TGA2975-SM

2.7 to 3.5 GHz, 12 W GaN Power Amplifier

General Description

Qorvo's TGA2975-SM is a packaged MMIC power amplifier which operates from 2.7 to 3.5 GHz. The TGA2975-SM is designed using Qorvo's TQGaN25 0.25-µm GaN on SiC process.

The TGA2975-SM typically provides more than 41 dBm of saturated output power, 52% power-added efficiency, and 31 dB small signal gain. It can operate under both pulse and CW conditions.

The TGA2975-SM is available in a low-cost, surface mount 24 lead 5 mm x 5 mm overmold QFN. It is ideally suited to support both commercial and defense related radar applications.

Both RF ports have integrated DC blocking capacitors and are fully matched to 50 ohms.

Lead-free and RoHS compliant

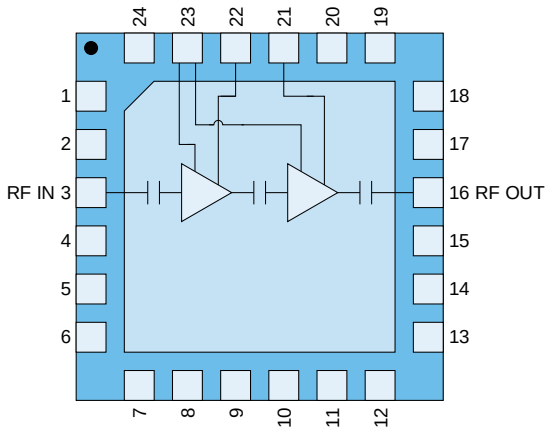
Evaluation Boards are available upon request.

QFN 5 x 5 mm 24 L

Product Features

- Frequency Range: 2.7-3.5 GHz
- P_{SAT}: >41 dBm (at P_{IN} = 16 dBm)
- PAE: >52 % (at P_{IN} = 16 dBm)
- Small Signal Gain: 31 dB
- Return Loss: > 9 dB
- Bias: V_D = 28 V, I_{DQ} = 175 mA
- Pulsed V_D: PW = 100 us, DC = 10 %
- Package Dimensions: 5.0 x 5.0 x 0.85 mm

Functional Block Diagram



Applications

- Commercial and Military Radar

Pad Configuration

Pad no.	Symbol
1, 2, 4 – 15, 17 - 20, 24	NC
3	RF IN
16	RF OUT
21	DRAIN 2
22	DRAIN 1
23	GATE

Ordering Information

Part	Description
TGA2975-SM	2.7-3.5 GHz, 12 W GaN Power Amplifier
TGA2975-SM_EVB	TGA2975-SM Evaluation Board

Absolute Maximum Ratings

Parameter	Value/Range
Drain Voltage (V_D)	40 V
Gate Voltage Range (V_G)	−8 to 0 V
Drain Current (I_{D1})	225 mA
Drain Current (I_{D2})	1250 mA
Gate Current (I_G)	See Graph (page 12)
Power Dissipation (P_{DISS}), 85 °C	27 W
Input Power (P_{IN}), CW, 50 Ω, 85 °C	30 dBm
Input Power (P_{IN}), CW, VSWR 10:1, V_D = 28 V, 85 °C	23 dBm
Channel Temperature (T_{CH})	275 °C
Mounting Temperature (30 Seconds)	260 °C
Storage Temperature	−55 to 150 °C

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

Recommended Operating Conditions

Parameter	Value
Drain Voltage (V_D)	28 V
Drain Current (I_{DQ})	175 mA

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

Electrical Specifications

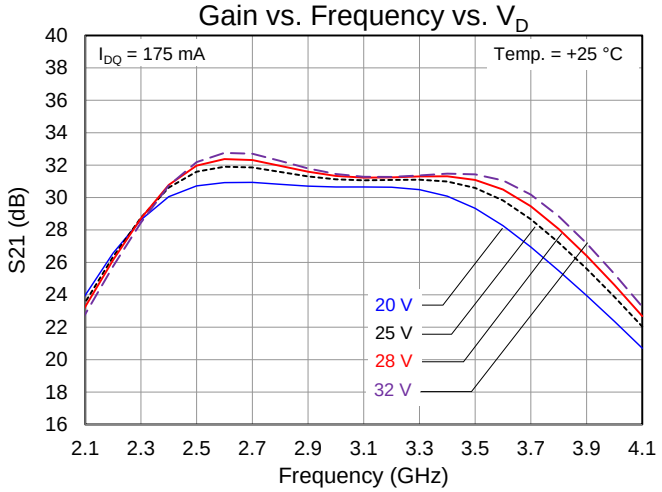
Test conditions unless otherwise noted: 25 °C, V_D = 28 V, I_{DQ} = 175 mA, Pulsed V_D: PW = 100 us, DC = 10 %

Parameter	Min	Typical	Max	Units
Operational Frequency Range	2.7		3.5	GHz
Small Signal Gain		31		dB
Input Return Loss		> 15		dB
Output Return Loss		> 9		dB
Output Power at Saturation (P_{IN} = 16 dBm)	40	> 41		dBm
Power-Added Efficiency (P_{IN} = 16 dBm)	45	> 52		%
Gain Temperature Coefficient		−0.05		dB/°C
Power Temperature Coefficient		−0.007		dBm/°C

