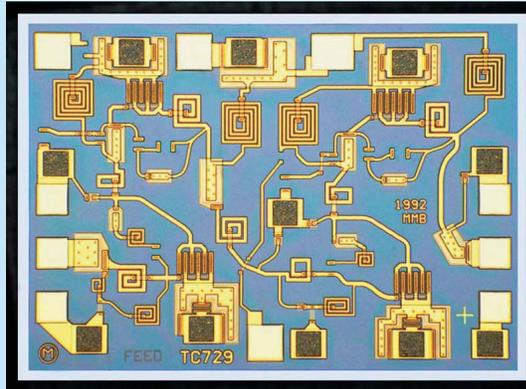


# Agilent HMMC-5620 6-20 GHz High-Gain Amplifier

## Data Sheet

### Features

- Wide-frequency Range:  
6-20 GHz
- High Gain: 17 dB
- Gain Flatness:  $\pm 1.0$  dB
- Return Loss:  
Input -15 dB  
Output -15 dB
- Single Bias Supply Operation
- Low DC Power Dissipation:  
 $P_{DC} \sim 0.5$  Watts
- Medium Power:  
20 GHz:  
 $P_{-1\text{ dB}}$  : 12 dBm  
 $P_{\text{sat}}$  : 13 dBm



Chip Size:	1410 × 1010 $\mu\text{m}$ (55.5 × 39.7 mils)
Chip Size Tolerance:	$\pm 10$ $\mu\text{m}$ ( $\pm 0.4$ mils)
Chip Thickness:	127 $\pm 15$ $\mu\text{m}$ (5.0 $\pm 0.6$ mils)
Pad Dimensions:	80 × 80 $\mu\text{m}$ (2.95 × 2.95 mils), or larger

### 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 MES-FET cascade stages provide high gain, while the single bias supply offers ease of use. E-Beam lithography is used to produce gate lengths of  $\sim 0.3$   $\mu\text{m}$ . The HMMC-5620 incorporates advanced MBE technology, Ti-Pt-Au gate metallization, silicon nitride passivation, and polyimide for scratch protection.

### Absolute Maximum Ratings<sup>1</sup>

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 Temperature		+160	$^{\circ}\text{C}$
$T_{case}$	Operating Case Temperature	-55		$^{\circ}\text{C}$
$T_{stg}$	Storage Temperature	-65	+165	$^{\circ}\text{C}$
$T_{max}$	Maximum Assembly Temperature (for 60 seconds maximum)		300	$^{\circ}\text{C}$

<sup>1</sup> Operation in excess of any one of these conditions may result in permanent damage to this device.  
 $T_A = 25^{\circ}\text{C}$  except for  $T_{ch}$ ,  $T_{stg}$ , and  $T_{max}$ .

### DC Specifications/Physical Properties<sup>1</sup>

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

<sup>1</sup> Measured in wafer form with  $T_{chuck} = 25^\circ\text{C}$ . (Except  $\theta_{ch-bs}$ )

### RF Specifications/Physical Properties

( $V_{DD} = 5.0\text{ V}$ ,  $I_{DD}(0) = 100\text{ mA}$ ,  $Z_{in} = Z_o = 50\ \Omega$ )<sup>1</sup>

Symbol	Parameters/Conditions	6.0-20.0 GHz			Units
		Min.	Typ.	Max.	
BW	Guaranteed Bandwidth	6		20	GHz
$S_{21}$	Small Signal Gain	15	17	21	dB
$\Delta S_{21}$	Small Signal Gain Flatness		$\pm 1.0$	$\pm 1.25$	dB
$RL_{in}$	Input Return Loss		-15	-10	dB
$RL_{out}$	Output Return Loss		-15	-10	dB
$S_{12}$	Reverse Isolation		-55		dB
$P_{-1\text{ dB}}$	Output Power at 1 dB Gain Compression		12		dBm
$P_{sat}$	Saturated Output Power		13		dBm
$H_2$	Second Harmonic, ( $6 < f_o < 20$ ) ( $P_o(f_o) = 10\text{ dBm}$ )		-30		dBc
$H_3$	Third Harmonic, ( $6 < f_o < 20$ ) ( $P_o(f_o) = 10\text{ dBm}$ )		-40		dBc
NF	Noise Figure		9.0		dB

<sup>1</sup> Small-signal data measured in wafer form with  $T_{chuck} = 25^\circ\text{C}$ . Large-signal data measured on individual devices mounted in an Agilent 83040 series modular microcircuit package @  $T_A = 25^\circ\text{C}$ .

