

Product Description

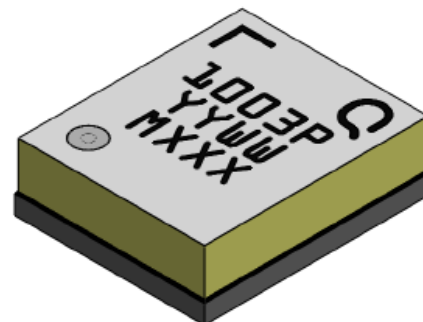
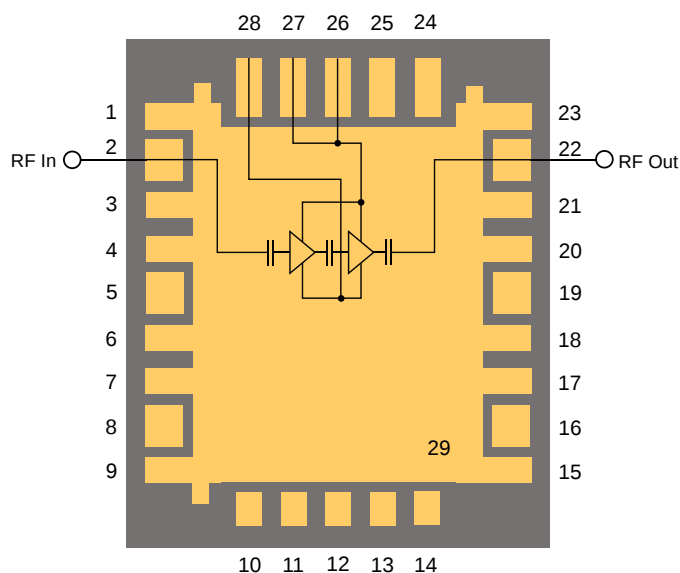
Qorvo's QPA1003P is a wideband high power MMIC amplifier fabricated on Qorvo's production 0.15 μ m GaN on SiC process (QGaN15). The QPA1003P operates from 1 – 8 GHz and typically provides 10 W saturated output power with power-added efficiency of 30% and large-signal gain of 25 dB. This combination of wideband performance provides the flexibility designers are looking for to improve system performance while reducing size and cost.

The QPA1003P is matched to 50 Ω with integrated DC blocking capacitors on both RF I/O ports simplifying system integration. The wideband performance makes it ideally suited in support of test instrumentation and electronic warfare, as well as, supporting multiple radar and communication bands.

Lead-free and RoHS compliant.

Evaluation boards are available upon request.

Functional Block Diagram



Product Features

- Frequency Range: 1 – 8 GHz
- P_{OUT} : 40 dBm @ $P_{IN} = 15$ dBm
- PAE: 30 % @ $P_{IN} = 15$ dBm
- Large Signal Gain: 25 dB @ $P_{IN} = 15$ dBm
- Small Signal Gain: 30 dB
- Bias: $V_D = +28$ V, $I_{DQ} = 650$ mA, $V_G = -2.2$ V Typical
- Package Dimensions: 5.0 x 6.0 x 1.76 mm
- Process Technology: QGaN15

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

Applications

- Electronic Warfare (EW)
- Radar
- Communications
- Test Instrumentation

Ordering Information

Part No.	Description
QPA1003P	1 – 8 GHz 10 W GaN Power Amplifier

Electrical Specifications

Test conditions unless otherwise noted: 25 °C, $V_D = +28\text{ V}$, $I_{DQ} = 650\text{ mA}$, $V_G = -2.2\text{ V}$ Typical, CW.

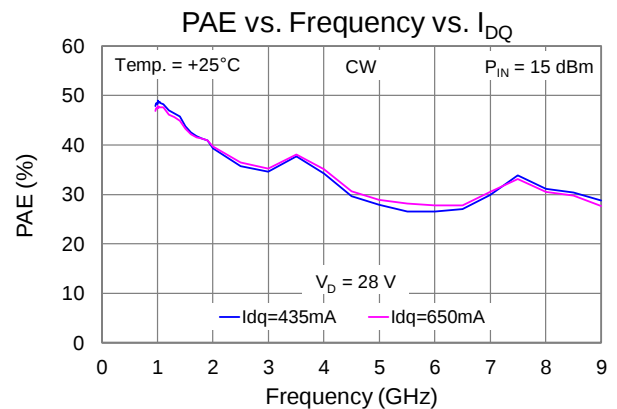
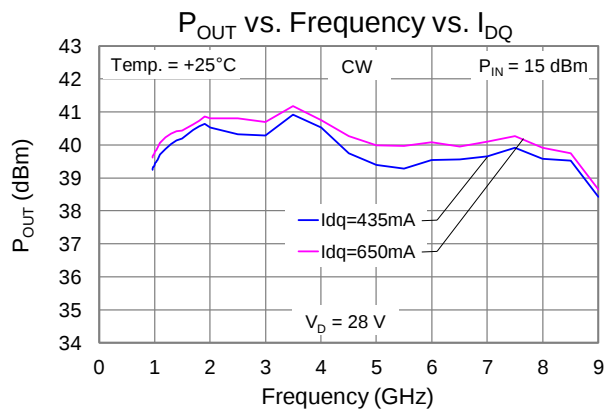
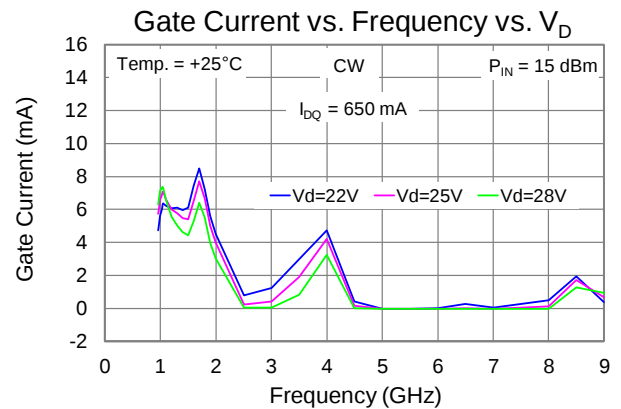
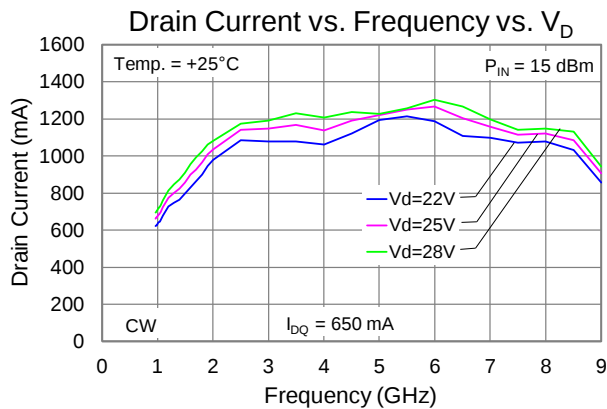
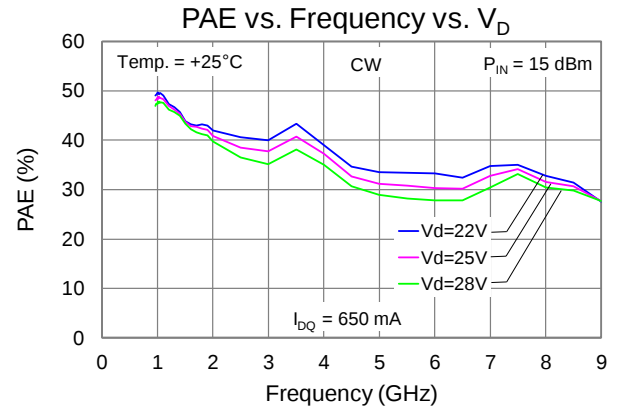
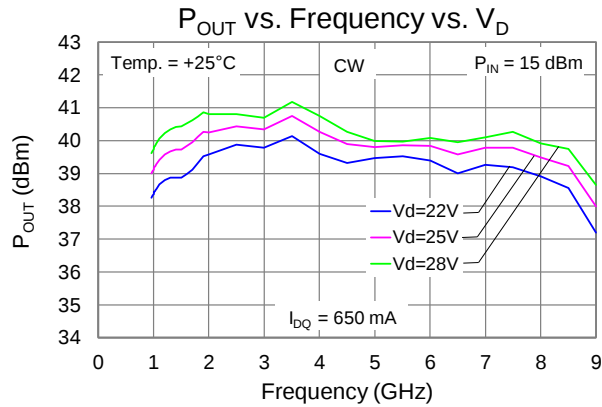
Parameter		Min	Typ	Max	Units
Operational Frequency Range		1	–	8	GHz
Output Power @ $P_{IN} = 15\text{ dBm}$	Frequency = 1 GHz		39.7	–	dBm
	Frequency = 4 GHz		40.7	–	
	Frequency = 8 GHz		39.9	–	
Power Added Efficiency @ $P_{IN} = 15\text{ dBm}$	Frequency = 1 GHz		47.5	–	%
	Frequency = 4 GHz		35	–	
	Frequency = 8 GHz		30.5	–	
Small Signal Gain	Frequency = 1 GHz		31.5	–	dB
	Frequency = 4 GHz		32.7	–	
	Frequency = 8 GHz		31.4	–	
Input Return Loss	Frequency = 1 GHz		12.7	–	dB
	Frequency = 4 GHz		12.1	–	
	Frequency = 8 GHz		9.8	–	
Output Return Loss	Frequency = 1 GHz		17.5	–	dB
	Frequency = 4 GHz		6.9	–	
	Frequency = 8 GHz		11.4	–	
Small Signal Gain Temperature Coefficient		–	-0.04	–	dB/°C
Output Power Temperature Coefficient		–	-0.014	–	dBm/°C