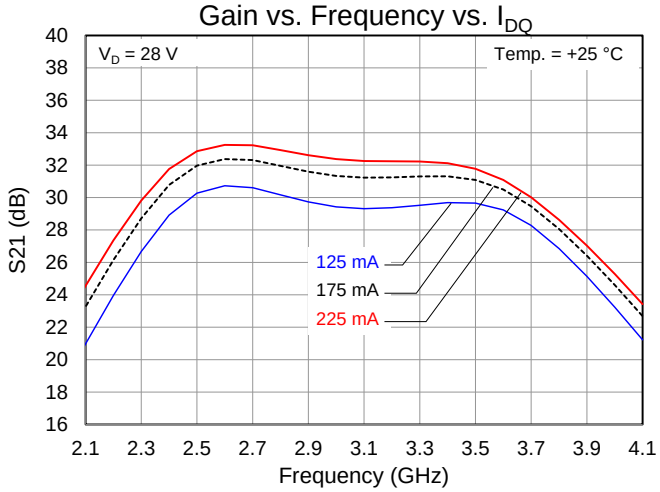
Typical Performance: Small Signal

Condition: CW

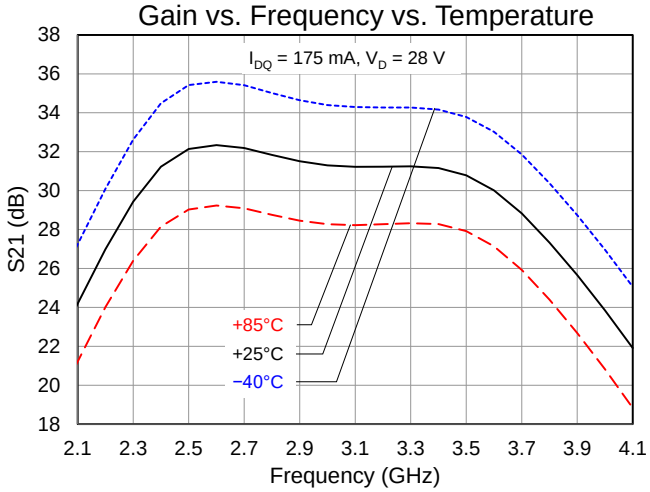
Gain vs. Frequency vs. V_D



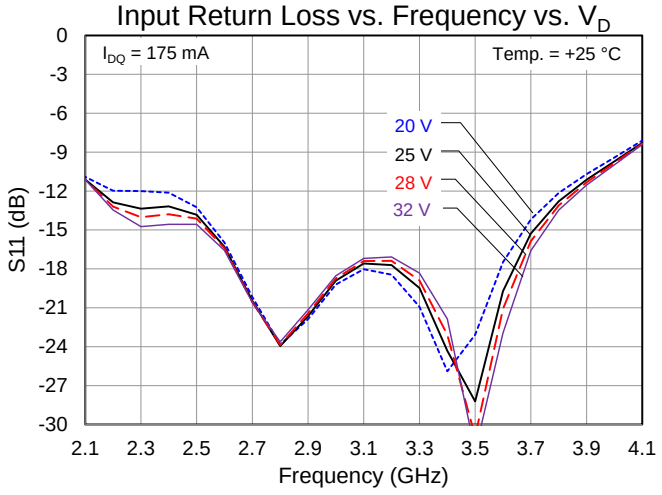
Gain vs. Frequency vs. I_{DQ}



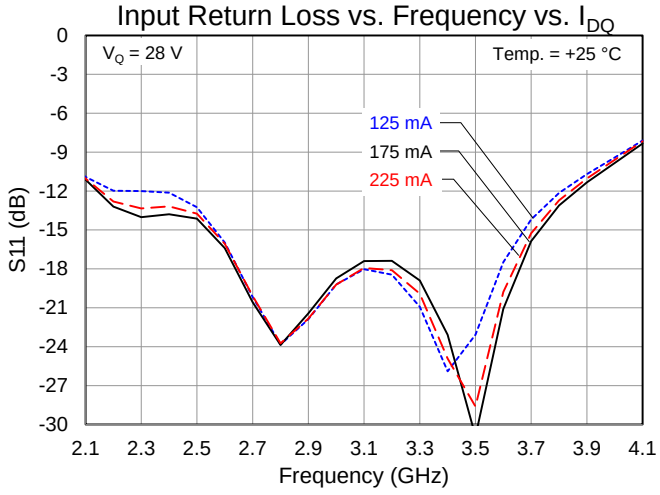
Gain vs. Frequency vs. Temperature



Input Return Loss vs. Frequency vs. V_D

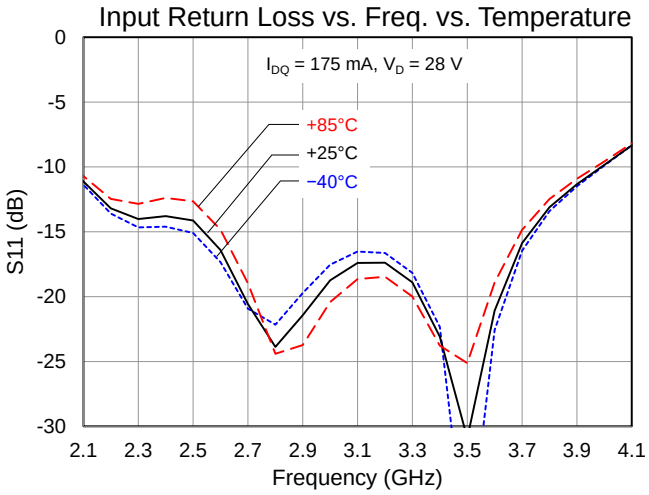


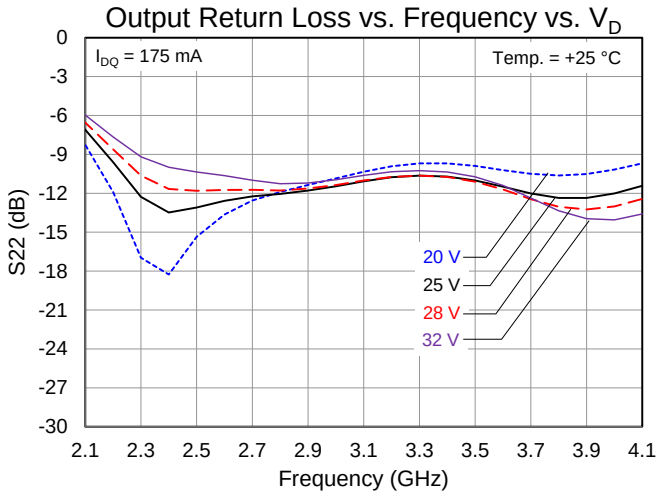
Input Return Loss vs. Frequency vs. I_{DQ}