### 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  $V_{DD} = 5.0$  V, 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, MWTC 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.

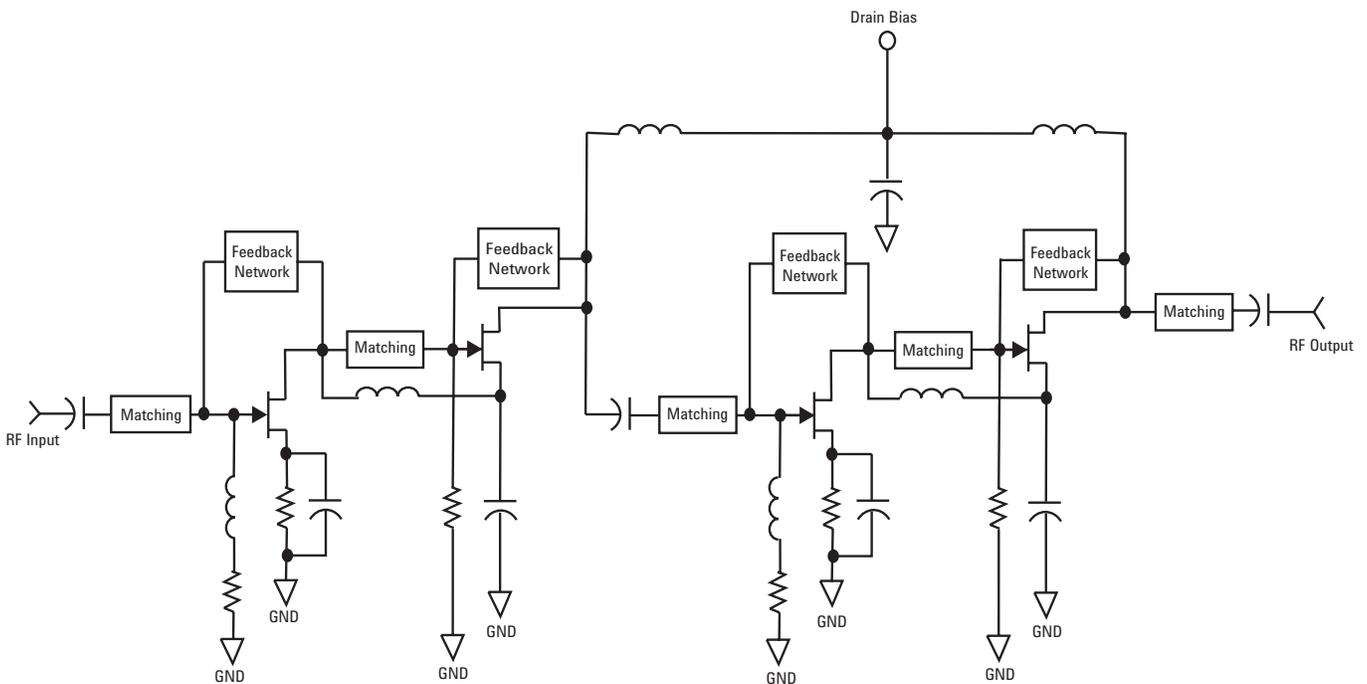


