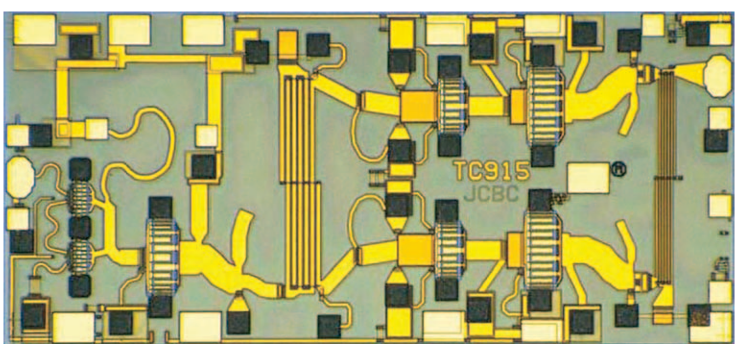
Keysight HMMC-5033
17.7–32 GHz Amplifier
1GG6-8009

Data Sheet



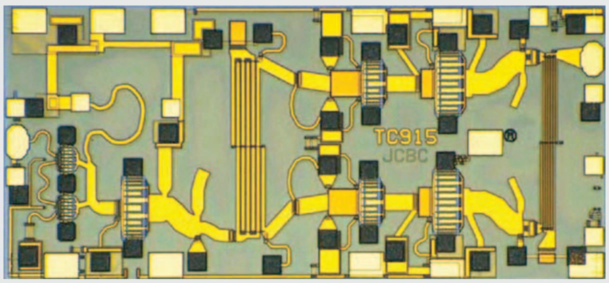
Features

- 22 dBm output $P_{(-1\ dB)}$
- High gain 8 dB gain
- 50 Ω input/output matching
- Small size
- RF detector network

KEYSIGHT TECHNOLOGIES

Description

The Keysight Technologies, Inc. HMMC-5033 is a MMIC power amplifier designed for use in wireless transmitters that operate within the 17.7 GHz to 32 GHz range. At 28 GHz it provides 26 dBm of output power ($P_{-1\ dB}$) and 18 dB of small-signal gain from a small easy-to-use device. The HMMC-5033 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.



Chip Size:
2.74 x 1.31 mm (108 x 51.6 mils)
Chip Size Tolerance:
± 10 µm (± 0.4 mils)
Chip Thickness:
127 ± 15 µm (5 ± 0.6 mils)
Pad Dimensions:
See page 6

1GG6-8008

Absolute Maximum Ratings[1]

Symbol	Parameters/conditions	Min	Max	Units
$V_{D1,2}$	Drain supply voltages		5.2	Volts
V_{G1}, V_{G2}	Gate supply voltages	–3.0	0.5	Volts
I_{D1}	First stage drain current		320	mA
I_{D2}	Second stage drain current		640	mA
P_{in}	RF input power		23	dBm
Det. bias	Applied detector bias (optional)		5.2	Volts
T_{ch}	Channel temperature[2]		170	°C
T_A	Backside ambient temperature	–55	+85	°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.

DC Specifications/Physical Properties[1] (Applies to All Part Numbers)

Symbol	Parameters/conditions	Min.	Typ.	Max	Units
V_{D1}	Drain supply voltage		3.5	5	Volts
V_{D2}	Drain supply voltage		5	5	Volts
I_{D1}	First stage drain supply current (V_{D1} = 3.5 V, V_{G1} = open, V_{GG} set for I_{D2} typical)		240	320	mA
I_{D2}	Second stage drain supply current (V_{D2} = 5 V, $V_{GG} \cong -0.8$ V)		460	640	mA
V_{G1}, V_{GG}	Gate supply operating voltages ($I_{D1} + I_{D2} \cong 700$ mA)		–0.8		Volts
V_P	Pinch-off voltage (V_{DD} = 2.5 V, $(I_{D1} + I_{D2}) \leq 20$ mA)	–2.5	–1.2	–0.8	Volts
Det. bias	Detector bias voltage (optional)		V_{D2}	5	Volts
$\theta 1_{ch-bs}$	First stage thermal resistance[2] (channel-to-backside at T_{ch} = 160 °C)		67		°C/Watt
$\theta 2_{ch-bs}$	Second stage thermal resistance[2] (channel-to-backside at T_{ch} = 160 °C)		37		°C/Watt
T_{ch}	Second stage channel temperature[3], (T_A = 75 °C, MTTF ≥ 10^6 hrs, V_{D2} = 5 V, I_{D2} = 460 mA		160		°C

