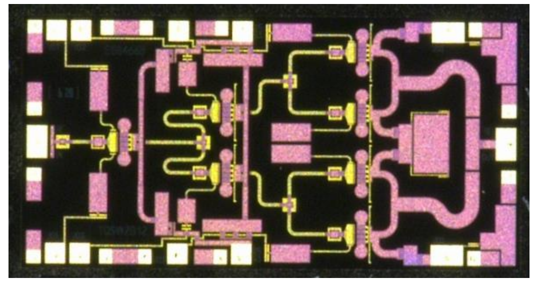
TGA2594

27 – 31 GHz 5 W GaN Power Amplifier



Product Description

Qorvo's TGA2594 is a Ka-band power amplifier fabricated on Qorvo's 0.15 um GaN on SiC process. Operating from 27 to 31 GHz, it achieves 5W saturated output power with an efficiency of 28 % PAE, and 23 dB small signal gain. Along with excellent linear characteristics, the TGA2594 is ideally suited to support both commercial and defense related satellite communications.

To simplify system integration, the TGA2594 is fully matched to 50 ohms with integrated DC blocking caps on both I/O ports.

The TGA2594 is 100 % DC and RF tested on-wafer to ensure compliance to electrical specifications.

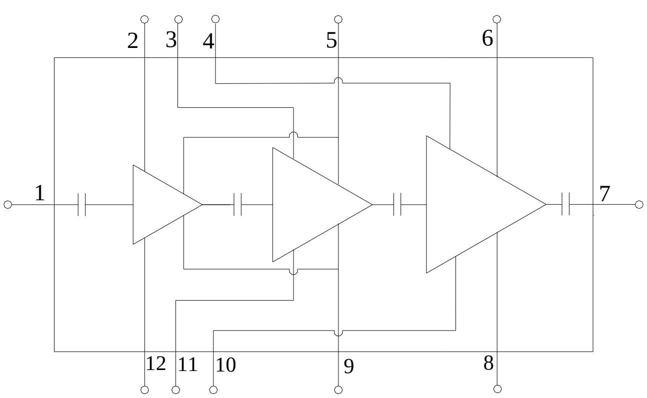
Lead-free and RoHS compliant.

Product Features

- Frequency Range: 27 to 31 GHz
- P_{OUT}: 36.5 dBm (P_{IN} = 18 dBm), CW
- PAE: 28 % (P_{IN} = 18 dBm), CW
- Small Signal Gain: 23 dB
- Return Loss: 10 dB
- IM3 @ 25 dBm/tone: −35 dBc
- IM5 @ 25 dBm/tone: −45 dBc
- Bias: V_D = +20 V, I_{DQ} = 140 mA, $V_G \approx$ −2.5 V Typical
- Chip Dimensions: 3.24 x 1.74 x 0.10 mm

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

Functional Block Diagram



Applications

- Satellite Communications

Ordering Information

Part No.	Description
TGA2594	27 – 31GHz 5W GaN Power Amplifier
TGA2594S2	Samples (2 pcs. pack)
TGA2594EVB	Evaluation Board for TGA2594

Absolute Maximum Ratings

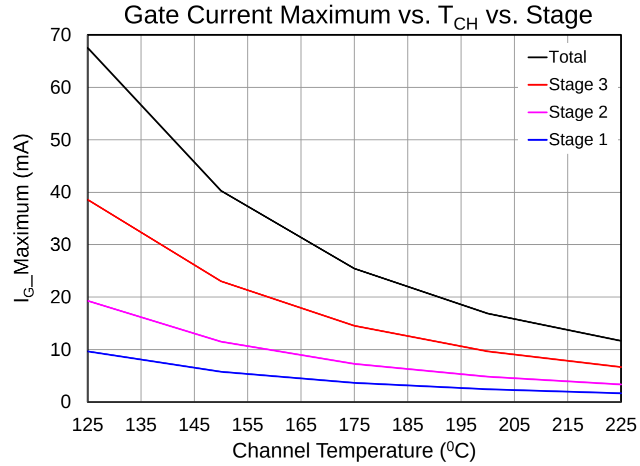
Parameter	Value / Range
Drain Voltage (V_D)	29.5
Gate Voltage Range (V_G)	−5 to 0 V
Drain Current (I_D)	1.4 A
Gate Current (I_G)	See chart
Power Dissipation (P_{DISS}), CW, 85°C	22 W
Input Power (P_{IN}), CW, 50 Ω, V_D=22 V, I_{DQ}=280 mA, 85 °C	30 dBm
Input Power (P_{IN}), CW, 10:1 VSWR, V_D=22 V , I_{DQ}=280 mA, 25 °C	25 dBm
Channel Temperature (T_{CH})	275 °C
Mounting Temperature (30 seconds)	320 °C
Storage Temperature	−40 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	Min	Typ	Max	Units
Drain Voltage (V_D)		+20		V
Drain Current, Quiescent (I_{DQ})		140		mA
Drain Current, RF (I_{D_Drive})		See charts page 6		mA
Gate Voltage Typ. Range (V_G)		−2 to −3		V
Operating Temp. Range	−40	+25	+85	°C

