Product Overview

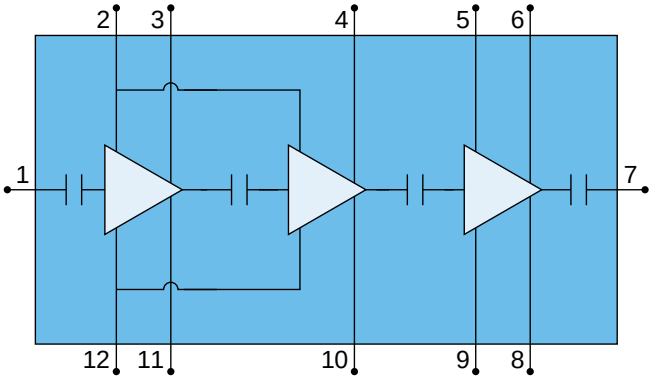
Qorvo's TGA2963 is a broadband high power MMIC amplifier fabricated on Qorvo's production 0.15 um GaN on SiC process (QGaN15). The TGA2963 operates from 6–18 GHz and provides more than 20 W saturated output power with power-added efficiency > 20% and large-signal gain > 20 dB. This combination of wideband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

The TGA2963 is matched to 50 Ω with integrated DC blocking capacitors on both RF I/O ports simplifying system integration. The broadband performance makes it ideally suited in support of test instrumentation and electronic warfare, as well as, supporting multiple radar and communication bands.

The TGA2963 is 100% DC and RF tested on-wafer to ensure compliance to electrical specifications.

Lead-free and RoHS compliant.

Functional Block Diagram



Key Features

- Frequency Range: 6–18 GHz
- P_{OUT}: > 43 dBm @ P_{IN} = 23 dBm
- PAE: > 20% @ P_{IN} = 23 dBm
- Large Signal Gain: > 20 dB @ P_{IN} = 23 dBm
- Small Signal Gain: > 26 dB
- Return Loss: > 6.5 dB
- Bias: V_D = 20 V, I_{DQ} = 2500 mA
- Chip Dimensions: 5.4 x 6.85 x 0.10 mm

Applications

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

Ordering Information

Part No.	Description
TGA2963	6–18 GHz 20 W GaN Power Amplifier
TGA2963 EVB	Evaluation Board

Absolute Maximum Ratings

Parameter	Value
Drain Voltage (V_D)	29.5 V
Gate Voltage Range (V_G)	-8 to 0 V
Drain Current (I_{D1})	960 mA
Drain Current (I_{D2})	1440 mA
Drain Current (I_{D3})	5760 mA
Gate Currents (I_{G1}/I_{G2} /I_{G3})	See plot on page
Power Dissipation (P_{DISS}), 85 °C, CW	150 W
Input Power (P_{IN}), 50 Ω, V_D = 20 V, I_{DQ} = 2500 mA, 85°C, CW	30 dBm
Input Power (P_{IN}), VSWR 3:1, V_D = 20 V, I_{DQ} = 2500 mA, 85 °C, CW	30 dBm
Mounting Temperature (30 seconds)	320 °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)	28 V
Drain Current (I_{DQ})	225 mA (Total)

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

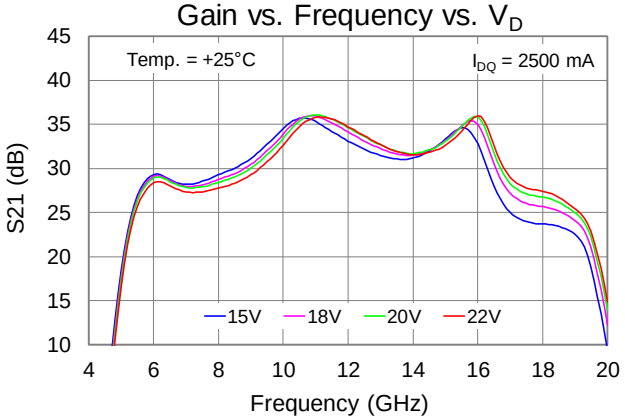
Electrical Specifications

Test conditions unless otherwise noted: 25 °C , V_D = 20 V, I_{DQ} = 2500 mA

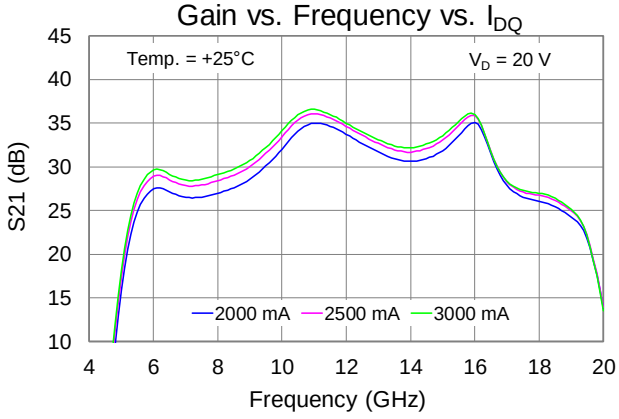
Parameter	Min	Typical	Max	Units
Operational Frequency Range	6		18	GHz
Small Signal Gain		>26		dB
Input Return Loss		>8		dB
Output Return Loss		>6.5		dB
Power Gain (Pin = 23 dBm)		>20		dB
Output Power (Pin = 23 dBm)		>43		dBm
Power Added Efficiency (Pin = 23 dBm)		>20		%
Small Signal Gain Temperature Coefficient		-0.062		dB/°C
Output Power Temperature Coefficient		-0.017		dBm/°C

Typical Performance (Small Signal)