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: $\theta(T) \cong \theta_{ch-bs}$ 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_{D1} = 3.5 V, V_{D2} = 5 V, I_{D2} = 460 mA [$I_{D1} \cong 240$ mA])

Symbol	Parameters/conditions	Lower band specifications			Mid band specifications			Upper band specifications			Units
		Min.	Typ.	Max.	Min.	Typ.	Max.	Min.	Typ.	Max.	
BW	Operating bandwidth	17.7		21	21		26.5	25		31.5	GHz
Gain	Small signal gain	17	22		17	20		15	18		dB
$P_{-1\,dB}$	Output power at 1 dB gain compression	22	23		24	25		25	26		dBm
P_{SAT}	Saturated output power[1]		25			27			28		dBm
$(RL_{in})_{MIN}$	Minimum input return loss	8	10		9	12		10	12		dB
$(RL_{out})_{MIN}$	Minimum output return loss	15	20		15	20		15	20		dB
Isolation	Minimum reverse isolation		50			50			50		dB

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

Applications

The HMMC-5033 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 for optimum efficiency, performance, and reliability is V_{D1} = 3.5 volts and V_{D2} = 5 volts with V_{GG} set for $I_{D1} + I_{D2}$ = 700 mA (no connection to V_{G1}). This bias arrangement results in default drain currents I_{D1} = 240 mA and I_{D2} = 460 mA.

A single DC gate supply connected to V_{GG} will bias all gain stages. If operation with both V_{D1} and V_{D2} at 5 volts is desired, an additional wire bond connection from the V_{G1} pad to the V_{GG} external bypass chip-capacitor (shorting V_{G1} to V_{GG}) will balance the currents in each gain stage. V_{GG} (= V_{G1}) can be adjusted for $I_{D1} + I_{D2}$ = 700 mA.

Muting can be accomplished by setting V_{G1} and/or V_{GG} to the pinchoff voltage V_P.

An on chip RF output power detector network is provided. The differential voltage between the det-ref and det-out pads can be correlated with the RF power emerging from the RF output port. Bias the diodes at ~200 mA.

The RF ports are AC-coupled at the RF input to the first stage and the RF output of the second stage.

If the output detector is biased using the on-chip optional det-bias network, an external AC-blocking capacitor may be required at the RF output port.

No ground wires are needed since 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.

“Keysight Technologies GaAs MMIC ESD, Die Attach and Bonding Guidelines – Application Note” provides basic information on these subjects..

Additional References:

1 Watt 17.7 GHz-32 GHz Linear Power Amplifier – Application Note

HMMC-5033 Intermodulation Distortion – Application Note

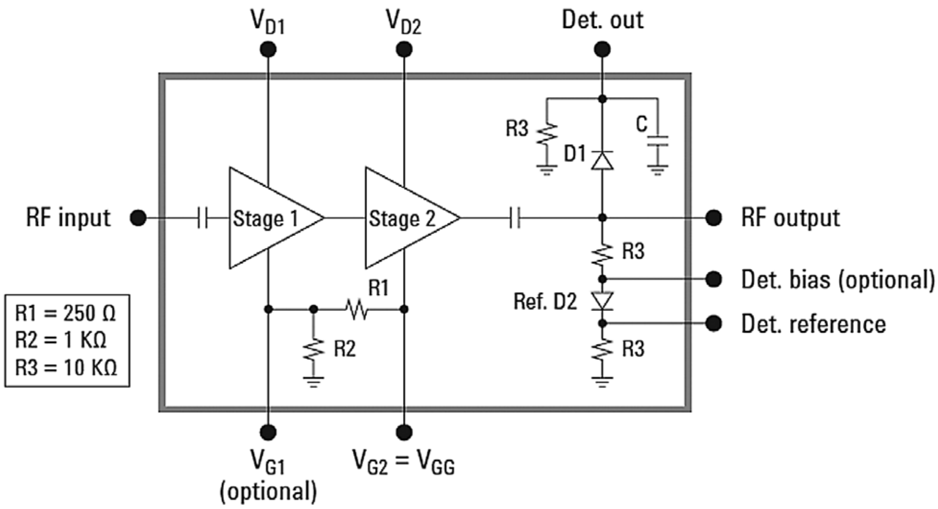


Figure 1. Simplified schematic diagram

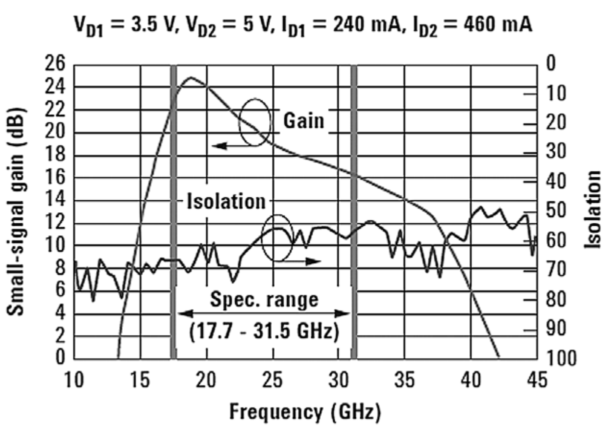


Figure 2. Gain and isolation vs. frequency

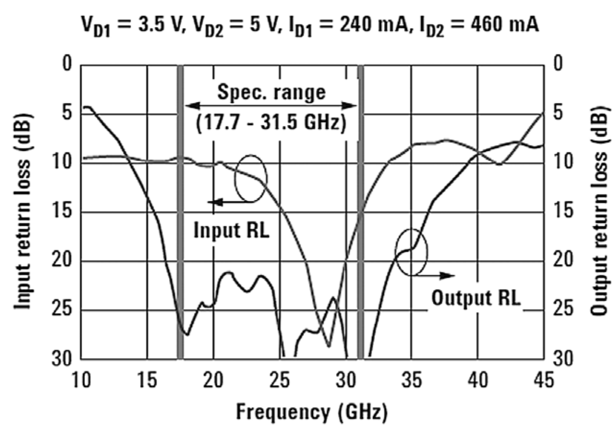


Figure 3. Input and output return loss vs. frequency

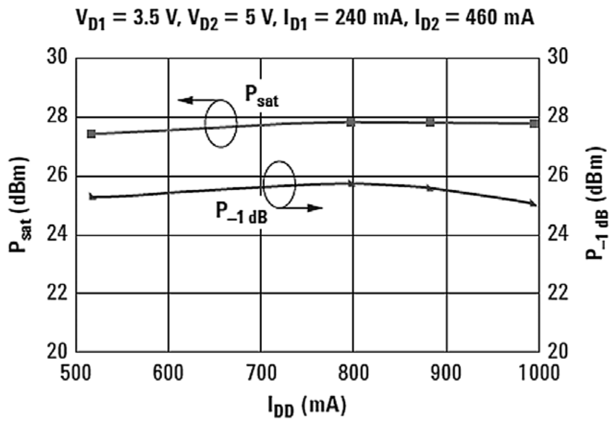


