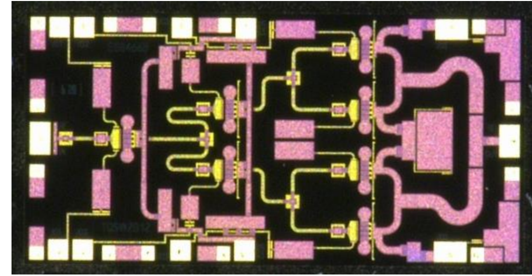
TGA2594

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.

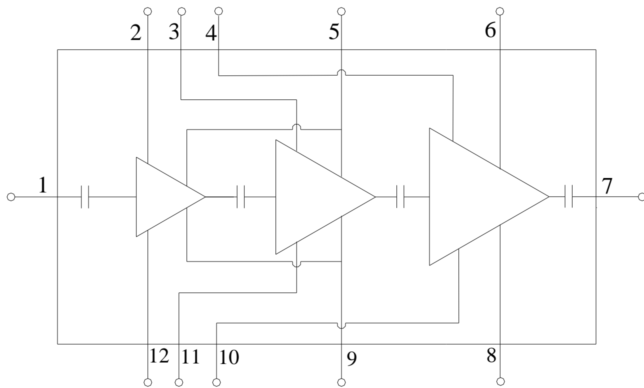
Lead-free and RoHS compliant.

Evaluation Boards are available upon request.

Product Features

- Frequency Range: 27 – 31GHz
- P_{SAT}: 37 dBm (typical across frequency)
- PAE: 28 %
- Small Signal Gain: 23 dB
- Input Return Loss: 10 dB
- IM3 @ 25 dBm / tone: −36 dBc
- IM5 @ 25 dBm / tone: −45 dBc
- Bias: V_D = +20 V, I_{DQ} = 140 mA, V_G = −3.0 V Typical
- Chip Dimensions: 3.24 x 1.74 x 0.10 mm

Functional Block Diagram



Applications

- Satellite Communications

Ordering Information

Part No.	ECCN	Description
TGA2594	3A001.b.2.c	27 – 31 GHz 5 W GaN Power Amplifier

Absolute Maximum Ratings

Parameter	Value / Range
Drain Voltage (V_D)	+29.5 V
Gate Voltage Range (V_G)	−5 to 0 V
Drain Current (I_D)	1400 mA
Gate Current (I_G)	−2.8 to 16.5 mA
Power Dissipation, 85 °C (P_{DISS})	22 W
Input Power, CW, 50 Ω, 85 °C, (P_{IN})	30 dBm
Input Power, CW, 10:1 VSWR, (P_{IN})	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

Parameter	Value / Range
Drain Voltage (V_D)	+20 V
Drain Current (I_{DQ})	140 mA
Gate Voltage (V_G)	−3.0 V Typical

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	27	–	31	GHz
Small Signal Gain	–	23	–	dB
Input Return Loss	–	10	–	dB
Output Return Loss	–	8	–	dB
Output Power @ P_{IN} = 18 dBm	–	37	–	dBm
Power Added Efficiency @ P_{IN} = 18 dBm	–	28	–	%
IM3 @ 25 dBm / tone	–	−36	–	dBc
IM5 @ 25 dBm / tone	–	−45	–	dBc
Small Signal Gain Temperature Coefficient	–	−0.09	–	dB/°C

Test conditions unless otherwise noted: 250 °C, V_D = +20 V, I_{DQ} = 140 mA, V_G = −3.0 V Typical

