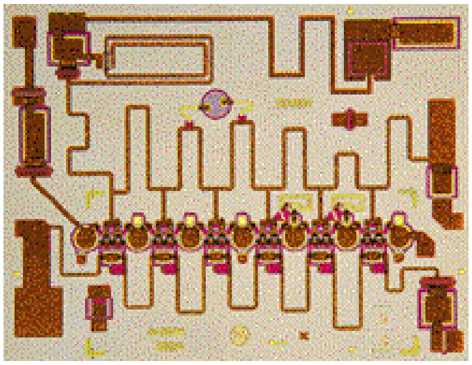
2 - 20 GHz Gain Block Amplifier TGA8622-SCC



Key Features and Performance

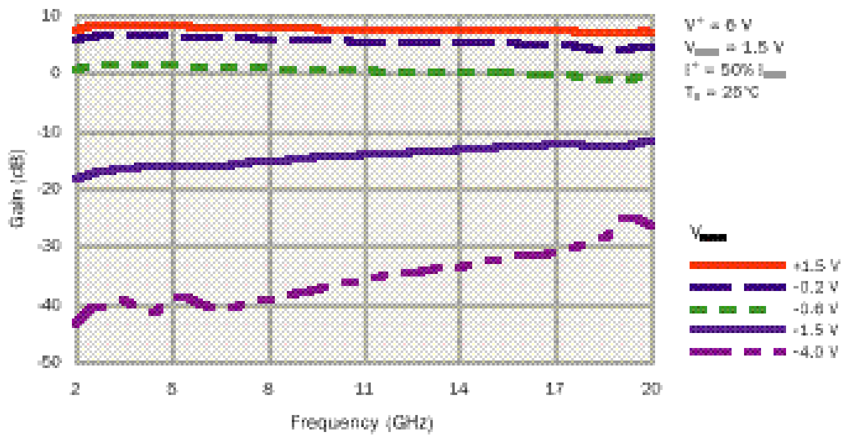
- 2 to 20 GHz Frequency Range
- 7.5 dB Gain with Greater than 30dB Gain-Control Capability
- 20 dBm Output Power at 1 dB Gain Compression
- 7 dB Noise Figure
- Input and Output SWR 1.7:1 Midband
- 2.769 x 2.159 x 0.152 mm (0.109 x 0.085 x 0.006 in.)

Description

The TriQuint TGA8622-SCC is a broadband general-purpose amplifier that operates over the 2 to 20 GHz frequency range. Six 200um dual-gate FETs provide the amplifier with a typical gain of 7.5 dB. Midband input and output SWRs are typically 1.7:1. This amplifier is directly cascadable and can be used in both gain control and active temperature compensation applications. Ground is provided to the circuitry through vias to the backside metallization.

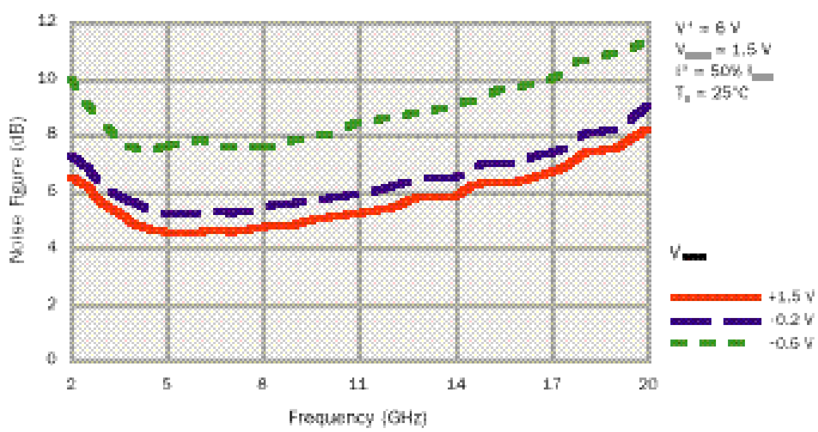
The TGA8622-SCC is available in chip form and is readily assembled using automated equipment. The device bond pads and backside are gold plated for compatibility with eutectic alloy attach methods as well as thermocompression and thermosonic wire-bonding processes.

