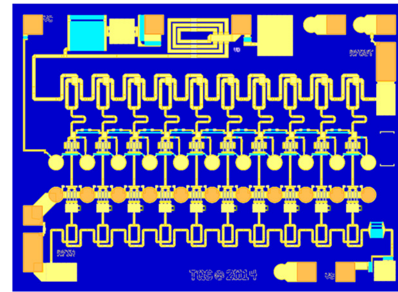
Applications

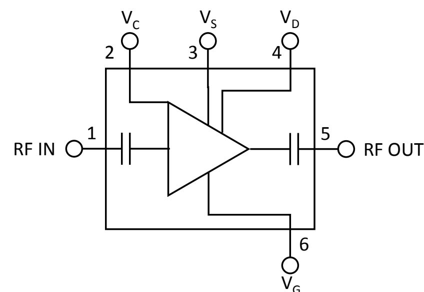
- Commercial & Military Communications
- Commercial & Military Radar
- Electronic Warfare
- Instrumentation
- LNA, driver, gain block, general amplification



Product Features

- Frequency Range: 2 – 22 GHz
- High Input Power Survivability: 40 dBm
- Noise Figure: 2.0 dB (midband)
- Gain > 15 dB
- IM3: -31 dBc (P_{IN}/tone=-4 dBm, Δf=10 MHz)
- P_{1dB} > 20 dBm
- Bias: V_D = 8 V, I_{DQ} = 125 mA
- Die Dimensions: 2.040 x 1.490 x 0.1 mm

Functional Block Diagram



General Description

The Qorvo TGA2227 is a wideband, low noise amplifier fabricated on Qorvo's TQGaN15 production GaN-on-SiC process. The TGA2227 operates from 2–22 GHz and provides > 15 dB of small signal gain with 2 dB of mid-band noise figure. The TGA2227 can be biased over a wide range of voltage with little impact on noise figure and gain; thus allowing the user to minimize power dissipation depending on power and linearity requirements.

Another key feature is the TGA2227's high robustness to incident power. Able to handle 40 dBm without performance degradation makes the TGA2227 an ideal choice for a front-end LNA. Depending on the application, this level of robustness could easily support the elimination of other receive protect circuitry. This would further support a more simplified board design, reduced BOM costs and lower overall noise figure.

Supported applications span both commercial and military communication and radar systems as well as electronic warfare, instrumentation and any other general RF amplification needs.

Lead-Free and RoHS compliant.

Evaluation boards are available upon request.

Pad Configuration

Pad Number	Symbol
1	RF Input
2	V_C
3	V_S
4	V_D
5	RF Output
6	V_G

Ordering Information

Part	ECCN	Description
TGA2227	EAR99	2-22 GHz GaN LNA

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Absolute Maximum Ratings

Parameter	Value
Drain Voltage (V_D)	22.0 V
Cascode Voltage (V_C)	V_C<V_D and V_C< 9 V
Drain Current (I_D)	300 mA
Gate Voltage (V_G)	-5 to 0 V
Gate Current (I_G)	See graph
RF Input Power (25 ℃, 50 Ω)	40 dBm
Channel Temperature (T_{CH})	275 ℃
Mounting Temperature (30 seconds maximum)	320 ℃
Storage Temperature	-55 to +150 ℃

[1] Maximum V_C is dependent on the V_D used

Recommended Operating Conditions

Parameter	Value
Drain Voltage (V_D), Low Pdiss Bias	8.0 V
Drain Voltage (V_D), Power Bias	15.0 V
Quiescent Drain Current (I_{DQ})	125 mA
Gate Voltage (V_G)	-3.0 V
Cascode Voltage (V_C), Low Pdiss Bias	2.0 V
Cascode Voltage (V_C), Power Bias	4.0 V
Operating Temperature Range	-40 to +85 ℃

Electrical Specifications – Low Pdiss Bias

Test conditions, unless otherwise noted: T_{BASE} = 25 ℃, V_D = 8 V, V_C = 2 V

Parameter	Min	Typical	Max	Units
Frequency Range	2		22	GHz
Small Signal Gain		16.0		dB
Noise Figure		2.5		dB
Input Return Loss		10		dB
Output Return Loss		12		dB
P_{SAT}		23.4		dBm
P_{1dB}		20.3		dBm
IM3 (P_{IN}/tone = -4 dBm, Δf = 10 MHz)		-31		dBc
S21 Temperature Coefficient		–0.022		dB/℃
NF Temperature Coefficient		0.012		dB/℃
Recommended Operating Voltage	5	8	20	V

Electrical Specifications – Power Bias

Test conditions, unless otherwise noted: T_{BASE} = 25 ℃, V_D = 15 V, V_C = 4 V

Parameter	Min	Typical	Max	Units
Frequency Range	2		22	GHz
Small Signal Gain		15.9		dB
Noise Figure		2.5		dB
Input Return Loss		10		dB
Output Return Loss		12		dB
P_{SAT}		25.8		dBm
P_{1dB}		22.6		dBm
IM3 (P_{IN}/tone = -4 dBm, Δf = 10 MHz)		-35		dBc
S21 Temperature Coefficient		–0.024		dB/℃
NF Temperature Coefficient		0.011		dB/℃

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Recommended Operating Voltage	5	15	20	V

