TGA4538

37-40 GHz Power Amplifier

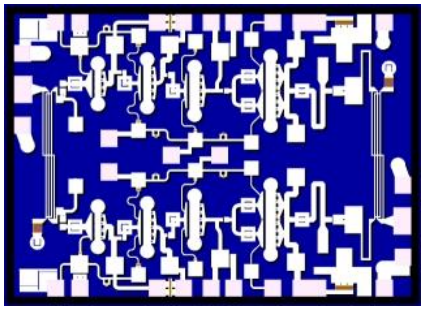
General Description

The Qorvo TGA4538 operates from 37-40 GHz and is designed using Qorvo's 3MI 0.15 um Power pHEMT production process.

The TGA4538 provides a nominal 29.5 dBm of saturated power with a small signal gain of 24 dB at V_D = 5 V and I_{DQ} = 600 mA. When biased at 6 V, 600 mA, TGA4538 provides a nominal 30.5 dBm of saturated power with a small signal gain of 24 dB.

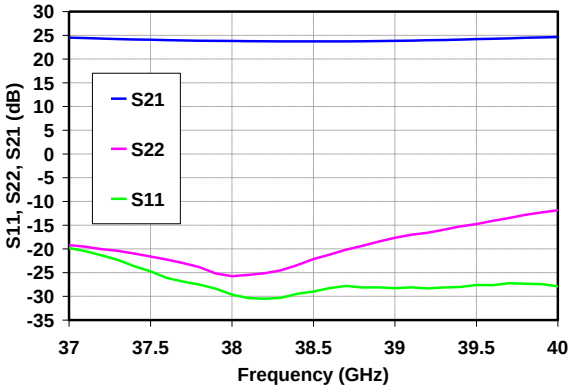
The TGA4538 is suitable for a variety of systems such as Point-to-Point radio and Millimeter-Wave Communications.

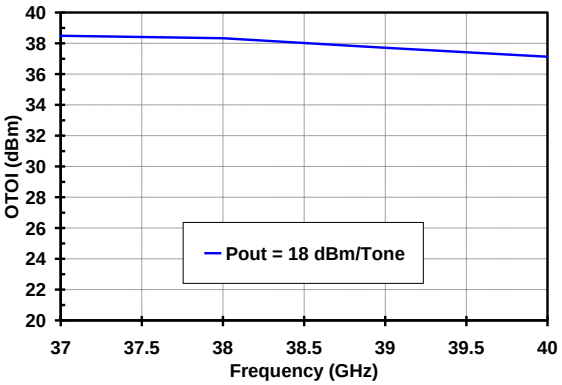
The TGA4538 is 100% DC and RF tested on-wafer to ensure performance compliance. The TGA4538 has a protective surface passivation layer providing environmental robustness.



Measured Performance

Bias conditions: V_D = 5 V, I_{DQ} = 600 mA, V_G = -0.63 V Typical





Product Features

- Frequency Range: 37-40 GHz
- OTOI: 37 dBm
- Small Signal Gain: 24 dB
- 29.5 dBm P_{SAT}, 28 dBm P1dB @ 5 V, 600 mA
- 30.5 dBm P_{SAT}, 29.5 dBm P1dB @ 6 V, 600 mA
- Chip Dimensions: 2.30 x 1.66 x 0.10 mm

Applications

- Point-to-Point Radio
- Millimeter Wave Communications

Ordering Information

Part	Description
TGA4538	TGA4538 Power Amplifier, Gel Pack, Qty 50

Absolute Maximum Ratings

Symbol	Parameter	Value	Units
V_D-V_G	Drain to Gate Voltage	10	V
V_D	Drain Voltage	6.5	V
V_G	Gate Voltage Range	-5 to 0	V
I_D	Drain Current	1390	mA
I_G	Gate Current Range	-4.2 to 92	mA
P_{IN}	Input Continuous Wave Power	22	dBm
$T_{CHANNEL}$	Channel Temperature	200	°C
T_{STO}	Storage Temperature	−55 to 150	°C

Exceeding any one or a combination of the Absolute Maximum Rating conditions may cause permanent damage to the device. Extended application of Absolute Maximum Rating conditions to the device may reduce device reliability.

Recommended Operating Conditions

Symbol	Parameter 1/	Value/Range	Units
V_D	Drain Voltage	5	V
I_{DQ}	Drain Current	600	mA
I_{D_Drive}	Drain Current under RF Drive	1000	mA
V_G	Typical Gate Voltage	-0.63	V

RF Characterization Table

Bias: V_D = 5 V, I_{DQ} = 600 mA, V_G = -0.63 V Typical, Data de-embedded to end of TFN feedings, bondwire effects included.

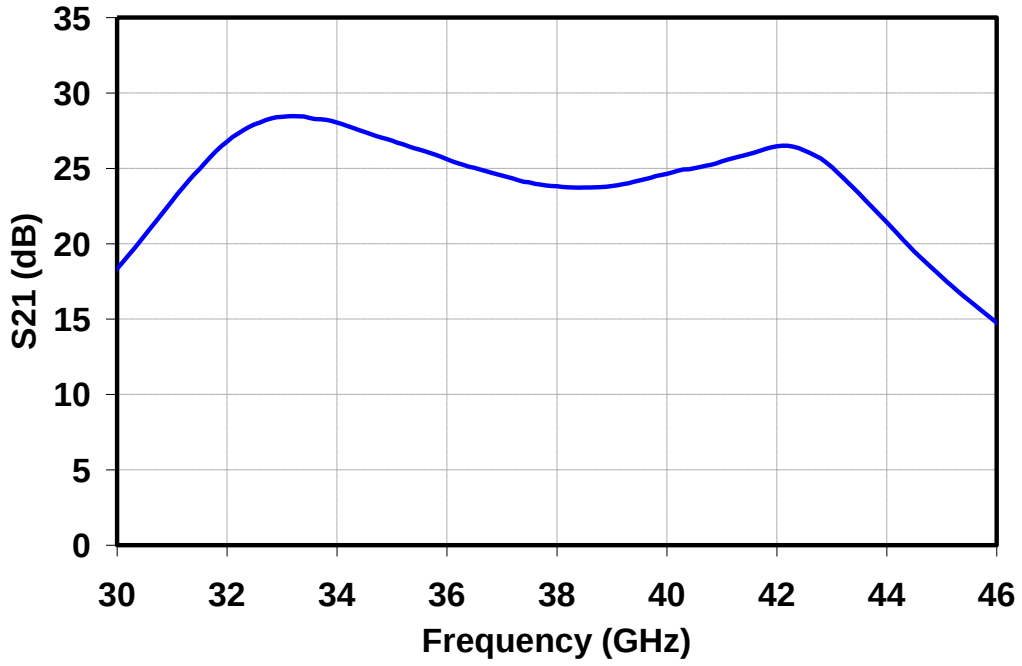
Symbol	Parameter	Test-Conditions	Min	Nominal	Max	Units
Gain	Small Signal Gain	f = 37-40 GHz	23	25		dB
IRL	Input Return Loss	f = 37-40 GHz		20		dB
ORL	Output Return Loss	f = 37-40 GHz		15		dB
P_{SAT}	Saturated Output Power	f = 37-40 GHz		29.5		dBm
P1dB	Output Power @ 1dB compression	f = 37-40 GHz	27	28		dBm
OTOI	Output TOI	f = 37-40 GHz	33	37		dBm

