



17.7 – 32 GHz Amplifier

Technical Data

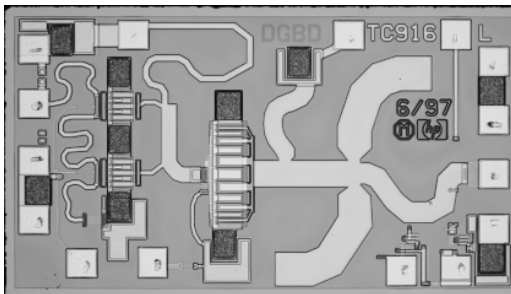
HMMC-5032

Features

- **22 dBm Output P_(-1 dB)**
- **8 dB Gain**
- **50 Ω Input/Output Matching**
- **Small Size**
- **Bias: 4.5 Volts, 250 mA**

Description

The HMMC-5032 is a MMIC power amplifier designed for use in wireless transmitters that operate within the 17.7 GHz to 32 GHz range. It provides 22 dBm of output power and 8 dB of small-signal gain from a small easy-to-use device. The HMMC-5032 was designed to be driven by the HMMC-5040 (20–40 GHz) or the HMMC-5618 (5.9–20 GHz) MMIC amplifier for linear transmit applications. This device has input and output matching circuitry for use in 50 ohm environments.



Chip Size: 1.4 x 0.78 mm (55.1 x 30.7 mils)
 Chip Size Tolerance: ±10 μm (±0.4 mils)
 Chip Thickness: 127 ± 15 μm (5.0 ± 0.6 mils)

Absolute Maximum Ratings^[1]

Symbol	Parameters/Conditions	Units	Min.	Max.
V _{D1,2}	Drain Supply Voltages	V		5
V _{G1,2}	Gate Supply Voltages	V	-3.0	0.5
Det. Bias	Applied Detector Bias (Optional)	V		5
I _{DD}	Total Drain Current	mA		460
P _{in}	RF Input Power	dBm		23
T _{ch}	Channel Temperature ^[2]	°C		+170
T _A	Backside Ambient Temp.	°C	-55	+95
T _{STG}	Storage Temperature	°C	-65	+170
T _{max}	Maximum Assembly Temp.	°C		+300

Notes:

1. Absolute maximum ratings for continuous operation unless otherwise noted.
2. Refer to *DC Specifications/Physical Properties* table for derating information.

HMMC-5032 DC Specifications/Physical Properties^[1]

Symbol	Parameters and Test Conditions	Units	Min.	Typ.	Max.
V _{DI,2}	Drain Supply Operating Voltages	V	2	4.5	5
I _{D1}	First Stage Drain Supply Current (V _{DD} = 4.5 V, V _{G1} ≅ -0.8 V)	mA		100	140
I _{D2}	Second Stage Drain Supply Current (V _{DD} = 4.5 V, V _{GG} ≅ -0.8 V)	mA		150	320
V _{G1,2}	Gate Supply Operating Voltages (I _{DD} ≅ 250 mA)	V		-0.8	
V _P	Pinch-off Voltage (V _{DD} = 4.5 V, I _{DD} ≤ 10 mA)	V	-2	-1.2	
Det. Bias	Detector Bias Voltage (Optional)	V		V _{DI,2}	5
θ _{ch-bs}	Thermal Resistance ^[2] (Channel-to-Backside at T _{ch} = 160°C)	°C/Watt		67	
T _{ch}	Channel Temperature ^[3] (T _A = 85°C, MTTF > 10 ⁶ hrs, V _{DD} = 4.5 V, I _{DD} = 250 mA)	°C		160	

Notes:

1. Backside ambient operating temperature T_A = 25°C unless otherwise noted.
2. Thermal resistance (°C/Watt) at a channel temperature T (°C) can be estimated using the equation:

$$\theta(T) \cong \theta_{ch-bs} \times [T(^{\circ}C) + 273] / [160^{\circ}C + 273].$$
3. Derate MTTF by a factor of two for every 8°C above T_{ch}.