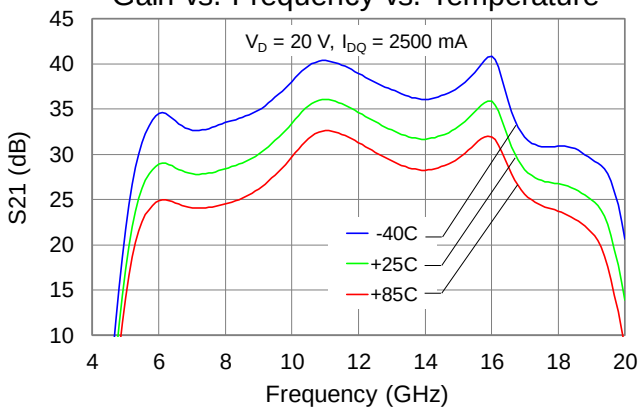
Gain vs. Frequency vs. V_D



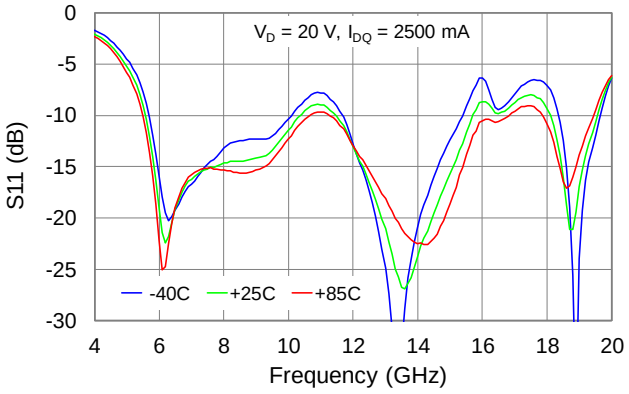
Gain vs. Frequency vs. I_{DQ}



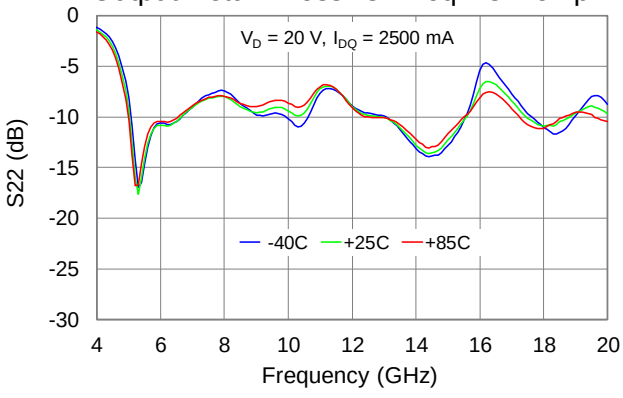
Gain vs. Frequency vs. Temperature



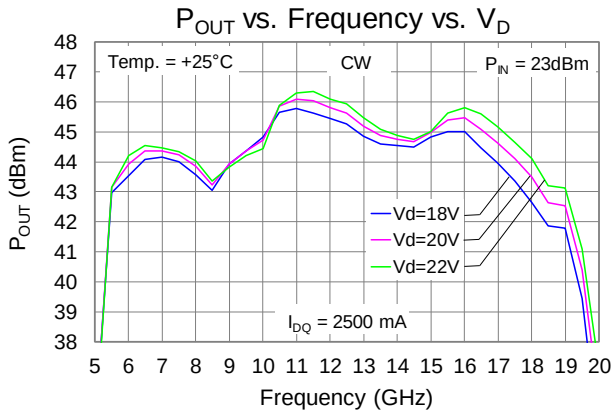
Input Return Loss vs. Freq. vs. Temp.

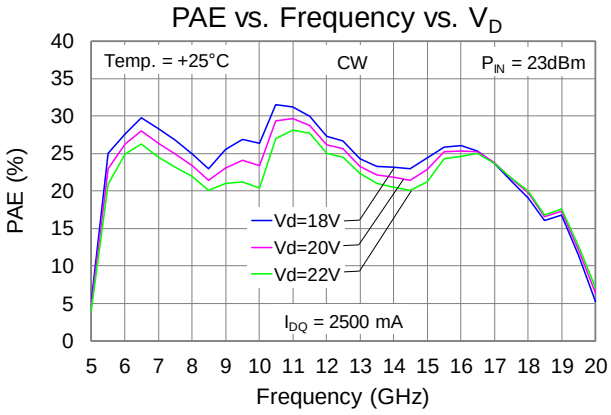


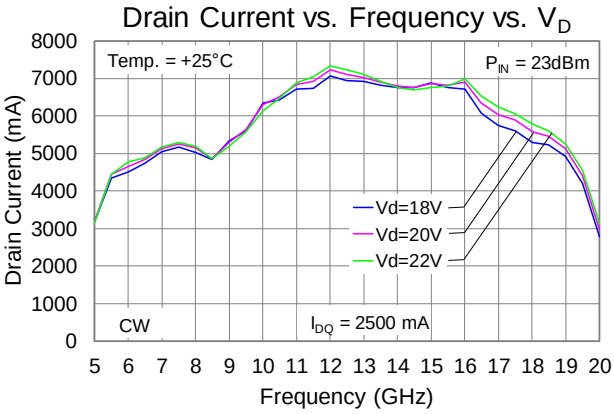
Output Return Loss vs. Freq. vs. Temp.

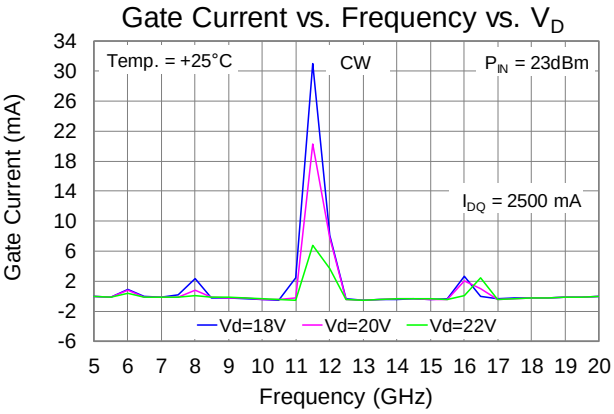


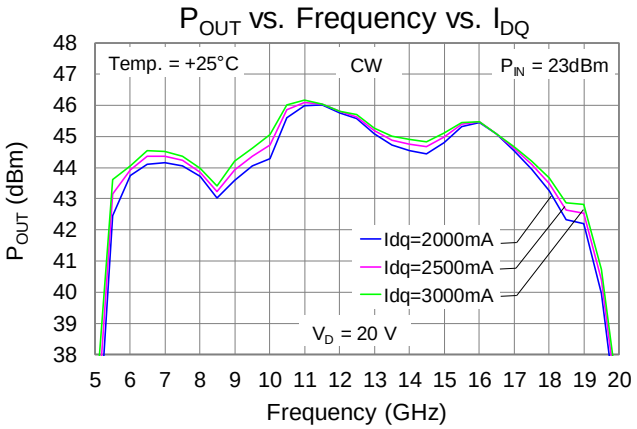
Typical Performance (Large Signal CW)