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



Electrical Specifications

Parameter	Conditions [(1) (2)]	Min	Typ	Max	Units
Operational Frequency Range		27		31	GHz
Output Power at Saturation, P_{SAT}	P_{IN} = +18 dBm	34.6	36.5		dBm
Power Added Efficiency, PAE	P_{IN} = +18 dBm		28		%
Small Signal Gain, S21			23		dB
Input Return Loss, IRL			10		dB
Output Return Loss, ORL			8		dB
3RD Intermodulation Products, IM3	$P_{OUT/TONE}$ = +25 dBm, Tone Spacing = 1 MHz		−35		dBc
5th Intermodulation Products, IM5	$P_{OUT/TONE}$ = +25 dBm, Tone Spacing = 1 MHz		−45		dBc
P_{SAT} Temperature Coefficient	T_{DIFF} = +25°C to +85°C; P_{IN} = +22 dBm		−0.01		dBm/°C
S21 Temperature Coefficient	T_{DIFF} = −40°C to +85°C		−0.09		dB/°C

Notes:
1. Test conditions unless otherwise noted: CW, V_D = +20 V, I_{DQ} = 140 mA, V_G = -2.5 V +/- 0.5 V typical , T_{BASE} = +25 °C, Z_0 = 50 Ω
2. T_{BASE} is back side of carrier plate

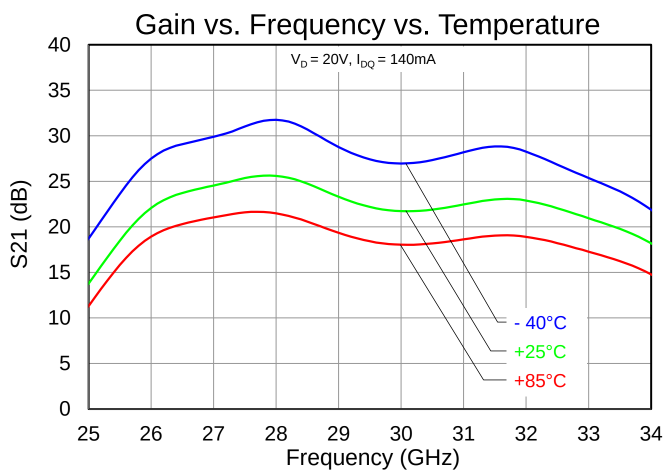
Thermal and Reliability Information

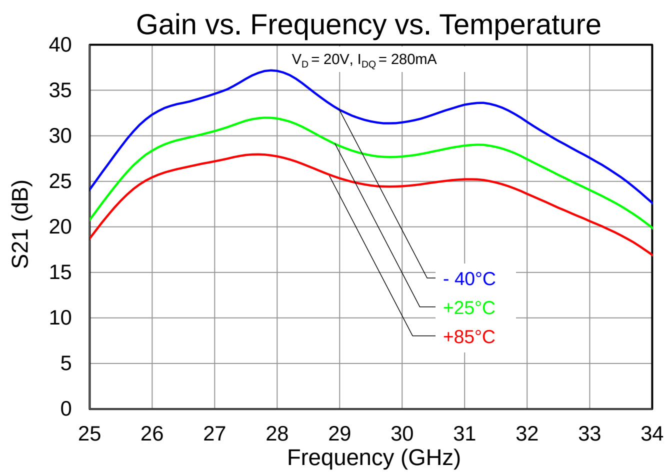
Parameter	Test Conditions	Value	Units
Thermal Resistance (θ_{JC})	For I_{DQ} = 140 mA: T_{BASE} = 85 °C, V_D = +20 V, I_{D_Drive} = 870 mA, Frequency = 28 GHz, P_{IN} = 18 dBm, P_{OUT} = 36.2 dBm, P_{DISS} = 13.3 W	5.64	ºC/W
Channel Temperature (T_{CH}) under RF Drive		160	°C

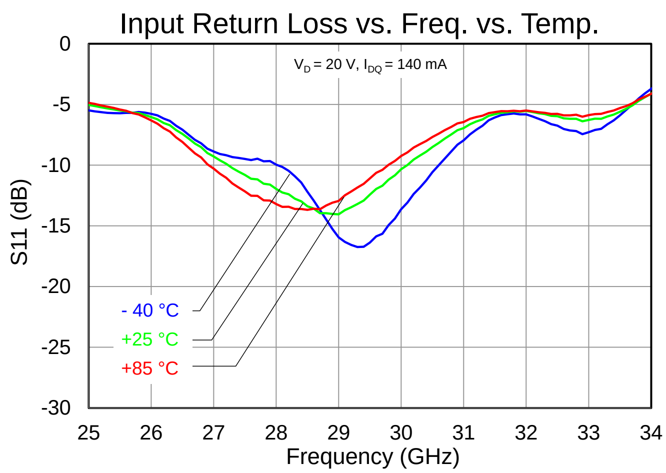
Notes:
1. Thermal resistance measured to back of carrier plate. MMIC mounted on 20 mils CuMo carrier using 1.5 mil 80/20 AuSn.
2. Channel temperature indicated is an IR scan equivalent temperature. Thermal resistance is calculated using this value. Additional information can be found in the Qorvo Applications Note "GaN Device TCHMAX Theta-JC and Reliability Estimates," located here https://www.qorvo.com/products/d/da006480