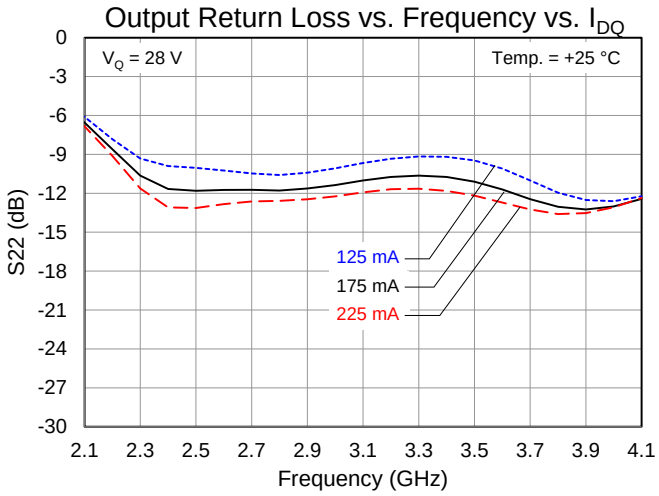


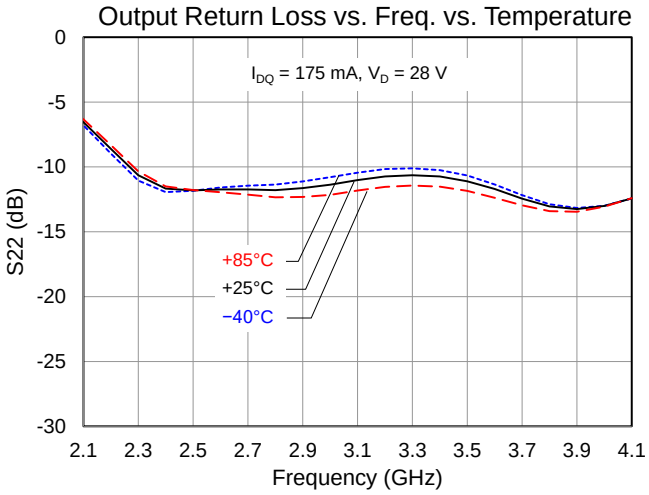
Typical Performance: Small Signal

Condition: CW





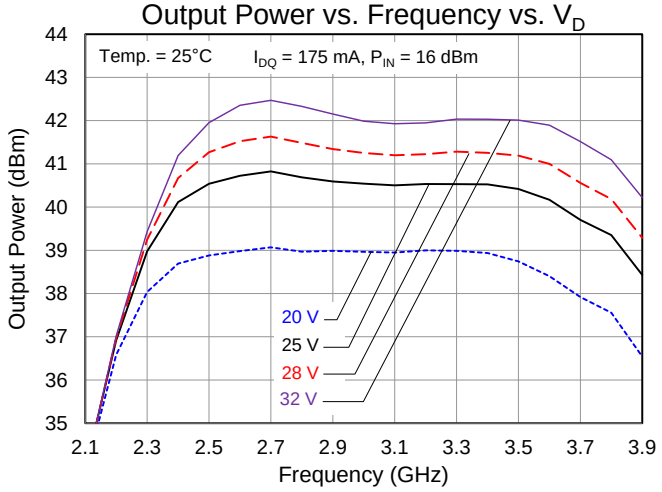




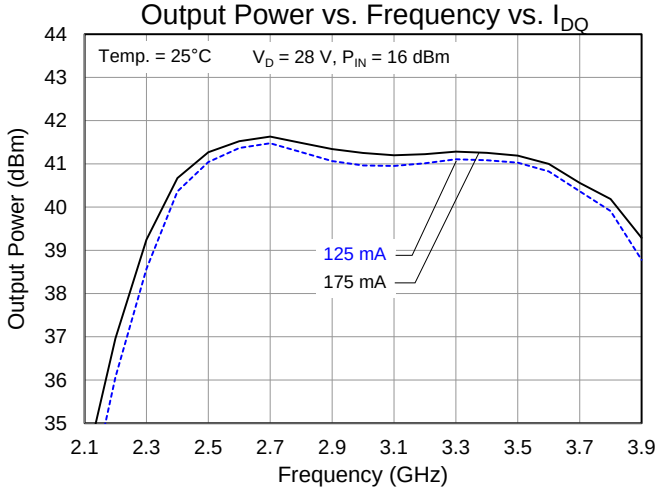
Typical Performance: Large Signal

Condition: Pulsed V_D, Pulse Width = 100 us, Duty Cycle = 10%

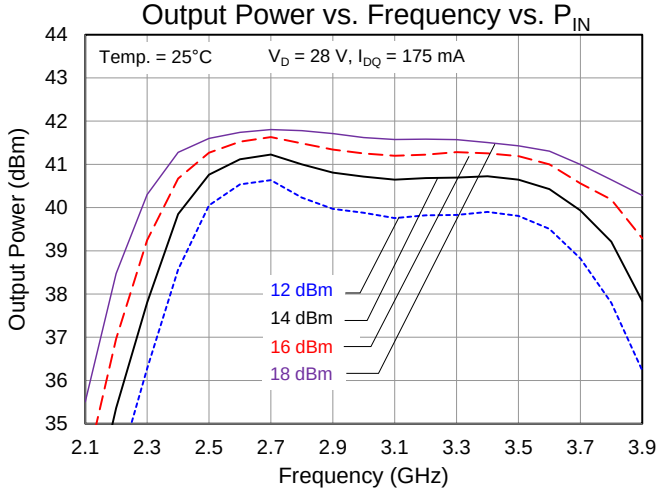
Output Power vs. Frequency vs. V_D



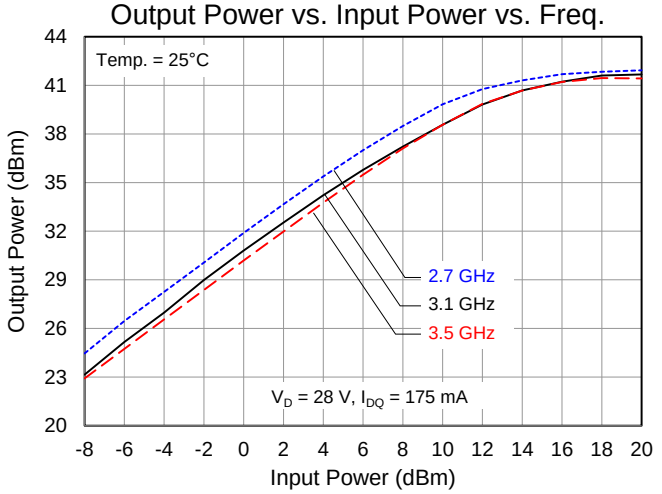
Output Power vs. Frequency vs. I_{DQ}



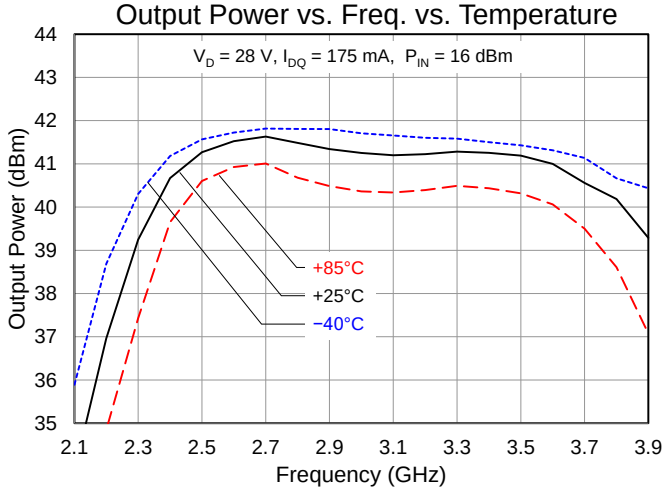
Output Power vs. Frequency vs. P_{IN}



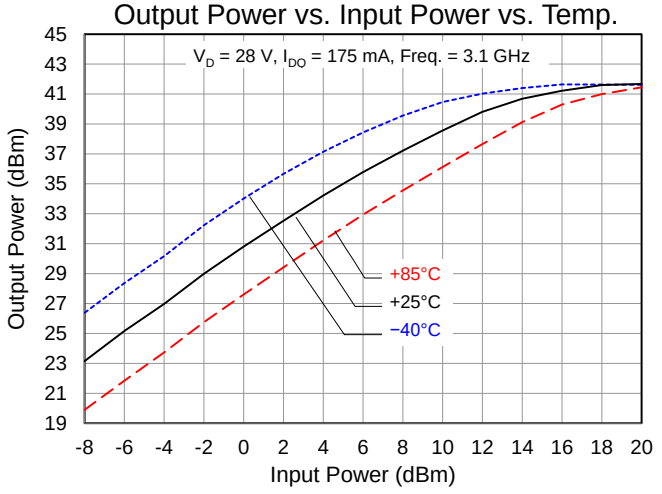
Output Power vs. Input Power vs. Freq.



Output Power vs. Freq. vs. Temperature



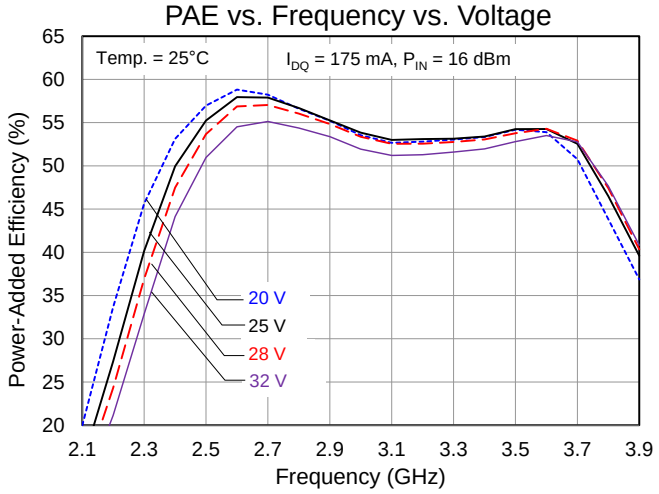
Output Power vs. Input Power vs. Temp.



