TGA2963-CP

6 – 18 GHz 20 W GaN Power Amplifier

Product Description

Qorvo's TGA2963-CP is a broadband high power MMIC amplifier fabricated on Qorvo's production 0.15um GaN on SiC process (QGaN15). The TGA2963-CP operates from 6 – 18 GHz and typically provides 20 W saturated output power with power-added efficiency of 20% and large-signal gain of 18 dB. This combination of wideband performance provides the flexibility designers are looking for to improve system performance while reducing size and cost.

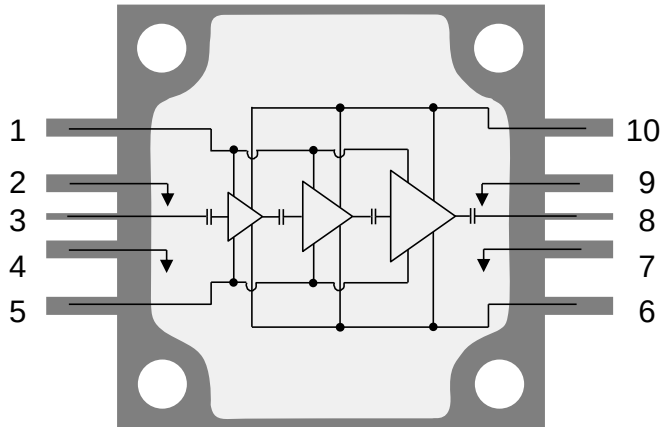
The TGA2963-CP is offered in a 10-lead 15 x 15 mm bolt-down package. Assembled with a pure-copper base, coupled with its high efficiency, the TGA2963-CP minimizes the strain on the system-level cooling requirements, further reducing system operating costs. The broadband performance makes it ideally suited to support test instrumentation and electronic warfare, as well as, supporting multiple radar and communication bands.

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.

Functional Block Diagram



Product Features

- Frequency Range: 6 – 18 GHz
- P_{OUT}: 43 dBm @ P_{IN} = 25 dBm
- PAE: 20 % @ P_{IN} = 25 dBm
- Large Signal Gain: 18 dB @ P_{IN} = 25dBm
- Small Signal Gain: 26 dB
- Bias: V_D = +20 V, I_{DQ} = 2500 mA, V_G = −2.3 V Typical
- Process Technology: QGaN15
- 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.

Applications

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

Ordering Information

Part No.	ECCN	Description
TGA2963-CP	3A001.b.2.c	6 – 18 GHz 20 W GaN Power Amplifier

Electrical Specifications

Test conditions unless otherwise noted: 25 °C, V_D = +20 V, I_{DQ} = 2500 mA, V_G = -2.3 V Typical, CW.

Parameter		Min	Typ	Max	Units
Operational Frequency Range		6	–	18	GHz
Output Power @ P_{IN} = 25 dBm	Frequency = 6 GHz		42.8	–	dBm
	Frequency = 12 GHz		45	–	
	Frequency = 18 GHz		43	–	
Power Added Efficiency @ P_{IN} = 25 dBm	Frequency = 6 GHz		21	–	%
	Frequency = 12 GHz		24	–	
	Frequency = 18 GHz		18	–	
Small Signal Gain	Frequency = 6 GHz		28	–	dB
	Frequency = 12 GHz		34	–	
	Frequency = 18 GHz		24	–	
Input Return Loss	Frequency = 6 GHz		16	–	dB
	Frequency = 12 GHz		12	–	
	Frequency = 18 GHz		9	–	
Output Return Loss	Frequency = 6 GHz		10	–	dB
	Frequency = 12 GHz		7.7	–	
	Frequency = 18 GHz		6.7	–	
Small Signal Gain Temperature Coefficient		–	-0.08	–	dB/°C
Output Power Temperature Coefficient		–	-0.015	–	dBm/°C

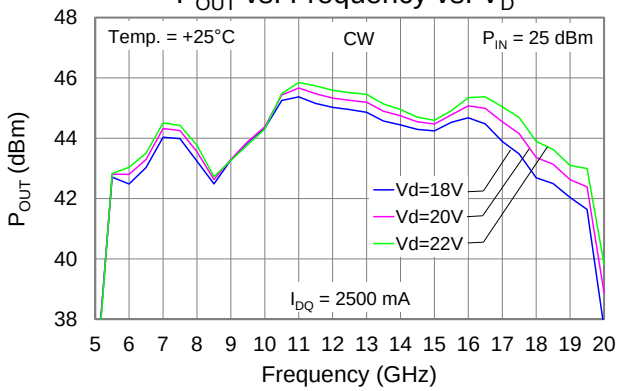
Recommended Operating Conditions

Parameter	Value / Range
Drain Voltage (V_D)	+20 V
Drain Current (I_{DQ})	2500 mA
Gate Voltage (V_G)	−2.3 V (Typ.)
Temperature (T_{BASE})	−40 to 85 °C

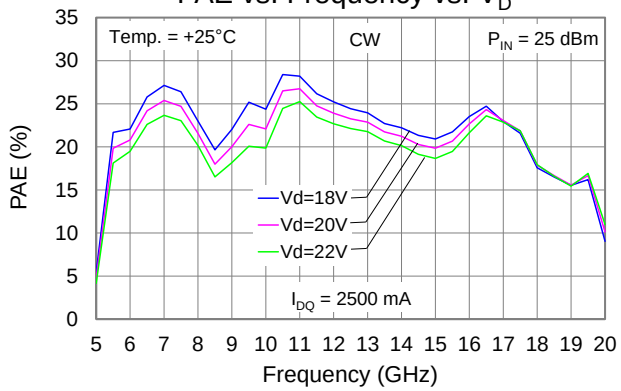
Electrical specifications are measured at specified test conditions. Specifications are not guaranteed over all recommended operating conditions.

Performance Plots – Large Signal (CW)

