1 Watt, GaAs pHEMT MMIC Power Amplifier, 27 GHz to 32 GHz

Preliminary Technical Data

HMC1132

FEATURES

- Saturated output power (P_{SAT}): 30.5 dBm at 22% power added efficiency (PAE)
- High output IP3: 35 dBm
- High gain: 22 dB
- DC supply: 6 V at 600 mA
- No external matching required
- 32-lead, 5 mm × 5 mm LFCSP package

APPLICATIONS

- Point-to-point radios
- Point-to-multipoint radios
- VSAT and SATCOM
- Military and space

FUNCTIONAL BLOCK DIAGRAM

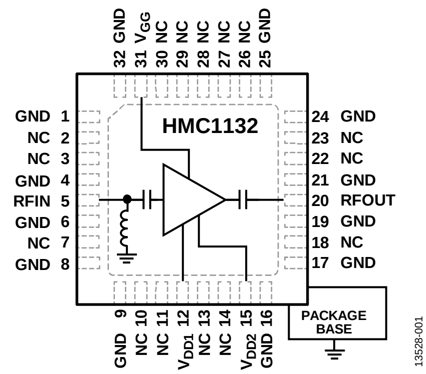

Figure 1.

GENERAL DESCRIPTION

The HMC1132 is a four-stage, GaAs pHEMT MMIC, 1 watt power amplifier that operates between 27 GHz and 32 GHz. The HMC1132 provides 22 dB of gain and 30.5 dBm of saturated output power at 22% PAE from a 6 V power supply.

The HMC1132 exhibits excellent linearity and it is optimized for high capacity, point-to-point and point-to-multipoint radio systems. The amplifier configuration and high gain make it an excellent candidate for last stage signal amplification before the antenna.

The HMC1132 amplifier input/outputs (I/Os) are internally matched to 50 Ω. The device is supplied in a compact, leadless QFN, 5 mm × 5 mm surface-mount package.

Rev. PrB
Document Feedback

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Technical Support
www.analog.com

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SPECIFICATIONS

ELECTRICAL SPECIFICATIONS

T_A = 25°C, V_{DD} = V_{DD1} = V_{DD2} = 6 V, I_{DD} = 600 mA.

Table 1.

Parameter	Symbol	Min	Typ	Max	Unit	Test Conditions/Comments
FREQUENCY RANGE		27		32	GHz	
GAIN		20	22		dB	
Gain Variation over Temperature			0.036		dB/°C	
RETURN LOSS						
Input			6		dB	
Output			14		dB	
POWER						
Output Power for 1 dB Compression	P1dB	28	30		dBm	
Saturated Output Power	P_{SAT}		30.5		dBm	
OUTPUT THIRD-ORDER INTERCEPT	IP3		35		dBm	Measurement taken at 6 V at 600 mA, P_{OUT} ÷ tone = 20 dBm
TOTAL SUPPLY CURRENT	I_{DD}		600		mA	Adjust the amplifier gate control voltage (V_{GG}) between −2 V and 0 V to achieve an I_{DD} = 600 mA, typical

TOTAL SUPPLY CURRENT BY V_{DD}

Table 2.

Parameter	Symbol	Min	Typ	Max	Unit	Test Conditions/Comments
SUPPLY CURRENT	I_{DD}					Adjust the amplifier gate control voltage (V_{GG}) between −2 V and 0 V to achieve an I_{DD} = 600 mA, typical
V_{DD} = 5 V			600		mA	
V_{DD} = 5.5 V			600		mA	
V_{DD} = 6 V			600		mA	

ABSOLUTE MAXIMUM RATINGS

Table 3.

Parameter	Rating
Drain Voltage Bias	7 V
RF Input Power (RFIN)[1]	18 dBm
Channel Temperature	150°C
Continuous P_{DISS} (T = 85°C) (Derate 61 mw/°C Above 85°C)	4.04 W
Thermal Resistance (R_{TH}) Junction to Ground Paddle	16.4°C/W
Maximum Peak Reflow Temperature	260°C
Storage Temperature Range	−65°C to +150°C
Operating Temperature Range	−40°C to +85°C
ESD Sensitivity (Human Body Model)	Class 1A, passed 250 V

[1] Maximum P_{IN} is limited to 18 dBm or thermal limits constrained by maximum power dissipation (see Figure 31), whichever is lower.

Stresses at or above those listed under Absolute Maximum Ratings may cause permanent damage to the product. This is a stress rating only; functional operation of the product at these or any other conditions above those indicated in the operational section of this specification is not implied. Operation beyond the maximum operating conditions for extended periods may affect product reliability.

ESD CAUTION

ESD (electrostatic discharge) sensitive device. Charged devices and circuit boards can discharge without detection. Although this product features patented or proprietary protection circuitry, damage may occur on devices subjected to high energy ESD. Therefore, proper ESD precautions should be taken to avoid performance degradation or loss of functionality.

