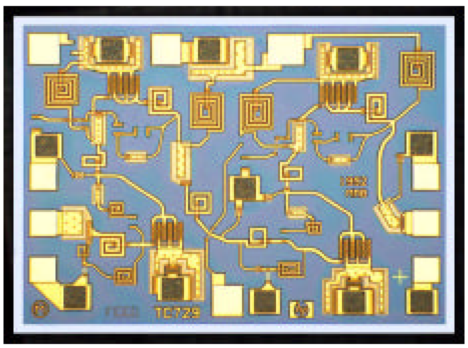
Agilent HMMC-5620
6–20 GHz High–Gain Amplifier

Data Sheet



Chip Size:	1410 × 1010 µm (55.5 × 39.7 mils)
Chip Size Tolerance:	± 10 µm (± 0.4 mils)
Chip Thickness:	127 ± 15 µm (5.0 ± 0.6 mils)
Pad Dimensions:	80 × 80 µm (2.95 × 2.95 mils), or larger

Features

- **Wide-Frequency Range: 6–20 GHz**
- **High Gain: 17 dB**
- **Gain Flatness: ± 1.0 dB**
- **Return Loss:**
  Input –15 dB
  Output –15 dB
- **Single Bias Supply Operation**
- **Low DC Power Dissipation: P_{DC} ~ 0.5 Watts**
- **Medium Power: 20 GHz: P_{-1dB}: 12 dBm, P_{sat}: 13 dBm**

Description

The HMMC-5620 is a wideband GaAs MMIC amplifier designed for medium output power and high gain over the 6 to 20 GHz frequency range. Four MESFET cascade stages provide high gain, while the single bias supply offers ease of use. E–Beam lithography is used to produce gate lengths of ≈0.3 µm. The HMMC-5620 incorporates advanced MBE technology, Ti–Pt–Au gate metallization, silicon nitride passivation, and polyimide for scratch protection.

Absolute Maximum Ratings[1]

Symbol	Parameters / Conditions	Min.	Max.	Units
V_{DD}	Positive Drain Voltage		7.5	volts
I_{DD}	Total Drain Current		135	mA
P_{DC}	DC Power Dissipation		1.0	watts
P_{in}	CW Input Power		20	dBm
T_{ch}	Operating Channel Temp.		+160	°C
T_{case}	Operating Case Temperature	–55		°C
T_{stg}	Storage Temperature	–65	+165	°C
T_{max}	Maximum Assembly Temp. (for 60 seconds maximum)		300	°C

Notes:

1. Operation in excess of any one of these conditions may result in permanent damage to this device. T_A = 25°C except for T_{ch}, T_{stg}, and T_{max}.

DC Specifications / Physical Properties[1]

Symbol	Parameters / Conditions	Min.	Typ.	Max.	Units
I_{DD}	Drain Current (V_{DD} = + 5.0 volts)	70	100	135	mA
I_{DD}	Drain Current (V_{DD} = + 7.0 volts)		105		mA
$\theta_{ch\text{-}bs}$	Thermal Resistance ($T_{backside}$ = 25°C)		70		°C / W

Notes:

1. Measured in wafer form with T_{chuck} = 25°C. (Except $\theta_{ch\text{-}bs}$).

RF Specifications / Physical Properties

(V_{DD} = 5.0V, I_{DD}(Q) = 100mA, Z_{in} = Z_o = 50Ω)[1]

Symbol	Parameters / Conditions	6.0–20 GHz			
		Min.	Typ.	Max.	Units
BW	Guaranteed Bandwidth	6		20	GHz
S_{21}	Small Signal Gain	15	17	21	dB
ΔS_{21}	Small Signal Gain Flatness		±1.0	±1.25	dB
RL_{in}	Input Return Loss		–15	–10	dB
RL_{out}	Output Return Loss		–15	–10	dB
S_{12}	Reverse Isolation		–55		dB
P_{-1dB}	Output Power at 1dB Gain Compression		12		dBm
P_{sat}	Saturated Output Power		13		dBm
H_2	Second Harmonic, (6 < f_0<20)($P_0(f_0)$ = 10 dBm)		–30		dBc
H_3	Third Harmonic, (6 < f_0<20)($P_0(f_0)$ = 10 dBm)		–40		dBc
NF	Noise Figure		9.0		dB

Notes:

1. Small-signal data measured in wafer form with T_{chuck} = 25°C. Large–signal data measured on individual devices mounted in an Agilent 83040 Series Modular Microcircuit Package @ T_A = 25°C.

