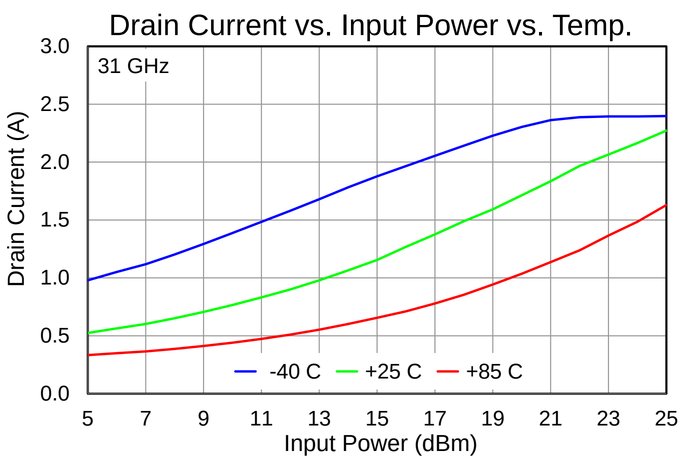


Performance Plots – Large Signal

Test conditions, unless otherwise noted: V_D = 22 V, I_{DQ} = 280 mA, T = 25 °C

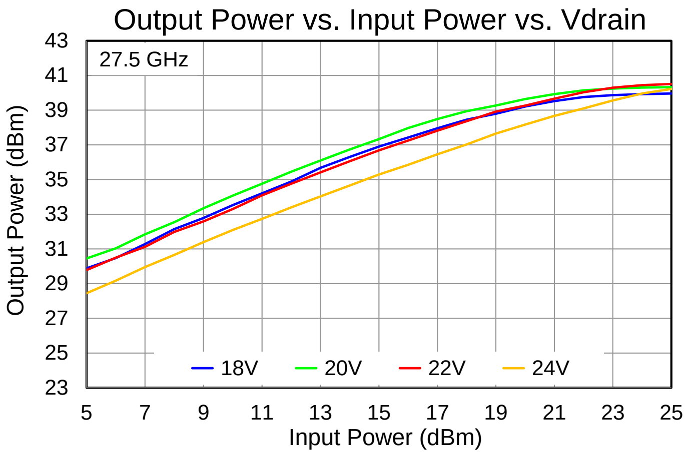


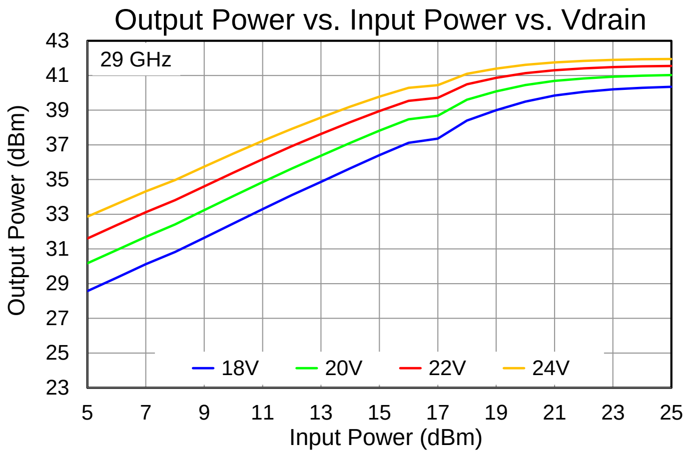


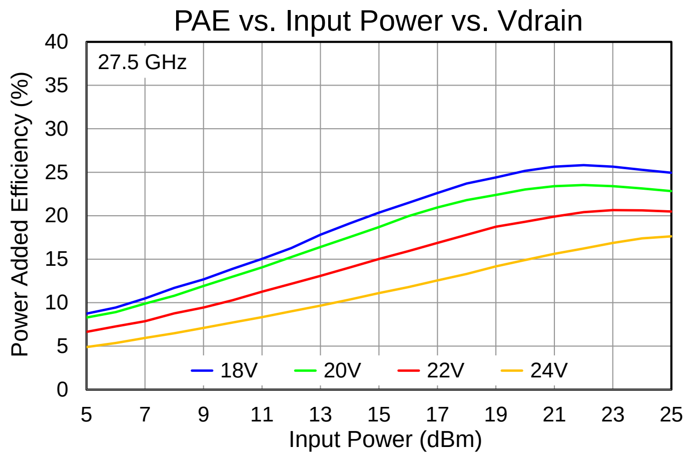


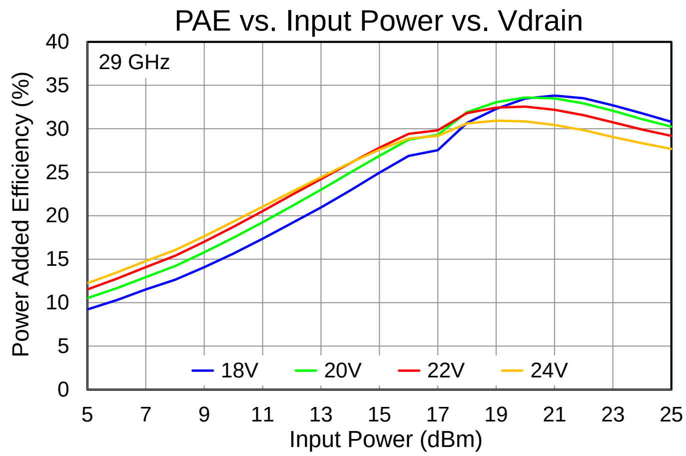
Performance Plots – Large Signal

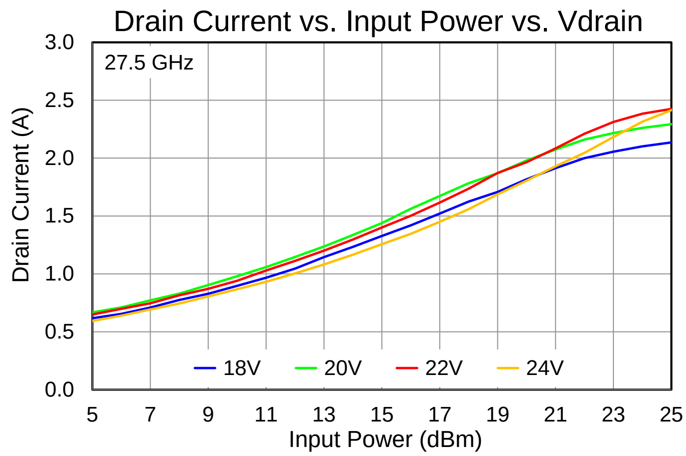
Test conditions, unless otherwise noted: V_D = 22 V, I_{DQ} = 280 mA, T = 25 °C