HMMC-5032 RF Specifications,

T_A = 25°C, Z_O = 50 Ω, V_{DD} = 4.5 V, I_{DD} = 250 mA

Symbol	Parameters/Conditions	Units	Low Band Specifications			Upper Band Specifications		
			Min.	Typ.	Max.	Min.	Typ.	Max.
BW	Operating Bandwidth	GHz	17.7		26.5	25		31.5
Gain	Small Signal Gain	dB	7	8		6	7	
ΔGain/ΔT	Temperature Coefficient of Gain	dB/°C		0.02			0.02	
P _{1dB}	Output Power at 1 dB Gain Compression	dBm	21	22		21	22	
P _{SAT}	Saturated Output Power ^[1]	dBm		24			24	
(RL _{in}) _{MIN}	Minimum Input Return Loss	dB	8	9		10	15	
(RL _{out}) _{MIN}	Minimum Output Return Loss	dB	9	10		15	20	
Isolation	Minimum Reverse Isolation	dB		35			30	

Note:

1. Devices operating continuously beyond 1 dB gain compression may experience power degradation.

HMMC-5032 Applications

The HMMC-5032 MMIC is a broadband power amplifier designed for use in transmitters that operate in various frequency bands between 17.7 GHz and 32 GHz. It can be attached to the output of the HMMC-5040 (20–40 GHz) or the HMMC-5618 (5.9–20 GHz) MMIC amplifier, increasing the power handling capability of transmitters requiring linear operation.

Biassing and Operation

The recommended DC bias condition is with both drains (V_{D1} and V_{D2}) connected to single 4.5 volt supply and both gates (V_{G1} and V_{G2}) connected to an adjustable negative voltage supply. The gate voltage is adjusted for a total drain supply current of typically 250 mA.

The RF input and output are AC-coupled.

An optional output power detector network is also provided. Detector sensitivity can be adjusted by biasing the diodes with typically 1 to 5 volts applied to the *Det-Bias* terminal. Simply connecting *Det-Bias* to the V_{D2} supply is a convenient method of biasing this detector network. The differential voltage between the *Det-Ref* and *Det-Out* bonding pads can be correlated to the RF power emerging from the *RF Output* port.

No ground wires are needed because ground connections are made with plated through-holes to the backside of the device.

Assembly Techniques

Electrical and thermal conductive epoxy die attach is the preferred assembly method. Solder die attach using a fluxless gold-tin (AuSn) solder preform can also be used. The device should be attached to an electrically conductive surface to complete the DC and RF ground paths. The backside metallization on the device is gold.

It is recommended that the electrical connections to the bonding pads be made using 0.7–1.0 mil diameter gold wire. The microwave/millimeter-wave connections should be kept as short as possible to minimize inductance. For assemblies requiring long bond wires, multiple wires can be attached to the RF bonding pads.

Thermosonic wedge is the preferred method for wire bonding to the gold bond pads. A guided-wedge at an ultrasonic power level of 64 dB can be used for the 0.7 mil wire. The recommended wire bond stage temperature is $150 \pm 2^\circ\text{C}$.

For more detailed information see Agilent application note #999, "GaAs MMIC Assembly and Handling Guidelines."

GaAs MMICs are ESD sensitive. Proper precautions should be used when handling these devices.

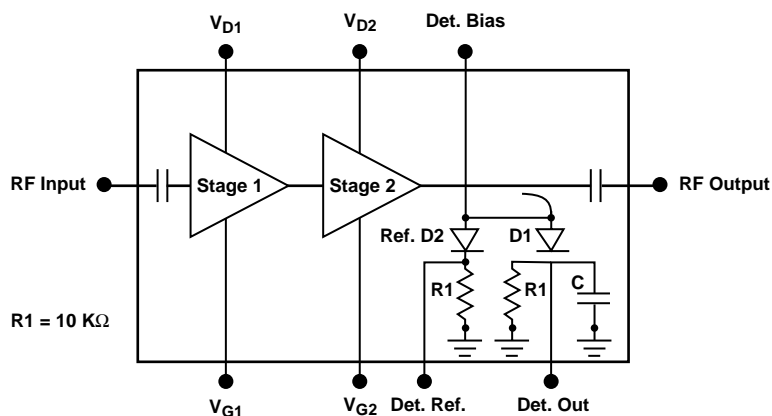


Figure 1. HMMC-5032 Simplified Schematic Diagram.

HMMC-5032 Typical Performance Characteristics

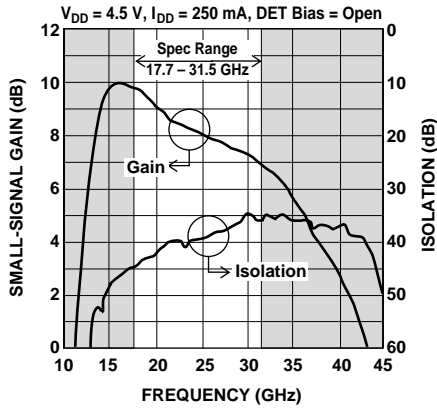


Figure 2. Gain and Isolation vs. Frequency.