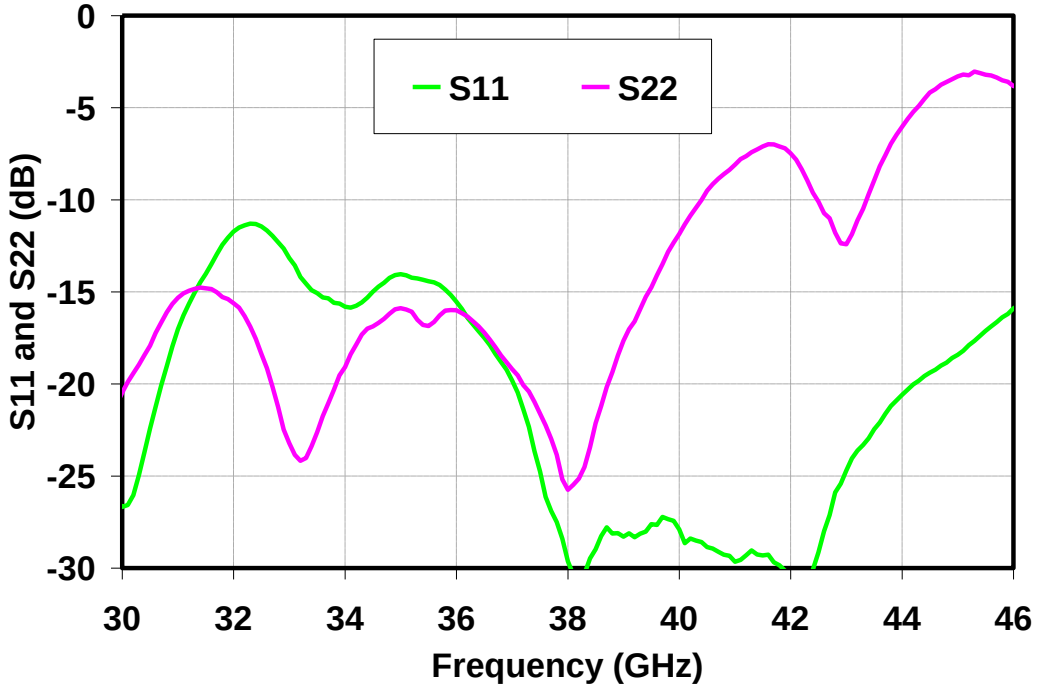
Bias: V_D = 6 V, I_{DQ} = 600 mA, V_G = -0.67 V Typical, Data de-embedded to end of TFN feedings, bondwire effects included.

Symbol	Parameter	Test-Conditions	Nominal	Units
Gain	Small Signal Gain	f = 37-40 GHz	24	dB
IRL	Input Return Loss	f = 37-40 GHz	19	dB
ORL	Output Return Loss	f = 37-40 GHz	15	dB
P_{SAT}	Saturated Output Power	f = 37-40 GHz	30.5	dBm
P1dB	Output Power @ 1dB compression	f = 37-40 GHz	29.5	dBm
OTOI	Output TOI	f = 37-40 GHz	37	dBm

Measured Data

Bias Conditions: V_D = 5 V, I_D = 600 mA, V_G = -0.63 V Typical





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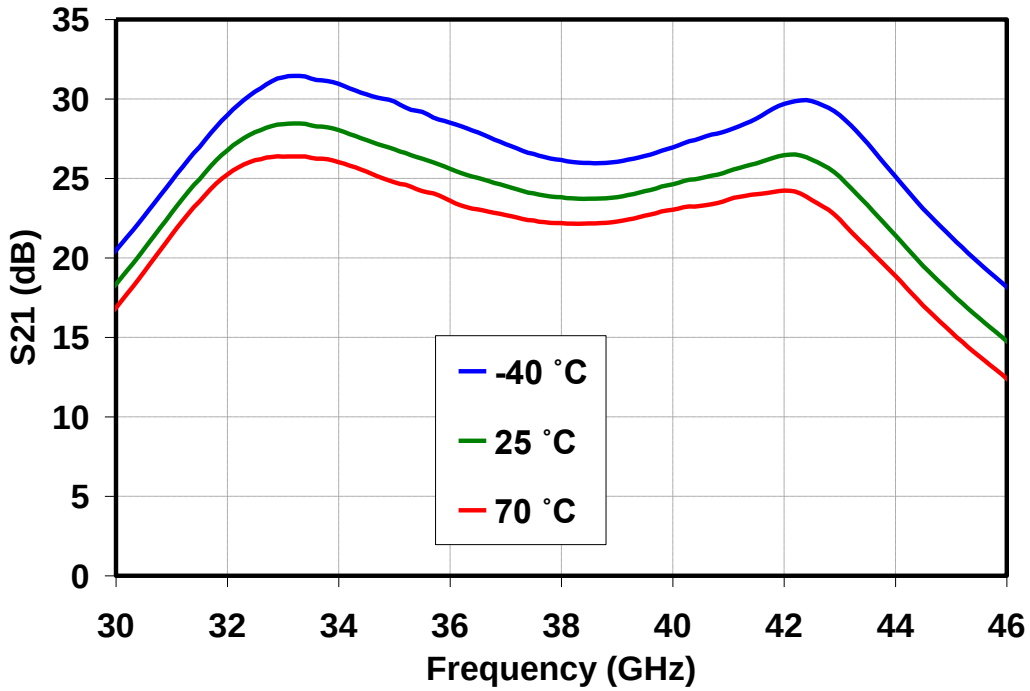