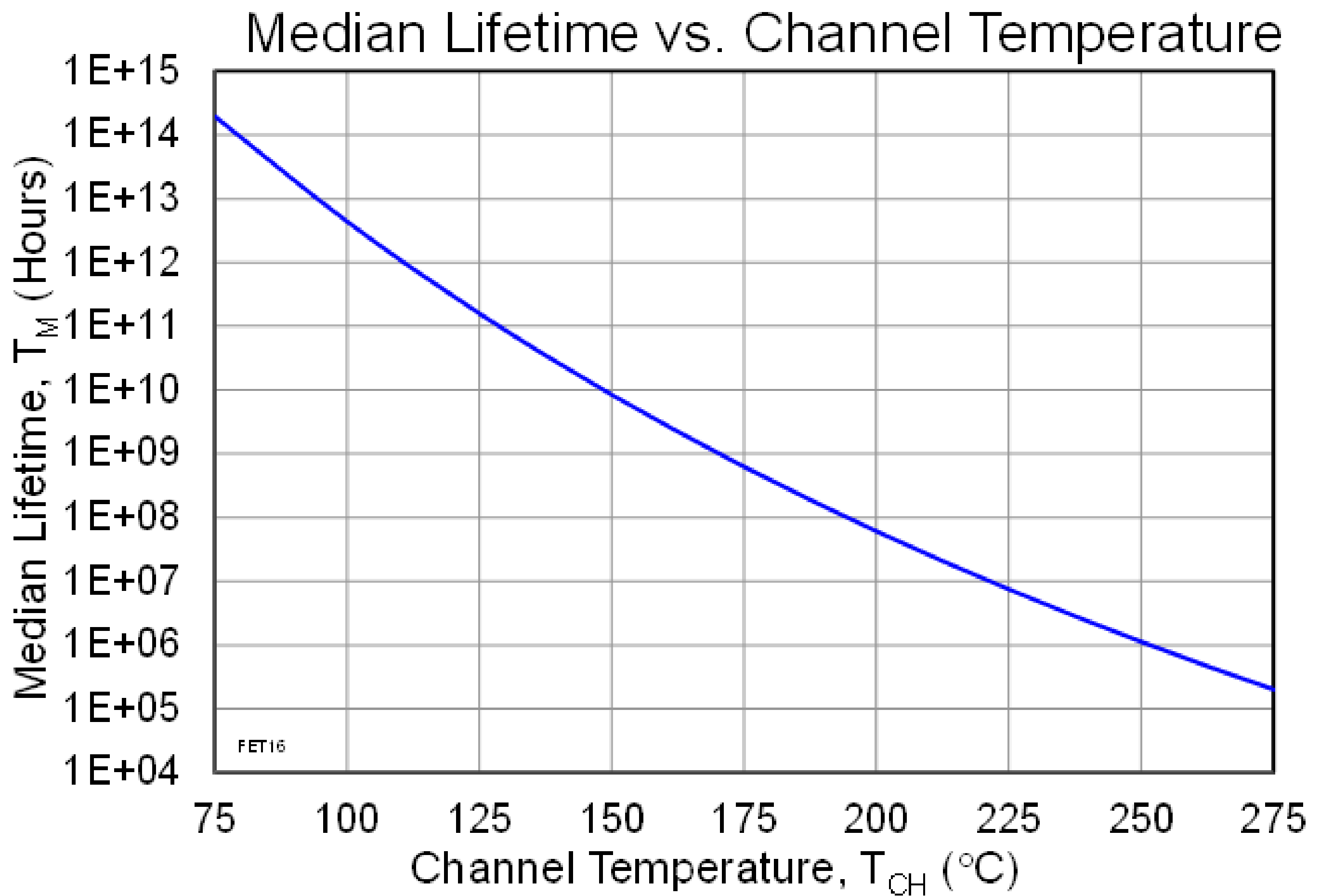
Thermal and Reliability Information

Parameter	Test Conditions	Value	Units
Thermal Resistance (θ_{JC}) [1]	T_{base} = 85 °C, V_D = +20 V, I_{D_Drive} = 720 mA, P_{OUT} = 35.8 W, P_{DISS} = 10.5 W	8.7	ºC/W
Channel Temperature, T_{CH} (Under RF Drive)		176	°C
Median Lifetime, T_M (Under RF Drive)		2.76 x 10^10	Hrs

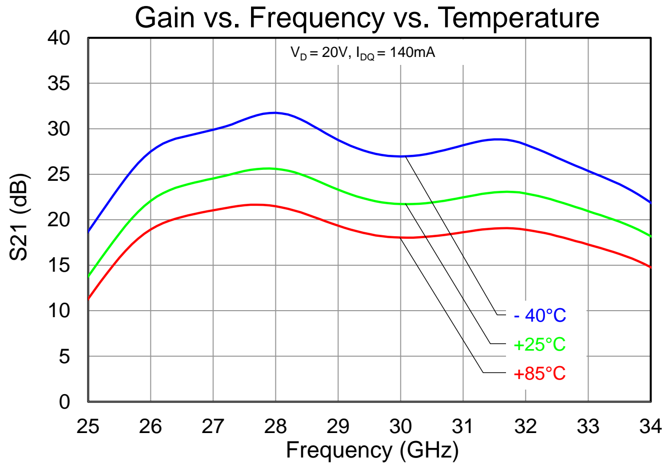
Notes:
1. Thermal resistance measured to back of carrier plate. MMIC mounted on 20 mils CuMo carrier using 1.5 mil 80/20 AuSn.