Figure 1. Schematic

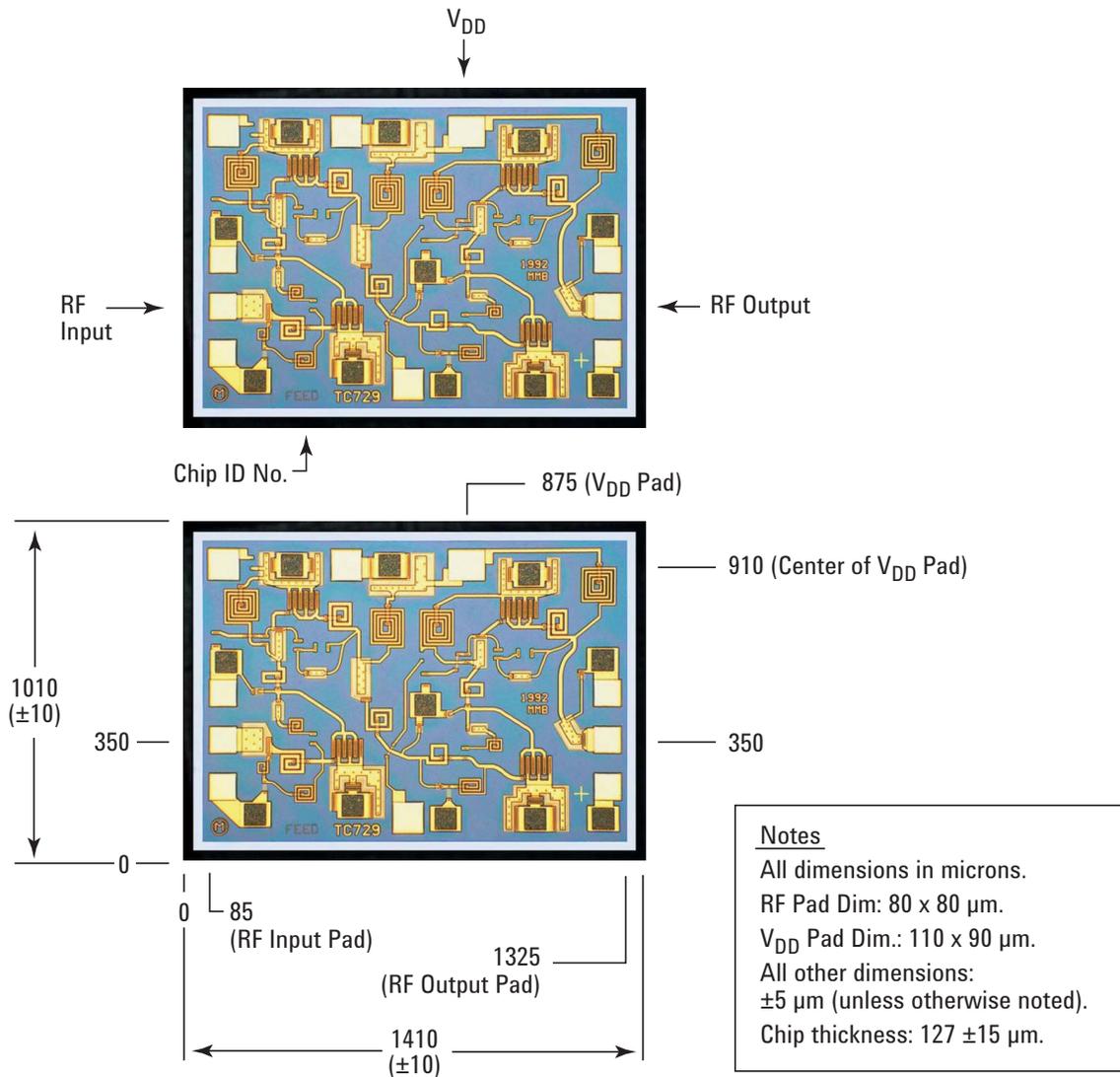


Figure 2. Bond Pad Locations

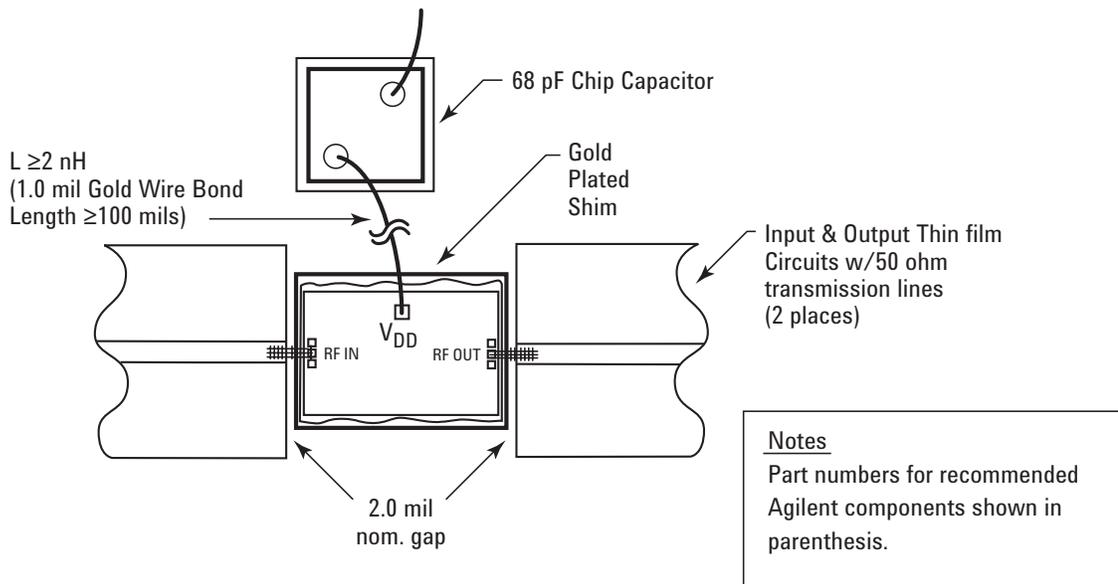


Figure 3. Assembly Diagram (For 6.0-20.0 GHz Operation)