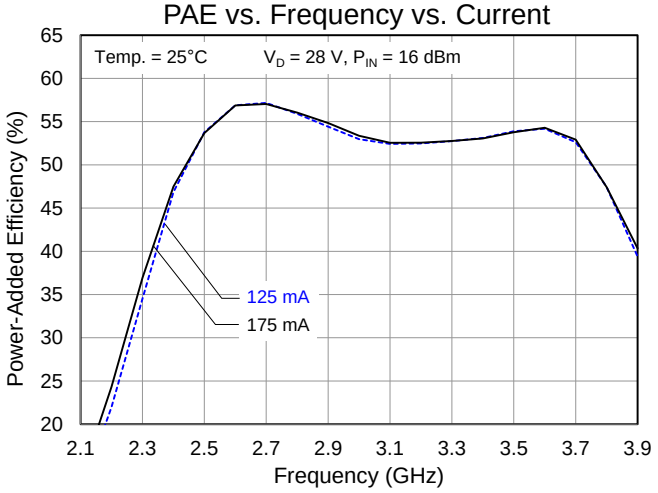
Typical Performance: Large Signal

Condition: Pulsed V_D, Pulse Width = 100 us, Duty Cycle = 10%

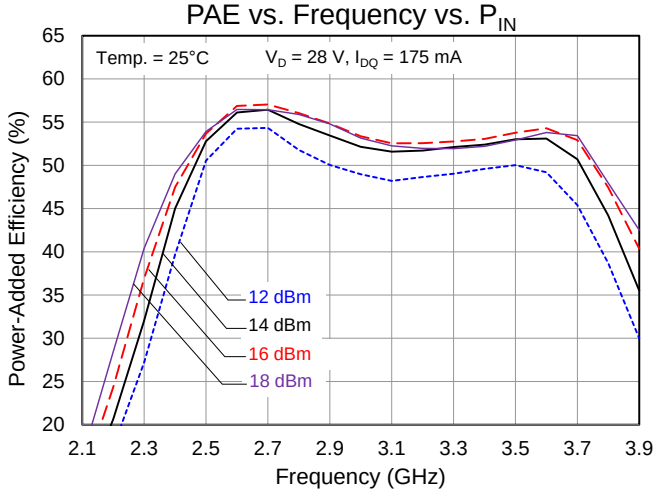
PAE vs. Frequency vs. Voltage



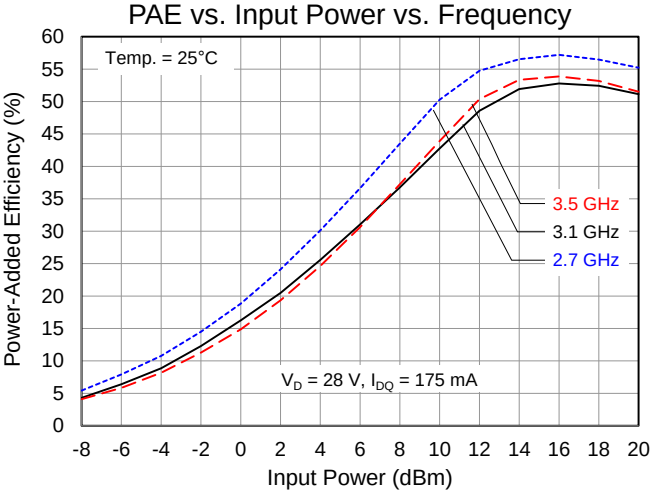
PAE vs. Frequency vs. Current



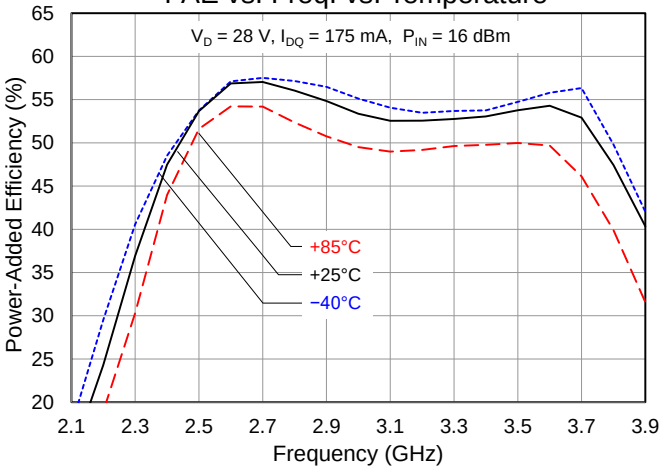
PAE vs. Frequency vs. P_{IN}



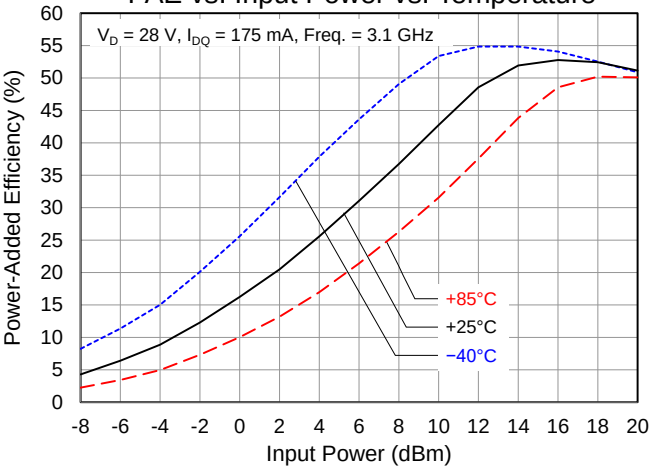
PAE vs. Input Power vs. Frequency



PAE vs. Freq. vs. Temperature



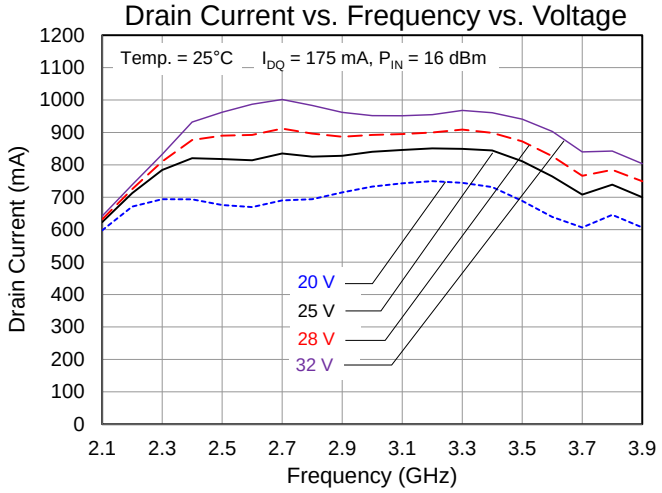
PAE vs. Input Power vs. Temperature



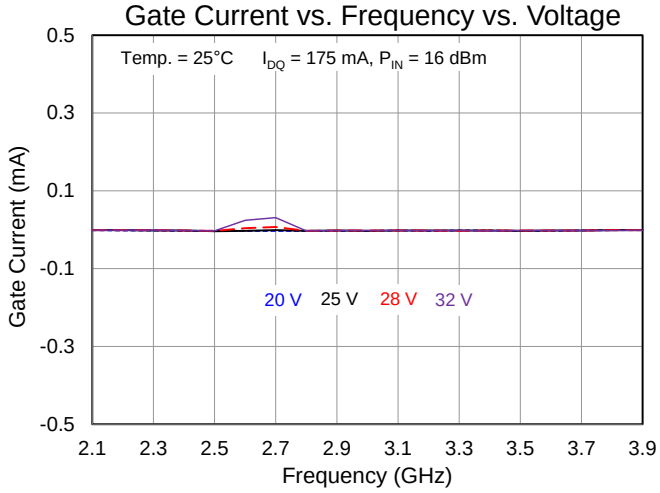
Typical Performance: Large Signal

Condition: Pulsed V_D, Pulse Width = 100 us, Duty Cycle = 10%

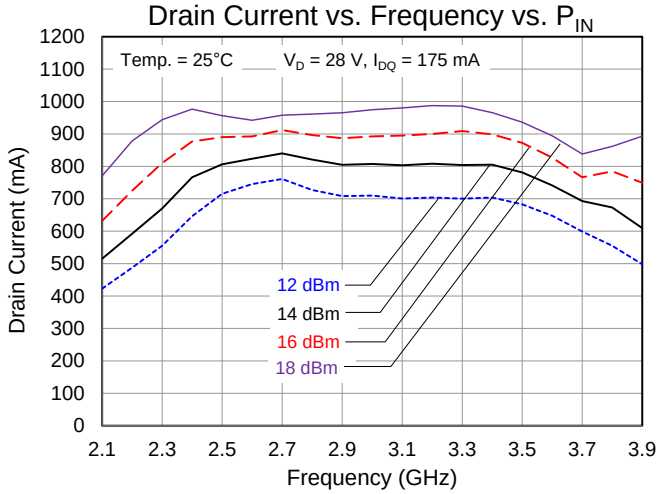
Drain Current vs. Frequency vs. Voltage



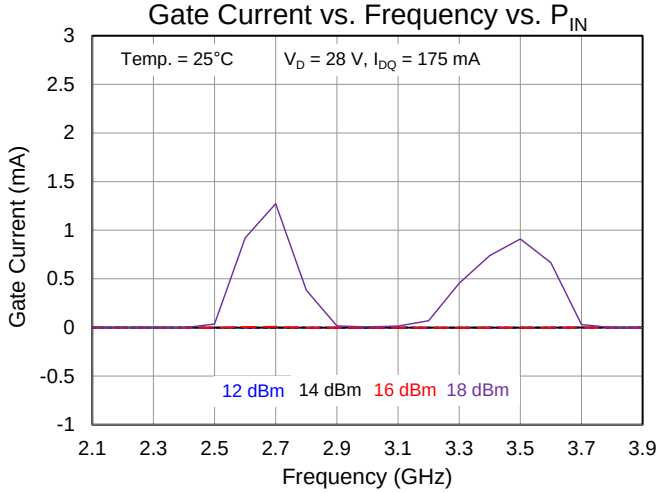
Gate Current vs. Frequency vs. Voltage



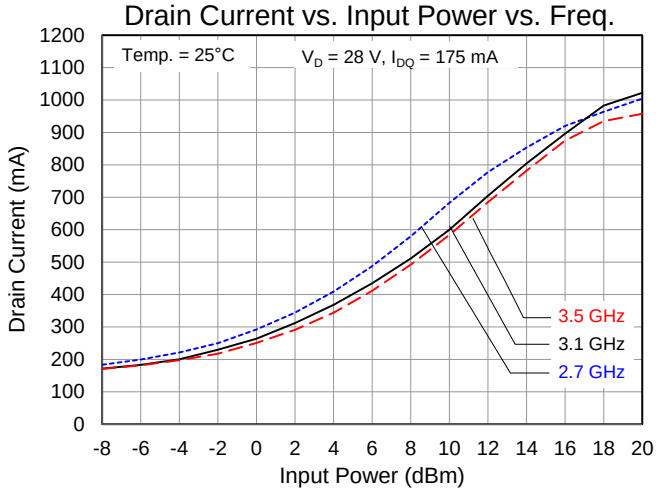
Drain Current vs. Frequency vs. P_{IN}



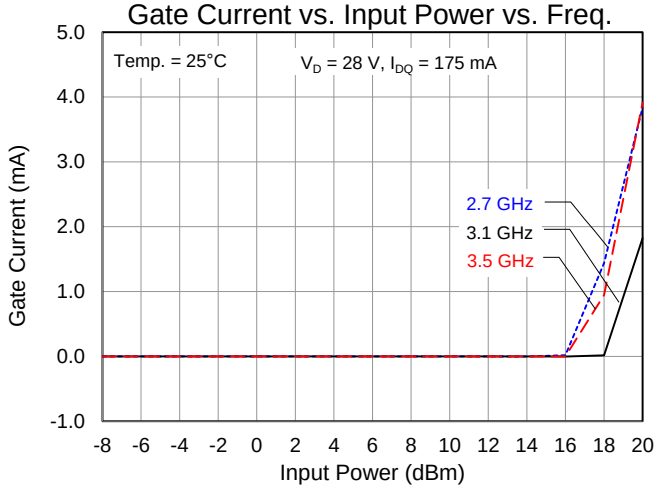
Gate Current vs. Frequency vs. P_{IN}



Drain Current vs. Input Power vs. Freq.



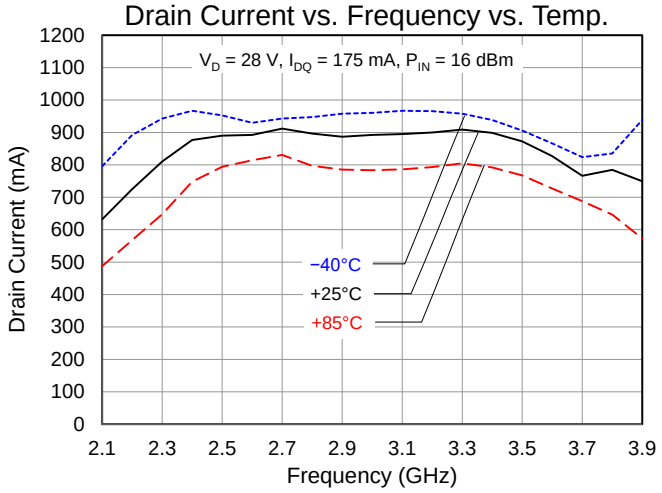
Gate Current vs. Input Power vs. Freq.



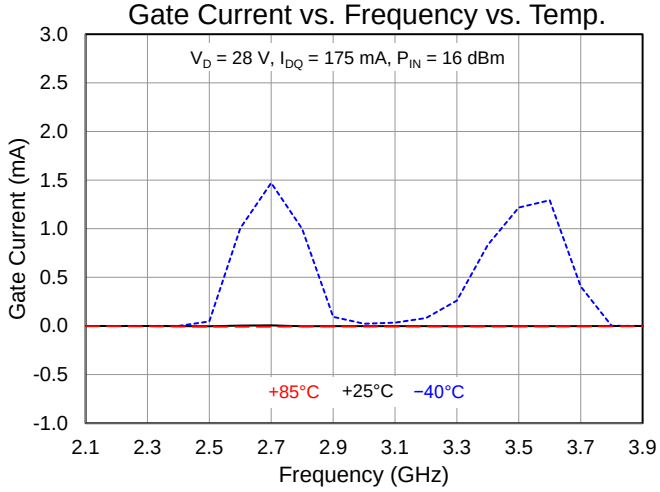
Typical Performance: Large Signal

Condition: Pulsed V_D, Pulse Width = 100 us, Duty Cycle = 10%

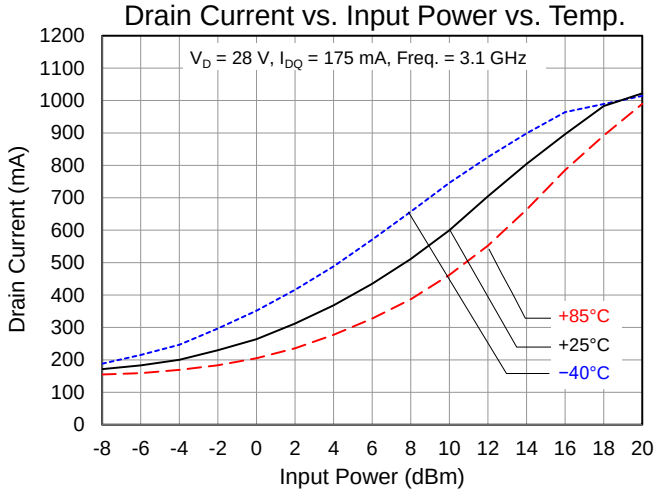
Drain Current vs. Frequency vs. Temp.