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Specifications

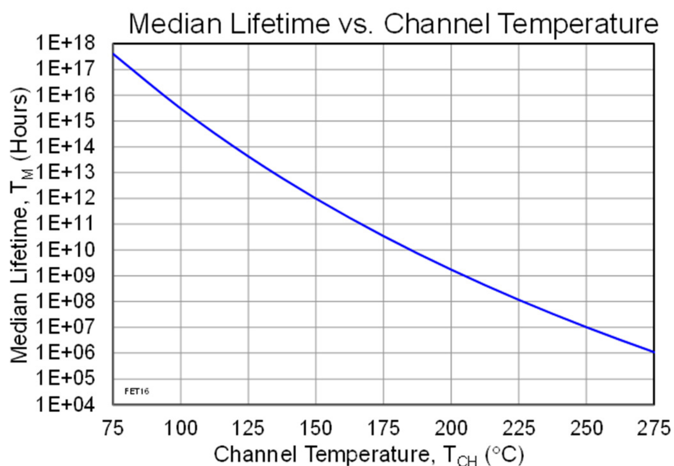
Thermal and Reliability Information

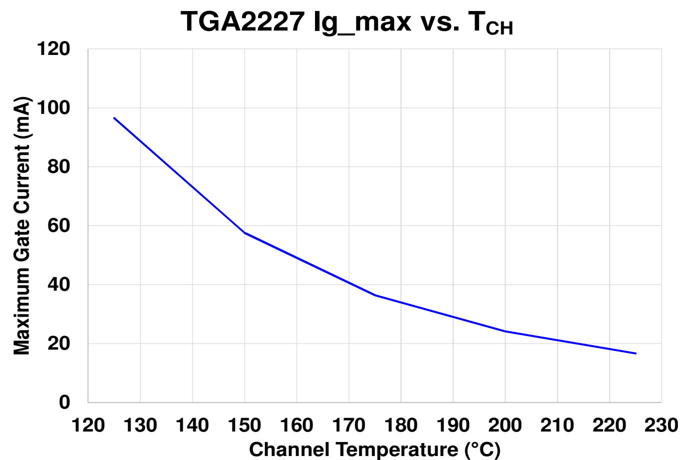
Parameter	Conditions	Value	Units
Thermal Resistance (θ_{JC}) (1)	T_{BASE} = 85°C, V_D = 8 V, V_C = 2.0 V, V_G = -2.4 V, I_{D_DRIVE} = 125 mA, P_{IN} = -10 dBm, P_{OUT} = 6 dBm, P_{DISS} = 1.00 W	6.00	°C/W
Channel Temperature (T_{CH}) (1)		91	°C
Median Lifetime (T_M)		1.60E+16	Hrs.
Thermal Resistance (θ_{JC}) (1)	T_{BASE} = 85°C, V_D = 15 V, V_C = 4.0 V, V_G = -2.4 V, I_{D_DRIVE} = 125 mA, P_{IN} = -10 dBm, P_{OUT} = 6 dBm, P_{DISS} = 2.16 W	7.87	°C/W
Channel Temperature (T_{CH}) (1)		102	°C
Median Lifetime (T_M)		2.04E+15	Hrs.
Thermal Resistance (θ_{JC}) (1)	T_{BASE} = 85°C, V_D = 15 V, V_C = 4.0 V, V_G = -2.4 V, I_{D_DRIVE} = 260 mA, P_{IN} = 16 dBm, P_{OUT} = 28.4 dBm, P_{DISS} = 3.75 W	8.27	°C/W
Channel Temperature (T_{CH}) (1)		116	°C
Median Lifetime (T_M)		1.76E+14	Hrs.

1. Die backside temperature fixed at 85 °C.

Median Lifetime

Test Conditions: 22 V; Failure Criterion = 10% reduction in $I_{D\ MAX}$





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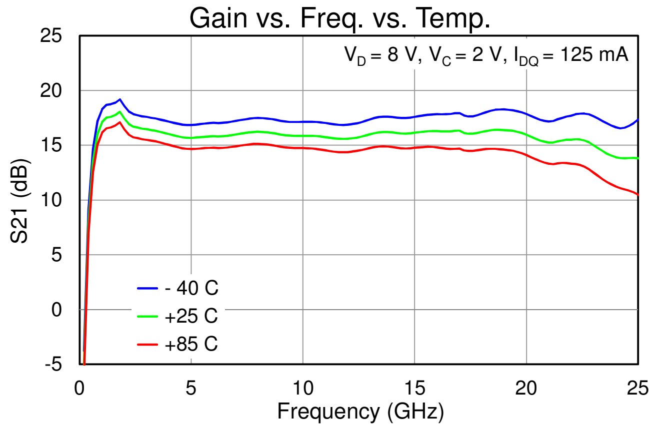
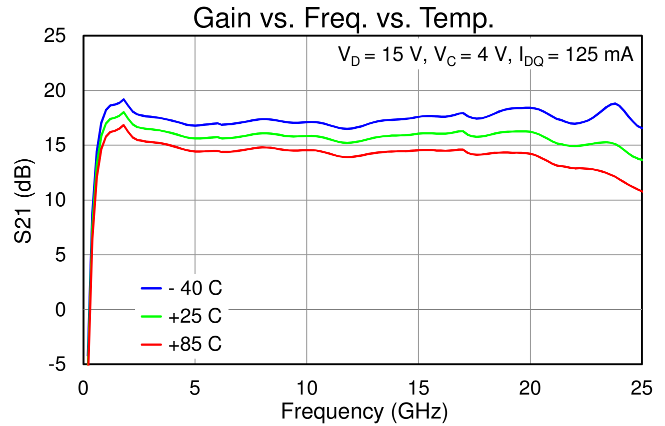
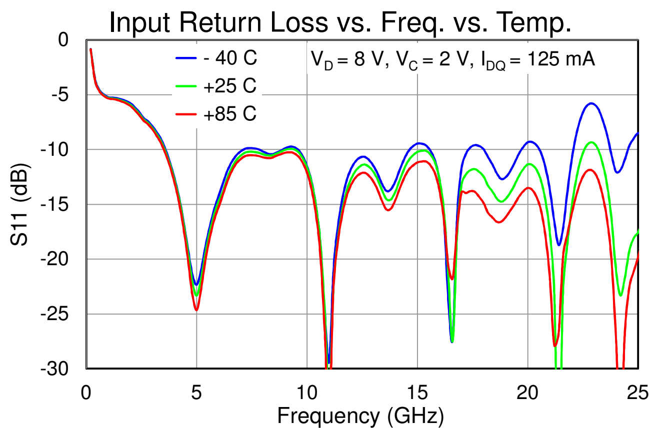
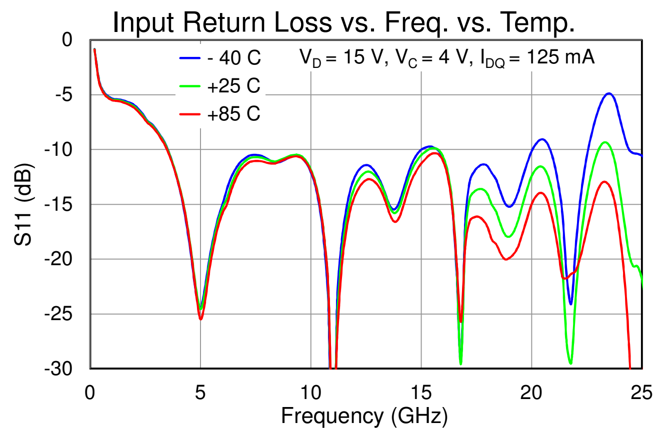
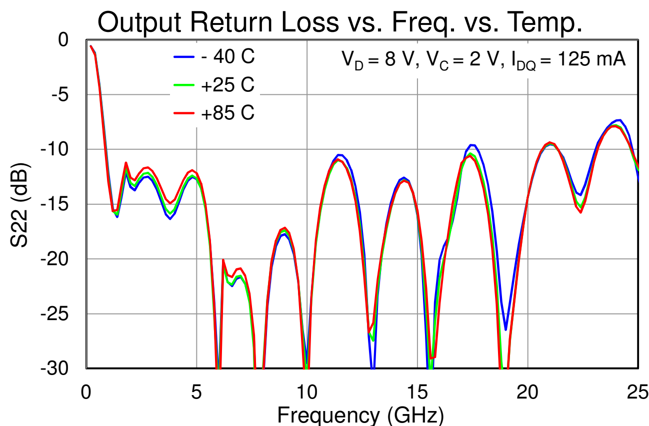
Typical Performance – Small Signal