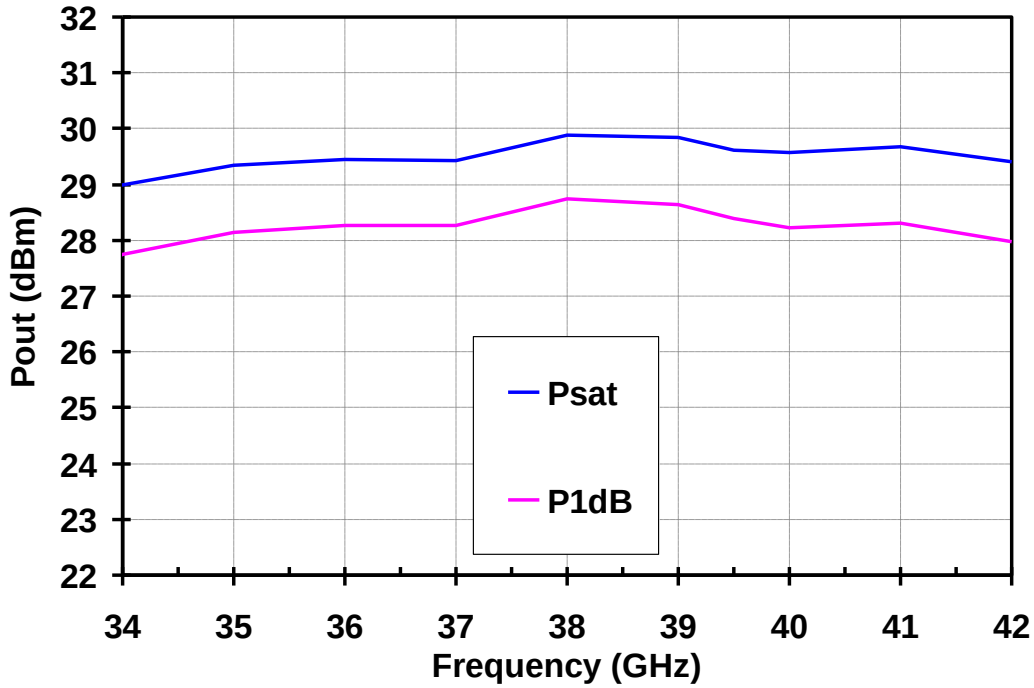

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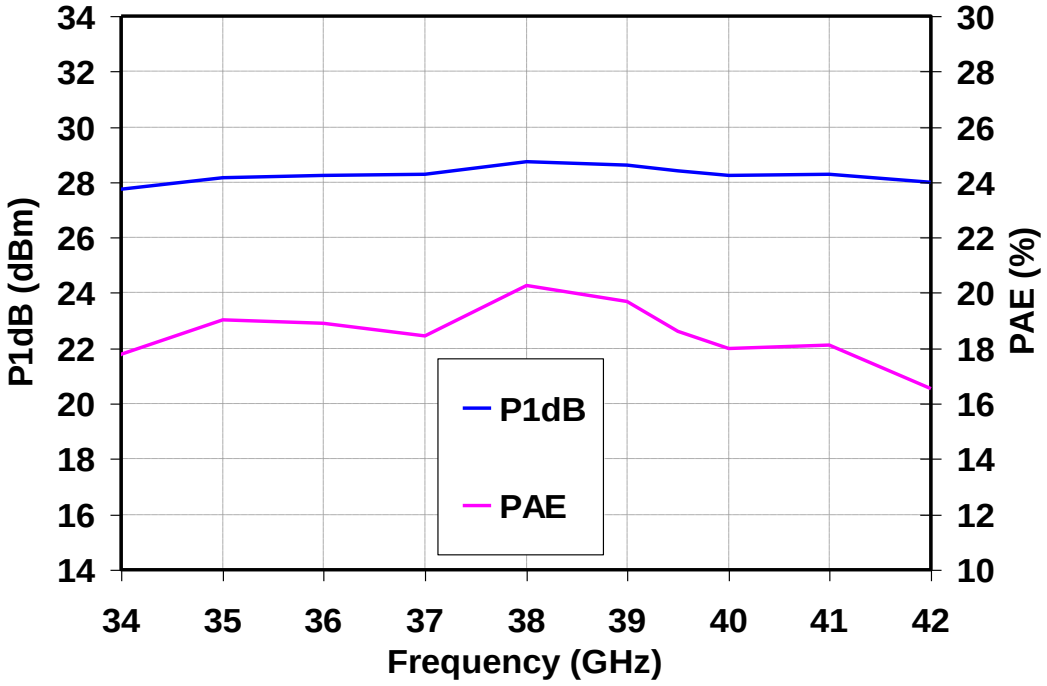

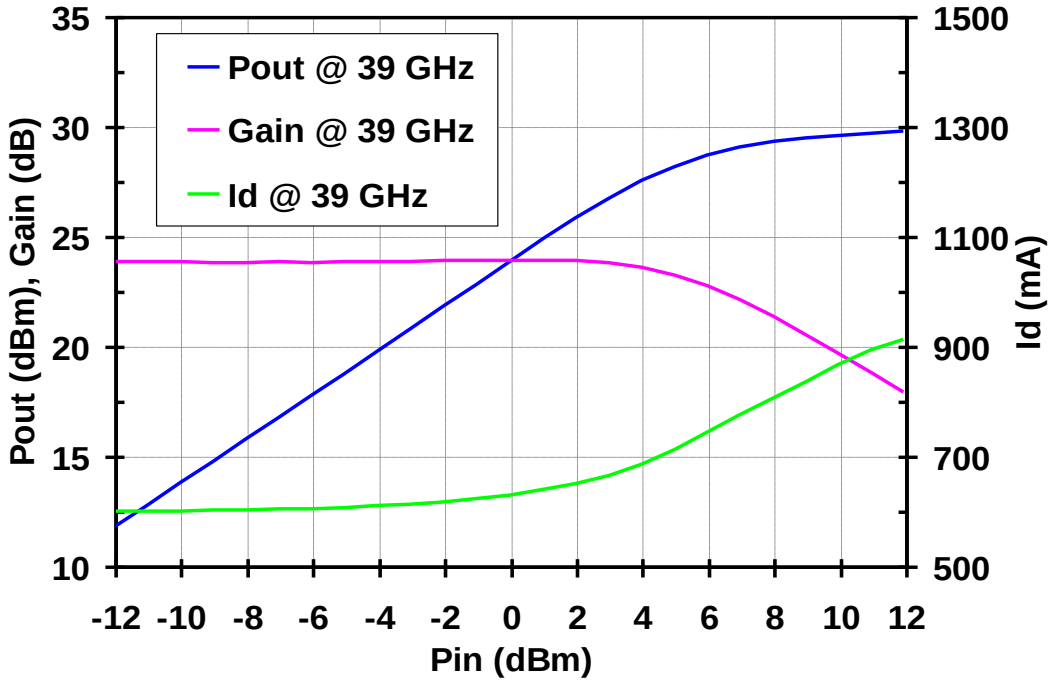

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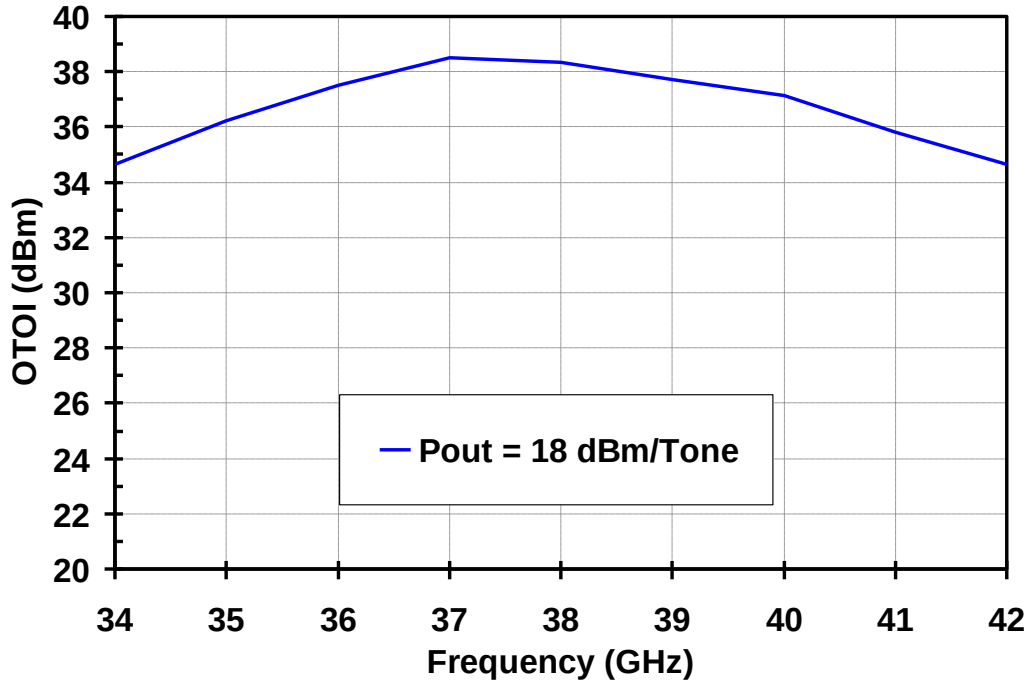