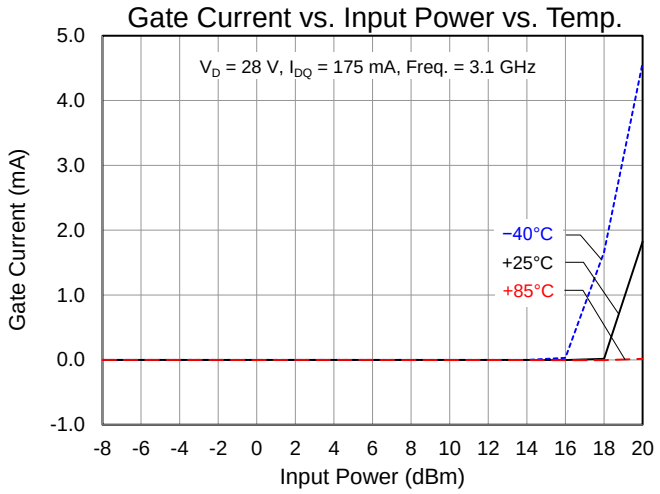
Gate Current vs. Frequency vs. Temp.



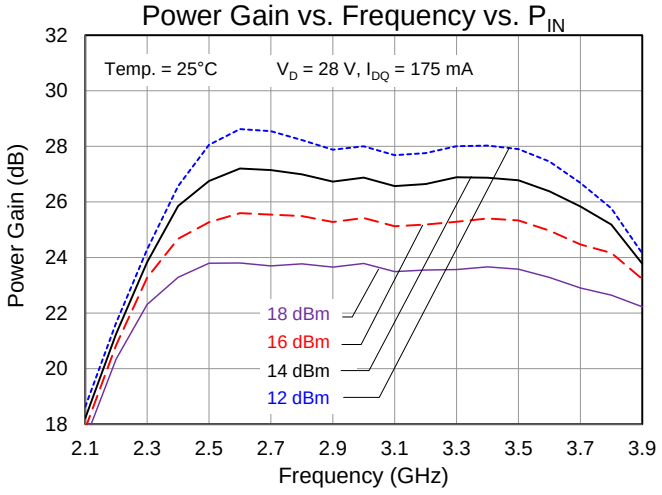
Drain Current vs. Input Power vs. Temp.



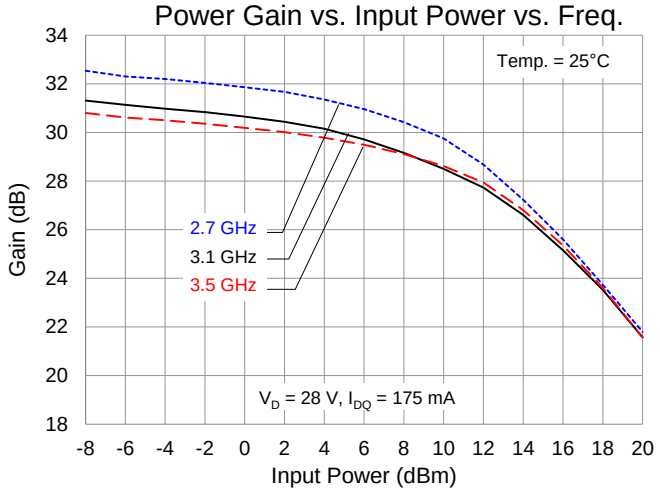
Gate Current vs. Input Power vs. Temp.



Power Gain vs. Frequency vs. P_{IN}



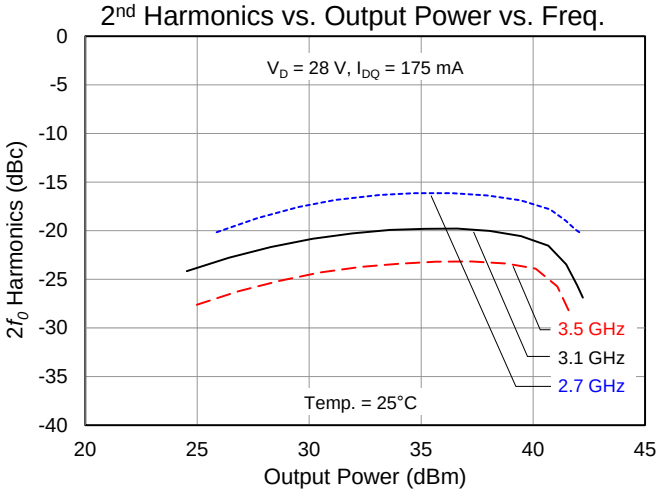
Power Gain vs. Input Power vs. Freq.



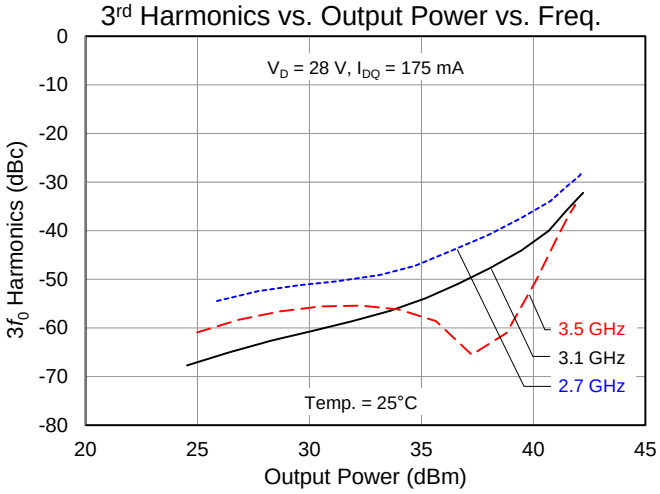
Typical Performance: Large Signal and Linearity

Condition: CW

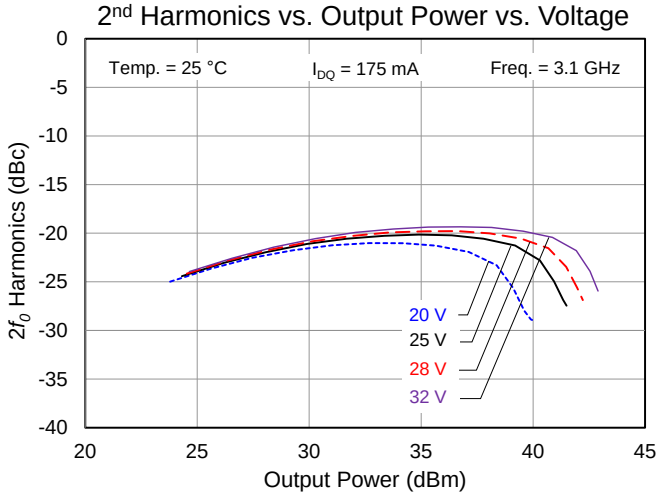
2nd Harmonics vs. Output Power vs. Freq.



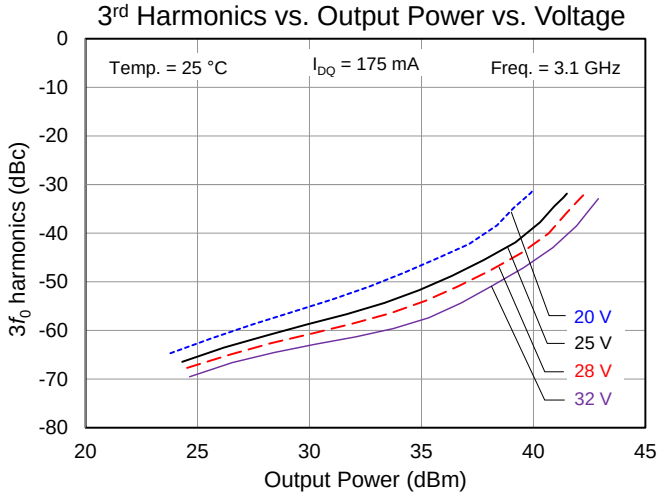
3rd Harmonics vs. Output Power vs. Freq.



