TGA3042-SM

7 – 10.5 GHz 4.5 W GaN Power Amplifier

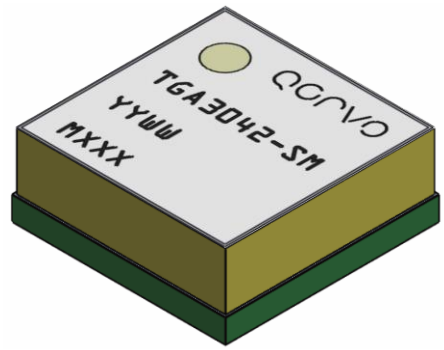
Product Description

Qorvo's TGA3042-SM is a packaged high power MMIC amplifier fabricated on Qorvo's production 0.15um GaN on SiC process (QGaN15). The TGA3042-SM operates from 7 – 10.5 GHz and typically provides 4.5 W saturated output power with power-added efficiency of 38.5% and large-signal gain of 23.5 dB. This combination of wideband performance provides the flexibility designers are looking for to improve system performance while reducing size and cost.

The TGA3042-SM is matched to 50Ω with integrated DC blocking capacitors on both RF I/O ports simplifying system integration. The wideband performance makes it ideally suited in support of multiple radar and communication bands.

Lead-free and RoHS compliant.

Evaluation boards are available upon request.

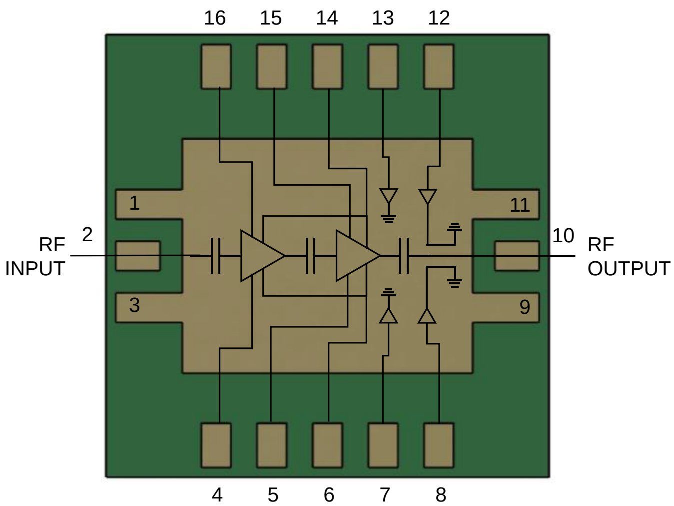


Product Features

- Frequency Range: 7 – 10.5 GHz
- P_{OUT}: 36.5 dBm at P_{IN} = 13 dBm
- PAE: 38.5 % at P_{IN} = 13 dBm
- Large Signal Gain: 23.5 dB at P_{IN} = 13 dBm
- Small Signal Gain: 32 dB
- Bias: V_D = 20 V, I_{DQ} = 200 mA
- Package Dimensions: 4.50 x 4.50 x 1.74 mm

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

Functional Block Diagram



Applications

- Radar
- Communications

Ordering Information

Part No.	Description
TGA3042-SM	7 – 10.5 GHz 4.5 W GaN Power Amplifier
TGA3042-SMPCB4B01	Evaluation Board

Absolute Maximum Ratings

Parameter	Value / Range
Drain Voltage (V_D)	29.5 V
Gate Voltage Range (V_G)	−8 to 0 V
Drain Current (I_D)	720 mA
Gate Current (I_G)	See chart pg. 13
Power Dissipation (P_{DISS}), 85°C	15.4 W
Input Power (P_{IN}), CW, 50Ω, V_D=20 V, I_{DQ}=200 mA, 85 °C	23 dBm
Input Power (P_{IN}), CW, VSWR 3:1, V_D=20 V, I_{DQ}=200 mA 85 °C	23 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 Operating Conditions

Parameter	Value / Range
Drain Voltage (V_D)	20 V
Drain Current (I_{DQ})	200 mA
Gate Voltage Range (V_G)	−2.8 to −2.0 V

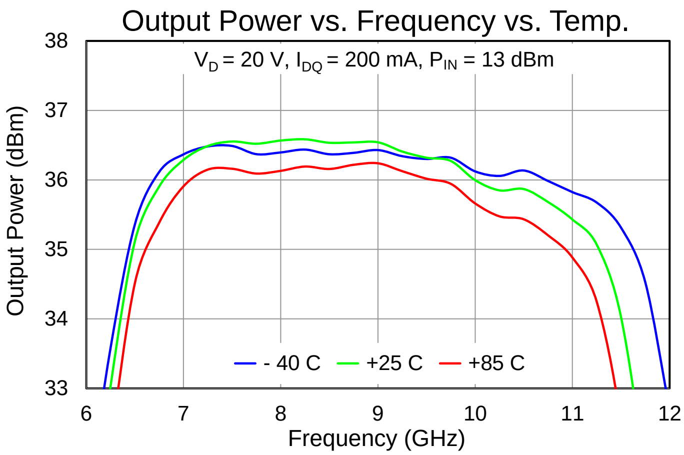
Electrical specifications are measured at specified test conditions. Specifications are not guaranteed over all recommended operating conditions.

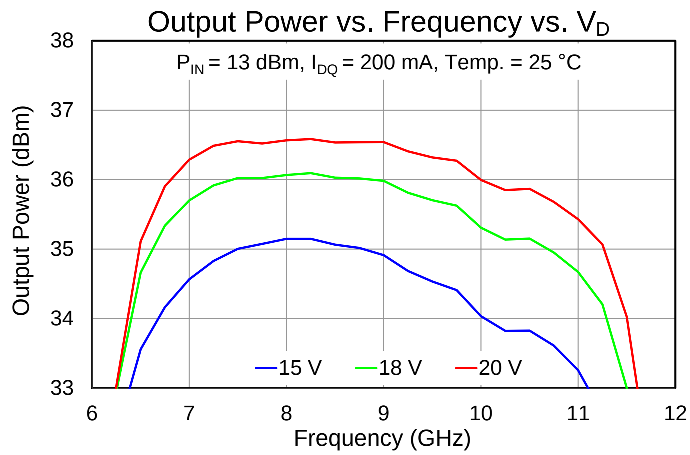
Electrical Specifications

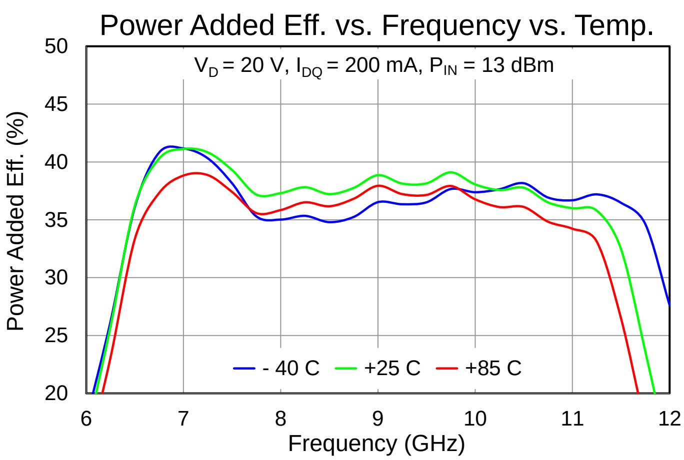
Parameter		Min	Typ	Max	Units
Operational Frequency Range		7		10.5	GHz
Output Power (Pin = 13 dBm)	7.0 GHz 9.0 GHz 10.5 GHz	35.0 35.0 34.5	36.3 36.5 35.9		dBm dBm dBm
Power Added Efficiency (Pin = 13 dBm)	7.0 GHz 9.0 GHz 10.5 GHz	30.0 30.0 28.0	41.1 38.9 37.8		% % %
3rd Order Intermodulation Level (P_{OUT}/Tone= 26 dBm)	7.0 GHz 9.0 GHz 10.5 GHz		−23.2 −24.7 −23.4		dBc dBc dBc
Small Signal Gain	7.0 GHz 9.0 GHz 10.5 GHz		33.3 32.9 30.6		dB dB dB
Input Return Loss	7.0 GHz 9.0 GHz 10.5 GHz		12 15 18		dB dB dB
Output Return Loss	7.0 GHz 9.0 GHz 10.5 GHz		9 13 10		dB dB dB
Output Power Temperature Coefficient (25 – 85 °C)			−0.006		dB/°C
Sm. Signal Gain Temperature Coefficient			−0.059		dB/°C

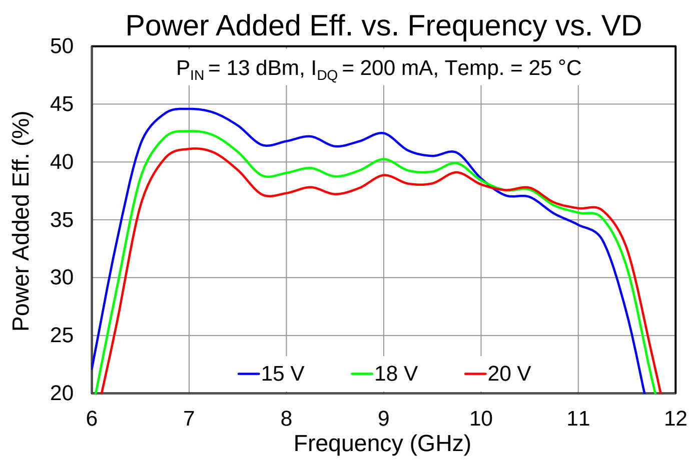
Test conditions unless otherwise noted: 25 °C, V_D = 20, I_{DQ} = 200 mA