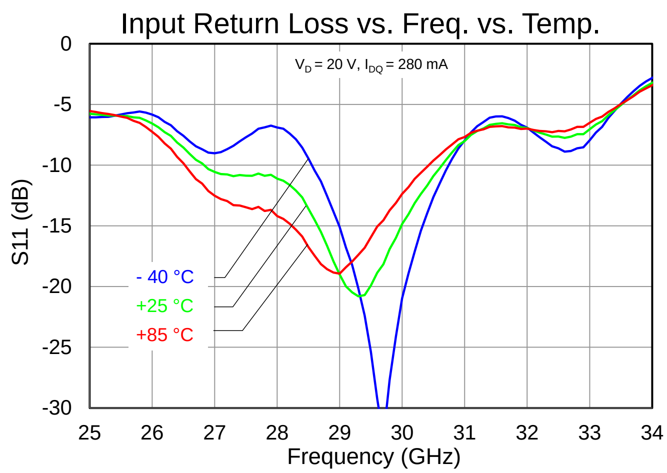
Typical Performance – Small Signal

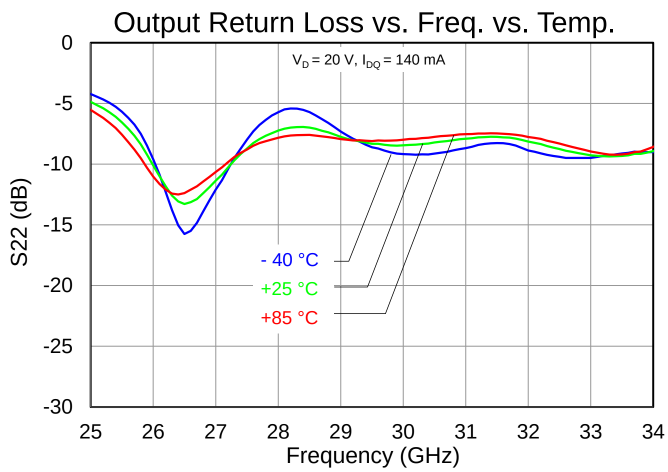
Test conditions unless otherwise noted: CW, V_D = +20 V, I_{DQ} = 140mA and 280mA, T_{BASE} =+25 °C