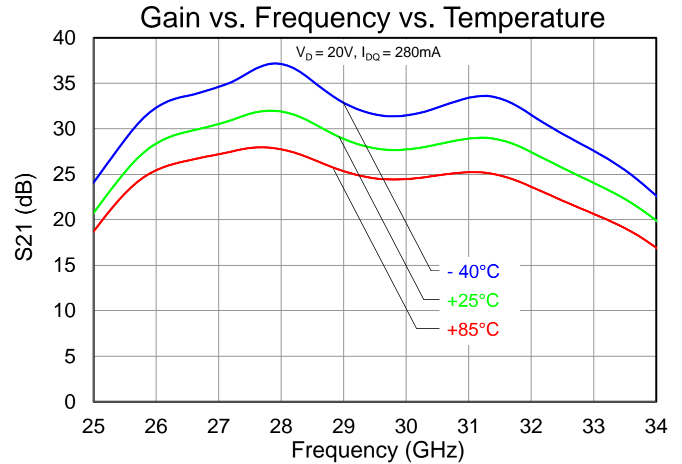
Median Lifetime

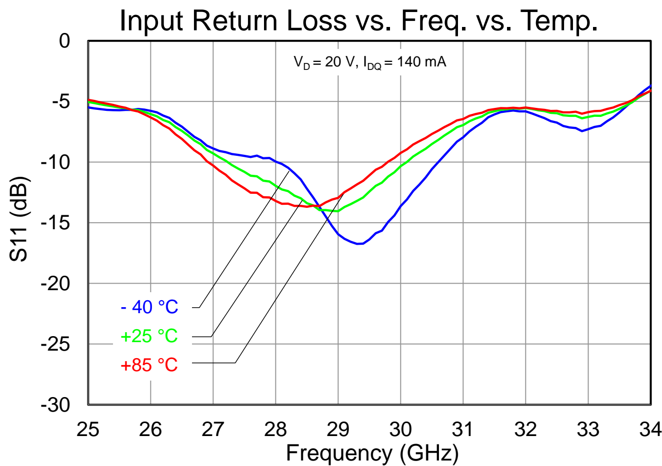
Test Conditions: V_D = +28 V; Failure Criteria = 10 % reduction in ID_MAX

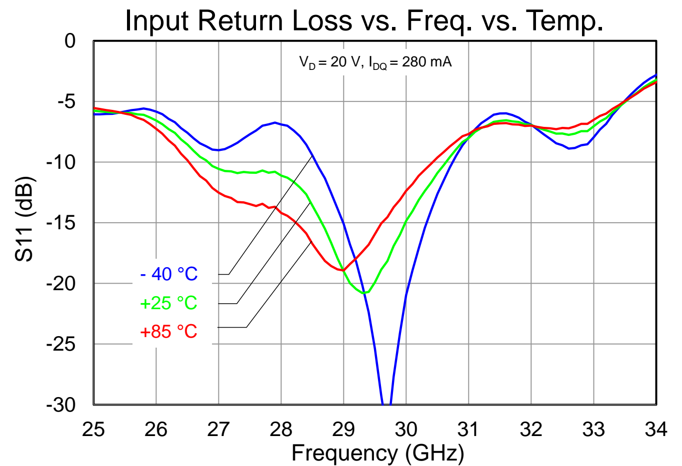


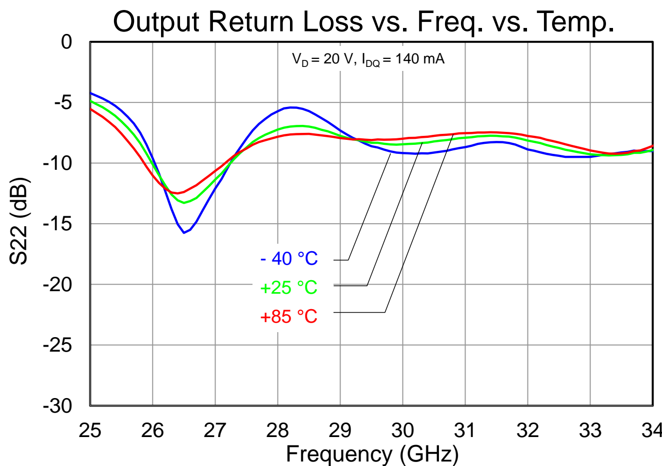
Typical Performance

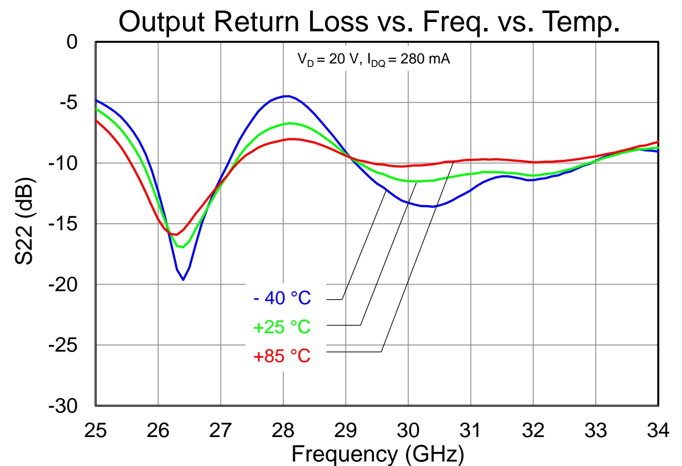












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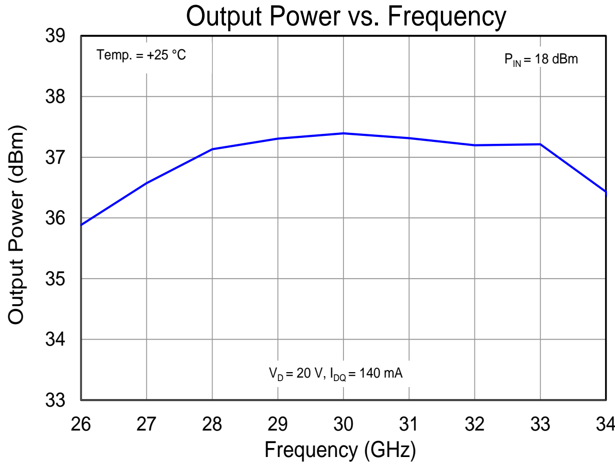