Recommended Operating Conditions

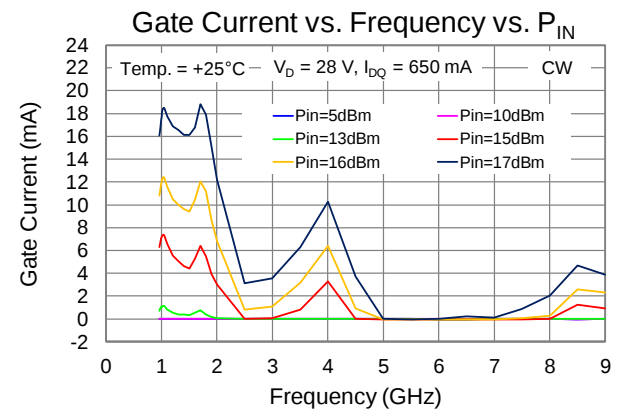
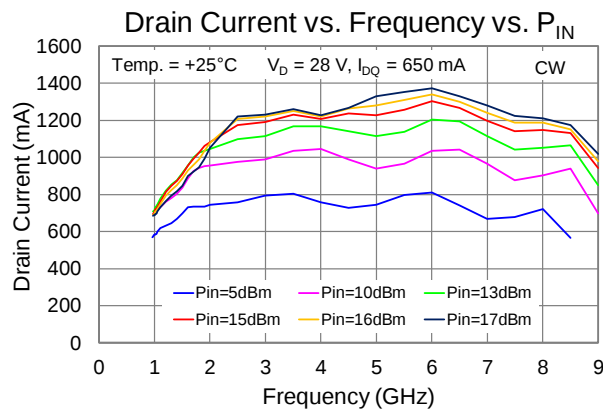
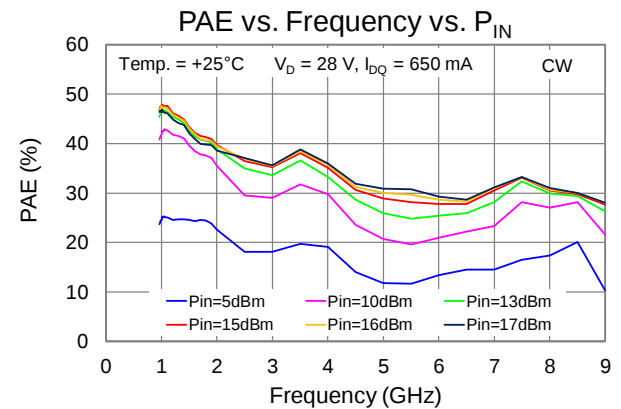
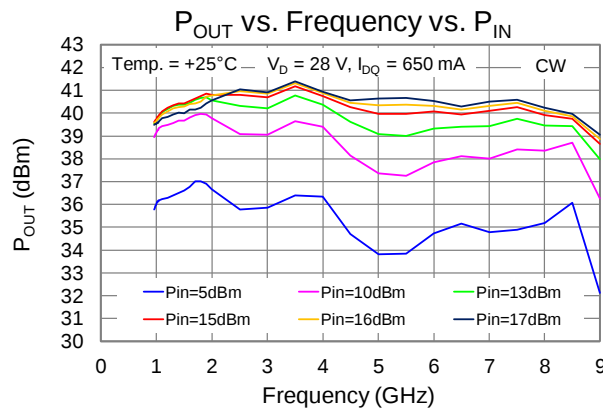
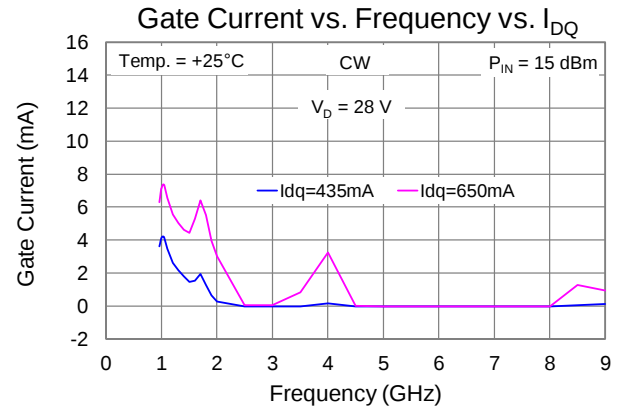
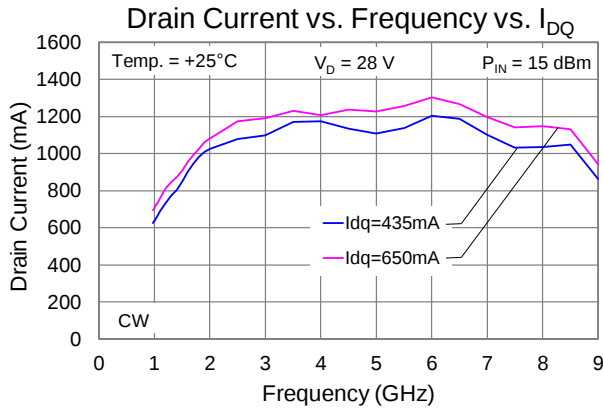
Parameter	Value / Range
Drain Voltage (V_D)	+28 V
Drain Current (I_{DQ})	650 mA
Gate Voltage (V_G)	-2.2 V (Typ.)
Temperature (T_{BASE})	-40 to 85 °C

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

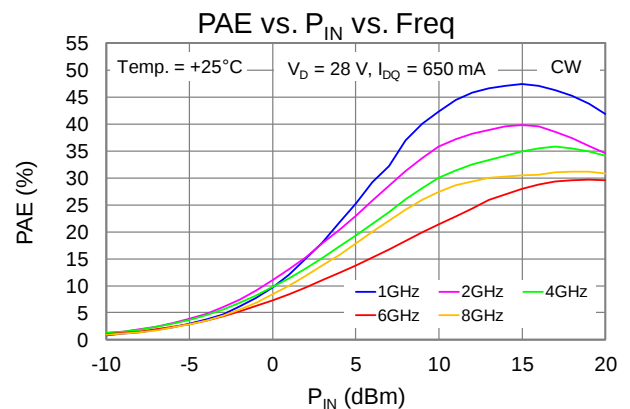
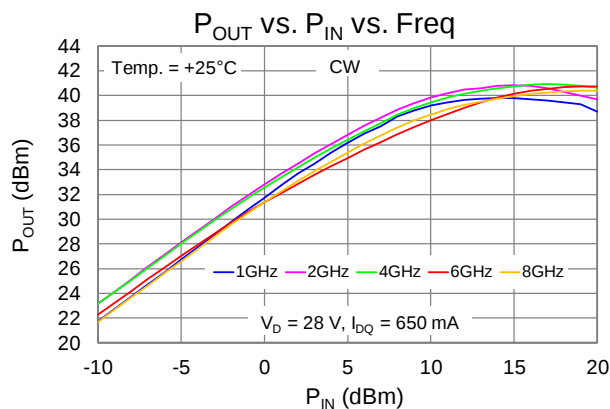
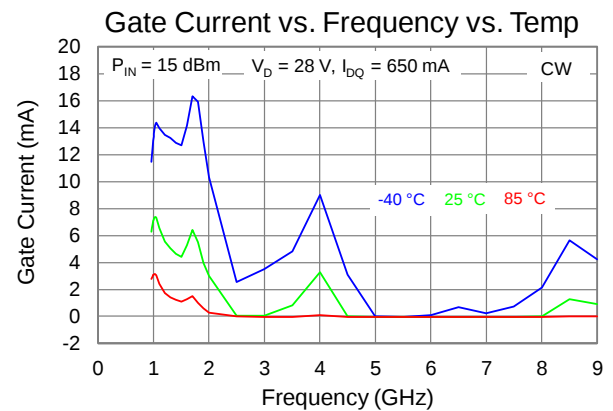
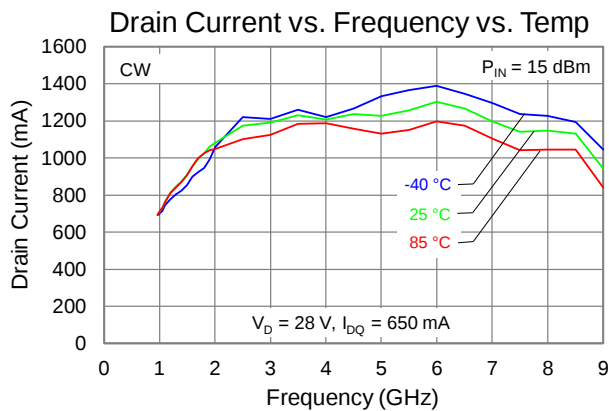
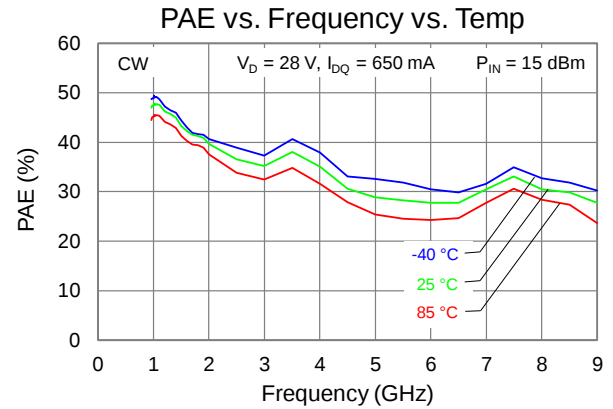
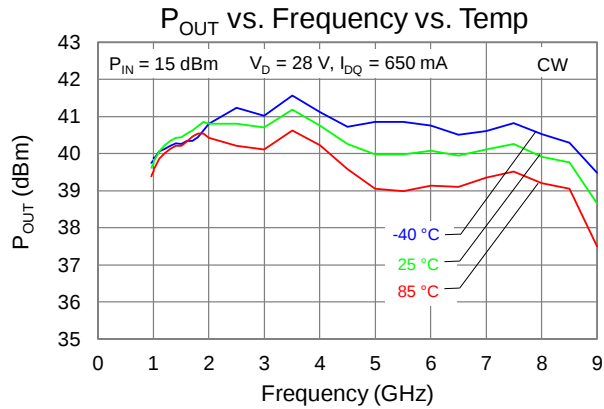
Performance Plots – Large Signal (CW)