PIN CONFIGURATION AND FUNCTION DESCRIPTIONS

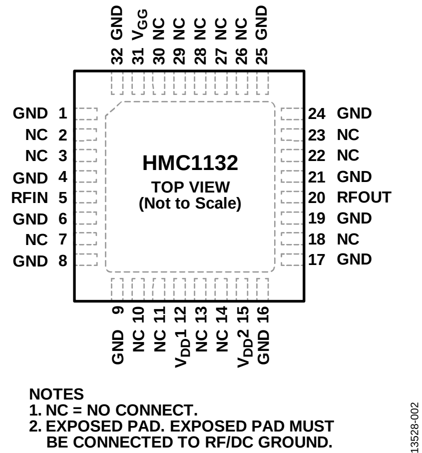

Figure 2. Pin Configuration

Table 4. Pad Function Descriptions

Pad No.	Mnemonic	Description
1, 4, 6, 8, 9, 16, 17, 19, 21, 24, 25, 32	GND	Ground. These pins are exposed ground paddles that must be connected to RF/dc ground.
2, 3, 7, 10, 11, 13, 14, 18, 22, 23, 26 to 30	NC	No Connect. These pins are not connected internally. However, all data was measured with these pins connected to RF/dc ground externally.
5	RFIN	RF Input. This pin is dc-coupled and matched to 50 Ω. See Figure 4 for the RFIN interface schematic.
12, 15	V_{DD1}, V_{DD2}	Drain Bias Voltage. External by pass capacitors of 100 pF, 10 nF, and 4.7 µF are required. See Figure 5 for the V_{DD1} and V_{DD2} interface schematic.
20	RFOUT	RF Output. This pin is ac-coupled and matched to 50 Ω. See Figure 6 for the RFOUT interface schematic.
31	V_{GG}	Gate Control for Amplifier. Adjust V_{GG} to achieve the recommended bias current. External bypass capacitors of 100 pF, 10 nF, and 4.7 µF are required. See Figure 7 for the V_{GG} interface schematic.
	EPAD	Exposed Paddle. The exposed pad must be connected to RF/dc ground.