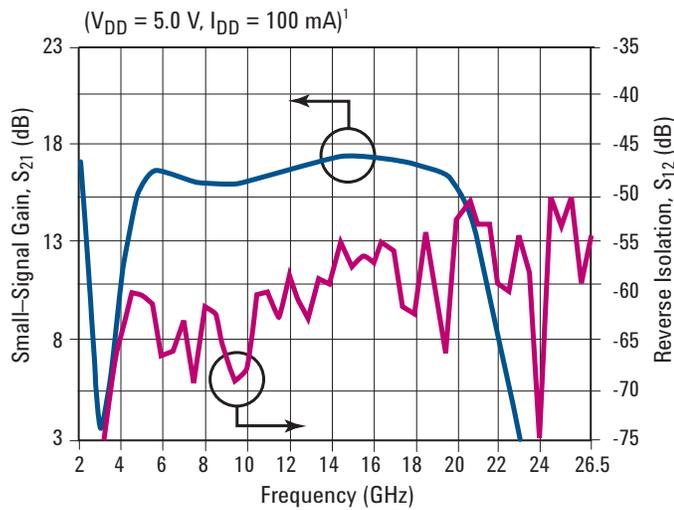


Figure 4. Typical Gain and Reverse Isolation vs. Frequency

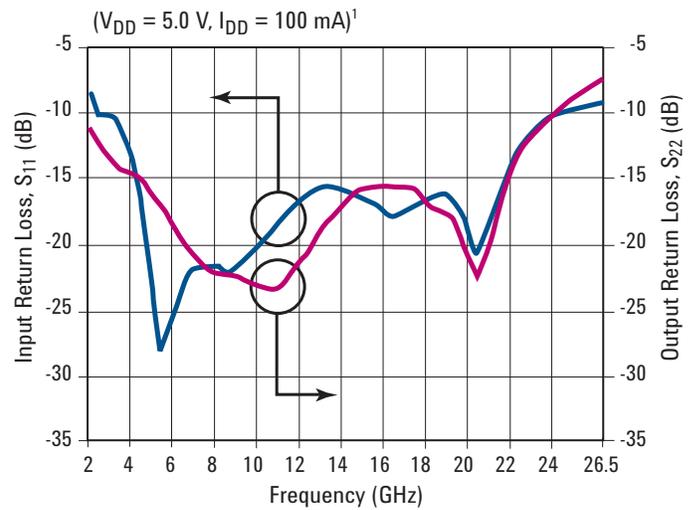


Figure 5. Typical Input and Output Return Loss vs. Frequency

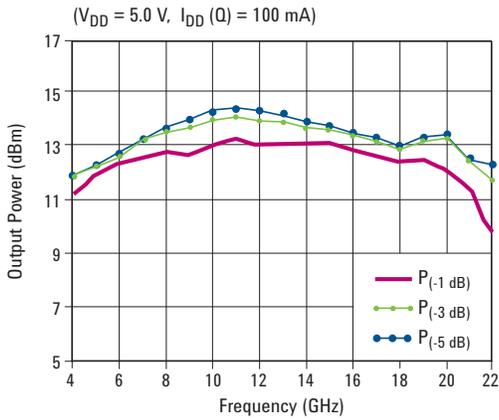
### Typical S-Parameters<sup>1</sup>

( $T_{\text{chuck}} = 25^{\circ}\text{C}$ ,  $V_{\text{DD}} = 5.0\text{ V}$ ,  $I_{\text{DD}} = 100\text{ mA}$ ,  $Z_{\text{in}} = Z_0 = 5\ \Omega$ )