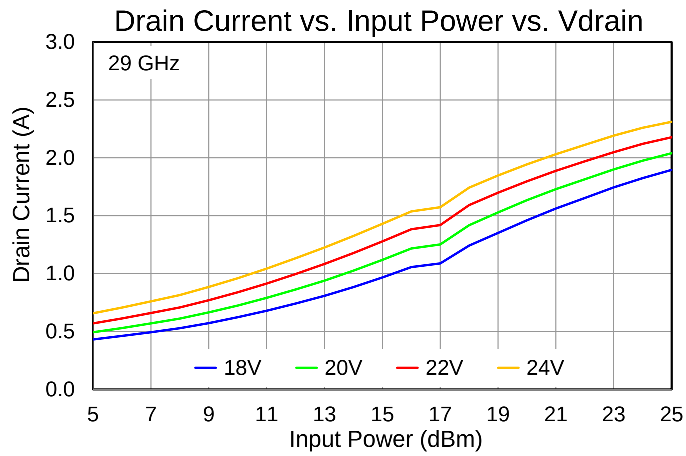






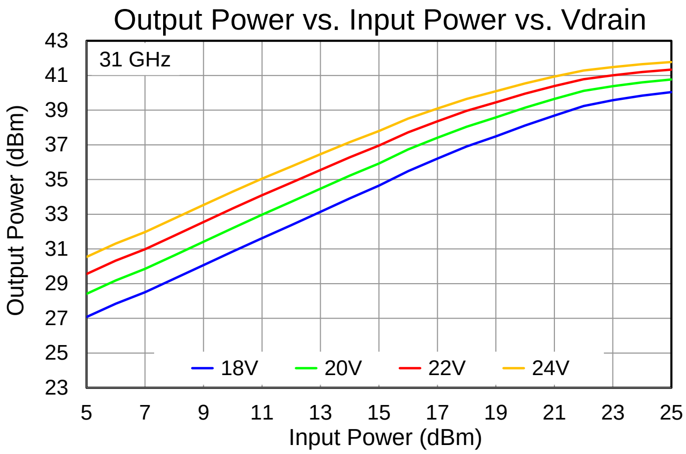


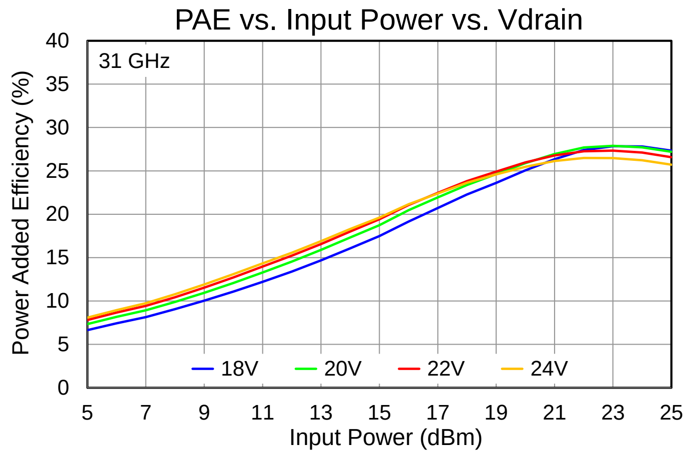


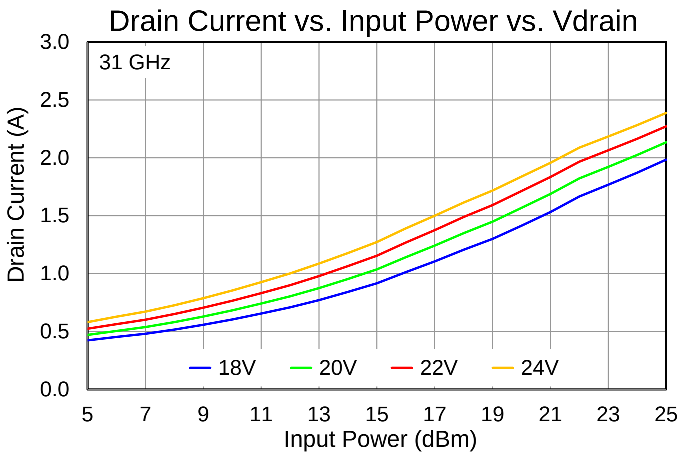


Performance Plots – Large Signal

Test conditions, unless otherwise noted: V_D = 22 V, I_{DQ} = 280 mA, T = 25 °C

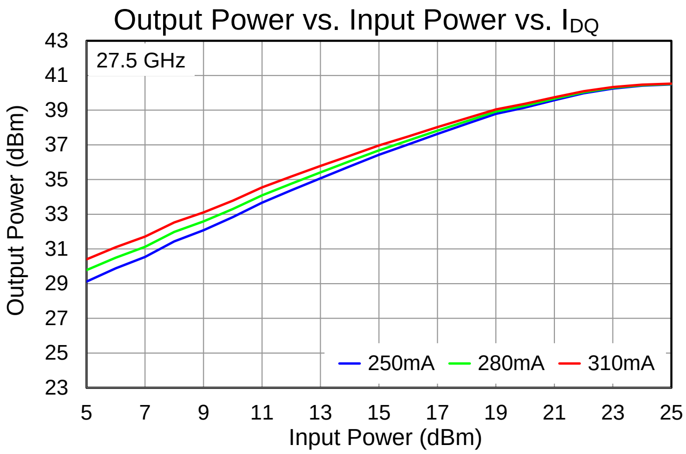


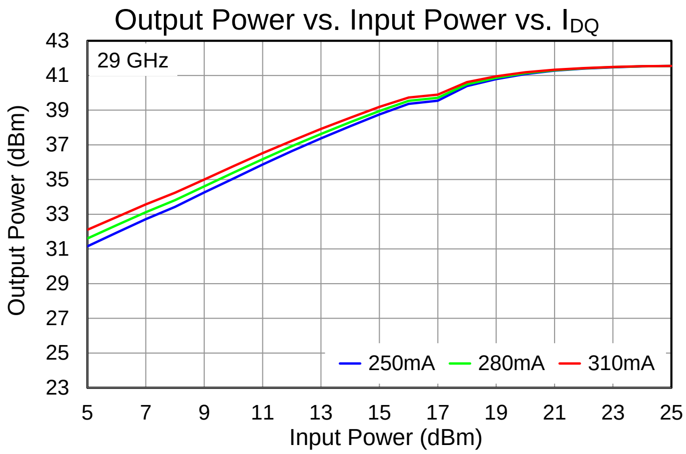


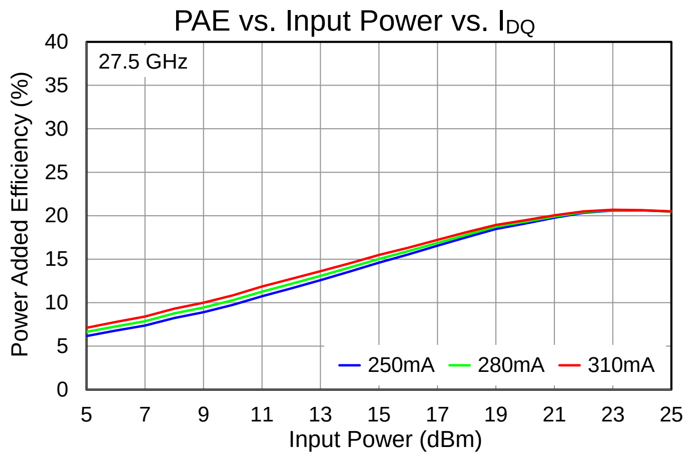


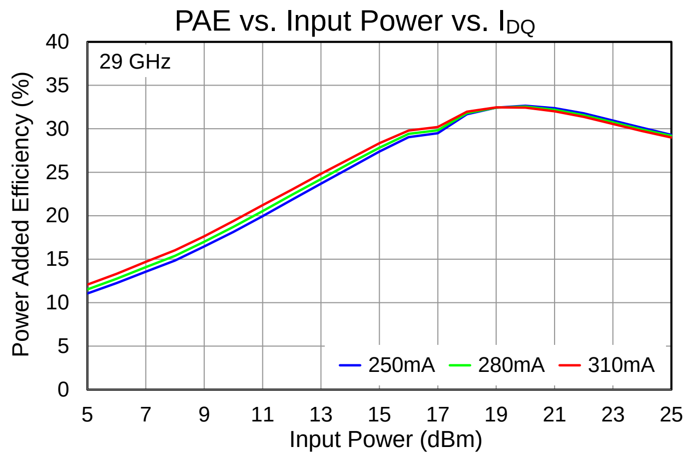
Performance Plots – Large Signal

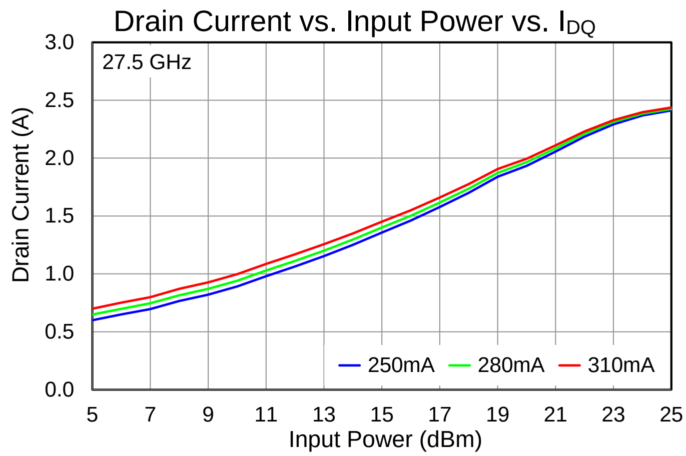
Test conditions, unless otherwise noted: V_D = 22 V, I_{DQ} = 280 mA, T = 25 °C