INTERFACE SCHEMATICS

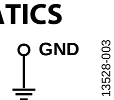

Figure 3. GND Interface

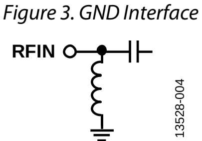

Figure 4. RFIN Interface

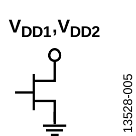

Figure 5. V_{DD1} and V_{DD2} Interface

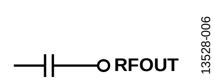

Figure 6. RFOUT Interface

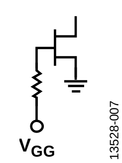

Figure 7. V_{GG} Interface

TYPICAL PERFORMANCE CHARACTERISTICS

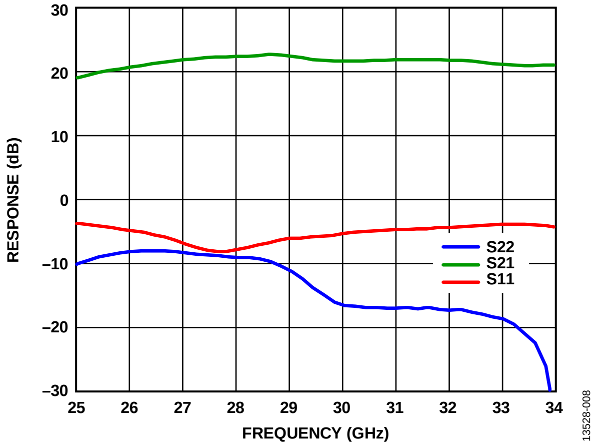

Figure 8. Broadband Gain and Return Loss vs. Frequency

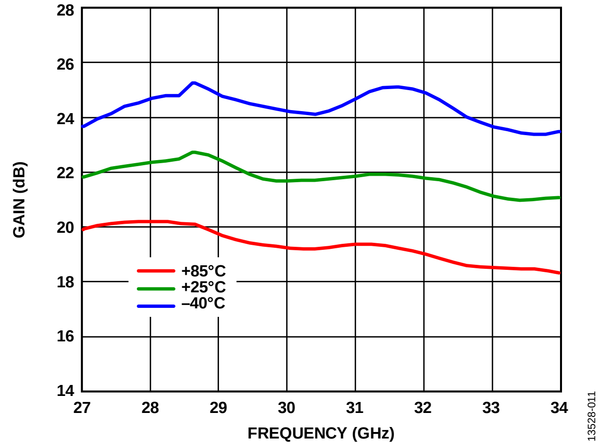

Figure 11. Gain vs. Frequency at Various Temperatures

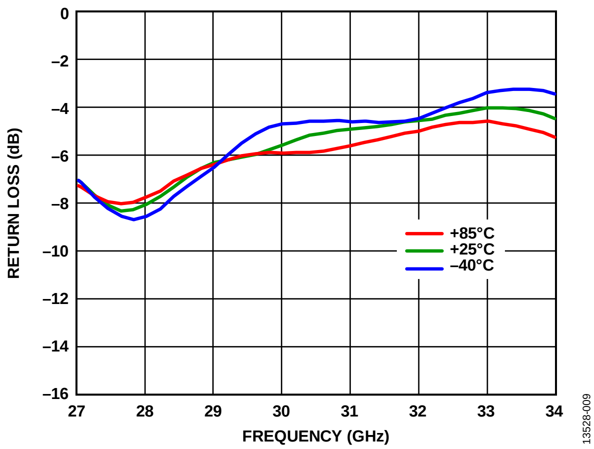

Figure 9. Input Return Loss vs. Frequency at Various Temperatures

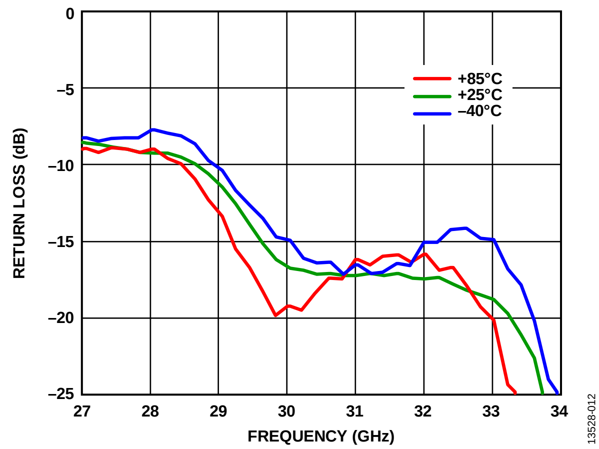

