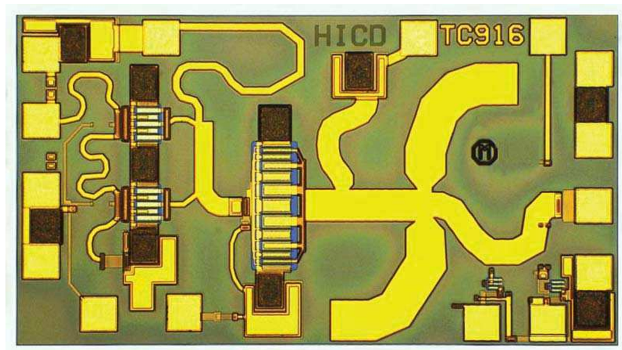
# Agilent HMMC-5032
# 17.7–32 GHz Amplifier

1GG6-8009

Data Sheet




Chip size: 1370 x 770 µm (53.3 x 30.0 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)

## 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 Ω environments.

## Absolute maximum ratings[1]

| Symbol | Parameters/conditions | Minimum | Maximum | Units |
|---|---|---|---|---|
| $V_{D1,2}$ | Drain supply voltages | | 5 | Volts |
| $V_{G1,2}$ | Gate supply voltages | –3.0 | 0.5 | Volts |
| Det. bias | Applied detector bias (optional) | | 5 | Volts |
| $I_{DD}$ | Total drain current | | 460 | mA |
| $P_{in}$ | RF input power | | 23 | dBm |
| $T_{ch}$ | Channel temperature[2] | | 170 | °C |
| $T_A$ | Backside ambient temperature | –55 | +95 | °C |
| $T_{st}$ | Storage temperature | –65 | +170 | °C |
| $T_{max}$ | Maximum assembly temperature | | 300 | °C |

1 Absolute maximum ratings for continuous operation unless otherwise noted.
2 Refer to *DC specifications/physical properties* table for derating information.

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## DC specifications/physical properties[1]

| Symbol | Parameters/conditions | Minimum | Typical | Maximum | Units |
|---|---|---|---|---|---|
| $V_{D1,2}$ | Drain supply operating voltages | 2 | 4.5 | 5 | Volts |
| $I_{D1}$ | First stage drain supply current ($V_{DD}$ = 4.5 V, $V_{G1} \cong -0.8$ V) | | 100 | 140 | mA |
| $I_{D2}$ | Second stage drain supply current ($V_{DD}$ = 4.5 V, $V_{GG} \cong -0.8$ V) | | 150 | 320 | mA |
| $V_{G1,2}$ | Gate supply operating voltages ($I_{DD} \cong 250$ mA) | | –0.8 | | Volts |
| $V_P$ | Pinch-off voltage ($V_{DD}$ = 4.5 V, $I_{DD}$ 10 mA) | –2 | –1.2 | | Volts |
| Det. bias | Detector bias voltage (optional) | | $V_{D1,2}$ | 5 | Volts |
| $\theta_{ch-bs}$ | Thermal resistance[2] (channel-to-backside at $T_{ch}$ = 160°C) | | 67 | | °C/Watt |
| $T_{ch}$ | Channel temperature[3] (TA = 85°C, MTTF > $10^6$ hrs $V_{DD}$ = 4.5 V, $I_{DD}$ = 250 mA) | | 160 | | °C |

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

## RF specifications
($T_A$ = 25°C, $Z_0$ = 50 Ω, $V_{DD}$ = 4.5 V, $I_{DD}$ = 250 mA)

| | | Low band specifications | | | Upper band specifications | | | |
|---|---|---|---|---|---|---|---|---|
| Symbol | Parameters/conditions | Minimum | Typical | Maximum | Minimum | Typical | Maximum | Units |
| BW | Operating bandwidth | 17.7 | | 26.5 | 25 | | 31.5 | GHz |
| Gain | Small signal gain | 7 | 8 | | 6 | 7 | | dB |
| ΔGain/ΔT | Temperature coefficient of gain | | 0.02 | | | 0.02 | | dB/°C |
| $P_{-1\ dB}$ | Output power at 1 dB gain compression | 21 | 22 | | 21 | 22 | | dBm |
| $P_{SAT}$ | Saturated output power[1] | | 24 | | | 24 | | dBm |
| $(RL_{in})_{MIN}$ | Minimum input return loss | 8 | 9 | | 10 | 15 | | dB |
| $(RL_{out})_{MIN}$ | Minimum output return loss | 9 | 10 | | 15 | 20 | | dB |
| Isolation | Minimum reverse isolation | | 35 | | | 30 | | dB |

1 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.