Applications

The HMMC-5620 amplifier is designed for use as a general purpose wideband, high gain stage in communication systems and microwave instrumentation. It is ideally suited for broadband applications requiring high gain and excellent port matches over a 6 to 20 GHz frequency range. Both RF input and output ports are AC-coupled on chip.

Biasing and Operation

This amplifier is biased with a single positive drain supply (V_{DD}). The recommended bias for the HMMC-5620 is V_{DD} = 5.0V, which results in I_{DD} = 100 mA (Typ.). No other bias supplies or connections to the device are required for 6 to 20 GHz operation. See Figure 3 for assembly information.

Assembly Techniques

For RF bonds, Agilent recommends low inductance mesh interconnections for best return loss performance.

GaAs MMICs are ESD sensitive. ESD preventive measures must be employed in all aspects of storage, handling, and assembly.

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

Agilent application note #54, "GaAs MMIC ESD, Die Attach and Bonding Guidelines" provides basic information on these subjects.

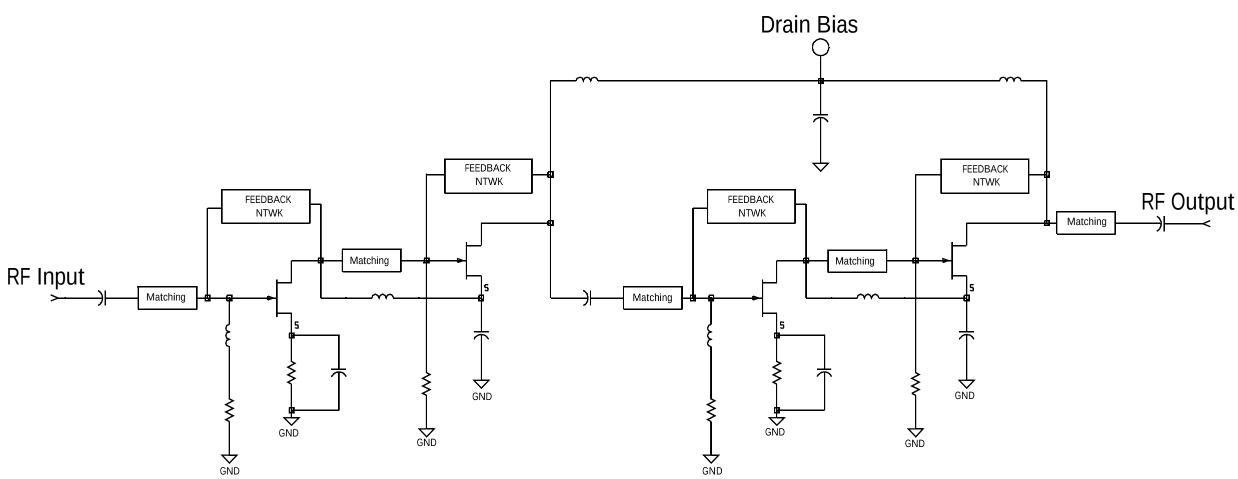


Figure 1.
Schematic

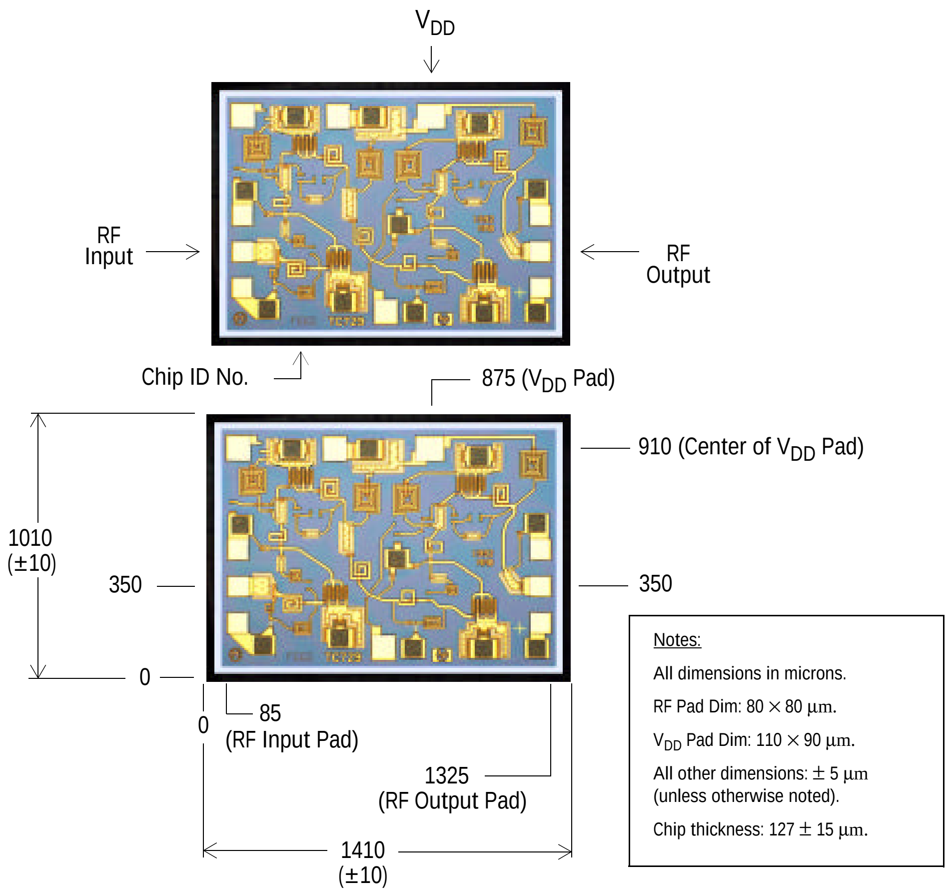


Figure 2.
Bond Pad Locations

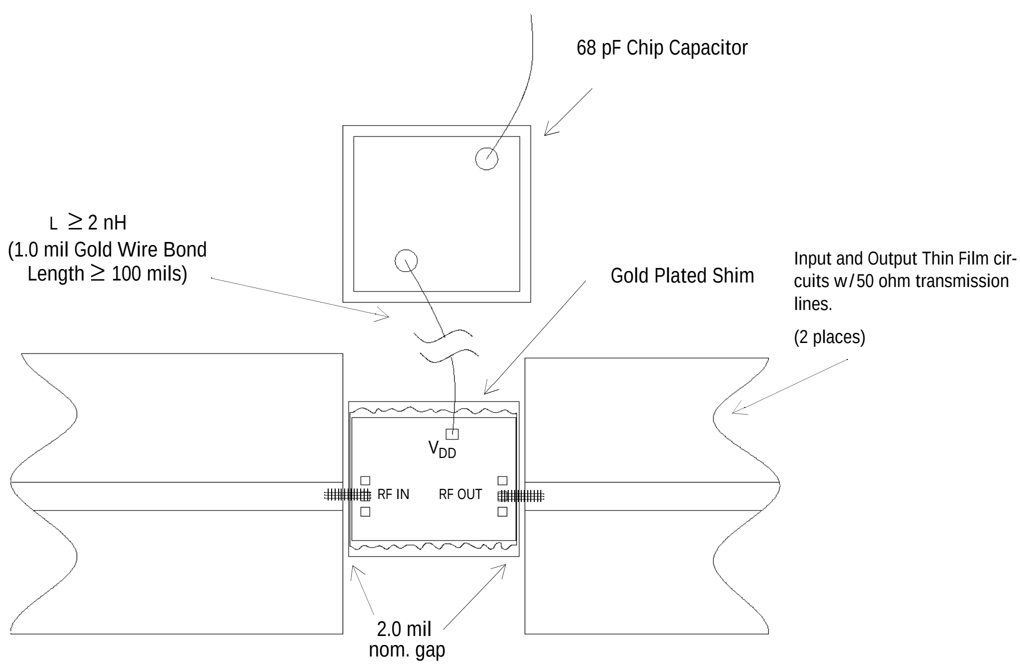


Figure 3.
Assembly Diagram
(For 6.0–20.0 GHz Operation)

