Product Description

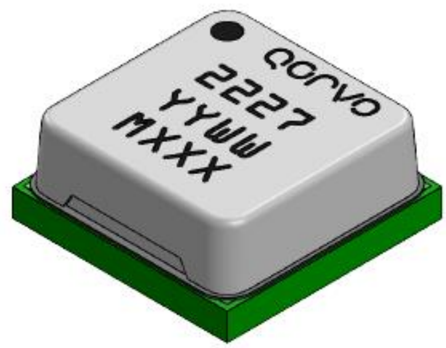
The TGA2227–SM is a packaged, low noise amplifier offering high electrical performance, along with exceptional robustness to incident power. Fabricated on Qorvo's 0.15 um GaN on SiC production process (QGaN15), the TGA2227–SM operates over 2 – 22 GHz and delivers >15 dB small signal gain and >+22 dBm P1dB while supporting 2 dB mid-band Noise Figure.

Robustness to incident power levels of up to 10 Watts is an industry first for a low noise MMIC amplifier and cannot be achieved in competing technologies. This supports potential system cost savings and board area reduction by removal of receive protection circuitry. This would also improve system-level noise figure.

The TGA2227–SM is an ideal choice for radar and EW applications as well as high power communication systems and test and measurement across commercial and military markets.

Lead–Free and RoHS compliant.

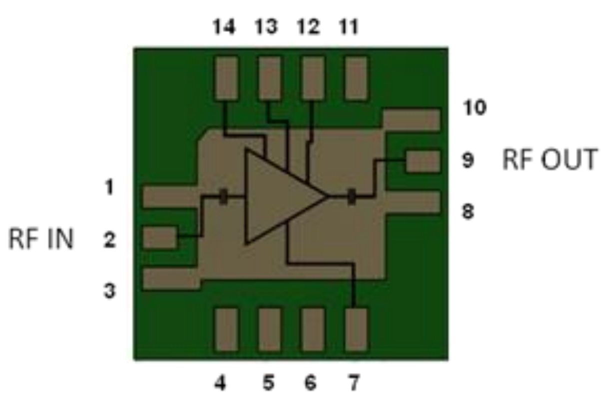
Evaluation boards are available upon request.



Product Features

- List Frequency Range: 2 – 22 GHz
- High Input Power Survivability: 40 dBm
- Noise Figure: 2.0 dB (mid–band)
- Gain > 15 dB
- IM3: −36.5 dBc (P_{IN}/tone =−4 dBm, Δf=10 MHz)
- P1dB > +22 dBm
- Bias: V_D = +8 V, I_{DQ} = 125 mA
- Operating Drain Voltage Range: +5 to +15 V
- Package Dimensions: 4.0 mm x 4.0 mm x 1.7 mm

Functional Block Diagram



Applications

- Commercial & Military Communications
- Commercial & Military Radar
- Electronic Warfare
- Instrumentation
- LNA, Driver, Gain Block, General Amplification

Ordering Information

Part No.	ECCN	Description
TGA2227-SM	EAR99	2 – 22 GHz GaN LNA
TGA2227-SM_EVB	EAR99	2 – 22 GHz GaN LNA Evaluation Board

Absolute Maximum Ratings

Parameter	Range / Value	Units
Drain Voltage (V_D)	+29.5	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 °C, 50 Ω)	+40	dBm
Channel Temperature (T_{CH})	+275	°C
Mounting Temperature (30 seconds maximum)	+260	°C
Storage Temperature	−55 to +150	°C

Maximum V_C is dependent on the V_D used.

Operation of this device outside the parameter ranges given above may cause permanent damage.

Recommended Operating Conditions

Parameter	Min	Typ	Max	Units
Drain Voltage (V_D), Low Pdiss Bias	+5	+8	+20	V
Drain Voltage (V_D), Power Bias	–	+15	–	V
Quiescent Drain Current (I_{DQ})	–	125	–	Ma
Gate Voltage (V_G)	–	−2.5	–	V
Cascode Voltage (V_C), Low Pdiss Bias	–	+2	–	V
Cascode Voltage (V_C), Power Bias	–	+4	–	V
Operating Temperature Range	−40	–	+85	°C

Electrical performance is measured under conditions noted in the electrical specifications table. Specifications are not guaranteed over all recommended operating conditions.

Electrical Specifications – Low Pdiss Bias

Parameter	Conditions	Min	Typ	Max	Units
Operational Frequency Range	–	2	–	22	GHz
Small Signal Gain	–	–	15.7	–	dB
Noise Figure	–	–	2.6	–	dB
Input Return Loss	–	–	10	–	dB
Output Return Loss	–	–	12	–	dB
P_{SAT}	–	–	+26.3	–	dBm
P_{1dB}	–	–	+23.0	–	dBm
IM3	P_{IN} / tone = −4 dBm, Δf = 10 MHz	–	−36.5	–	dBc
S21 Temperature Coefficient	–	–	−0.024	–	dB / °C
NF Temperature Coefficient	–	–	0.013	–	dB / °C

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

Electrical Specifications – Power Bias

Parameter	Conditions	Min	Typ	Max	Units
Operational Frequency Range	–	2	–	22	GHz
Small Signal Gain	–	–	15.7	–	dB
Noise Figure	–	–	2.7	–	dB
Input Return Loss	–	–	10	–	dB
Output Return Loss	–	–	12	–	dB
P_{SAT}	P_{IN} = +14 dBm	–	27.9	–	dBm
P_{1dB}	–	–	25.4	–	dBm
IM3	P_{IN} / tone = −4 dBm, Δf = 10 MHz	–	-41.8	–	dBc
S21 Temperature Coefficient	–	–	−0.025	–	dB / °C
NF Temperature Coefficient	–	–	0.012	–	dB / °C