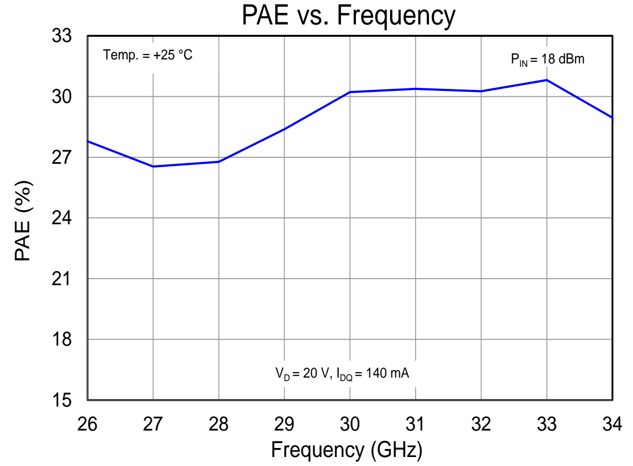

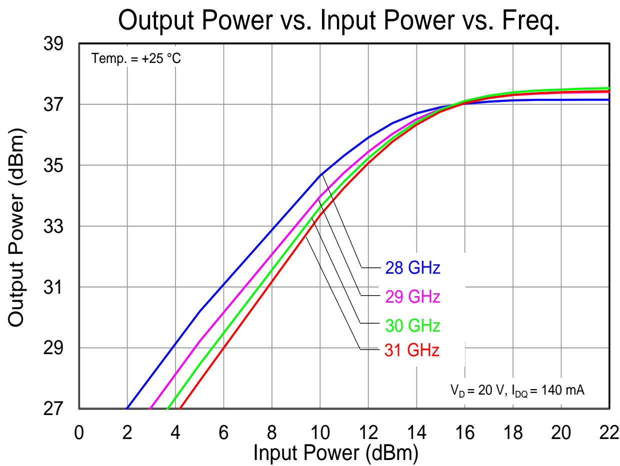

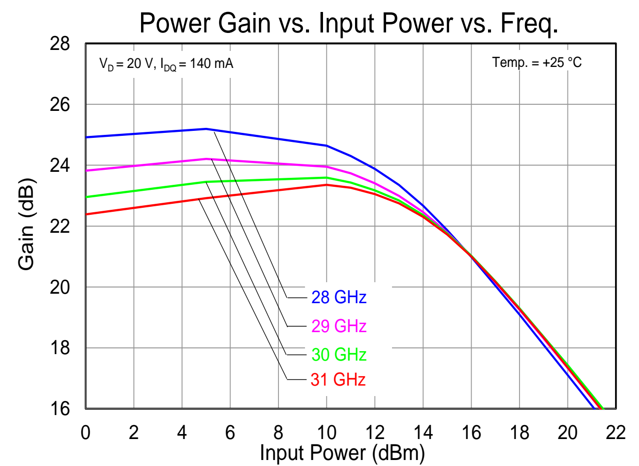

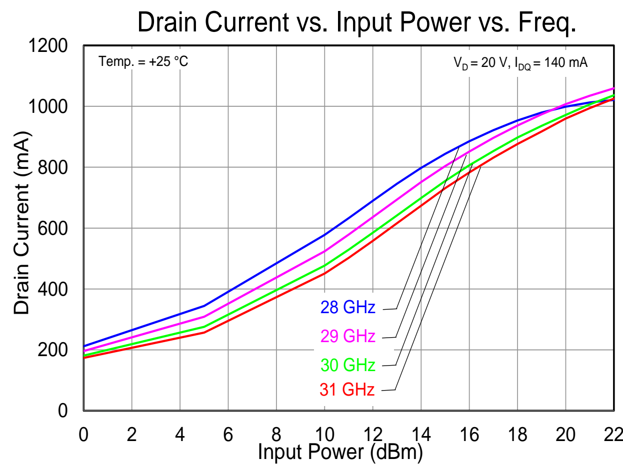

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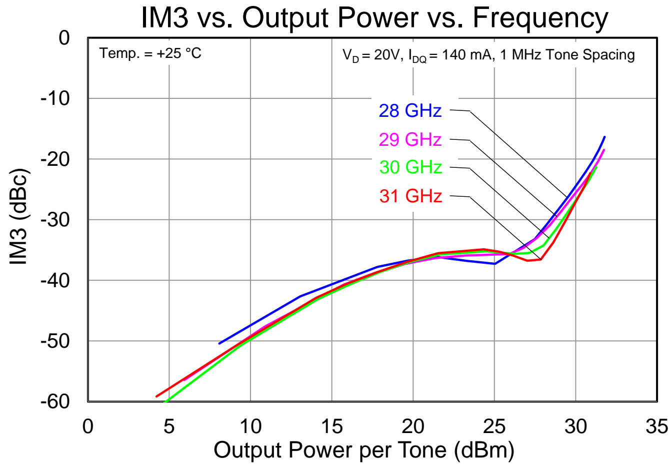