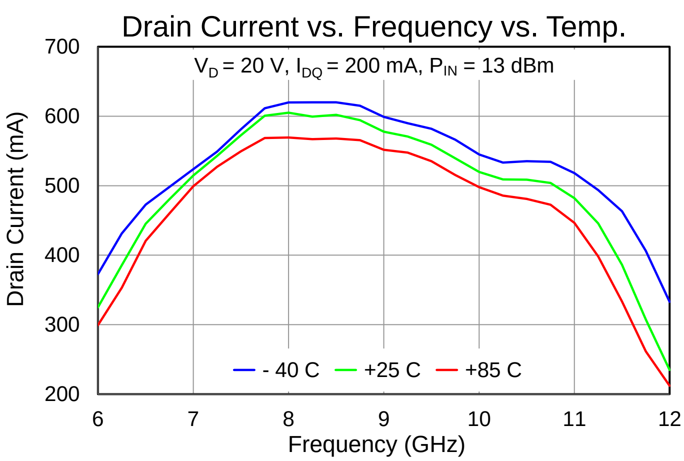
Performance Plots – Large Signal (CW)

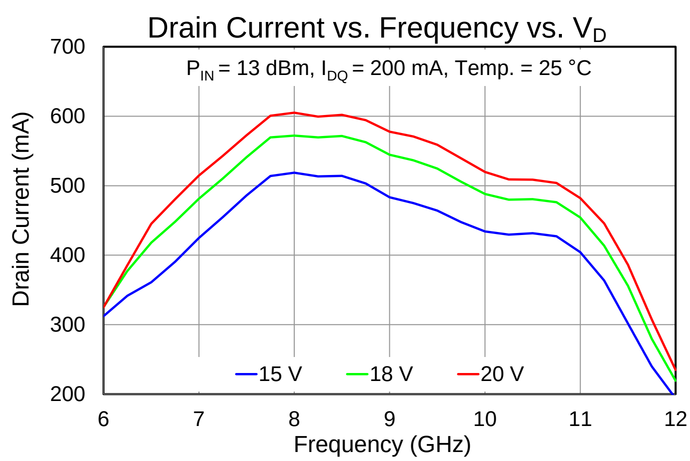




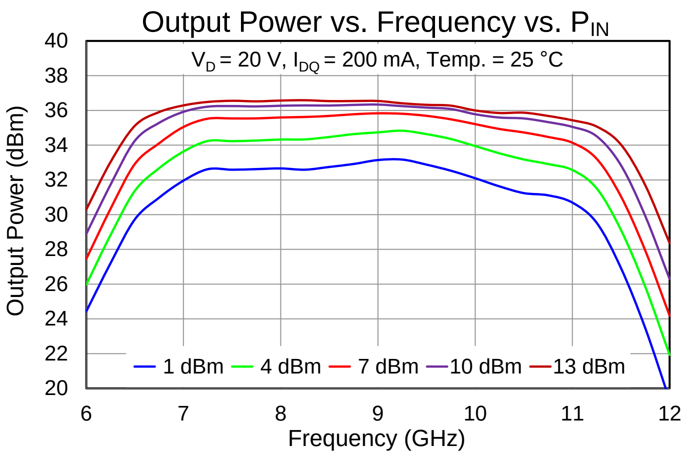


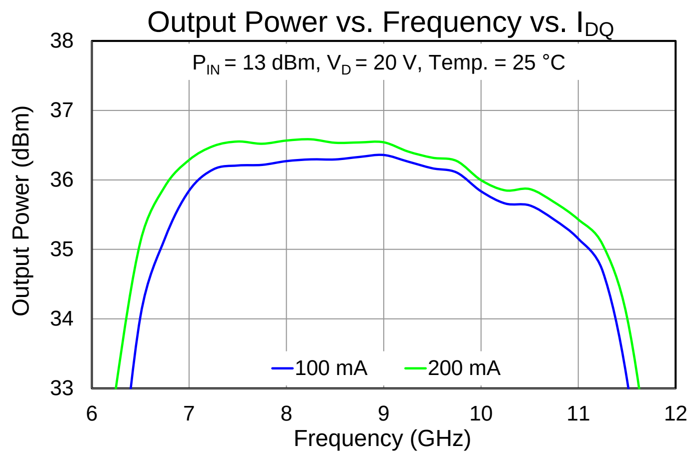


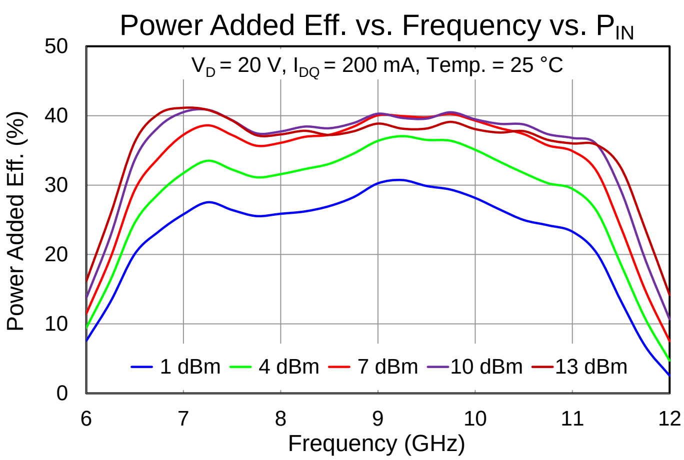


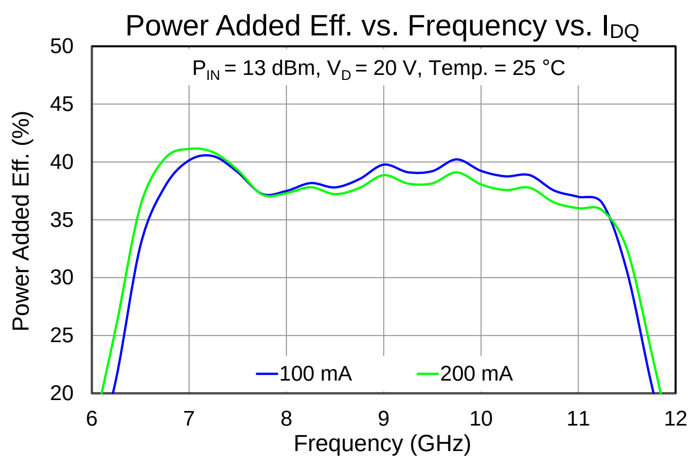


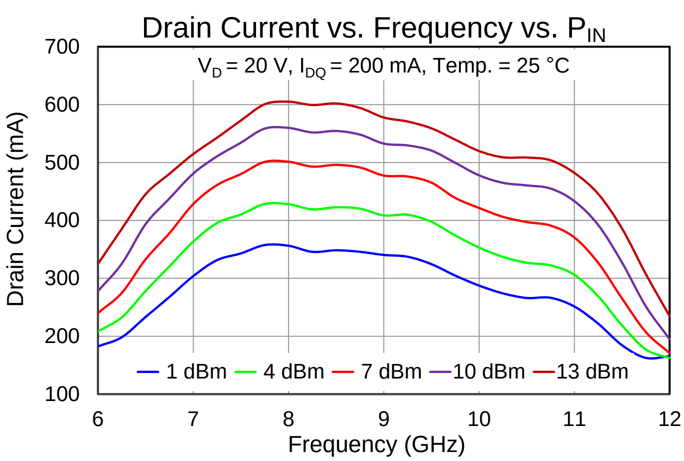
Performance Plots – Large Signal (CW)

