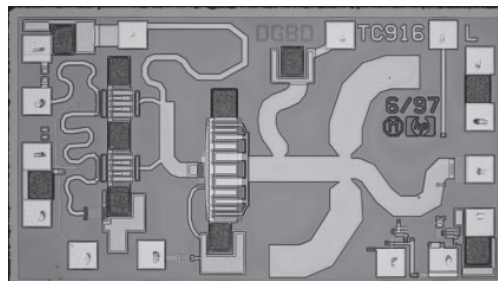


# Avago HMMC-5032

## 17.7–32 GHz Amplifier

## Data Sheet



Chip Size: 1.4 x 0.78 mm (55.1 x 30.7 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)

### 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.

### Features

- 22 dBm output  $P_{(-1\text{dB})}$
- 8 dB gain
- 50 $\Omega$  input/output matching
- Small size
- Bias: 4.5 volts, 250 mA

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

Symbol	Parameters/Conditions	Units	Min.	Max.
$V_{D1}, V_{D2}$	Drain Supply Voltages	V		5
$V_{G1}, V_{G2}$	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 <sup>[2]</sup>	$^{\circ}\text{C}$		170
$T_A$	Backside Ambient Temp.	$^{\circ}\text{C}$	-55	+95
$T_{st}$	Storage Temperature	$^{\circ}\text{C}$	-65	+170
$T_{max}$	Max. Assembly Temperature	$^{\circ}\text{C}$		300

#### Notes:

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

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

Symbol	Parameters and Test Conditions	Units	Min.	Typ.	Max.
$V_{D1}, V_{D2}$	Drain Supply Operating Voltage	V	2	4.5	5
$I_{D1}$	First Stage Drain Supply Current ( $V_{DD} = 4.5V, V_{G1} \cong -0.8V$ )	mA		100	140
$I_{D2}$	Second Stage Drain Supply Current ( $V_{DD} = 4.5V, V_{GG} \cong -0.8V$ )	mA		150	320
$V_{G1}, V_{G2}$	Gate Supply Operating Voltages ( $I_{DD} \cong 250$ mA)	V		-0.8	
$V_P$	Pinch-Off Voltage ( $V_{DD} = 4.5V, I_{DD} \leq 10$ mA)	V	-2	-1.2	
Det. Bias	Detector Bias Voltage (Optional)	V		$V_{D1,2}$	5
$\theta_{ch-bs}$	Thermal Resistance <sup>[2]</sup> (Channel-to-Backside at $T_{ch} = 160^\circ C$ )	$^\circ C/W$		67	
$T_{ch}$	Channel Temperature <sup>[3]</sup> ( $T_A = 85^\circ C, MTTF > 10^6$ hrs, $V_{DD} = 4.5V, I_{DD} = 250$ mA)	$^\circ C$		160	

### Notes:

- Backside ambient operating temperature  $T_A = 25^\circ C$  unless otherwise noted.
- Thermal resistance (in  $^\circ C/Watt$ ) at a channel temperature  $T(^\circ C)$  can be estimated using the equation:  $\theta(T) = \theta_{ch-bs} \times [T(^\circ C) + 273]/[160^\circ C + 273]$ .
- Derate MTTF by a factor of two for every  $8^\circ C$  above  $T_{ch}$ .

## HMMC-5032 RF Specifications, ( $T_A = 25^\circ C, Z_0 = 50\Omega, V_{DD} = 4.5$ 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	
$\Delta Gain/\Delta T$	Temperature Coefficient of Gain	dB/ $^\circ C$		0.02			0.02	
$P_{-1dB}$	Output Power at 1 dB Gain Compression	dBm	21	22		21	22	
$P_{sat}$	Saturated Output Power <sup>[1]</sup>	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:

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

### 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.

### Biasing 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

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.

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.

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

### Additional References

PN# 3, “HMMC-5040 and HMMC-5032 Demo, 20-32 GHz High Gain Medium Power Amp,” and PN# 4, “HMMC-5032 Intermodulation Distortion.”

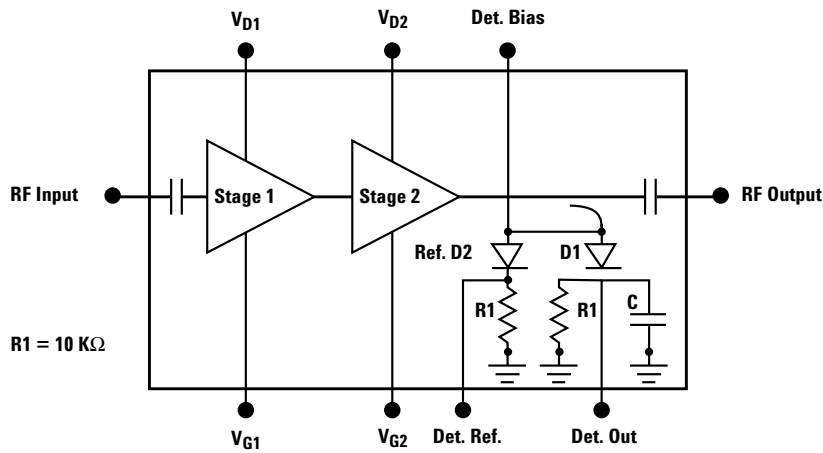


Figure 1. HMMC-5032 Simplified Schematic Diagram.