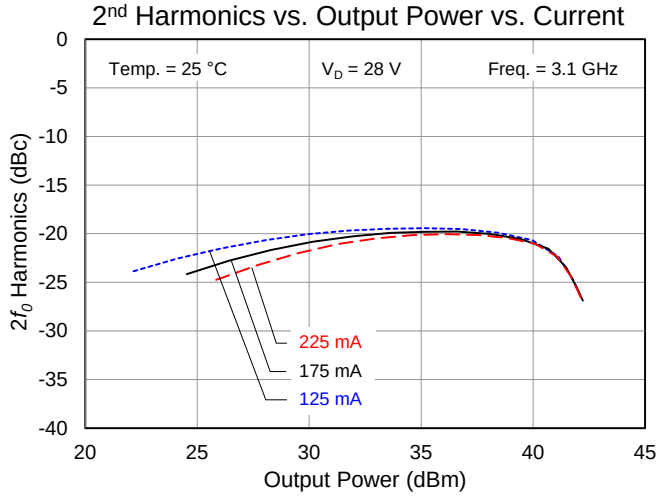
2nd Harmonics vs. Output Power vs. Voltage



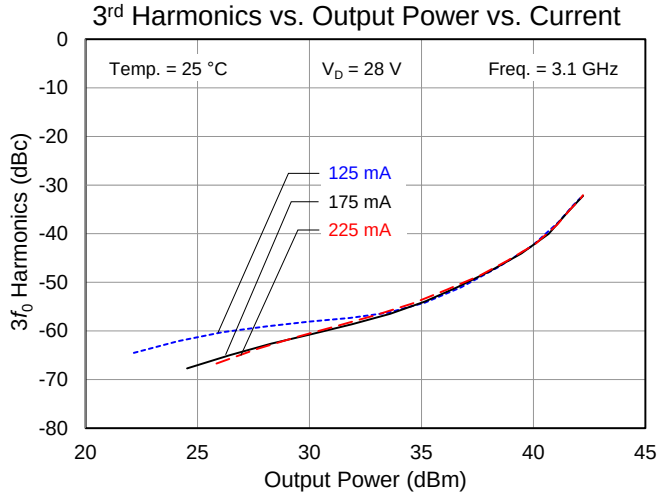
3rd Harmonics vs. Output Power vs. Voltage



2nd Harmonics vs. Output Power vs. Current



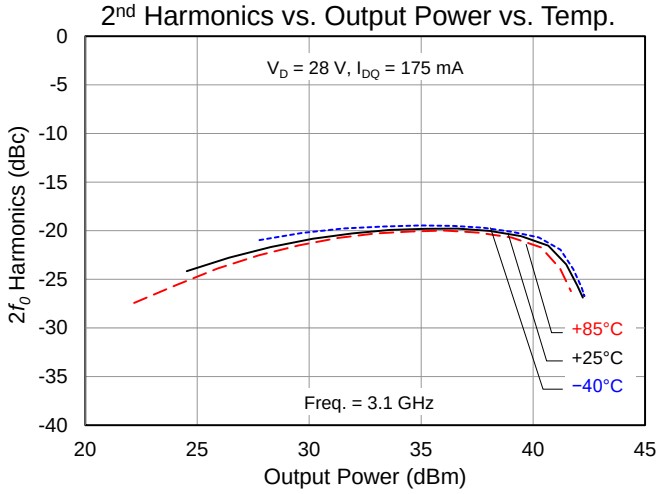
3rd Harmonics vs. Output Power vs. Current



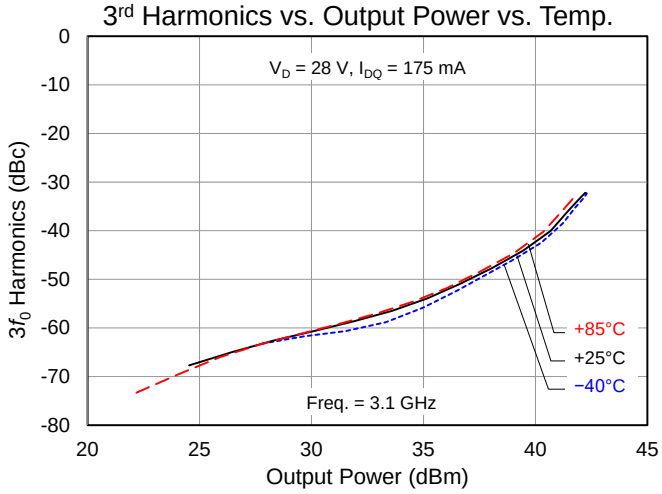
Typical Performance: Large Signal and Linearity

Condition: CW

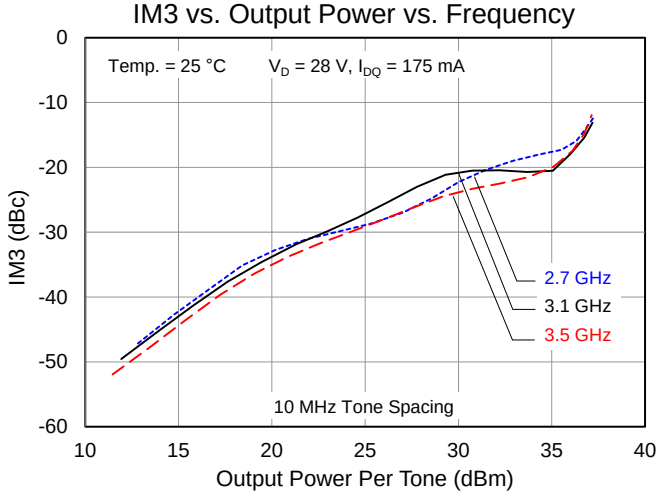
2nd Harmonics vs. Output Power vs. Temp.



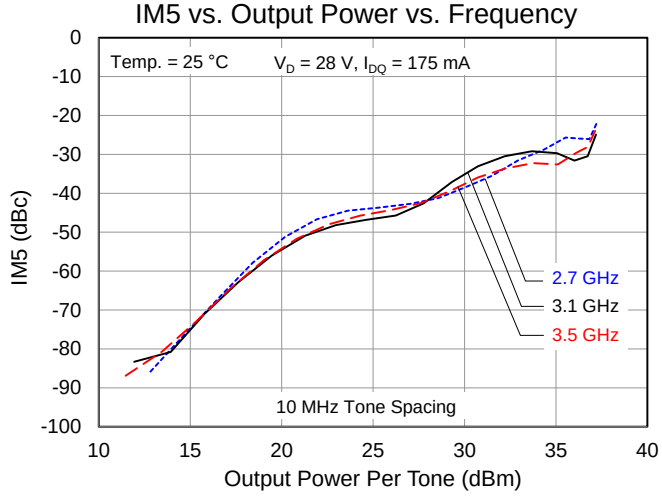
3rd Harmonics vs. Output Power vs. Temp.