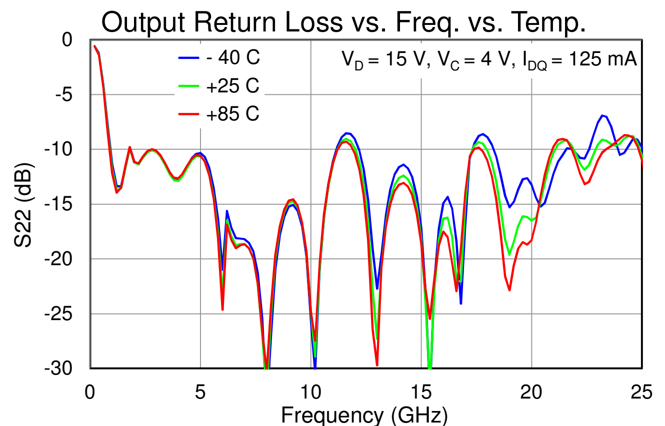












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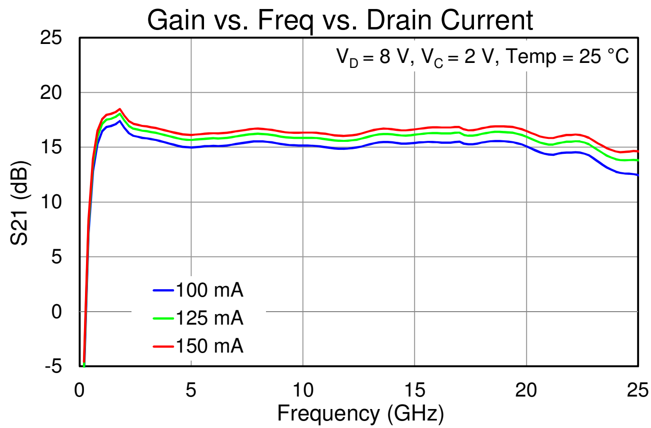
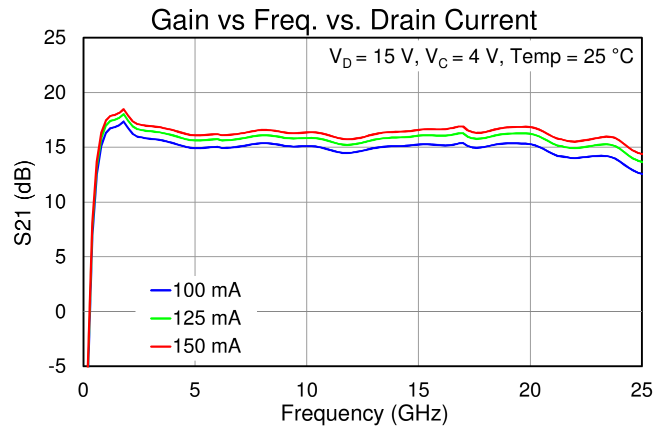
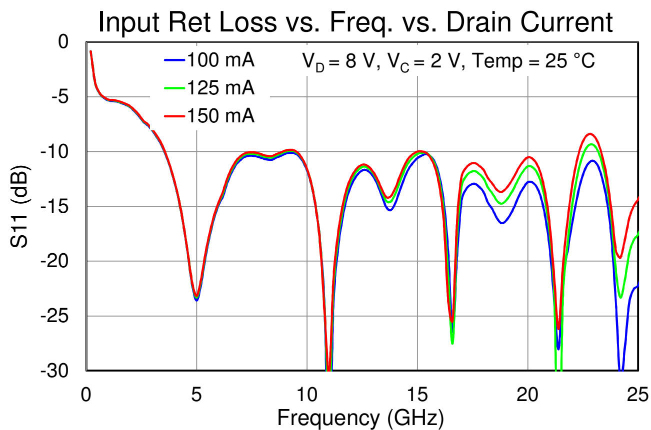
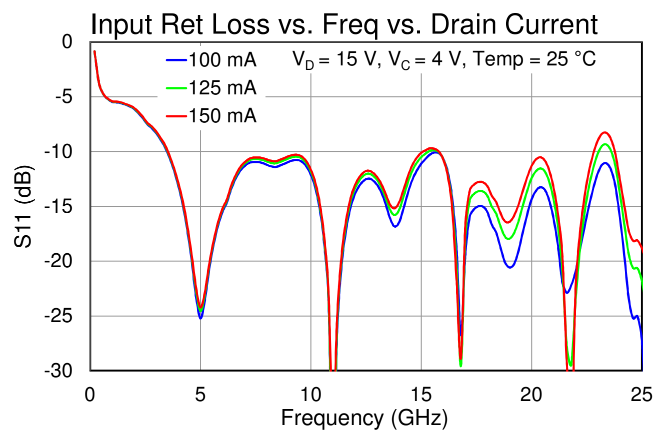
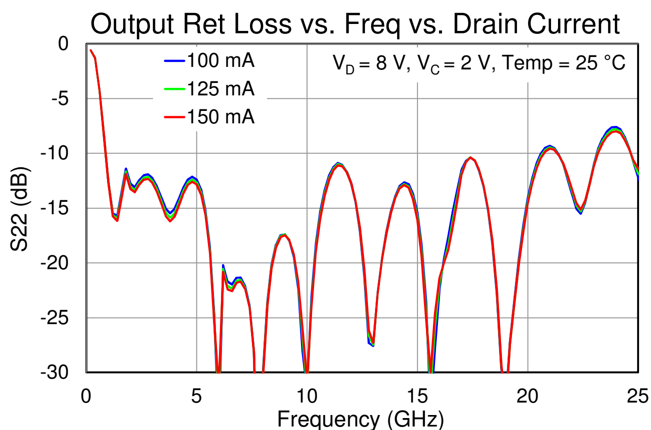
Typical Performance – Small Signal