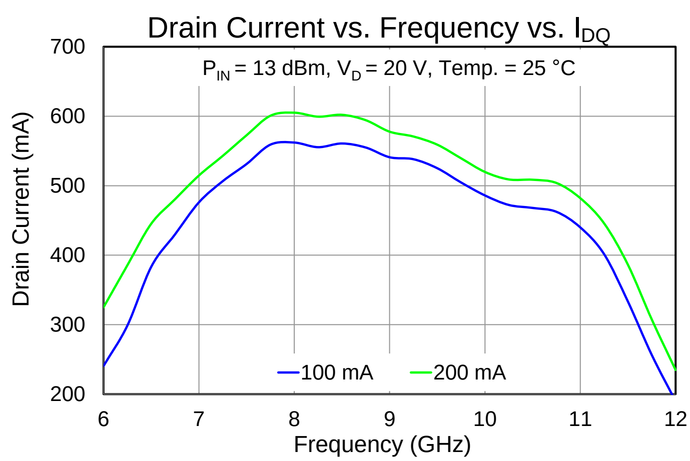












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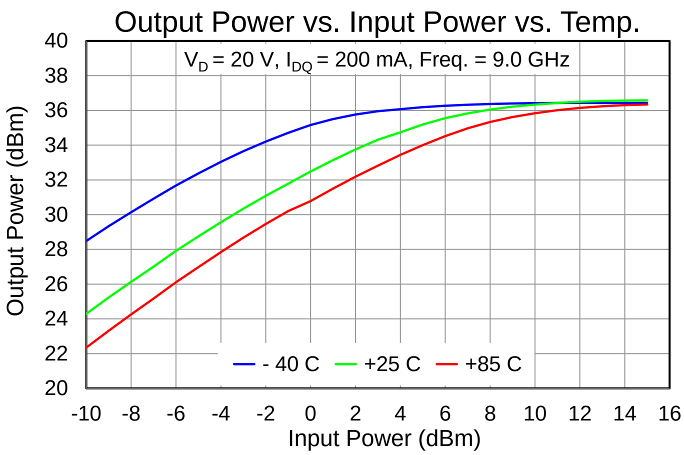
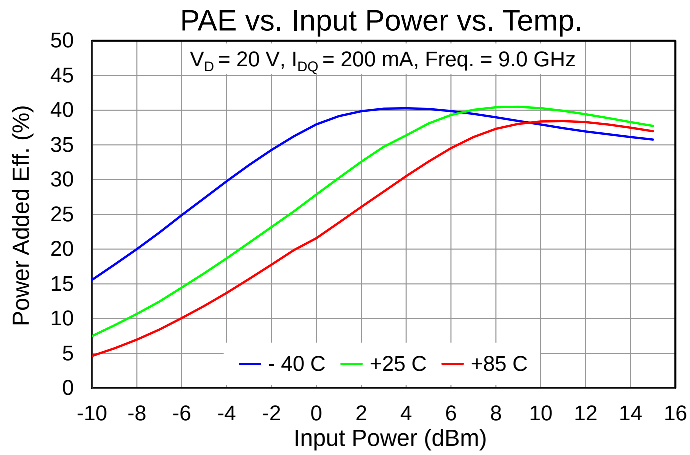
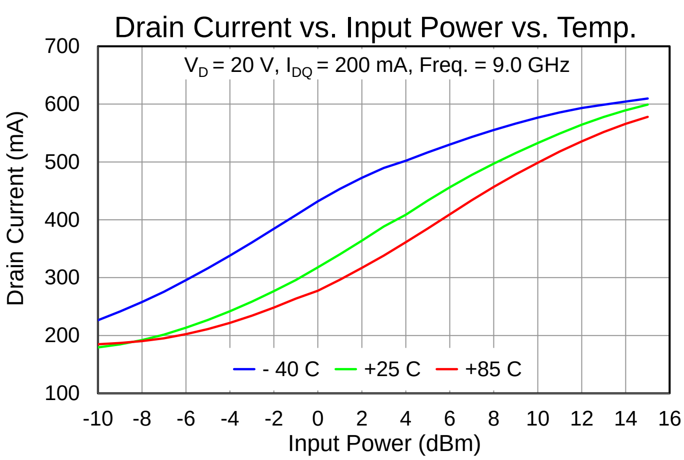
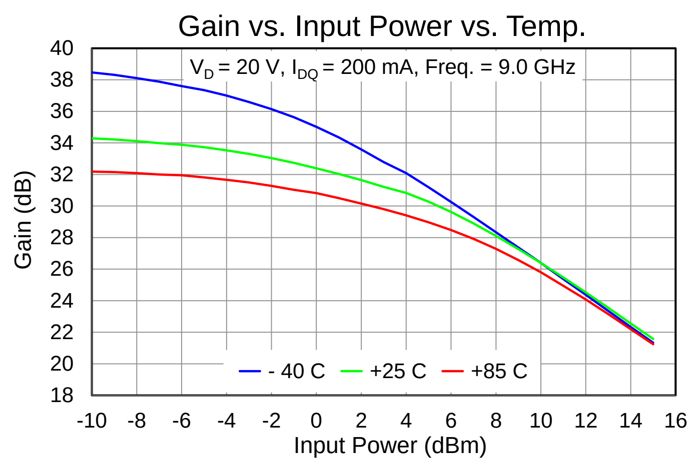
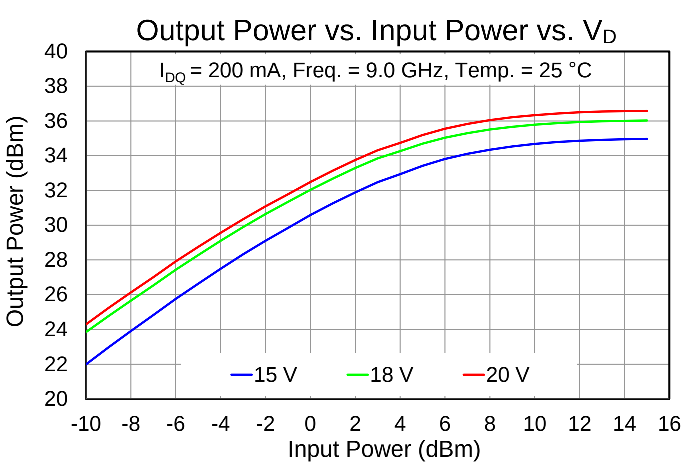
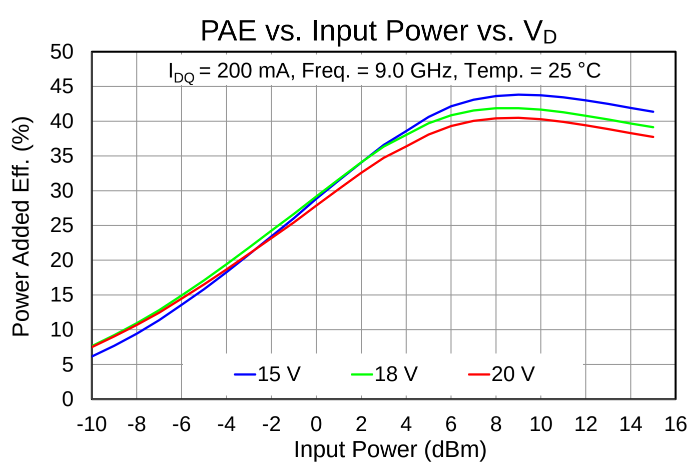




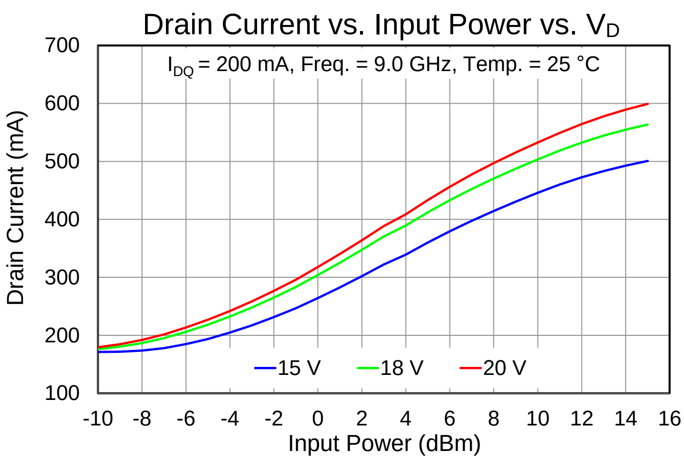


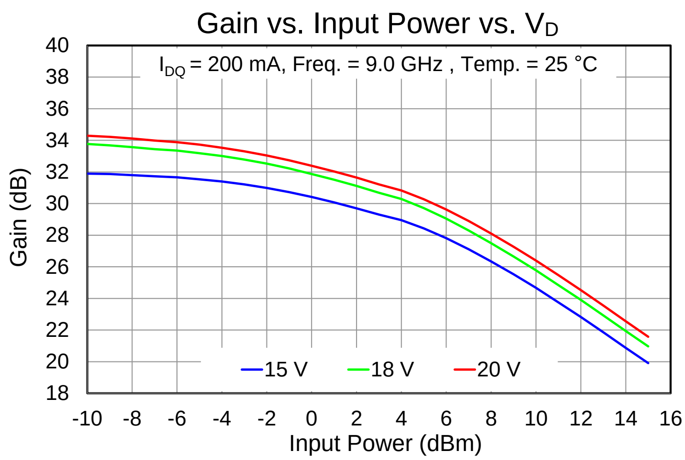


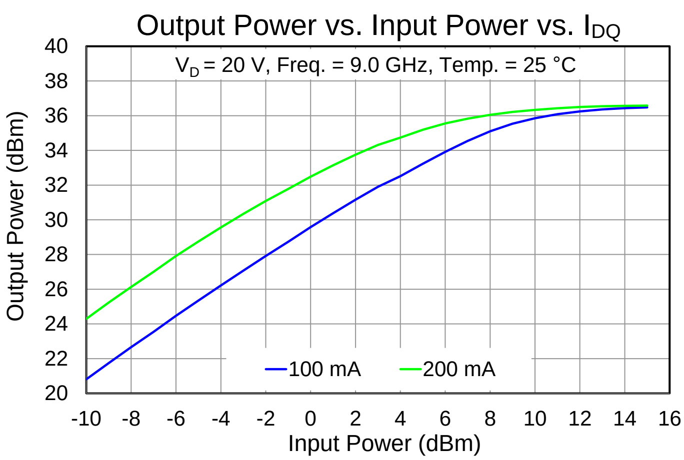


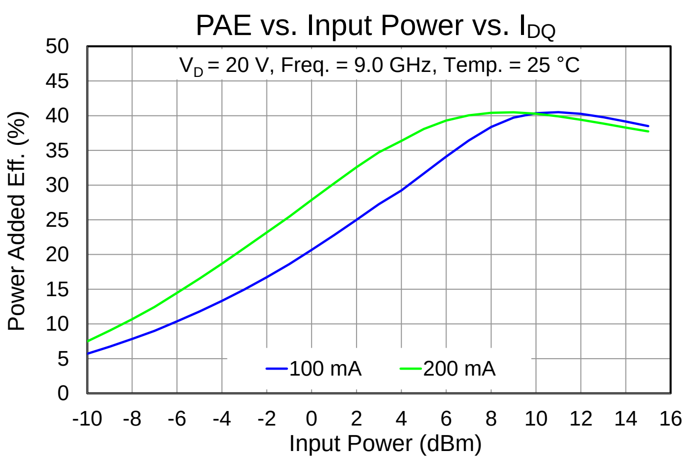


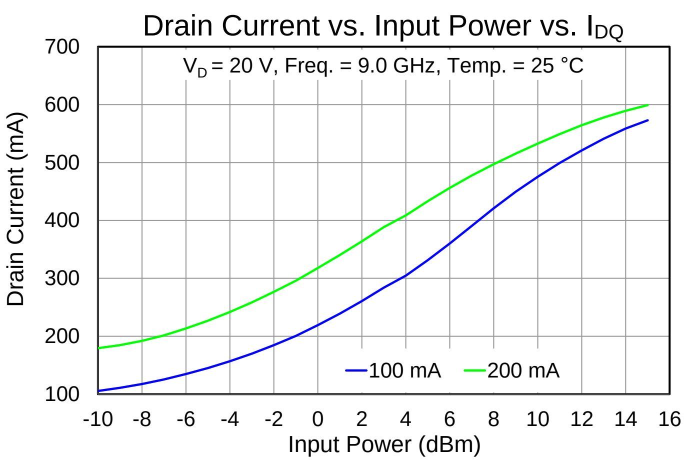
Performance Plots – Large Signal (CW)