Agilent 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"

PN# 4, "HMMC-5032 Intermodulation Distortion"

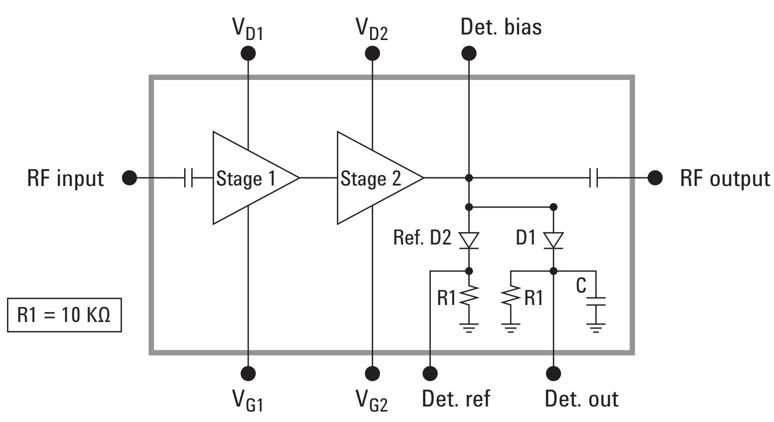


**Figure 1. Simplified schematic diagram**

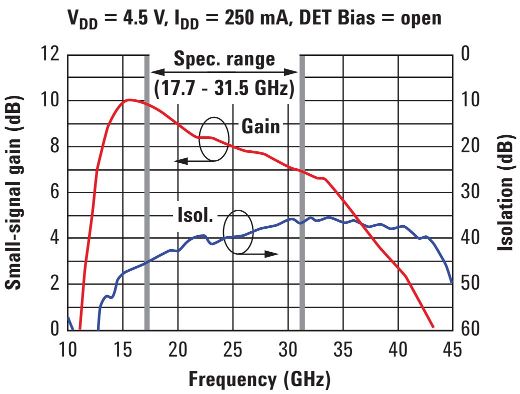


Figure 2. Gain and isolation vs. frequency

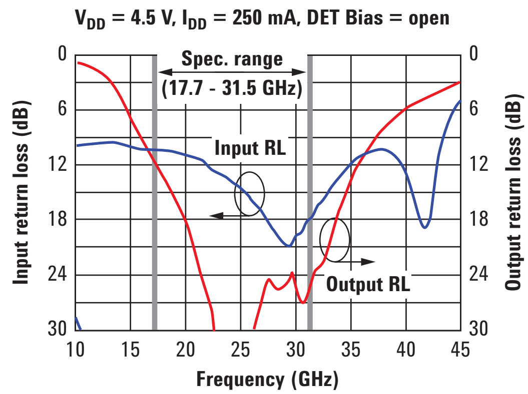


Figure 3. Input and output return loss vs. frequency