TYPICAL SMALL-SIGNAL POWER GAIN
Gp vs. V_{CTRL}

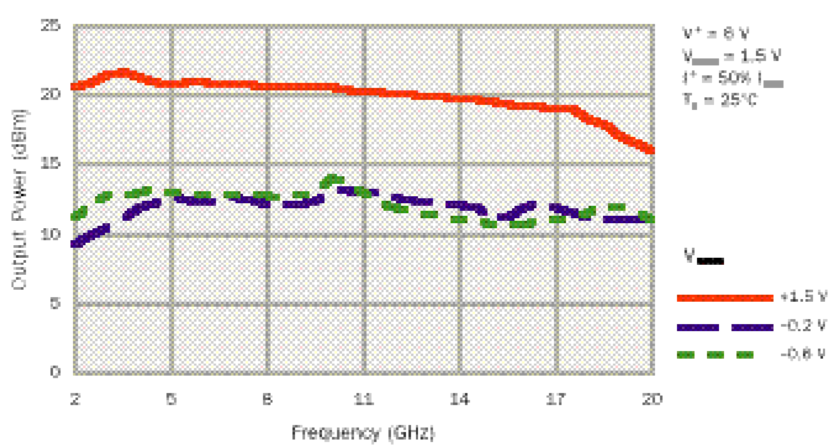


V_{CTRL} for particular gain levels is shown for reference only and may vary from device to device.

TYPICAL NOISE FIGURE
NF vs. V_{CTRL}



TYPICAL OUTPUT POWER
P_{1dB} vs. V_{CTRL}



TYPICAL RETURN LOSS

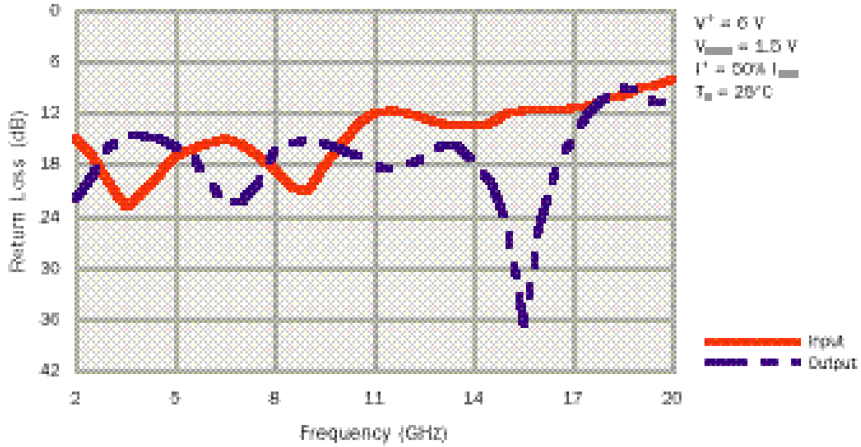


TABLE I
MAXIMUM RATINGS

SYMBOL	PARAMETER	VALUE
V^+	POSITIVE SUPPLY VOLTAGE	8V
$V^+ - V^-$	POSITIVE SUPPLY VOLTAGE RANGE WITH RESPECT TO NEGATIVE SUPPLY VOLTAGE	0V to 12V
V^-	NEGATIVE SUPPLY VOLTAGE RANGE	0V to –5V
V_{CTRL}	GAIN CONTROL VOLTAGE RANGE	-5V to 4V
$V_{CTRL} - V^+$	GAIN CONTROL VOLTAGE RANGE WITH RESPECT TO POSITIVE SUPPLY VOLTAGE	0V to –10V
I^-	NEGATIVE GATE CURRENT	12 mA
P_{in}	INPUT CONTINUOUS WAVE POWER	26 dBm
I^+	POSITIVE SUPPLY CURRENT	370mA
P_D	POWER DISSIPATION, AT (OR BELOW) 25°C BASE-PLATE TEMPERATURE *	2.9W
T_{CH} **	OPERATING CHANNEL TEMPERATURE	150 ^{0}C
T_M	MOUNTING TEMPERATURE (30 SECONDS)	320 ^{0}C
T_{STG}	STORAGE TEMPERATURE	-65 to 150 ^{0}C

Ratings over channel temperature range, T_{CH} (unless otherwise noted)

Stresses beyond those listed under “Maximum Ratings” may cause permanent damage to the device.