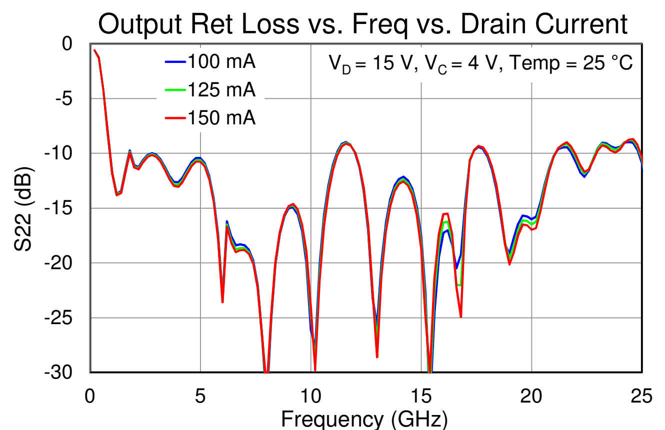












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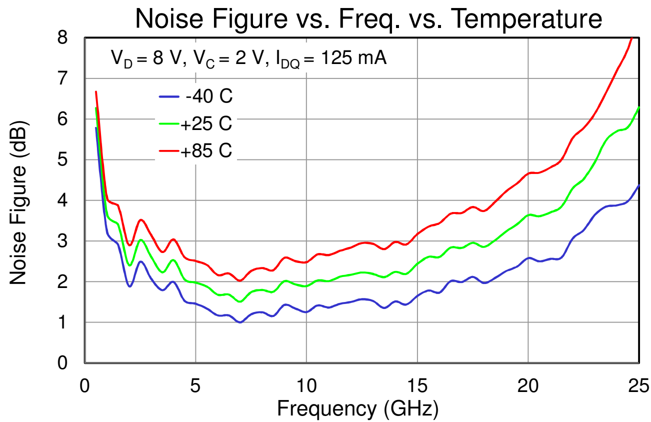
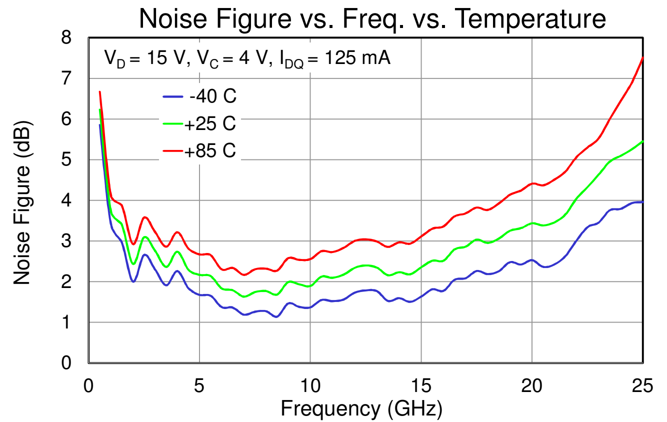
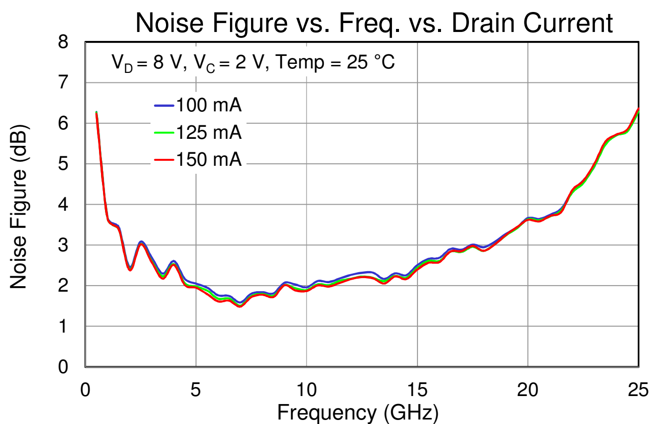
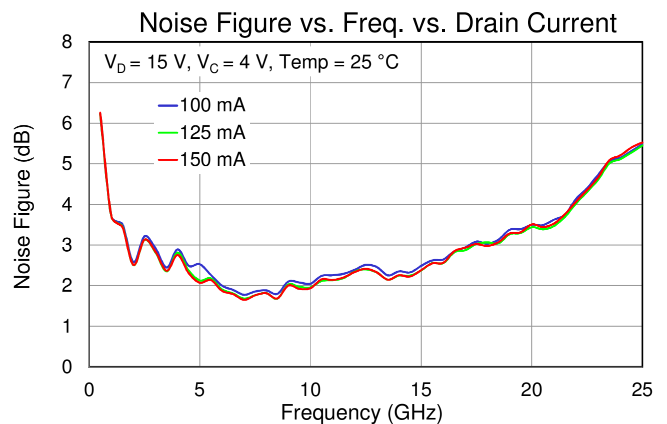
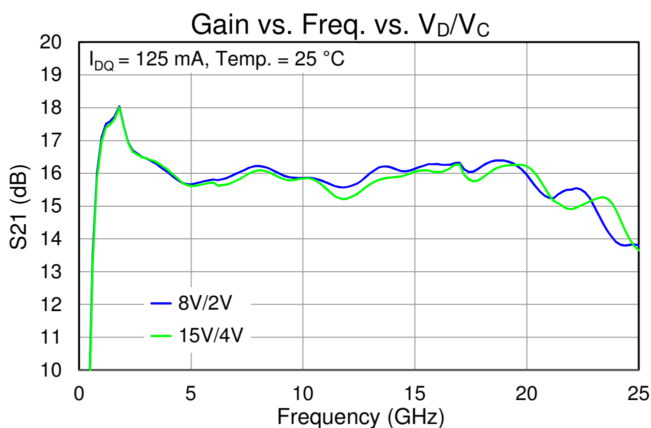
Typical Performance – Noise Figure

