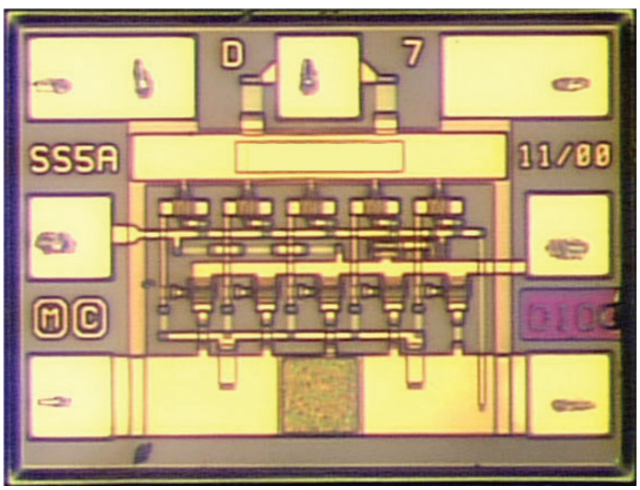
Keysight 1GC1-4030
DC - 10 GHz Medium Power Series– Shunt HBT Amplifier

Data Sheet



Features

- Frequency range: DC – 10 GHz
- Moderate gain: 11 dB
- P_{-1dB}: +19 dBm
- Low 1/f noise corner: < 20 kHz
- Return loss:
  Input: 20 dB
  Output: 15 dB
- Single supply operation
  V_{Supply} > 4.8 volts

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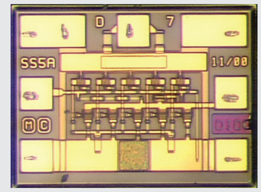
Description

The 1GC1-4030 is a DC – 10 GHz, 11 dB gain, feedback amplifier designed to be used as a cascadable gain block for a variety of applications. The device consists of a modified Darlington feedback pair which reduces the sensitivity to process variations and provides 50 ohm input/output port matches. Furthermore, this amplifier is fabricated using HFTC's Heterojunction Bipolar Transistor (HBT) process which provides excellent process uniformity, reliability and 1/f noise performance. The device requires a single positive supply voltage and generally operates Class-A for good distortion performance. DC power dissipation is less than 0.68 watts.



- Chip size: 610 x 460 µm (24 x 18 mils)
- Chip size tolerance: ±10 µm (± 0.4 mils)
- Chip thickness: 127 ±15 µm (5.0 ± 0.6 mils)
- Pad dimensions: 80 x 80 µm (3.2 x 3.2 mils), or larger

Absolute maximum ratings[1]

(@ T_A = 25 °C, unless otherwise indicated)

Symbol	Parameters/conditions	Min	Max	Units
V_{cc}	Collector pad voltage		7	Volts
I_{out}	Maximum collector current		90	mA
P_{in}	CW input power		18	dBm
T_J	Maximum junction temperature		170	°C
T_{op}	Operating temperature	-55	+85	°C
T_{bs}[2]	Die backside temperature		+85	°C
T_{stg}	Storage temperature	65	165	°C
T_{max}	Maximum assembly temperature		+300	°C

1. Operation in excess of any one of these conditions may result in permanent damage to this device.
2. MTTF > 5 x 10^5 hours @ T_{bs} = 85 °C. Operation in excess of maximum backside temperature (T_{bs}) will degrade MTTF.

DC specifications/physical properties

(Typicals are for T_A = 25 °C, V_{cc}= +5 V, I_{out}= +80 mA)

Symbol	Parameters/conditions	Min	Typ	Max	Units
V_{out}	Output pad voltage	4.3	4.8	5.3	Volts
V_{in}	Input pad voltage	3.1	3.4	3.7	Volts
I_{C1}	Stage–one supply current	50	60	70	mA
I_{C2}	Stage–two supply current		80		mA
I_{C1} + I_{C2}	Total supply current		140		mA
θch-s	Thermal resistance ($T_{substrate}$ = 25 °C)		130		°C/W

RF specifications[1]

(Typicals are for T_A = 25 °C, V_{cc}= +5 V, I_{out}= 80 mA)