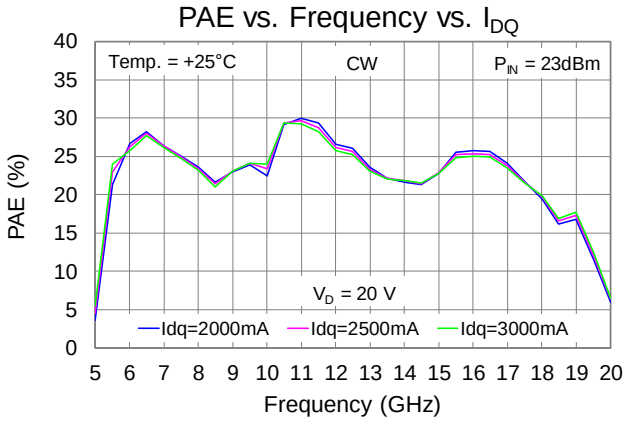






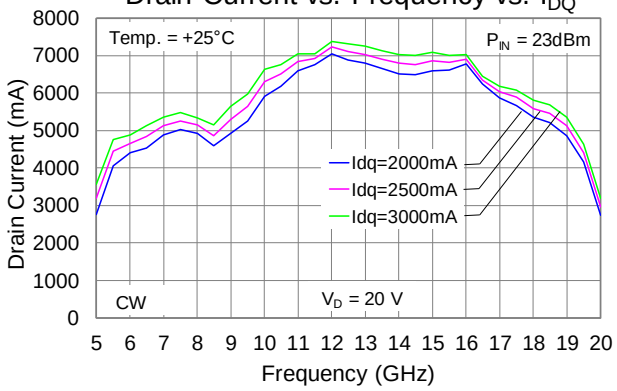




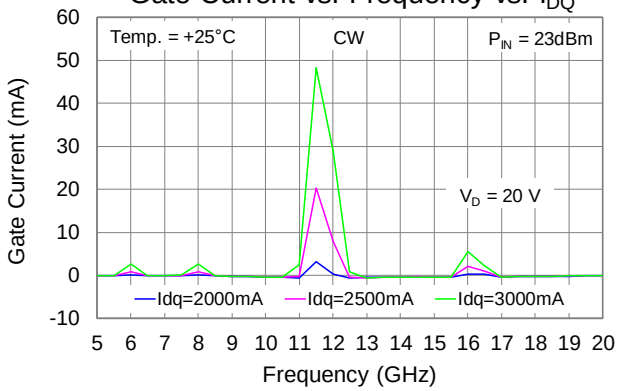


Typical Performance (Large Signal CW)

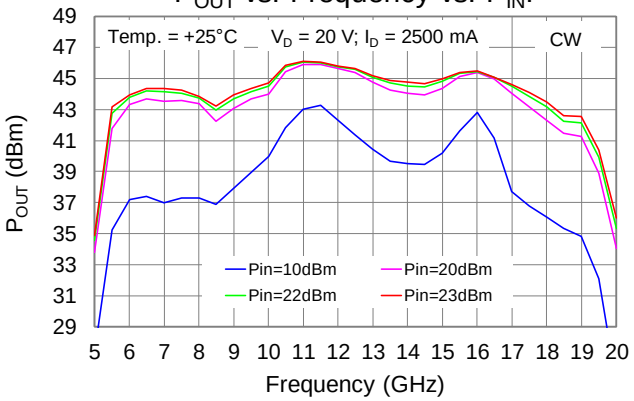
Drain Current vs. Frequency vs. I_{DQ}



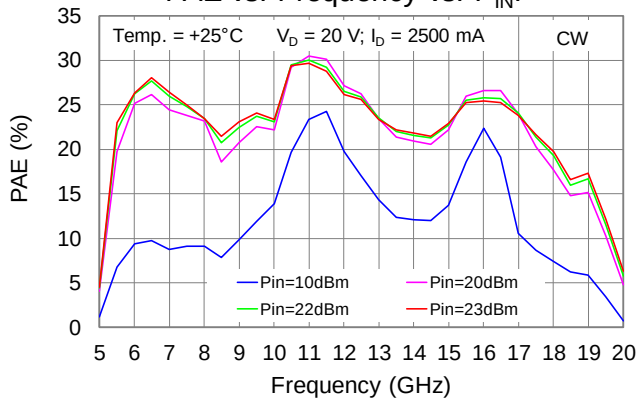
Gate Current vs. Frequency vs. I_{DQ}



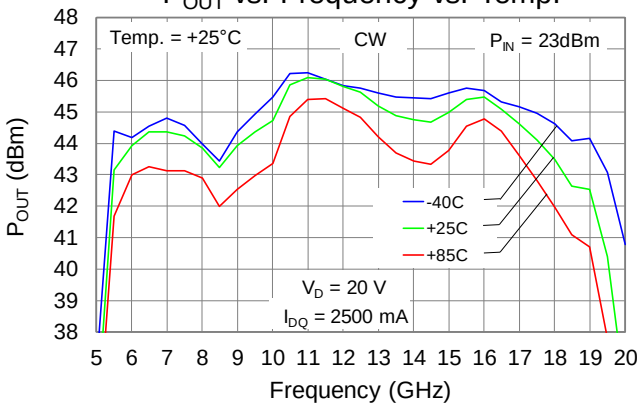
P_{OUT} vs. Frequency vs. P_{IN}.



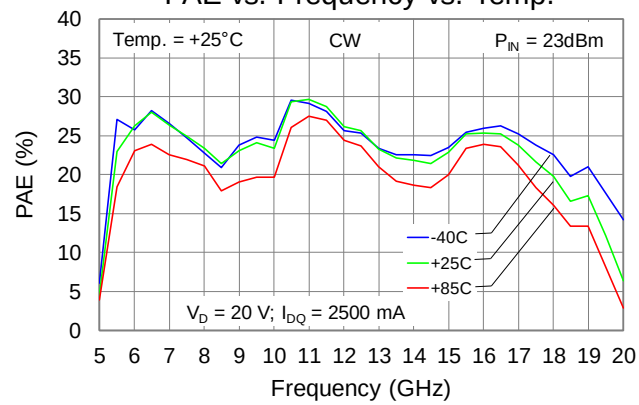
PAE vs. Frequency vs. P_{IN}.



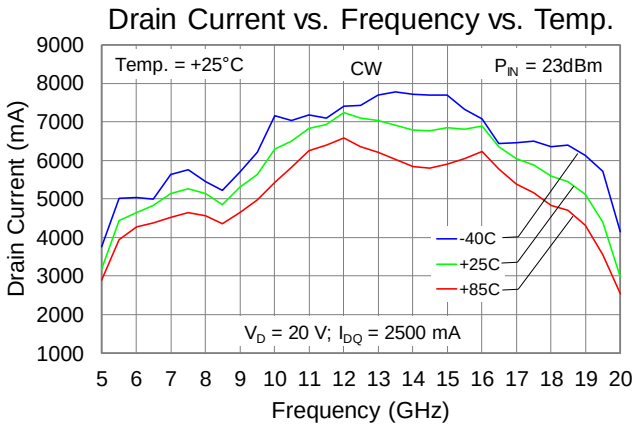
P_{OUT} vs. Frequency vs. Temp.

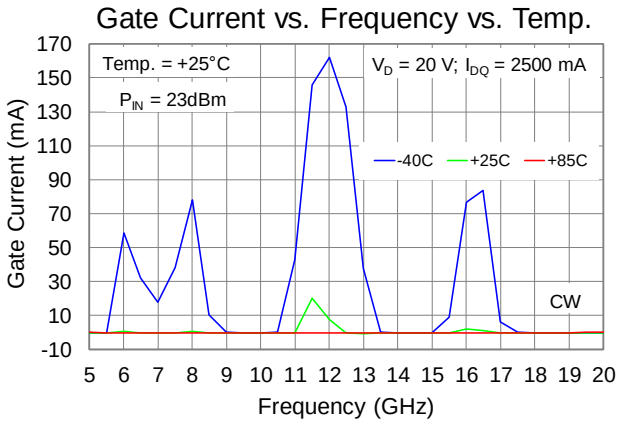


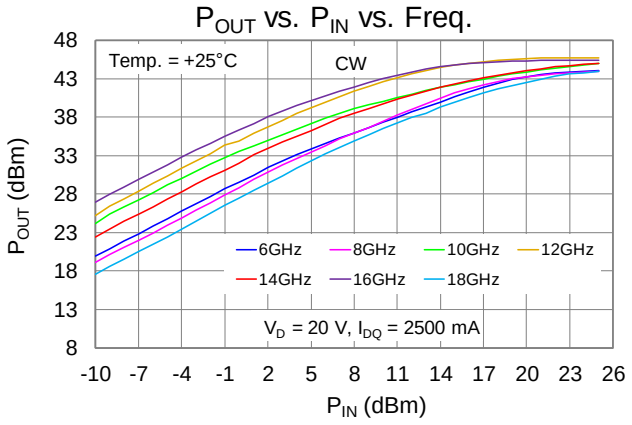
PAE vs. Frequency vs. Temp.