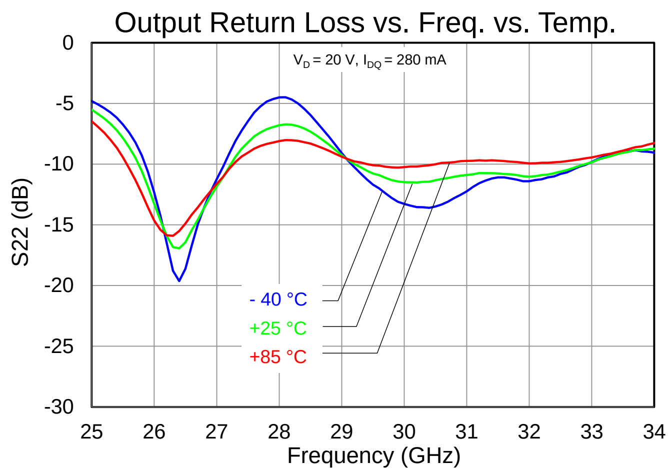






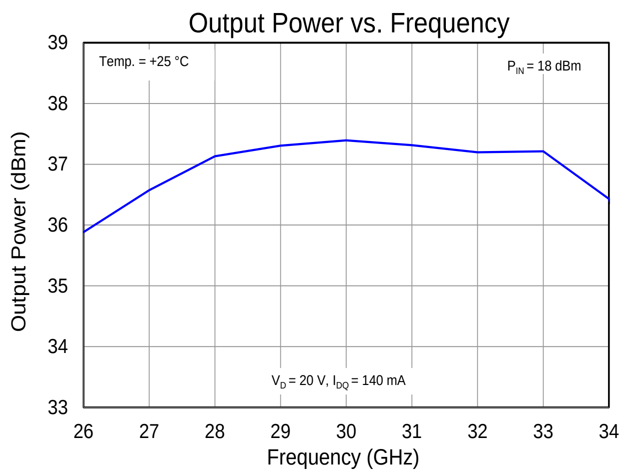


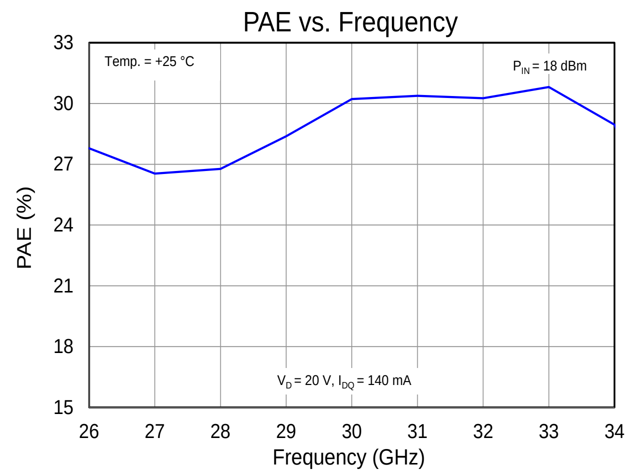


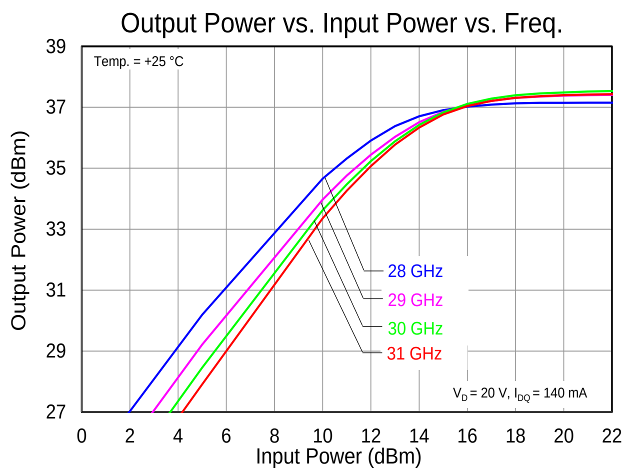


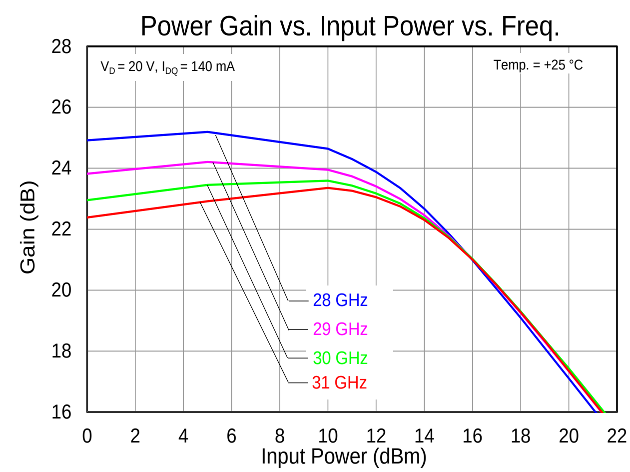
Typical Performance – Large Signal

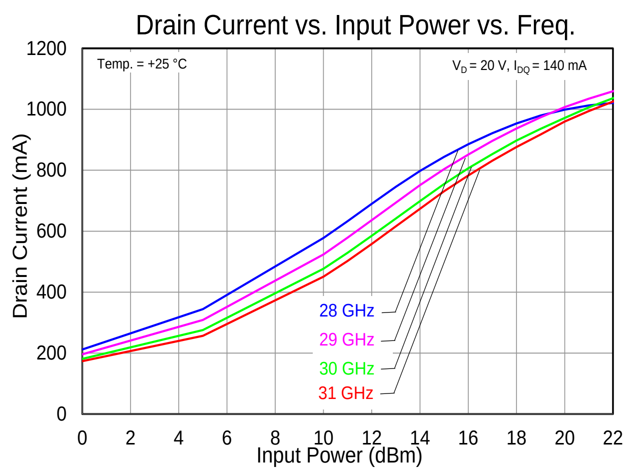
Test conditions unless otherwise noted: CW, V_D = +20 V, I_{DQ} = 140 mA, T_{BASE} =+25 °C