These are stress ratings only, and functional operation of the device at these or any other conditions beyond those indicated under “RF Specifications” is not implied. Exposure to maximum rated conditions for extended periods may affect device reliability.

*For operation above 25°C base-plate temperature, derate linearly at the rate of 6.1mW/°C.
** Operating channel temperature, T_{CH}, directly affects the device MTTF. For maximum life, it is recommended that channel temperature be maintained at the lowest possible level.

TABLE II
DC PROBE TESTS (100%)
(TA = 25 DEGREES C $\pm$ 5 DEGREES C)

NOTE	SYMBOL	TEST CONDITIONS	LIMITS MIN	LIMITS MAX	UNITS
	I_{DSS}	0.5 ≤ Vds ≤ 3.5V	156	340	mA
		VGs=0.0V	156	444	
	Gm	0.5 ≤ VDS ≤ 3.5V	180	240	mS
		VGs=-O.5V	144	240	
1/	| Vp |	0.5 ≤ Vds ≤ 3.5V Ids=600 uA	1.1	4.4	V
1/	$\| V_{BRGD} \|$	I_{GD}=1200 uA	8	30	V
1/	$\| V_{BRGS} \|$	I_{GS} = 1200 uA.	8	30	V

1/ Vp, V_{BRGD}, V_{BRGS} are negative

TABLE III
RF WAFER CHARACTERIZATION TESTS
(TA = 25 DEGREES C + 5 DEGREES C)
(BIAS: V+=6 V, I+=0.5 I_{DSS}, V_{CTRL}=l.5 V)

NOTE	TEST	MEASUREMENT CONDITIONS	VALUE MIN	VALUE TYP	VALUE MAX	UNITS
	SMALL-SIGNAL GAIN MAGNITUDE	F = 2 GHz F = 2.5 GHz F = 3 – 20 GHz	4.5 5.5 6.0	6.0 7.0 7.5		dB
	SMALL-SIGNAL GAIN RIPPLE	F = 2 – 20 GHz			2.5	dB Peak-to-Peak
	POWER OUTPUT AT 1 dB GAIN COMPRESSION	F = 2 – 18 GHz	18.0	20 17		dBm
	NOISE FIGURE	F = 2 GHz F = 2.5 GHz F = 3 – 13.5 GHz F = 14 GHz F = 14.5 GHz F = 15 GHz F = 15.5 GHz F = 16 – 18 GHz		8.0 7.5 7.0 7.0 7.0 7.5 7.5 7.5	9.0 8.5 8.0 8.2 8.4 8.6 8.8 9.0	dB
	INPUT RETURN LOSS MAGNITUDE	F = 2 – 15.5 GHz F = 16 – 20 GHz	10 7.4	14 8.9		dB
	OUTPUT RETURN LOSS MAGNITUDE	F = 2 – 18 GHz F = 18 – 20 GHz	10 7.4	14 8.9		dB
1/	GAIN DRIFT	F = 10 GHz			0.25	dB
	OUTPUT THIRD ORDER INTERCEPT POINT	F = 2 GHz F = 10 GHz F = 18 GHz		33 33 30		dBm

1/ Gain drift shall be defined as the change in small signal gain from the application of DC power to 30 minutes.

TABLE IV
AUTOPROBE FET PARAMETER MEASUREMENT CONDITONS

FET Parameters	Test Conditions
I_{DSS} : Maximum drain current (I_{DS}) with gate voltage (V_{GS}) at zero volts.	V_{GS} = 0.0 V, drain voltage (V_{DS}) is swept from 0.5 V up to a maximum of 3.5 V in search of the maximum value of I_{DS}; voltage for I_{DSS} is recorded as VDSP.
G_m : Transconductance; $\frac{(I_{DSS} - IDS1)}{VG1}$	For all material types, V_{DS} is swept between 0.5 V and VDSP in search of the maximum value of I_{ds}. This maximum I_{DS} is recorded as IDS1. For Intermediate and Power material, IDS1 is measured at V_{GS} = VG1 = -0.5 V. For Low Noise, HFET and pHEMT material, V_{GS} = VG1 = -0.25 V. For LNBECOLC, use V_{GS} = VG1 = -0.10 V.
V_P : Pinch-Off Voltage; V_{GS} for I_{DS} = 0.5 mA/mm of gate width.	V_{DS} fixed at 2.0 V, V_{GS} is swept to bring I_{DS} to 0.5 mA/mm.
V_{BVGD} : Breakdown Voltage, Gate-to-Drain; gate-to-drain breakdown current (I_{BD}) = 1.0 mA/mm of gate width.	Drain fixed at ground, source not connected (floating), 1.0 mA/mm forced into gate, gate-to-drain voltage (V_{GD}) measured is V_{BVGD} and recorded as BVGD; this cannot be measured if there are other DC connections between gate-drain, gate-source or drain-source.
V_{BVGS} : Breakdown Voltage, Gate-to-Source; gate-to-source breakdown current (I_{BS}) = 1.0 mA/mm of gate width.	Source fixed at ground, drain not connected (floating), 1.0 mA/mm forced into gate, gate-to-source voltage (V_{GS}) measured is V_{BVGS} and recorded as BVGS; this cannot be measured if there are other DC connections between gate-drain, gate-source or drain-source.