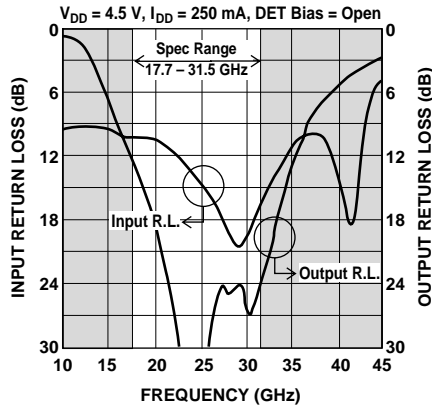


Figure 3. Input and Output Return Loss vs. Frequency.

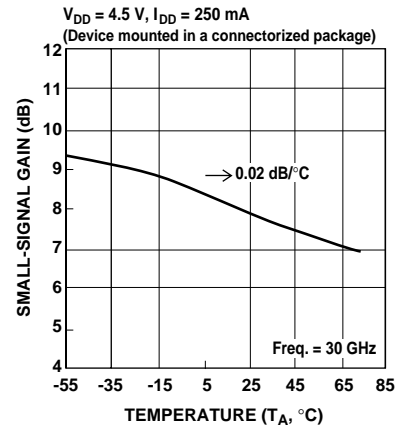


Figure 4. Gain vs. Temperature.

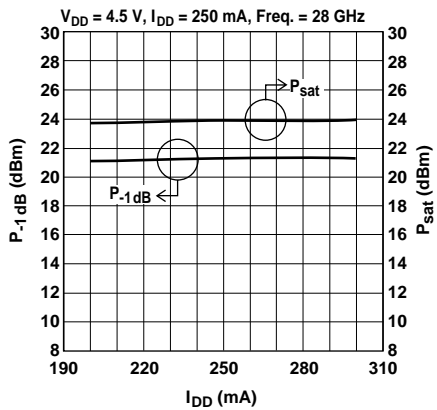


Figure 5. Output Power Loss vs. Total Drain Current.

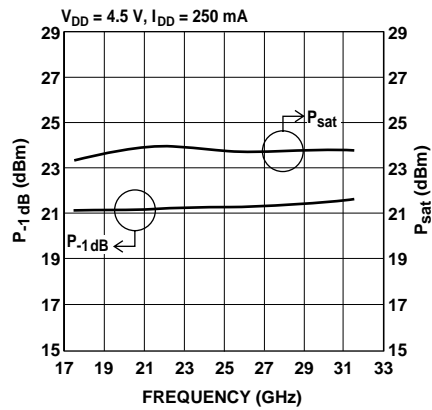


Figure 6. Output Power vs. Frequency.

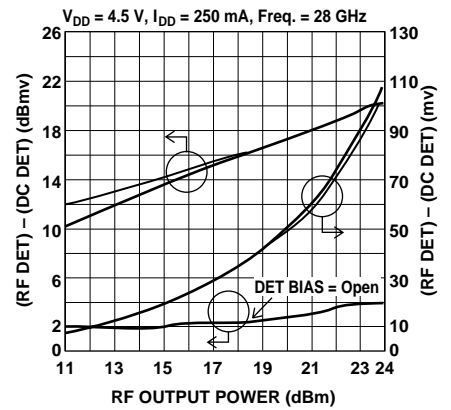


Figure 7. Detector Voltages vs. Output Power for Various Detector Bias Voltages.

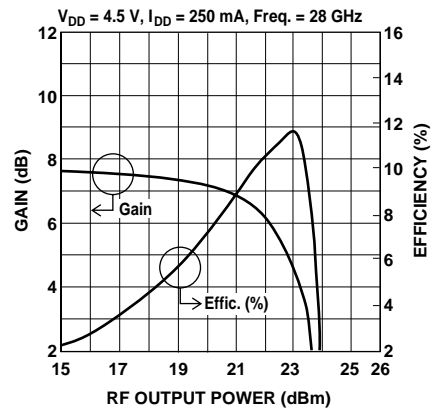


Figure 8. Gain Compression and Efficiency vs. Power Out.

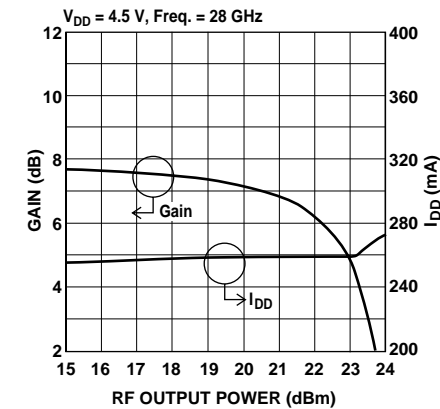


Figure 9. Gain and Total Drain Current vs. Output Power.