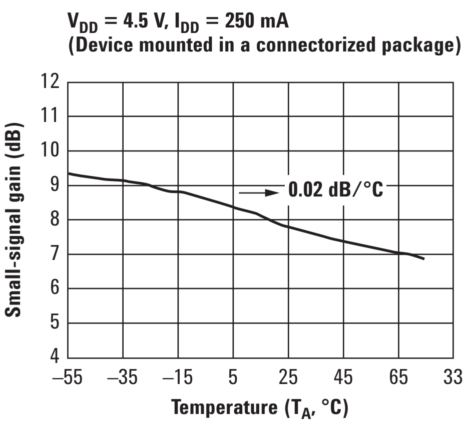


Figure 4. Gain vs. temperature

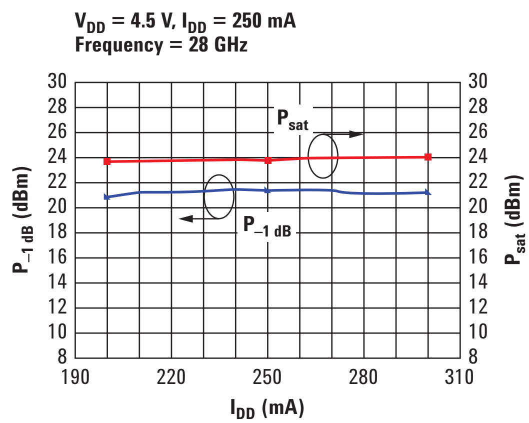


Figure 5. Output power vs. total drain current

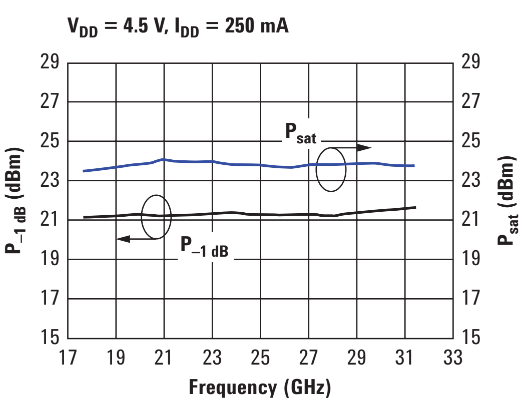


Figure 6. Output power vs. frequency

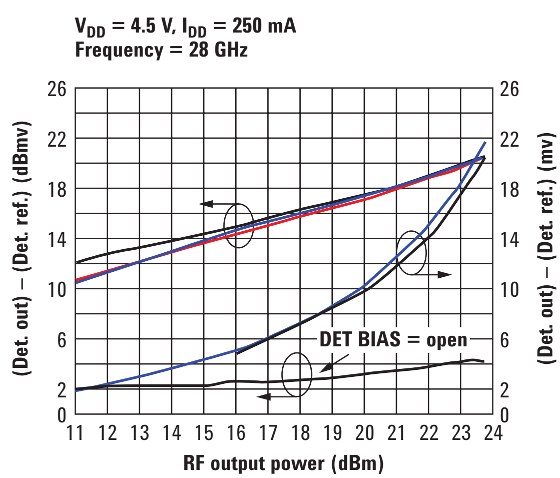


Figure 7. Detector voltages vs. output power for various detector bias voltage

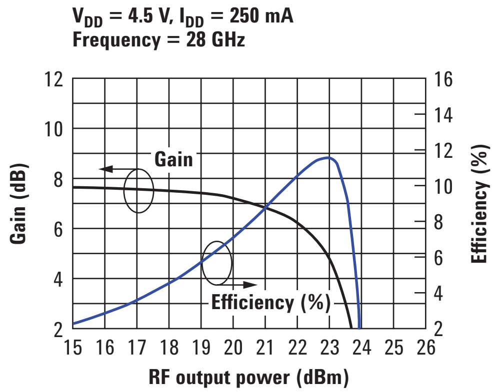