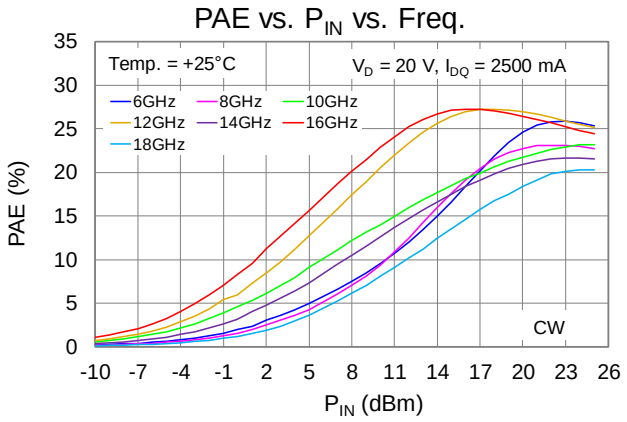


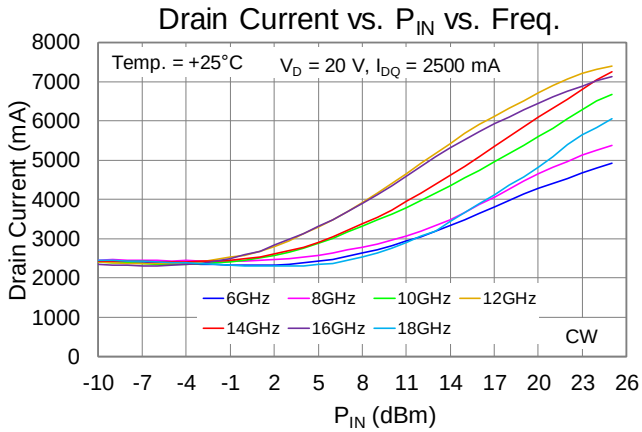
Typical Performance (Large Signal CW)