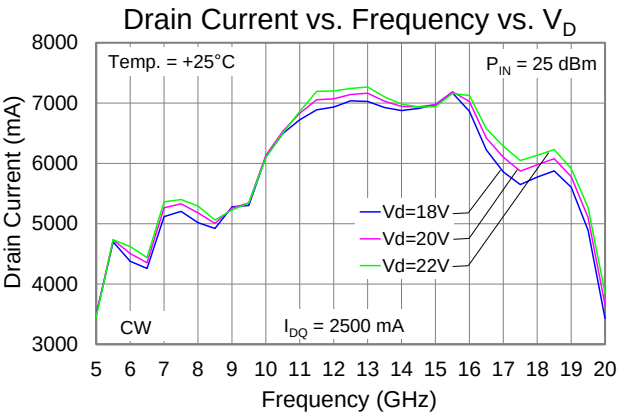
P_{OUT} vs. Frequency vs. V_D



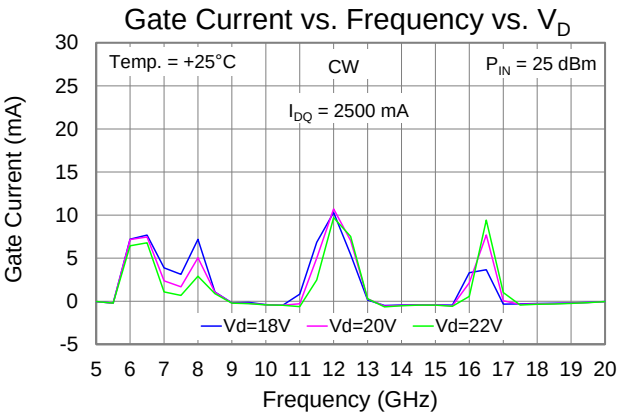
PAE vs. Frequency vs. V_D



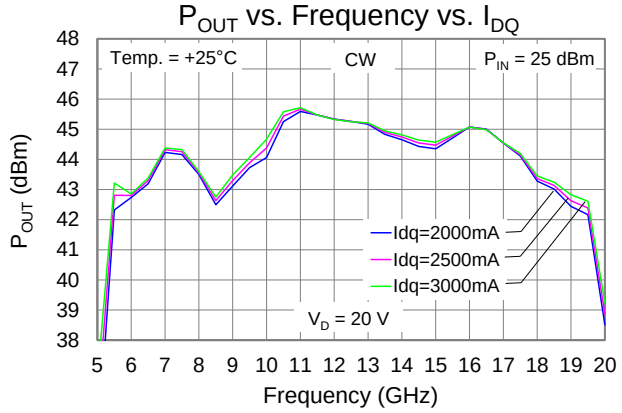
Drain Current vs. Frequency vs. V_D



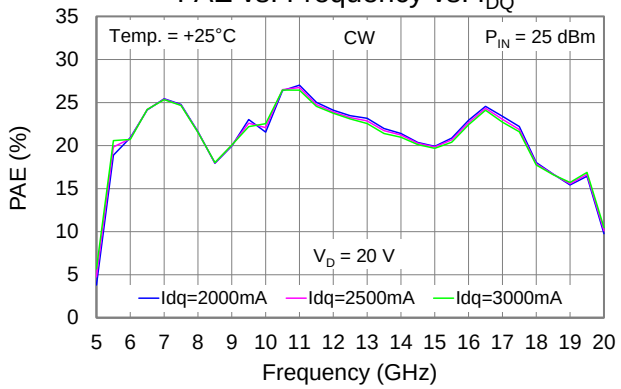
Gate Current vs. Frequency vs. V_D



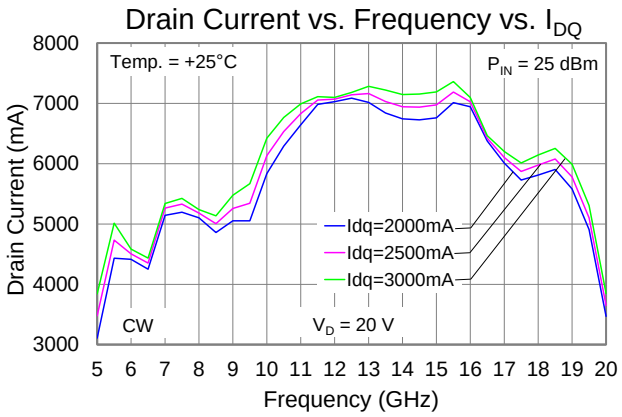
P_{OUT} vs. Frequency vs. I_{DQ}

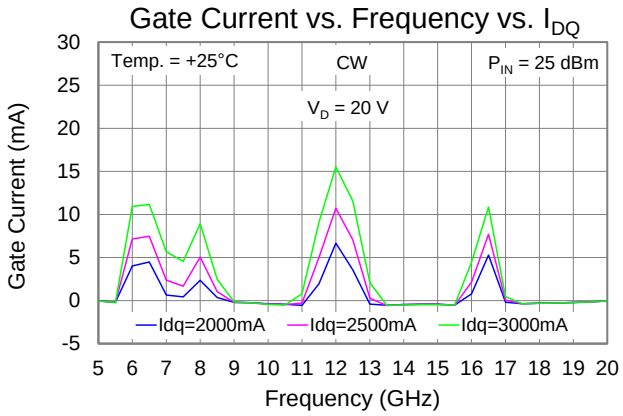


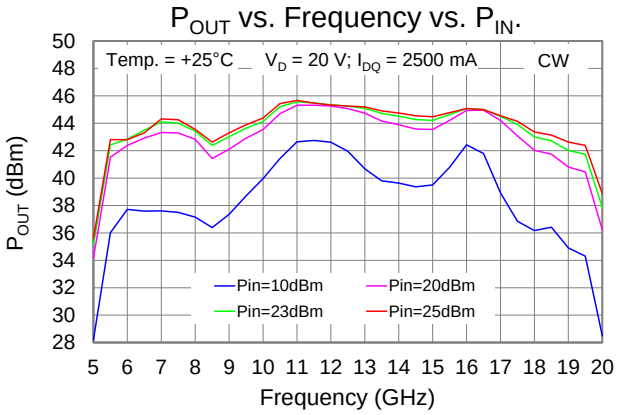
PAE vs. Frequency vs. I_{DQ}

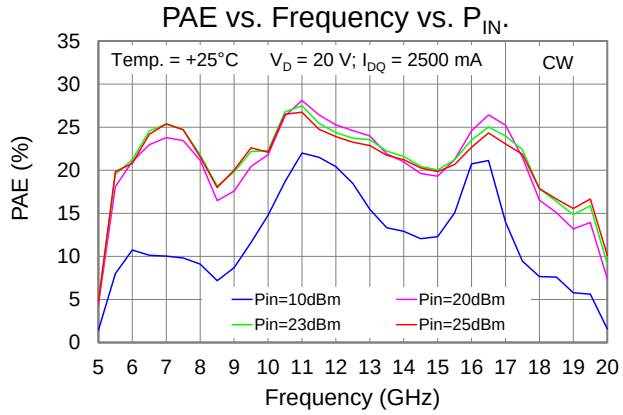


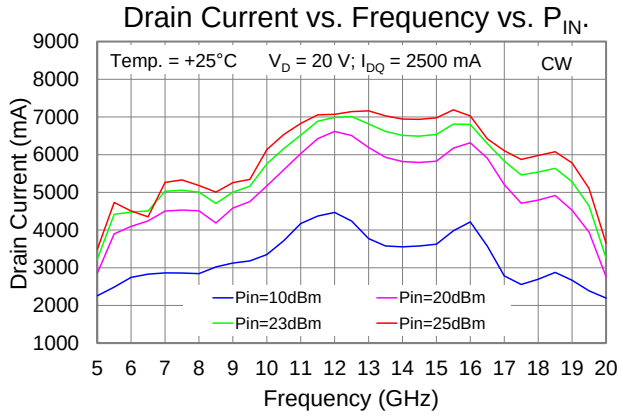
Performance Plots – Large Signal (CW)