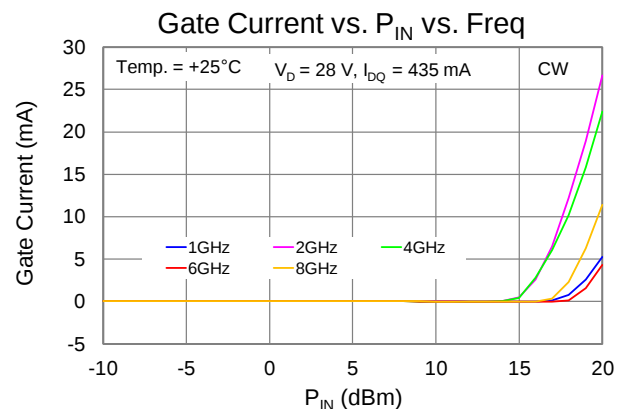
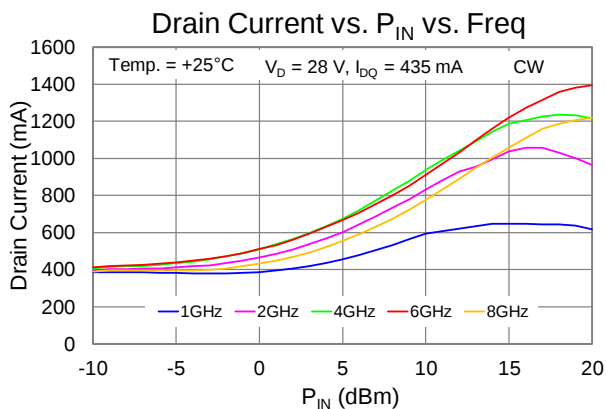
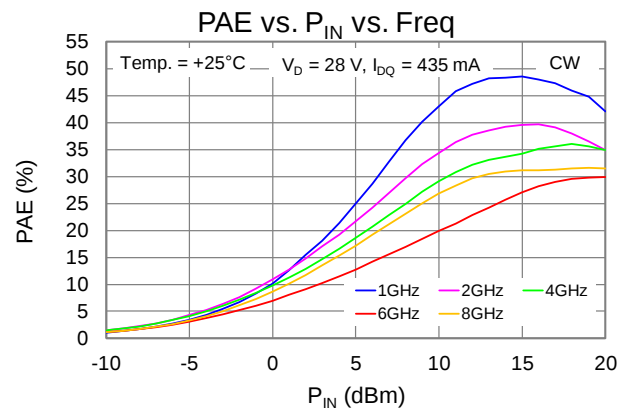
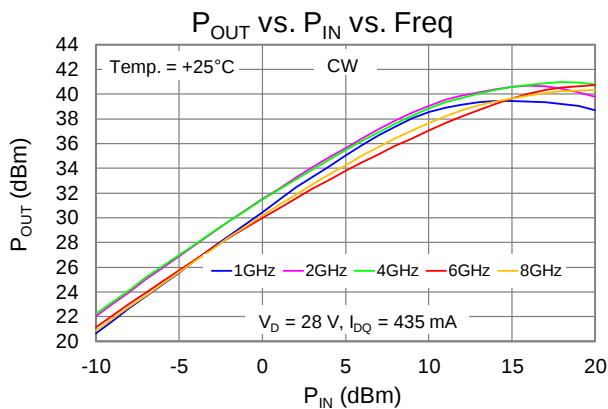
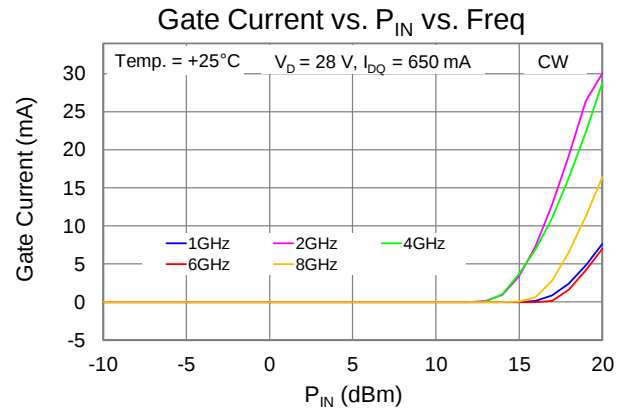
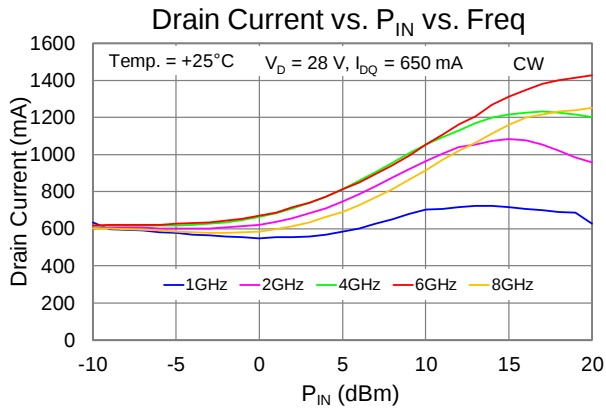
Performance Plots – Large Signal (CW)



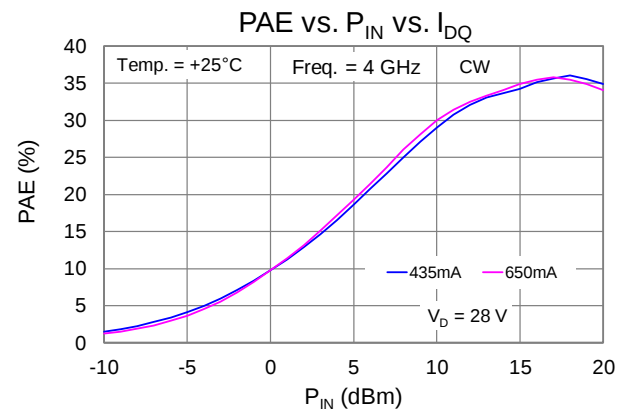
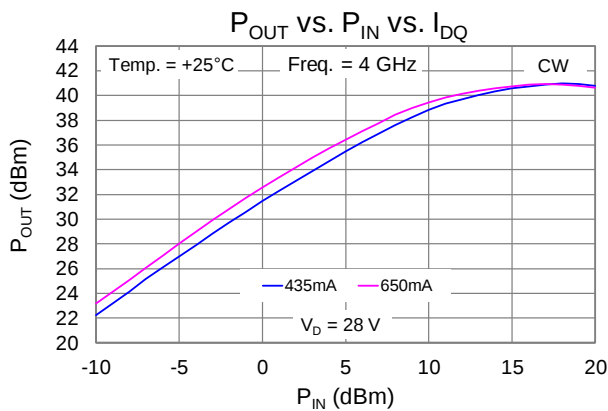
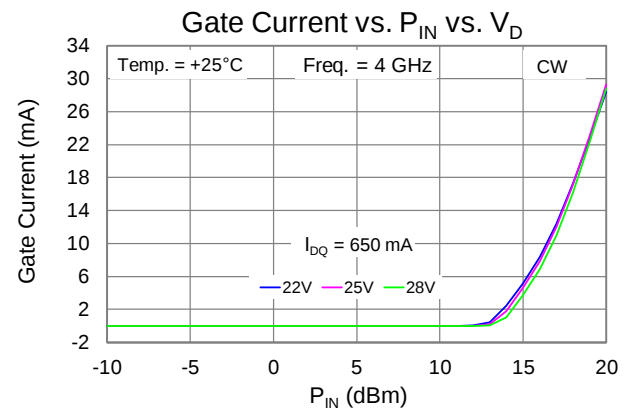
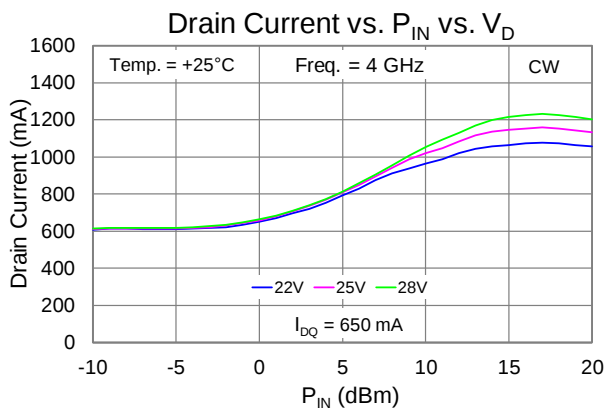
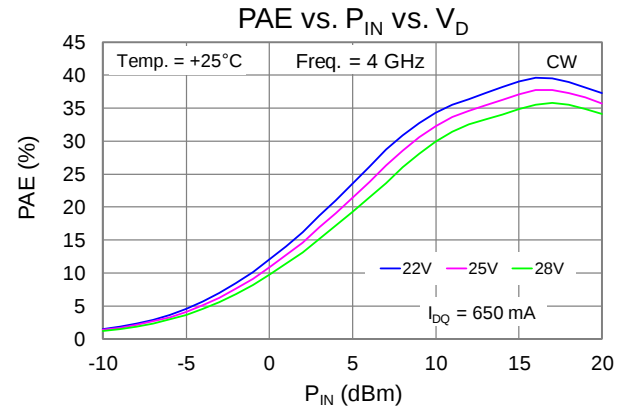
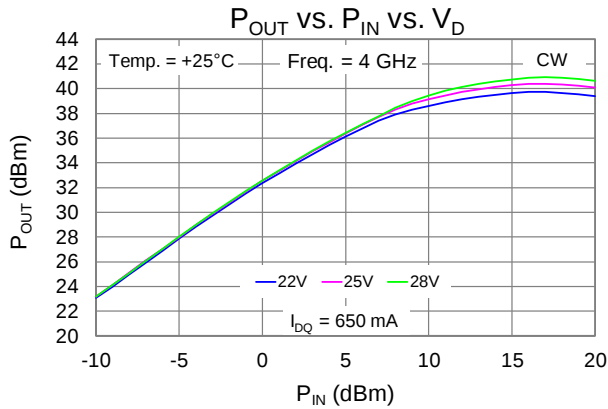
Performance Plots – Large Signal (CW)