# HMMC-5032 Typical Performance Characteristics

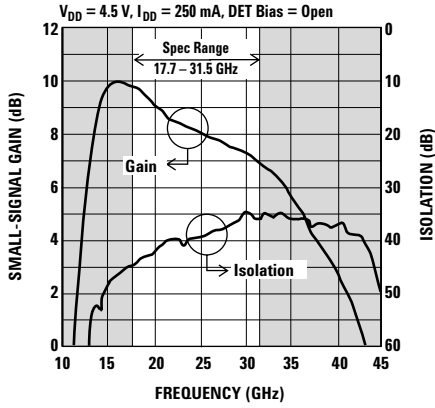


Figure 2. Gain and Isolation vs. Frequency.

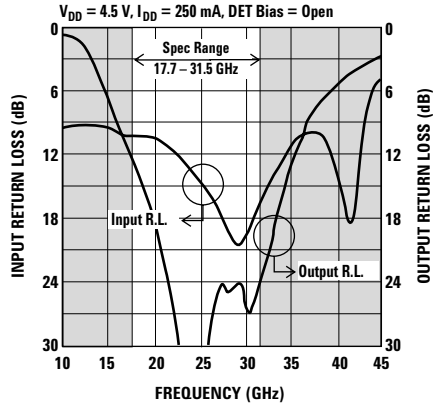


Figure 3. Input and Output Return Loss vs. Frequency.

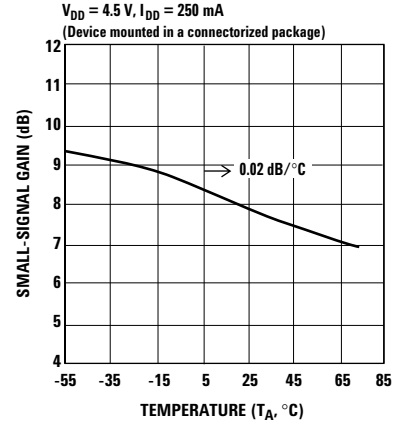


Figure 4. Gain vs. Temperature.

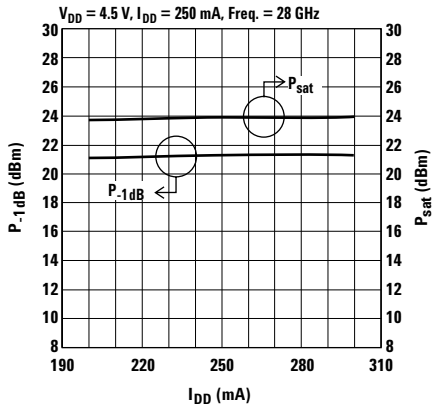


Figure 5. Output Power vs. Total Drain Current.

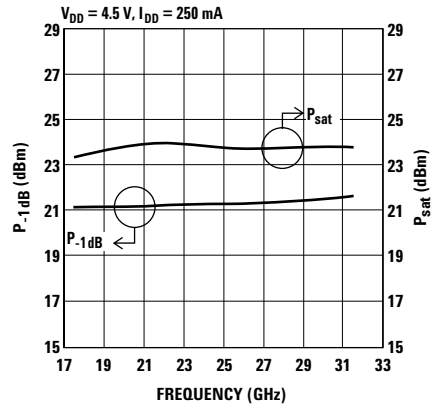


Figure 6. Output Power vs. Frequency.

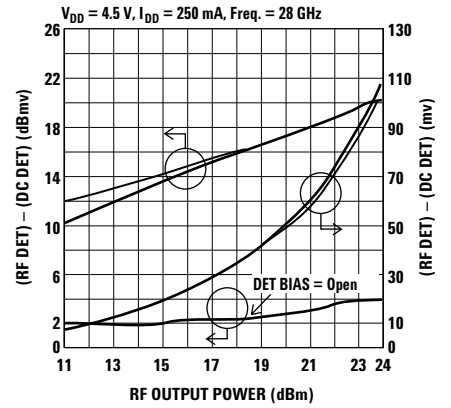


Figure 7. Detector Voltages vs. Output Power for Various Detector Bias Voltages.

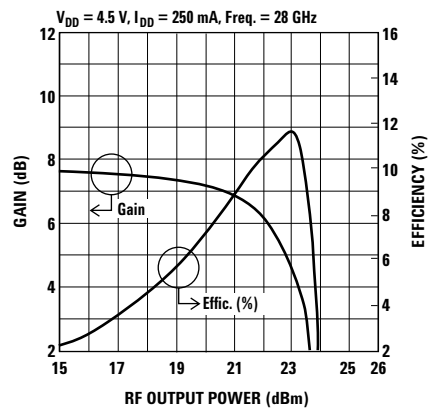


Figure 8. Gain Compression and Efficiency vs. Power Out.