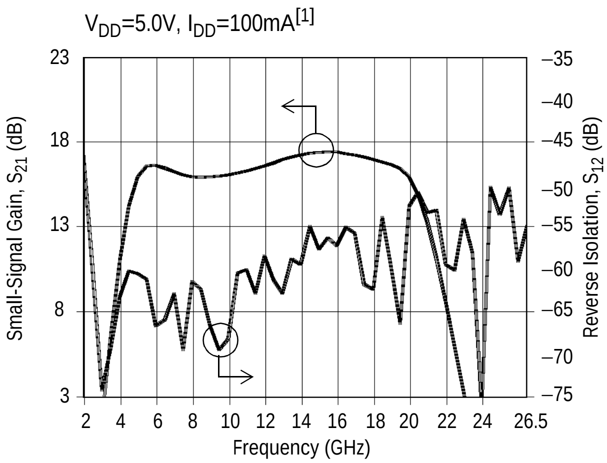


Figure 4.
Typical Gain and Reverse Isolation vs. Frequency

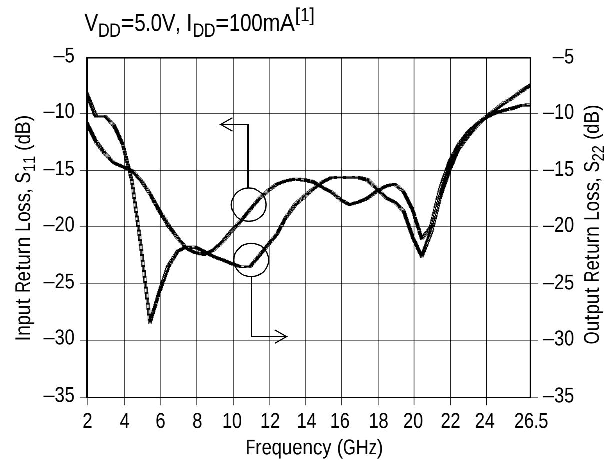


Figure 5.
Typical Input and Output Return Loss vs. Frequency

Typical S-Parameters[1]

(T_{chuck} = 25°C, V_{DD} = 5.0V, I_{DD} = 100 mA, $Z_{in} = Z_o$ = 5Ω)