Figure 12. Output Return Loss vs. Frequency at Various Temperatures

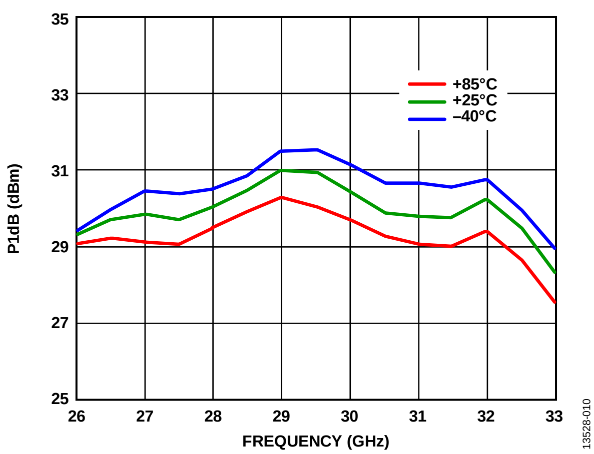

Figure 10. P1dB vs. Frequency at Various Temperatures

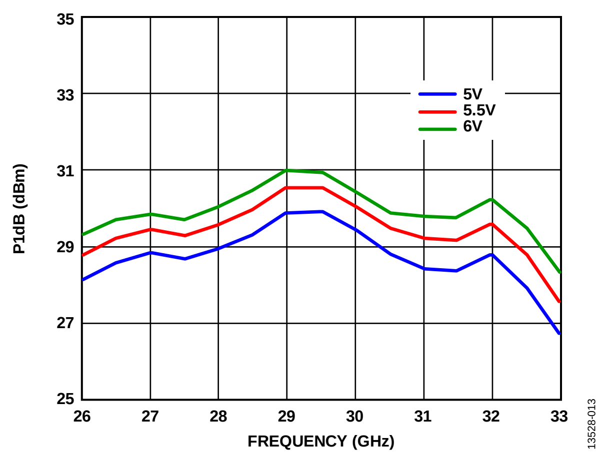

Figure 13. P1dB vs. Frequency at Various Supply Voltages

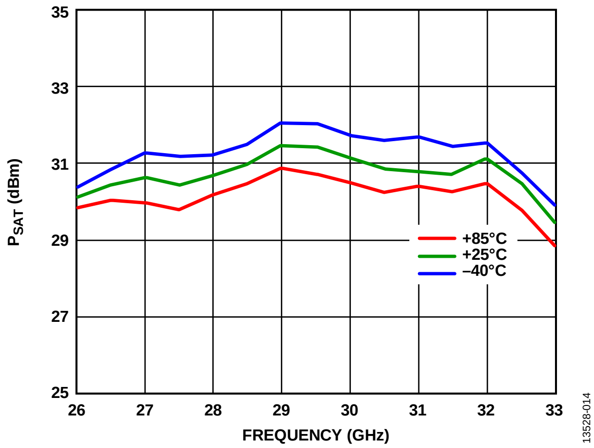

Figure 14. P_{SAT} vs. Frequency at Various Temperatures

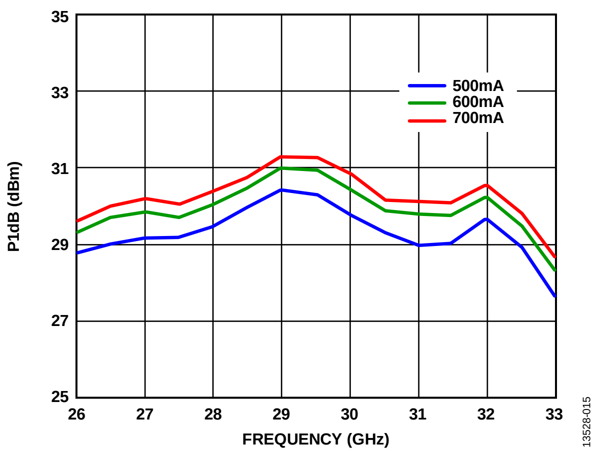

Figure 15. P1dB vs. Frequency at Various Supply Currents (I_{DD})

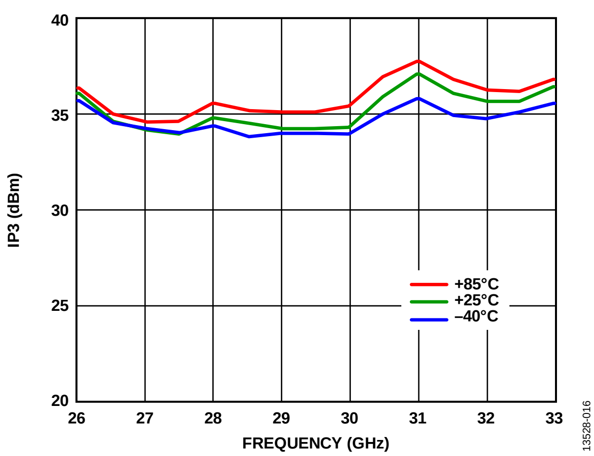

Figure 16. Output IP3 vs. Frequency at Various Temperatures, P_{OUT}/Tone = 20 dBm

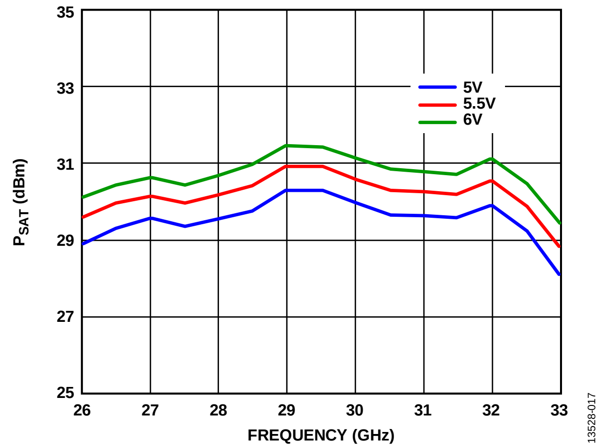

Figure 17. P_{SAT} vs. Frequency at Various Supply Voltages

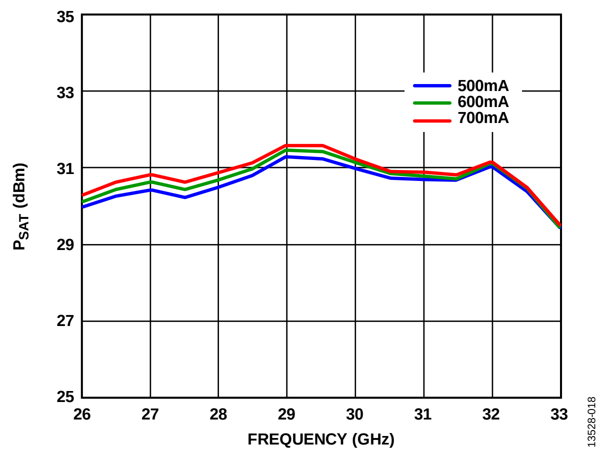

Figure 18. P_{SAT} vs. Frequency at Various Supply Currents (I_{DD})