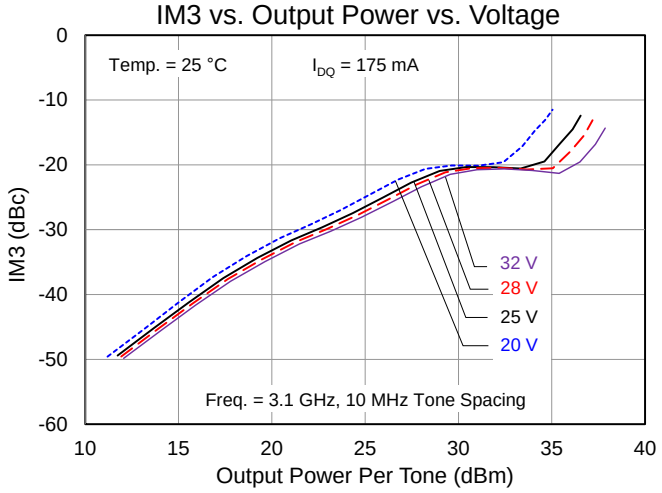
IM3 vs. Output Power vs. Frequency



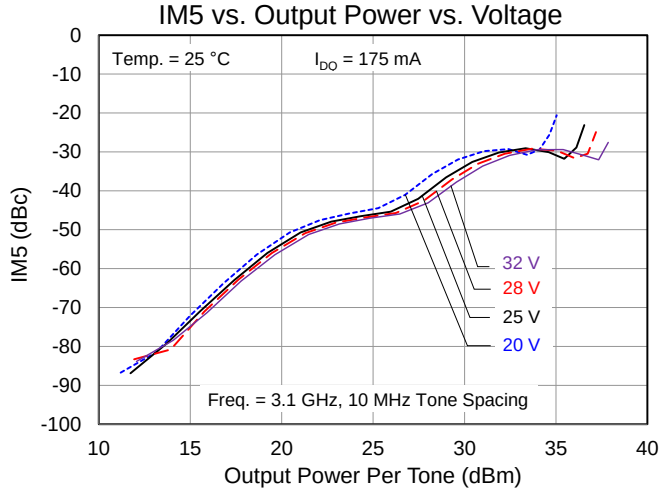
IM5 vs. Output Power vs. Frequency



IM3 vs. Output Power vs. Voltage

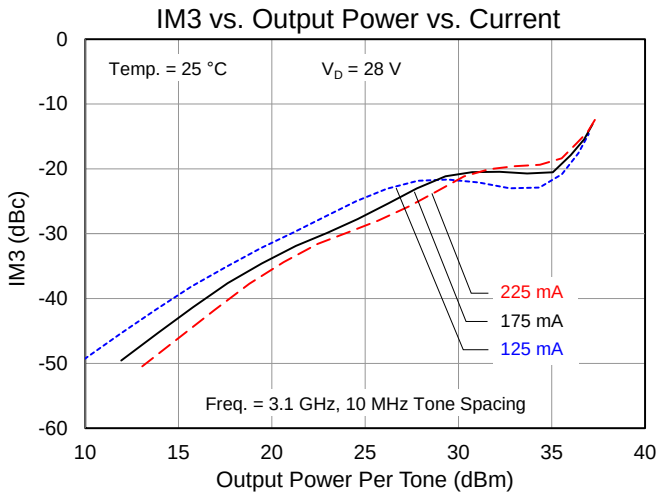


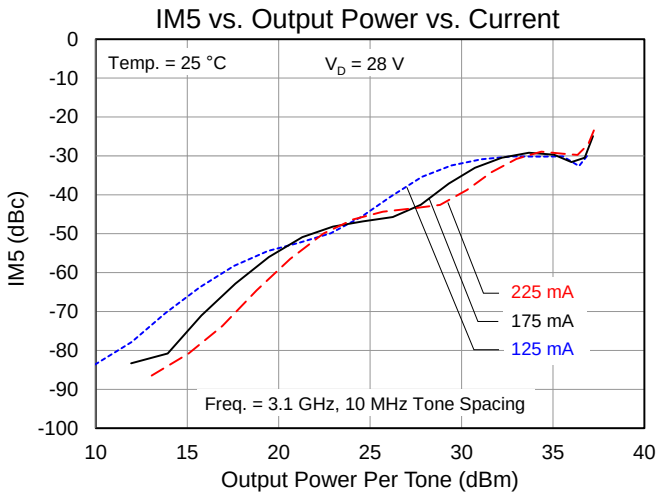
IM5 vs. Output Power vs. Voltage

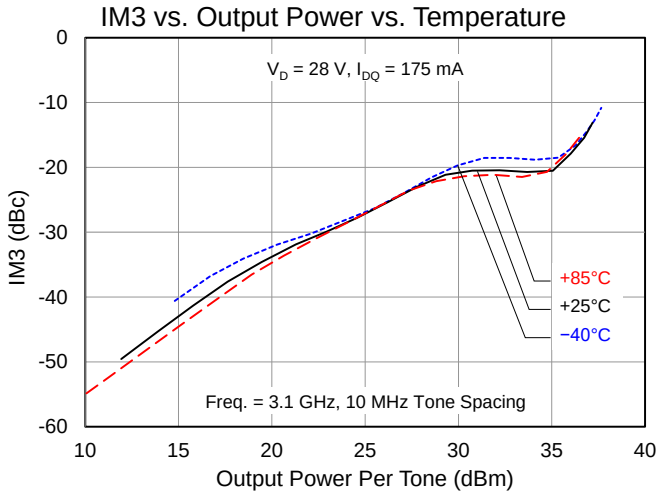


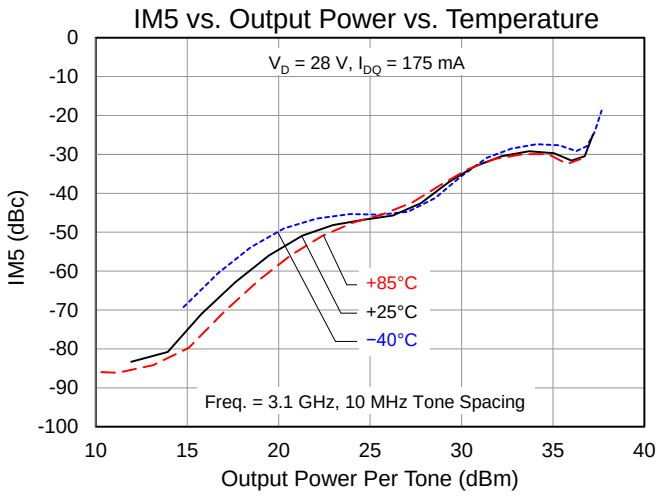
Typical Performance: Large Signal and Linearity

Condition: CW







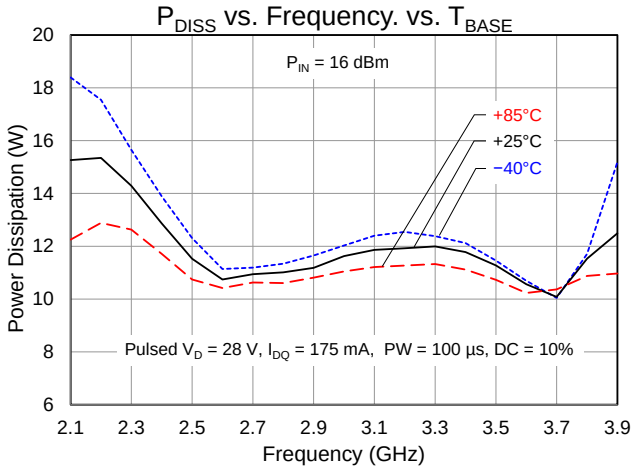


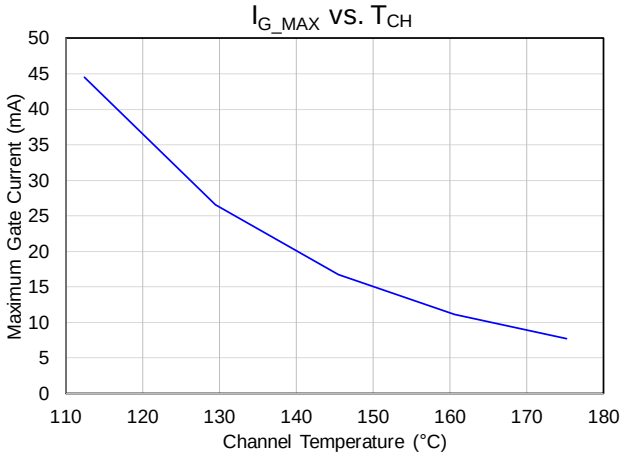
Thermal and Reliability Information

Parameter	Test Conditions	Value	Units
Thermal Resistance (θ_{JC})(1)	T_{BASE} = 85 °C, V_D = 28 V, I_{DQ} = 175 mA, P_{DISS} = 4.9 W (Quiescent DC, CW)	2.43	°C/W
Channel Temperature (T_{CH})(2)		96.9	°C
Thermal Resistance (θ_{JC})(1)	T_{BASE} = 85 °C, V_D = 28 V, I_{D_Drive} = 805 mA, Freq. = 3.3 GHz, P_{IN} = 16 dBm, P_{OUT} = 40.5 dBm, P_{DISS} = 11.0 W (PW = 100 µs, DC = 10%)	2.16	°C/W
Channel Temperature (T_{CH})(2) (w/RF drive)		108.8	°C

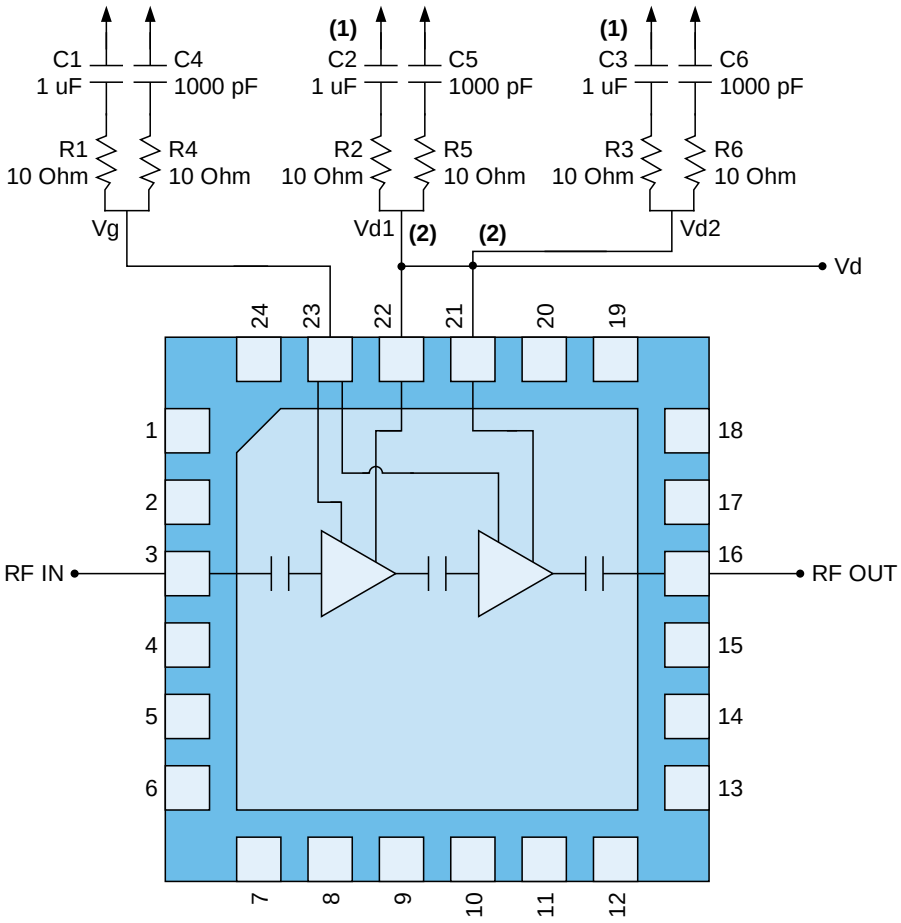
Notes:
1. Thermal resistance determined to the back of package (85 °C)
2. IR scan equivalent. Refer to the following document: GaN Device Channel Temperature, Thermal Resistance, and Reliability Estimates