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

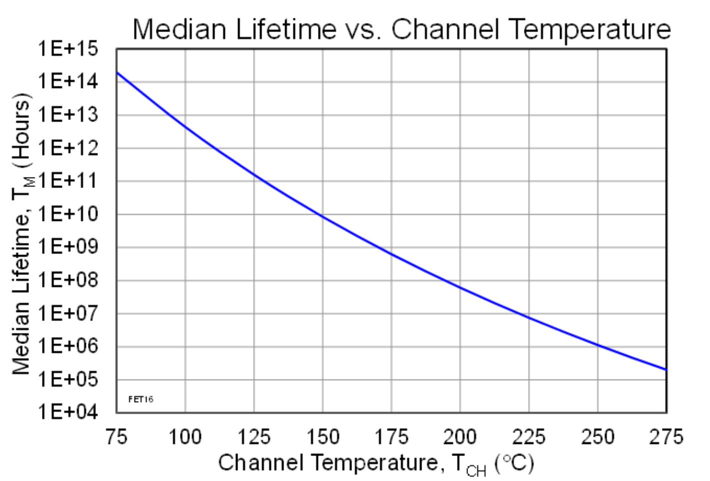
Thermal and Reliability Information

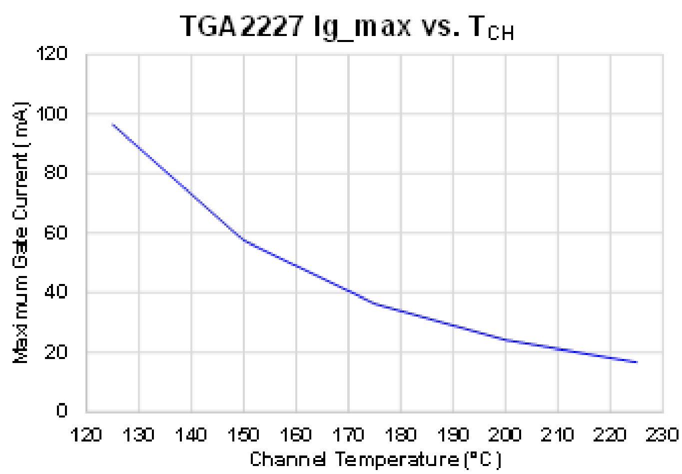
Parameter	Test Conditions	Value	Units
Thermal Resistance (θ_{JC}) (1)	T_{BASE} = +85 °C, V_D = +8 V, V_C = +2.0 V, V_G = −2.4 V, I_{D_DRIVE} = 125 mA, P_{IN} = −10 dBm, P_{OUT} = +6 dBm, P_{DISS} = 1.00 W	5.87	°C/W
Channel Temperature (T_{CH}) (1)		92.1	°C
Median Lifetime (T_M)		1.29E+16	Hrs.
Thermal 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} = 1.875 W	9.79	°C/W
Channel Temperature (T_{CH}) (1)		98.6	°C
Median Lifetime (T_M)		3.81E+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} = 230 mA, P_{IN} = +16 dBm, P_{OUT} = +28.4 dBm, P_{DISS} = 2.301 W	9.78	°C/W
Channel Temperature (T_{CH}) (1)		99.8	°C
Median Lifetime (T_M)		3.05E+15	Hrs.

Notes:
1. Package backside temperature fixed at 85 °C.

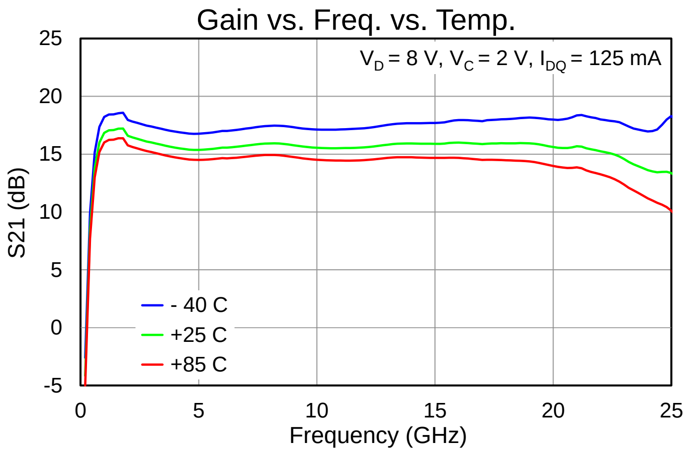
Median Lifetime

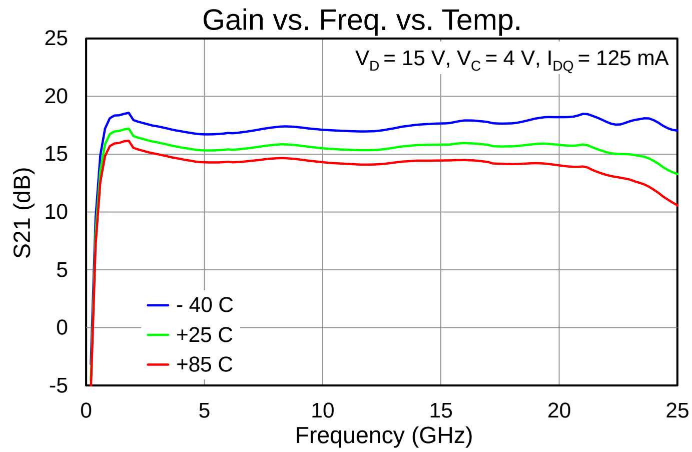
Test Conditions: V_D = 28 V; Failure Criterion = 10% reduction in ID MAX