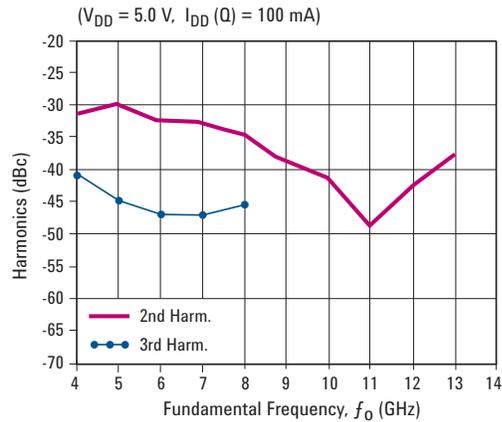
Freq. (GHz)	S <sub>11</sub>			S <sub>12</sub>			S <sub>21</sub>			S <sub>22</sub>		
	dB	Mag	Ang	dB	Mag	Ang	dB	Mag	Ang	dB	Mag	Ang
2.0	-10.7	0.292	-100.3	-46.1	0.0049	-174.7	-6.2	0.491	-52.2	-8.1	0.395	-152.2
3.0	-13.5	0.212	-117.5	-74.1	0.0002	114.0	3.5	1.489	-170.0	-10.1	0.311	-171.5
4.0	-14.6	0.186	-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

<sup>1</sup> Data obtained from on-wafer measurements.

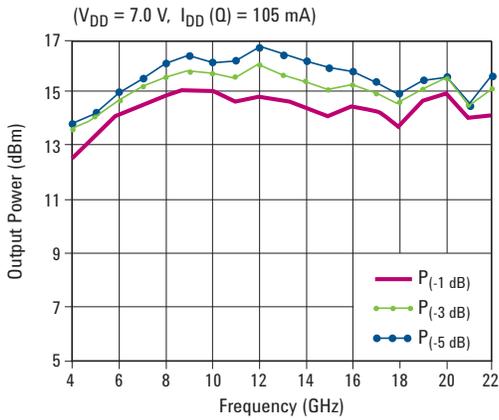
## Additional Performance Characteristics



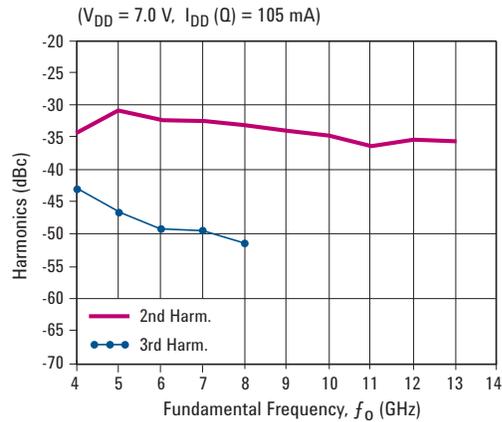
**Figure 6.** Typical Output Power vs. Frequency (w/5 V bias)



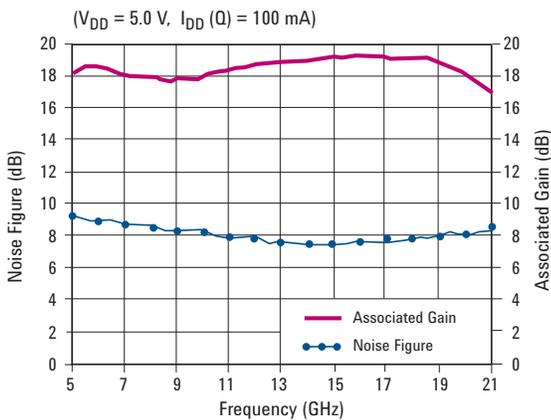
**Figure 7.** Typical Second and Third Harmonics vs. Fundamental Frequency at  $P_{out} = 10\text{ dBm}$



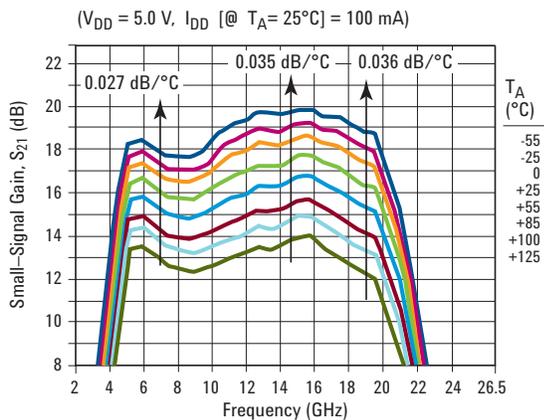
**Figure 8.** Typical Output Power vs. Frequency (w/7 V bias)



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



**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 @  $T_A = 25^\circ\text{C}$ , 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. Customers considering the use of this, or other MWTC GaAs ICs, for their design should obtain the current production specifications from MWTC Semiconductor Marketing. In this data sheet the term typical refers to the 50th percentile performance. For additional information contact MWTC Marketing at 707-577-4482.



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#### Other Asia Pacific Countries:

(tel) (65) 6375 8100

(fax) (65) 6755 0042

Email: [tm\\_ap@agilent.com](mailto:tm_ap@agilent.com)

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