Freq.	S_{11}			S_{12}			S_{21}			S_{22}		
(GHz)	dB	Mag	Ang	dB	Mag	Ang	dB	Mag	Ang	dB	Mag	Ang
2.0	–10.7	0.292	–100.3	–46.1	0.0049	–174.7	–6.2	0.491	–52.2	–8.1	0.395	–152.2
3.0	–13.5	0.212	–117.5	–74.1	0.0002	114.0	3.5	1.489	–170.0	–10.1	0.311	–171.5
4.0	–14.6	0.186	–136.6	–63.1	0.0007	–122.1	13.0	4.486	82.2	–12.7	0.232	136.5
5.0	–15.8	0.162	–168.9	–60.4	0.0010	–161.8	16.0	6.310	–26.5	–21.7	0.082	61.5
6.0	–18.4	0.120	157.5	–66.5	0.0005	162.7	16.7	6.839	–116.8	–25.7	0.052	–86.6
7.0	–20.9	0.090	123.0	–62.7	0.0007	–175.3	16.3	6.531	173.2	–22.1	0.079	–131.4
8.0	–22.2	0.078	83.1	–61.3	0.0009	–178.0	16.0	6.310	114.2	–21.7	0.082	–150.6
9.0	–21.9	0.080	41.3	–66.5	0.0005	–62.4	16.0	6.310	60.2	–22.5	0.075	–156.7
10.0	–20.2	0.097	6.6	–68.1	0.0004	–159.3	16.1	6.383	9.0	–23.2	0.070	–152.9
11.0	–18.4	0.120	–21.0	–60.0	0.0010	–113.5	16.3	6.531	–40.7	–23.4	0.067	–143.0
12.0	–16.7	0.146	–46.4	–58.3	0.0012	–112.2	16.6	6.761	–89.9	–21.5	0.084	–136.8
13.0	–15.8	0.161	–70.0	–62.7	0.0007	–130.0	17.0	7.079	–139.4	–19.1	0.111	–133.7
14.0	–15.8	0.163	–90.0	–59.3	0.0011	–161.1	17.3	7.328	170.1	–17.2	0.137	–143.0
15.0	–16.4	0.151	–105.6	–57.5	0.0013	173.9	17.4	7.413	118.6	–16.0	0.159	–152.8
16.0	–17.5	0.134	–115.4	–57.1	0.0014	–165.9	17.5	7.499	66.0	–15.5	0.168	–167.9
17.0	–17.7	0.130	–114.1	–55.6	0.0017	175.5	17.3	7.328	12.3	–15.5	0.167	–179.7
18.0	–16.8	0.145	–118.4	–62.3	0.0008	98.2	17.0	7.079	–43.1	–16.5	0.149	162.9
19.0	–16.1	0.156	–131.6	–59.7	0.0010	112.8	16.7	6.839	–101.9	–17.7	0.130	145.2
20.0	–18.5	0.119	–143.8	–52.5	0.0024	72.9	16.0	6.310	–168.5	–20.8	0.091	93.0
21.0	–19.9	0.101	–108.1	–53.2	0.0022	–7.1	15.3	5.842	119.8	–20.4	0.096	–4.3
22.0	–14.2	0.195	–107.7	–59.3	0.0011	–8.0	10.7	3.414	54.2	–14.9	0.179	–63.6
23.0	–11.6	0.263	–125.6	–54.0	0.0020	–54.4	5.4	1.857	–0.4	–12.0	0.250	–93.3
24.0	–10.3	0.306	–142.2	–75.8	0.0002	–158.2	0.3	1.034	–47.5	–10.3	0.306	–110.4
25.0	–9.6	0.330	–157.2	–53.5	0.0021	–165.8	–4.5	0.595	–90.5	–9.0	0.353	–124.2
26.0	–9.2	0.347	–169.9	–59.0	0.0011	–137.5	–9.0	0.355	–131.1	–7.9	0.402	–134.3
26.5	–9.1	0.349	–357.4	–54.9	0.0018	78.2	–11.2	0.275	–511.3	–7.4	0.426	–140.2

Notes:

1. Data obtained from on–wafer measurements.

Additional Performance Characteristics

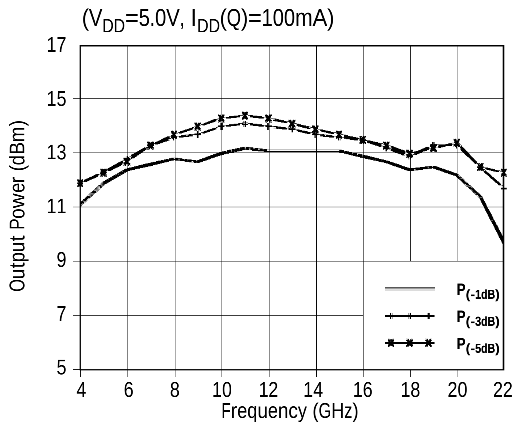


Figure 6.
Typical Output Power vs. Frequency (w/ 5V bias)

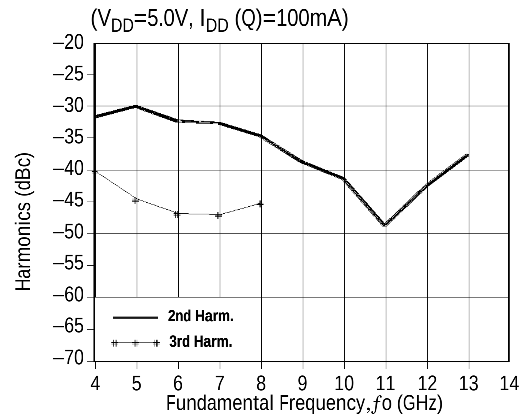


Figure 7.
Typical Second and Third Harmonics vs. Fundamental Frequency at P_{out} = 10 dBm