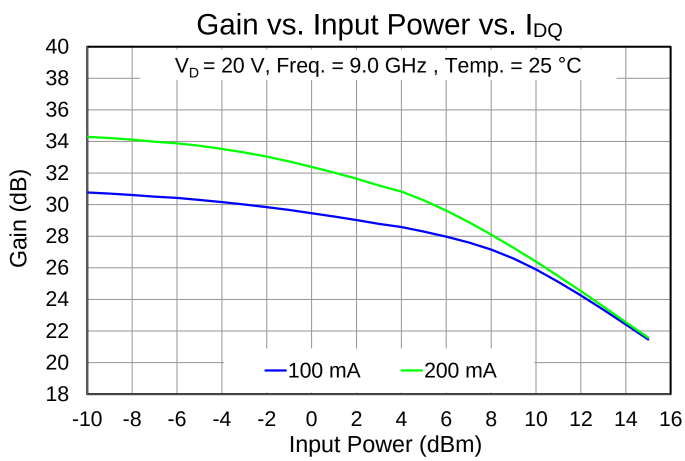




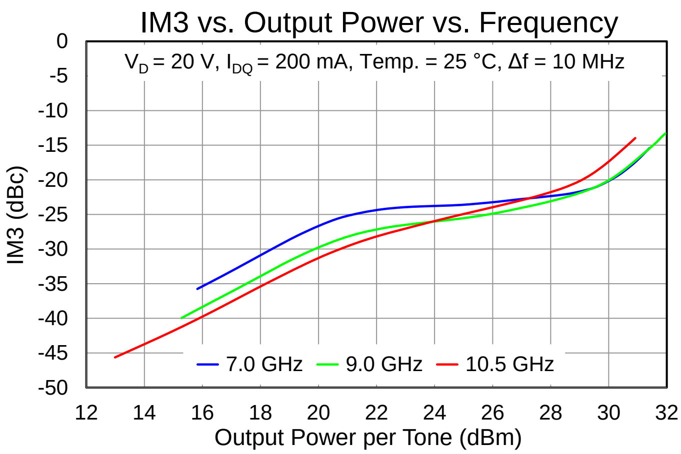


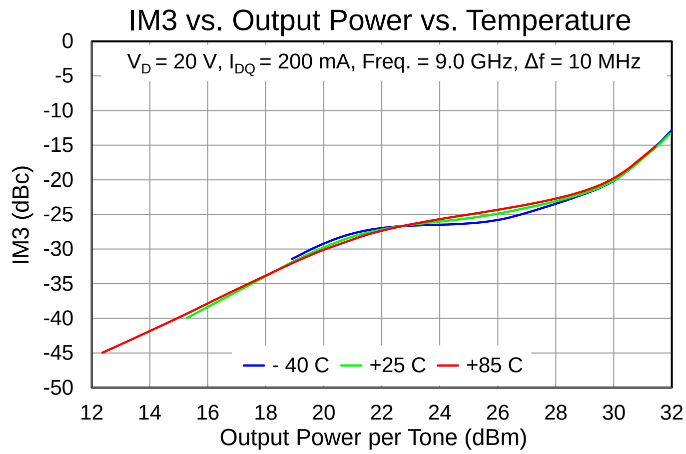


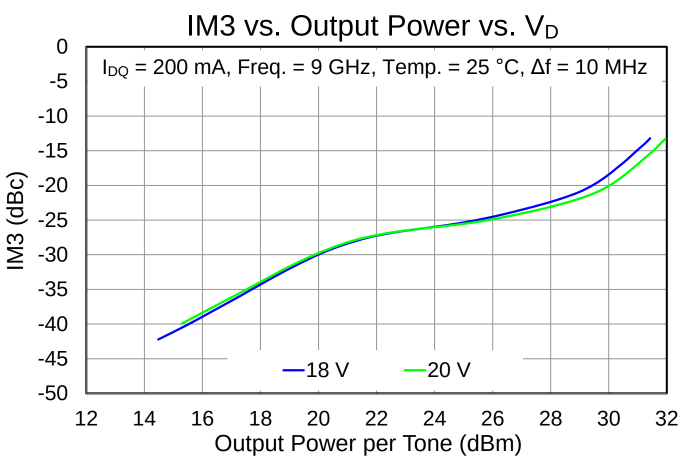


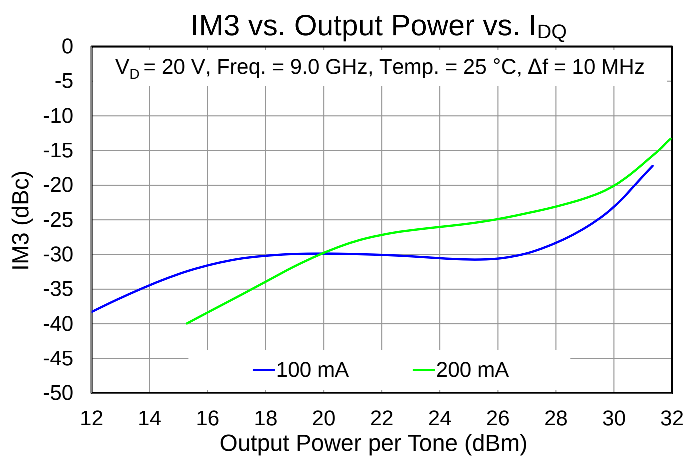


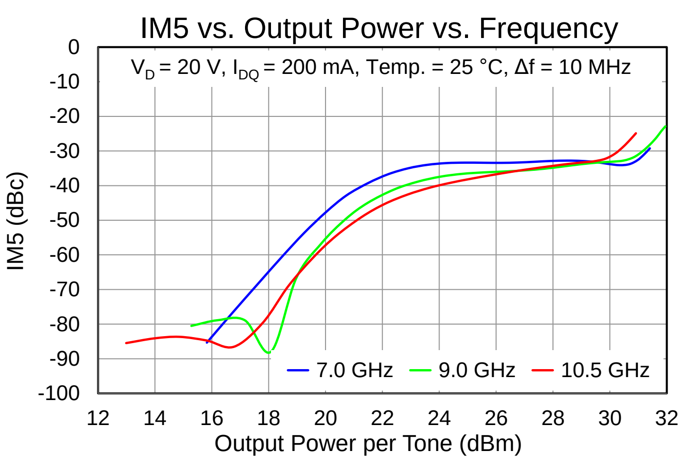
Performance Plots – Linearity

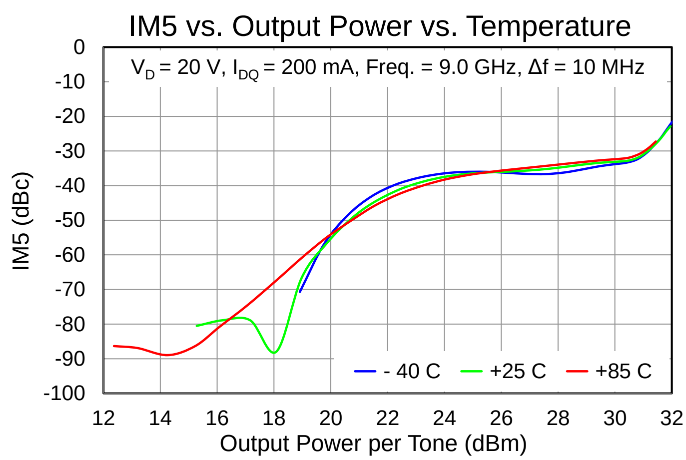




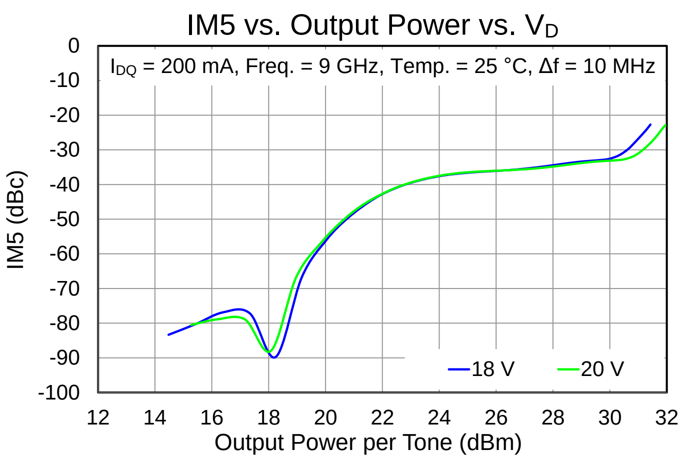


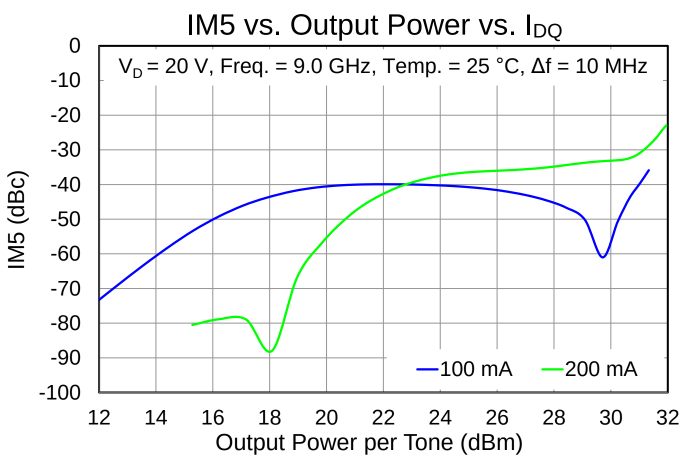


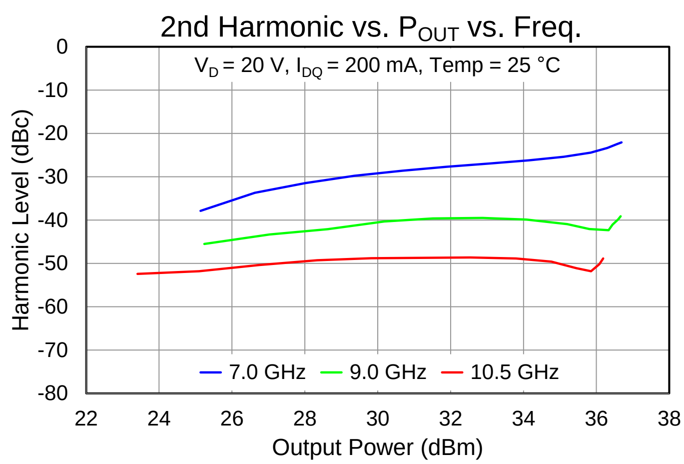


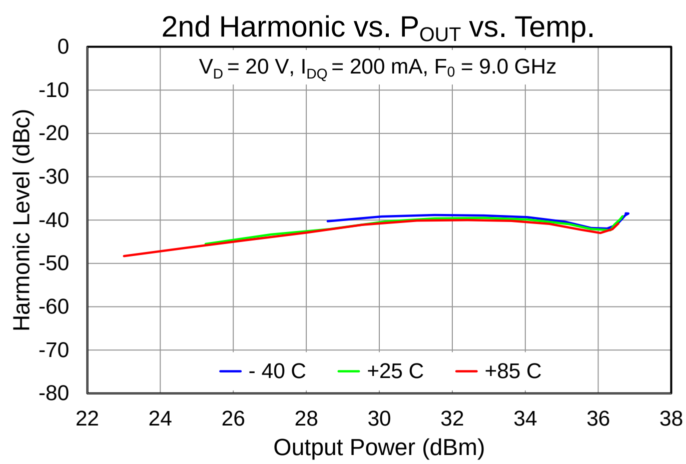


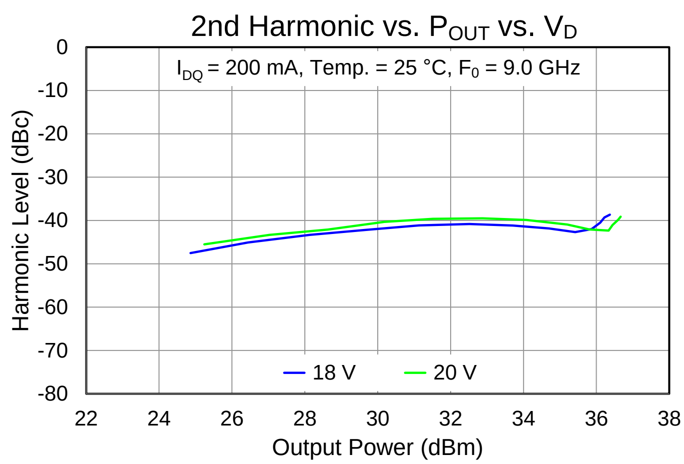
Performance Plots – Linearity, Harmonics