Symbol	Parameters/conditions	DC - 6 GHz			DC - 10 GHz			Units
		Min	Typ	Max	Min	Typ	Max	
BW	Operating bandwidth	8			10			GHz
S_{21}	Small signal gain	10	11		10	11		dB
ΔS_{21}	Small signal gain flatness		±0.2			±0.5		dB
TC	Temperature coefficient of gain		0.005			0.02		dB/°C
RL_{in}	Input return loss		–20			–20		dB
RL_{out}	Output return loss		–20			–15		dB
ISO	Isolation, reverse		16			17		dB
P_{1dB}	Output power at 1 db gain compression		19.5			18.5		dBm
P_{out}	Output power flatness vs. frequency		±0.5			±1		dBm
P_{sat}	Saturated output power		20			19		dBm
H_s	Second harmonics, P_{out} = +10 dbm		–30			–30		dBc
	Second harmonics, P_{out} = $P_{1\,db}$		–20			–20		dBc
H_3	Third harmonics, P_{out} = +10 dbm		–40			–40		dBc
	Third harmonics, P_{out} = $P_{1\,db}$		–20			–20		dBc
NF	Noise figure		7			7		dB

1. These RF specifications can be achieved when the device is properly biased and heat sunk. Specifications are per output and based on performance attained with a 1GC1-4030 mounted in an Keysight 83040 series Modular Microcircuit Package.

Biasing

The 1GC1-4030 can be operated from a single positive supply. This supply must be connected to two points on the chip, namely the V_{CC} pad and the output pad. The supply voltage may be directly connected to the V_{CC} pad as long as the voltage is between +4.75 to +5 volts; however, if the supply is higher than +7 volts, a series resistor (R_{CC}) should be used to reduce the voltage to the V_{CC} pad. See the bonding diagram for the equation used to select R_{CC}. In the case of the output pad, the supply voltage must be connected to the output transmission line through a resistor (R_{OUT}) and an inductor. See the bonding diagram for the equation used to select R_{OUT}. If R_{OUT} is greater than 300 ohms, the inductor may be omitted, however, the amplifier's gain may be reduced by ~0.5 dB. Figure 4 shows the recommended assembly and bonding method.

The chip contains a backside via to provide a low inductance ground path: therefore, the ground pad on the IC should not be bonded.

The voltage at the IN and OUT pads of the IC will be approximately 3.4 and 4.8 volts respectfully; therefore, DC blocking caps should be used at the input and output of the device.

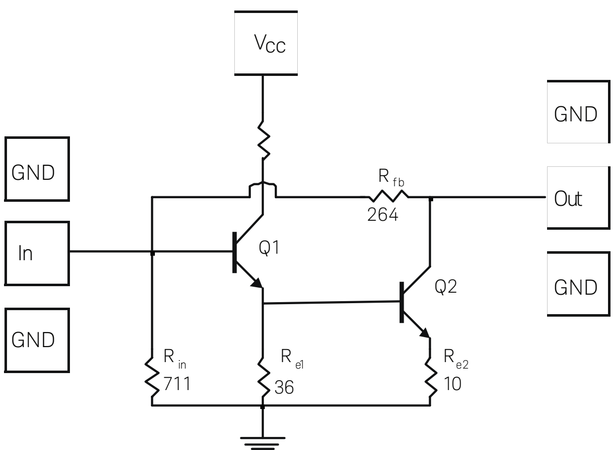
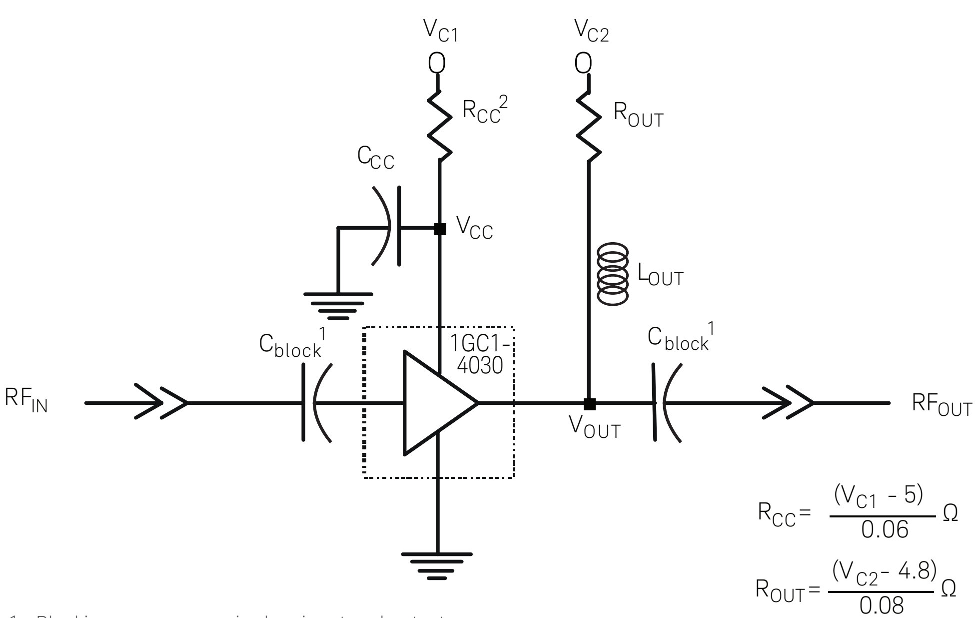