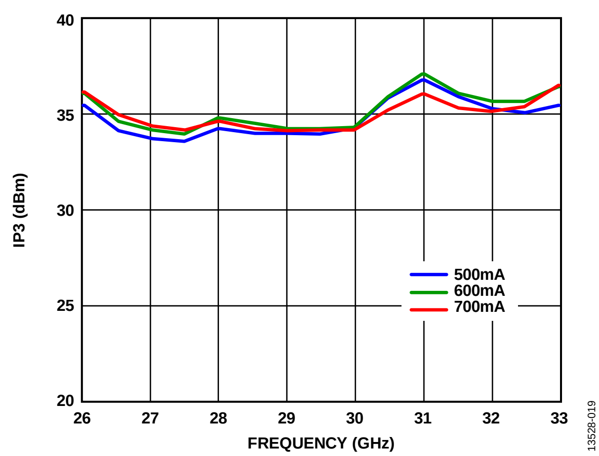

Figure 19. Output IP3 vs. Frequency at Various Supply Currents, P_{OUT}/Tone = 20 dBm

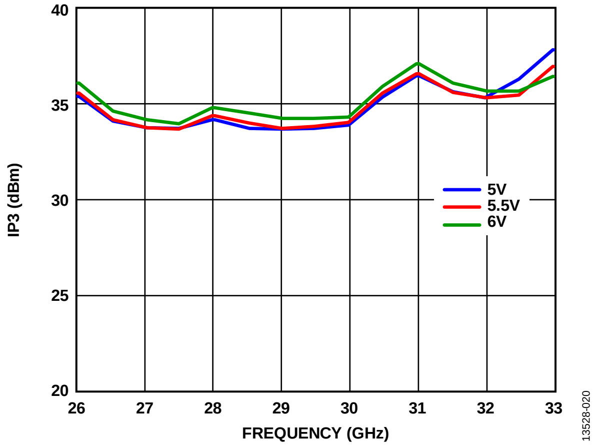

Figure 20. Output IP3 vs. Frequency at Various Supply Voltages, P_{OUT}/Tone = 20 dBm