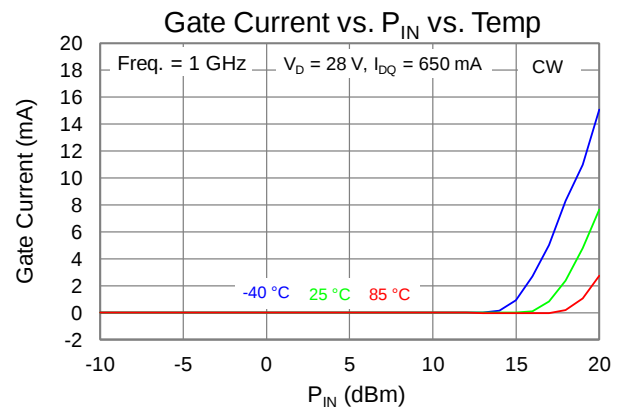
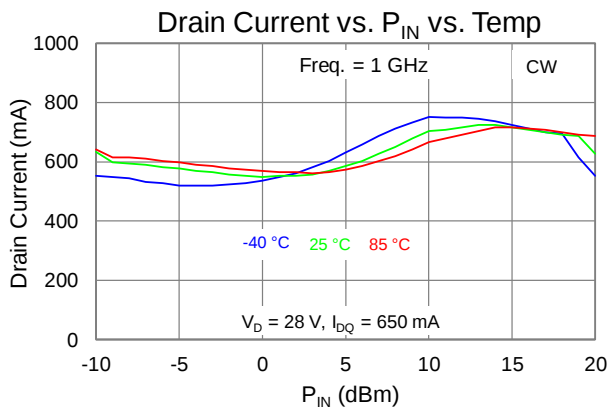
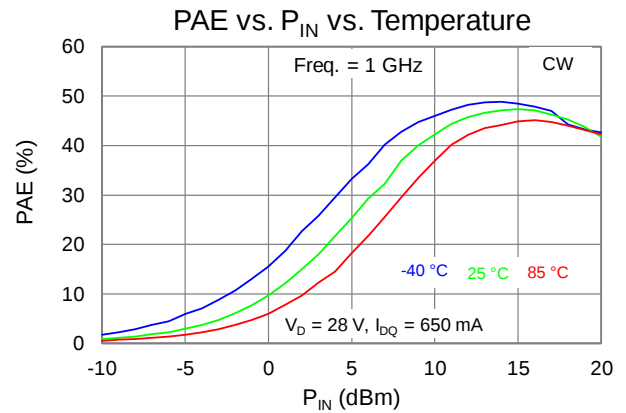
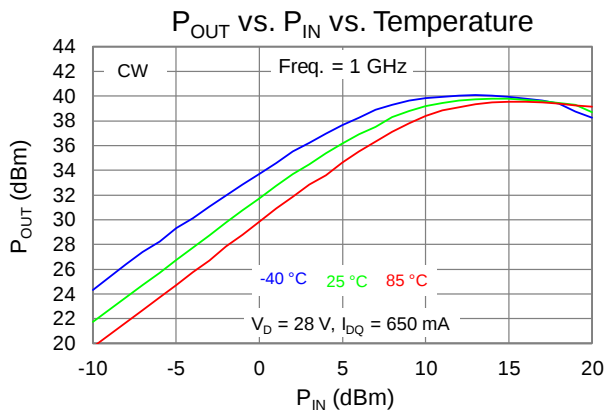
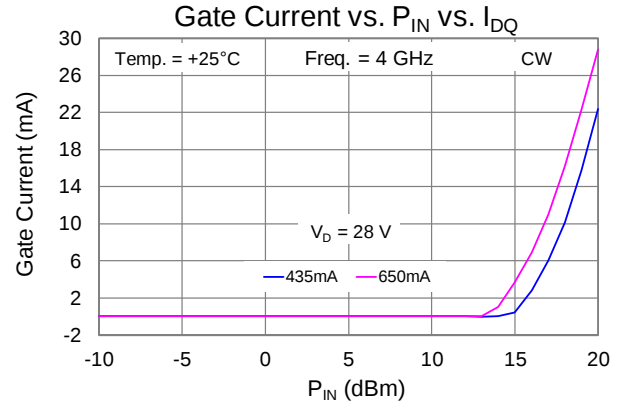
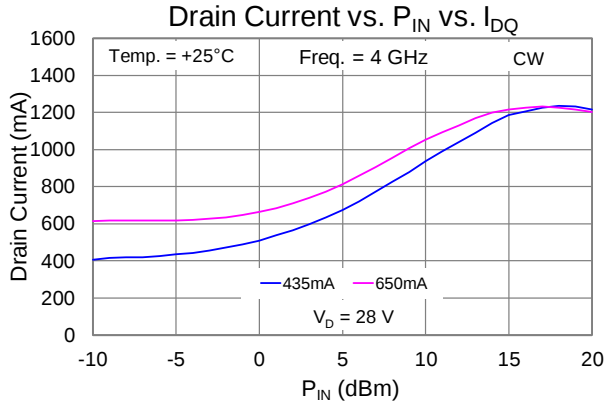
Performance Plots – Large Signal (CW)



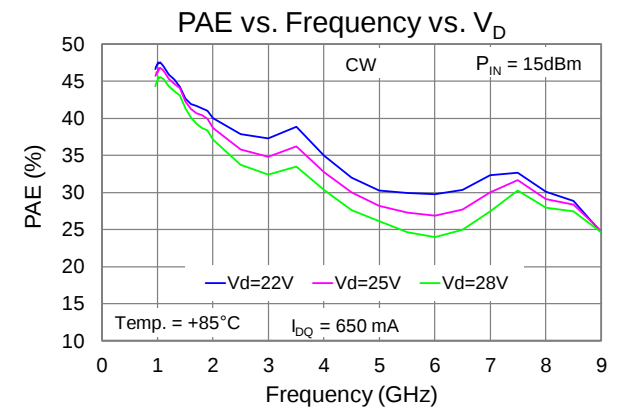
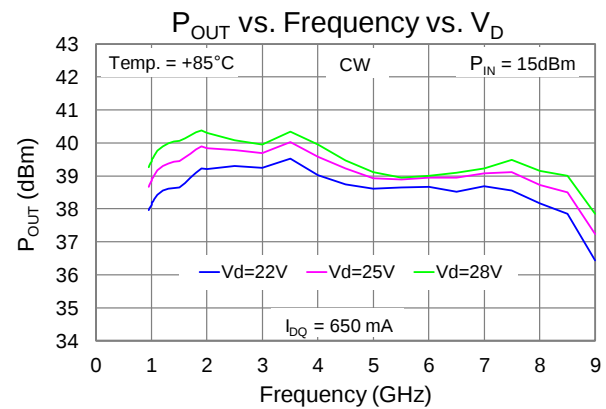
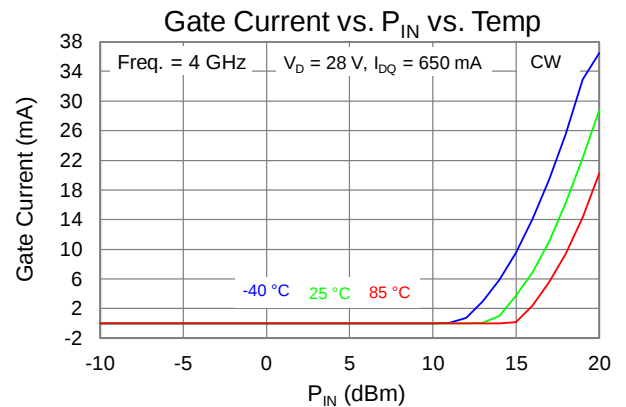
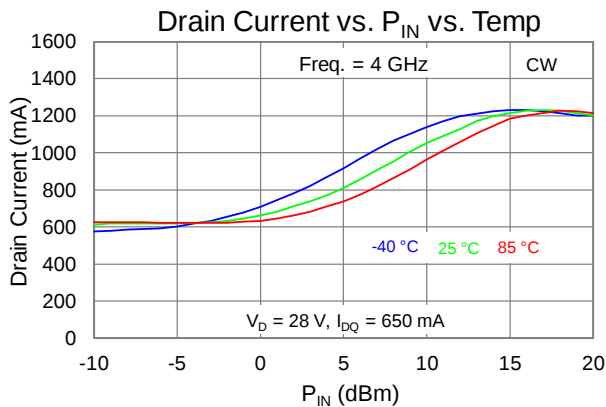
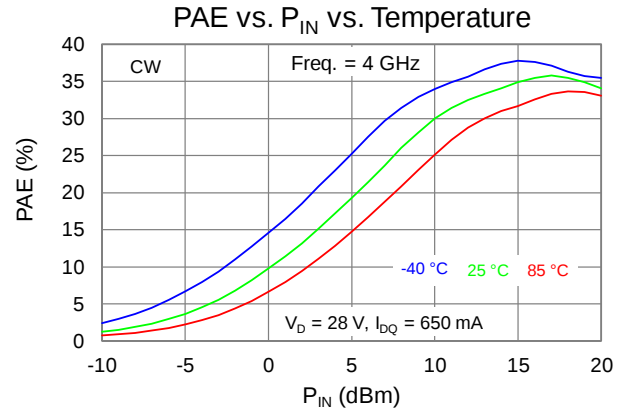
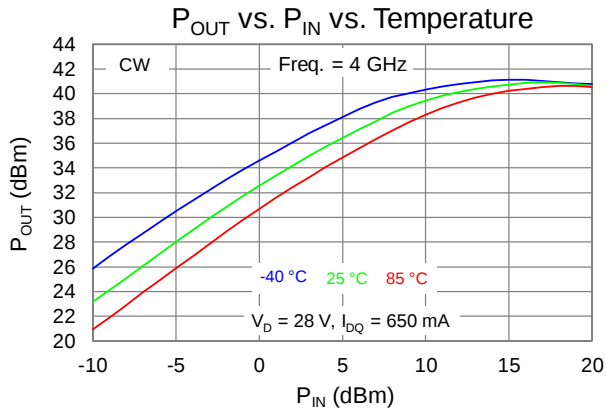
Performance Plots – Large Signal (CW)