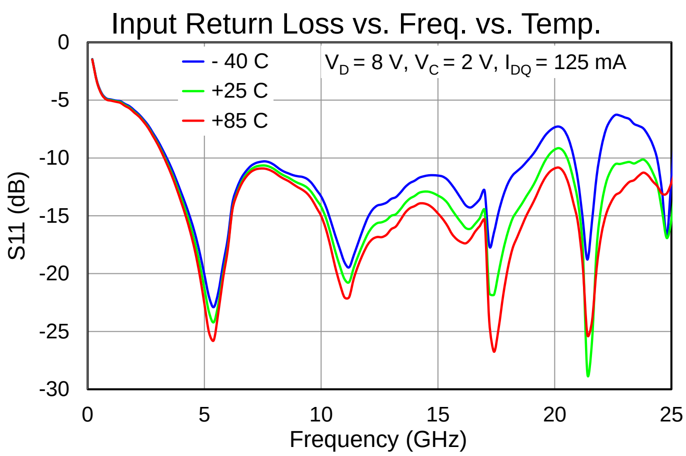


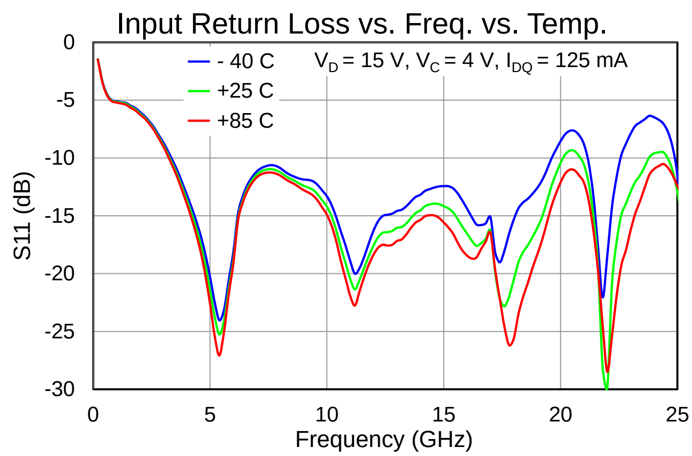


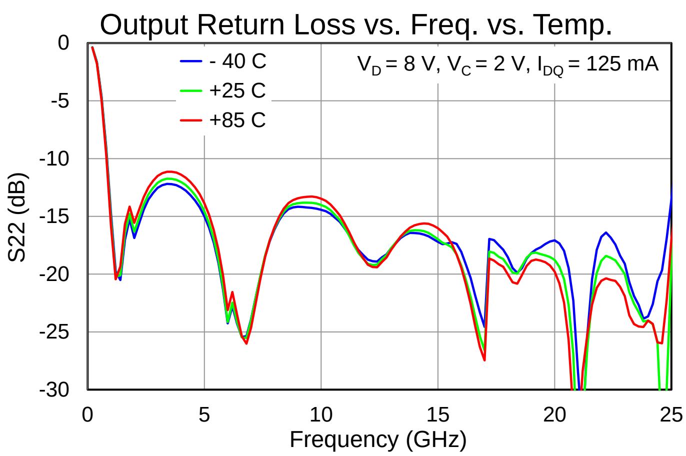
Performance Plots – Small Signal

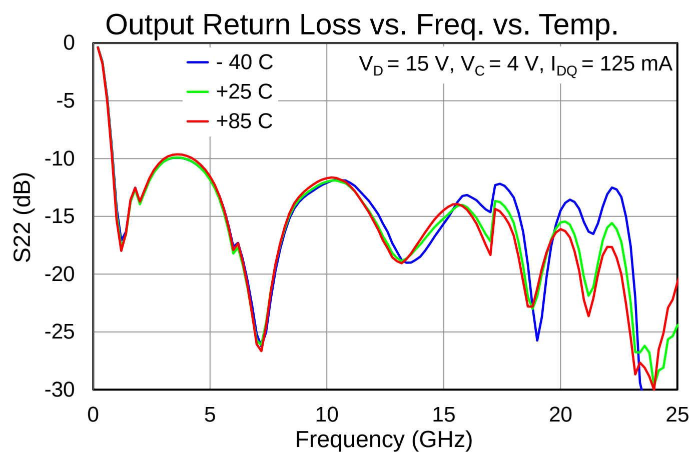




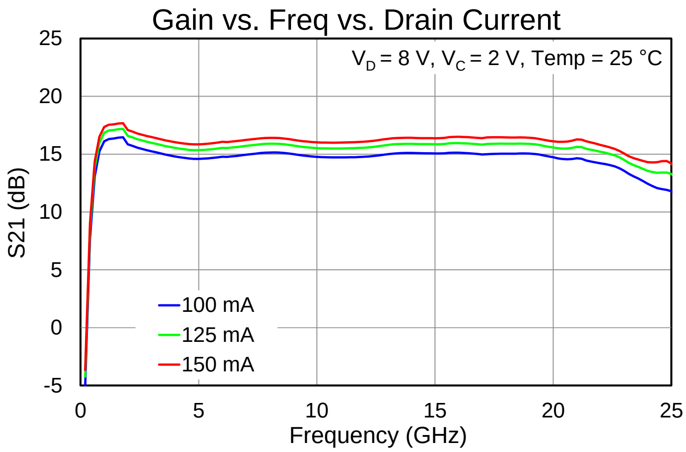


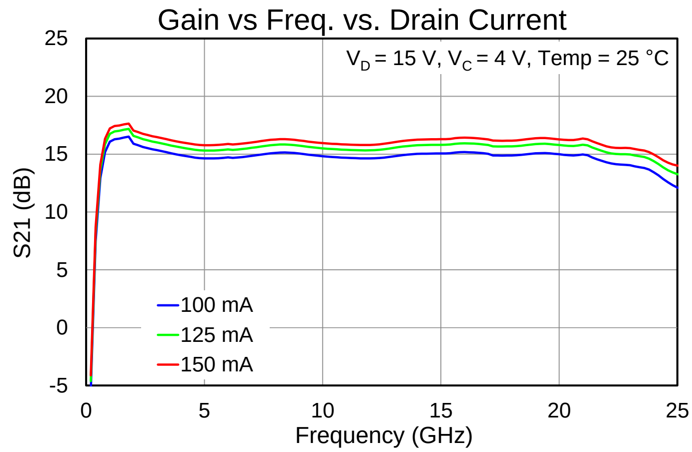


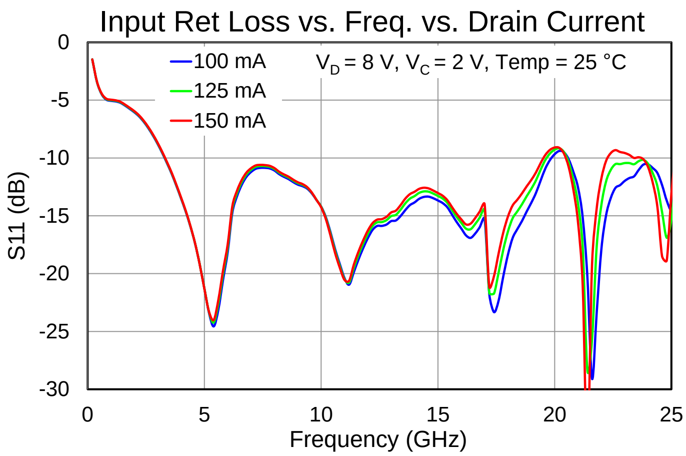