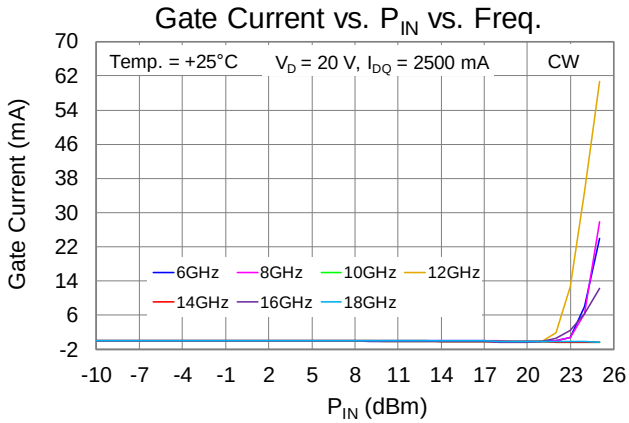




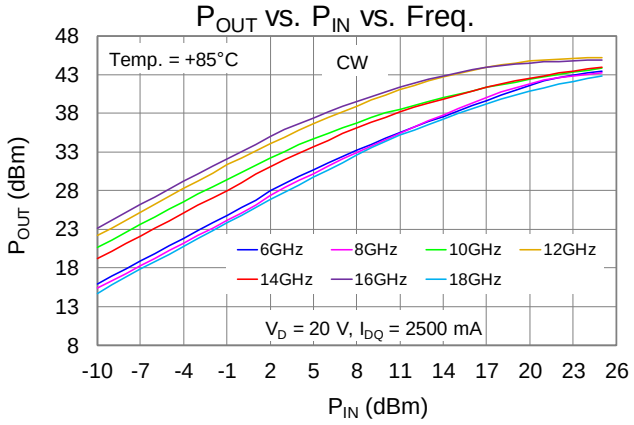


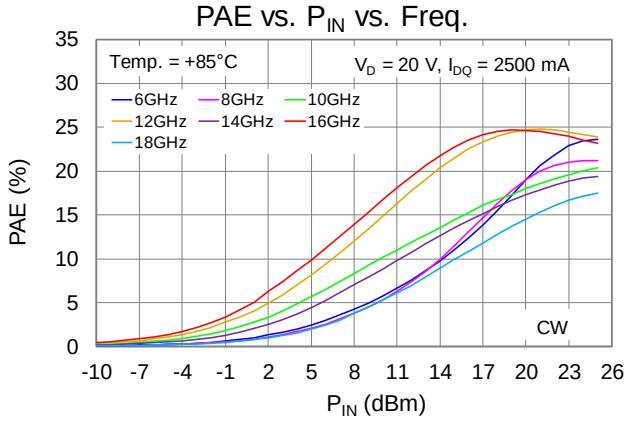


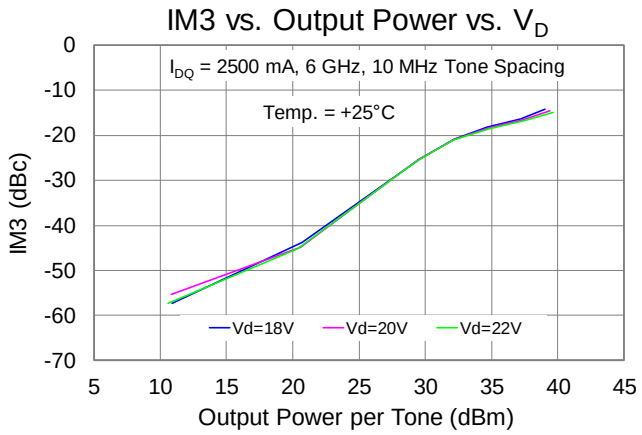


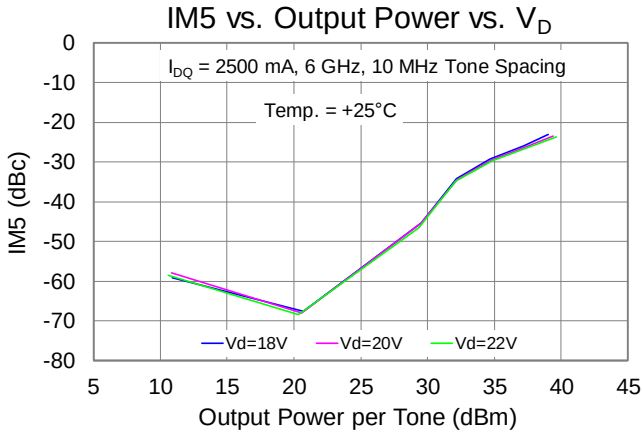


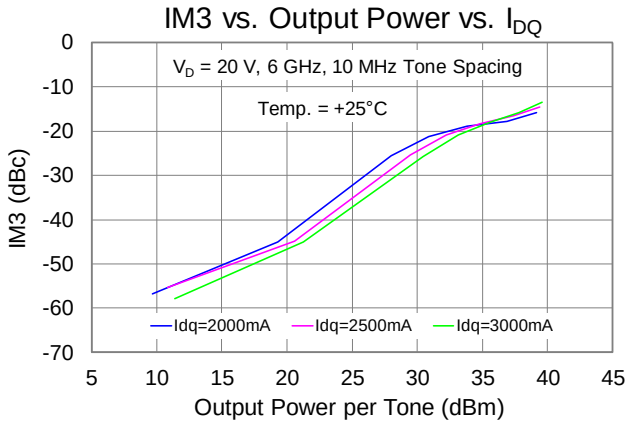
Typical Performance (Large Signal & Linearity)

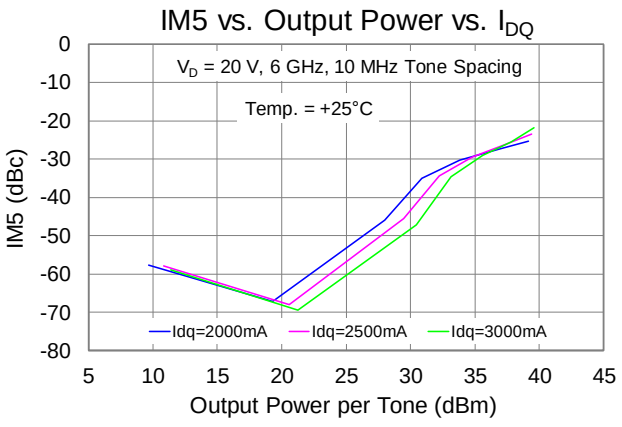




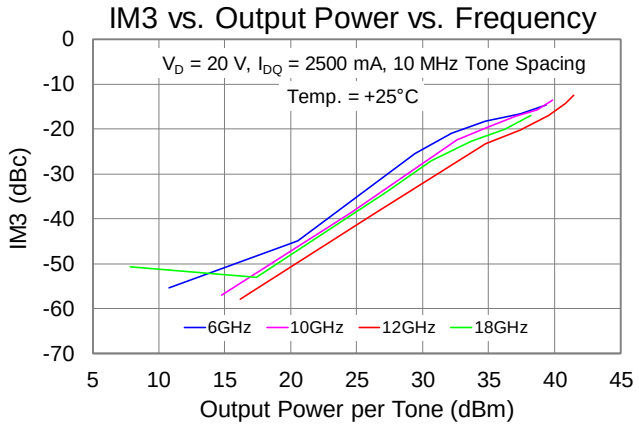


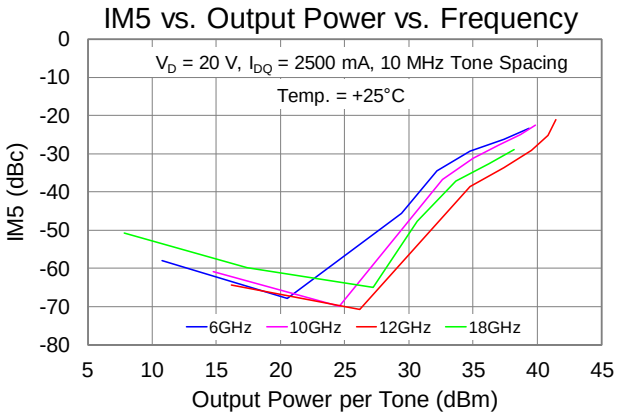


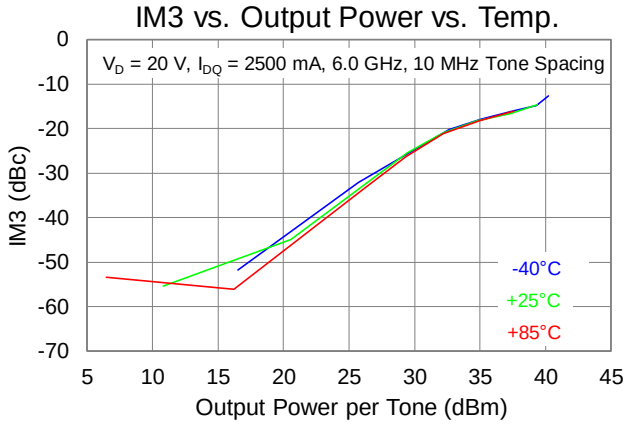


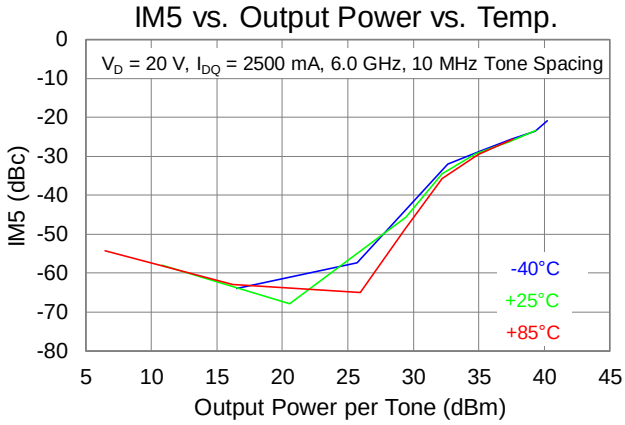


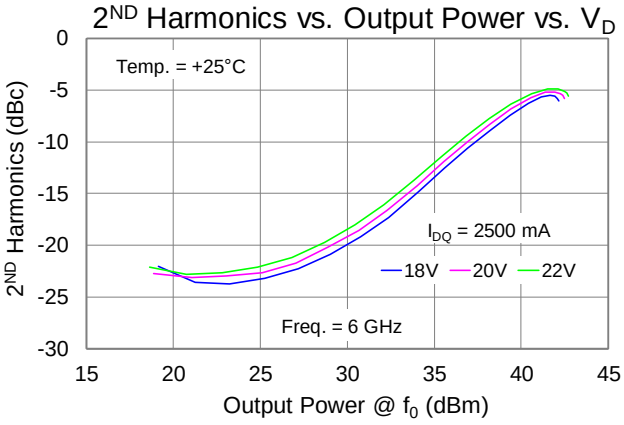
Typical Performance (Linearity)