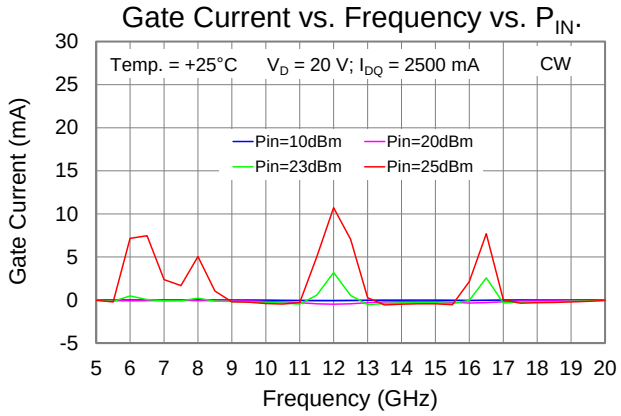




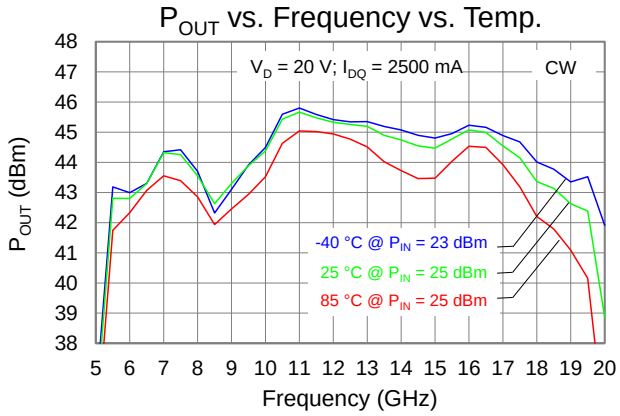


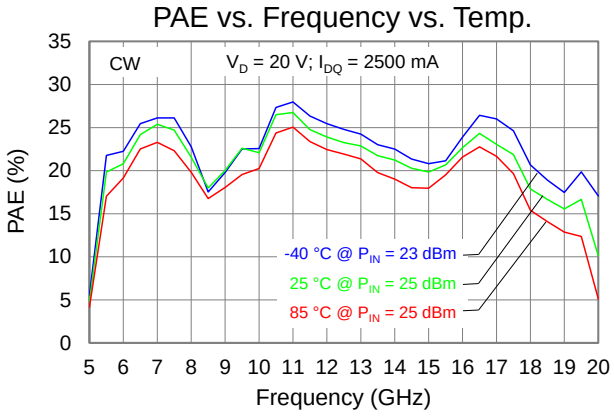


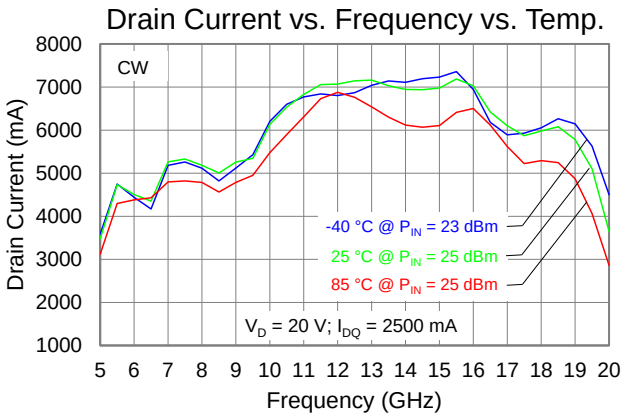


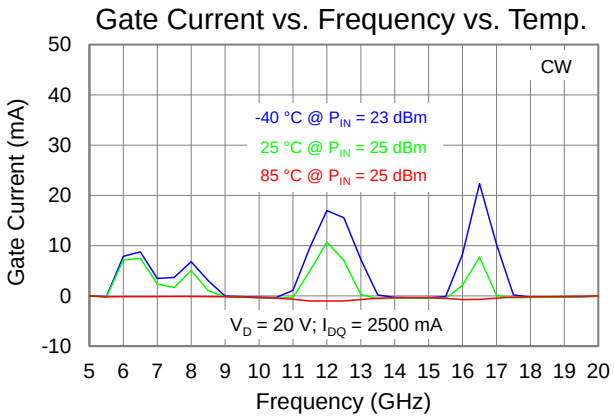


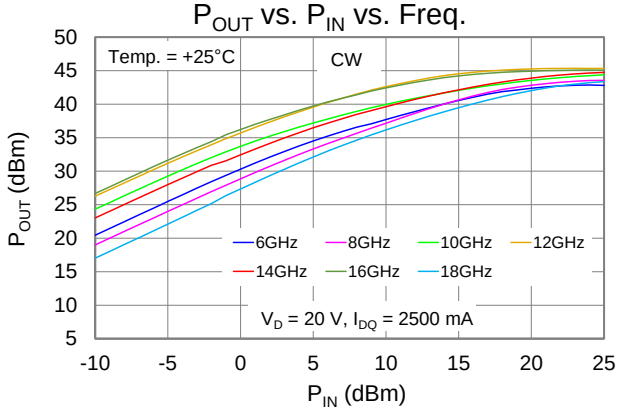
Performance Plots – Large Signal (CW)