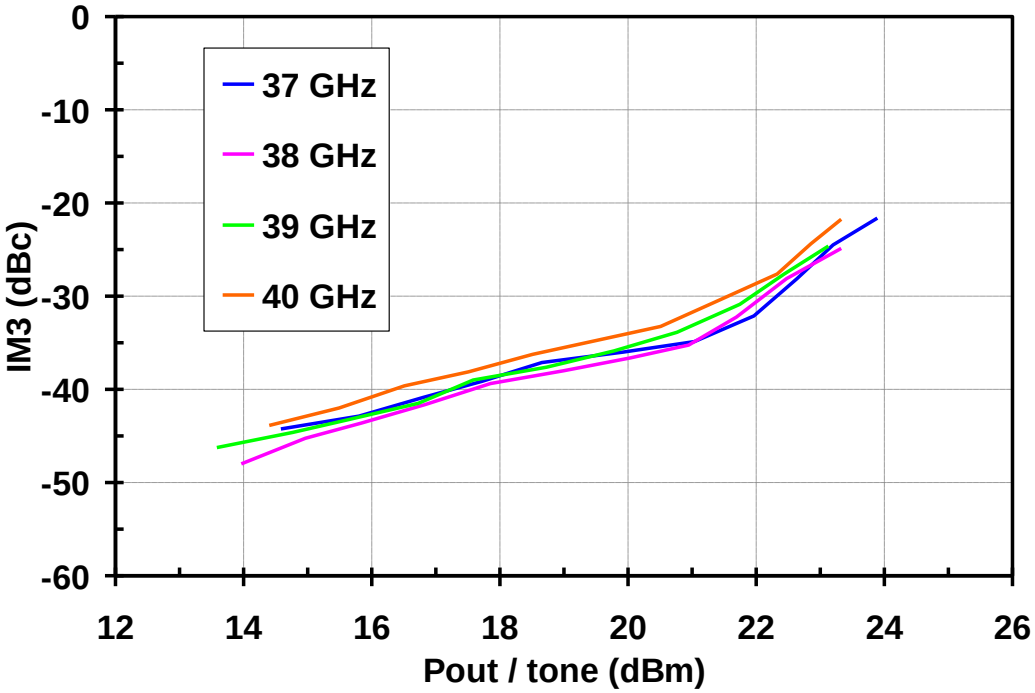

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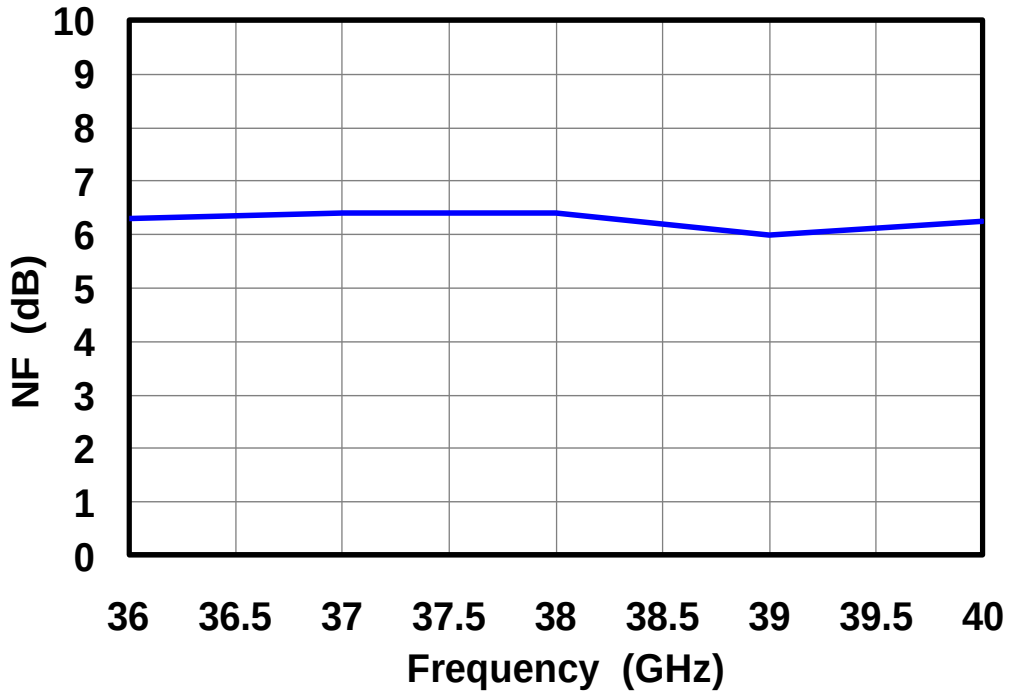

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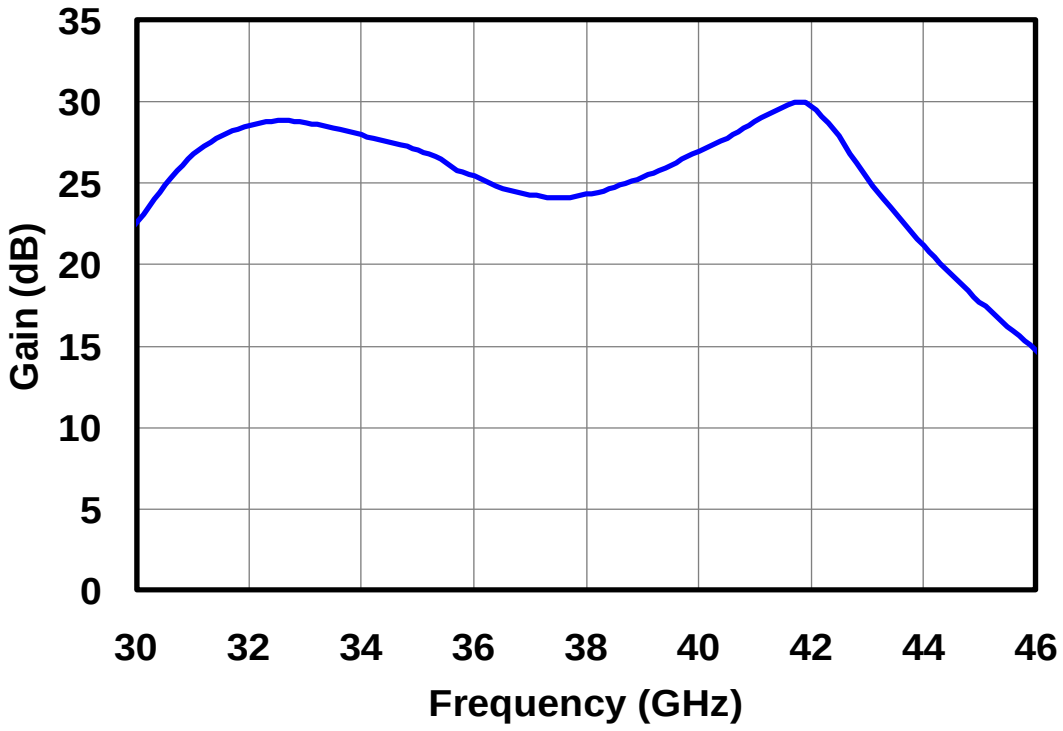