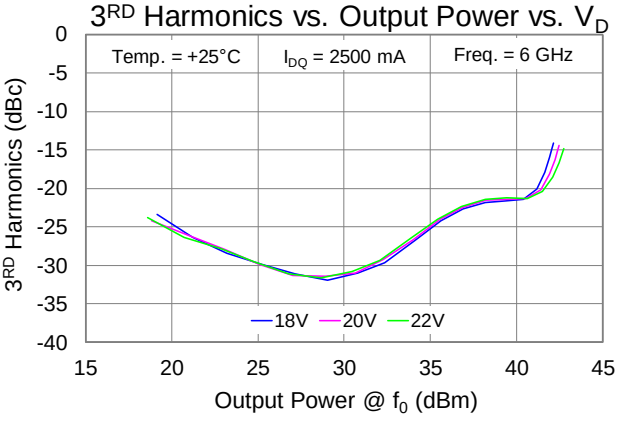




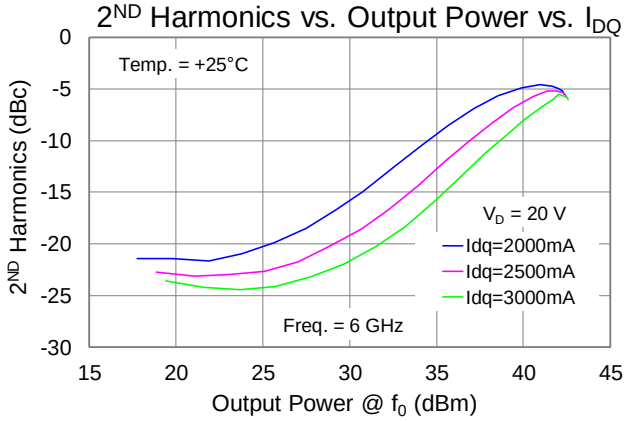


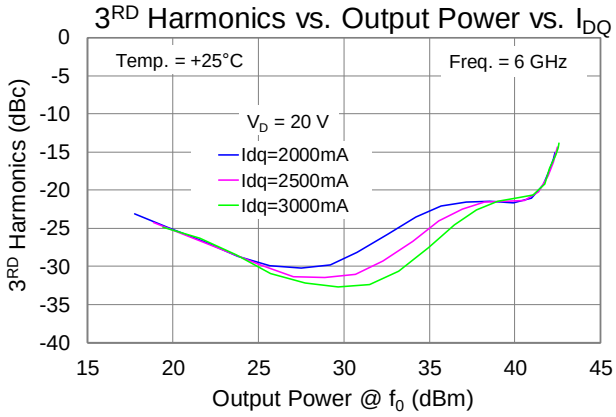


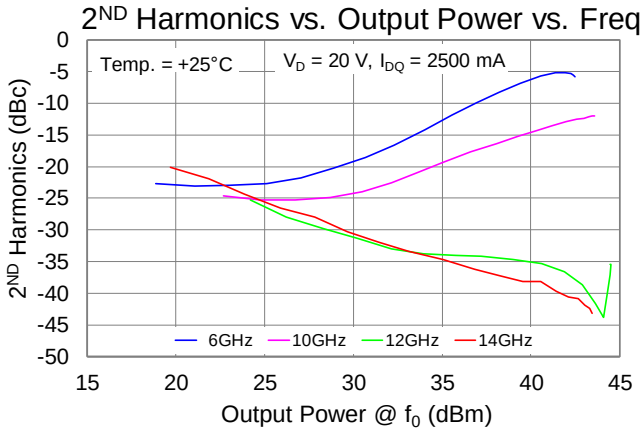


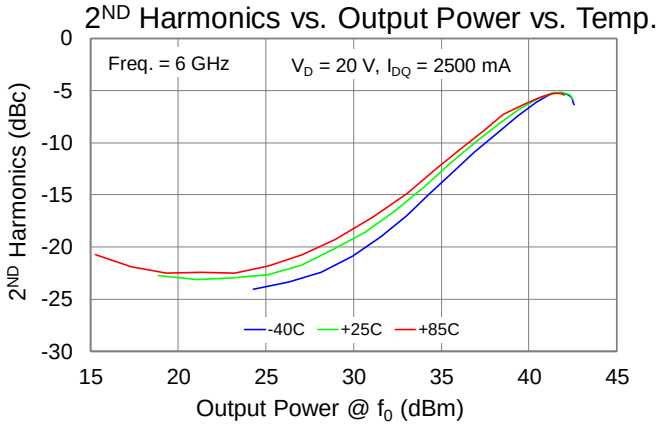


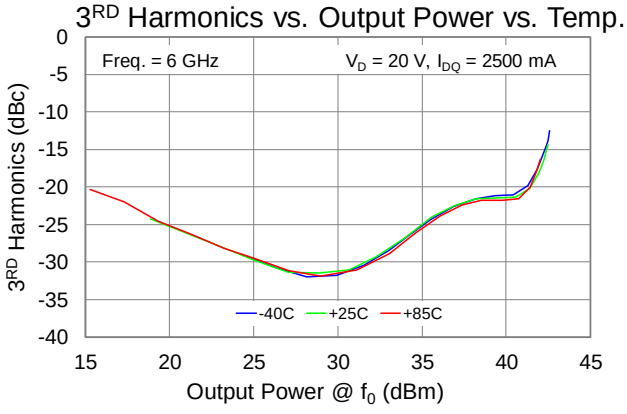
Typical Performance (Linearity)









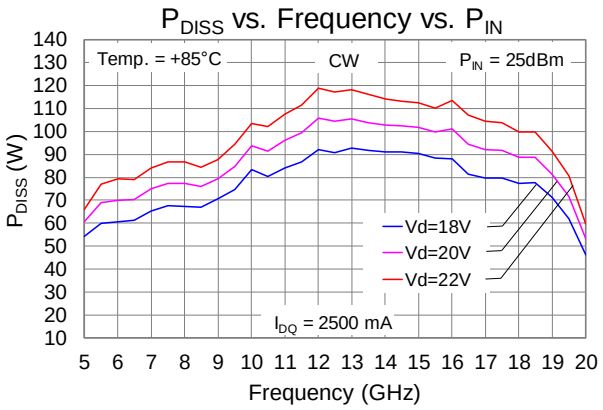


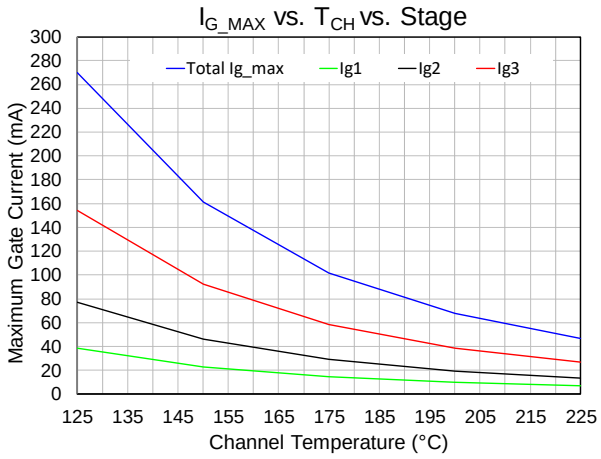
Thermal and Reliability Information

Parameter	Test Conditions	Value	Units
Thermal Resistance (θ_{JC}) (1)	T_{base} = 85 °C, CW, V_D = 20 V, I_{DQ} = 2500 mA P_{DISS} = 50 W	0.86	ºC/W
Channel Temperature (T_{CH}) (No RF drive)		128.2	°C
Thermal Resistance (θ_{JC}) (1)	T_{base} = 85 °C, V_D = 20 V, I_{DQ} = 2500 mA, CW I_{D_Drive} = 6.6 A, Freq = 12 GHz. P_{IN} = 25 dBm, P_{OUT} = 45 dBm, P_{DISS} = 106 W	0.99	ºC/W
Channel Temperature (T_{CH}) (Under RF drive)		189.4	°C