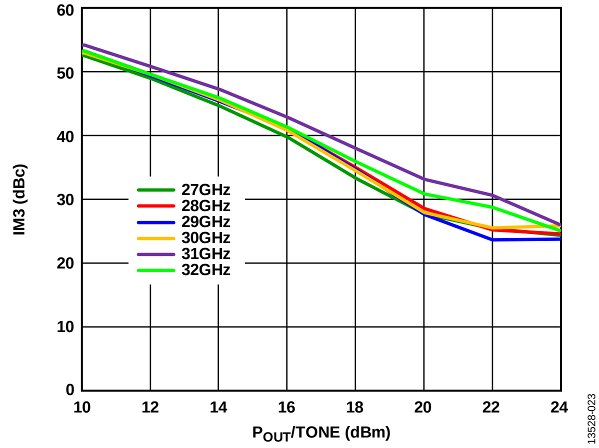

Figure 23. Output IM3 at V_{DD} = 5 V

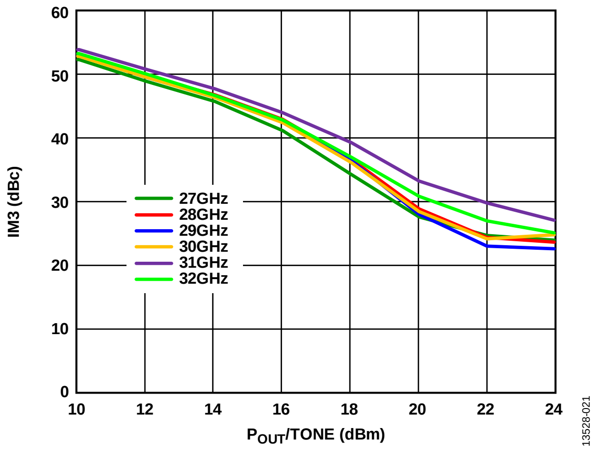

Figure 21. Output Third-Order Intermodulation Distortion (IM3) at V_{DD} = 5.5 V

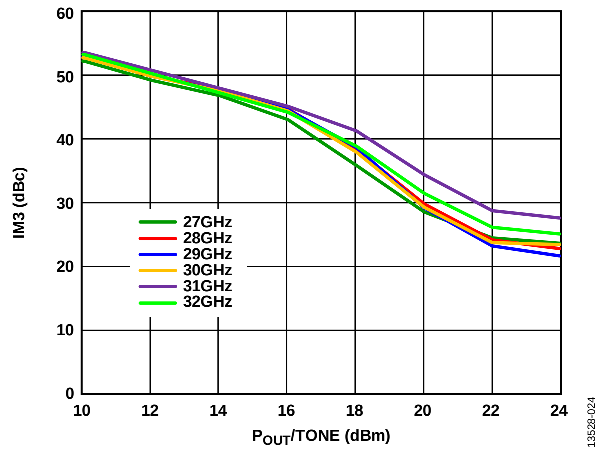

Figure 24. Output IM3 at V_{DD} = 6 V

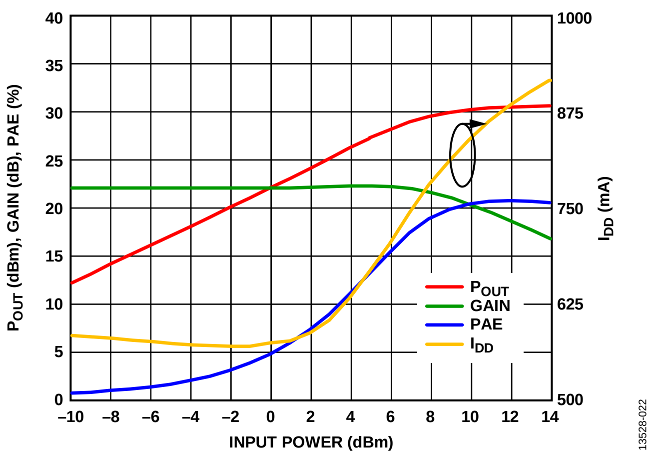

Figure 22. Power Compression at 27 GHz

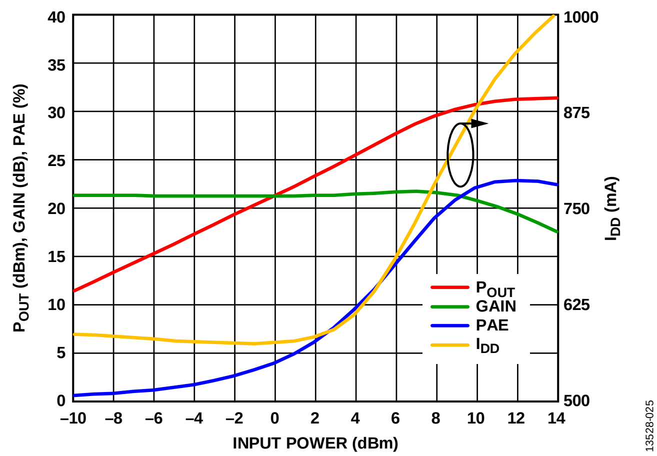

Figure 25. Power Compression at 29.5 GHz

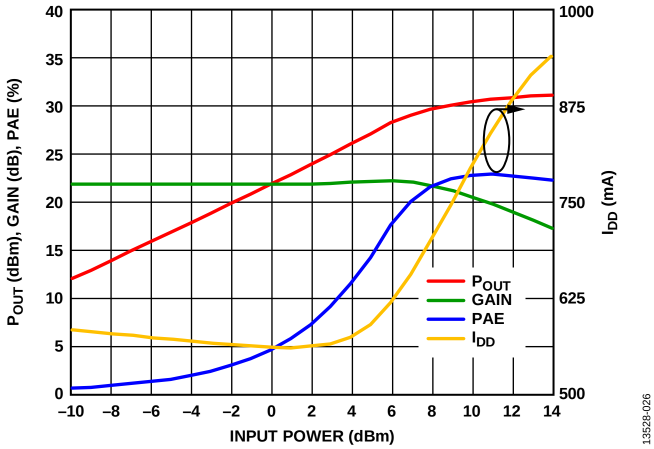

Figure 26. Power Compression at 32 GHz

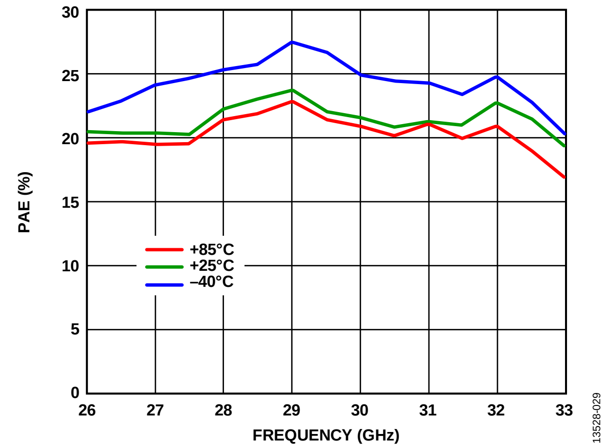