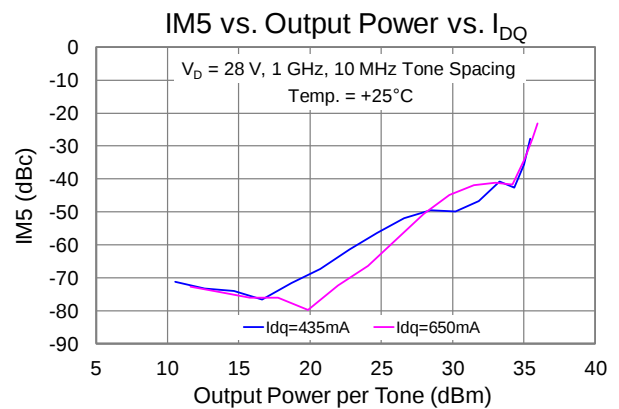
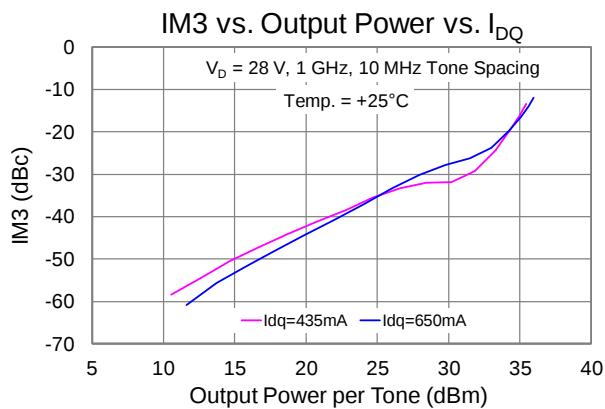
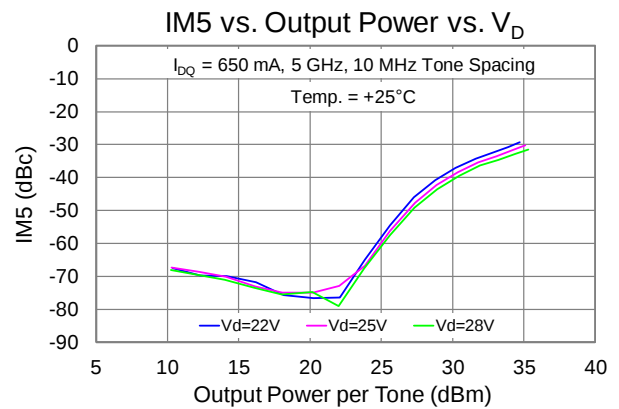
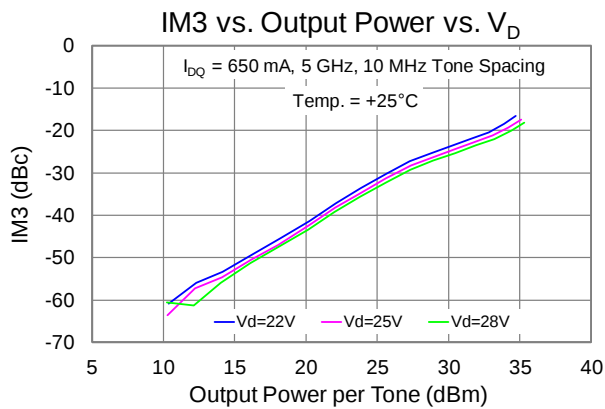
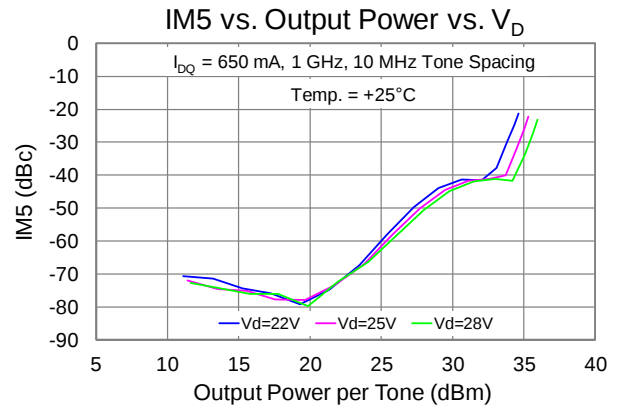
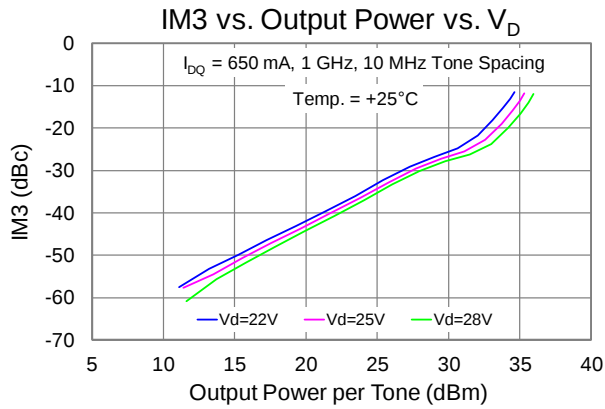
Performance Plots – Large Signal (CW)



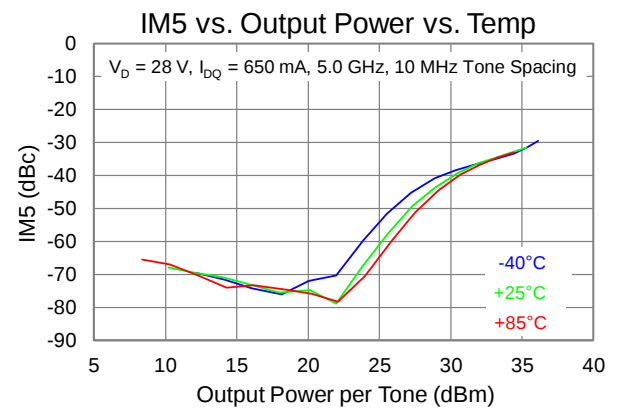
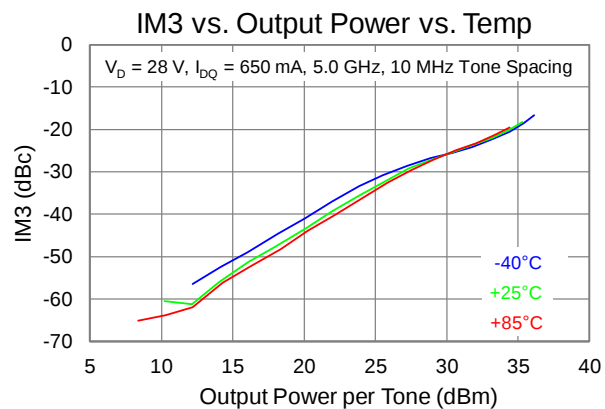
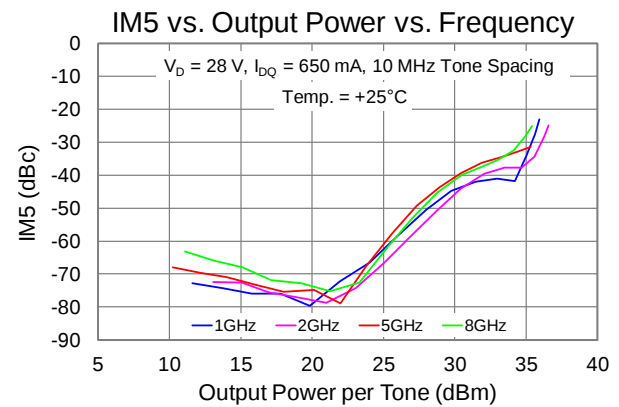
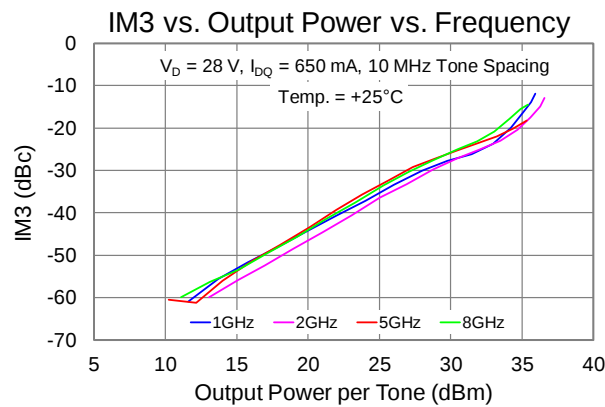
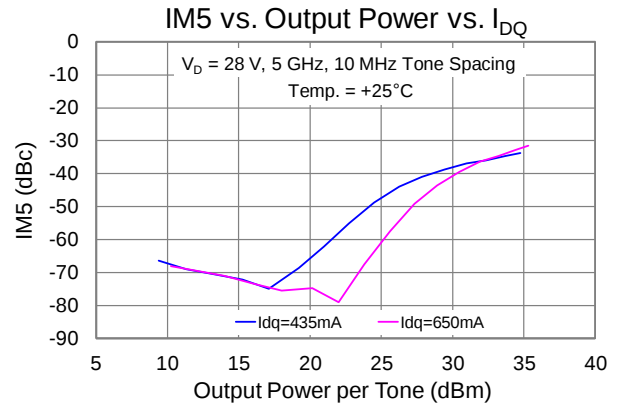
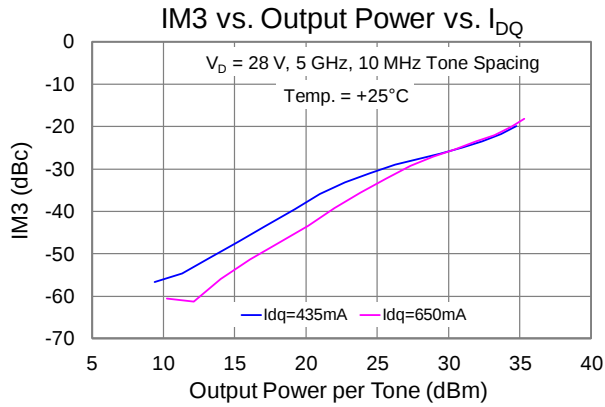
Performance Plots – Large Signal (CW)