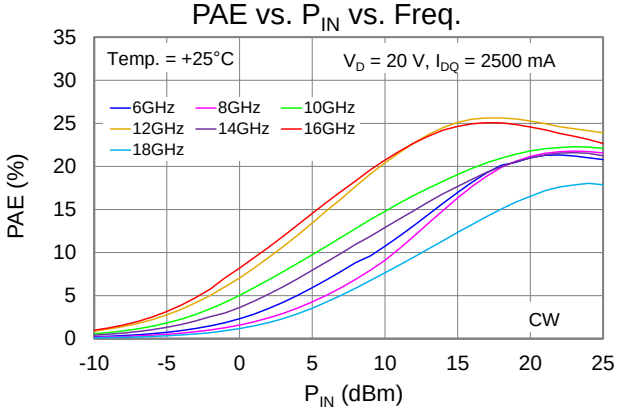




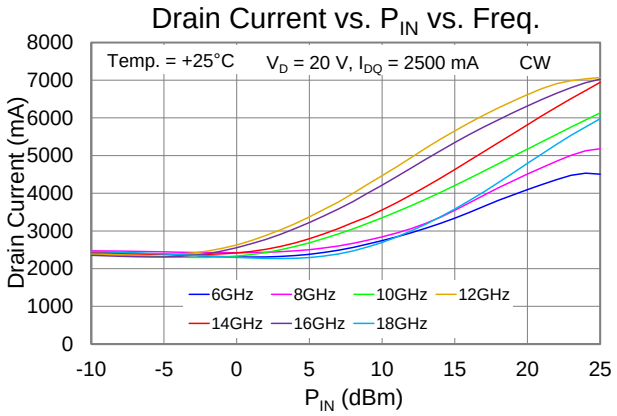


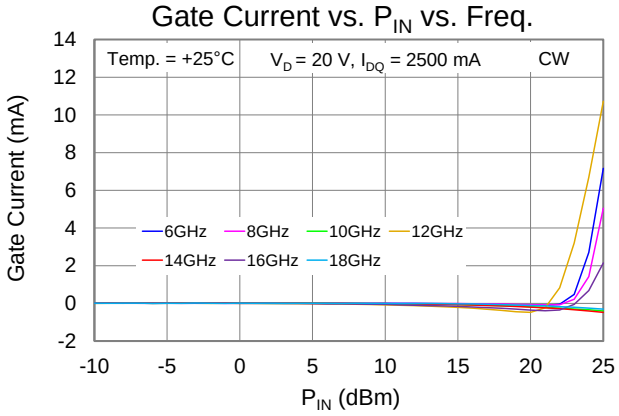


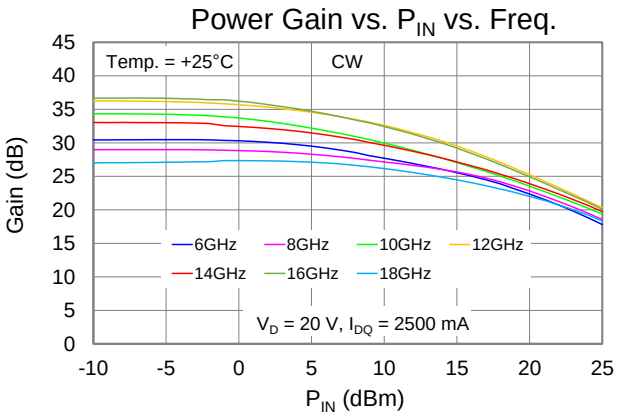


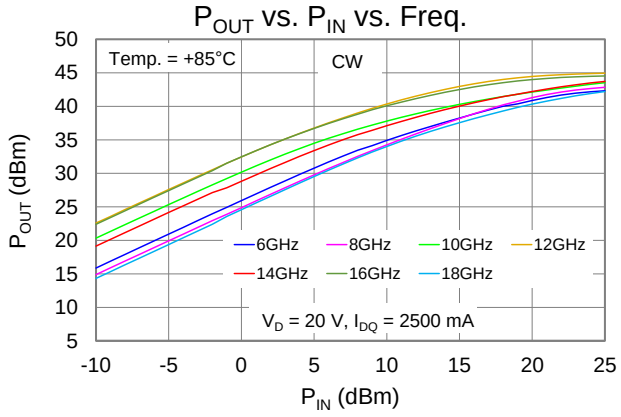


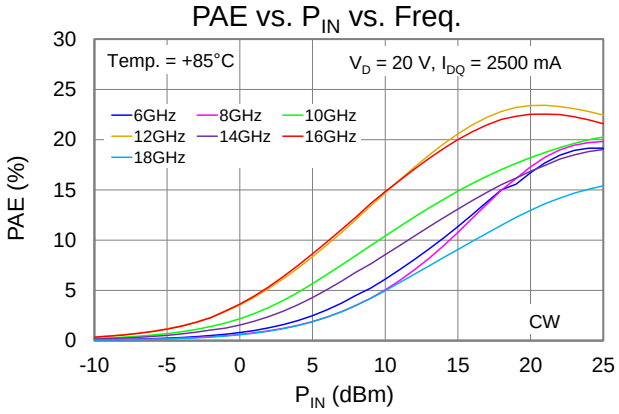
Performance Plots – Large Signal (CW)



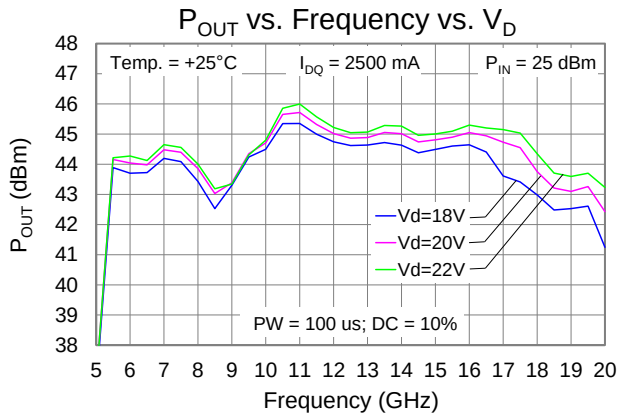


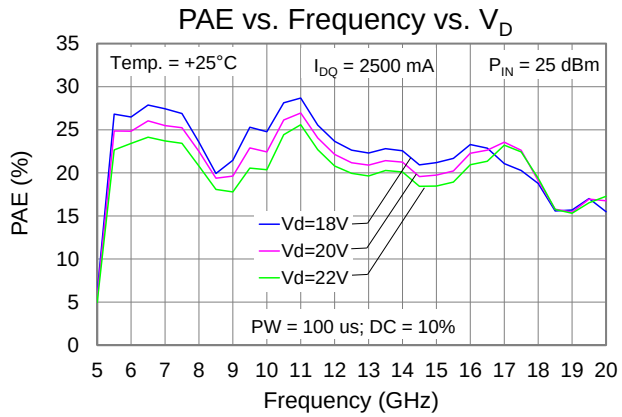


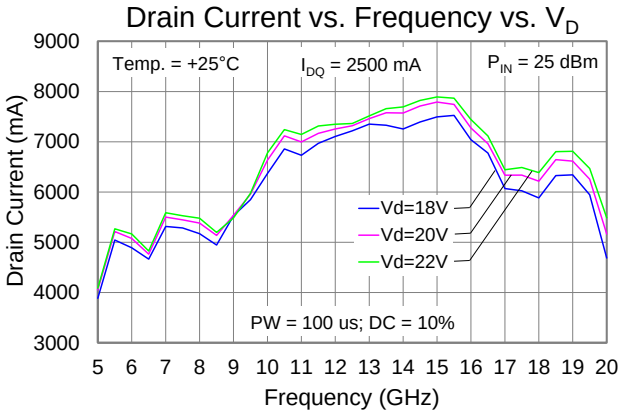


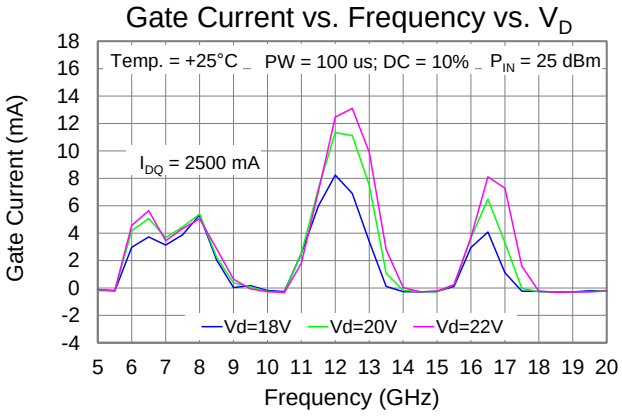


Performance Plots – Large Signal (Pulsed)