Figure 29. PAE vs. Frequency at Various Temperatures, P_{IN} = 10 dBm

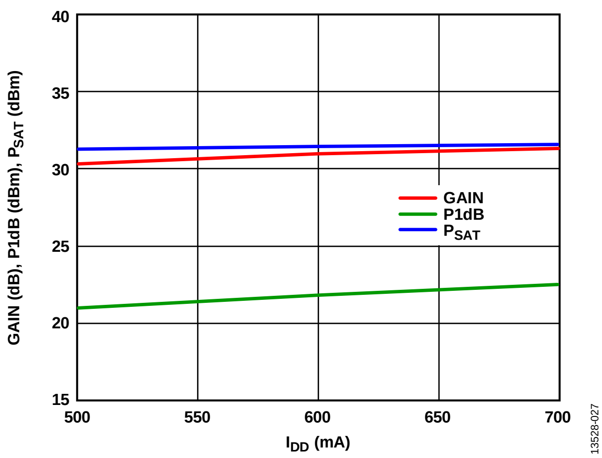

Figure 27. Gain and Power vs. Supply Current at 29.5 GHz

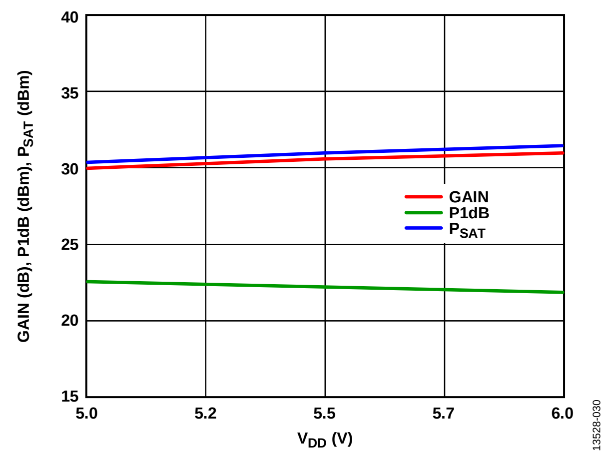

Figure 30. Gain and Power vs. Supply Voltage at 29.5 GHz

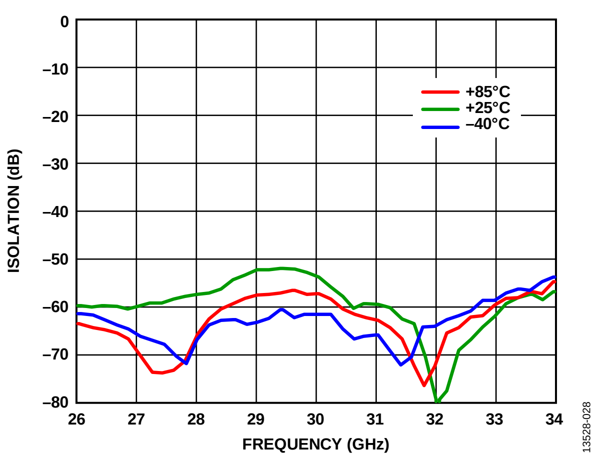

Figure 28. Reverse Isolation vs. Frequency at Various Temperatures

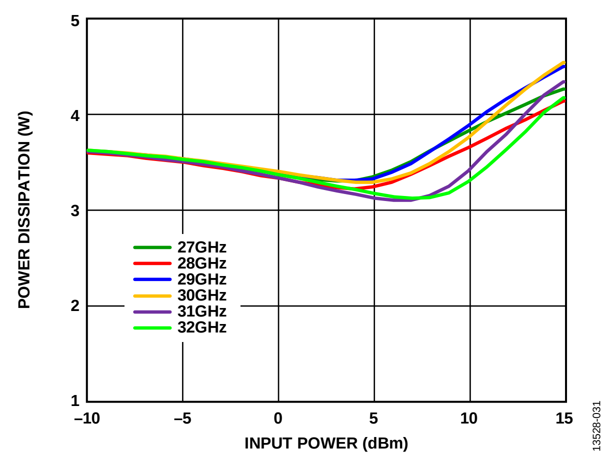

Figure 31. Power Dissipation at 85°C

APPLICATIONS INFORMATION

APPLICATION CIRCUIT

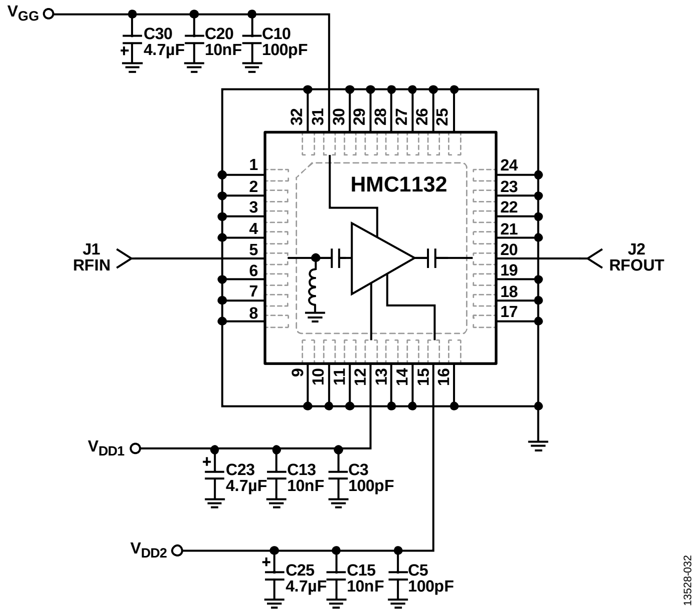

Figure 32. Typical Application Circuit

EVALUATION PRINTED CIRCUIT BOARD (PCB)