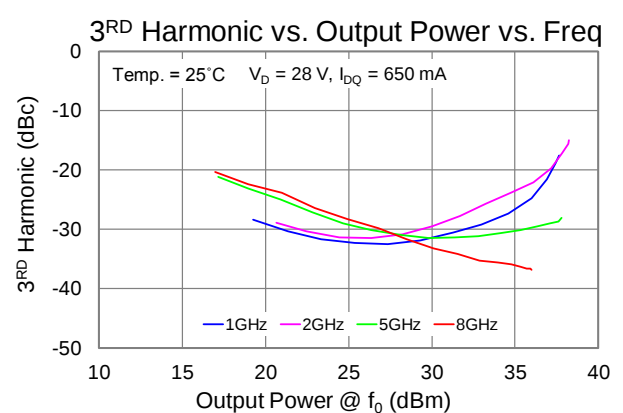
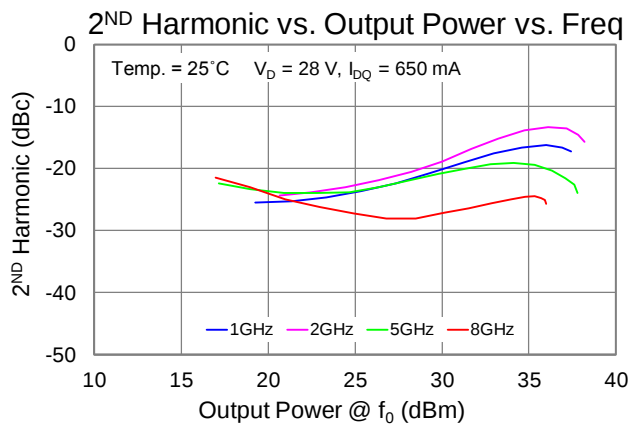
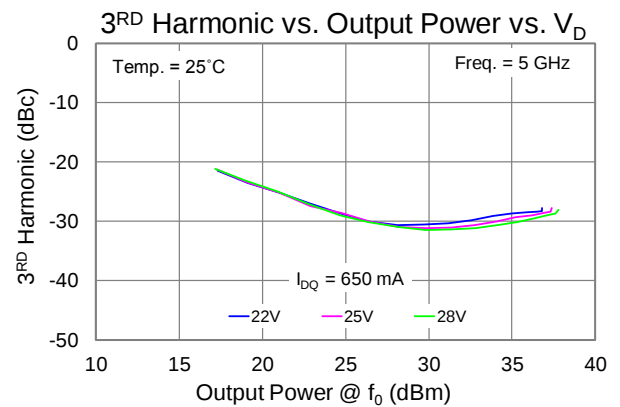
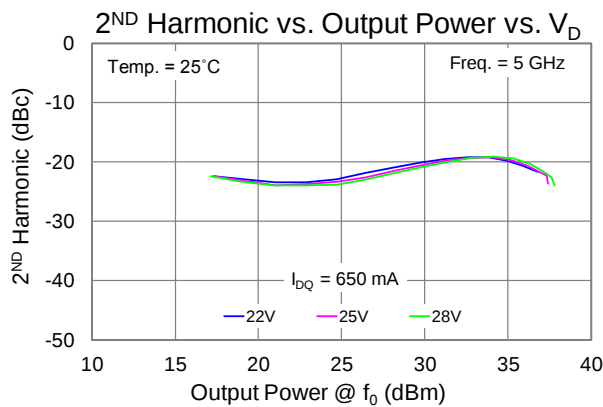
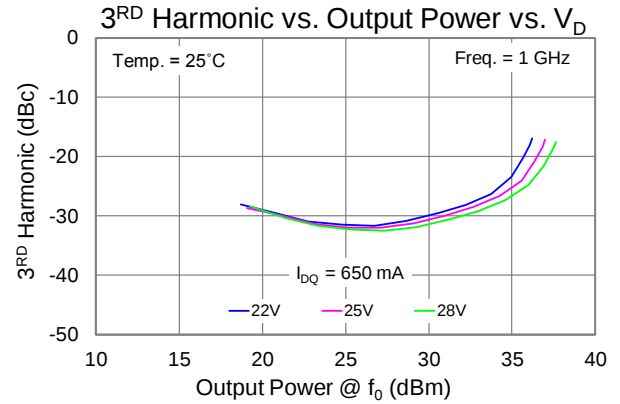
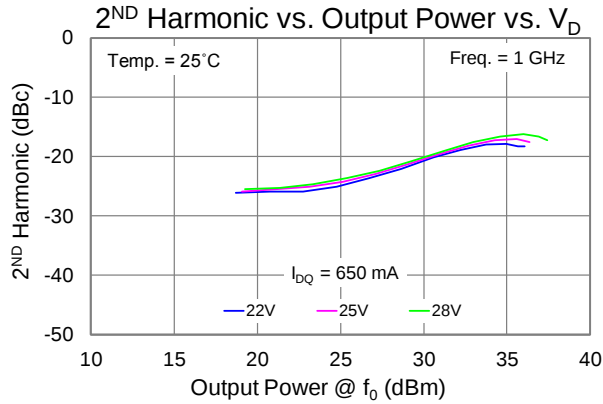
Performance Plots – Linearity



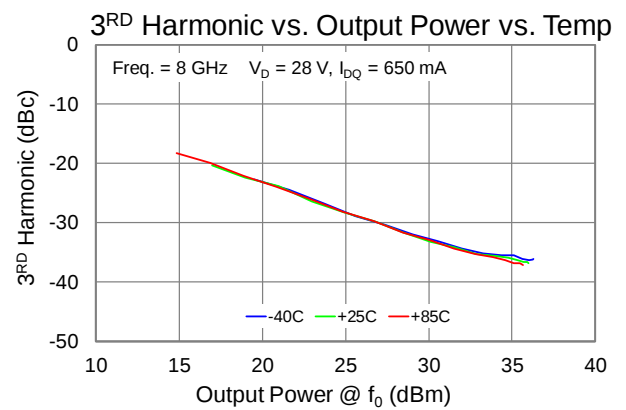
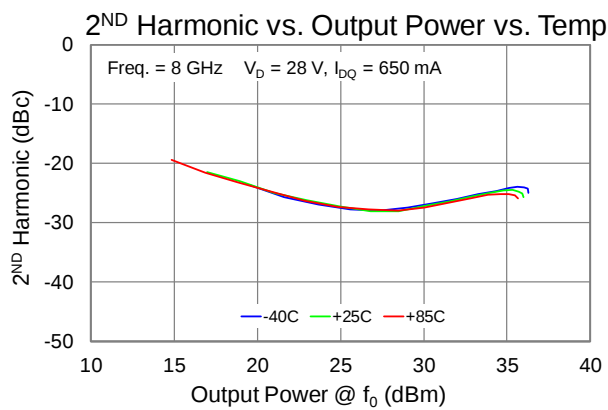
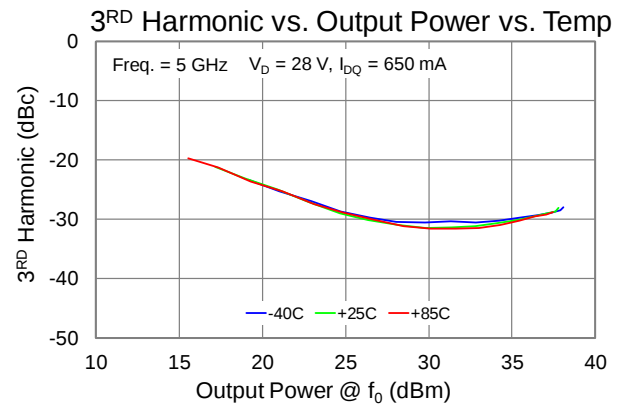
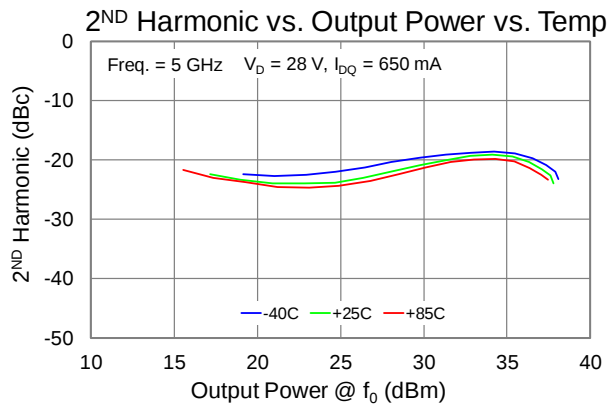
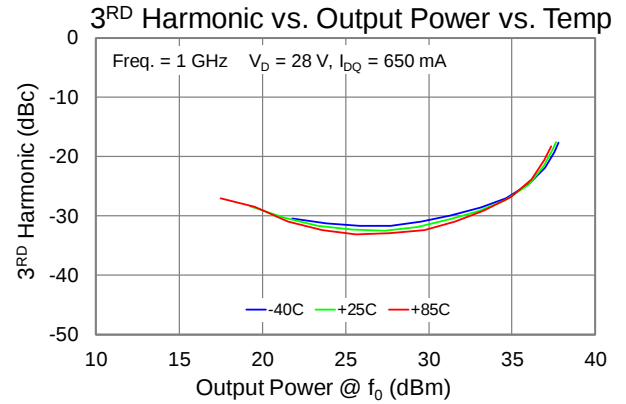
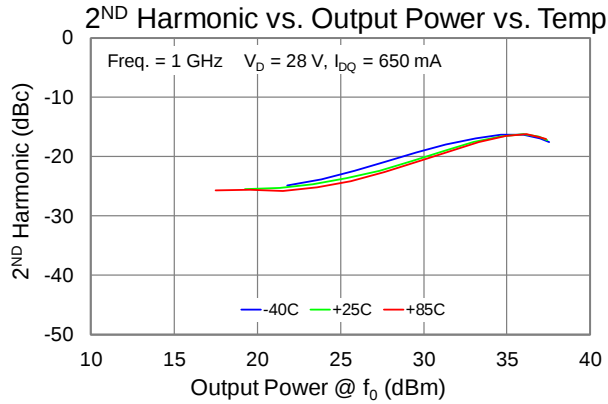
Performance Plots – Linearity