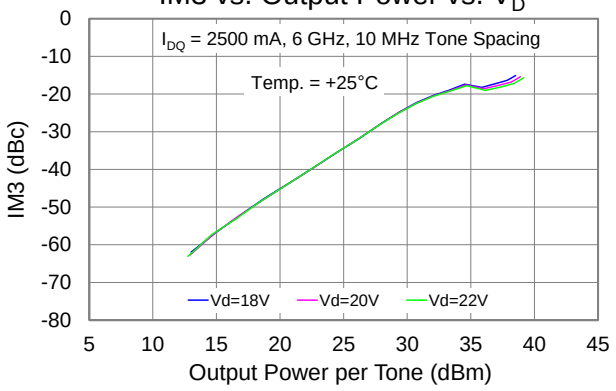




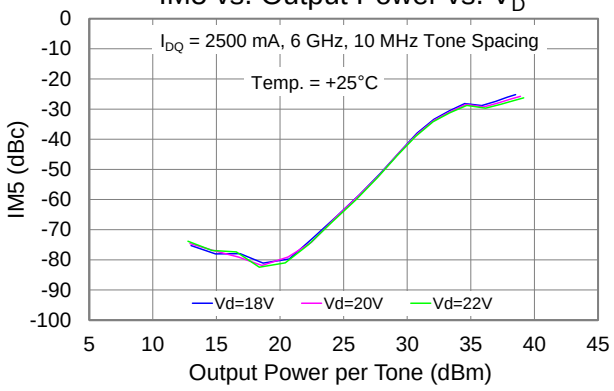


Performance Plots – Linearity

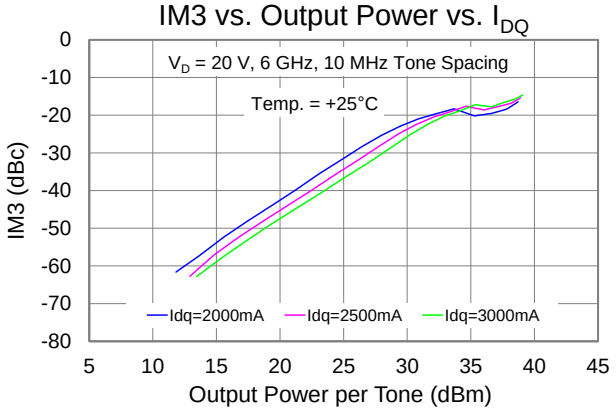
IM3 vs. Output Power vs. V_D



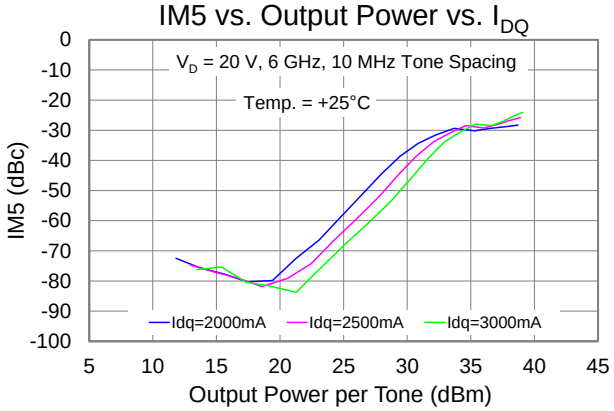
IM5 vs. Output Power vs. V_D



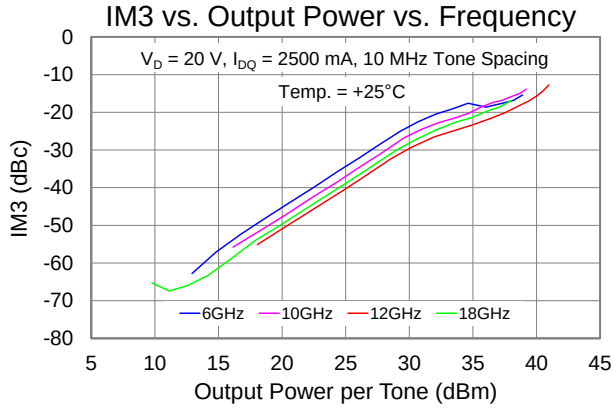
IM3 vs. Output Power vs. I_{DQ}



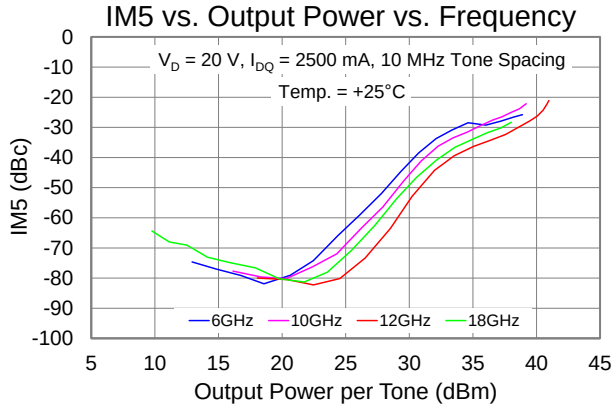
IM5 vs. Output Power vs. I_{DQ}



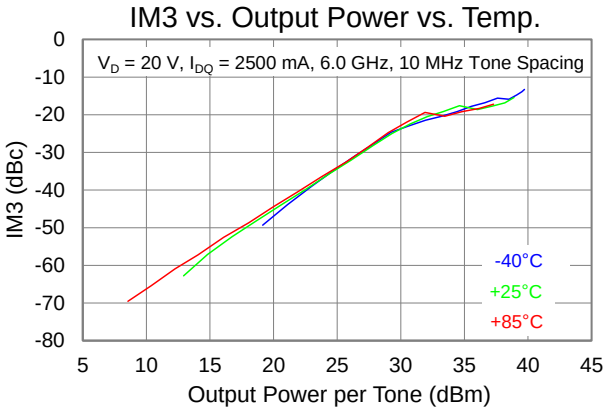
IM3 vs. Output Power vs. Frequency

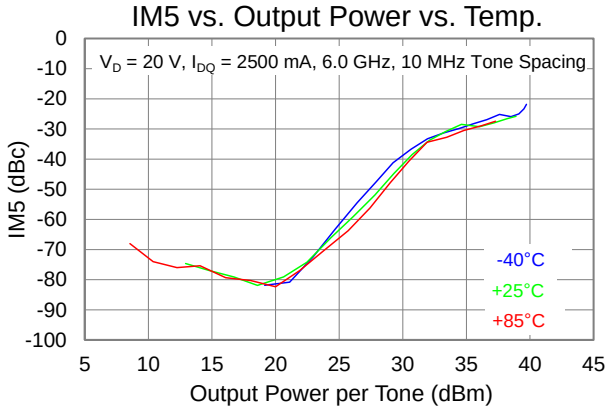


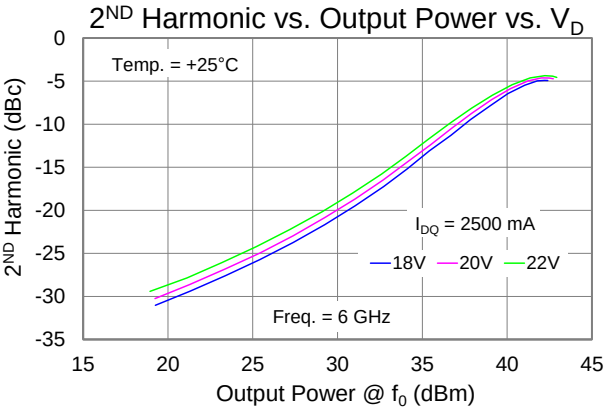
IM5 vs. Output Power vs. Frequency

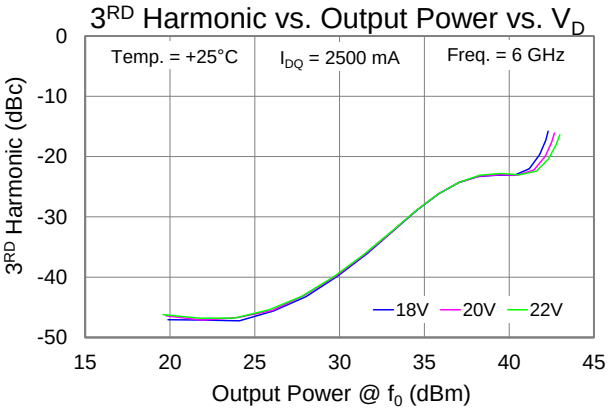