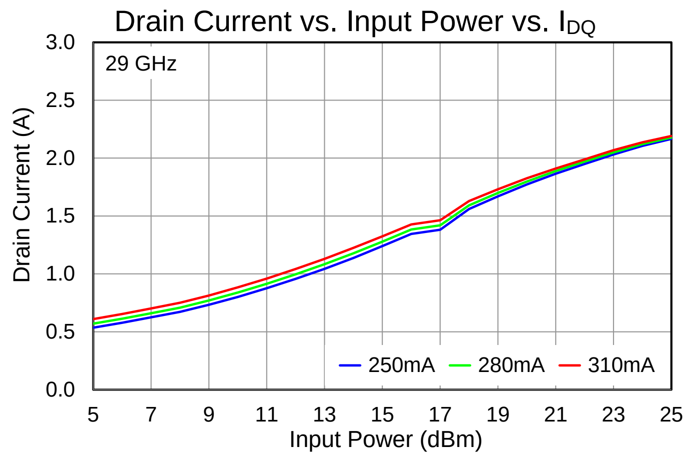






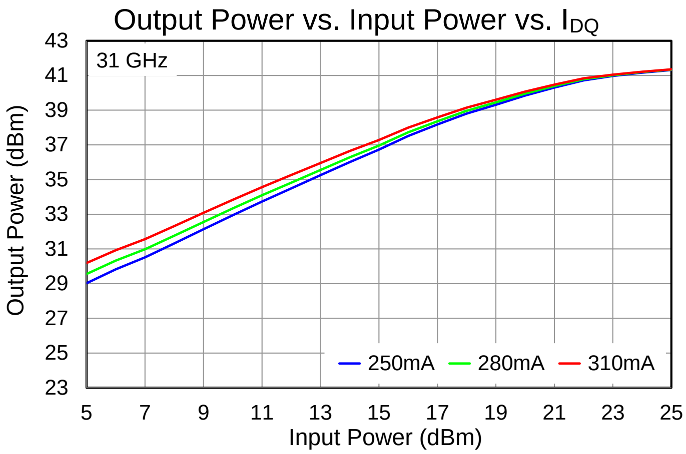


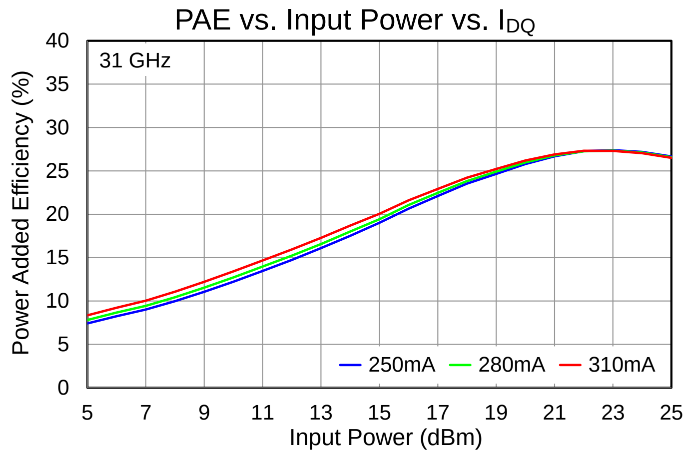


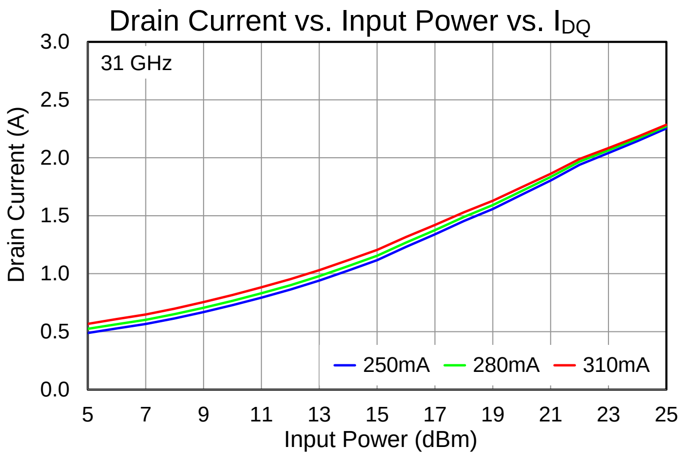


Performance Plots – Large Signal

Test conditions, unless otherwise noted: V_D = 22 V, I_{DQ} = 280 mA, T = 25 °C

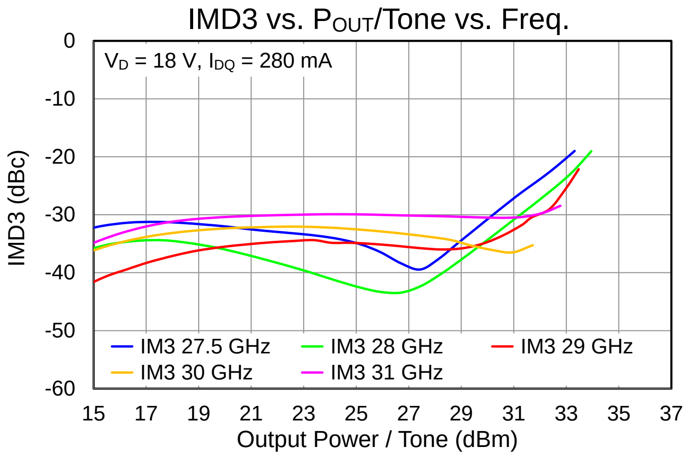


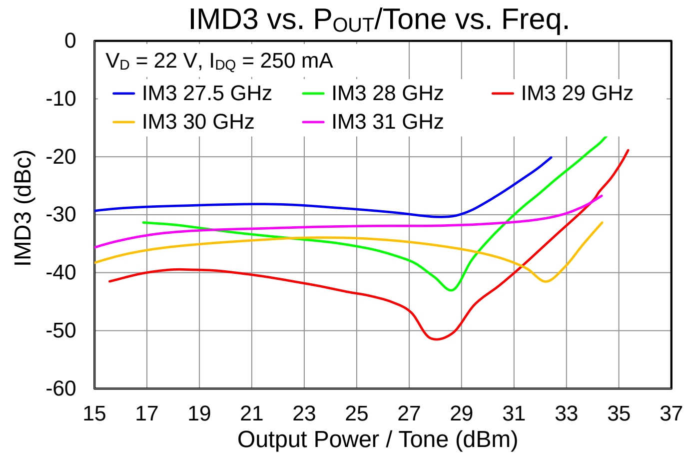


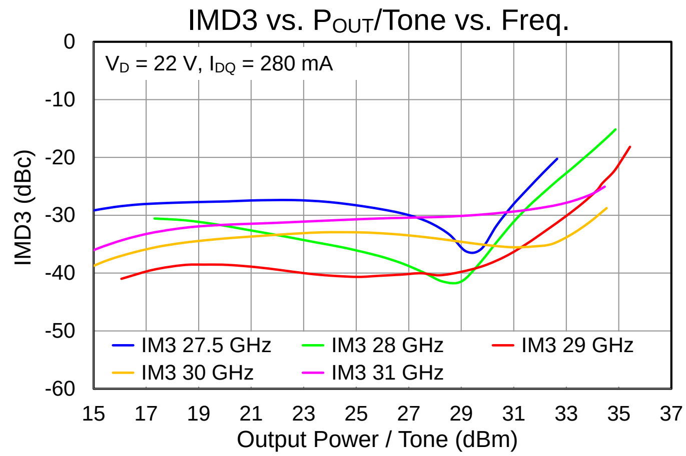


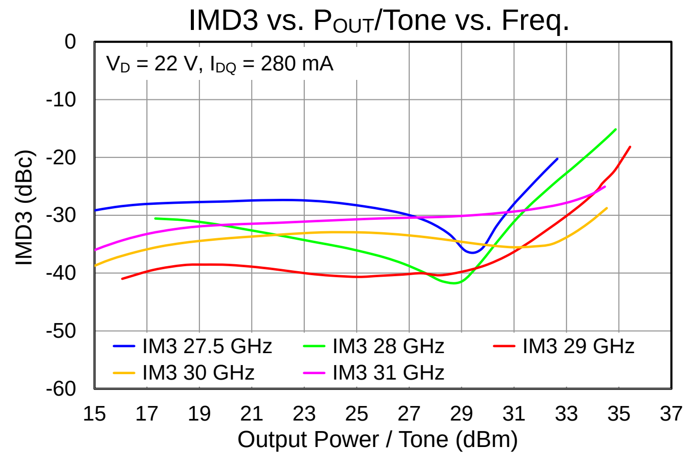
Performance Plots – Linearity

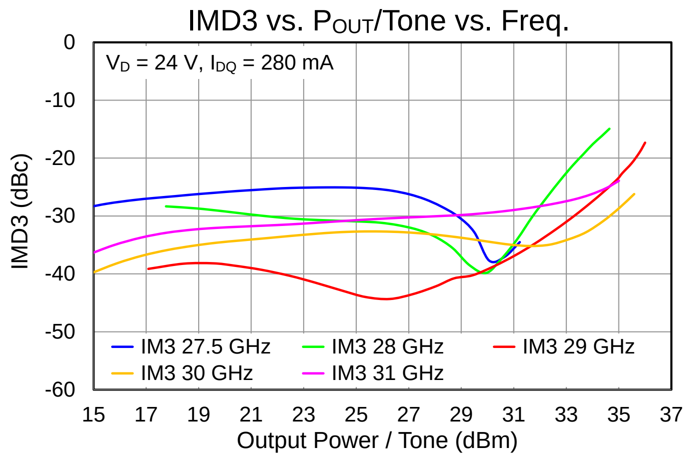