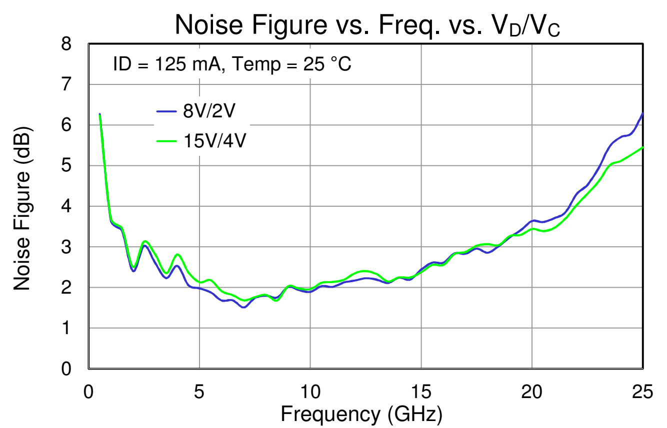












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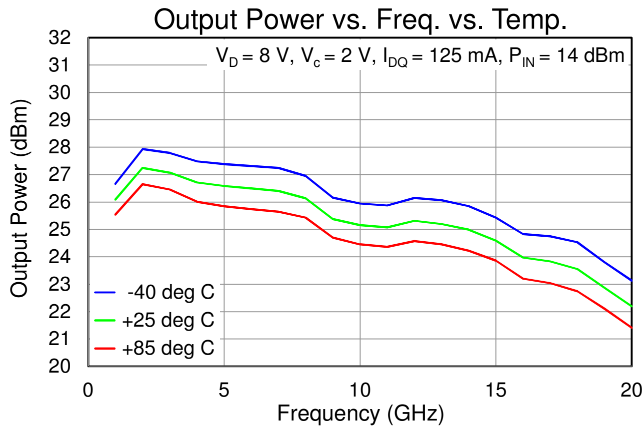
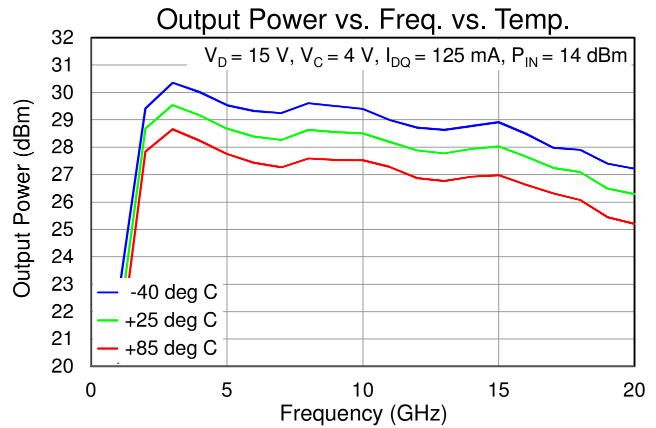
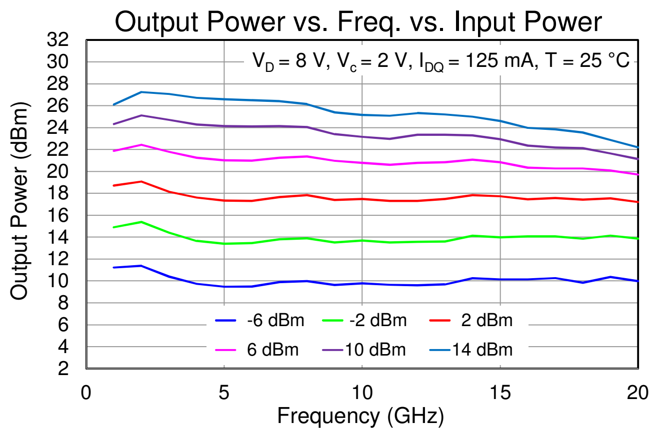
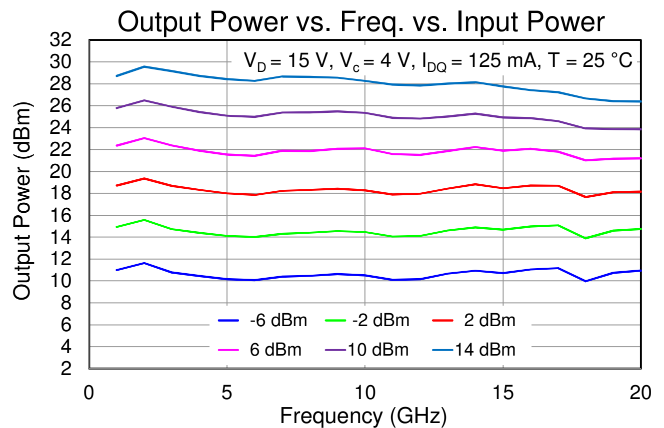
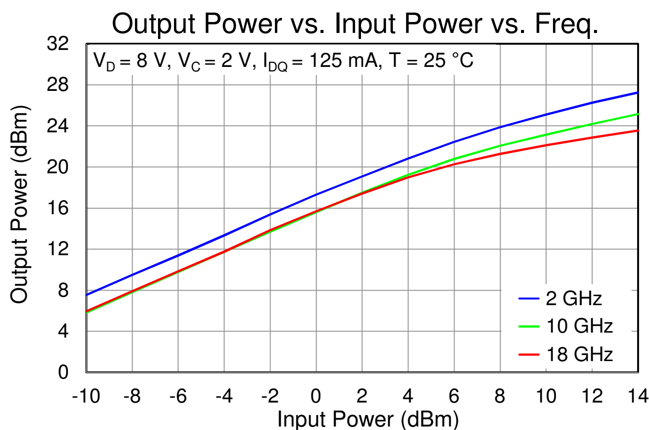
Typical Performance – Large Signal

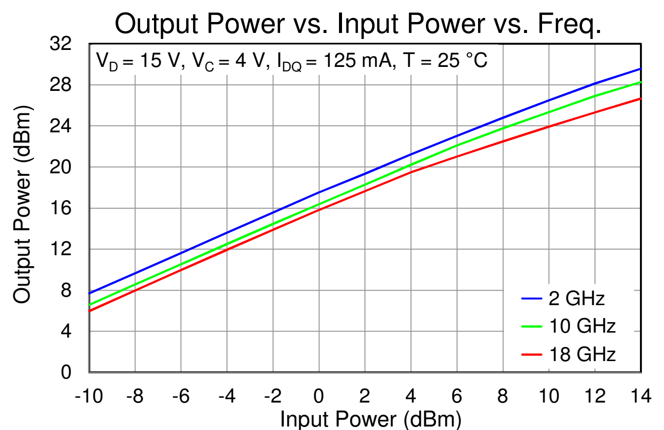












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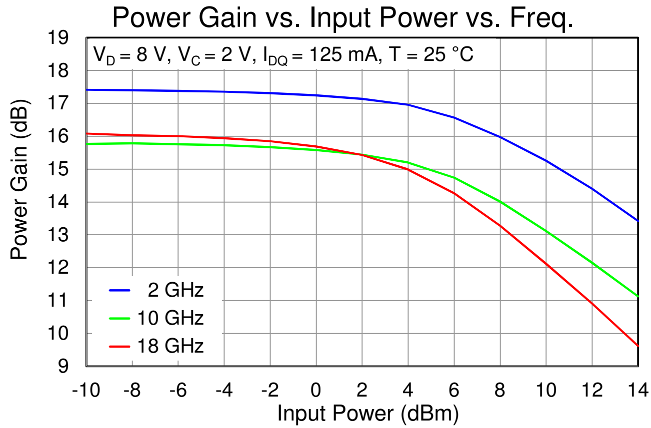
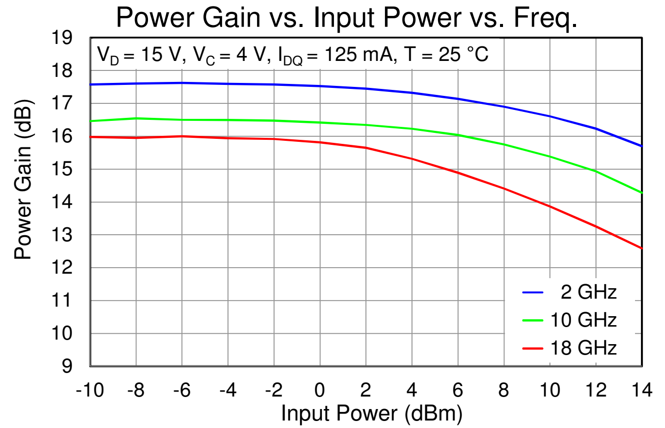
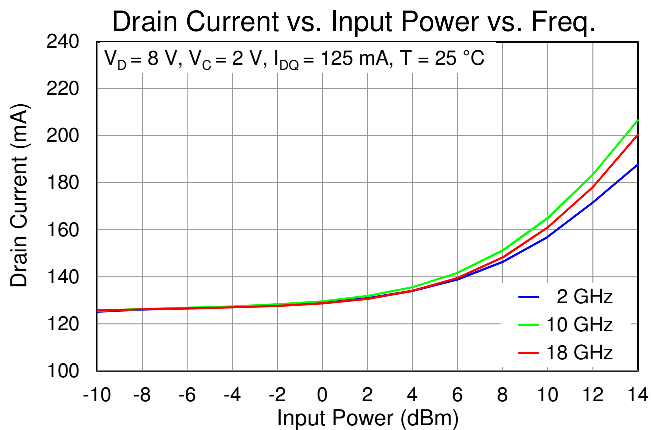
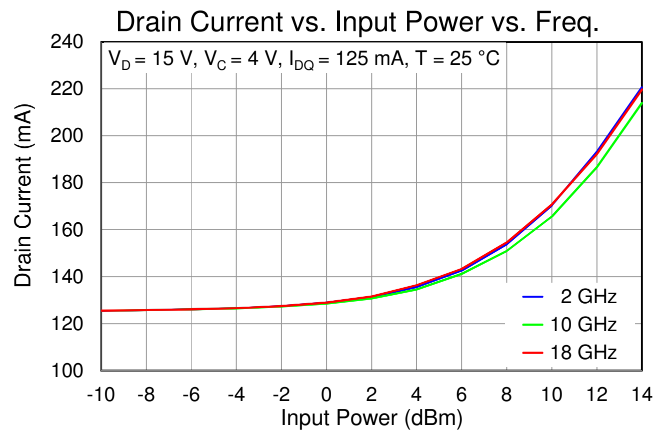
Typical Performance – Large Signal