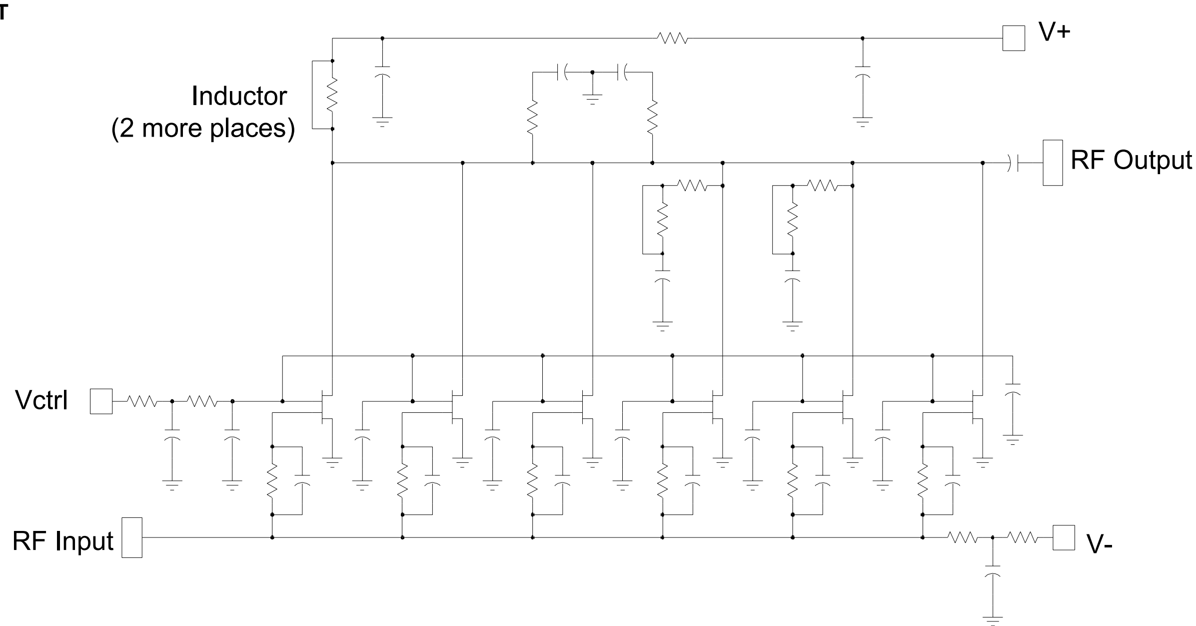
TYPICAL S-PARAMETERS

Frequency	S11		S21		S12		S22		GAIN
(GHz)	MAG	ANG(°)	MAG	ANG(°)	MAG	ANG(°)	MAG	ANG(°)	(dB)
2.0	0.18	168	2.34	128	0.007	81	0.08	55	7.4
2.5	0.14	150	2.55	108	0.011	59	0.15	-33	8.1
3.0	0.10	148	2.62	87	0.013	37	0.17	-81	8.4
3.5	0.07	175	2.66	66	0.014	16	0.19	-116	8.5
4.0	0.09	-160	2.64	46	0.014	-5	0.19	-143	8.4
4.5	0.12	-153	2.61	26	0.014	-24	0.18	-165	8.3
5.0	0.14	-158	2.57	7	0.014	-37	0.17	176	8.2
5.5	0.16	-166	2.54	-12	0.015	-61	0.14	160	8.1
6.0	0.17	-177	2.49	-30	0.015	-81	0.11	152	7.9
6.5	0.18	172	2.47	-48	0.016	-99	0.07	163	7.8
7.0	0.17	163	2.46	-66	0.016	-118	0.08	-166	7.8
7.5	0.14	159	2.46	-84	0.018	-136	0.11	-149	7.8
8.0	0.12	159	2.44	-103	0.020	-155	0.15	-149	7.8
8.5	0.09	166	2.43	-121	0.021	-172	0.17	-152	7.7
9.0	0.09	-174	2.42	-139	0.023	171	0.18	-153	7.7
9.5	0.12	-161	2.41	-158	0.024	155	0.17	-157	7.7
10.0	0.17	-157	2.40	-177	0.025	139	0.16	-160	7.6
10.5	0.22	-157	2.38	165	0.026	124	0.15	-165	7.5
11.0	0.26	-160	2.36	147	0.026	108	0.13	-167	7.4
11.5	0.27	-162	2.35	128	0.026	91	0.12	-167	7.4