Figure 1. 1GC1-4030 simplified block diagram



1. Blocking caps are required on input and output
2. RCC is only needed if V_{C1} > 5 V

Figure 2. 1GC1-4030 Biasing diagram

Assembly Techniques

Solder die attach using a AuSn solder preform is the recommended assembly method. Gold thermosonic wedge bonding with 0.7 mil wire is recommended for all bonds. Tool force should be 22 grams ±1 gram, stage temperature is 150 ±2 °C, and ultrasonic power and duration of 64 ±1 dB and 76 ±8 msec, respectively. The top and bottom metallization is gold.

MMIC ESD precautions, handling considerations, die attach and bonding methods are critical factors in successful GaAs MMIC performance and reliability.

Keysight document, *GaAs MMIC ESD, Die Attach and Bonding Guidelines - Application Note* (5991-3484EN) provides basic information on these subjects.

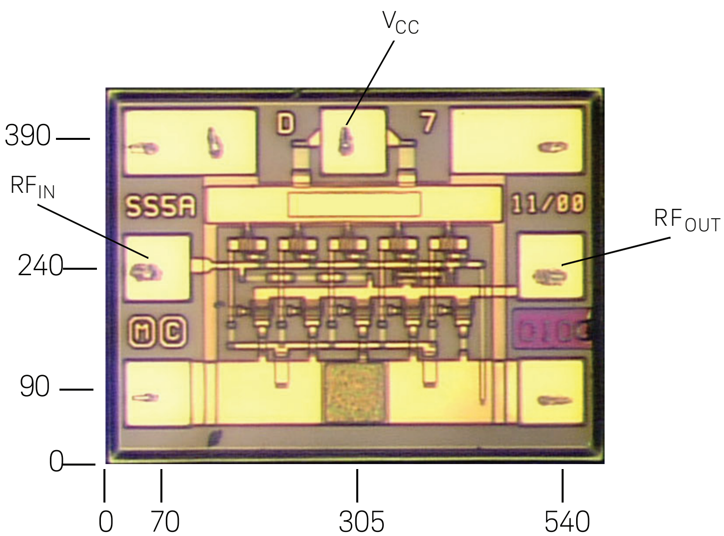


Figure 3. 1GC1-4030 chip bias/RF bond pad locations

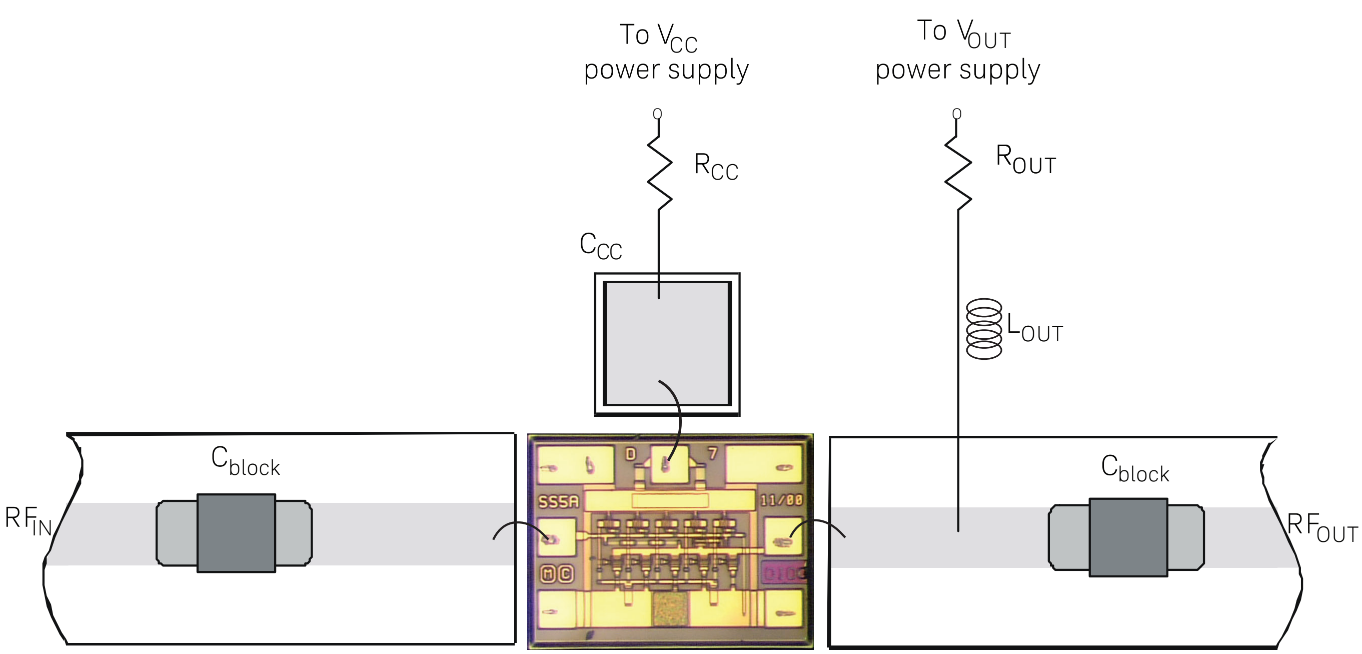


Figure 4. 1GC1-4030 chip assembly diagram

S–Parameters

(T_A = 25 °C, V_{cc} = 5V, V_{Out} = 4.8V, I_{C1}= 60 mA, I_{C2} = 80 mA, Z_o = 50 ohms)