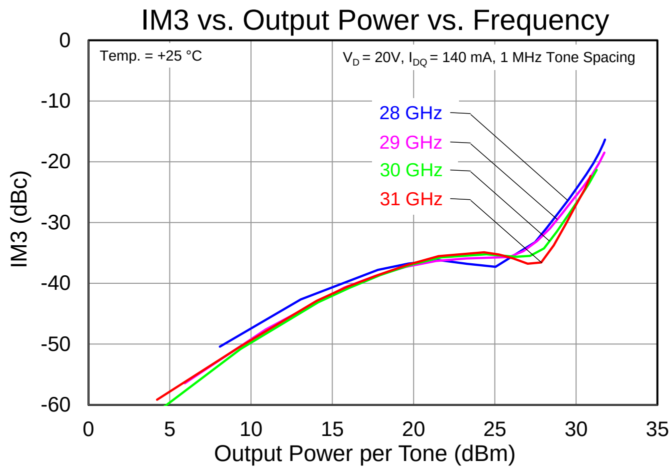


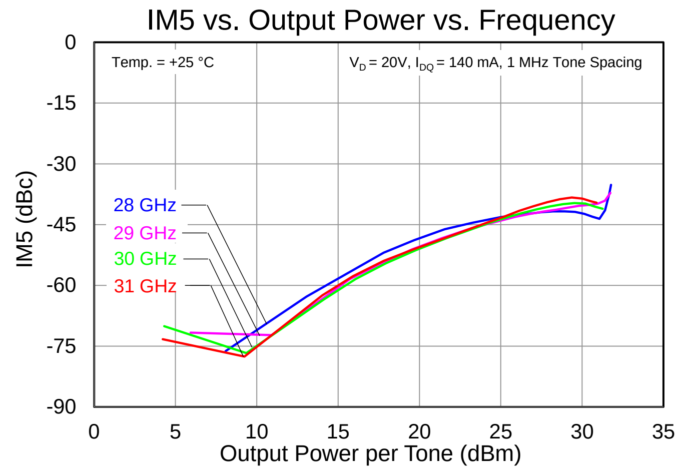


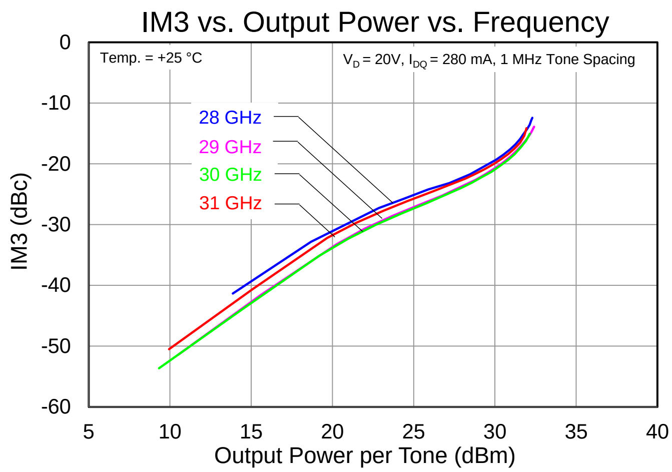


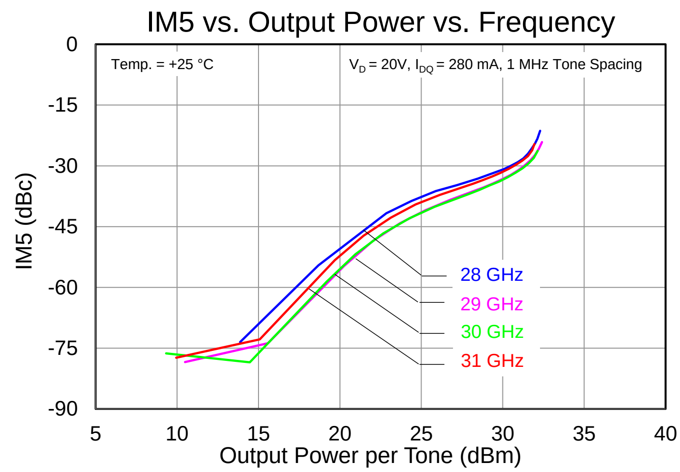
Typical Performance – Linearity

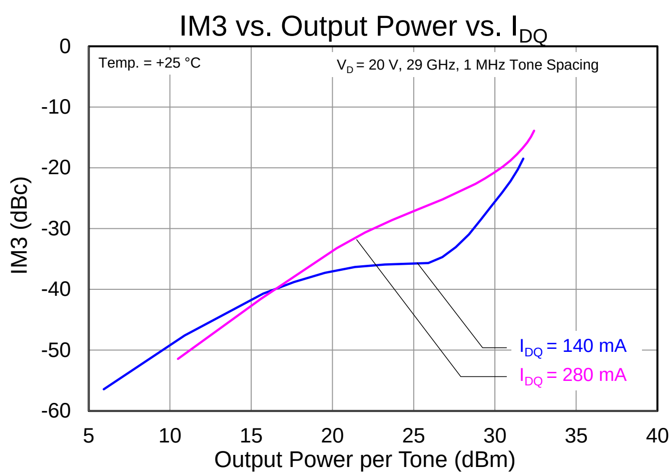
Test conditions unless otherwise noted: CW, V_D = +20 V, I_{DQ} = 140 mA, Tone Spacing = 1 MHz, T_{BASE} =+25 °C