Figure 4. Output power vs. total drain current

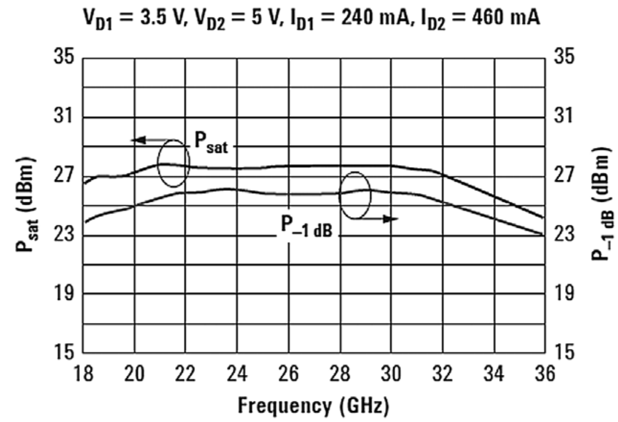


Figure 5. Output power vs. frequency

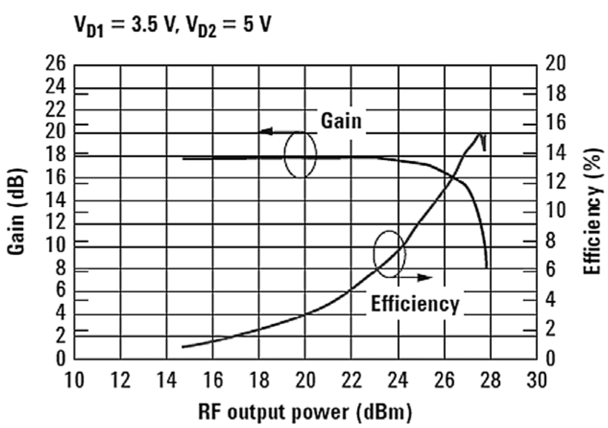


Figure 6. Gain compression and efficiency at 28 GHz

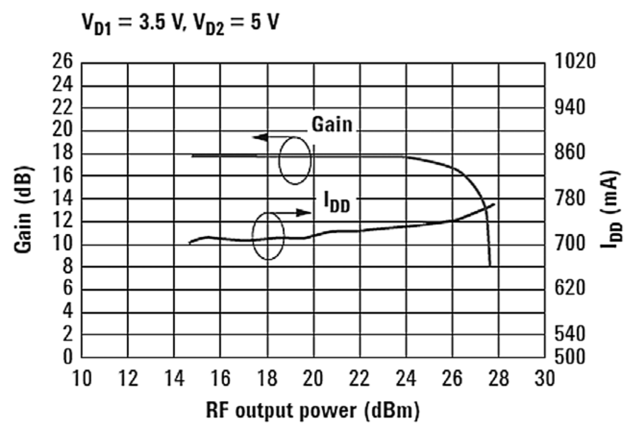


Figure 7. Gain and total drain currentvs. output power

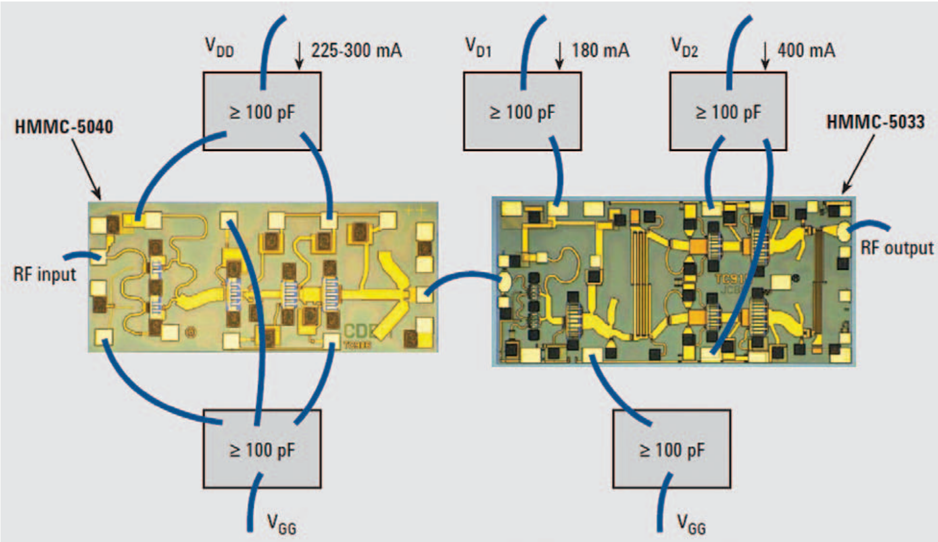


Figure 8. Assembly diagram illustrating the HMMC-5033 cascaded with the HMMC-5040 for 20–32 GHz applications