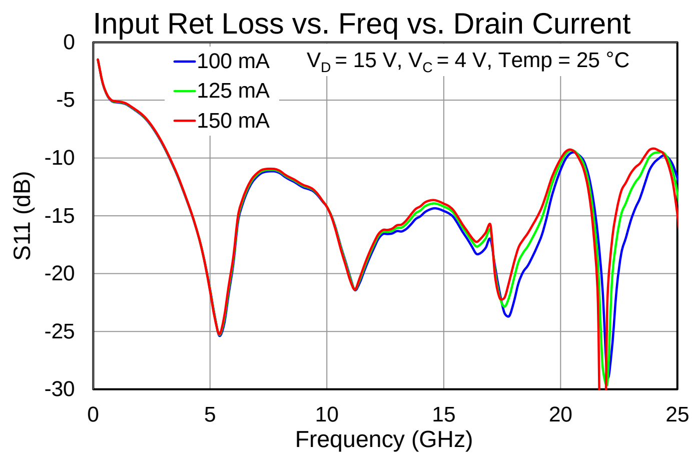


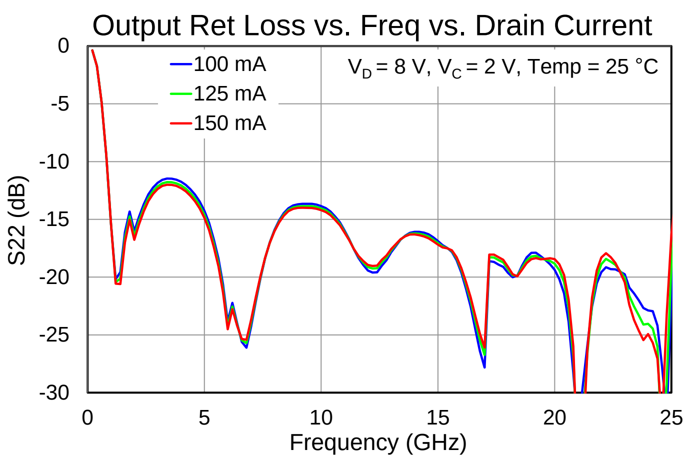
Performance Plots – Small Signal

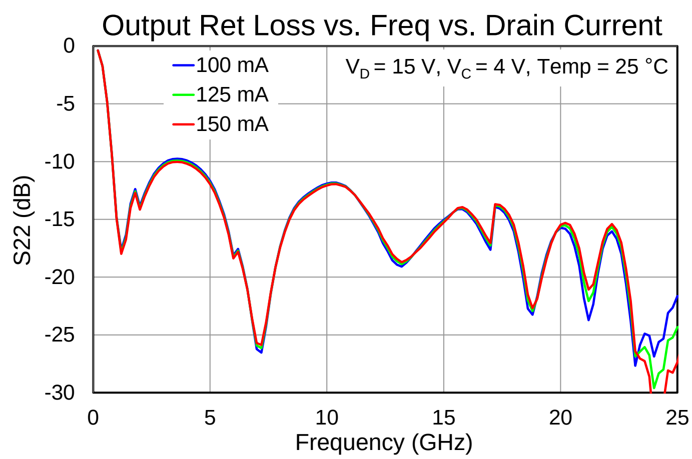




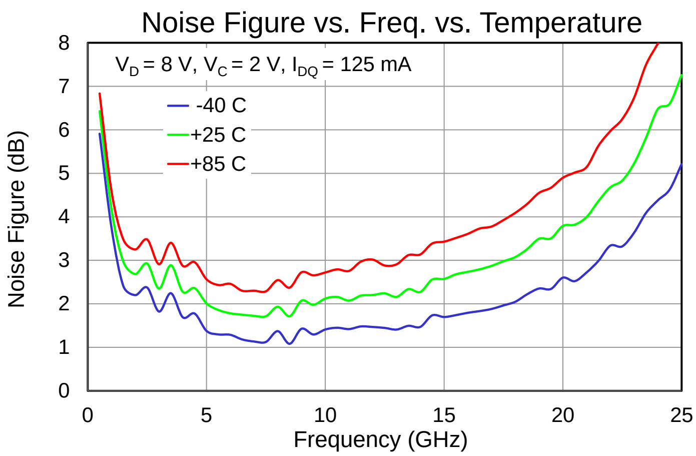


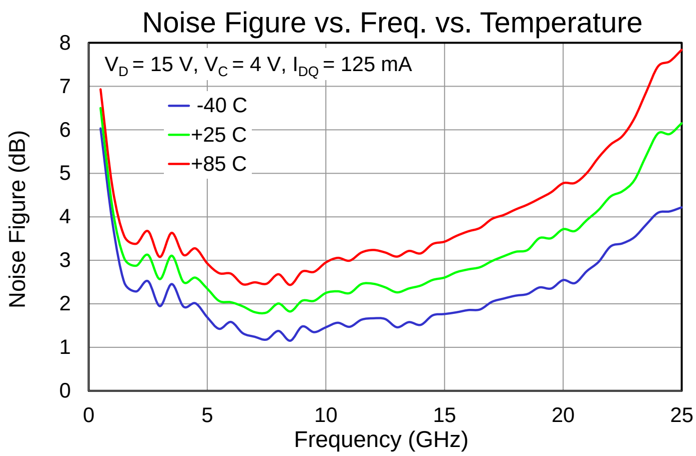


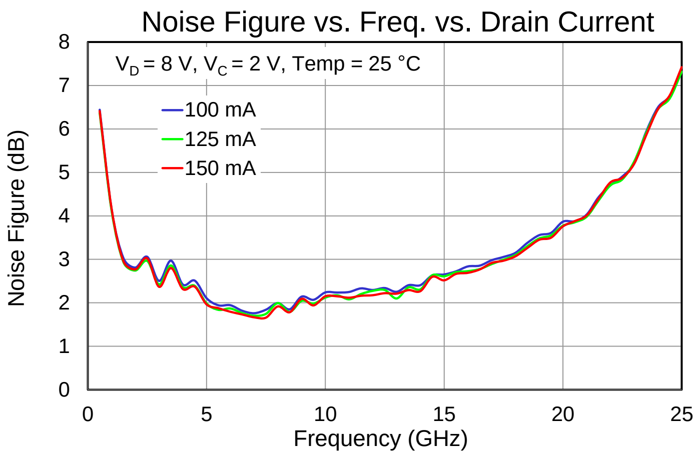


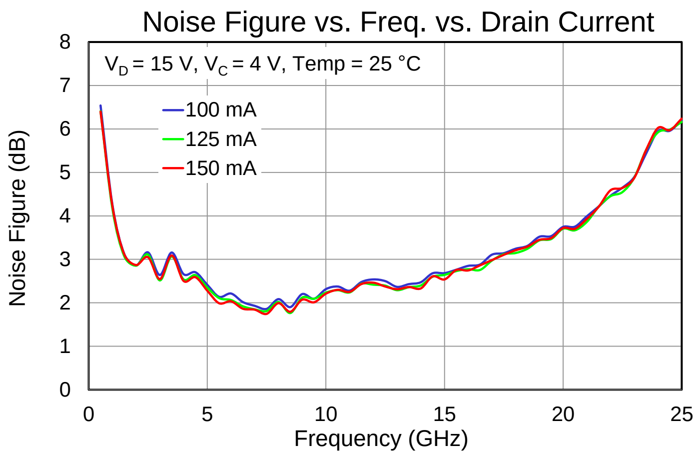


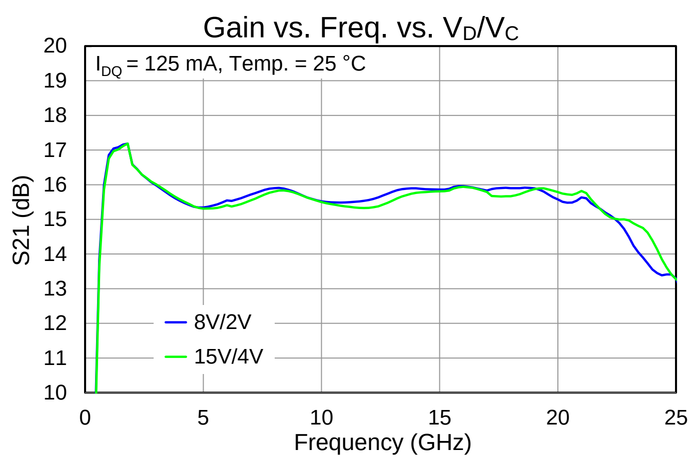