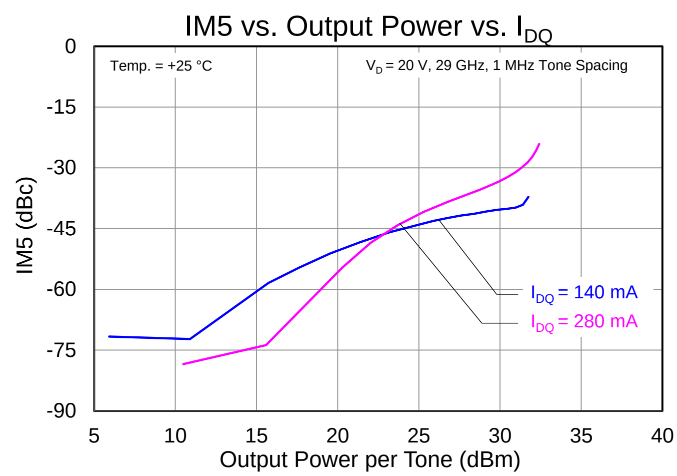






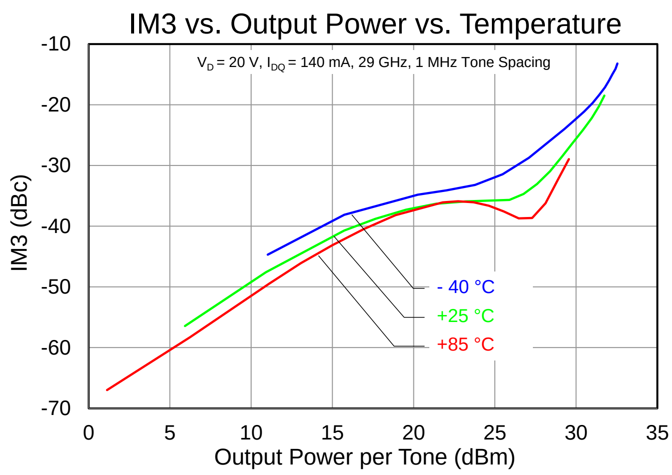


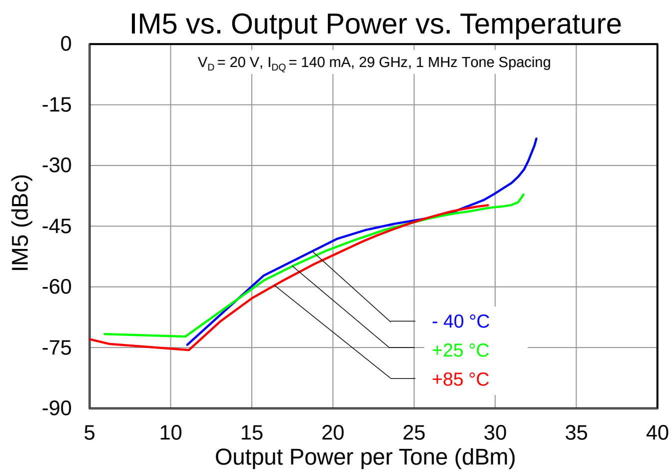


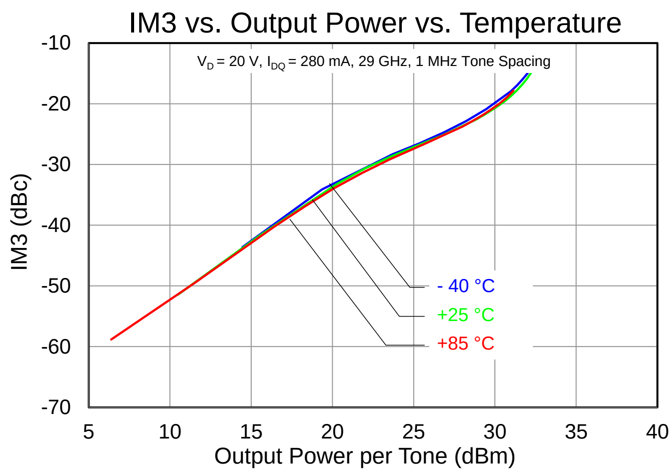


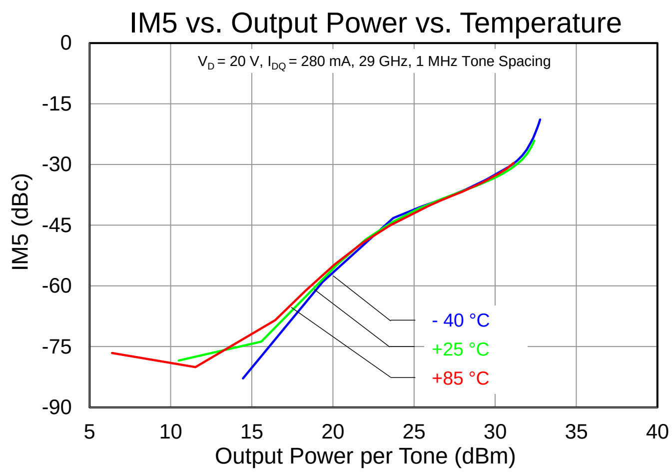
Typical Performance – Linearity (cont.)

Test conditions unless otherwise noted: CW, V_D = +20 V, I_{DQ} = 140 mA, Tone Spacing = 1 MHz, T_{BASE} =+25 °C