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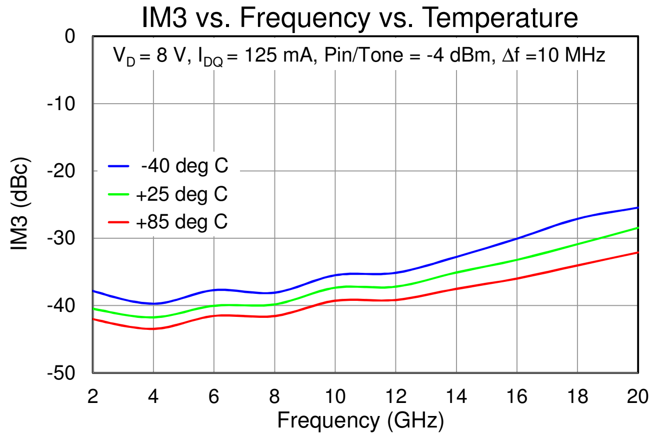
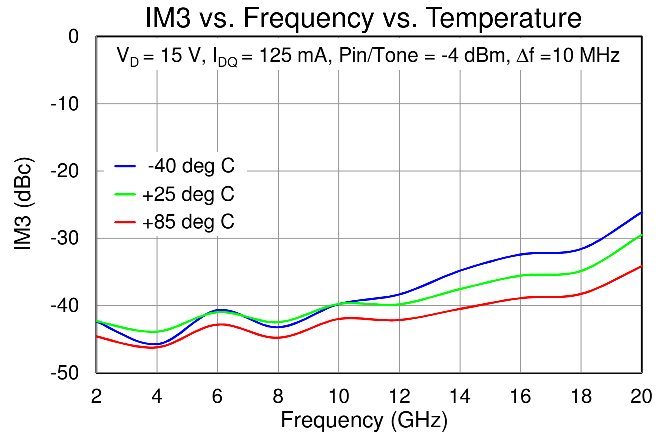
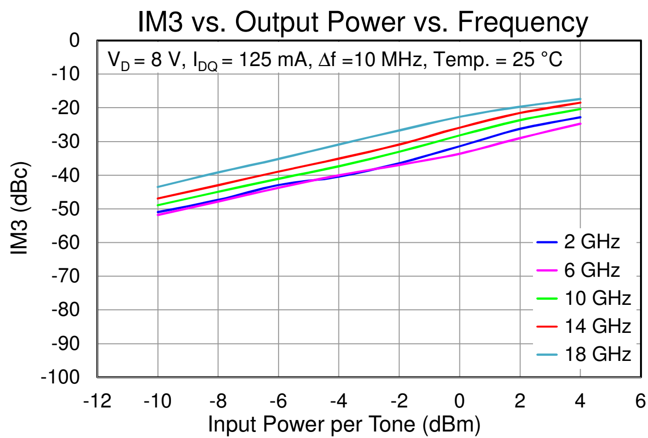
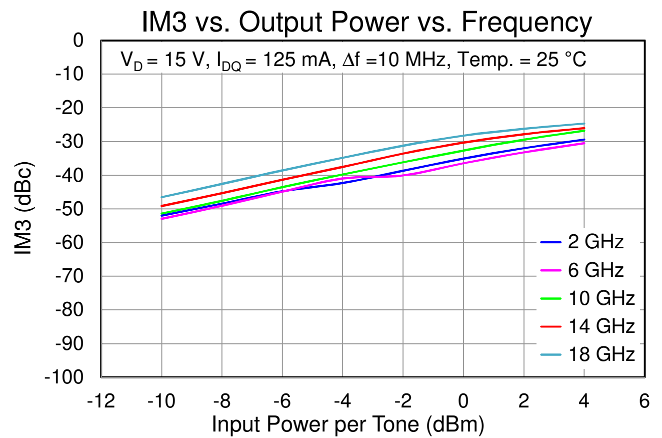
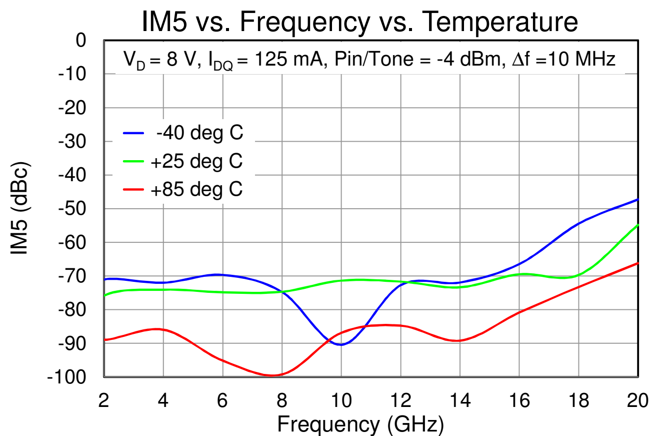
Typical Performance – Linearity