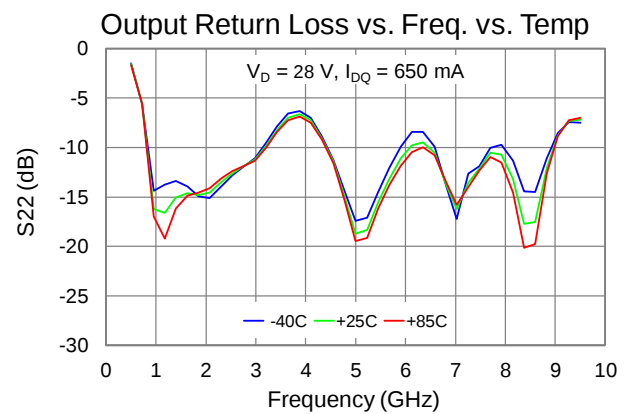
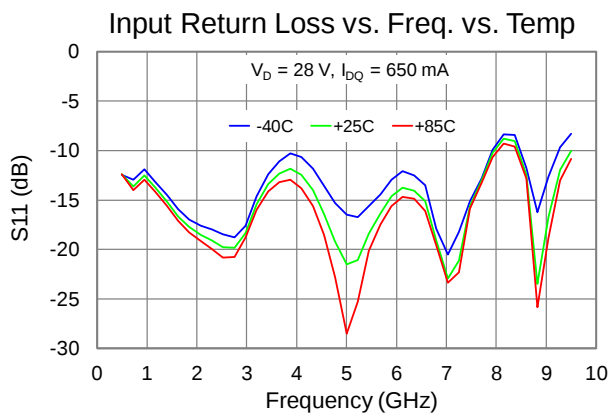
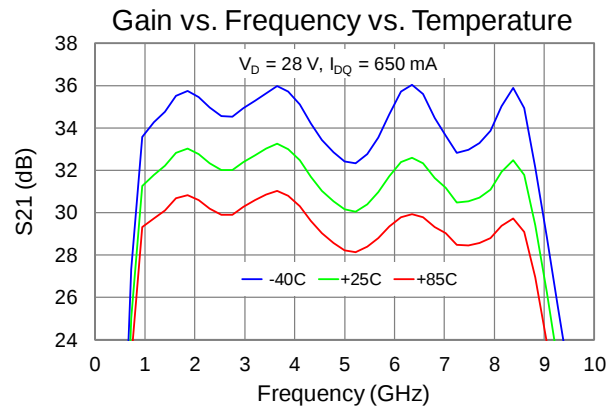
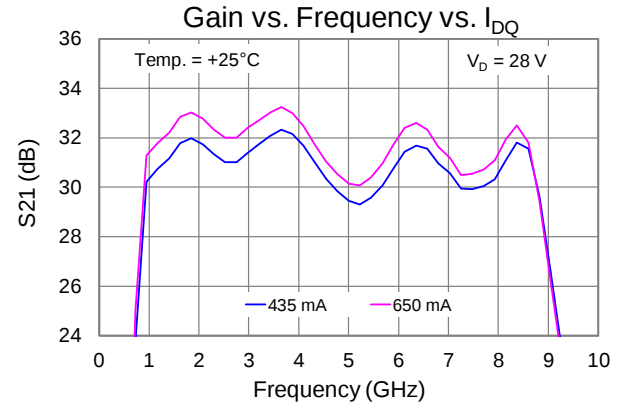
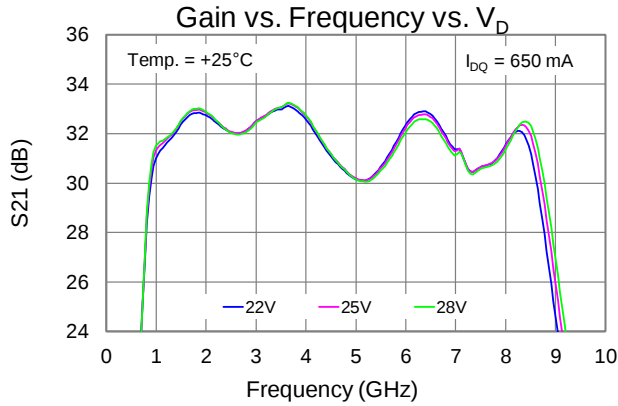
Performance Plots – Linearity



Performance Plots – Linearity



Performance Plots – Small Signal



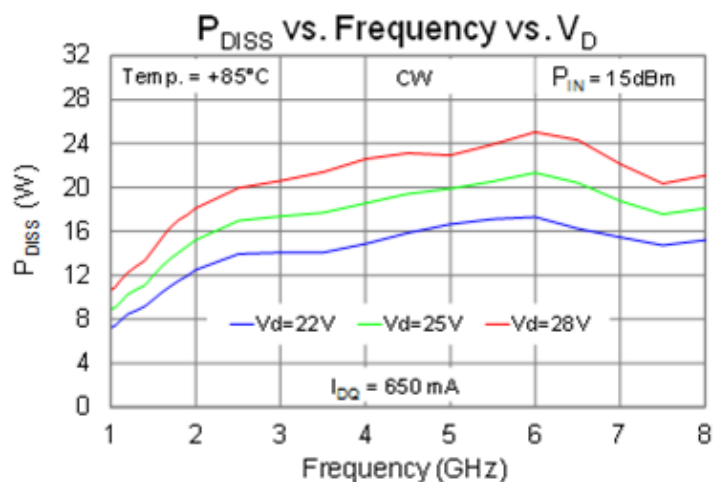
Thermal and Reliability Information

Parameter	Test Conditions	Value	Units
Thermal Resistance (θ_{JC}) ⁽¹⁾	$T_{BASE} = 85^{\circ}\text{C}$, $V_D = +28\text{ V}$ (CW)	3.62	$^{\circ}\text{C/W}$
Channel Temperature (T_{CH}) (Quiescent)	At $I_{DQ} = 650\text{ mA}$, $P_{DISS} = 18.2\text{ W}$	151	$^{\circ}\text{C}$
Thermal Resistance (θ_{JC}) ⁽¹⁾	$T_{BASE} = 85^{\circ}\text{C}$, $V_D = +25\text{ V}$ (CW)	4.19	$^{\circ}\text{C/W}$
Channel Temperature (T_{CH}) (Under RF drive)	At Freq = 6.0 GHz, $P_{IN} = 15\text{ dBm}$: $I_{DQ} = 650\text{ mA}$, $I_{D_Drive} = 1.2\text{ A}$ $P_{OUT} = 39\text{ dBm}$, $P_{DISS} = 21\text{ W}$	173	$^{\circ}\text{C}$
Thermal Resistance (θ_{JC}) ⁽¹⁾	$T_{BASE} = 85^{\circ}\text{C}$, $V_D = +28\text{ V}$ (CW)	4.16	$^{\circ}\text{C/W}$
Channel Temperature (T_{CH}) (Under RF drive)	At Freq = 6.0 GHz, $P_{IN} = 15\text{ dBm}$: $I_{DQ} = 650\text{ mA}$, $I_{D_Drive} = 1.2\text{ A}$ $P_{OUT} = 39\text{ dBm}$, $P_{DISS} = 25\text{ W}$	189	$^{\circ}\text{C}$

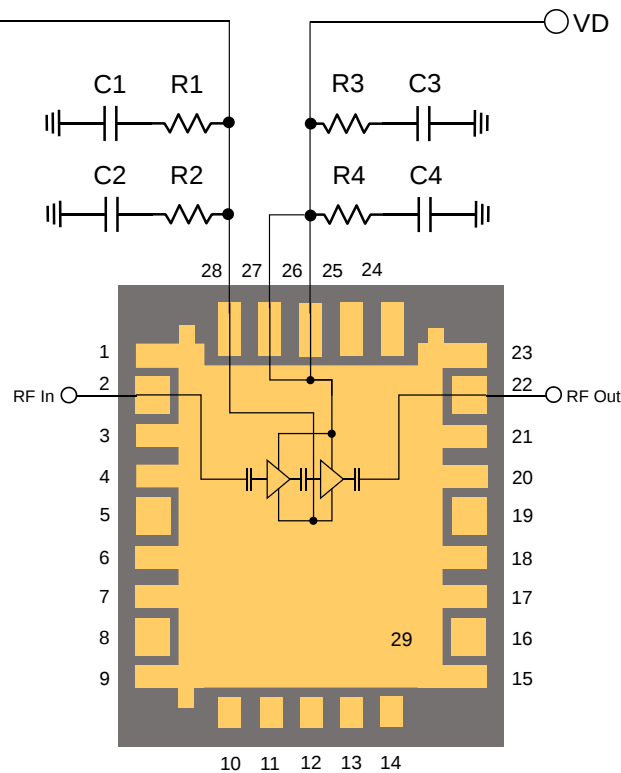
Notes:

1. Thermal resistance measured to back of package.
2. Refer to the following document: [GaN Device Channel temperature, Thermal Resistance, and Reliability Estimates](#)

Power Dissipation



Applications Circuit and Pin Layout



Bias Up Procedure

1. Set I_D limit to 1.3 A, I_G limit to 10 mA
2. Apply -5 V to V_G
3. Apply $+28\text{ V}$ to V_D ; ensure I_{DQ} is approx. 0 mA
4. Adjust V_G until $I_{DQ} = 650\text{ mA}$ ($V_G \sim -2.2\text{ V Typ.}$).
5. Turn on RF supply