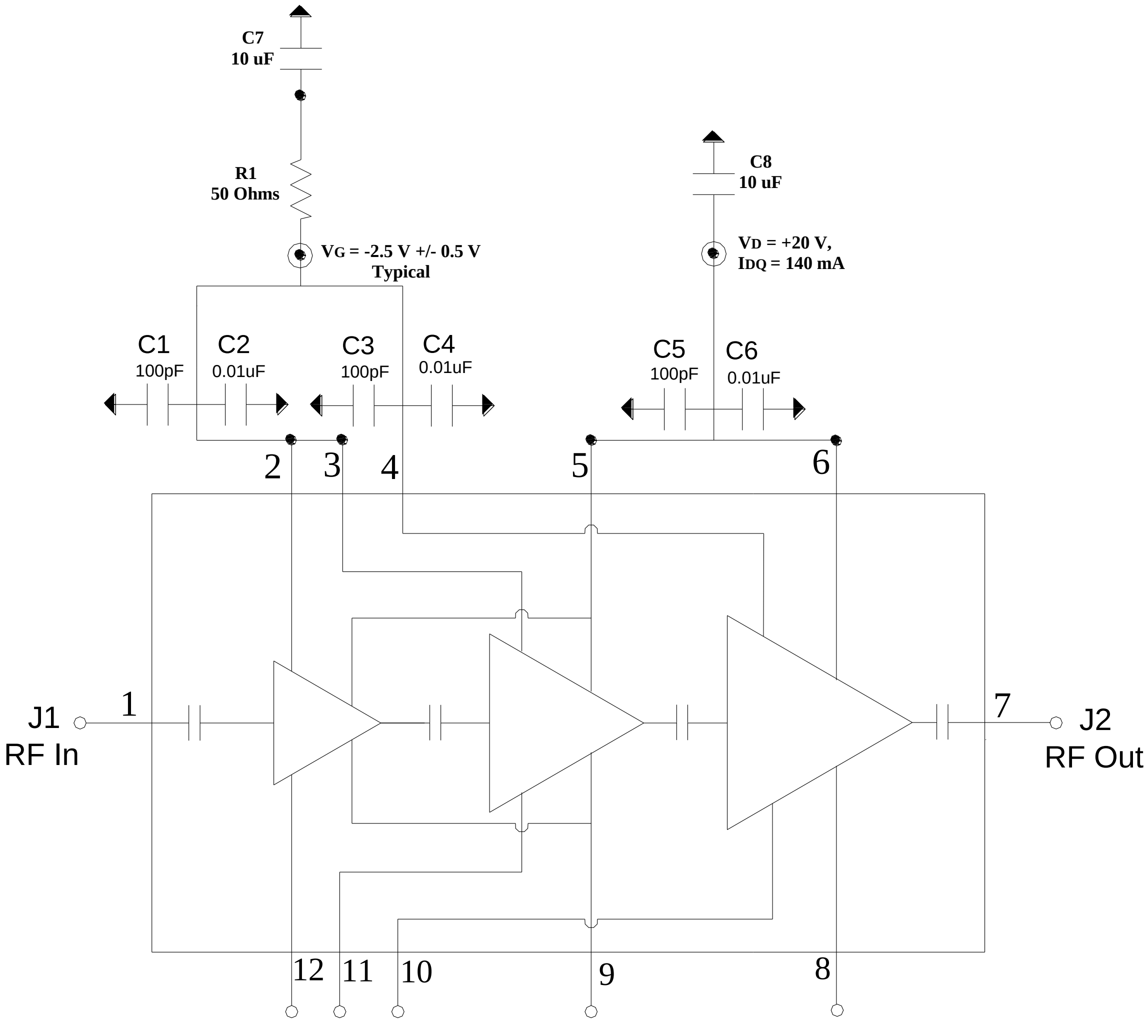








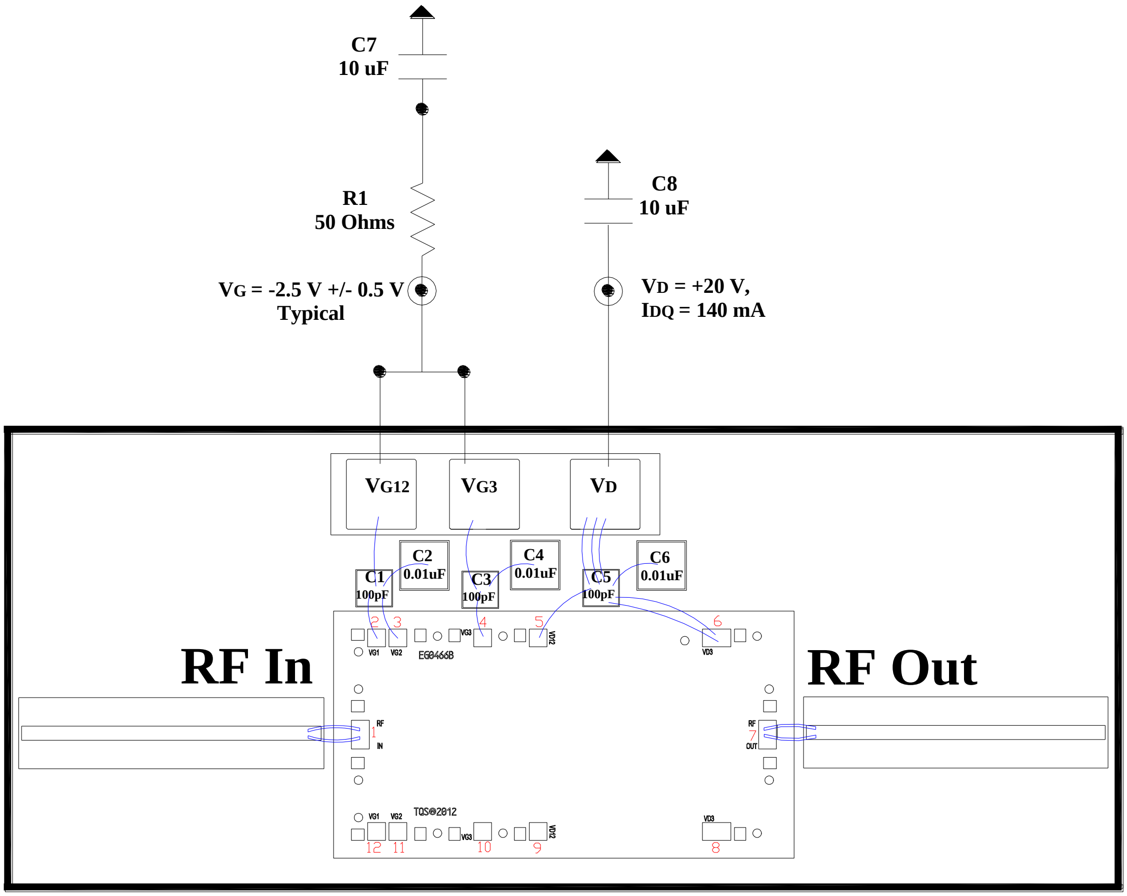
Application Circuit



Bias Up Procedure
1. Set I_D limit to 1.2 A, I_G limit to 10 mA
2. Apply −5 V to V_G (Combine all V_G's together)
3. Apply +20 V to V_D (Combine all V_D's together)
4. Adjust V_G until I_{DQ} = 140 mA (V_G ~ -2.5 V +/- Typ.)
5. Apply RF supply

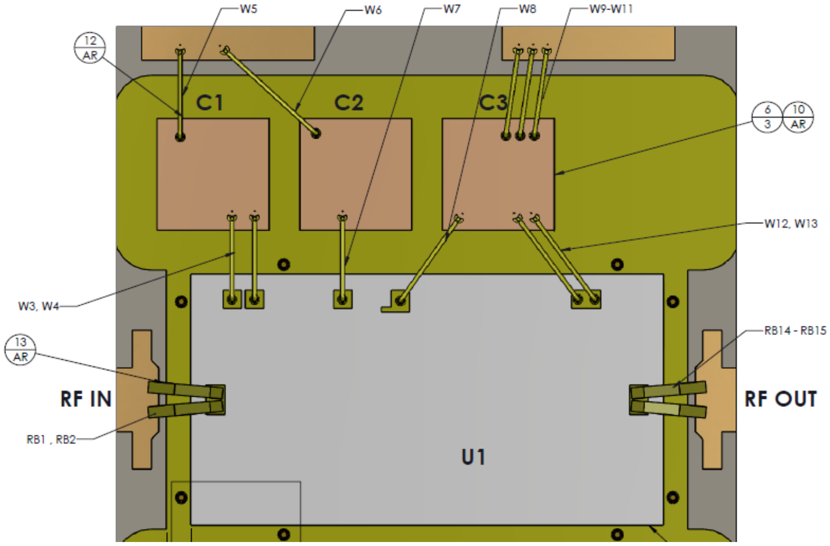
Bias Down Procedure
1. Turn off RF signal
2. Reduce V_G to −5 V; ensure I_{DQ} is approx. 0 mA
3. Set V_D to 0 V
4. Turn off V_D supply
5. Turn off V_G supply