Freq GHz	S11			S12			S21			S22		
	dB	Mag	Ang	dB	Mag	Ang	dB	Mag	Ang	dB	Mag	Ang
0.5	-30.0	0.032	91.4	-15.2	0.173	1.5	11.2	3.648	174.9	-23.0	0.071	6.0
1.0	-29.3	0.034	94.5	-15.4	0.171	-1.2	11.2	3.633	167.7	-23.4	0.067	-3.2
1.5	-28.2	0.039	92.9	-15.5	0.168	-4.3	11.2	3.615	160.5	-23.6	0.066	-11.6
2.0	-26.9	0.045	88.7	-15.6	0.166	-7.2	11.1	3.597	153.4	-23.7	0.065	-19.5
2.5	-25.7	0.052	83.0	-15.7	0.163	-9.9	11.1	3.581	146.6	-23.7	0.065	-27.3
3.0	-24.6	0.059	77.0	-15.8	0.162	-12.4	11.1	3.570	140.1	-23.7	0.065	-35.6
3.5	-23.7	0.065	71.0	-15.9	0.160	-14.5	11.0	3.566	133.8	-23.8	0.064	-44.7
4.0	-23.1	0.070	65.4	-16.0	0.159	-16.5	11.1	3.569	127.5	-24.0	0.063	-55.1
4.5	-22.6	0.074	60.3	-16.0	0.158	-18.5	11.1	3.581	121.4	-24.2	0.061	-67.0
5.0	-22.4	0.076	55.8	-16.0	0.158	-20.5	11.1	3.601	115.2	-24.4	0.060	-80.4
5.5	-22.4	0.076	51.6	-16.1	0.157	-22.5	11.2	3.630	108.9	-24.4	0.060	-95.0
6.0	-22.4	0.075	47.5	-16.1	0.156	-24.7	11.3	3.664	102.4	-24.1	0.062	-109.7
6.5	-22.6	0.074	42.9	-16.2	0.155	-27.0	11.4	3.703	95.8	-23.6	0.066	-123.5
7.0	-23.0	0.071	37.0	-16.3	0.154	-29.4	11.5	3.745	89.0	-22.8	0.073	-135.2
7.5	-23.4	0.068	28.7	-16.3	0.153	-31.9	11.6	3.792	82.0	-21.8	0.081	-144.6
8.0	-24.0	0.063	16.6	-16.4	0.151	-34.5	11.7	3.841	74.7	-20.8	0.091	-151.9
8.5	-24.6	0.059	-0.9	-16.5	0.149	-37.1	11.8	3.890	67.2	-19.7	0.103	-157.5
9.0	-24.7	0.058	-24.7	-16.6	0.147	-39.8	11.9	3.937	59.5	-18.6	0.117	-161.8
9.5	-23.7	0.065	-52.3	-16.8	0.145	-42.6	12.0	3.978	51.4	-17.5	0.133	-165.4
10.0	-21.7	0.083	-77.4	-16.9	0.143	-45.5	12.1	4.011	43.1	-16.4	0.151	-168.6