Test conditions, unless otherwise noted: V_D = 22 V, I_{DQ} = 280 mA, T = 25 °C, Tone Spacing = 10 MHz

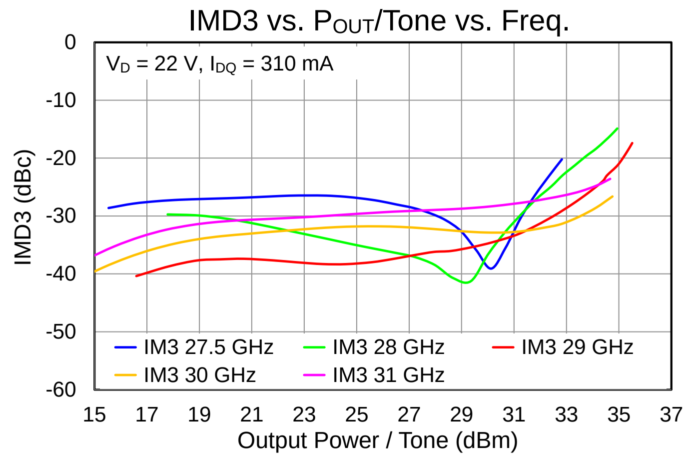






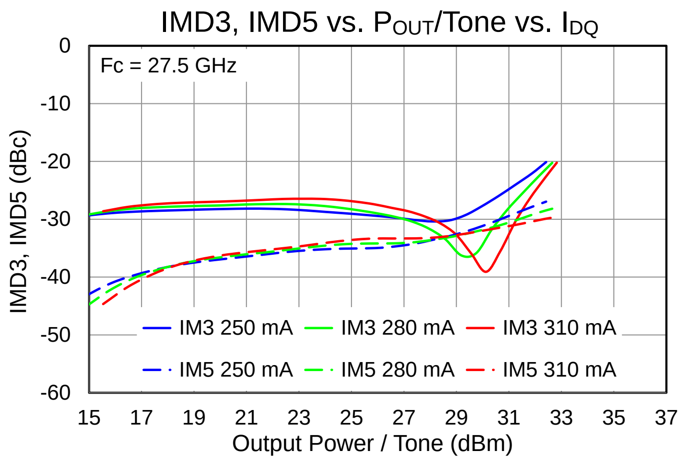


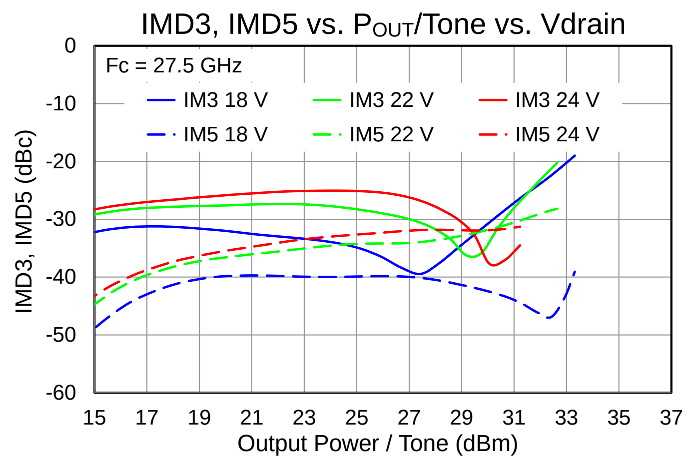


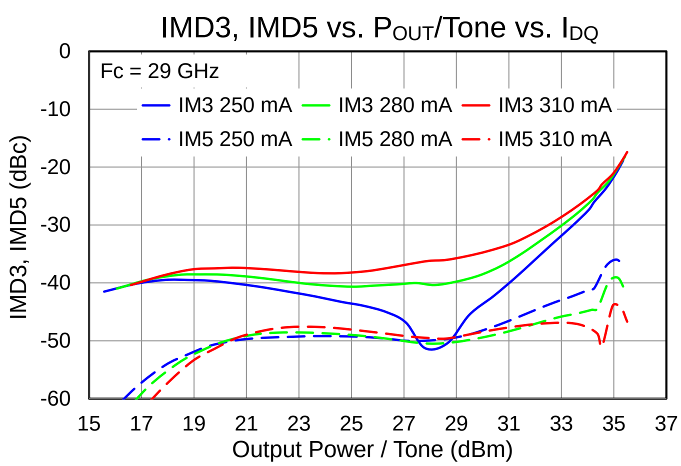


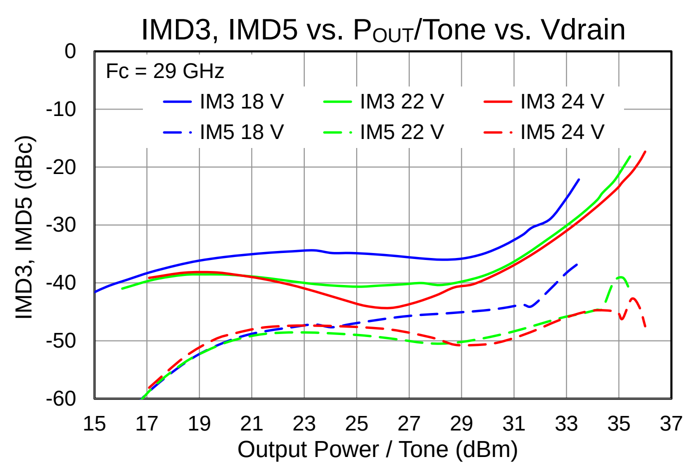
Performance Plots – Linearity

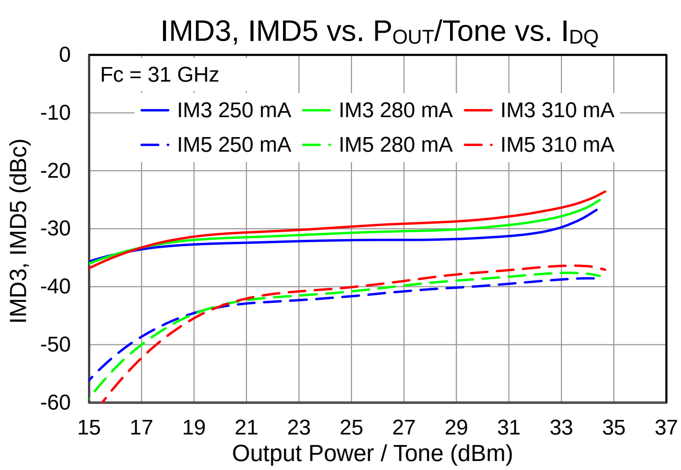
Test conditions, unless otherwise noted: V_D = 22 V, I_{DQ} = 280 mA, T = 25 °C, Tone Spacing = 10 MHz