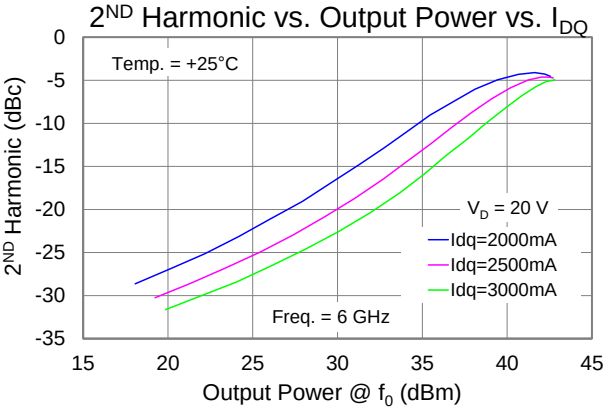
Performance Plots – Linearity

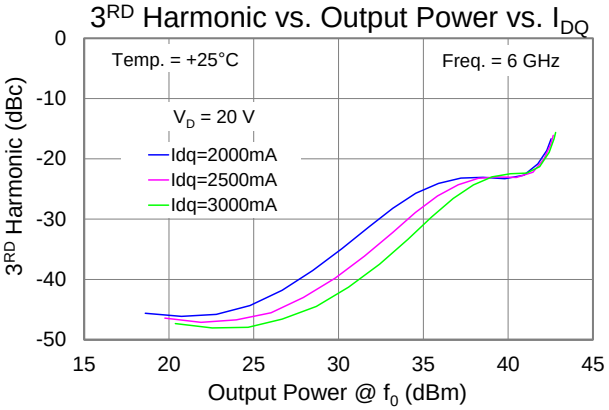




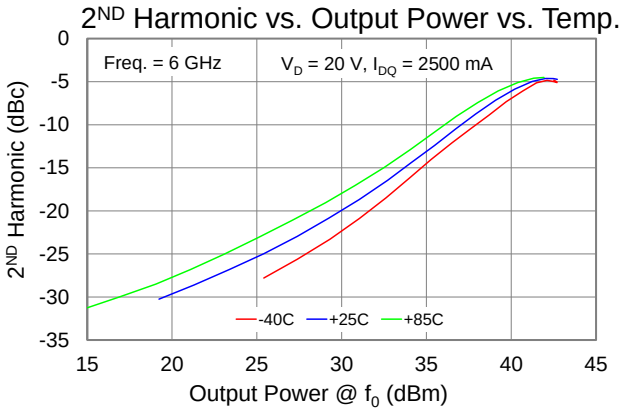


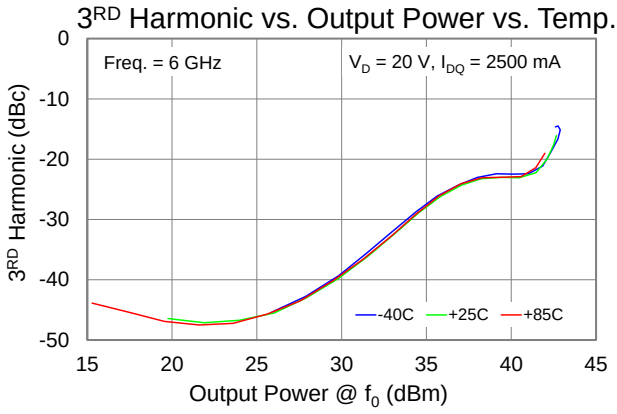


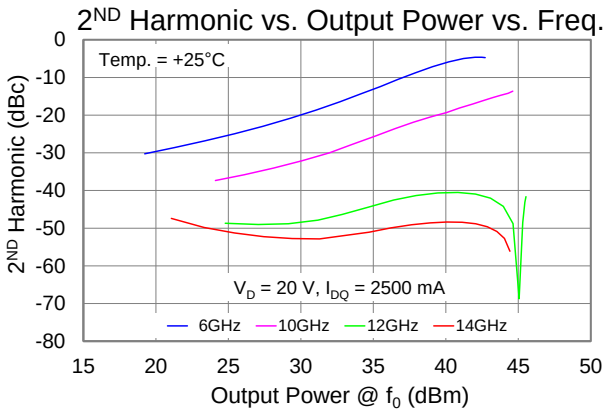




Performance Plots – Linearity

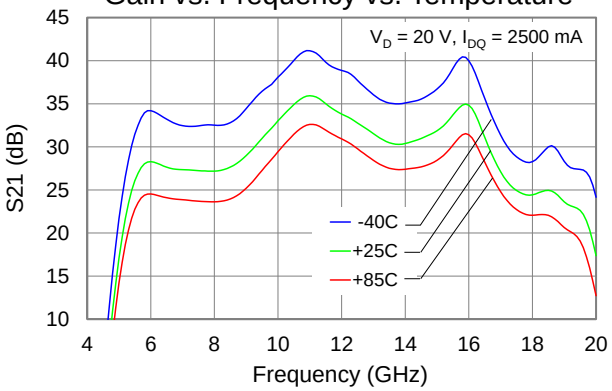




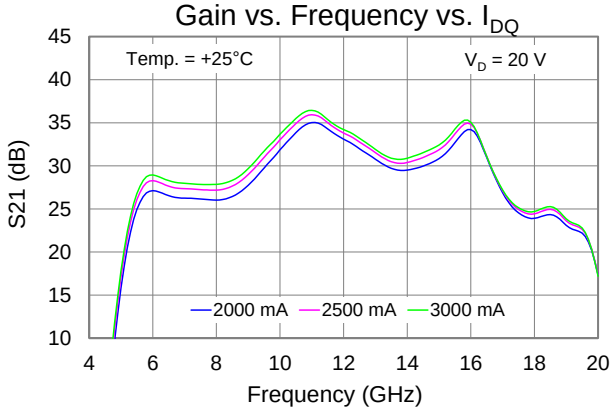


Performance Plots – Small Signal

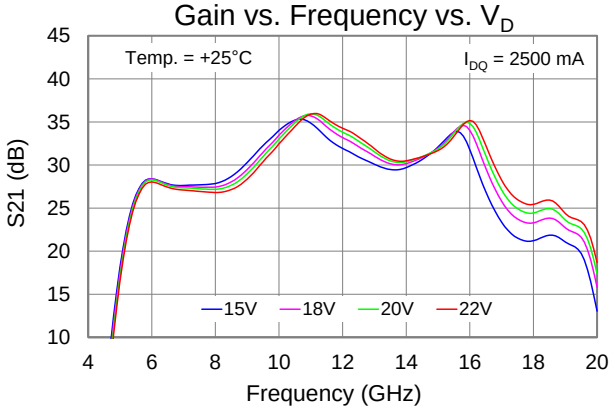
Gain vs. Frequency vs. Temperature



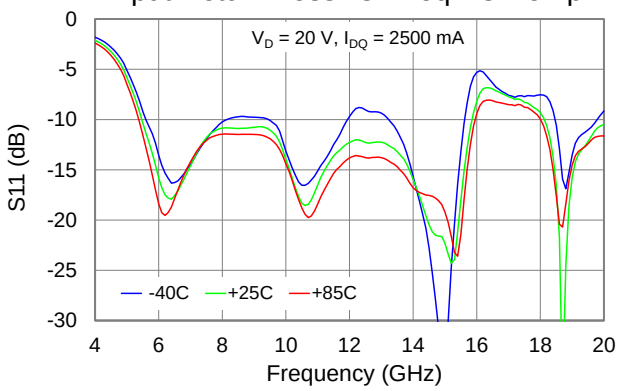
Gain vs. Frequency vs. I_{DQ}



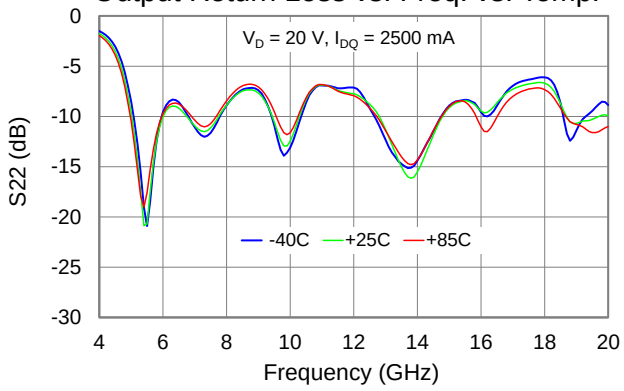
Gain vs. Frequency vs. V_D



Input Return Loss vs. Freq. vs. Temp.