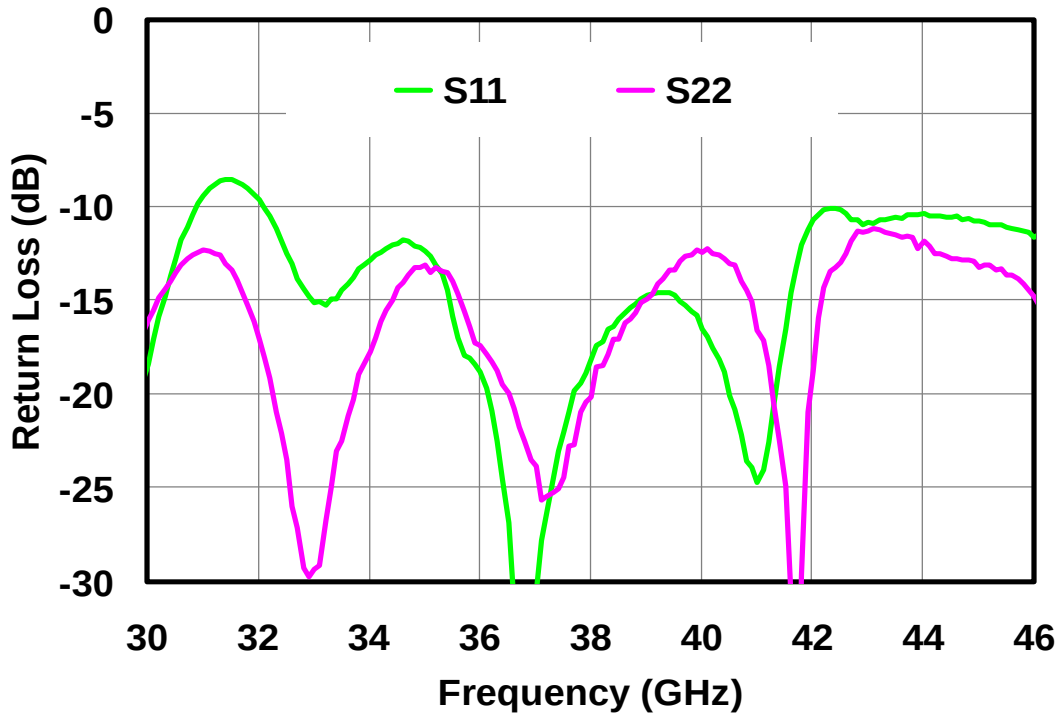

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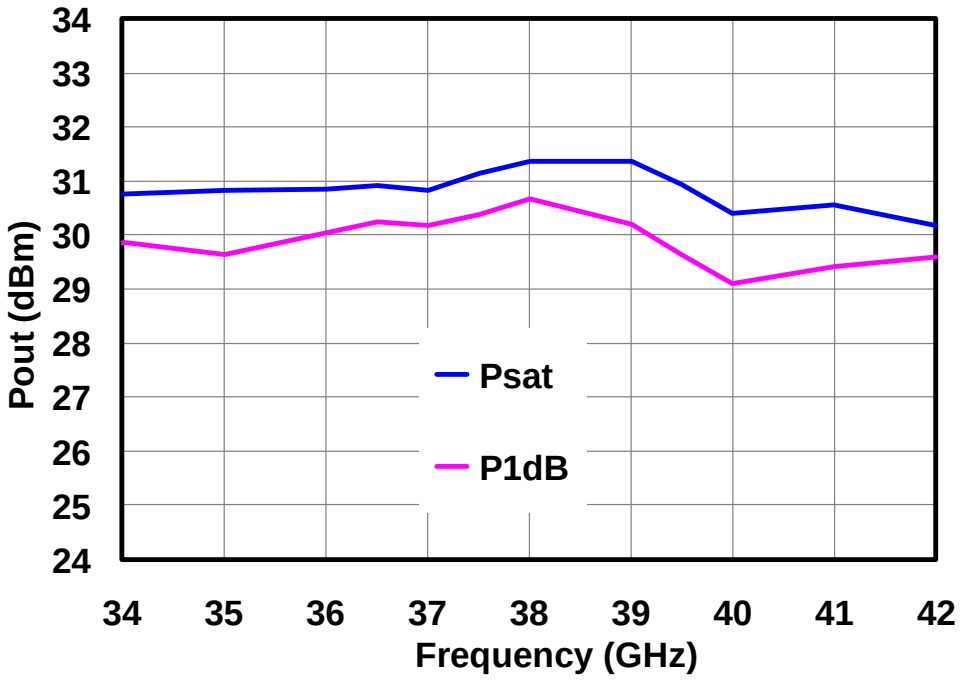