12.0	0.26	-165	2.35	110	0.025	77	0.13	-167	7.4
12.5	0.24	-169	2.38	91	0.025	61	0.14	-172	7.5
13.0	0.23	-174	2.36	71	0.025	44	0.17	172	7.5
13.5	0.22	-178	2.35	53	0.025	25	0.17	144	7.4
14.0	0.21	-175	2.38	33	0.025	4	0.14	120	7.5
14.5	0.22	-169	2.38	12	0.027	-18	0.10	100	7.5
15.0	0.25	-164	2.38	-8	0.028	-41	0.06	80	7.5
15.5	0.26	-162	2.39	-29	0.030	-62	0.02	2	7.6
16.0	0.26	-162	2.36	-51	0.031	-84	0.07	-122	7.5
16.5	0.26	-166	2.31	-72	0.033	-104	0.13	-151	7.3
17.0	0.26	-170	2.33	-93	0.036	-125	0.19	-175	7.3
17.5	0.28	-172	2.31	-116	0.038	-146	0.25	159	7.3
18.0	0.33	-174	2.22	-138	0.035	-166	0.31	133	6.9
18.5	0.33	-174	2.19	-159	0.037	-174	0.36	114	6.8
19.0	0.36	-169	2.21	179	0.042	163	0.37	98	6.9
19.5	0.38	-167	2.29	155	0.041	140	0.29	95	7.2
20.0	0.40	-164	2.28	125	0.040	119	0.28	133	7.1

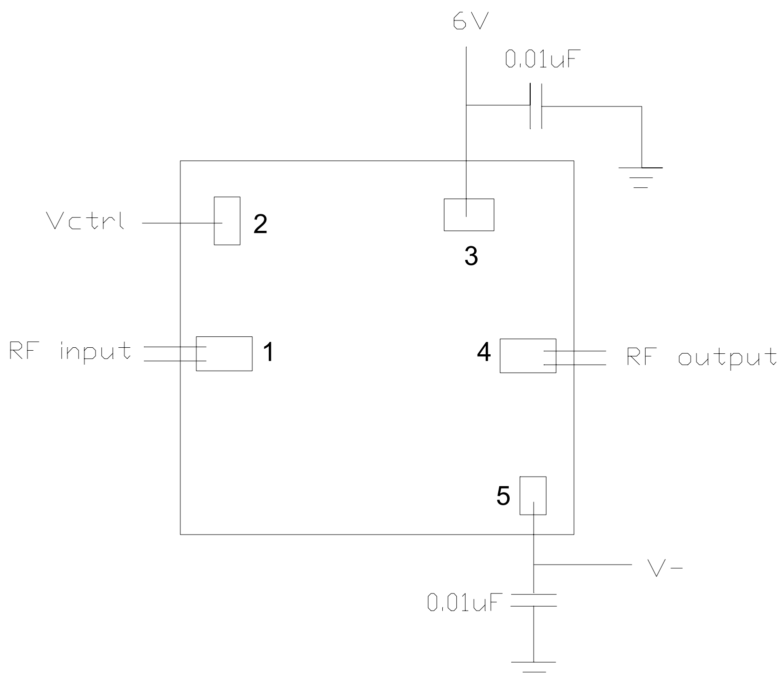
T_A = 25°C, V+ = 6 V, V_{CTRL} = 1.5 V, I+ = 50% I_{DSS}

The reference planes for S-parameter data include bond wires as specified in the equivalent schematic. The S-parameters are also available on floppy disk and the world wide web.