10.5	-19.2	0.110	-97.5	-17.1	0.140	-48.5	12.1	4.028	34.4	-15.3	0.171	-171.7
11.0	-16.8	0.145	-113.4	-17.3	0.137	-51.4	12.1	4.028	25.4	-14.2	0.194	-174.9
11.5	-14.6	0.186	-126.8	-17.5	0.133	-54.4	12.1	4.005	16.2	-13.2	0.219	-178.4
12.0	-12.7	0.233	-138.6	-17.8	0.129	-57.2	11.9	3.957	6.7	-12.1	0.247	177.8
12.5	-11.0	0.283	-149.3	-18.1	0.125	-60.0	11.8	3.880	-3.0	-11.2	0.277	173.7
13.0	-9.5	0.337	-159.4	-18.4	0.120	-62.6	11.5	3.775	-12.9	-10.2	0.309	169.3
13.5	-8.2	0.391	-168.9	-18.7	0.116	-65.0	11.2	3.641	-22.9	-9.3	0.341	164.6
14.0	-7.0	0.446	-178.1	-19.1	0.111	-67.2	10.8	3.479	-32.8	-8.5	0.374	159.6
14.5	-6.1	0.498	173.2	-19.4	0.107	-69.2	10.3	3.290	-42.8	-7.8	0.406	154.6
15.0	-5.2	0.547	164.9	-19.8	0.102	-71.1	9.8	3.080	-52.6	-7.2	0.437	149.6
15.5	-4.6	0.592	157.1	-20.2	0.098	-72.8	9.1	2.853	-62.3	-6.7	0.465	144.6
16.0	-4.0	0.632	149.6	-20.6	0.093	-74.3	8.4	2.619	-71.7	-6.2	0.491	139.7
16.5	-3.5	0.666	142.6	-21.0	0.089	-75.7	7.5	2.384	-80.6	-5.8	0.514	135.0
17.0	-3.2	0.695	135.9	-21.4	0.085	-76.8	6.7	2.157	-89.2	-5.4	0.536	130.3
17.5	-2.9	0.720	129.6	-21.8	0.081	-77.8	5.8	1.945	-97.2	-5.1	0.557	125.7
18.0	-2.6	0.743	123.6	-22.1	0.079	-78.5	4.9	1.755	-104.6	-4.8	0.578	121.1
18.5	-2.3	0.766	117.9	-22.3	0.077	-79.2	4.0	1.590	-111.5	-4.5	0.599	116.5
19.0	-2.0	0.790	112.4	-22.5	0.075	-79.7	3.2	1.452	-117.8	-4.1	0.621	111.9
19.5	-1.8	0.817	107.2	-22.5	0.075	-79.9	2.5	1.340	-123.8	-3.8	0.646	107.5
20.0	-1.4	0.851	102.9	-22.4	0.076	-79.3	2.0	1.253	-129.2	-3.4	0.675	103.8

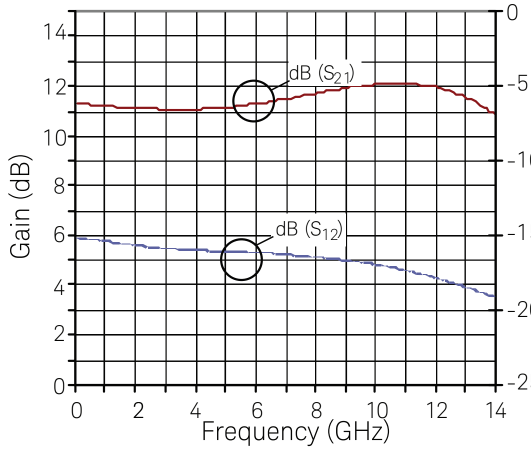


Figure 5. Gain and isolation vs. frequency[1]