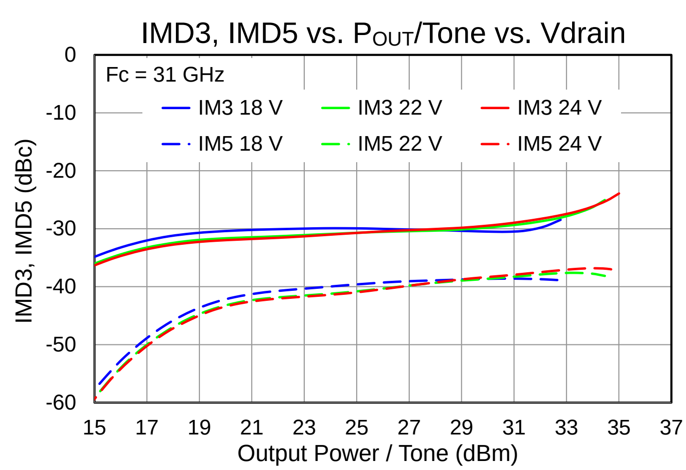






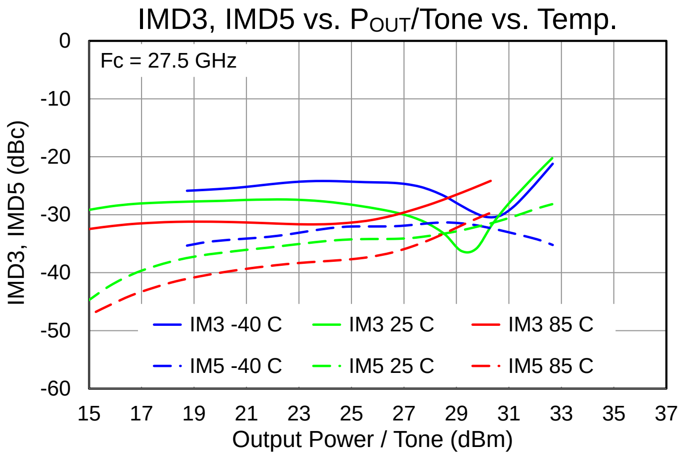


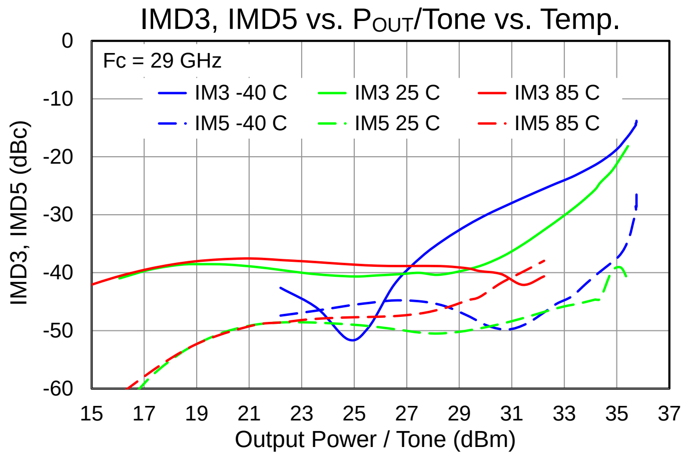


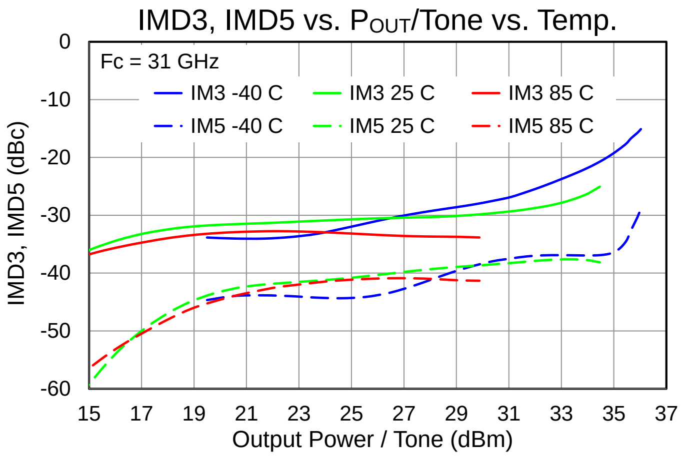


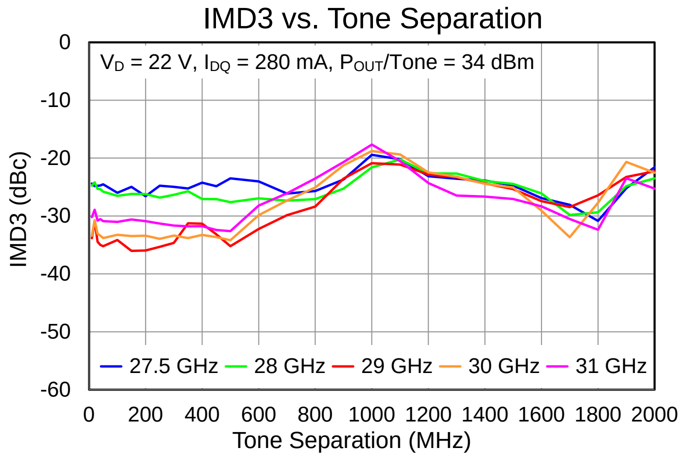
Performance Plots – Linearity

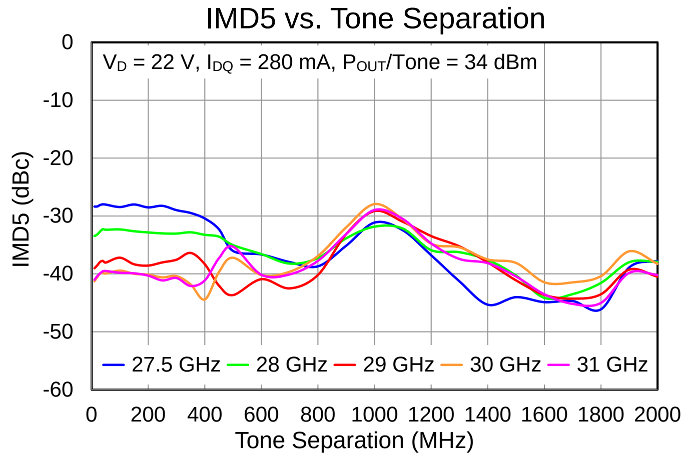
Test conditions, unless otherwise noted: V_D = 22 V, I_{DQ} = 280 mA, T = 25 °C, Tone Spacing = 10 MHz