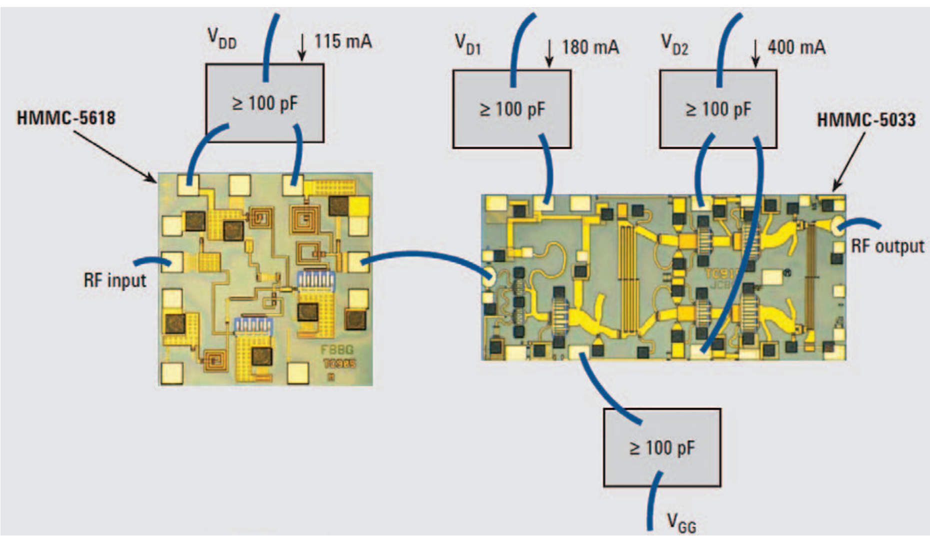


Figure 9. Assembly diagram illustrating the HMMC-5033 cascaded with the HMMC-5618 for 17.7–20 GHz applications

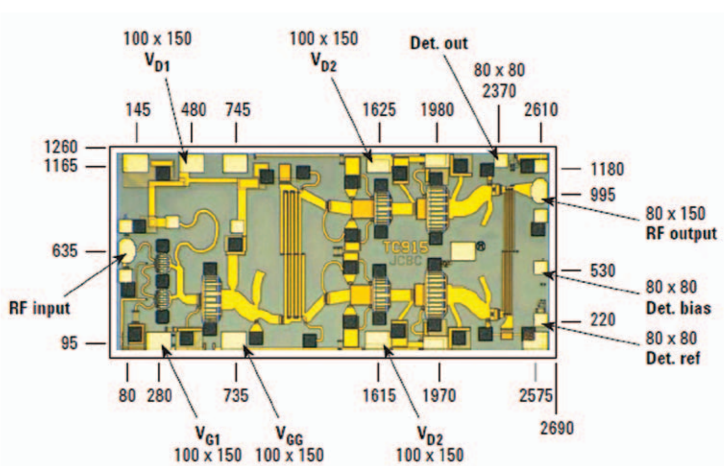


Figure 10. Bonding pad locations

Notes

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 TCA GaAs ICs, for their design should obtain the current production specifications from Keysight Technologies, Inc.. In this data sheet the term typical refers to the 50th percentile performance. For additional information and support email: mmic_helpline@keysight.com.

myKeysight

www.keysight.com/find/mykeysight
A personalized view into the information most relevant to you.

Three-Year Warranty

www.keysight.com/find/ThreeYearWarranty
Keysight's commitment to superior product quality and lower total cost of ownership. The only test and measurement company with three-year warranty standard on all instruments, worldwide.

Keysight Assurance Plans

www.keysight.com/find/AssurancePlans
Up to five years of protection and no budgetary surprises to ensure your instruments are operating to specification so you can rely on accurate measurements.

www.keysight.com/quality
Keysight Technologies, Inc.
DEKRA Certified ISO 9001:2008
Quality Management System

Keysight Channel Partners

www.keysight.com/find/channelpartners
Get the best of both worlds: Keysight's measurement expertise and product breadth, combined with channel partner convenience.

www.keysight.com/find/mmic

For more information on Keysight Technologies' products, applications or services, please contact your local Keysight office. The complete list is available at:
www.keysight.com/find/contactus

Americas

Canada	(877) 894 4414
Brazil	55 11 3351 7010
Mexico	001 800 254 2440
United States	(800) 829 4444

Asia Pacific

Australia	1 800 629 485
China	800 810 0189
Hong Kong	800 938 693
India	1 800 112 929
Japan	0120 (421) 345
Korea	080 769 0800
Malaysia	1 800 888 848
Singapore	1 800 375 8100
Taiwan	0800 047 866
Other AP Countries	(65) 6375 8100

Europe & Middle East

Austria	0800 001122
Belgium	0800 58580
Finland	0800 523252
France	0805 980333
Germany	0800 6270999
Ireland	1800 832700
Israel	1 809 343051
Italy	800 599100
Luxembourg	+32 800 58580
Netherlands	0800 0233200
Russia	8800 5009286
Spain	0800 000154
Sweden	0200 882255
Switzerland	0800 805353
	Opt. 1 (DE)
	Opt. 2 (FR)
	Opt. 3 (IT)
United Kingdom	0800 0260637

For other unlisted countries:
www.keysight.com/find/contactus
(BP-07-01-14)

KEYSIGHT TECHNOLOGIES

Published in USA, August 3, 2014
5989-6210EN
www.keysight.com