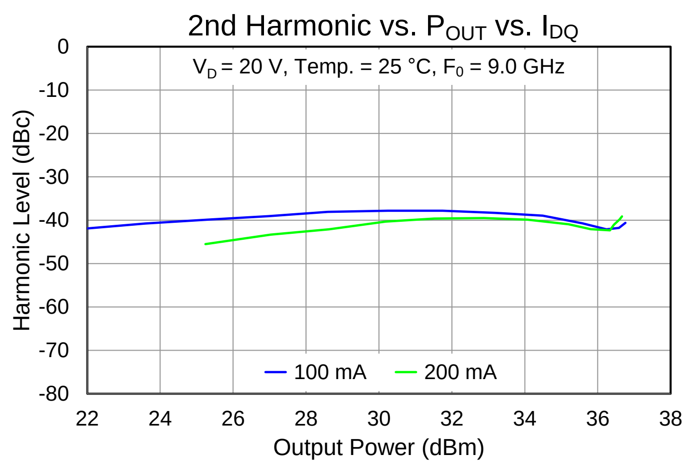




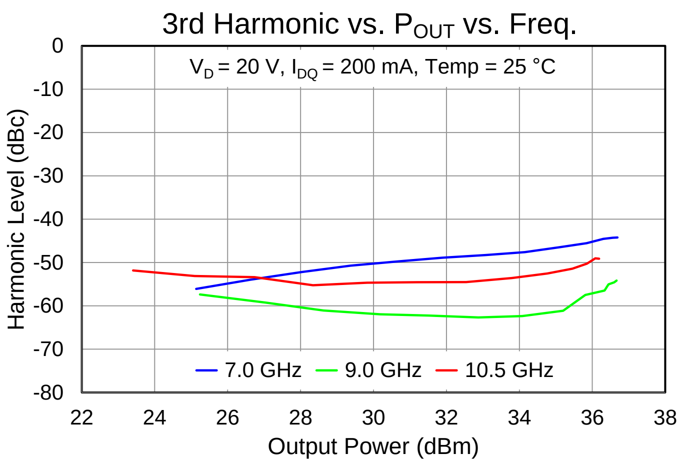


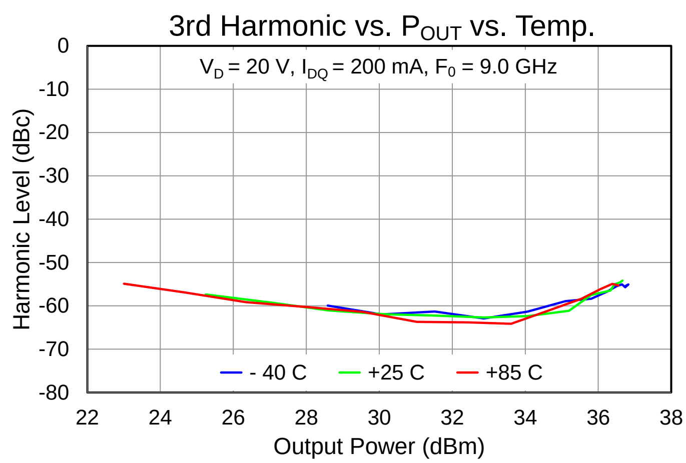


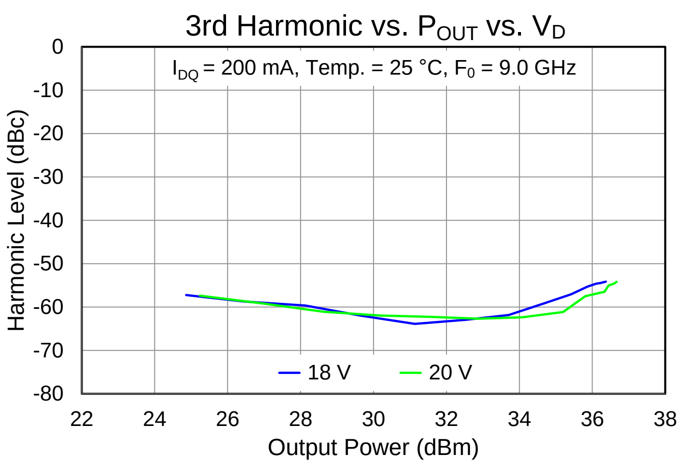


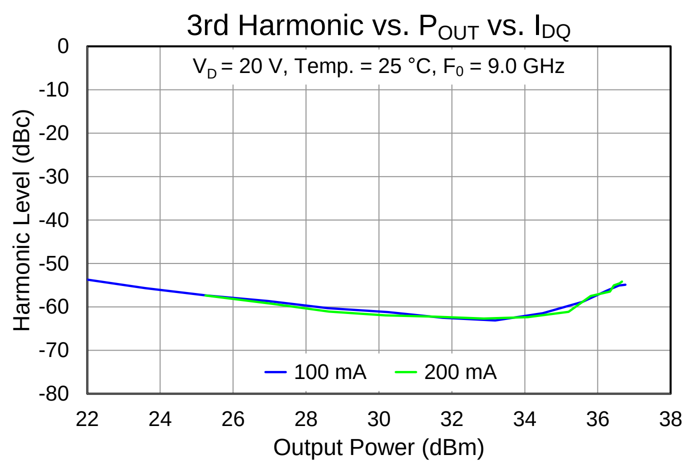


Performance Plots – Harmonics



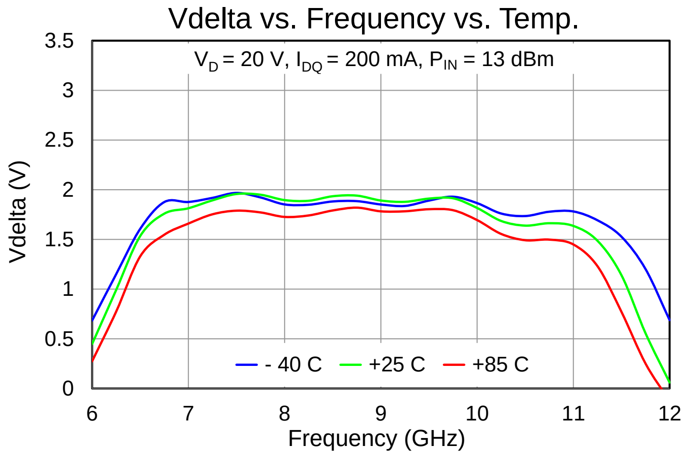


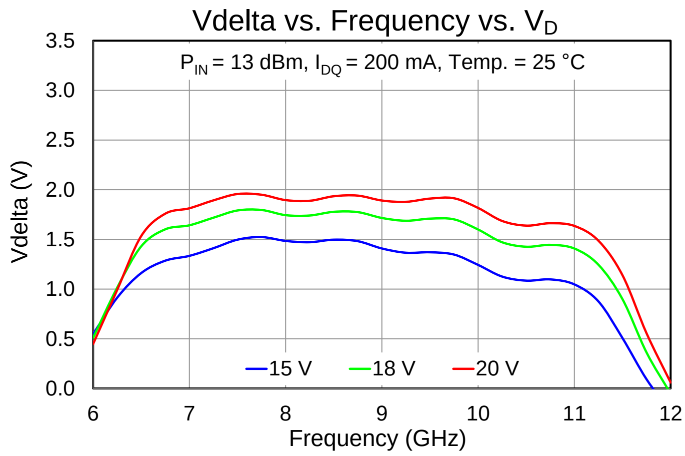


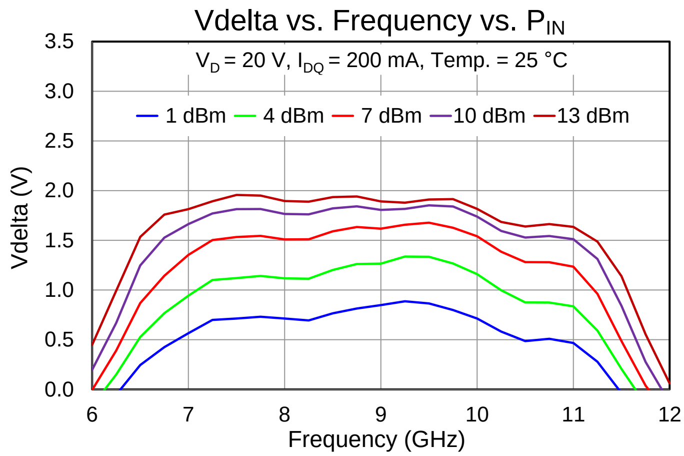


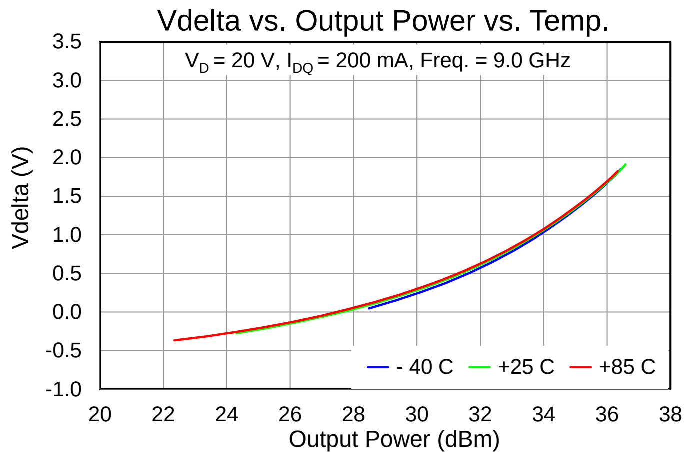
Performance Plots – Detector Voltage

Note: $V_{DELTA} = V_{REF} - V_{DET}$

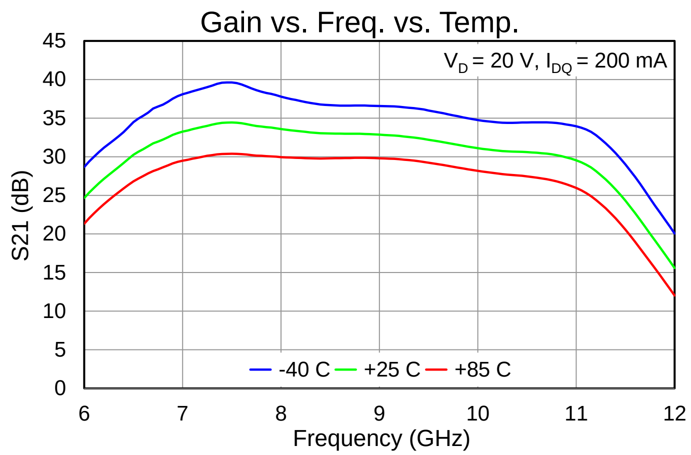


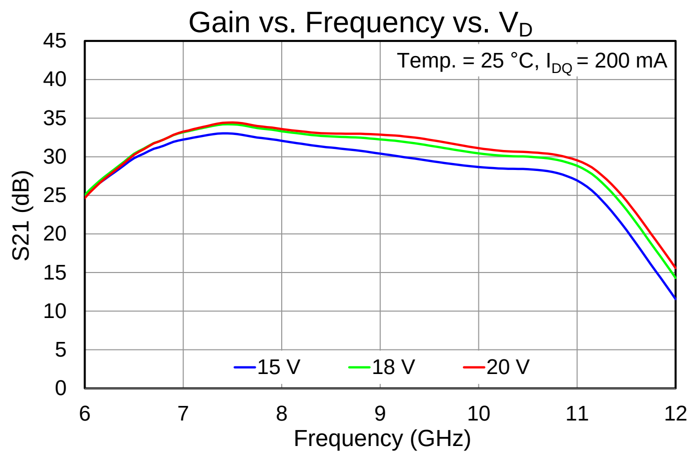


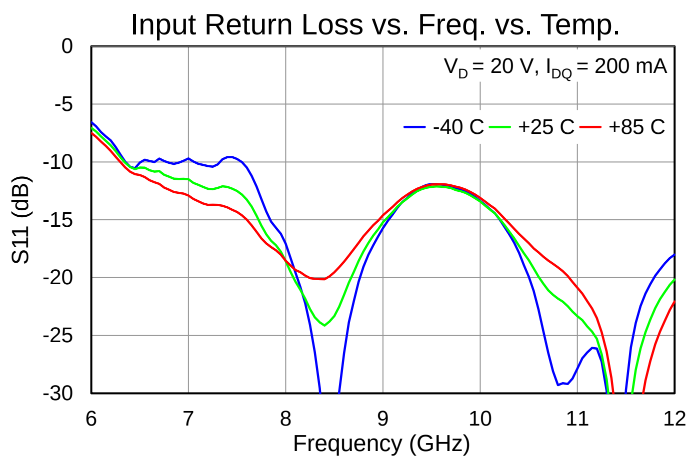