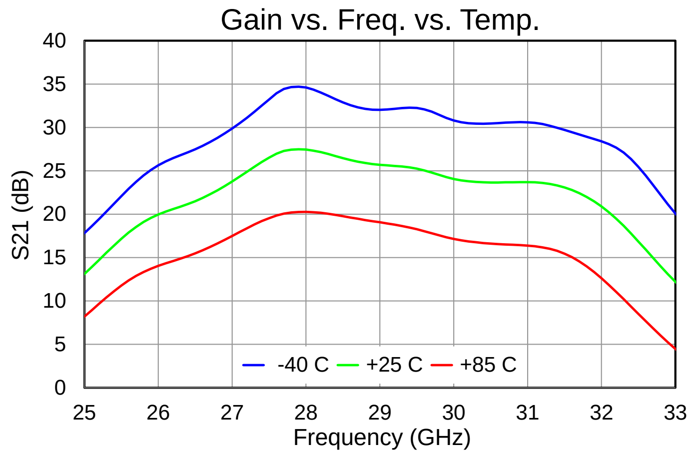


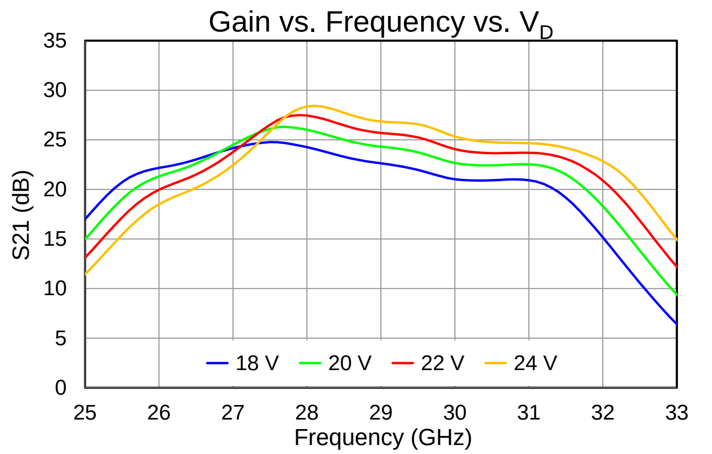


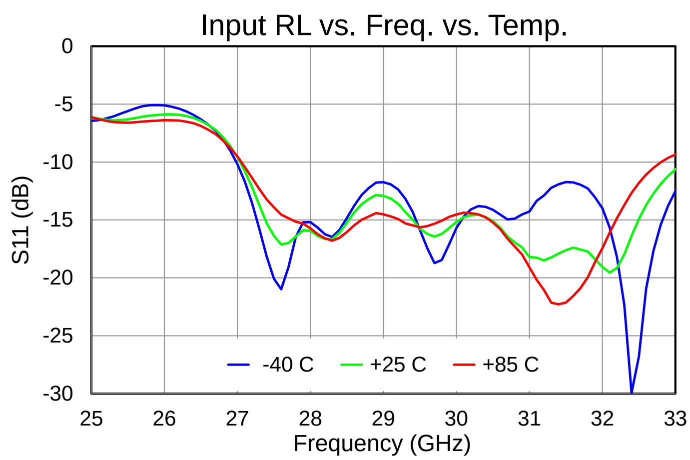


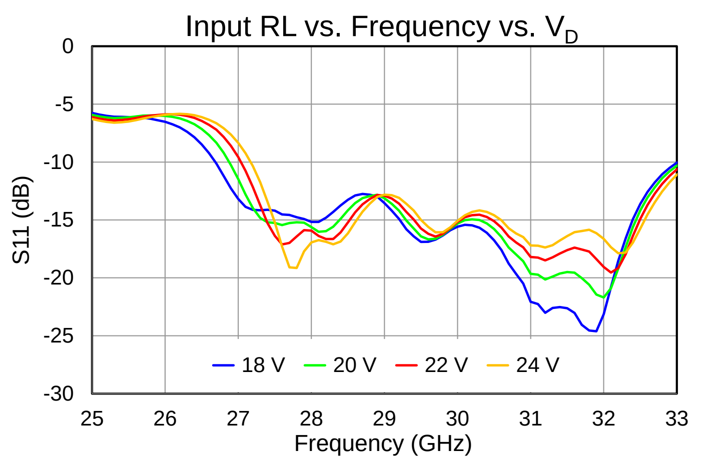
Performance Plots – Small Signal

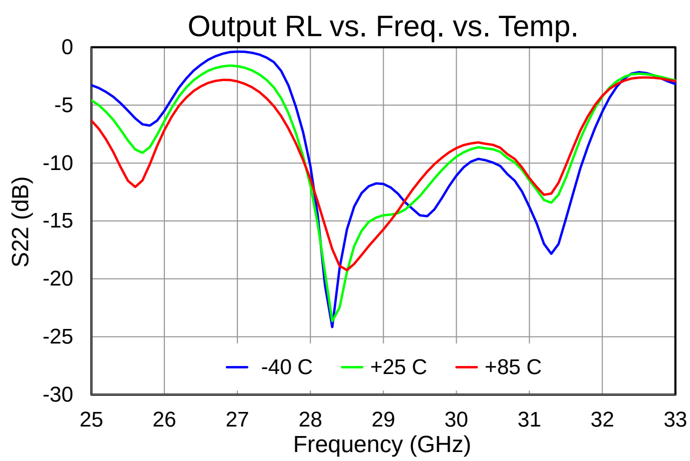
Test conditions, unless otherwise noted: V_D = 22 V, I_{DQ} = 280 mA, T = 25 °C