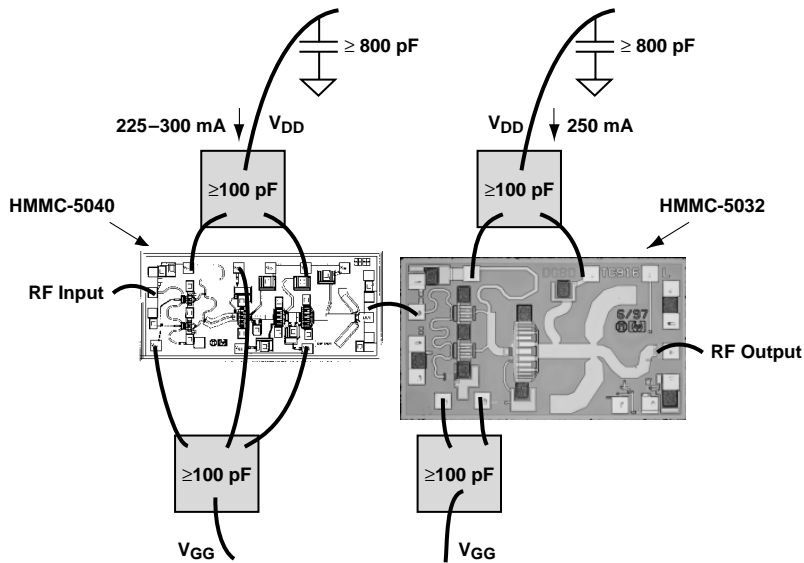


Figure 10. Assembly diagram illustrating the HMMC-5032 cascaded with the HMMC-5040 for 20–32 GHz applications.

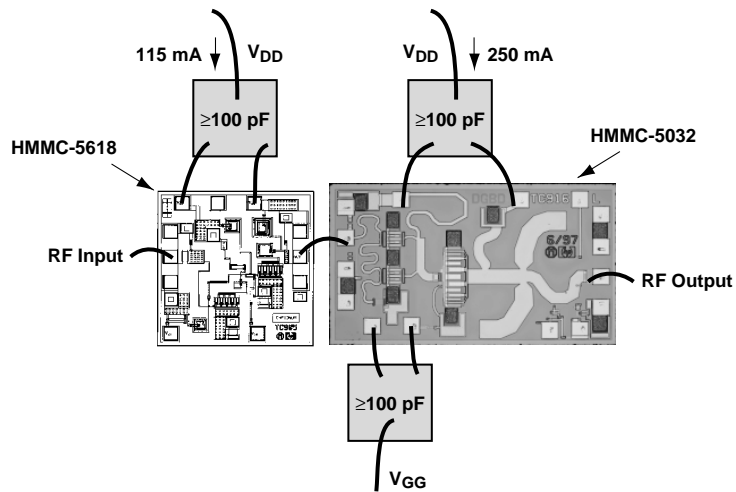


Figure 11. Assembly diagram illustrating the HMMC-5032 cascaded with the HMMC-5618 for 17.7–20 GHz applications.

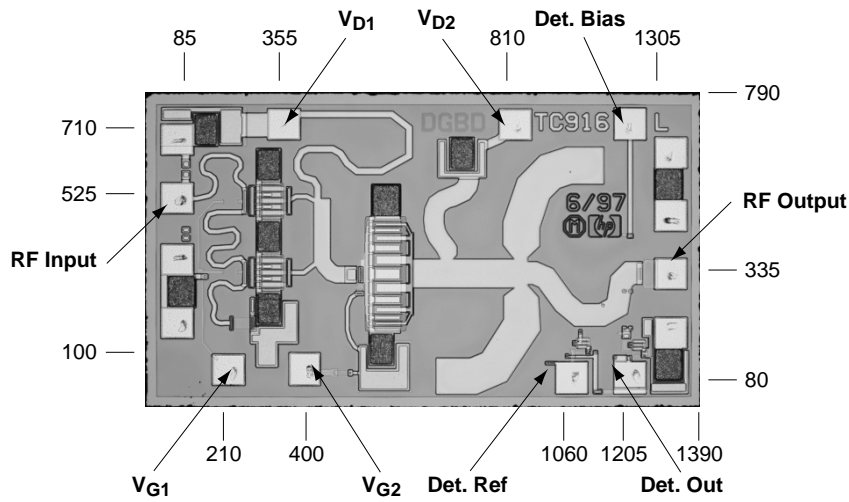


Figure 12. HMMC-5032 Bonding Pad Locations. (Dimensions are in micrometers)

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 sales representative.