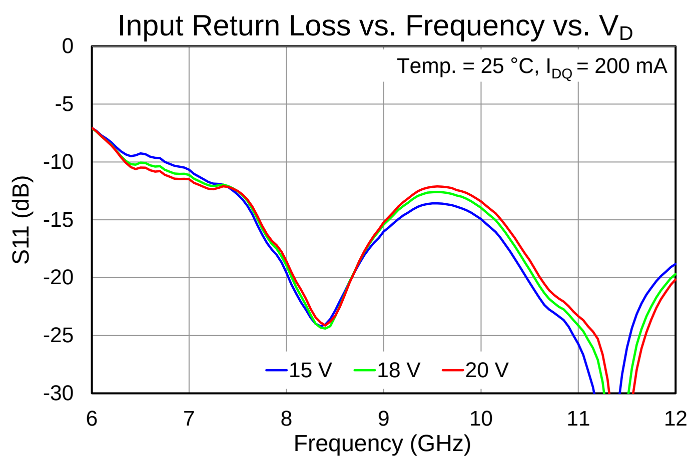


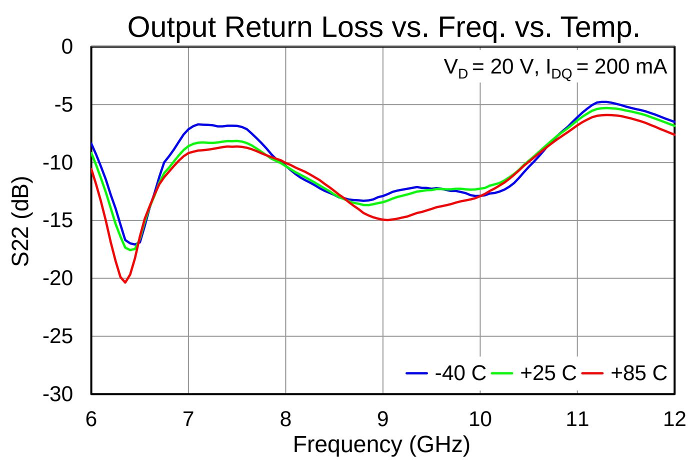
Performance Plots – Small Signal

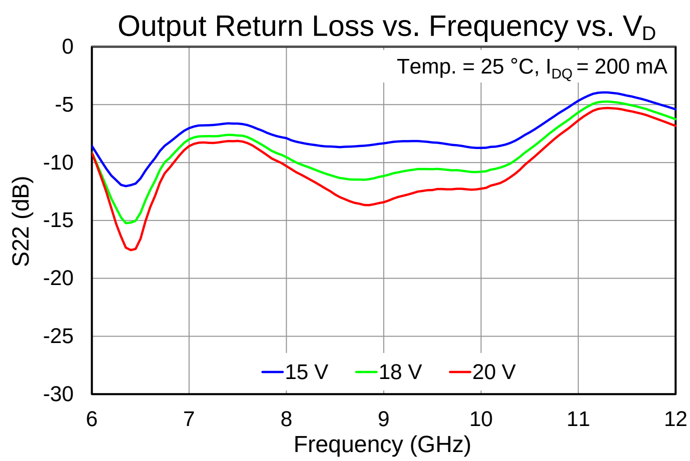












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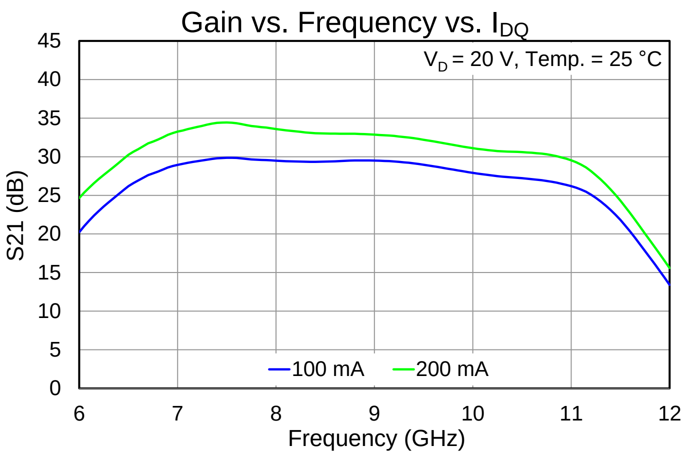
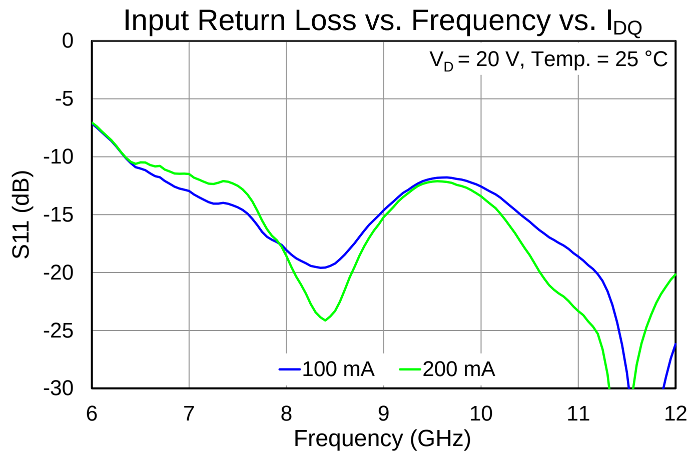
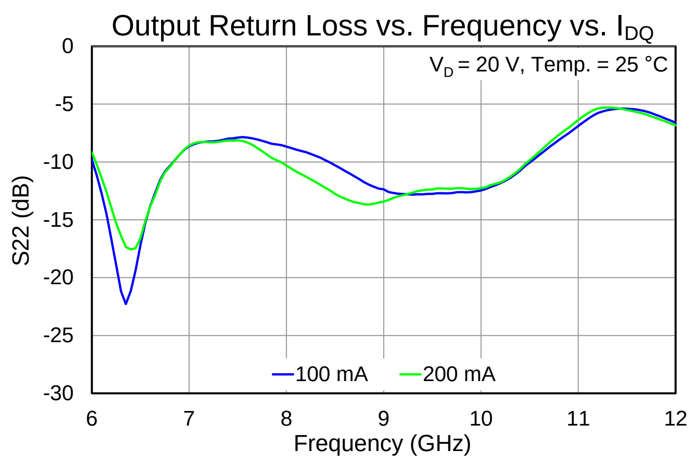




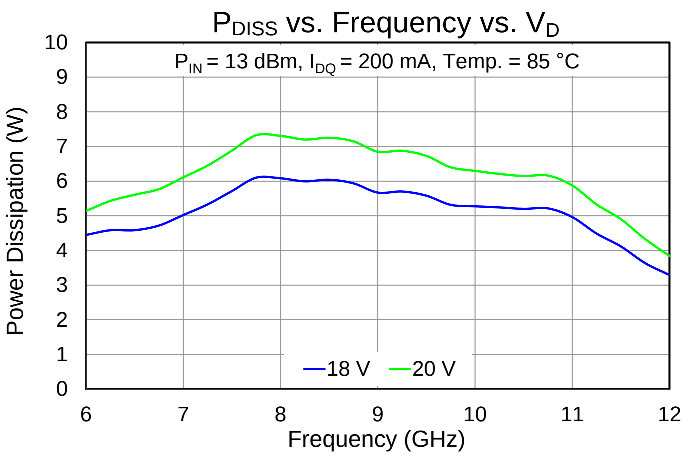


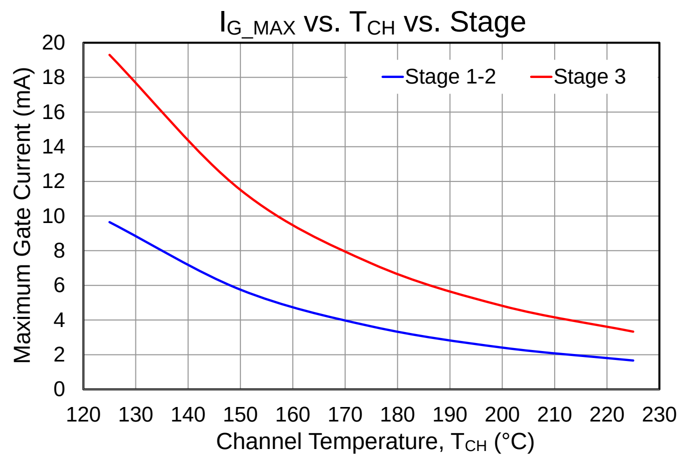
Thermal and Reliability Information

Parameter	Test Conditions	Value	Units
Thermal Resistance (θ_{JC}) [1]	T_{BASE} = 85°C, V_D = +20 V, I_{DQ} = 200 mA, P_{DISS} = 4.0 W	6.13	°C/W