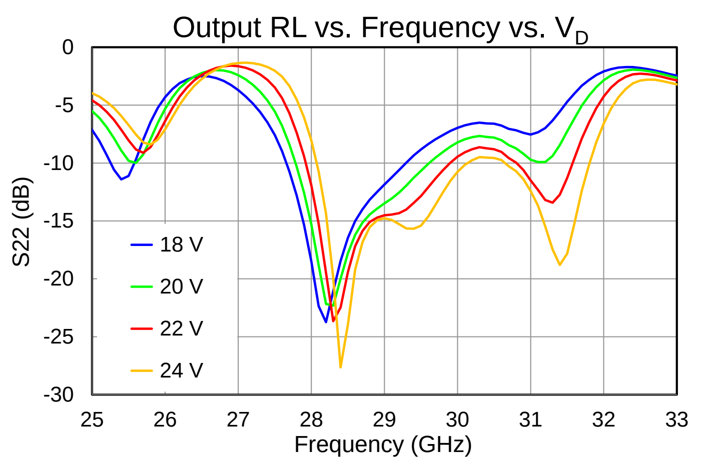






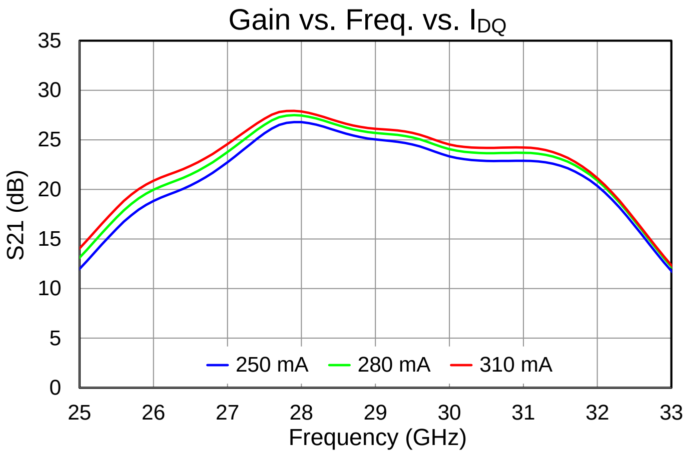


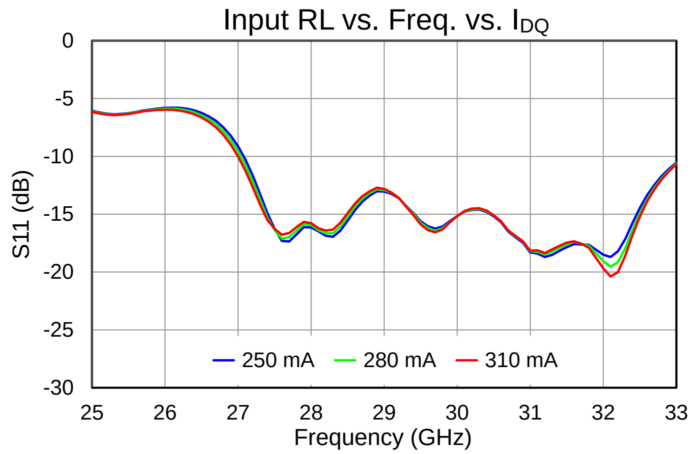


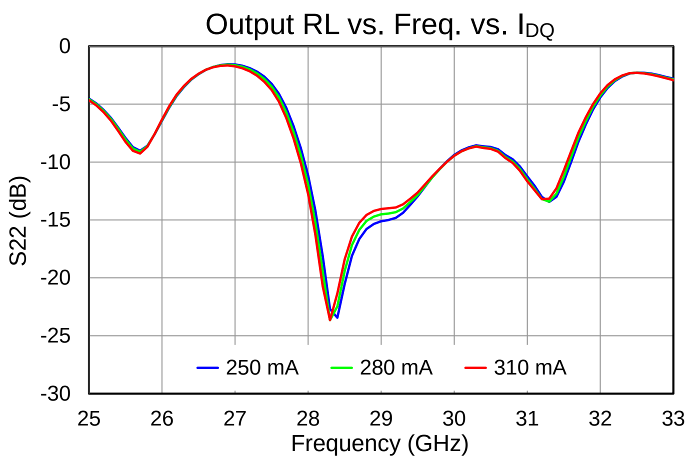


Performance Plots – Small Signal

Test conditions, unless otherwise noted: V_D = 22 V, I_{DQ} = 280 mA, T = 25 °C





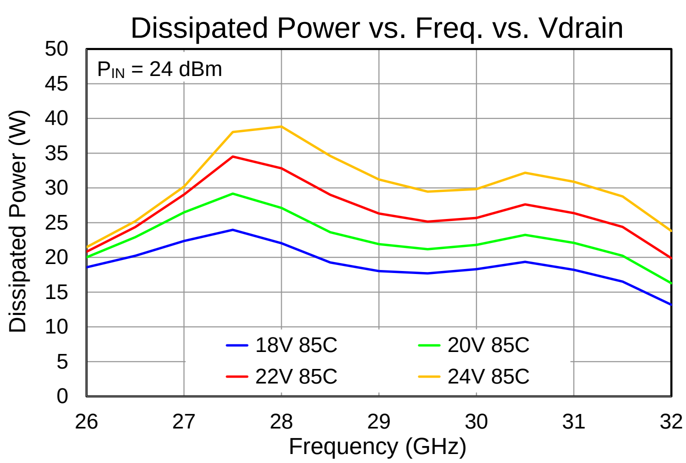


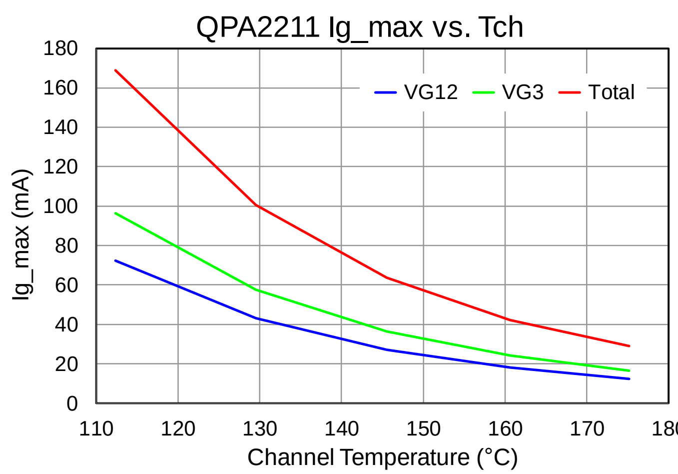
Thermal and Reliability Information

Parameter	Test Conditions	Value	Units
Thermal Resistance (θ_{JC}) [1]	T_{base} = 85 °C, V_D = 22 V, I_{DQ} = 280 mA, P_{DISS} = 6.16 W, No RF (quiescent DC operation)	2.27	ºC/W
Channel Temperature, T_{CH} (No RF) [2]		99.0	ºC
Thermal Resistance (θ_{JC}) [1]	T_{base} = 85 °C, V_D = 22 V, I_{DQ} = 280 mA, Freq = 27.5 GHz, I_{D_Drive} = 1.90 A, P_{IN} = 24 dBm, P_{OUT} = 38.7 dBm, P_{DISS} = 34.5 W	2.93	ºC/W
Channel Temperature, T_{CH} (Under RF) [2]		186.1	ºC

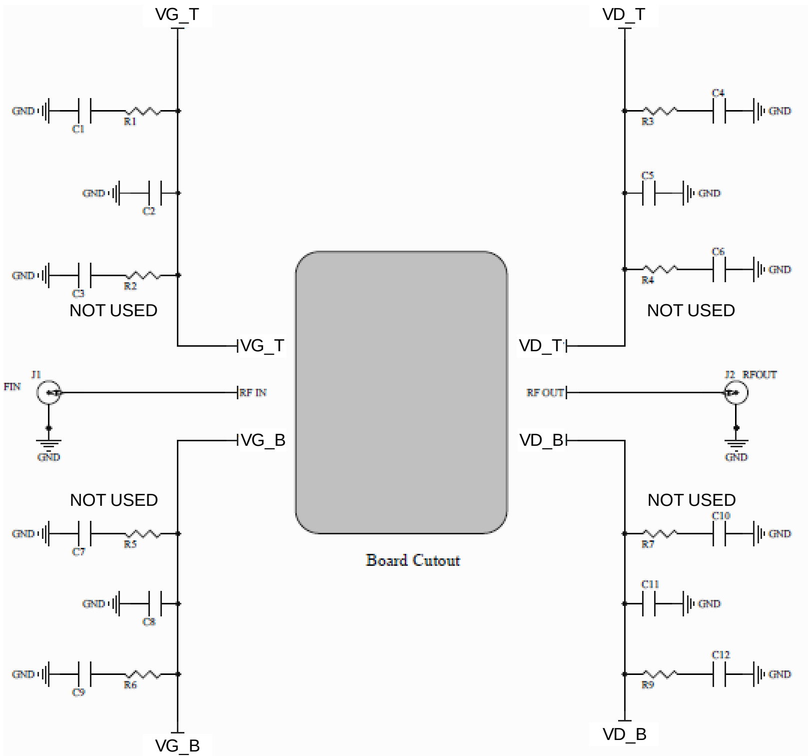
Notes:
1. Thermal resistance is referenced to the back of package (85 ºC)
2. IR Scan equivalent temperature. Refer to the following document: GaN Device Channel Temperature, Thermal Resistance, and Reliability Estimates

Dissipated Power and Maximum Gate Current





Applications Information and Pin Layout



Notes:
1. V_G must be biased from both sides (Pins 1 and 5)
2. V_D must be biased from both sides (Pins 6 and 10)

Bias Up Procedure

1. Set I_D limit to 3500 mA, I_G limit to 40 mA
2. Apply −5 V to V_G
3. Apply 22 V to V_D; ensure I_{DQ} is approx. 0 mA
4. Adjust V_G until I_{DQ} = 280 mA
5. Turn on RF supply