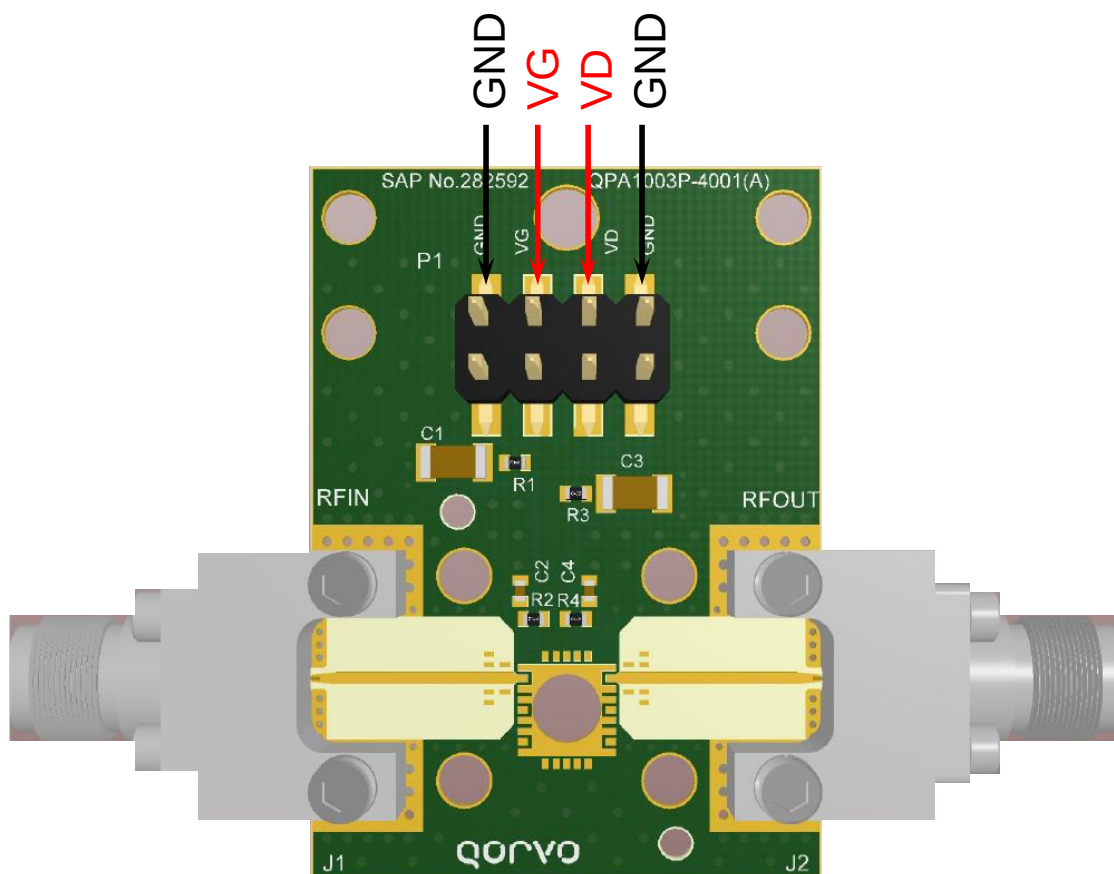
Bias Down Procedure

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

Pin No.	Symbol	Description
1, 3, 4, 6, 7, 9, 15, 17, 18, 20, 21, 23	GND	Must be grounded on the PCB
2	RF IN	RF Input; matched to $50\ \Omega$, DC blocked
5, 8, 10-14, 16, 19, 24, 25	NC	No internal connection. Should be connected to PCB ground
22	RF OUT	RF Output; matched to $50\ \Omega$, DC blocked
26, 27	VD	Drain voltage, bias network is required; see Application Circuit as an example
28	VG	Gate voltage, bias network is required; see Application Circuit as an example
29	GND	Center pad ground connection

Evaluation Board (EVB) Layout Assembly



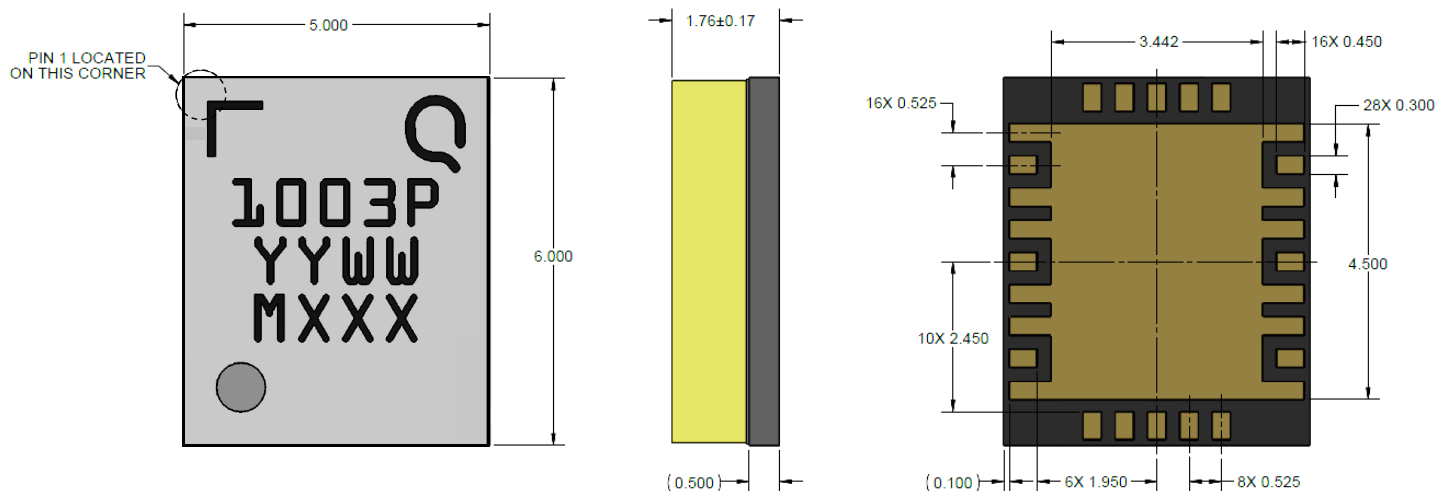
Notes:

- PCB is 4 metal layers, each 0.5 oz. copper.
Core 1 – Taconics TSM-DS, 0.010 in. thick
Core 2 – Epoxy coated glass fabric
Core 3 – 370HR, 0.006 in. thick
- Center of PCB mounting area is a copper coin for thermal management and RF grounding.

Bill of Materials

Reference Des.	Value	Description	Manuf.	Part Number
C1, C3	1 uF	Cap, 1205, 50 V, 20 %, X7R	Various	–
C2, C4	1000 pF	Cap, 0402, 50 V, 10 %, X7R	Various	–
R1, R2, R3, R4	5.1 Ohm	Res, 0402, 50 V, 5 %	Various	–

Mechanical Information



Units: Millimeter (mm)

Tolerances: unless specified

x.xx = ± 0.25

x.xxx = ± 0.100

Materials:

Base: EHS Laminate

Lid: Laminate

All metalized features are gold plated

Part is epoxy sealed

Marking:

1003P: Part number

YY: Part Assembly year

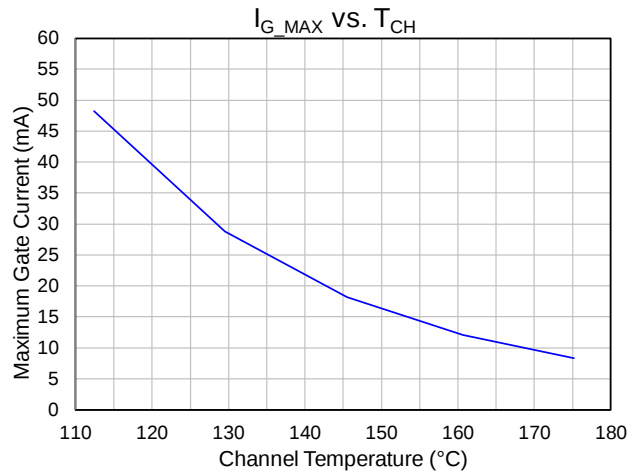
WW: Part Assembly week

MXXX: Batch ID

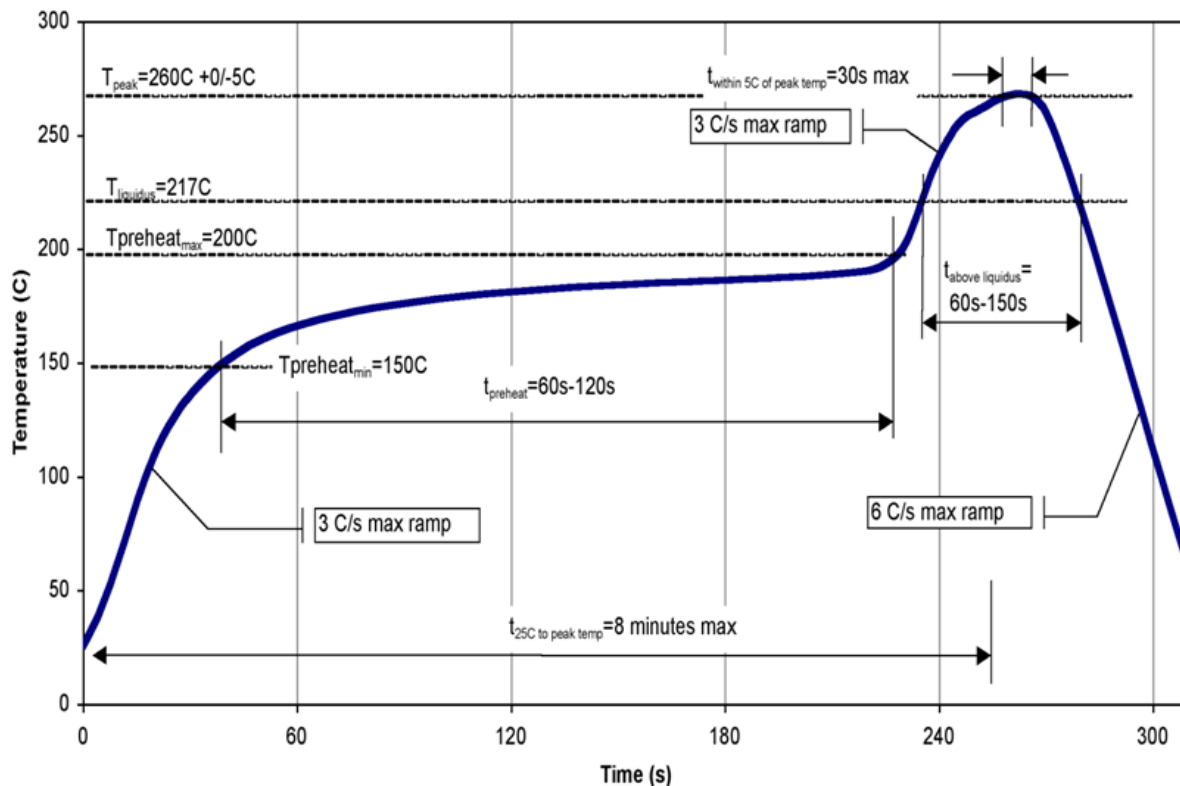
Absolute Maximum Ratings

Parameter	Value / Range
Drain Voltage (V_D)	+29.5 V
Gate Voltage Range (V_G)	-8 to 0 V
Drain Current	1300 mA
Forward Gate Current (I_G)	See I_{G_MAX} plot
Power Dissipation (P_{DISS}), 85 °C, CW	30 W
Input Power, CW, 50 Ω , (P_{IN}), $V_D = +28$ V, $I_{DQ} = 650$ mA, 85 °C,	18 dBm
Input Power, CW, VSWR 3:1, (P_{IN}) $V_D = +28$ V, $I_{DQ} = 650$ mA, 85 °C	18 dBm
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)	TBD	ESDA / JEDEC JS-001-2012
MSL – Moisture Sensitivity Level	TBD	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
- Antimony Free
- TBBP-A (C₁₅H₁₂Br₄O₂) Free
- PFOS Free

Contact Information

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

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Email: customer.support@qorvo.com

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