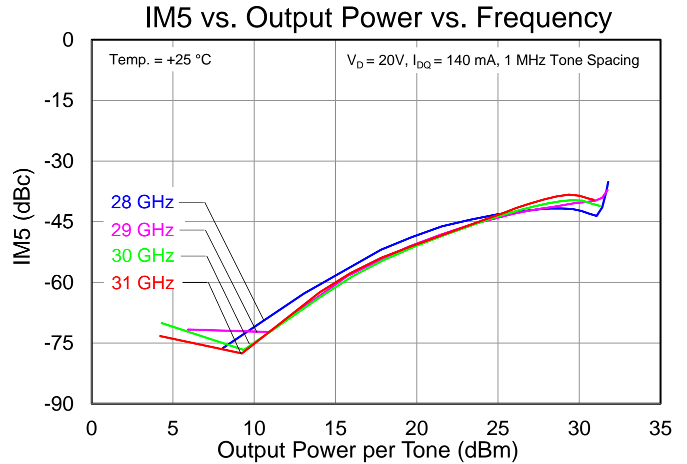

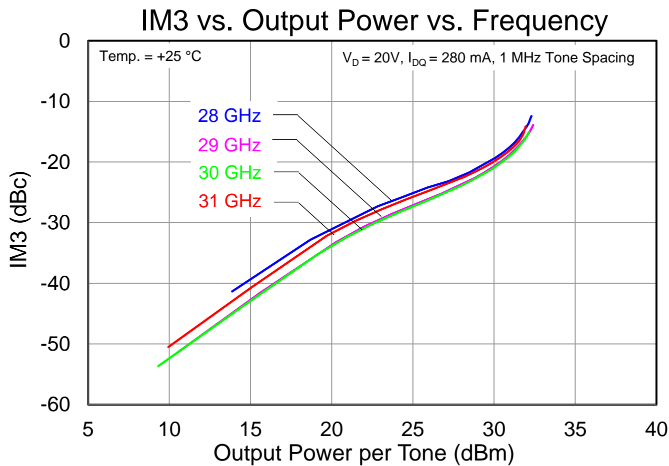

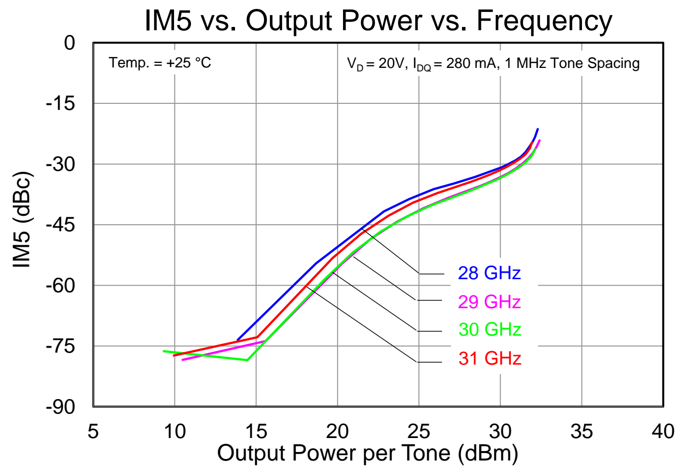

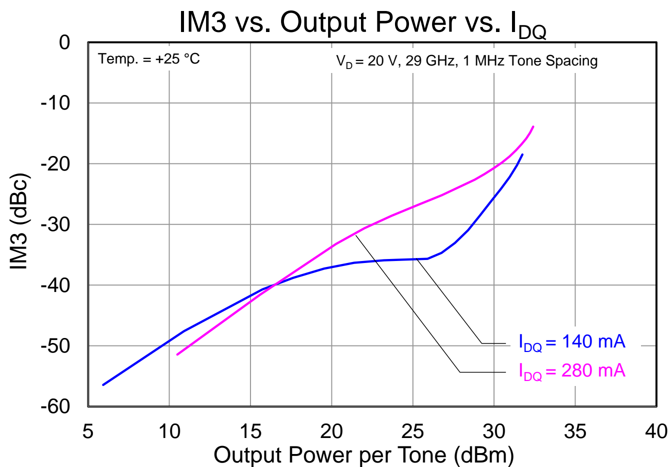

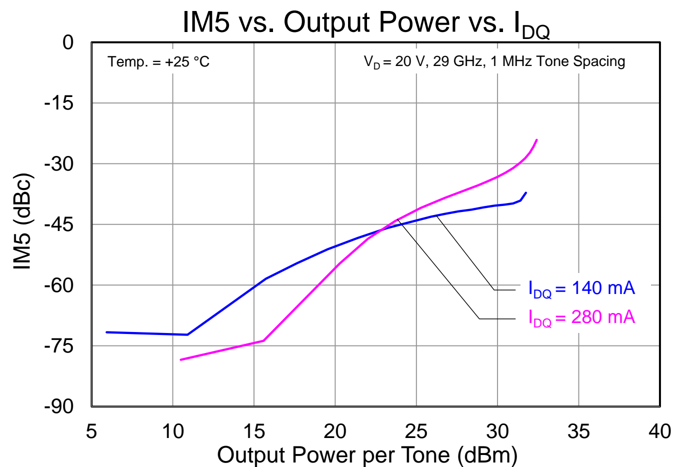