Figure 8. Gain compression and efficiency vs. power out

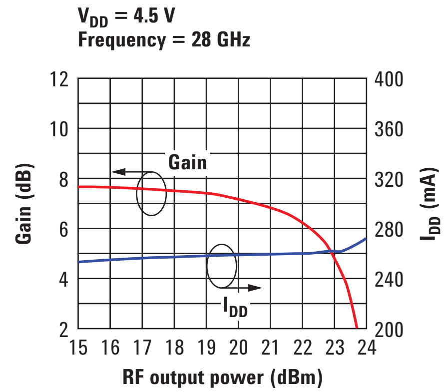


Figure 9. Gain and total drain current vs. output power

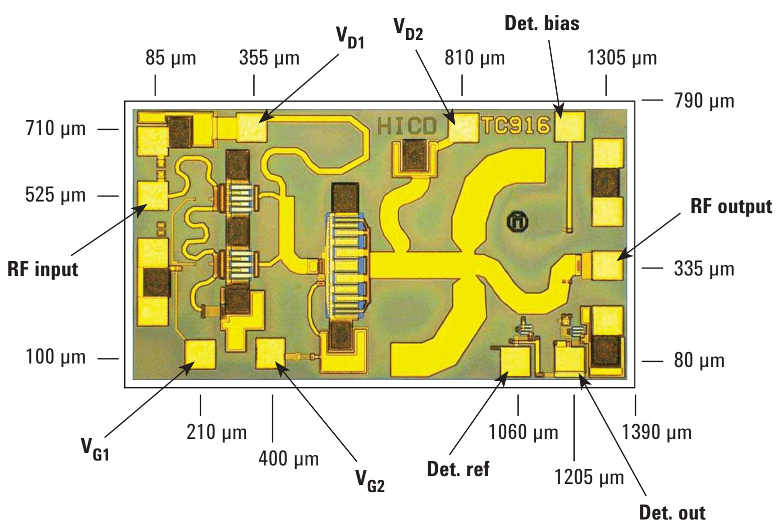


Figure 10. Bonding pad locations

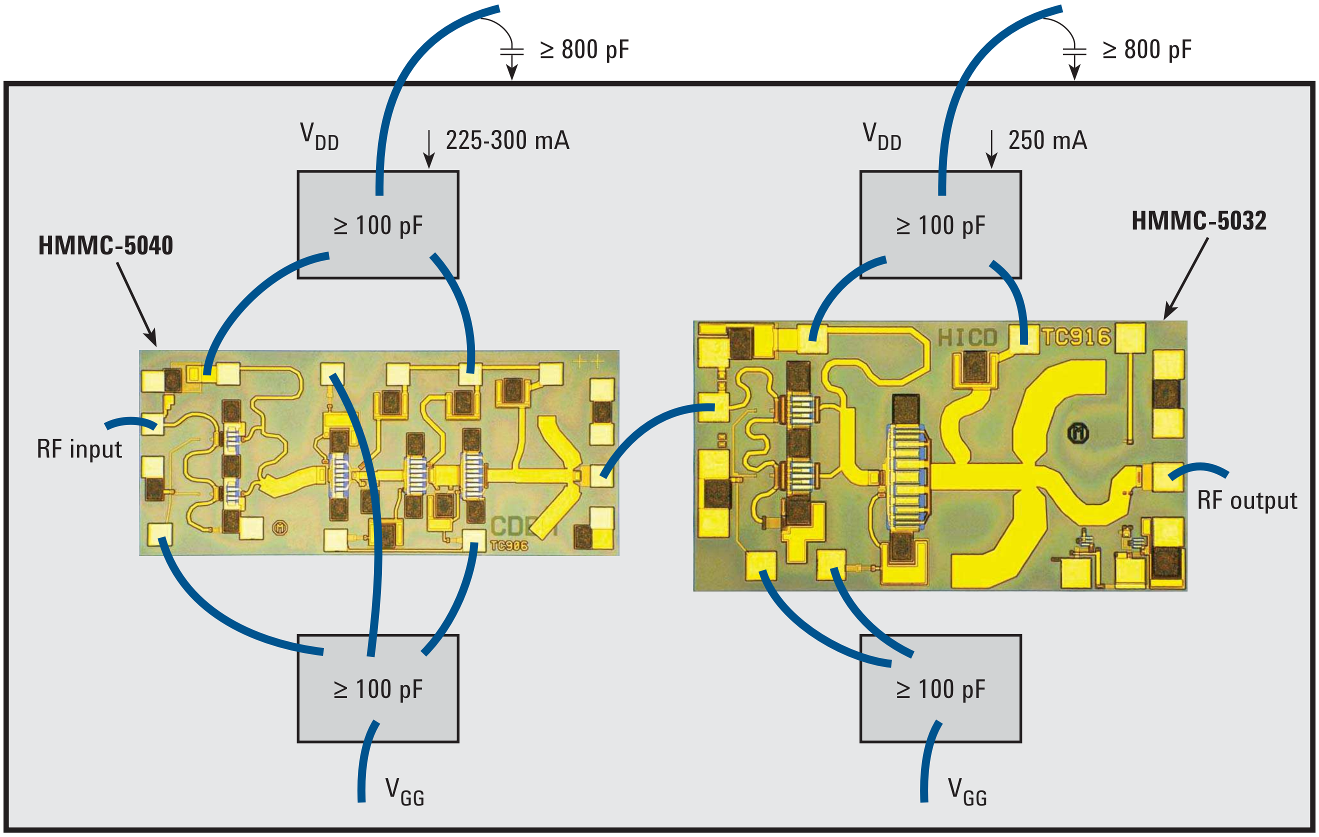


**Figure 11. Assembly diagram illustrating the HMMC-5032 cascaded with the HMMC-5040 for 20-32 