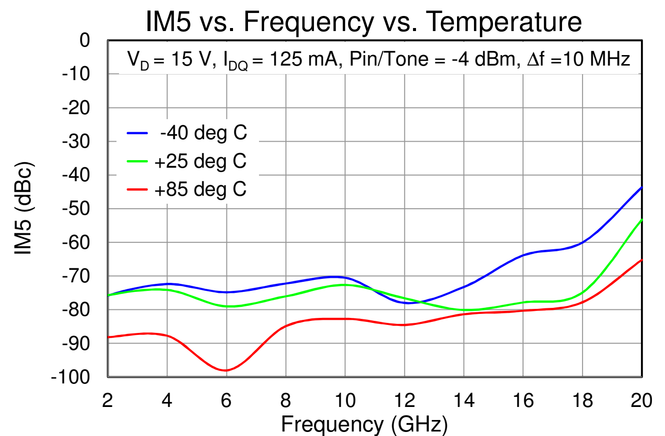












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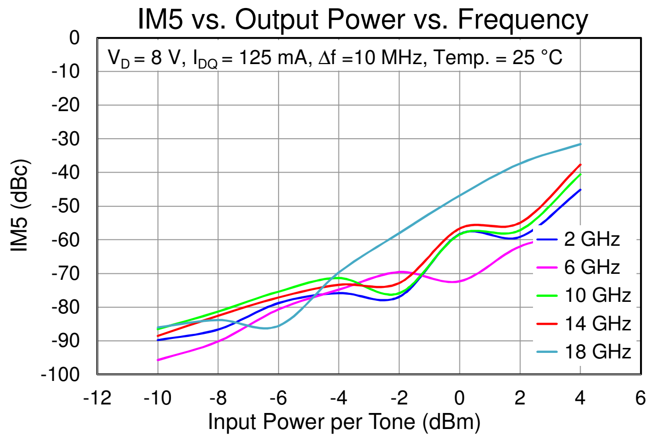
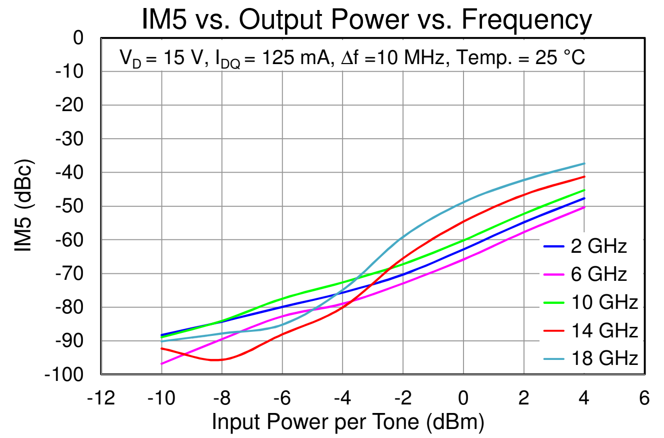
Typical Performance – Linearity





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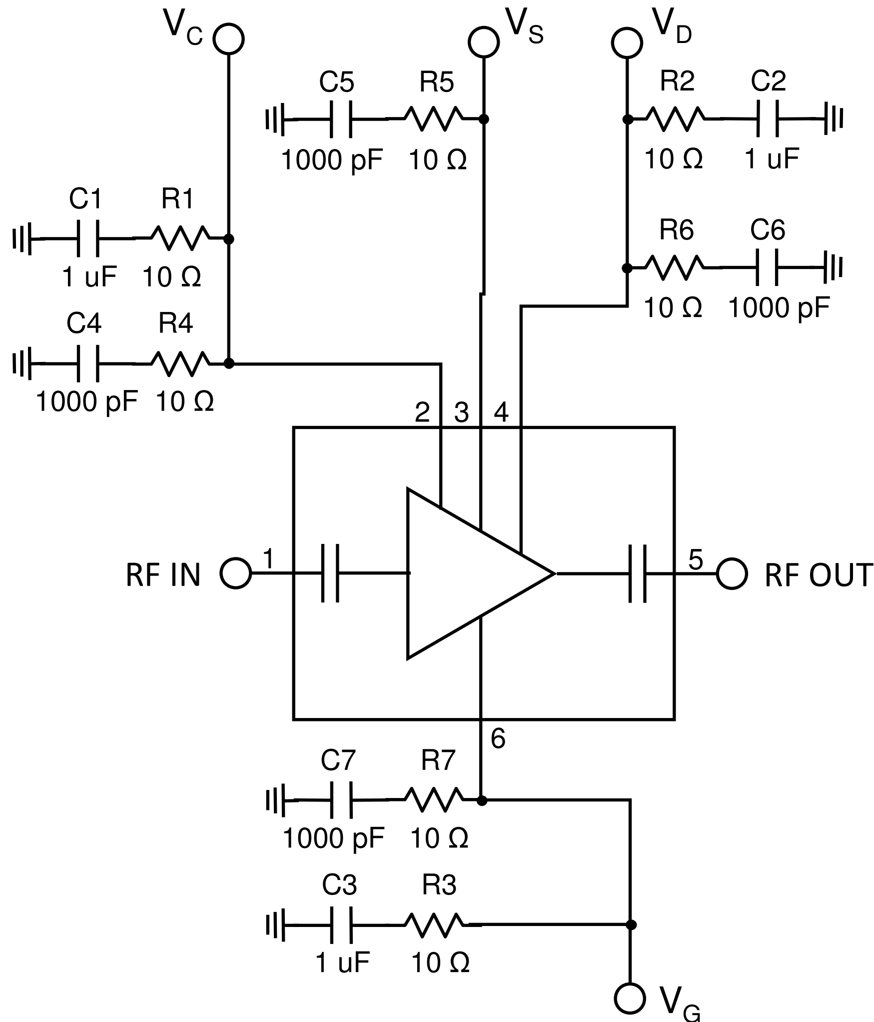
Application Circuit



Bias Up Procedure

1. Set V_G = -5.0 V, V_C = 0.0 V, V_D = 0.0 V
2. Adjust V_D to desired drain voltage
3. Adjust V_C to desired voltage
4. Adjust V_G until I_{DS} = 125 mA
5. Turn on RF signal

Bias-down Procedure

1. Turn off RF signal
2. Adjust V_G to -5.0 V
3. Adjust V_C to 0.0 V
4. Adjust V_D to 0.0 V
5. Adjust V_G to 0.0 V

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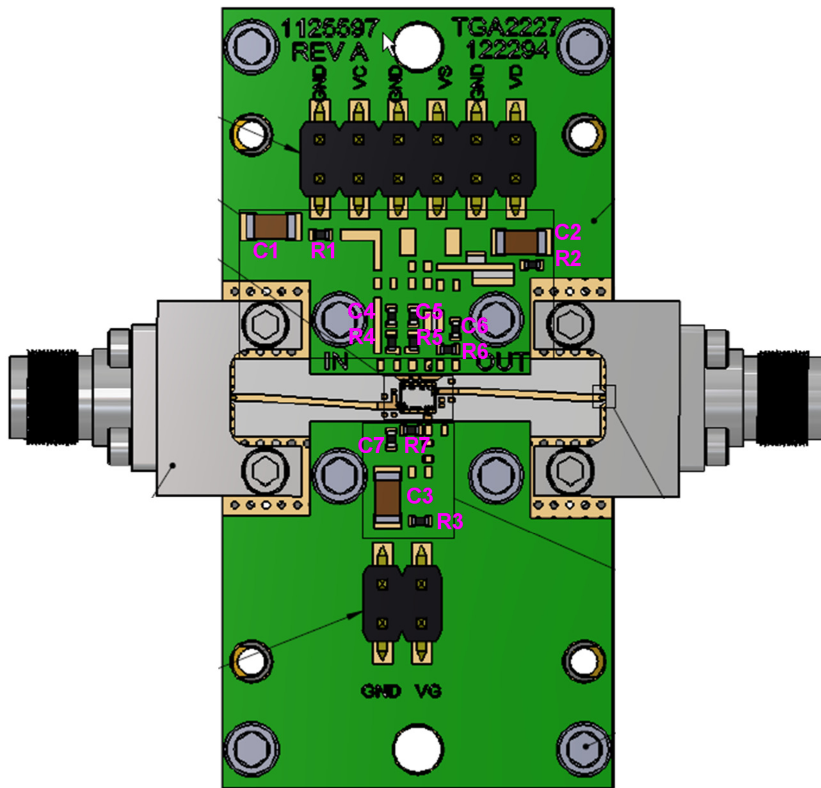
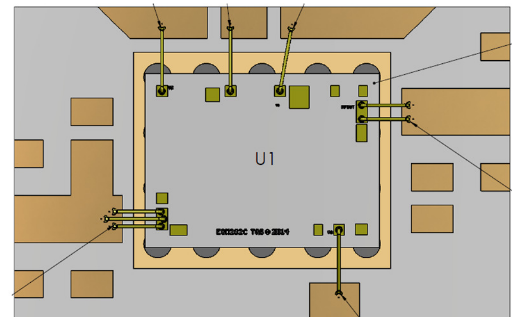
Evaluation Board and Mounting Detail