Assembly Drawing

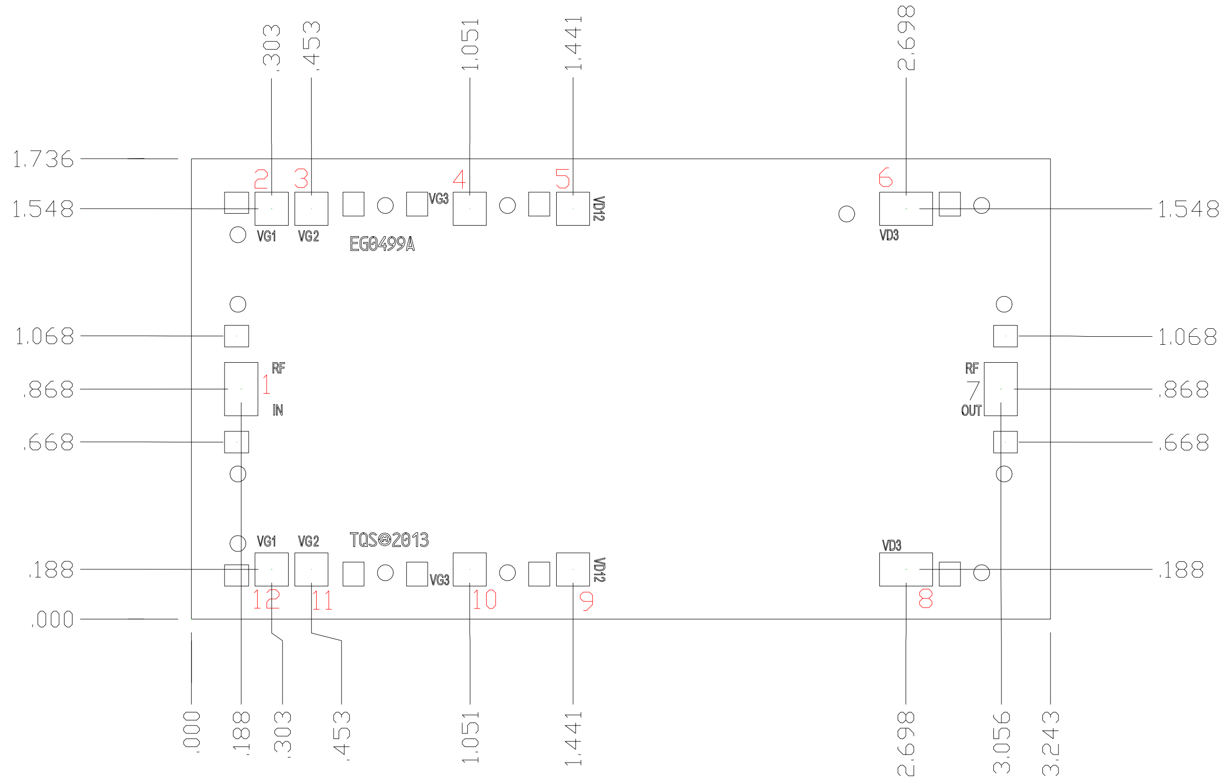


Notes: Minimize RF wirebond lengths to achieve optimum return loss. Options in order of preference are:

1. Short w = 5mil ribbon bonds
2. Multiple short wedge or chisel bonds
3. Multiple ball bonds



Mechanical Drawing



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 Description

Pad No.	Symbol	Pad Size	Description
1	RF In	0.125 x 0.200	Input; matched to 50 Ω; DC blocked.
2, 12	V_{G1}	0.125 x 0.125	Gate voltage, V_{G1} top and bottom. Bias network is required; see Application Circuit on page 8 as an example.
3, 11	V_{G2}	0.125 x 0.125	Gate voltage, V_{G2} top and bottom. Bias network is required; see Application Circuit on page 8 as an example.
4, 10	V_{G3}	0.125 x 0.125	Gate voltage, V_{G1} top and bottom. Bias network is required; see Application Circuit on page 8 as an example.
5, 9	V_{D12}	0.125 x 0.125	Drain voltage, V_{D12} top and bottom. Bias network is required; see Application Circuit on page 8 as an example.
6, 8	V_{D3}	0.200 x 0.125	Drain voltage, V_{D3} top and bottom. Bias network is required; see Application Circuit on page 8 as an example.
7	RF Out	0.125 x 0.200	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
ESD – Charged Device Model (CDM)	C3	ANSI/ESD/JEDEC JS-002

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 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
- Halogen Free (Chlorine, Bromine)
- Antimony Free
- TBBP-A ($C_{15}H_{12}Br_{4}0_{2}$) 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**

Important Notice