Output Return Loss vs. Freq. vs. Temp.



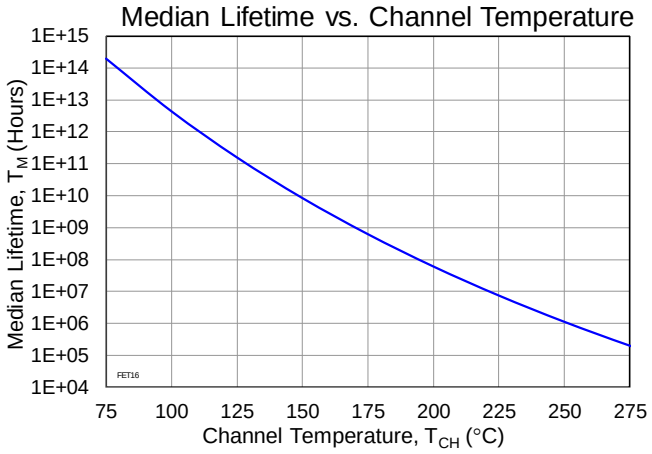
Thermal and Reliability Information

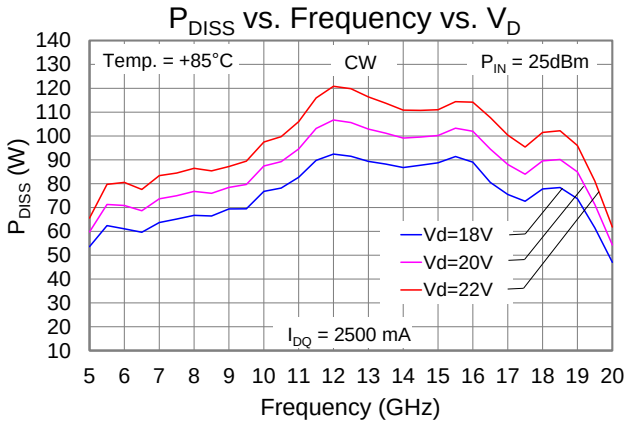
Parameter	Test Conditions	Value	Units
Thermal Resistance (θ_{JC}) (1)	T_{BASE} = 85°C, V_D = +20 V (CW) At I_{DQ} = 2500 mA, P_{DISS} = 50 W	1.1	°C/W
Channel Temperature (T_{CH}) (Quiescent)		140	°C
Median Lifetime (T_M)		2.6E+10	Hrs
Thermal Resistance (θ_{JC}) (1)	T_{BASE} = 85 °C, V_D = +20 V (CW) At Freq = 12 GHz, P_{IN} = 25 dBm: I_{DQ} = 2500 mA, I_{D_Drive} = 6.9 A P_{OUT} = 45 dBm, P_{DISS} = 107 W	1.32	°C/W
Channel Temperature (T_{CH}) (Under RF drive)		226	°C
Median Lifetime (T_M)		6.9E+6	Hrs
Thermal Resistance (θ_{JC}) (1)	T_{BASE} = 85 °C, V_D = +22 V (CW) At Freq = 12 GHz, P_{IN} = 25 dBm: I_{DQ} = 2500 mA, I_{D_Drive} = 7 A P_{OUT} = 45 dBm, P_{DISS} = 120 W	1.36	°C/W
Channel Temperature (T_{CH}) (Under RF drive)		250	°C
Median Lifetime (T_M)		1.1E+6	Hrs

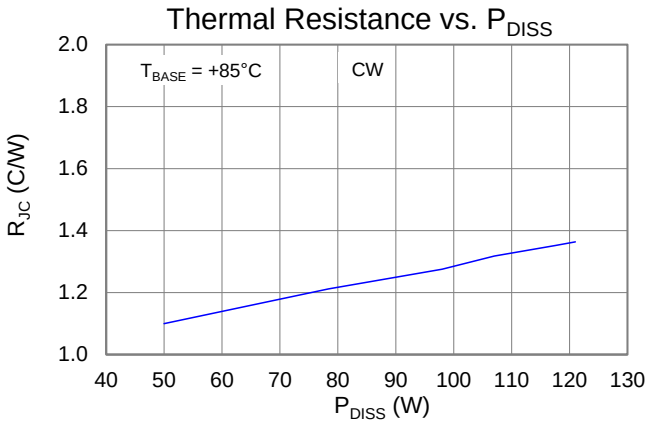
Notes:
1. Thermal resistance measured to back of package.

Median Lifetime

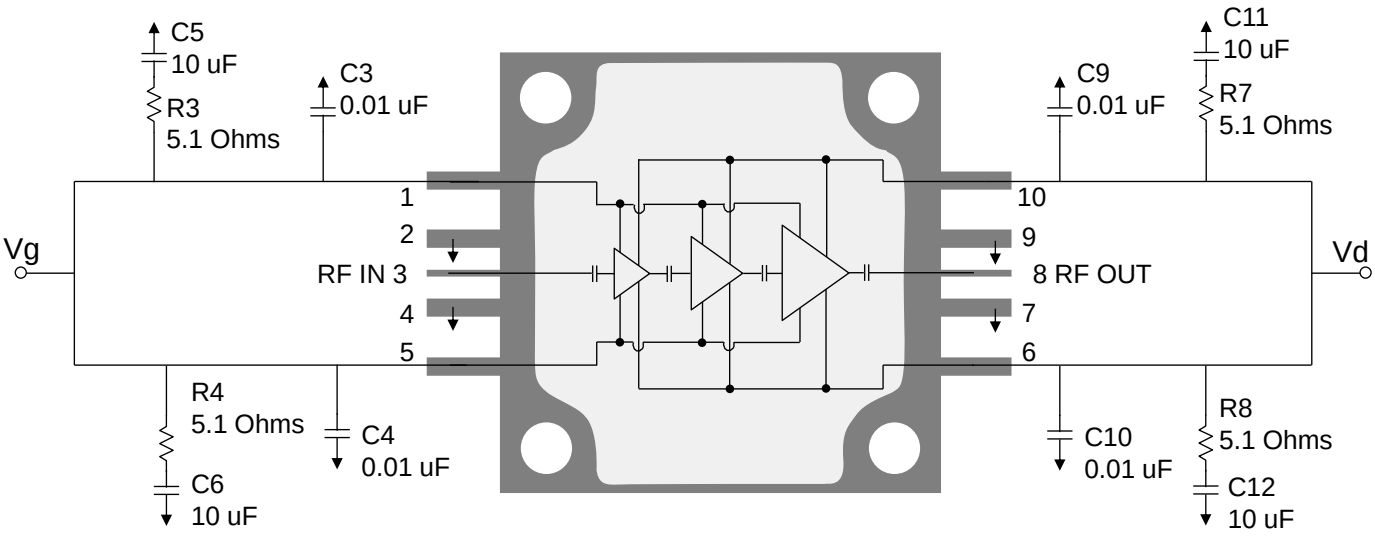
Test Conditions: V_D = +28 V; Failure Criteria = 10 % reduction in I_{DQ_MAX}