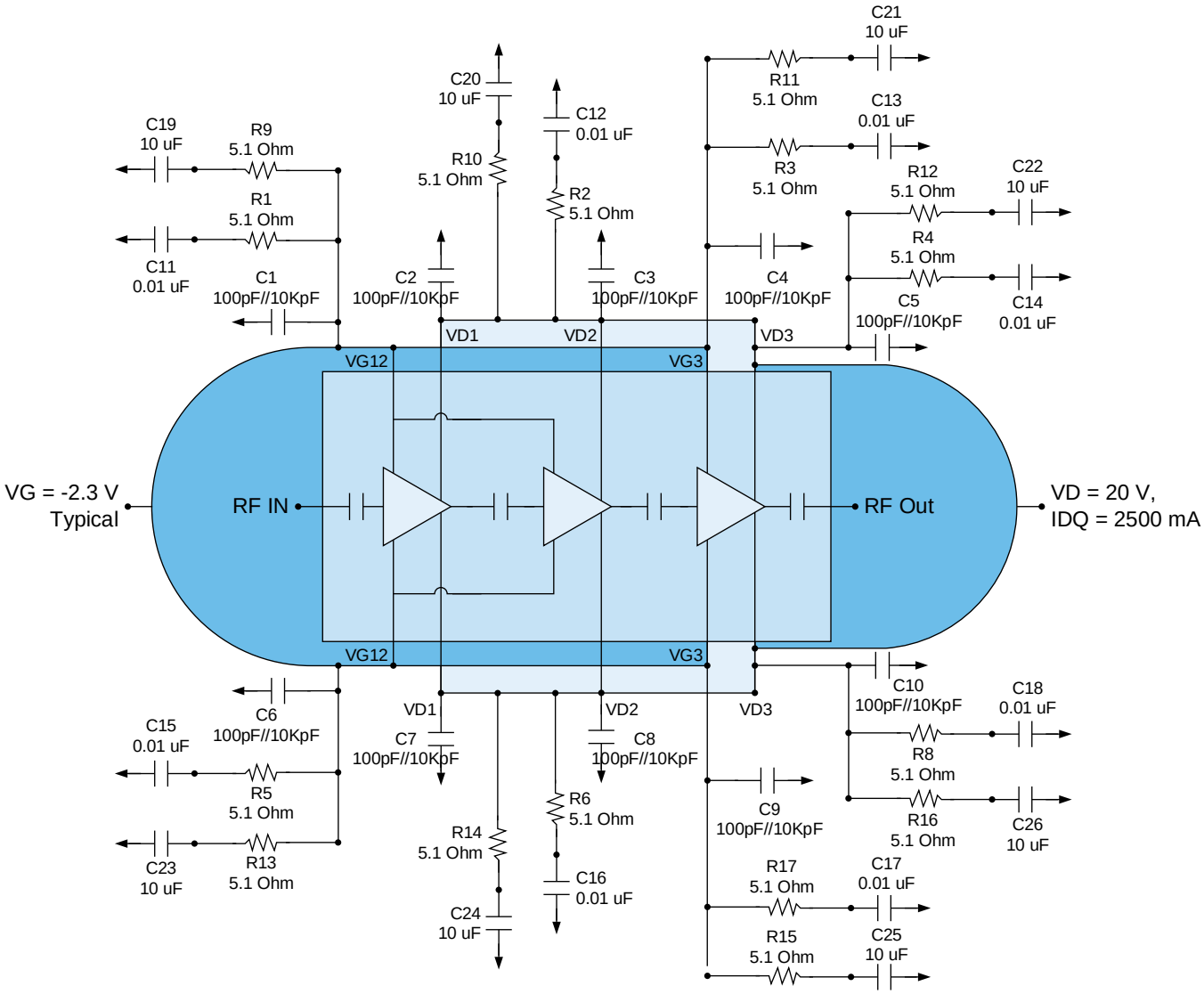
Notes:
1. Thermal resistance measured to back of carrier plate. MMIC mounted on copper-moly carrier using eutectic die attach.
2. Refer to the following document: GaN Device Channel Temperature, Thermal Resistance, and Reliability Estimates.