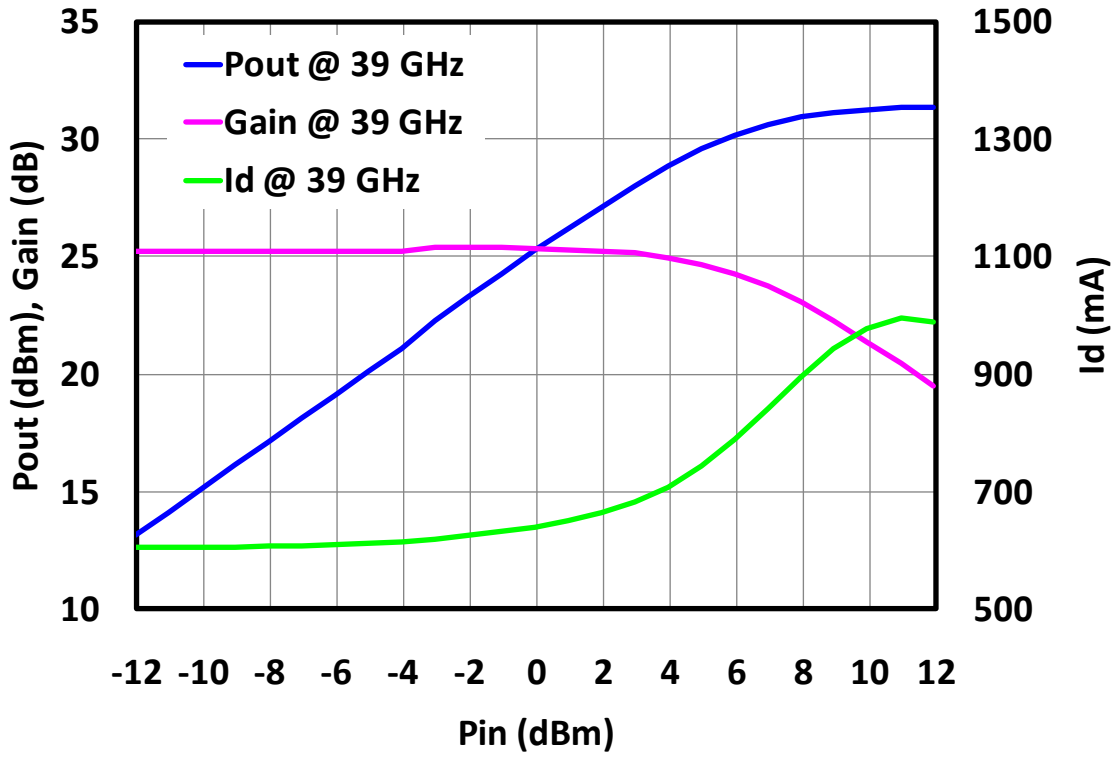

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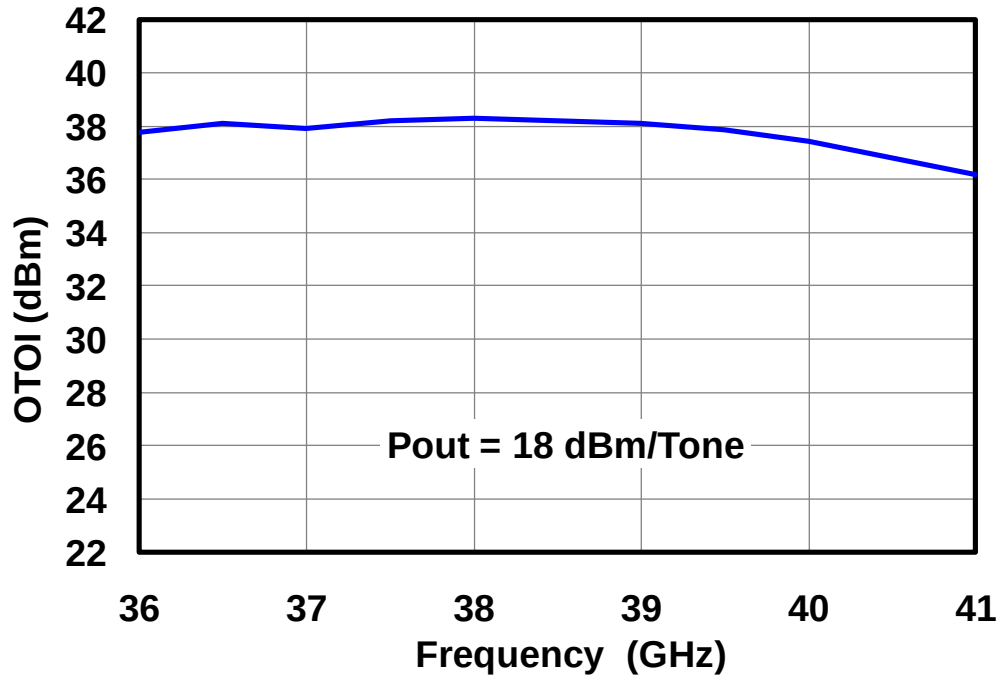
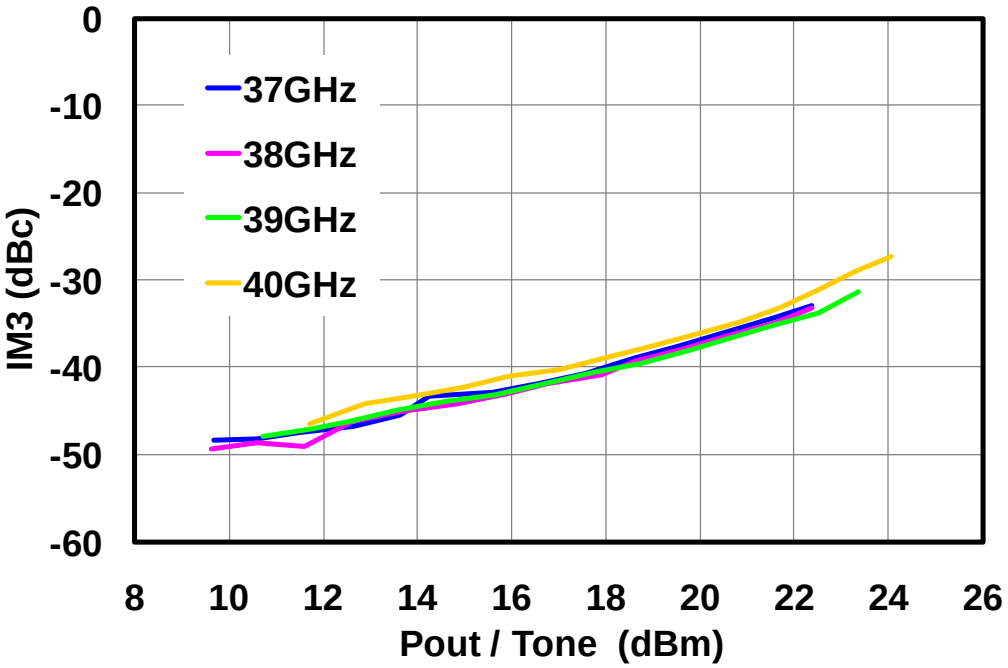