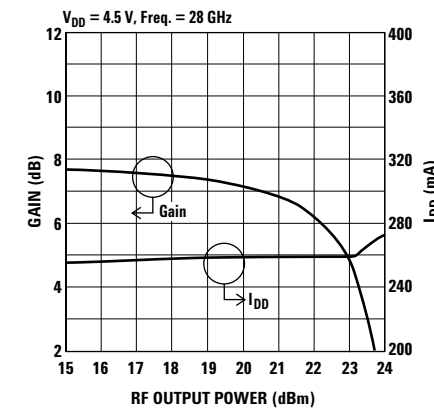


Figure 9. Gain and Total Drain Current vs. Output Power.

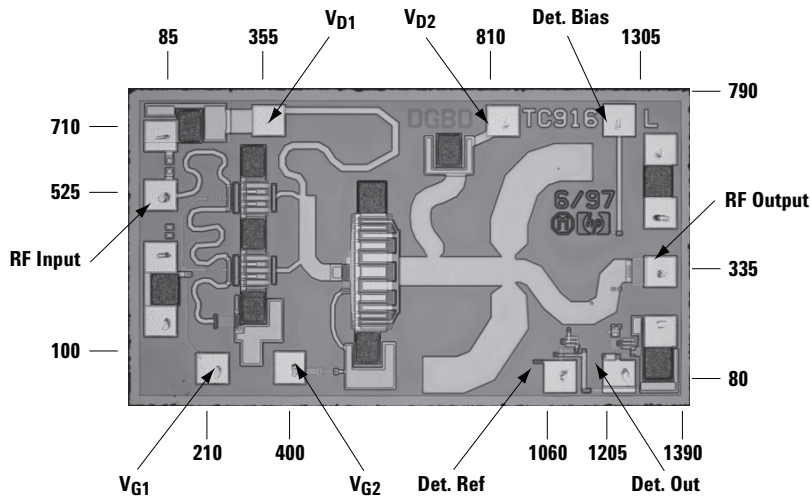


Figure 10. HMMC-5032 Bonding Pad Locations. (Dimensions are in micrometers)

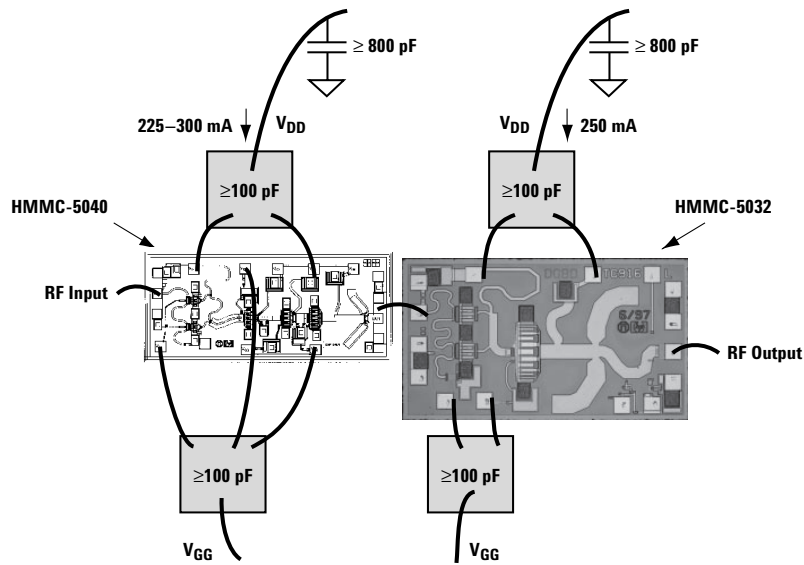


Figure 11. Assembly diagram illustrating the HMMC-5032 cascaded with the HMMC-5040 for 20–32 GHz applications.

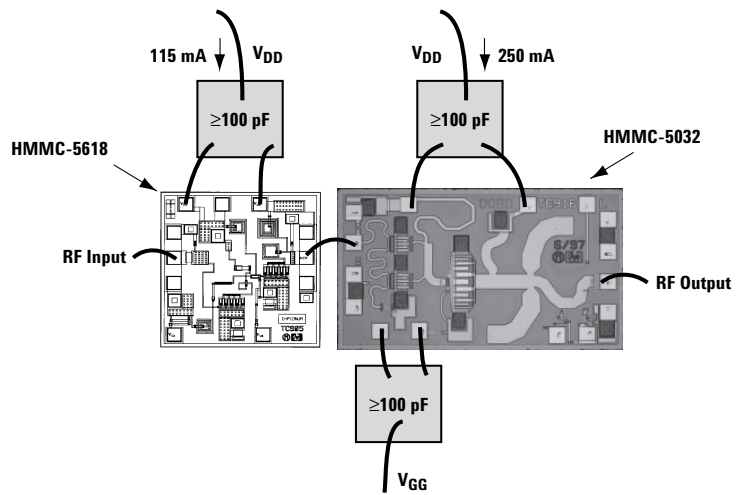


Figure 12. Assembly diagram illustrating the HMMC-5032 cascaded with the HMMC-5618 for 17.7–20 GHz applications.

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 Avago Technologies' sales representative.

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