Performance Plots – Noise Figure

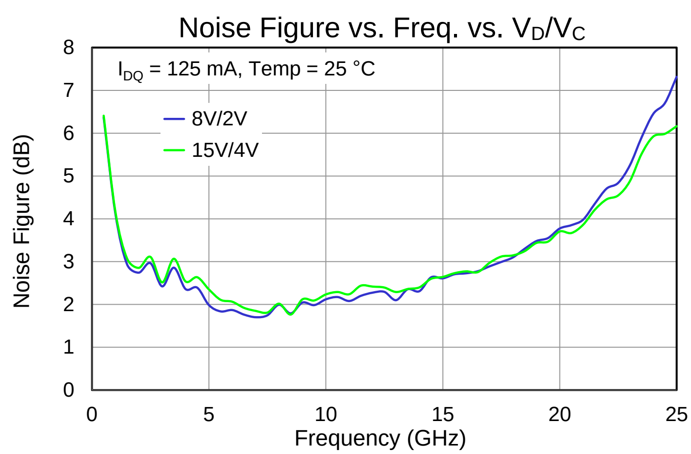




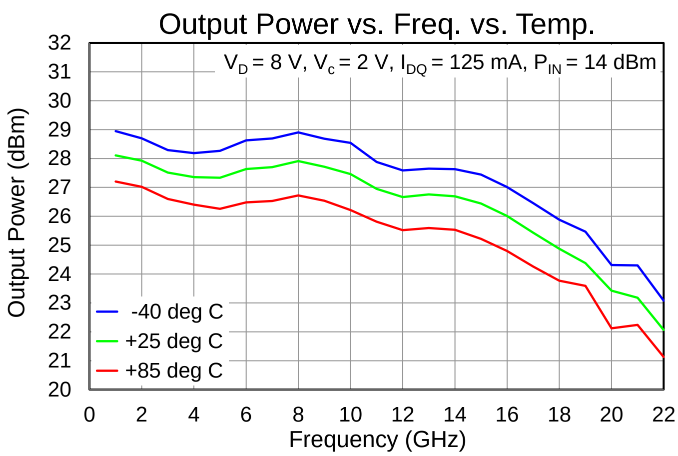


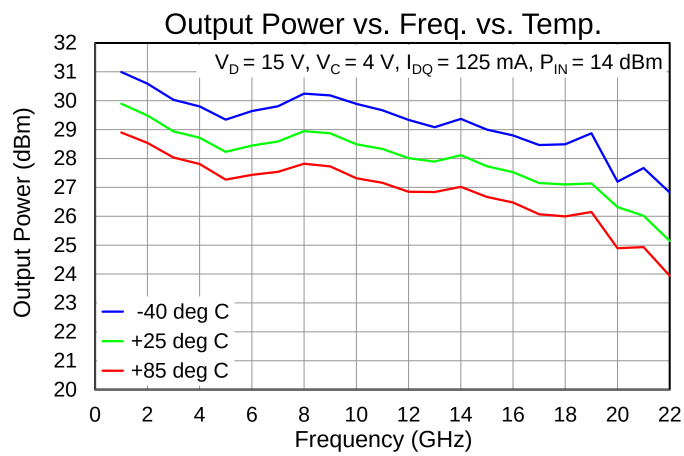


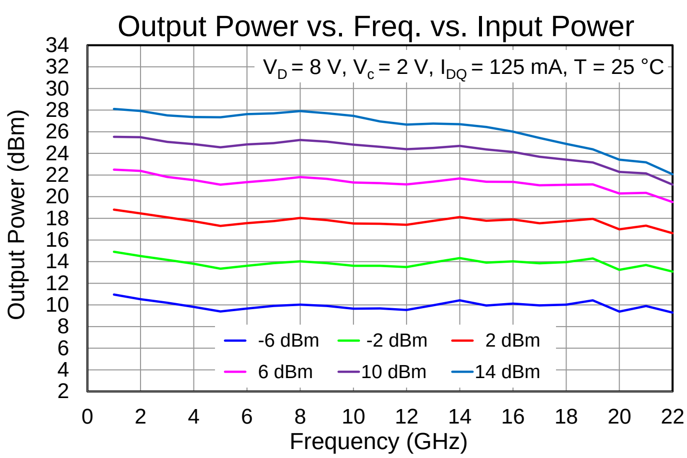


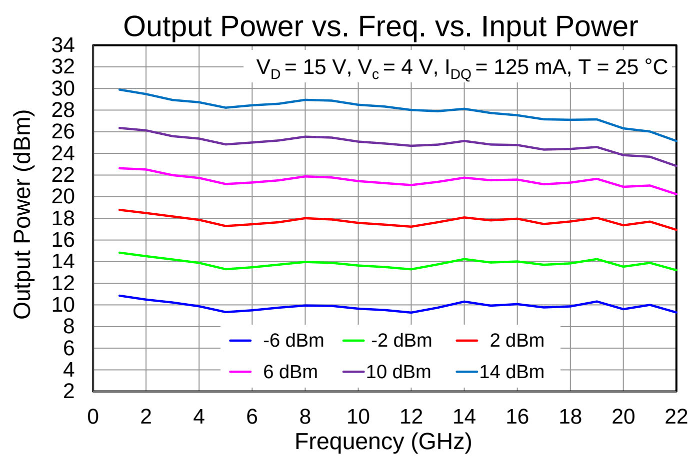


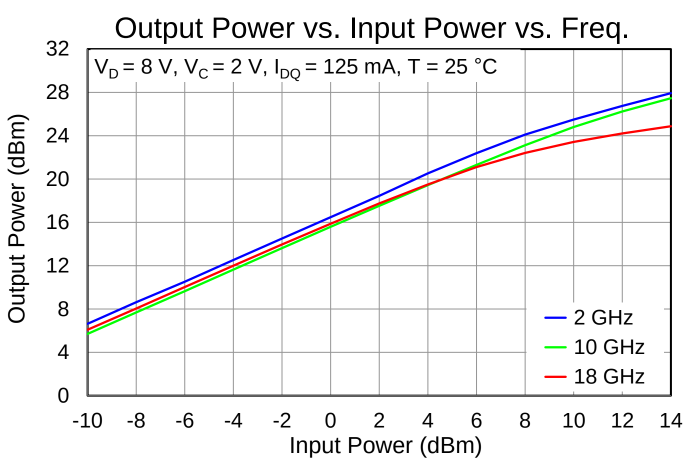
Performance Plots – Large Signal