Channel Temperature (T_{CH}) (Quiescent, No RF) [2]		109.5	°C
Thermal Resistance (θ_{JC}) [1]	T_{BASE} = 85 °C, V_D = +20 V, I_{DQ} = 200 mA, Freq = 7.75 GHz, P_{IN} = 13 dBm, I_{D_Drive} = 569 mA, P_{OUT} = 36.1 dBm, P_{DISS} = 7.33 W	6.52	°C/W
Channel Temperature (T_{CH}) (Under RF drive) [2]		132.8	°C

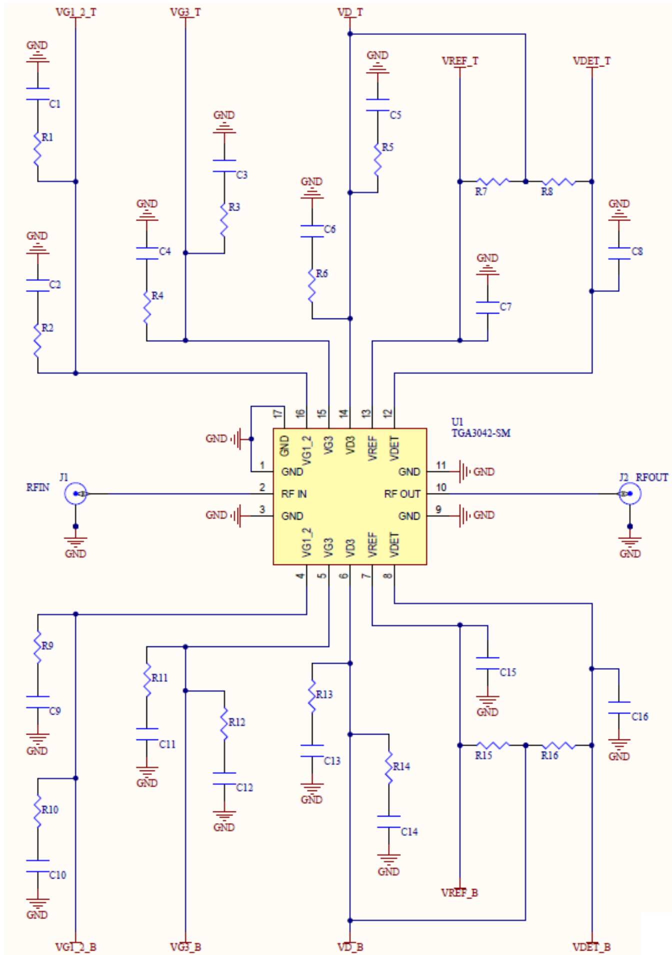
Notes:
1. Thermal resistance referenced to the back of the package, with a fixed base temperature of 85 °C.
2. IR scan equivalent. Refer to the following document: GaN Device Channel Temperature, Thermal Resistance, and Reliability Estimates