EQUIVALENT SCHEMATIC



RECOMMENDED
BIAS CIRCUIT



RF connections: Bond using two 1.0-mil diameter, 20-mil-length gold bond wires at both RF Input and RF Output.

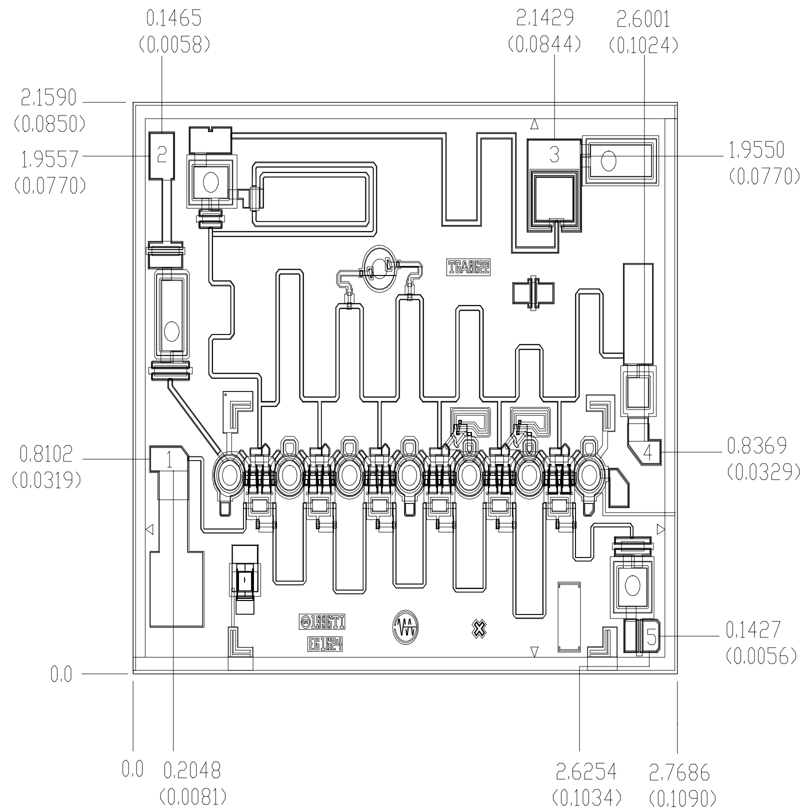
Measuring I_{DSS}: Set V-, V+, and V_{CTRL} to 0 V. Connect V_{CTRL} to V+. Short V- to ground. Increase V+, V_{CTRL} from 0 V and measure I+ maximum for V+, V_{CTRL} </= 4 V. I+ maximum is I_{DSS}.

Maximum gain bias (in this sequence):
Set V- to -1 V, V+ to 6 V, and V_{CTRL} to 1.5 V. Adjust V- to achieve I+ = 50% I_{DSS}.

Gain reduction: Set bias for maximum gain condition and decrease V_{CTRL} from 1.5 V.
(I+ will drop accordingly; do not re-adjust V-.)

GaAs MMIC devices are susceptible to damage from Electrostatic Discharge. Proper precautions should be observed during handling, assembly and test.

MECHANICAL DRAWING



Units: millimeters (inches)
Thickness: 0.1524 (0.006) (reference only)
Chip edge to bond pad dimensions are shown to center of bond pad
Chip size: +/- 0.0508 (0.002)

Bond Pad #1 (RF Input)	0.1981 x 0.1016 (0.0078 x 0.0040)
Bond Pad #2 (Vctrl)	0.1270 x 0.1778 (0.0050 x 0.0070)
Bond Pad #3 (V+)	0.3429 x 0.1143 (0.0135 x 0.0045)
Bond Pad #4 (RF Output)	0.1676 x 0.1016 (0.0066 x 0.0040)
Bond Pad #5 (V-)	0.0864 x 0.1245 (0.0034 x 0.0049)

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