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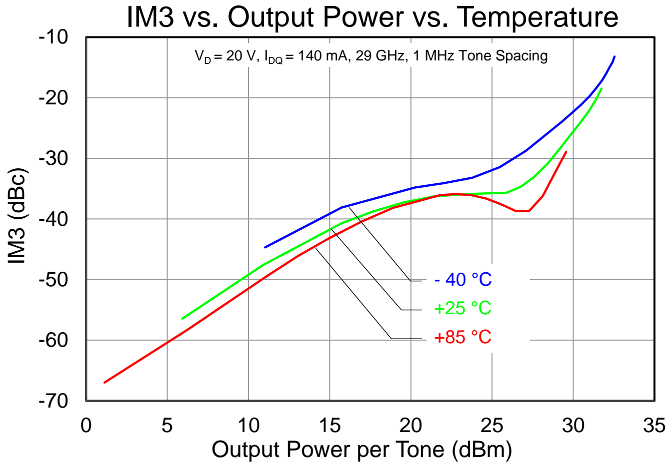
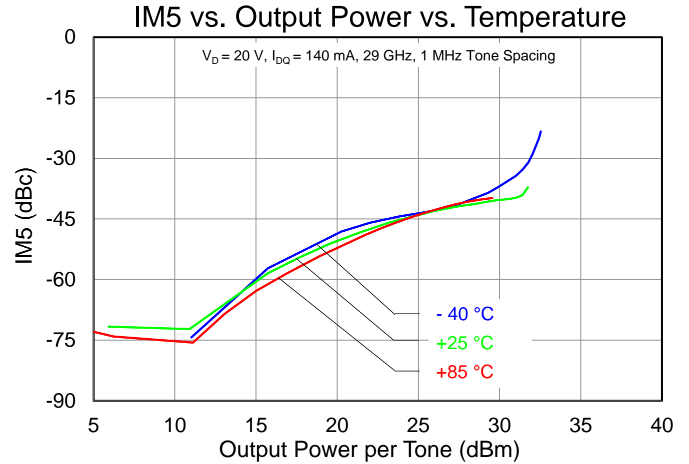
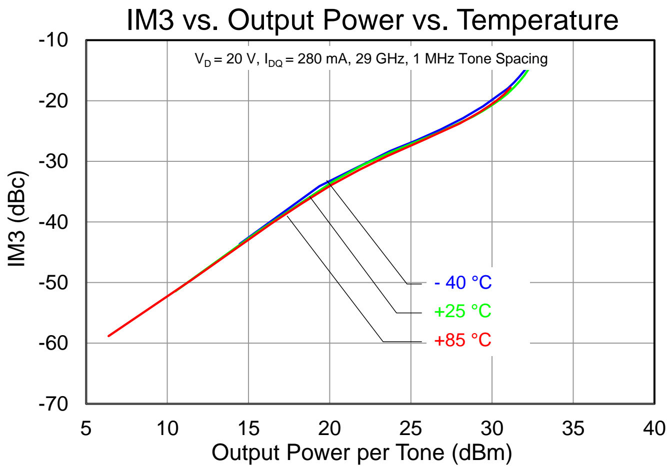
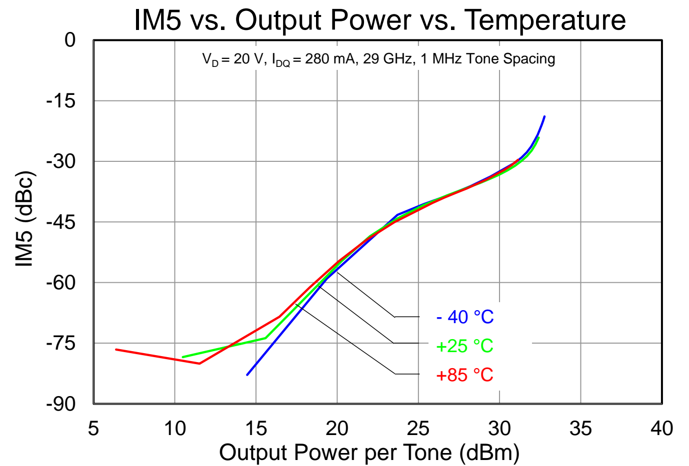
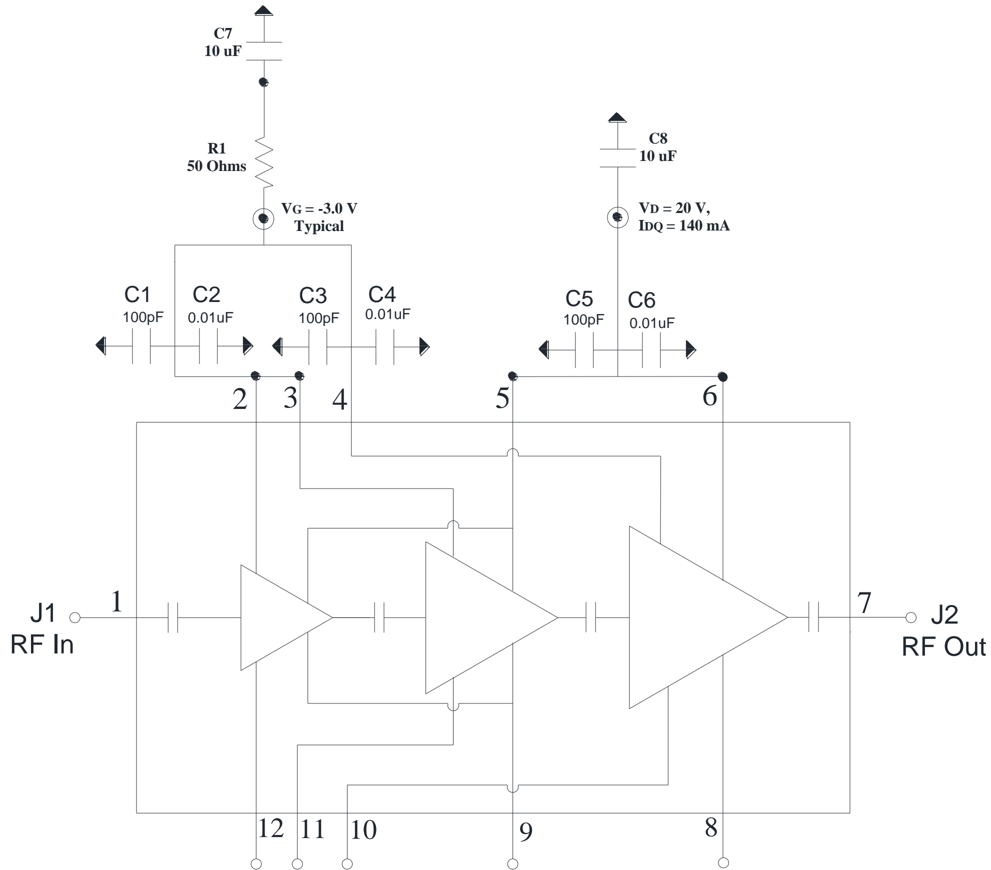