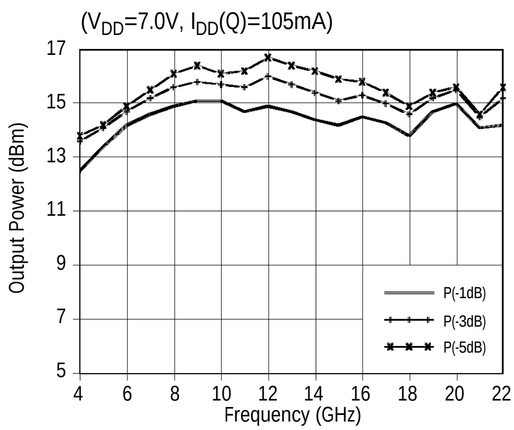


Figure 8.
Typical Output Power vs. Frequency (w/ 7V bias)

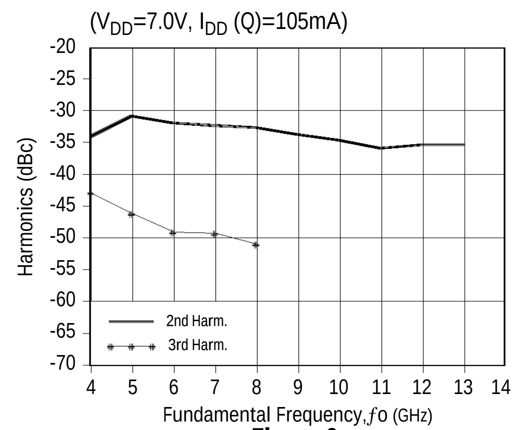


Figure 9.
Typical Second and Third Harmonics vs. Fundamental Frequency at P_{out} = 10 dBm

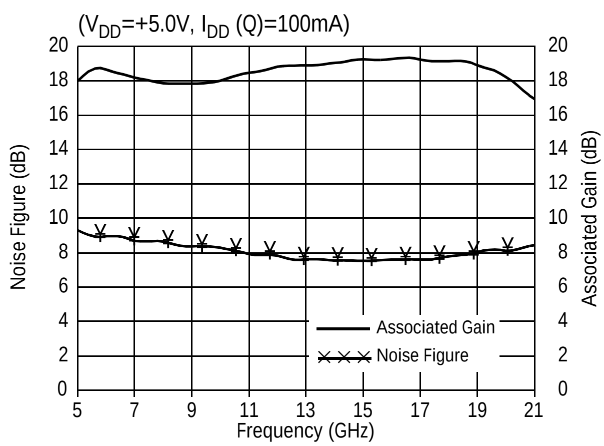


Figure 10.
Typical Noise Figure Performance vs. Frequency

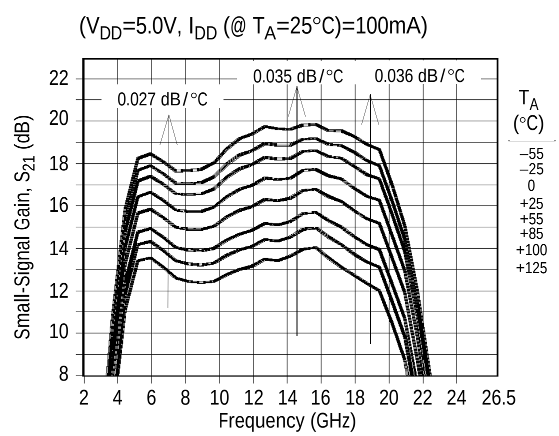


Figure 11.
Typical Small-Signal Gain vs. Temperature

Note: All data measured on individual devices mounted in an 83040 Series Modular Microcircuit Package @ T_A = 25°C, except where noted.

This data sheet contains a variety of typical and guaranteed performance data. The information supplied should not be interpreted as a complete list of circuit specifications. In this data sheet the term *typical* refers to the 50th percentile performance. For additional information contact your local Agilent Technologies' sales representative.

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