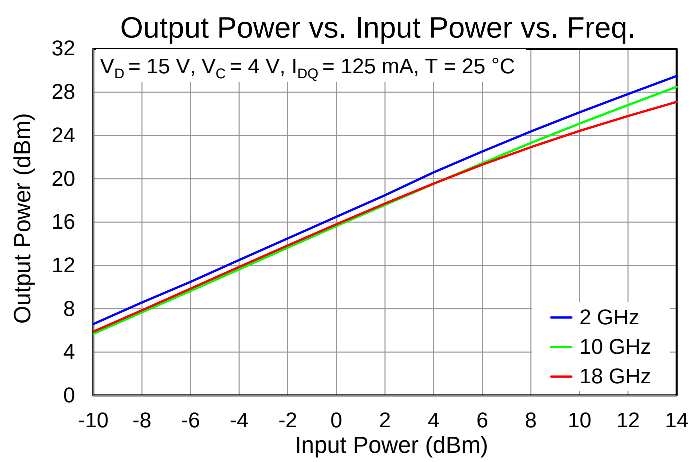




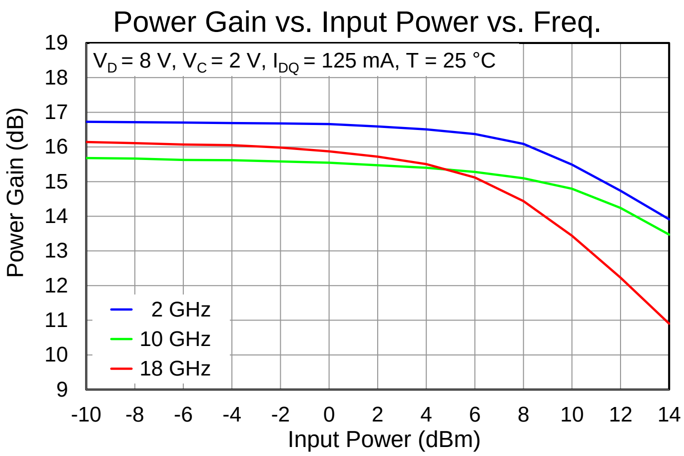


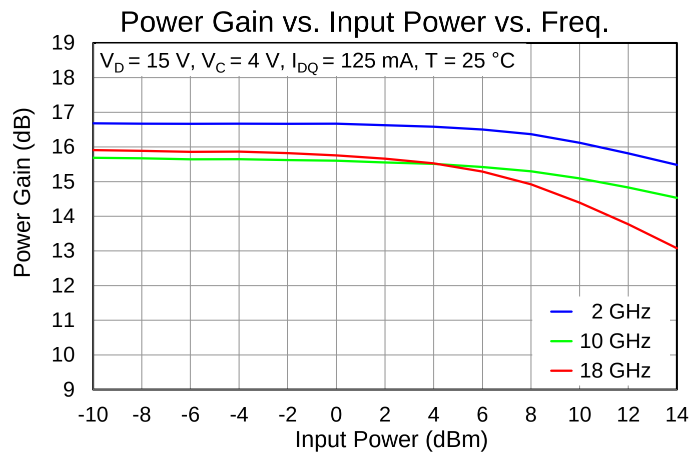


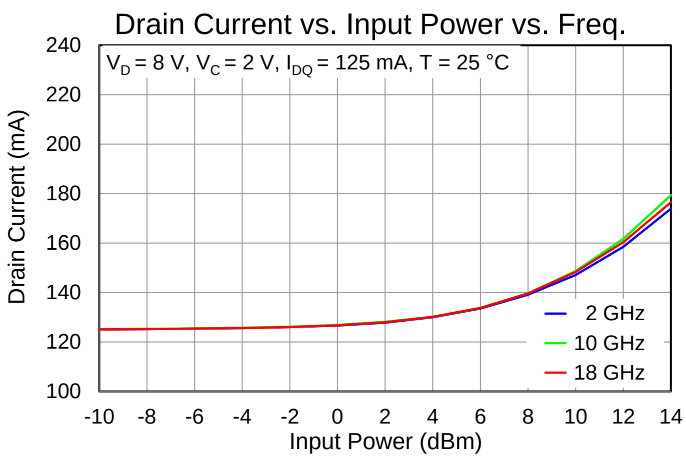


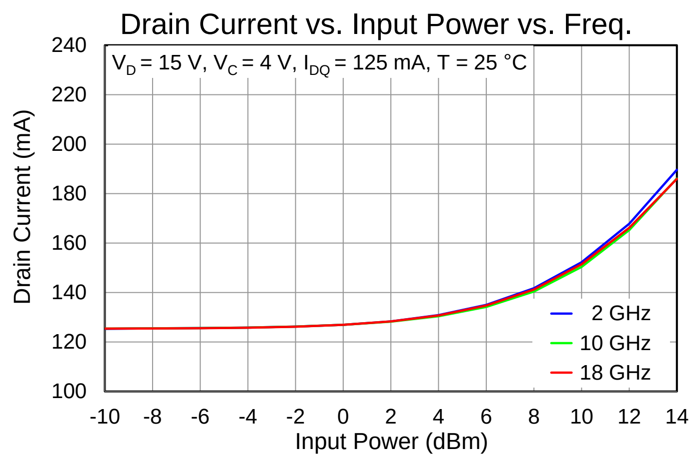


Performance Plots – Large Signal

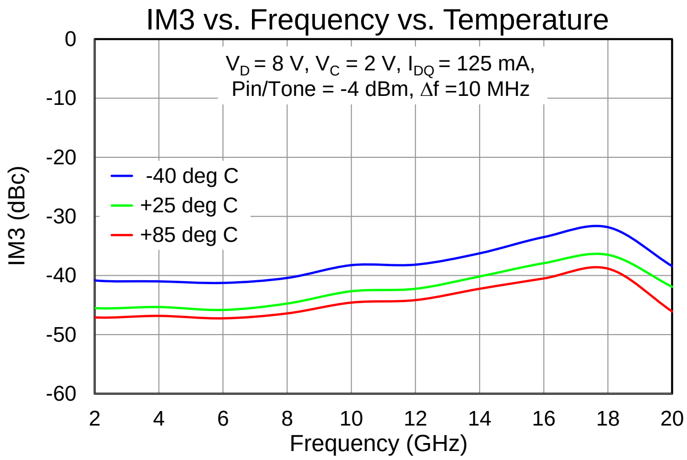


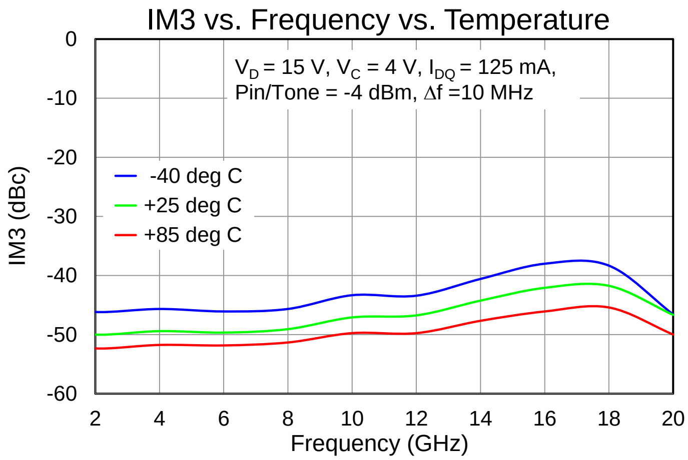


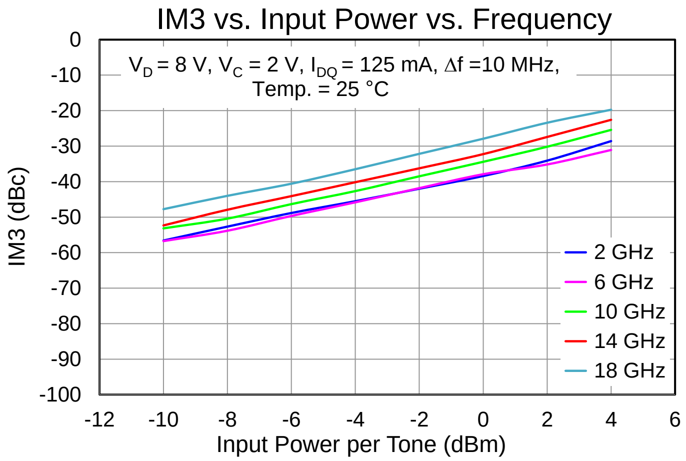