MMIC mounting/wire bonding detail

RF Layer is 0.008” thick Rogers Corp. RO4003C, ε_r = 3.38. Metal layers are 0.5 oz. copper. The microstrip line at the connector interface is optimized for the Southwest Microwave end launch connector 1092-01A-5.

The trace pattern shown has been developed and tested for optimized assembly at TriQuint Semiconductor. The PCB land pattern has been developed to accommodate lead tolerances. Since processes vary from company to company, careful process development is recommended.

Note: Conductive epoxy is used for attaching the die to the EVB PCB.

Note: Multiple vias should be employed under die to minimize inductance and thermal resistance.

Bill of Materials

Ref. Designation	Value	Description	Manufacturer	Part Number
C1 – C3	1 uF, 50 V, 5%	CAP X5R 1206	Various	
C4 – C7	1000 pF, 50 V, 10%	CAP X7R 0402	Various	
R1 – R2, R4 – R7	10 Ohm, 5%	RES 0402, SMD	Various	
R3	Not used			

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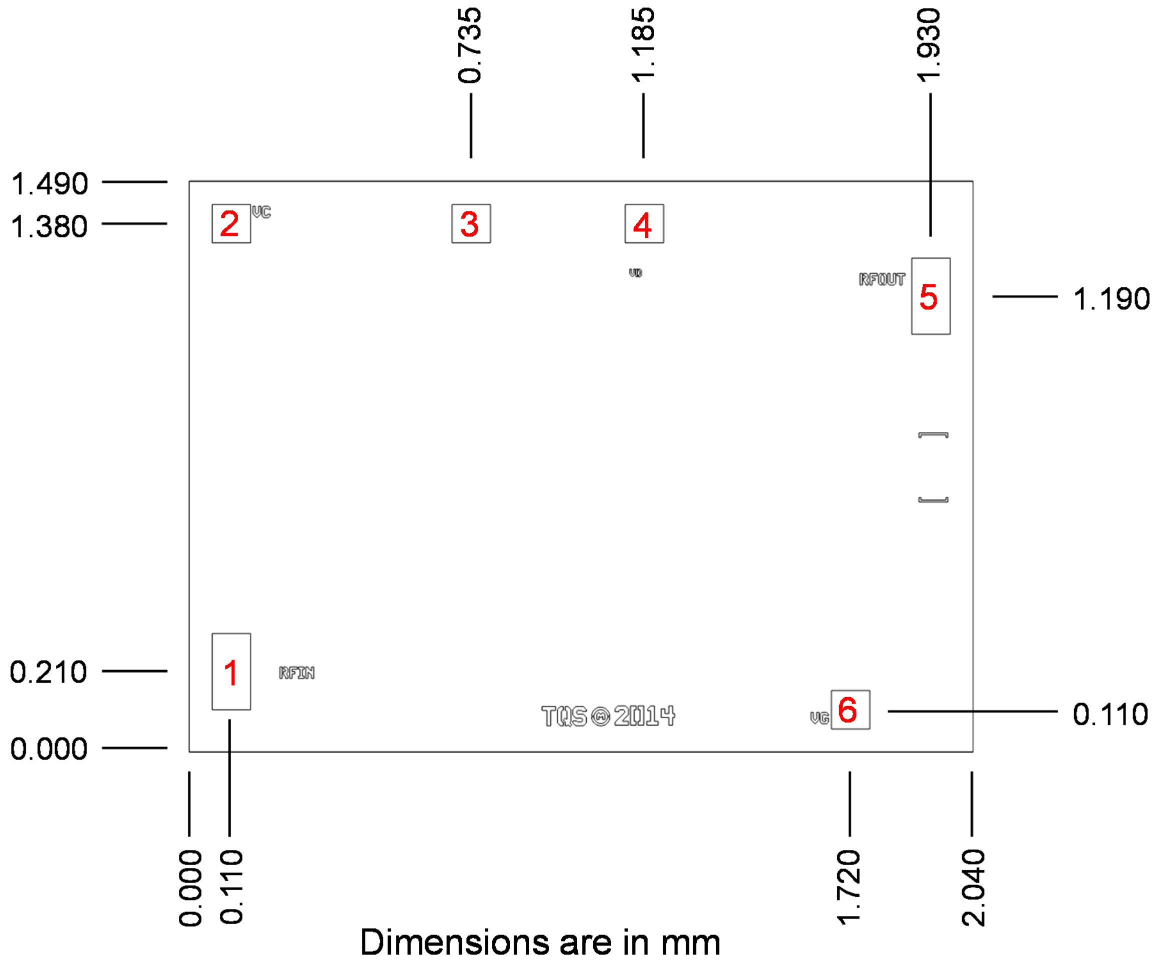
Mechanical Drawing and Bond Pad Description



Pad Number	Symbol	Description	Pad Size (um x um)
1	RF Input	RF input pad, DC blocked	100 x 200
2	V_C	Cascode voltage	100 x 100
3	V_S	Drain voltage monitor	100 x 100
4	V_D	Drain voltage	100 x 100
5	RF Output	RF output pad, DC blocked	100 x 200
6	V_G	Gate voltage	100 x 100

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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 and for die attach to soft substrates.
- 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 ultrasonics are critical parameters.
- Aluminum wire should not be used.
- Devices with small pad sizes should be bonded with 0.0007-inch wire.

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Product Compliance Information

ESD Sensitivity Ratings

Caution! ESD-Sensitive Device

ESD Rating: TBD
Value: TBD
Test: Human Body Model (HBM)
Standard: JEDEC Standard JESD22-A114

ECCN

US Department of Commerce: EAR99

Solderability

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

Conductive epoxy die attach is recommended for soft substrate PCBs.

RoHS-Compliance

This part is compliant with EU 2002/95/EC RoHS directive (Restrictions on the Use of Certain Hazardous Substances in Electrical and Electronic Equipment).

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, and information about TriQuint:

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Email:	**info-sales@tqs.com**	**Fax:**	**+1.972.994.8504**

For technical questions and application information: **Email: info-products@tqs.com**

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