Power Dissipation and Maximum Gate Current





Applications Information



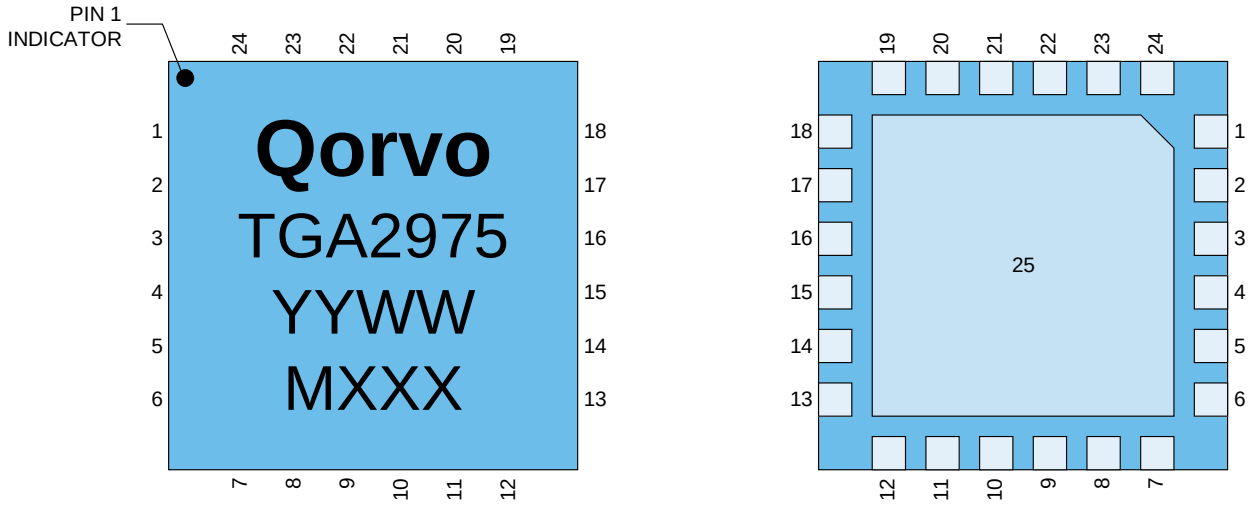
Notes:

1. Remove if pulsing on drain
2. V_D: Tied V_{D1} & V_{D2} together

Bias-up Procedure
Set I_D limit to 1.3 A, I_G limit to 8 mA
Apply −5 V to V_G
Apply +28 V to V_D; ensure I_{DQ} is approx. 0 mA
Adjust V_G until I_{DQ} = 175 mA (V_G ~ −2.7 V Typ.).
Turn off RF signal

Bias-down Procedure
Turn off RF signal
Reduce V_G to −5 V; ensure I_{DQ} is approx. 0 mA
Set V_D to 0 V
Turn off V_D supply
Turn off V_G supply

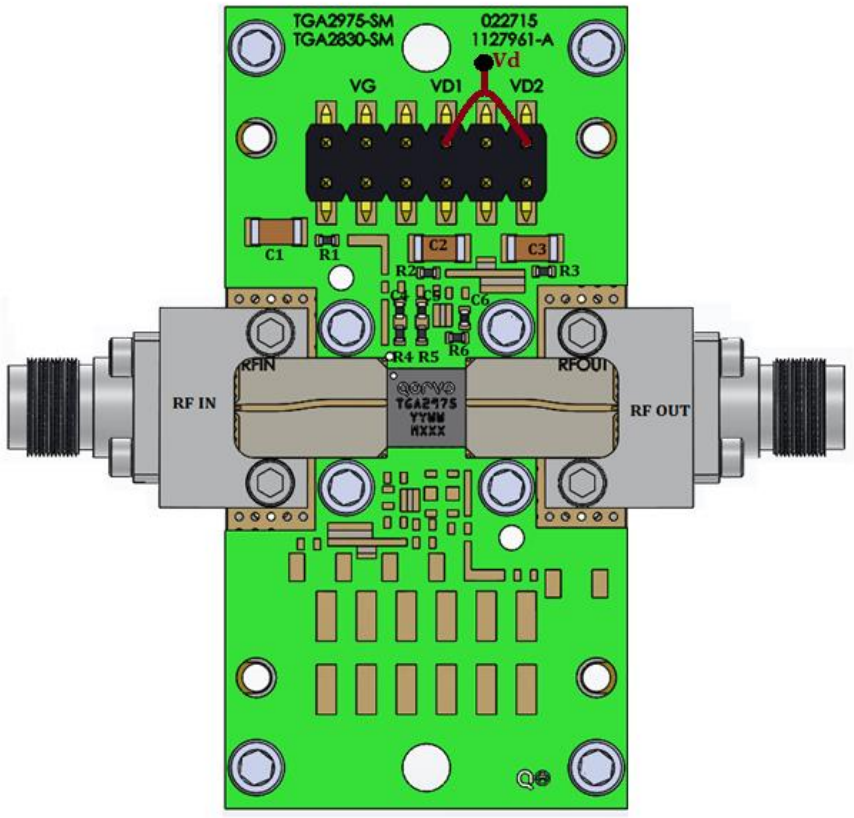
Pin Layout



Pin Description

Pin No.	Symbol	Description
1, 2, 4-15, 17-20, 24	NC	No internal connection; can be grounded on PCB or left open
3	RF_{IN}	Input; matched to 50 Ω; DC blocked
16	RF_{OUT}	Output; matched to 50 Ω; DC blocked
21	DRAIN 2	Drain voltage; bias network is required; see recommended Application Information on page 13
22	DRAIN 1	Drain voltage; bias network is required; see recommended Application Information on page 13
23	GATE	Gate voltage; bias network is required; see recommended Application Information on page 13
25	GND	Ground Paddle. Multiple vias should be employed to minimize inductance and thermal resistance.

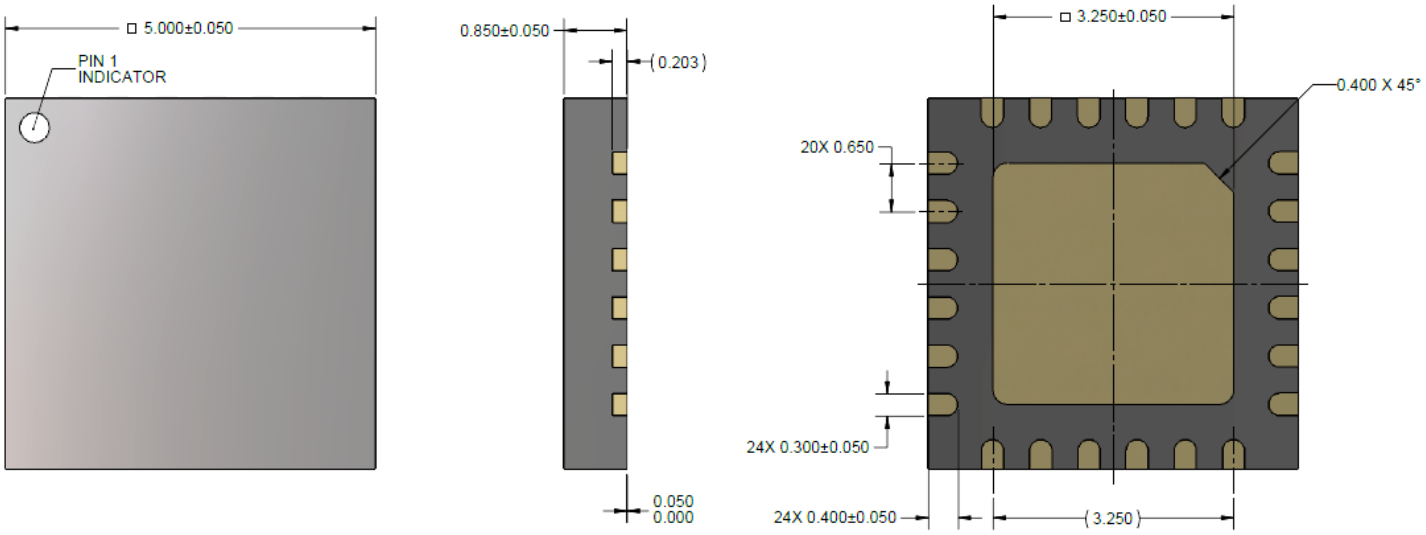
Evaluation Board



Bill of Material

Reference Design	Value	Description	Manufacture	Part Number
C1–C3	1 µF	Cap, 1206, 50 V, 5%, X7R	Various	
C4–C6	1000 pF	Cap, 0402, 100 V, 10%, X7R	Various	
R1–R6	10 Ω	Res, 0402, 5%	Various	

Mechanical Information



Units: millimeter (mm)
Tolerances: unless specified
x.xx = ± 0.01
x.xxx = ± 0.005
Materials:
Package Leads are Ni-Pd-Au
Part is Mold Encapsulated.
Marking:
2975: Part number
YY: Part Assembly year
WW: Part Assembly week
MXXX: Batch ID

Recommended Soldering Temperature Profile