GHz applications**

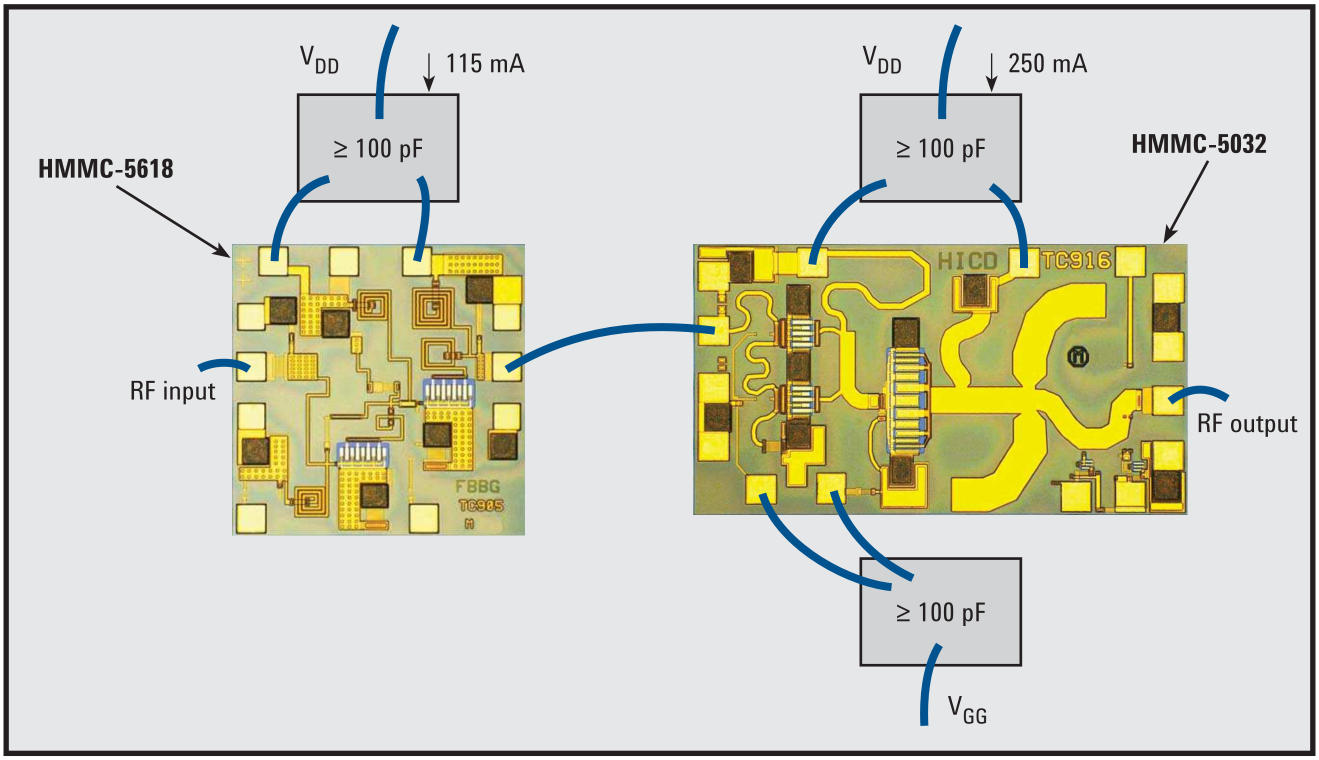


**Figure 12. Assembly diagram illustrating the HMMC-5032 cascaded with the HMMC-5618 for 17.7-20 GHz applications**

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**Other Asia Pacific Countries:**
(tel) (65) 6375 8100
(fax) (65) 6755 0042
Email: tm_ap@agilent.com
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