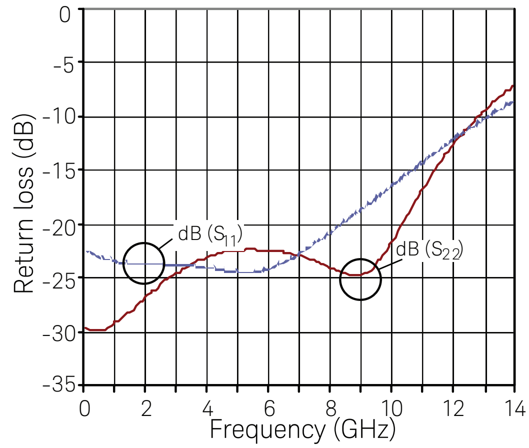


Figure 6. Return loss vs. frequency[1]

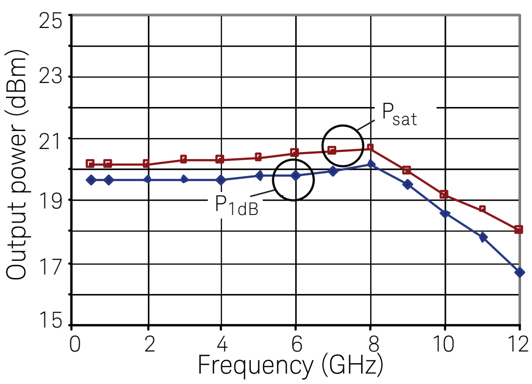


Figure 7. Output power vs. frequency[1]

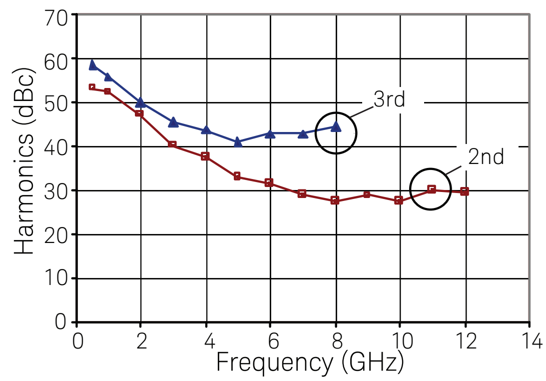


Figure 8. Harmonics vs. frequency @P_{OUT}= +10 dBm[1]

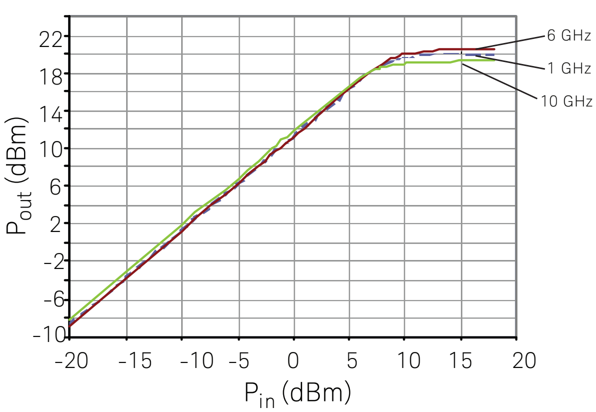


Figure 9. P_{in} vs. P_{out}[1]

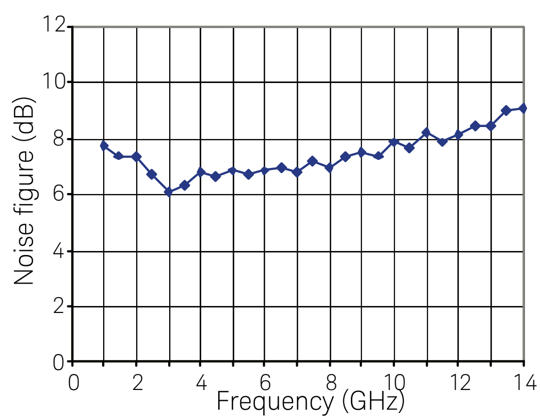


Figure 10. Noise figure vs. frequency[1]

1. All data was taken with T_A = 25 °C, V_C = 4.8 V, I_{CC} = 140 mA.
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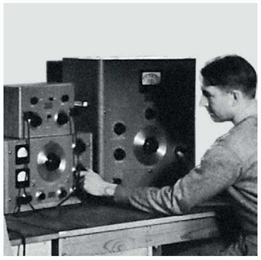
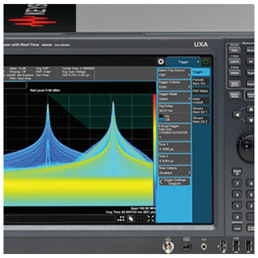


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