Application Circuit



Note: The MMIC can also be biased from the bottom by using the same application bias circuit from the top.

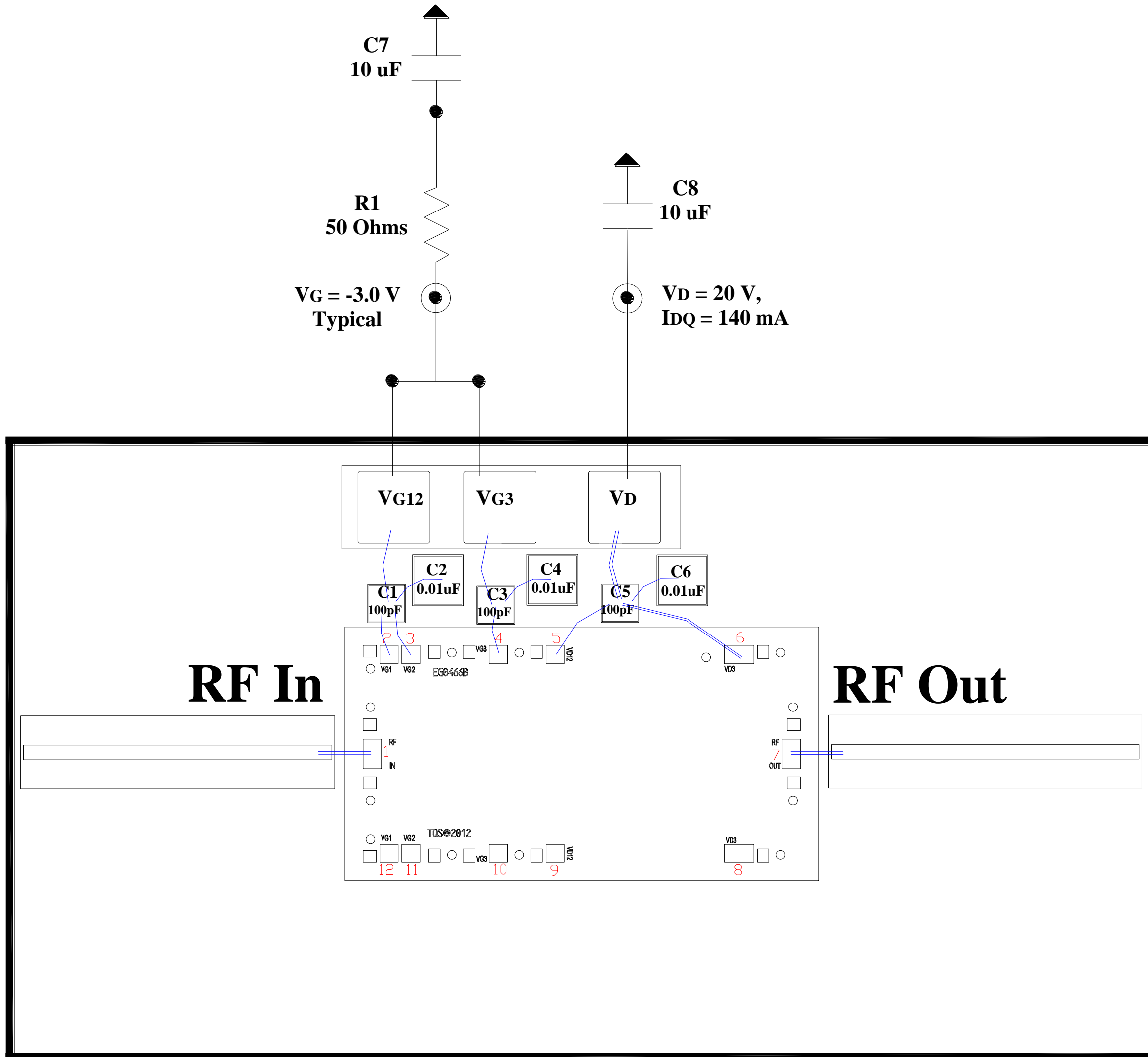
Bias Up Procedure

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 ~ −3 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

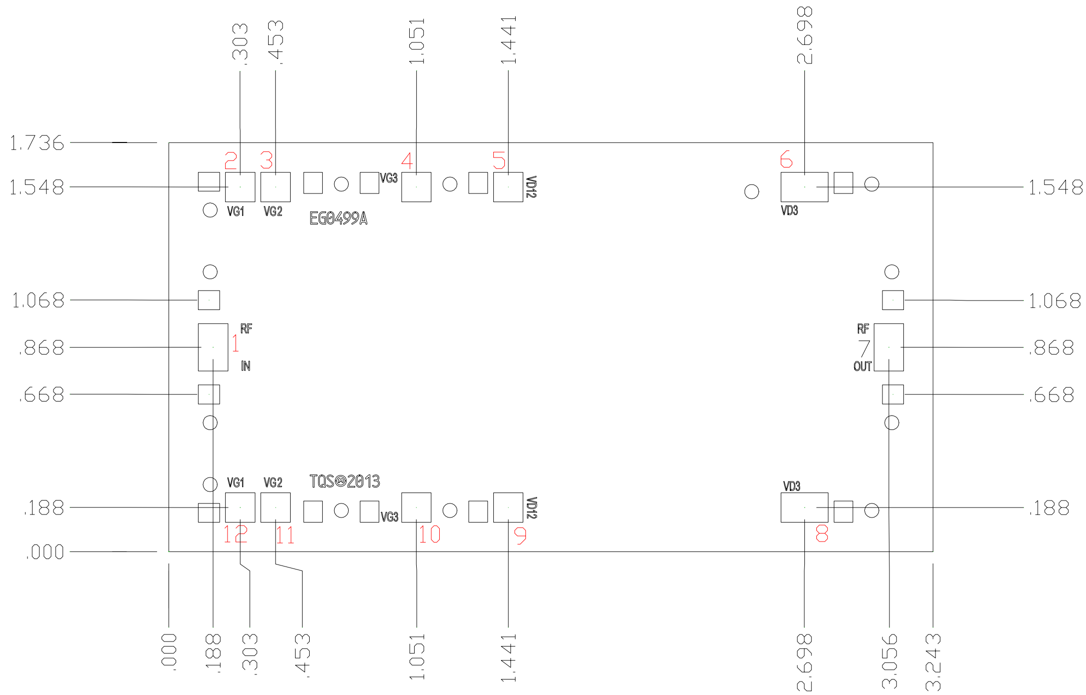
Assembly Drawing



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

Pin Configuration and 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

Pin No.	Symbol	Pad Size	Description
1	RF In	0.125 x 0.200	Input; matched to 50 ohms; 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_{G3} 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 ohms; 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.
- Organic attachment (i.e. epoxy) can be used in low-power applications.
- Curing should be done in a convection oven; proper exhaust is a safety concern.

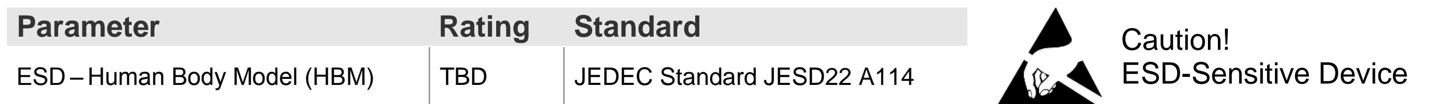
Reflow process assembly notes:

- 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)	TBD	JEDEC Standard JESD22 A114

Caution!
ESD-Sensitive Device

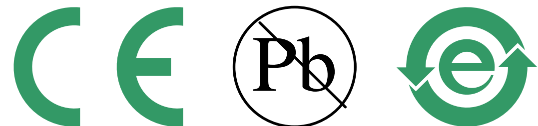
Solderability

Compatible with the latest version of J-STD-020, Lead free solder, 260 °C

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 ($C_{15}H_{12}Br_4O_2$) Free
- PFOS Free
- SVHC Free



Contact Information

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