Power Dissipation and Maximum Gate Current





Application Information



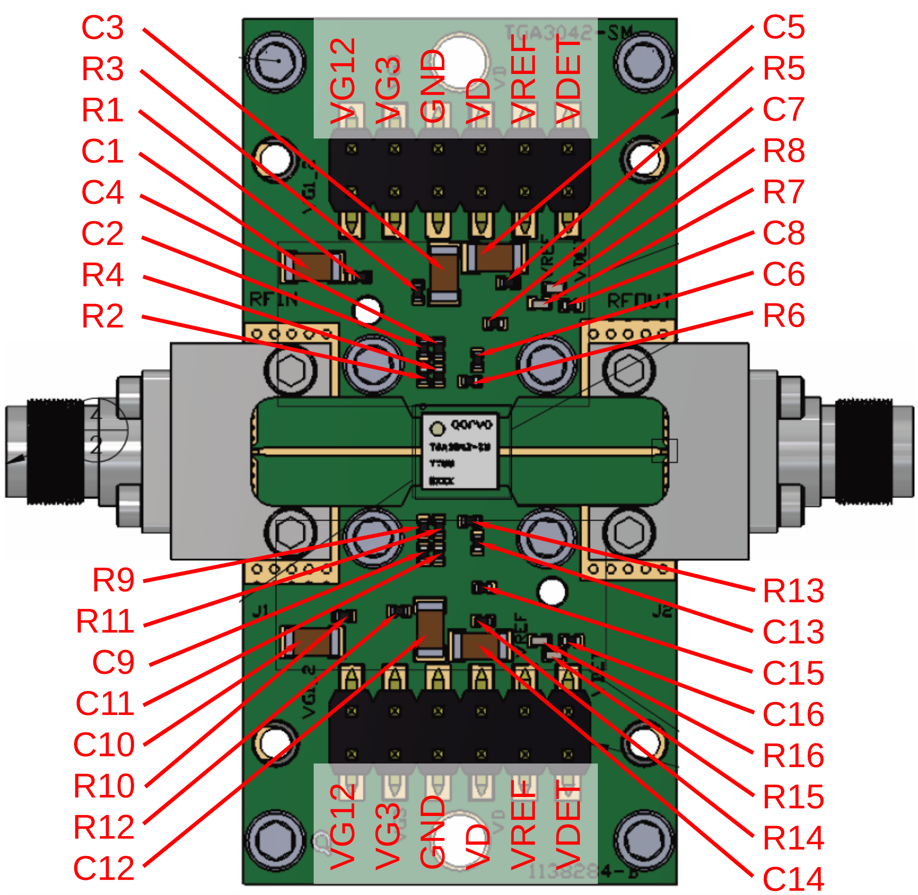
Bias Up Procedure

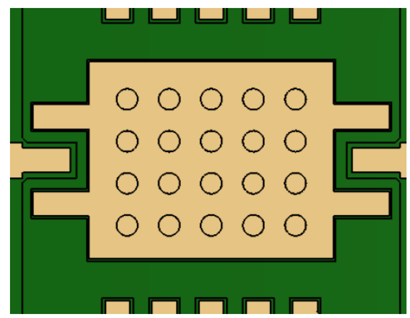
1. Set I_D limit to 1000 mA, I_G limit to 20 mA
2. Apply −5 V to V_G
3. Apply +20 V to V_D; ensure I_{DQ} is approx. 0 mA
4. Adjust V_G until I_{DQ} = 200 mA (V_G ~ −2.2 V Typ.).
5. Turn on RF supply

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

Evaluation Board (EVB) Layout





Mounting Detail

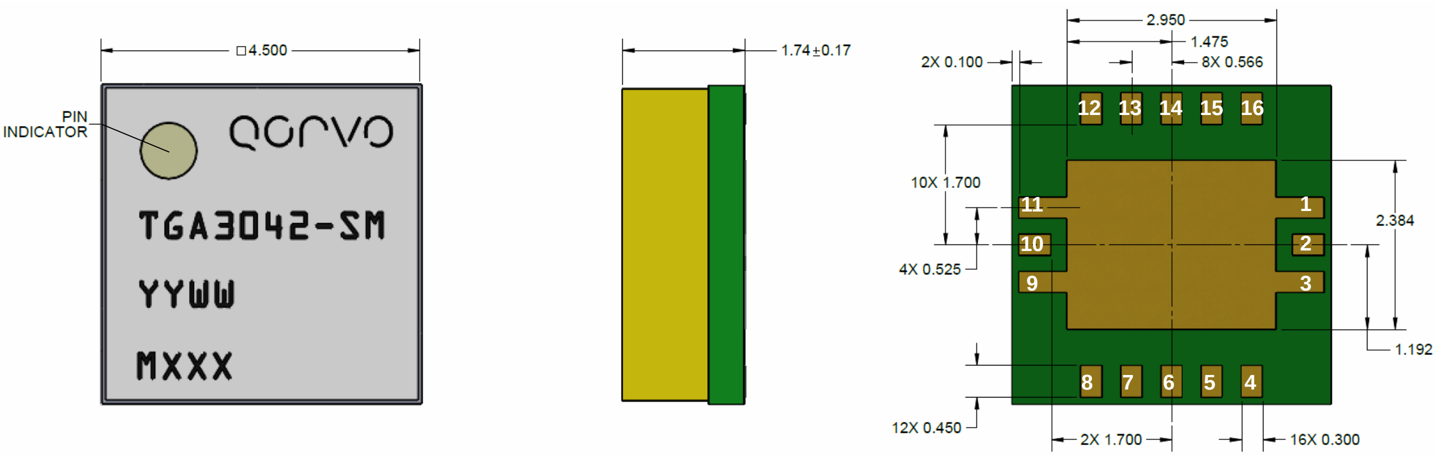
NOTES:

1. RF Layer is 8 mil thick Rogers Corp. RO4003C, ε_r = 3.38. Both metal layers are 0.5 oz. copper.
2. TGA3042-SM can be biased from either the top side or the bottom side. Bypassing components are required for the side(s) being biased. Bypass components are required for the side not biased if using the EVB PCB layout in other applications. Do not include metal traces for applications using the EVB PCB layout if biasing and bypassing from one side only

Bill of Materials

Reference Des.	Value	Description	Manuf.	Part Number
C1, C3, C5, C10, C12, C14	1.0 uF	CAP CER 50V 5% X7R 1206	Various	
C2, C4, C6 – C9, C11, C13, C15, C16	1000 pF	CAP, 0402, 1000pF, 10%, 100V, X7R	Various	
R7, R8, R15, R16	25.5 kΩ	RES, 1/16W, 1%, 0402	Various	
R1 – R6, R9 – R14	5.1 Ω	RES, 5%, 0402, 1/10W	Various	
J1, J2	N/A	2.92 mm RF Edge Launch Connector	Southwest Microwave	1092-01A-5

Mechanical Information



Units: millimeters
Tolerances: unless specified
  x.xx = ± 0.25
  x.xxx = ± 0.100
Materials:
  Base: Laminate
  Lid: FR4
  All metalized features are gold plated
  Part is epoxy sealed
Marking:
  TGA3042-SM: Part number
  YY: Part Assembly year
  WW: Part Assembly week
  MXXX: Batch ID

Pin Description

Pad No.	Symbol	Description
1, 3, 9, 11, Center	GND	Ground. Must be grounded on the PCB. Conductive filled vias recommended for least inductance and improved thermal performance (see Mounting Detail)
2	RF_{IN}	RF Input; matched to 50 Ω; DC blocked
4, 16	V_{G1-2}	Stage 1-2 Gate Voltage. Can be biased from either side. Bias network is required; see recommended Application Information and EVB Layout above.
5, 15	V_{G3}	Stage 3 Gate Voltage. Can be biased from either side. Bias network is required; see recommended Application Information and EVB Layout above.
6, 14	V_D	Drain voltage; Drain can be biased from either side. Bias network is required; see recommended Application Information and EVB Layout above.
7, 13	V_{REF}	Reference voltage
8, 12	V_{DET}	Detector voltage
10	RF_{OUT}	RF Output; matched to 50 Ω; DC blocked

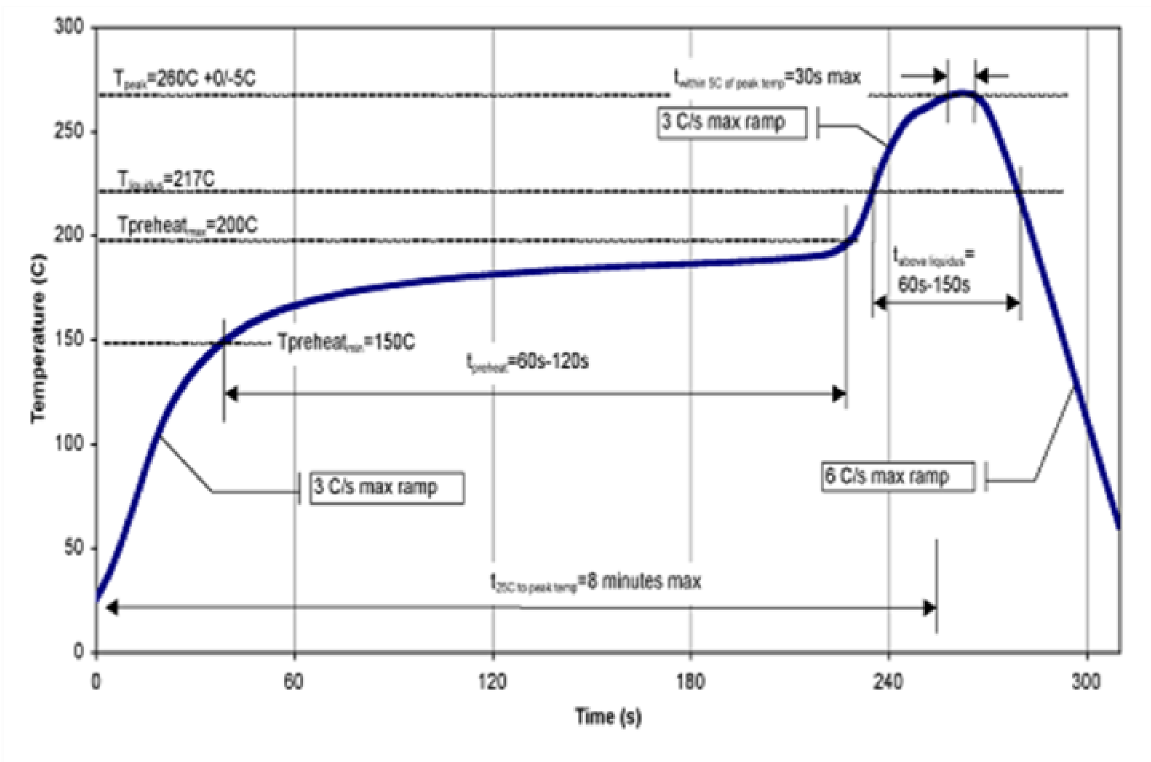
Assembly Notes

Compatible with lead-free soldering processes with 260°C peak reflow temperature.

This package is air-cavity and non-hermetic, and therefore cannot be subjected to aqueous washing. The use of no-clean solder to avoid washing after soldering is highly recommended.

Contact plating: Ni-Au.

Solder rework not recommended.



Recommended Soldering Temperature Profile