Applications Information and Pad Layout



Bias Up Procedure

1. Set I_D limit to 8 A, I_G limit to 50 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} = 2500 mA (V_G ~ −2.3 V Typ.).
5. Turn on RF supply

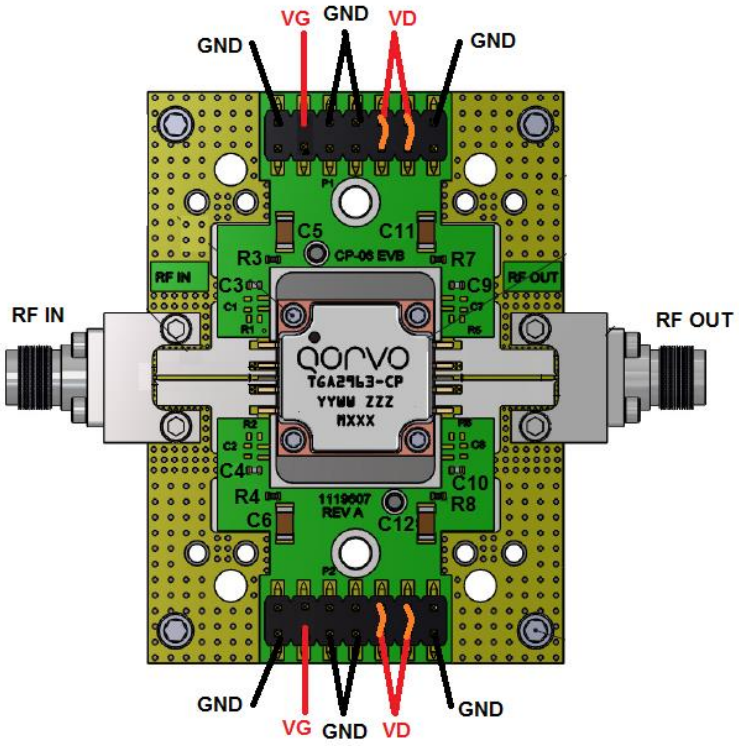
Bias Down Procedure

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

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.
3	RF_{IN}	Input; matched to 50 Ω; DC blocked
2,4,7,9	GND	Must be grounded on the PCB.
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 blocked

Evaluation Board



Notes:

1. Both Top and Bottom V_D and V_G must be biased.
2. We recommend to have a jumper between top and bottom of each V_D head pin as indicated above since this part is operating under high current.
3. Remove R7, R8, C10 & C11 for pulsed operation.

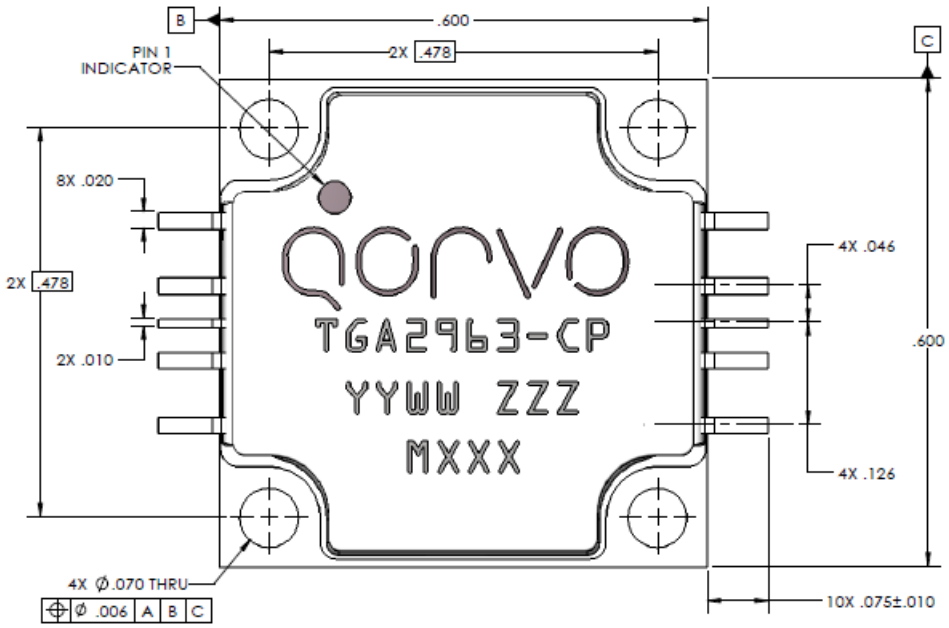
Bill of Materials

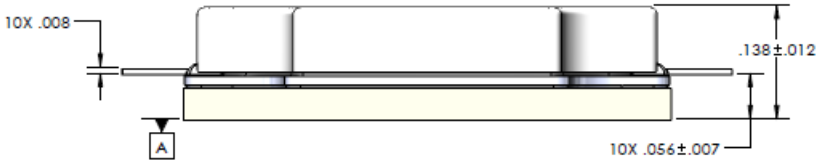
Reference Des.	Value	Description	Manuf.	Part Number
C3, C4, C9, C10	0.01 µF	Cap, 0402, 50 V, 10 %, X7R	Various	–
C5, C6, C11, C12	10 µF	Cap, 1206, 50 V, 20 %, X5R	Various	–
R3, R4, R7, R8	5.1 Ohm	Res, 0402, 50 V, 5 %	Various	–

Assembly Notes

1. Clean the board or module with alcohol. Allow it to dry fully.
2. Screws are recommended for mounting the TGA2963-CP to the T-Carrier.
3. To improve the thermal and RF performance, we recommend the following:
   a. Apply thermal compound (Artic Silver) between the package and the T-Carrier.
   b. Attach a heat sink to the bottom of the T-Carrier and apply thermal compound between the heat sink and the T-Carrier.
4. Apply solder to each pin of the TGA2963-CP.
   Clean the assembly with alcohol.

Mechanical Information





Units: inches
Tolerances: unless specified
x.xx = ± 0.01
x.xxx = ± 0.005
Materials:
Base: Copper
Lid: Plastic
All metalized features are gold plated
Part is epoxy sealed
Marking:
2963: Part number
YY: Part Assembly year
WW: Part Assembly week
ZZZ: Serial Number
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	8160 mA
Forward Gate Current (I_G)	See I_{G_MAX} plot
Power Dissipation (P_{DISS}), 85 °C, CW	150 W
Input Power, CW, 50 Ω, (P_{IN}), V_D = +20 V, I_{DQ} = 2500 mA, 85 °C,	30 dBm
Input Power, CW, VSWR 3:1, (P_{IN}) V_D = +20 V, I_{DQ} = 2500 mA, 85 °C	30 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.