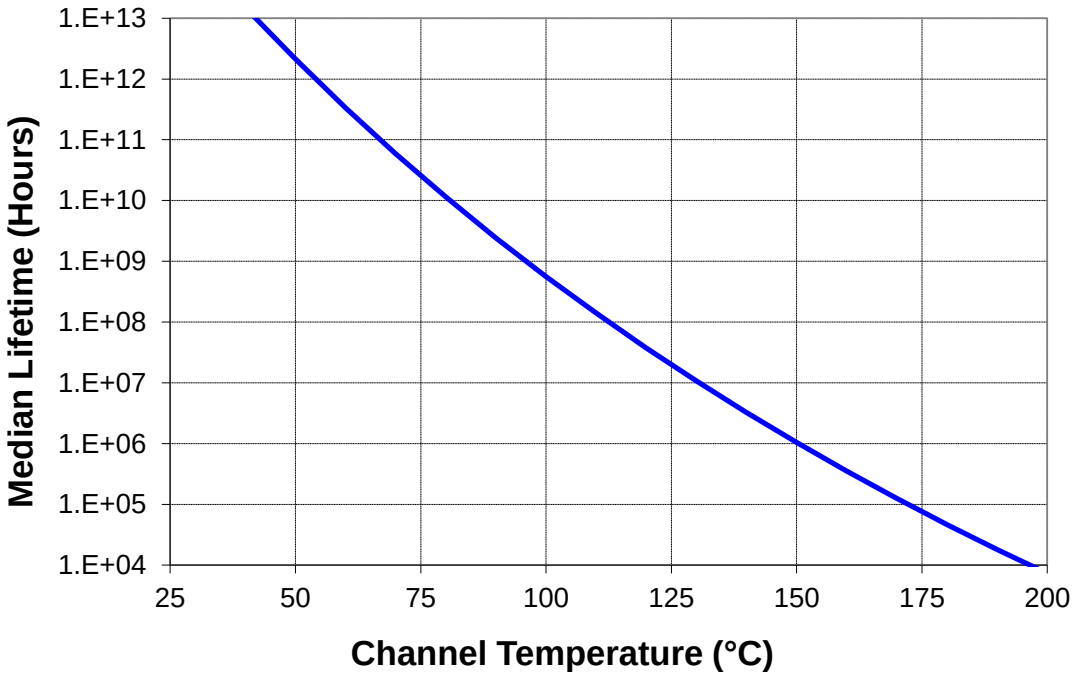


Power Dissipation and Thermal Properties

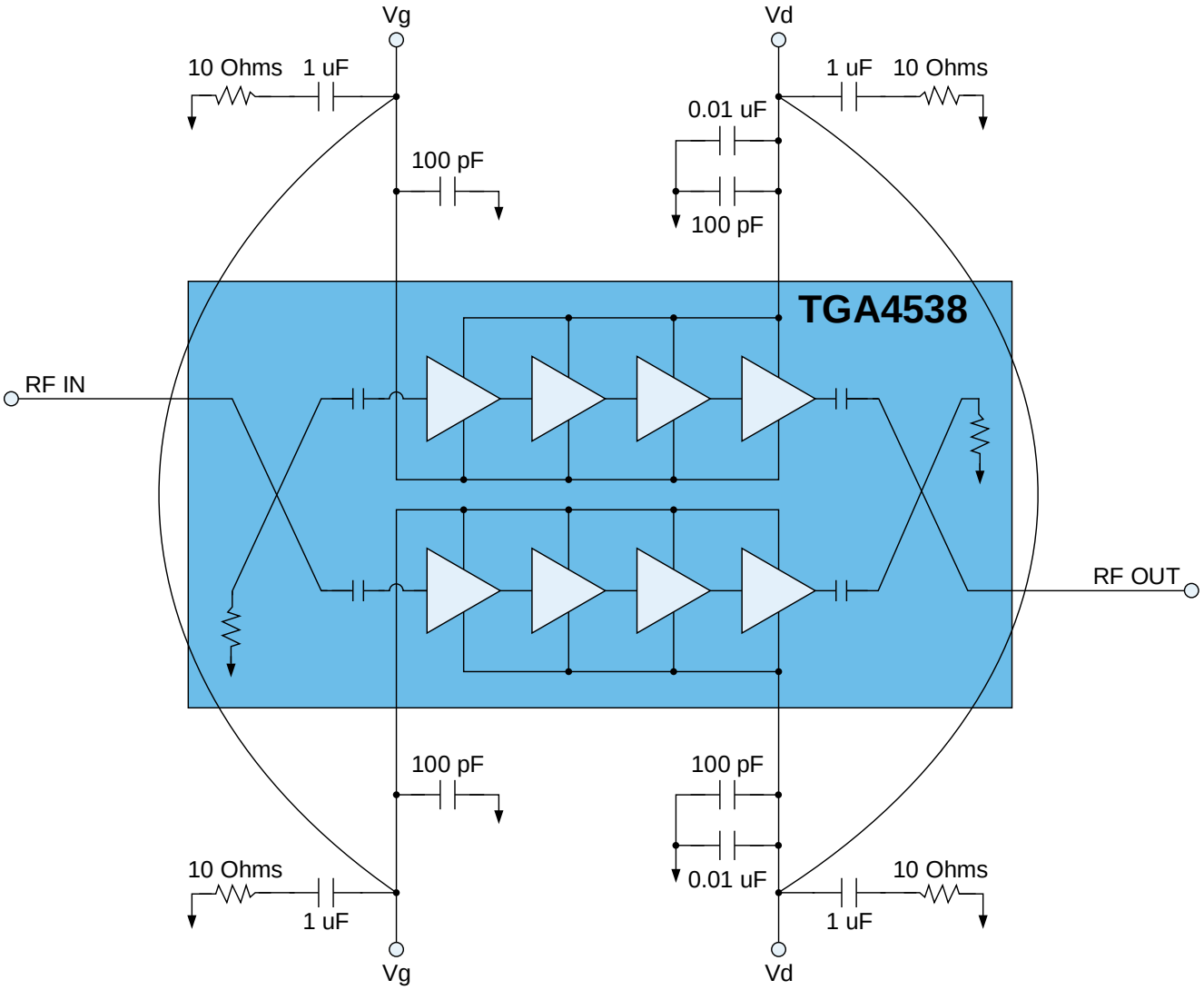
Applications	Test Conditions	Value
Maximum Power Dissipation	P_D = 6.5 W	$T_{CHANNEL}$ = 200 °C T_M = 7.1 E + 3 Hrs
Quiescent Bias, Small Signal	V_D = 5 V I_D = 600 mA P_D = 3.0 W	θjc = 19.9 °C/W $T_{CHANNEL}$ = 129 °C T_M = 1.1 E + 7 Hrs
Under RF Drive	V_D = 5 V I_D = 1000 mA P_{OUT} = 29.5 dBm P_D = 4.1 W	θjc = 19.9 °C/W $T_{CHANNEL}$ = 152 °C T_M = 8.1 E + 5 Hrs

Die mounted to 40 mil CuMo carrier plate with AuSn eutectic. Thermal resistance measured at back of carrier plate.
$T_{BASEPLATE}$ = 70 °C