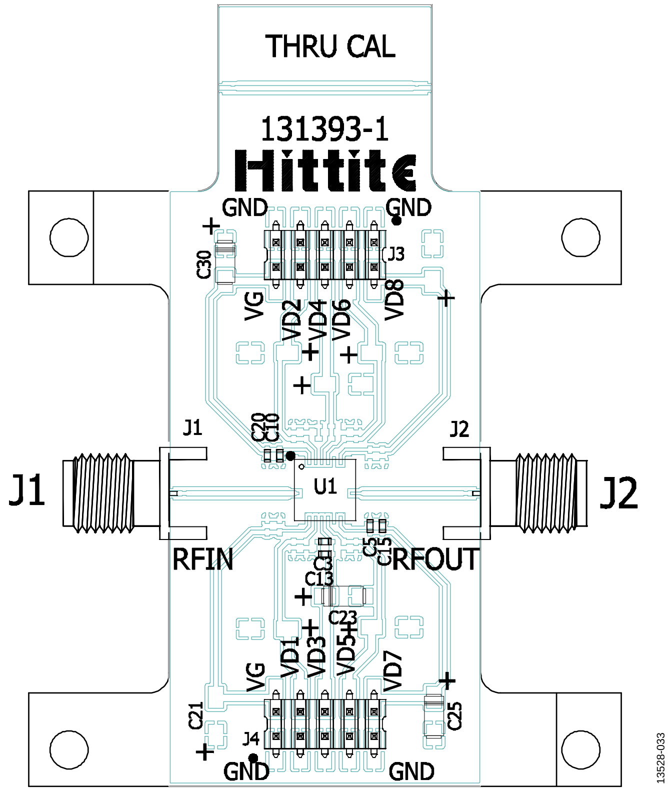

Figure 33. Evaluation Printed Circuit Board (PCB)

BILL OF MATERIALS

Use RF circuit design techniques for the circuit board used in the application. Provide 50 Ω impedance to the signal lines and connect the package ground leads and exposed paddle directly to the ground plane, similar to that shown in Figure 33. Use a sufficient number of via holes to connect the top and bottom ground planes. The evaluation circuit board shown in Figure 33 is available from Analog Devices, Inc., upon request.

Table 5. Bill of Materials for Evaluation PCB EV1HMC1132LP5D

Item	Description
J1, J2	Conn, SRI K connector.
J3, J4	DC pins.
C3, C5, C10	100 pF capacitors, 0402 package.
C13, C15, C20	10,000 pF capacitors, 0402 package.
C23, C25, C30	4.7 µF capacitors, Case A package.
U1	HMC1132LP5DE amplifier.
PCB	131393 evaluation board. Circuit board material: Rogers 4350 or Arlon 25FR.

OUTLINE DIMENSIONS

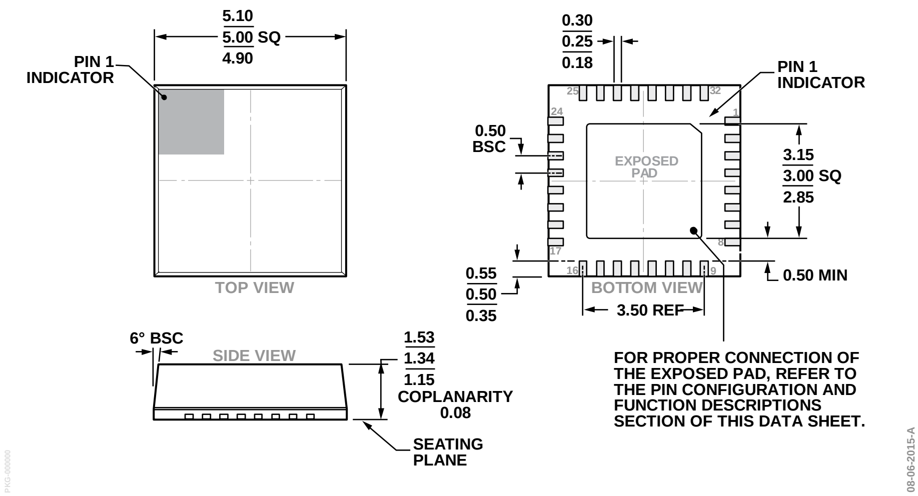

Figure 34. 32-Lead Lead Frame Chip Scale Package [LFCSP]
5 mm × 5 mm Body and 1.34 mm Package Height
(HCP-32-2)
Dimensions shown in millimeters