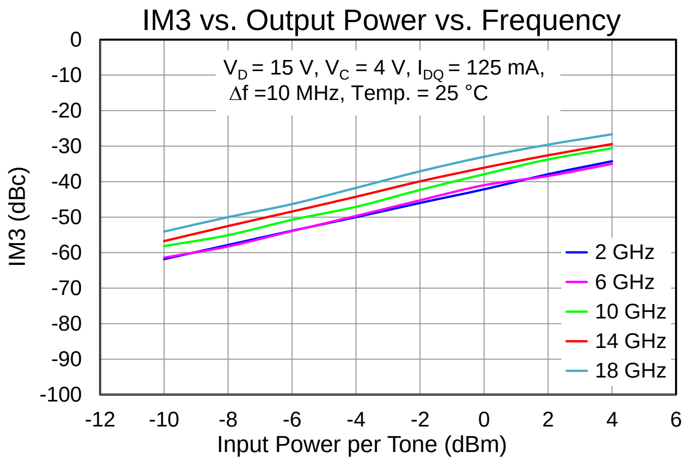


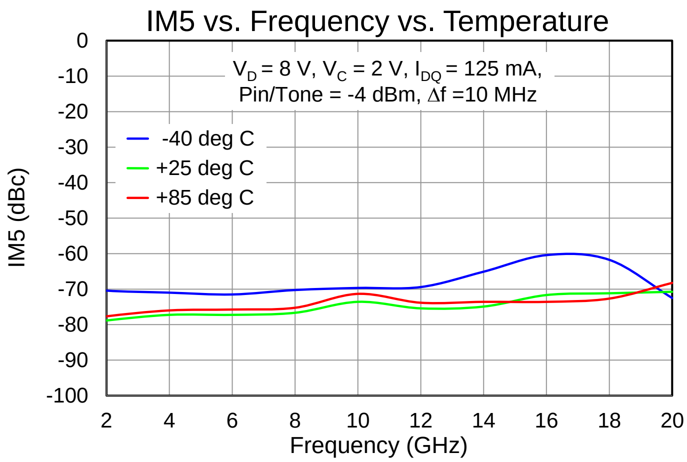
Performance Plots – Linearity

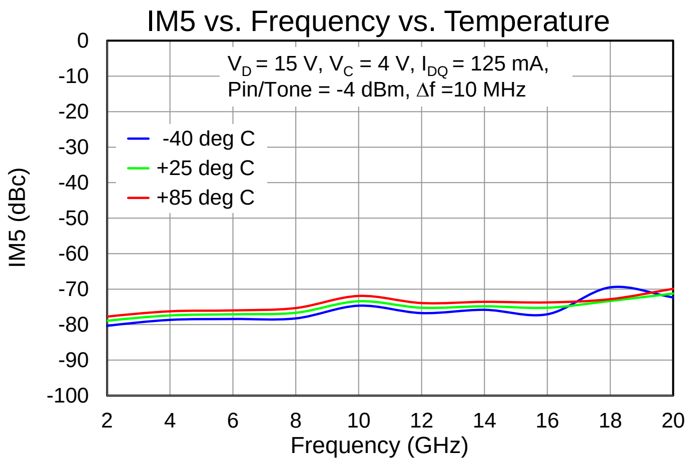












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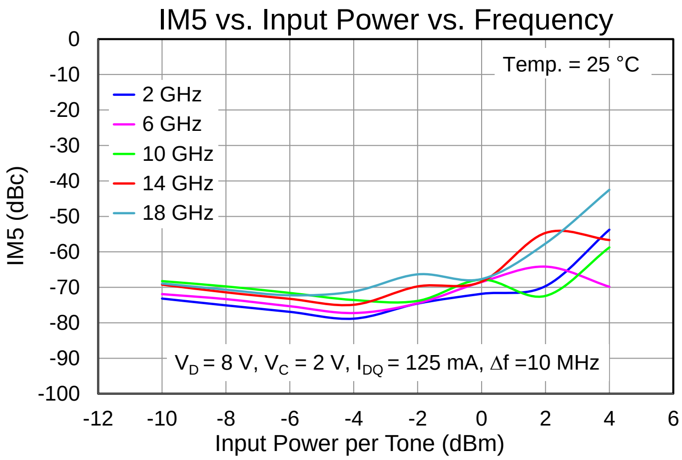
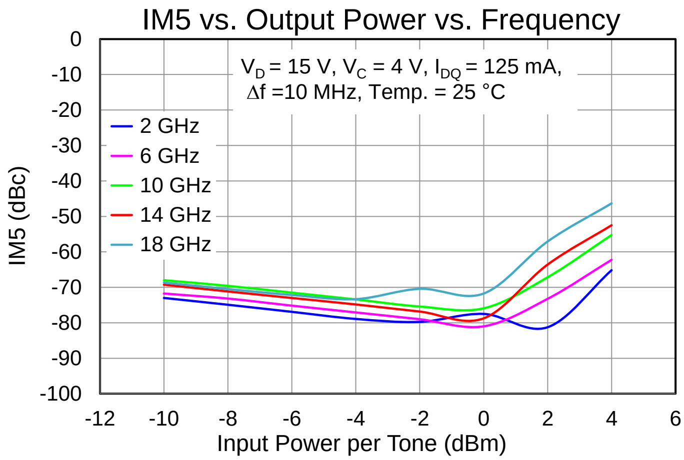
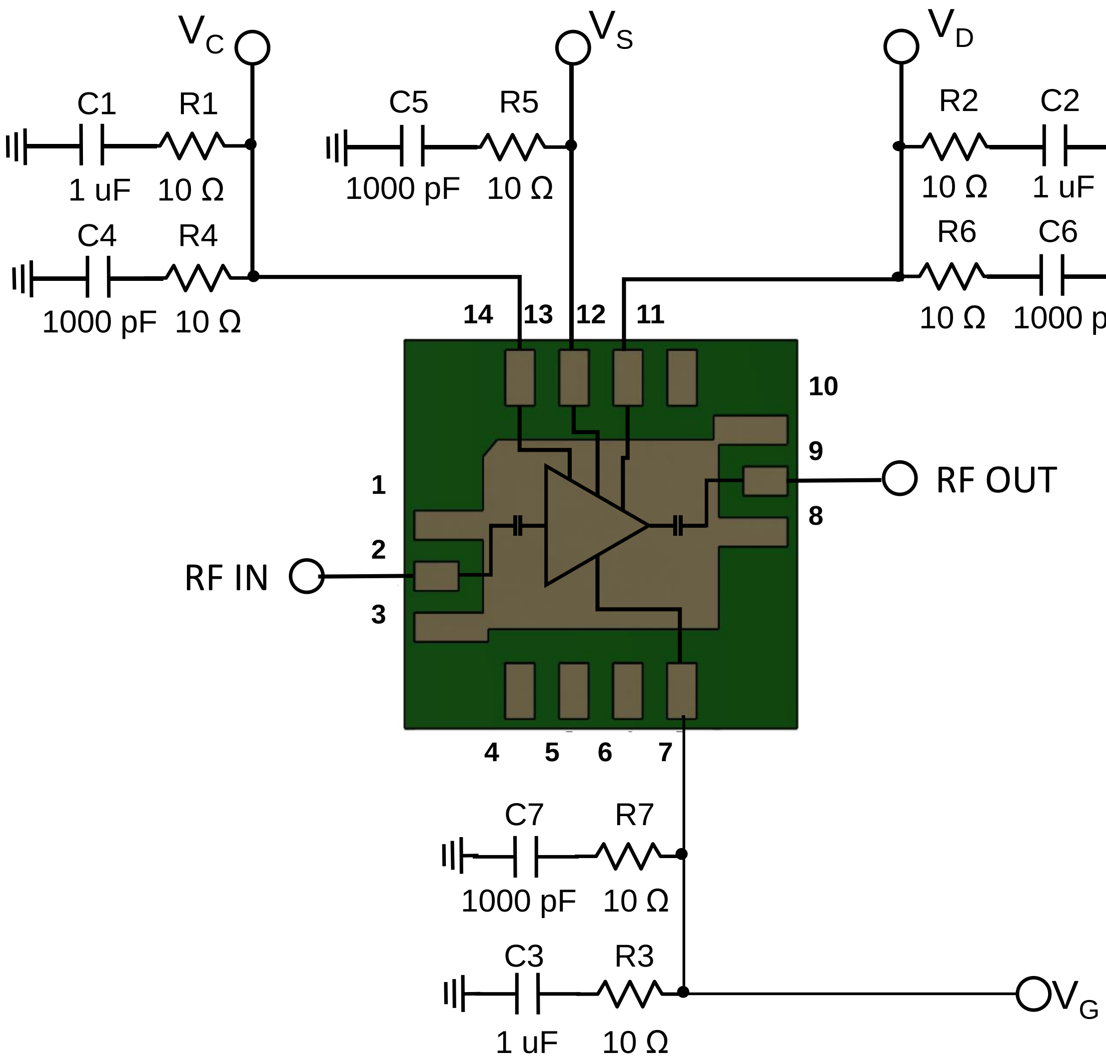