Median Lifetime vs Channel Temperature



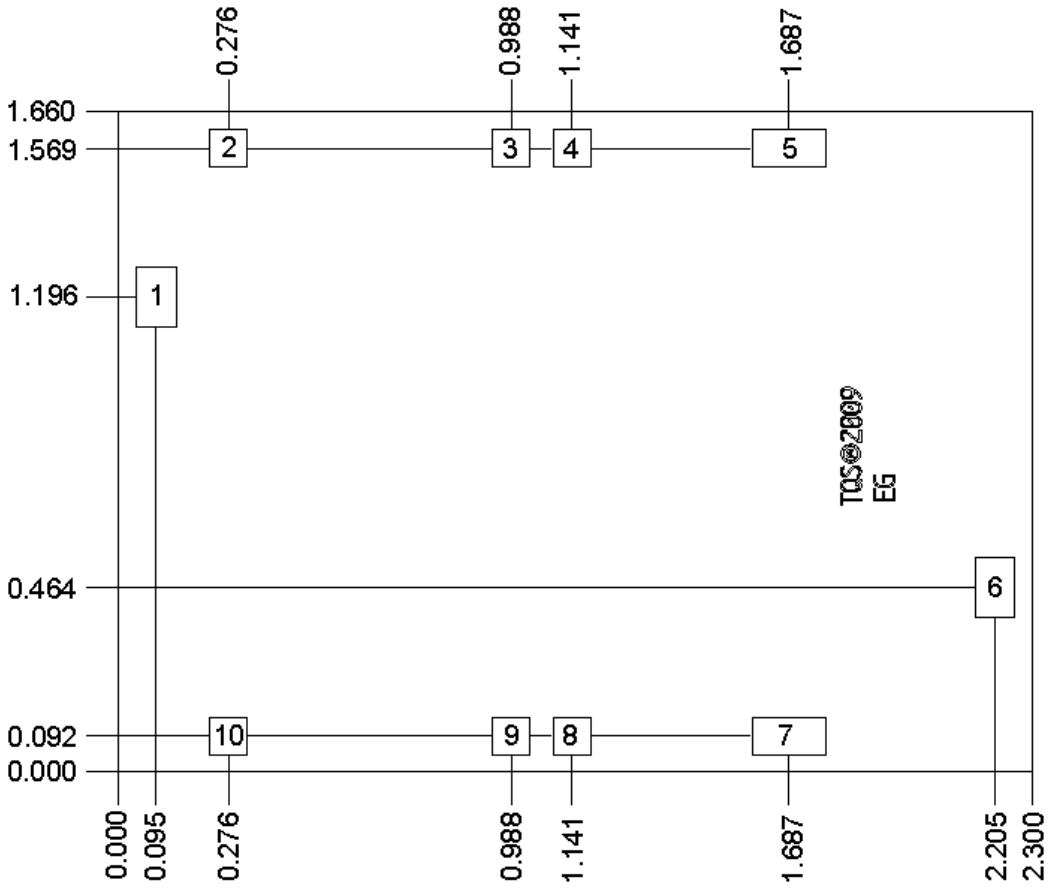
Application Schematic



Bias-up Procedure
1. Set I_D limit to 1390 mA, I_G limit to 10 mA
2. Set V_G to −1.5 V
3. Set V_D +5 or +6 V
4. Adjust V_G more positive until I_{DQ} = 600 mA
5. Apply RF signal

Bias-down Procedure
1. Turn off RF signal
2. Reduce V_G to −1.5 V. Ensure $I_{DQ} \approx$ 0mA
3. Set V_D to 0V
4. Turn off V_D supply
5. Turn off V_G supply

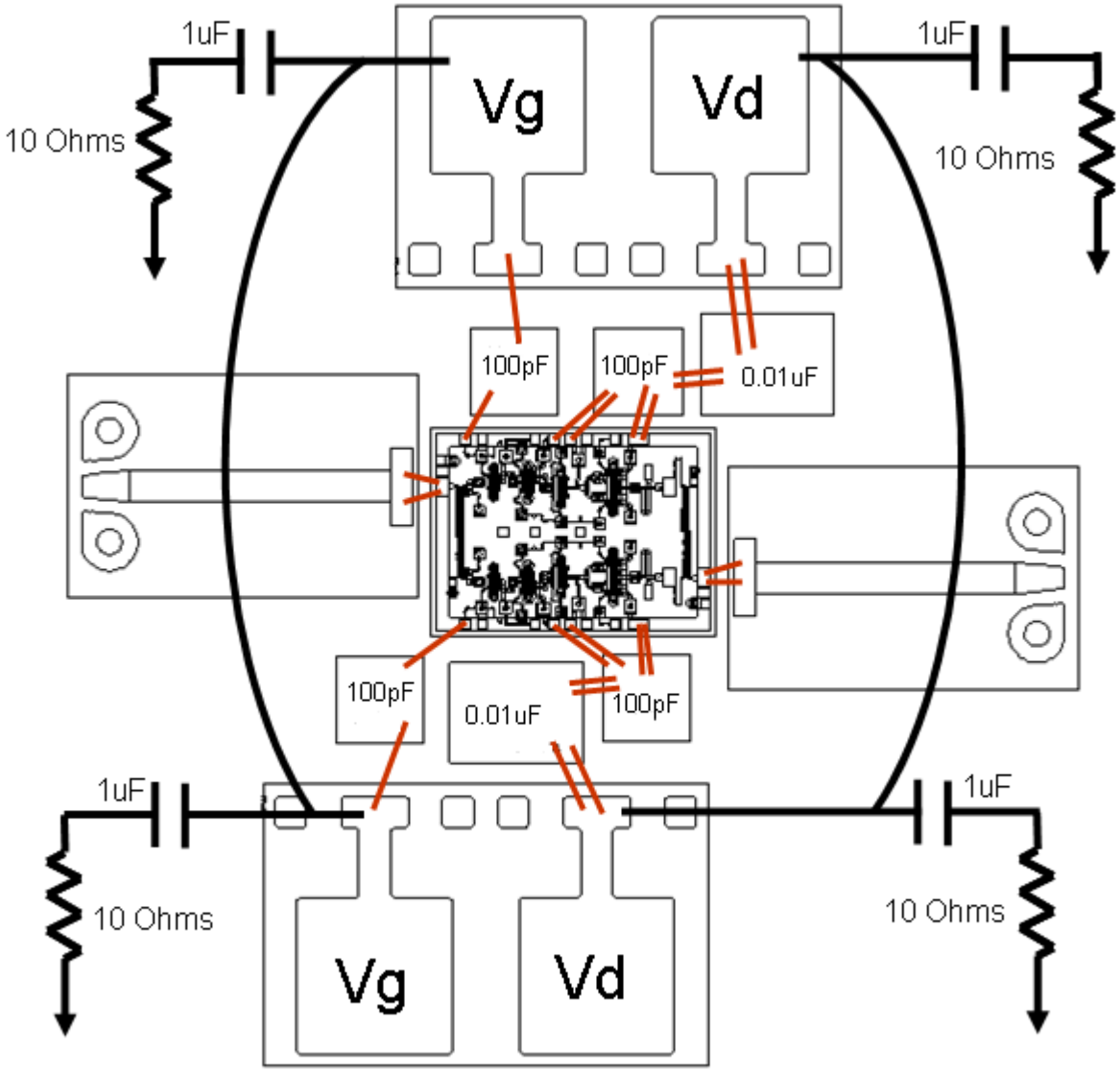
Mechanical Drawing



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	Symbol	Pad Size	Description
1	RF_{In}	0.082 x 0.132	RF input pad, DC blocked
2, 10	V_G	0.075 x 0.075	Gate Control Voltage
3, 9	V_{D1}	0.075 x 0.075	Drain Voltage, Stage 1 and Stage 2
6	RF_{Out}	0.082 x 0.123	RF output pad, DC blocked
5, 7	V_{D3}	0.168 x 0.075	Drain Voltage, Stage 4
4, 8	V_{D2}	0.075 x 0.075	Drain Voltage, Stage 3

Recommended Assembly Diagram



Notes:

1. Need to connect bias from both sides.
2. GaAs MMIC devices are susceptible to damage from Electrostatic Discharge. Proper precautions should be observed during handling, assembly and test

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)	N / A	JEDEC Standard JESD22 A114

Caution!
ESD-Sensitive Device

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

Contact Information

For the latest specifications, additional product information, worldwide sales and distribution locations, and information about Qorvo:

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Tel: 1-844-890-8163

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