Dissipated Power and Maximum Gate Current





Application Circuit



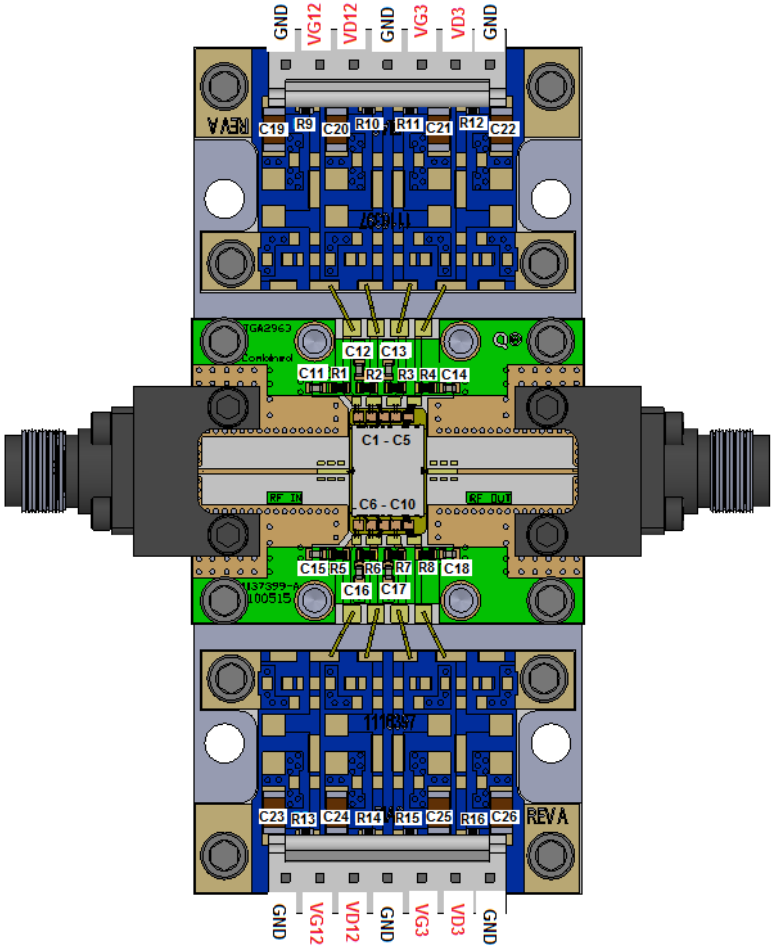
Bias-up Procedure

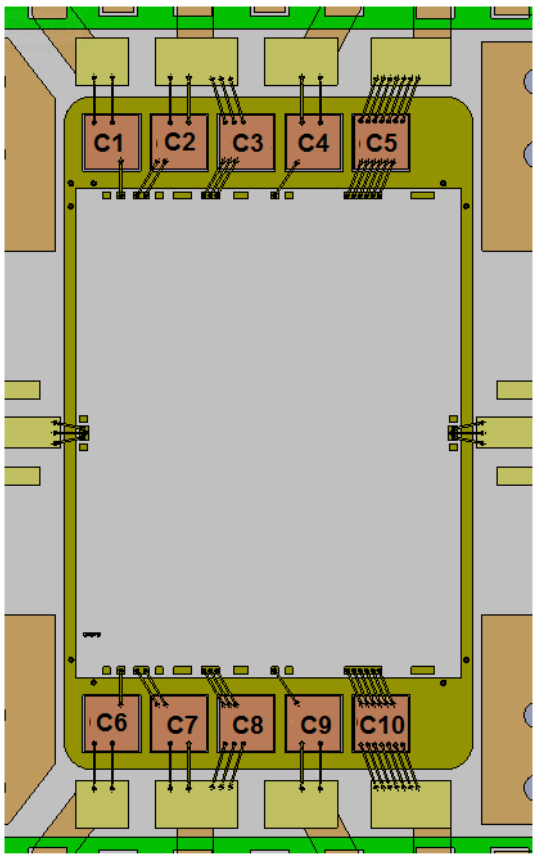
1. Set I_D limit to 8 A, I_G limit to 50 mA
2. Set V_G to -5.0 V
3. Set V_D +20 V
4. Adjust V_G more positive until I_{DQ} = 2500 mA (V_G ~ -2.3 V Typical)
5. Apply RF signal

Bias-down Procedure

1. Turn off RF signal
2. Reduce V_G to -5.0 V. Ensure I_{DQ} ~ 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 Assembly





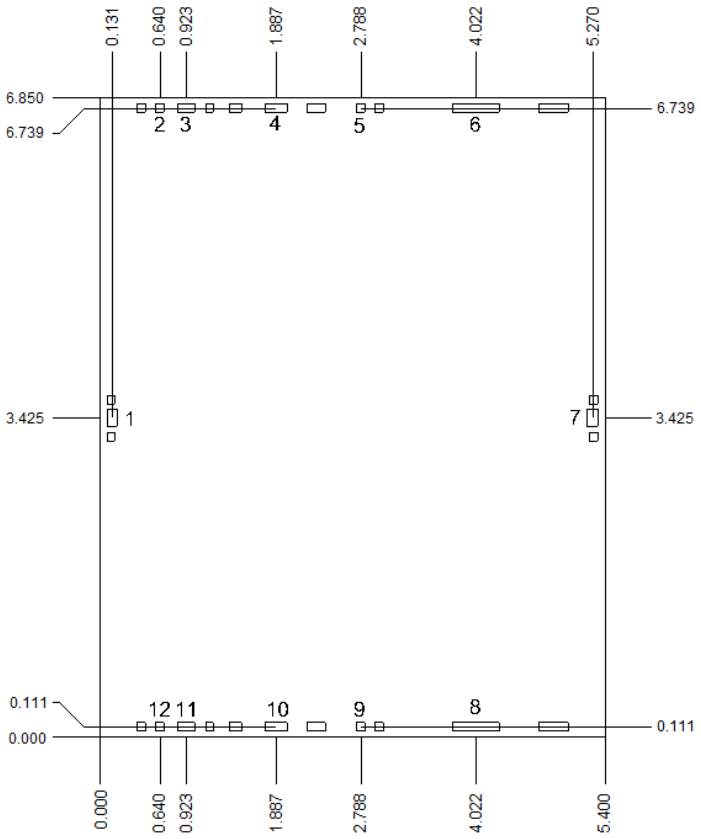
MMIC mounting/wire bonding detail

Notes: The MMIC must be biased from both sides top and bottom.

Bill of Materials

Reference Design	Value	Description	Manuf.	Part Number
C1 – C10	100 pF/10k pF	Cap, 30 x 30, 50 V, Single Layer	Various	
C11 – C18	0.01 uF	Cap, 0402, 50 V, 10%, X7R	Various	
C19 – C26	10 uF	Cap, 1206, 50 V, 20%, X5R	Various	
R1 – R16	5.1 Ω	Res, 0402, 50 V, 5%, SMT	Various	

Mechanical Drawing & Bond Pad Description



Unit: millimeters
Thickness: 0.10
Die x, y size tolerance: +/- 0.050
Chip edge to bond pad dimensions are shown to center of pad
Ground is backside of die

Bond Pad	Symbol	Pad Size	Description
1	RF In	0.115 x 0.190	RF Input; matched to 50 Ω; DC blocked.
2, 12	VG12	0.090 x 0.090	Gate voltage 1-2, bias network is required; see Application Circuit as an example.
3, 11	VD1	0.190 x 0.090	Drain voltage 1, bias network is required; see Application Circuit as an example.
4, 10	VD2	0.235 x 0.090	Drain voltage 2, bias network is required; see Application Circuit as an example.
5, 9	VG3	0.090 x 0.090	Gate voltage 3, bias network is required; see Application Circuit as an example.
6, 8	VD3	0.508 x 0.090	Drain voltage 3, bias network is required; see Application Circuit as an example.
7	RF Out	0.115 x 0.190	RF Output; matched to 50 Ω; DC blocked.

Assembly Notes

Component placement and adhesive attachment assembly notes:

- Vacuum pencils and/or vacuum collets are the preferred method of pick up.
- Air bridges must be avoided during placement.
- The force impact is critical during auto placement.

Reflow process assembly notes:

- Use AuSn (80/20) solder and limit exposure to temperatures above 300 °C to 3-4 minutes, maximum.
- An alloy station or conveyor furnace with reducing atmosphere should be used.
- Do not use any kind of flux.
- Coefficient of thermal expansion matching is critical for long-term reliability.
- Devices must be stored in a dry nitrogen atmosphere.

Interconnect process assembly notes:

- Thermosonic ball bonding is the preferred interconnect technique.
- Force, time, and ultrasonic are critical parameters.
- Aluminum wire should not be used.
- Devices with small pad sizes should be bonded with 0.0007-inch wire.

Handling Precautions

Parameter	Rating	Standard
ESD – Human Body Model (HBM)	1A	ANSI/ESD/JEDEC JS-001

Caution!

ESD-Sensitive Device

Solderability

Use only AuSn (80/20) solder, and limit exposure to temperatures above 300 °C to 3 – 4 minutes, maximum.

RoHS Compliance

This part is compliant with 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 (C15H12Br402) 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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