Application Circuit



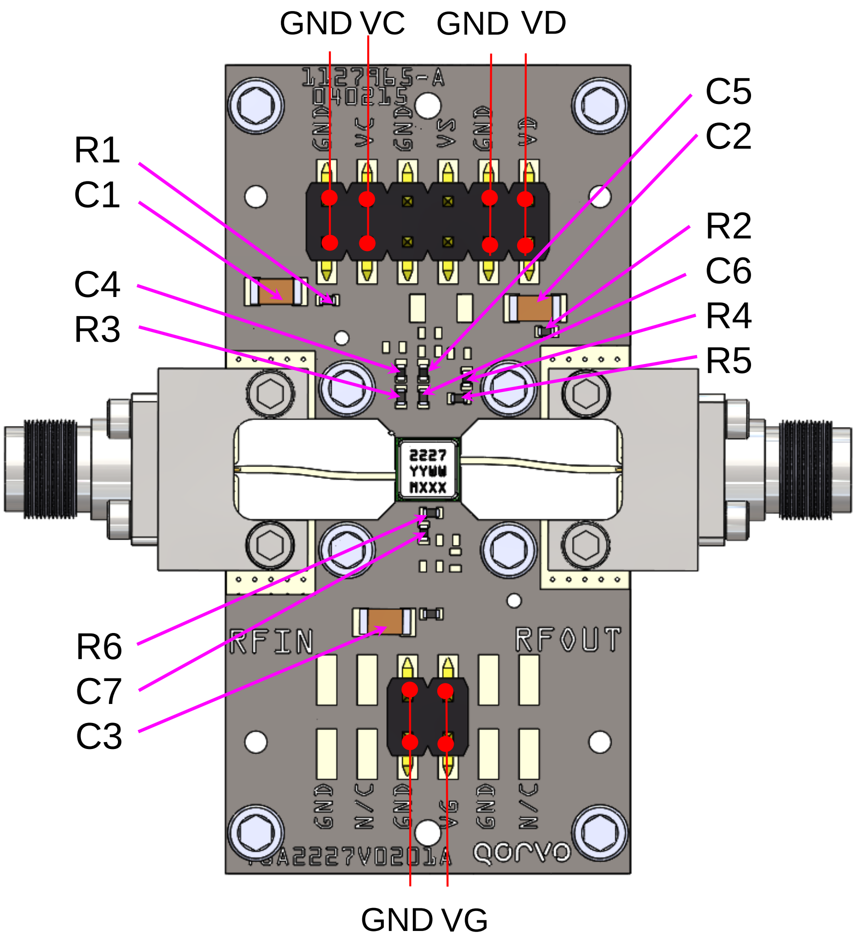
Bias Up Procedure

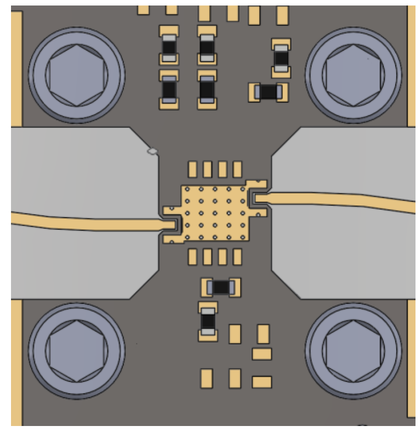
1. Set V_G = −5.0 V, V_C = 0.0 V, V_D = 0.0 V
2. Adjust V_D to desired drain voltage
3. Adjust V_C to desired voltage
4. Adjust V_G until I_{DQ} = 125 mA
5. Turn on RF signal

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

EVB Part Number or Ref. Design Name





Mounting pad detail

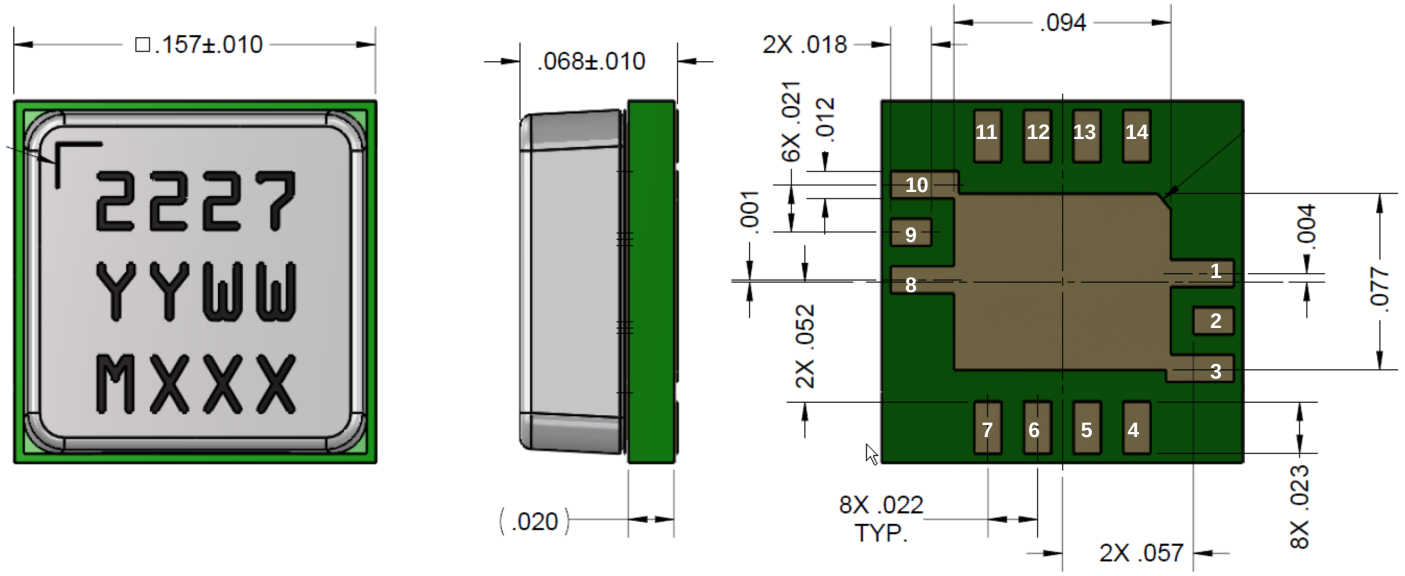
RF Layer is 0.008” thick Rogers Corp. RO4003C, ε_r = 3.38. Metal layers are 0.5 oz. copper. The microstrip line at the connector interface is optimized for the Southwest Microwave end launch connector 1092-01A-5.

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

Bill of Materials

Reference Des.	Value	Description	Manuf.	Part Number
C1 – C3	1 uF, +50 V, 5 %	CAP X7R 1206	Various	–
C4 – C7	1000 pF, +50 V, 10 %	CAP X7R 0402	Various	–
R1 – R6	10 Ohm, 5 %	RES 0402, SMD	Various	–

Pin Configuration and Description



Units: inches
Tolerances: unless specified
x.xx = ± 0.01
x.xxx = ± 0.005
Marking:
2227: Part number
YY: Part Assembly year
WW: Part Assembly week
MXXX: Batch ID

Pin No.	Label	Description
1, 3, 8, 10	GND	RF Ground
2	RF Input	RF input pad, DC blocked
4. 5. 6. 11	NC (or GND)	No connection in package; grounding may improve performance
7	VG	Gate voltage
9	RF Output	RF output pad, DC blocked
12	VD	Drain voltage
13	VS	Drain voltage monitor
14	VC	Cascode voltage

Recommended Soldering Temperature Profile