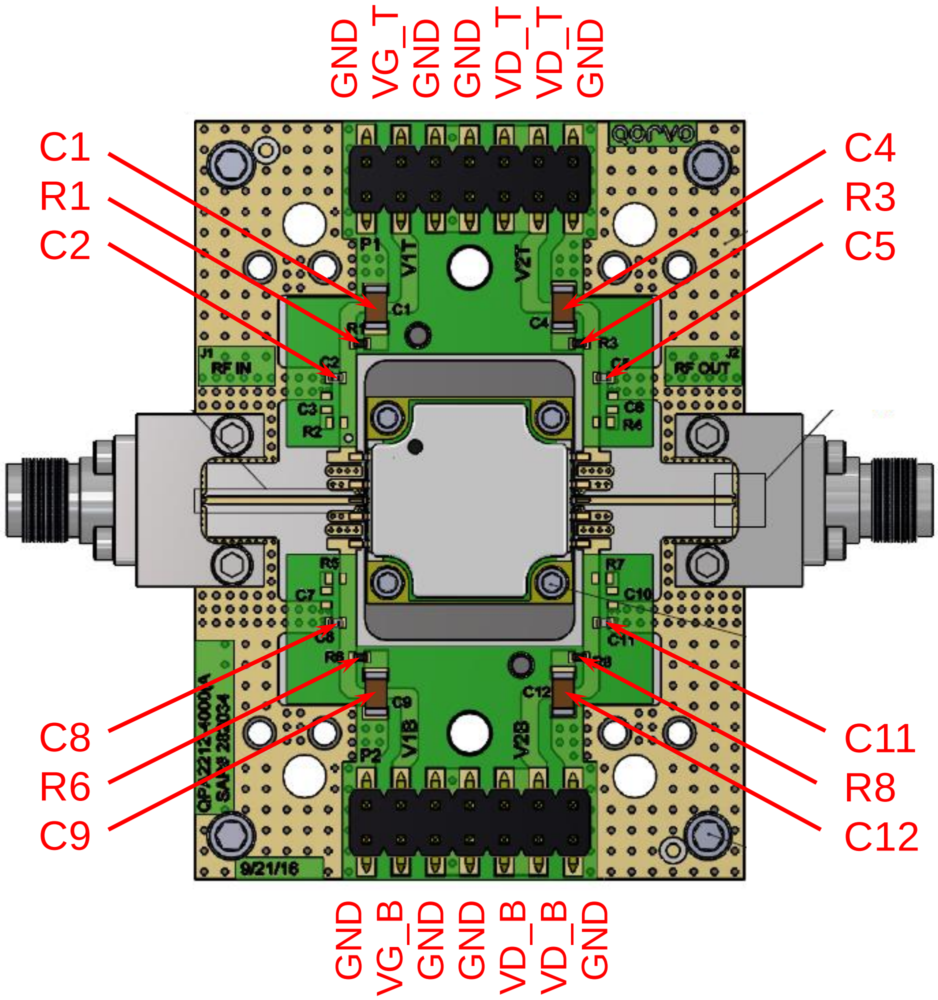
Bias Down Procedure

1. Turn off RF supply
2. Reduce V_G to −5 V; ensure I_{DQ} is approx. 0 mA
3. Set V_D to 0 V
4. Turn off V_D supply
5. Turn off V_G supply

Pin Description

Pad No.	Symbol	Description
1,5	V_G	Gate Voltage; Bias network is required; must be biased from both sides; see recommended Application Information above
2,4,7,9	GND	Must be grounded on the PCB
3	RF_{IN}	Input; matched to 50 Ω; DC grounded
6,10	V_D	Drain voltage; Bias network is required; must be biased from both sides; see recommended Application Information above
8	RF_{OUT}	Output; matched to 50 Ω; DC grounded

Evaluation Board (EVB) Assembly Drawing



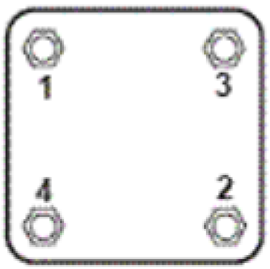
PCB NOTES:
1. PCB is made from Rogers 6035HTC dielectric, 0.010 inch thick, 0.5 oz. copper both sides.
2. Both Top and Bottom V_D and V_G must be biased.

Bill of Materials

Reference Des.	Value	Description	Manufacturer	Part Number
C2,C5,C8,C11	0.01 uF	CAP, 0402, 50 V, 10%, X7R	Various	–
C1,C4,C9,C12	10 uF	CAP, 1206, 50 V, 20%, X5R	Various	–
R1,R6	5.1 Ω	RES, 5.1 OHM, 5%, 50V, 0402	Various	–
R3,R8	0 Ω	RES, 0 OHM, JMPR, 0402	Various	–
J1, J2	2.4 mm	CONNECTOR RF 2.4MM	Southwest Microwave	1492-04A-5

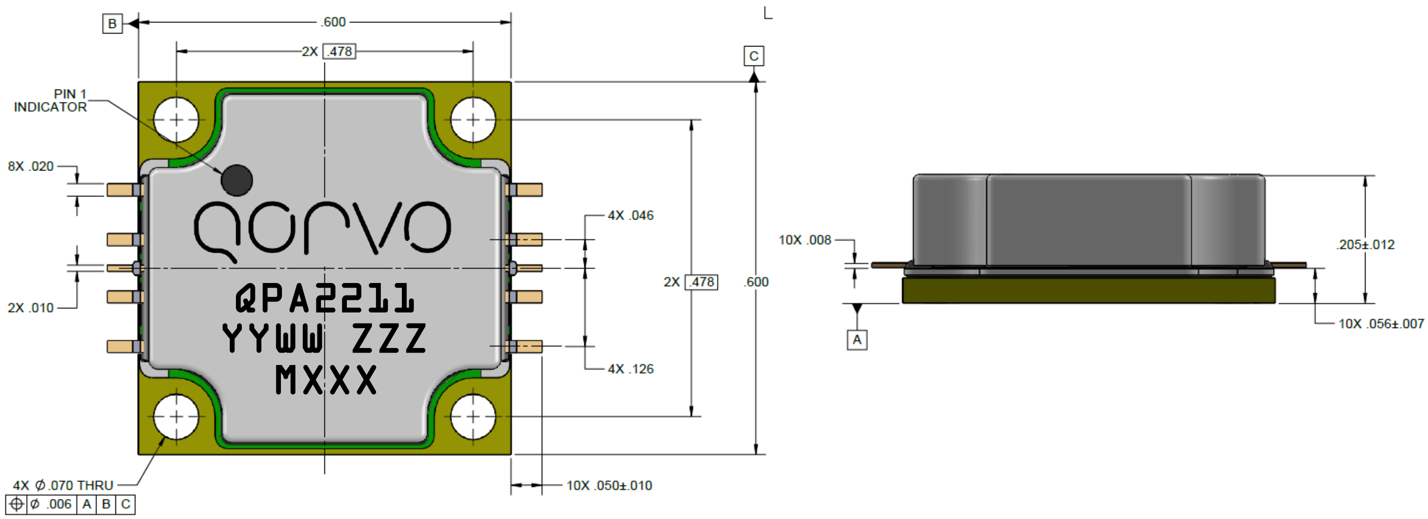
Assembly Notes

1. Carefully clean the PC board and package leads with alcohol. Allow it to dry fully.
2. To improve the thermal and RF performance, Qorvo recommends attaching a heat sink to the bottom of the PCB and apply thermal compound (Arctic Silver 5 recommended) or a 4 mil indium shim between the heat sink and the package.
3. (The following is for *information only*. There are many variables in a second level assembly that Qorvo does not control, so Qorvo does not recommend an absolute torque value.) Use screws to attach the component to the heat sink. A suggested torque value is 16 in-oz. for a 0-80 screw. Start with screws finger tight, then torque to 8 in-oz., then torque to final value. Use the following tightening pattern:



4. Apply no-flux solder to each pin of the QPA2211. The component leads should be manually soldered, and the package cannot be subjected to conventional reflow processes. The use of no-clean solder to avoid washing after soldering is recommended.

Mechanical Information



Units: inches
Tolerances: (unless specified)
x.xx = ± 0.01
x.xxx = ± 0.005
Materials:
Base: Copper
Leads: Alloy 194
Lid: LCP (liquid crystal polymer)
All metalized features are gold plated
Part is epoxy sealed
Marking:
QPA2211: Part number
YY: Part Assembly year
WW: Part Assembly week
ZZZ: Serial Number (unique for all parts within one assembly lot)
MXXX: Batch ID

Handling Precautions

Parameter	Rating	Standard
ESD – Human Body Model (HBM)	2	ANSI/ESD/JEDEC JS-001
ESD – Charge Device Model (CDM)	C3	ANSI/ESD/JEDEC JS-002
MSL – Moisture Sensitivity Level	NA	

Caution!
ESD-Sensitive Device

Solderability

The component leads should be manually soldered, and the package cannot be subjected to conventional reflow processes. Soldering of the component leads is compatible with the latest version of J-STD-020, lead-free solder, 260 °C. The use of no-clean solder to avoid washing after soldering is recommended.

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

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

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