0.01 GHz to 10 GHz, MMIC, GaAs, pHEMT RF Gain Block

Enhanced Product

HMC788A-EP

FEATURES

- Gain: 14 dB typical
- Operational frequency range: 0.01 GHz to 10 GHz
- Input/output internally matched to 50 Ω
- High input linearity
  - 1 dB compression (P1dB): 20 dBm typical
  - Output third-order intercept (OIP3): 33 dBm typical
- Supply voltage: 5 V typical
- 2 mm × 2 mm, 6-lead lead frame chip scale package

ENHANCED PRODUCT FEATURES

- Supports defense and aerospace applications (AQEC standard)
- Extended industrial temperature range: −55°C to +105°C
- Controlled manufacturing baseline
- One assembly/test site
- 1 fabrication site
- Enhanced product change notification
- Qualification data available on request

APPLICATIONS

- Cellular, 3G, LTE, WiMAX, and 4G
- LO driver applications
- Microwave radio
- Test and measurement equipment
- Ultra wideband (UWB) communications

FUNCTIONAL BLOCK DIAGRAM

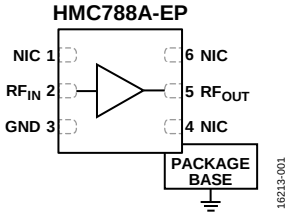

Figure 1.

GENERAL DESCRIPTION

The HMC788A-EP is a 0.01 GHz to 10 GHz, gain block, monolithic microwave integrated circuit (MMIC) amplifier using gallium arsenide (GaAs) and pseudomorphic high electron mobility transistor (pHEMT) technology.

This 2 mm × 2 mm LFCSP amplifier can be used as either a cascadable 50 Ω gain stage, or to drive the local oscillator (LO) port of many of the single and double balanced mixers from Analog Devices, Inc. with up to 20 dBm output power.

The HMC788A-EP offers 14 dB of gain and an OIP3 of 33 dBm while requiring only 76 mA from a 5 V supply.

The Darlington feedback pair exhibits reduced sensitivity to normal process variations and yields excellent gain stability over temperature while requiring a minimal number of external bias components.

Additional application and technical information can be found in the HMC788A data sheet.

Rev. A

Document Feedback

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REVISION HISTORY

10/2018—Rev. 0 to Rev. A

Changes to Table 2 and Figure 2 4

10/2017—Revision 0: Initial Version

SPECIFICATIONS

ELECTRICAL SPECIFICATIONS

Collector bias voltage (V_{CC}) = 5 V, case temperature (T_{CASE}) = 25°C, 6.35 µH external inductor between V_{CC} and radio frequency output (RF_{OUT}), 50 Ω system, unless otherwise noted.

Table 1.

Parameter	Symbol	Min	Typ	Max	Unit	Test Conditions/Comments
OVERALL FUNCTION						
Frequency Range		0.01		10	GHz	
Gain		12	14		dB	0.01 GHz to 6.0 GHz
		9	12		dB	6.0 GHz to 10.0 GHz
Gain Variation Over Temperature			0.004		dB/°C	0.01 GHz to 6.0 GHz
			0.007		dB/°C	6.0 GHz to 10.0 GHz
Reverse Isolation			23		dB	0.01 GHz to 6.0 GHz
			20		dB	6.0 GHz to 10 GHz
RADIO FREQUENCY (RF) INPUT INTERFACE						
Input Return Loss			16		dB	0.01 GHz to 6.0 GHz
			9		dB	6.0 GHz to 10.0 GHz
RF OUTPUT INTERFACE						
Output Power for 1 dB Compression	P1dB	18	20		dBm	0.01 GHz to 6.0 GHz
		15	18		dBm	6.0 GHz to 10.0 GHz
Output Return Loss			9		dB	0.01 GHz to 6.0 GHz
			12		dB	6.0 GHz to 10.0 GHz
DISTORTION AND NOISE						
Output Third-Order Intercept	OIP3		33		dBm	0.01 GHz to 6.0 GHz
			30		dBm	6.0 GHz to 10.0 GHz
Noise Figure	NF		6		dB	0.01 GHz to 6.0 GHz
			7		dB	6.0 GHz to 10.0 GHz
POWER INTERFACE						
Supply Voltage		4.5	5	5.5	V	
Supply Current	I_{CC}	60	65		mA	V_{CC} = 4.5 V
			76		mA	V_{CC} = 5 V
			87	90	mA	V_{CC} = 5.5 V

ABSOLUTE MAXIMUM RATINGS

Table 2.

Parameter	Rating
V_{CC}	7 V
RF_{IN} (V_{CC} = 5 V)	20 dBm
Continuous Power Dissipation, P_{DISS}[1]	
T_{CASE} = 85°C	0.76 W
T_{CASE} = 105°C	0.59 W
Junction (T_J) Temperature	175°C
Operating (T_{OPR}) Temperature Range	−55°C to +105°C
Storage Temperature Range	−65°C to +150°C
Electrostatic Discharge (ESD) Sensitivity, Human Body Model (HBM)	Class 1A

[1] For maximum power dissipation vs. case temperature, see Figure 2.

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.

THERMAL RESISTANCE

Thermal performance is directly linked to printed circuit board (PCB) design and operating environment. Careful attention to PCB thermal design is required.

θ_{JC} is the junction to case thermal resistance.

Table 3. Thermal Resistance

Package Type	θ_{JC}	Unit
CP-6-10[1]	118.0	°C/W

[1] Thermal impedance simulated values are based on a JEDEC 2S2P thermal test board with nine thermal vias. See JEDEC JESD51.

POWER DERATING CURVES

Figure 2 shows the maximum power dissipation vs. case temperature.

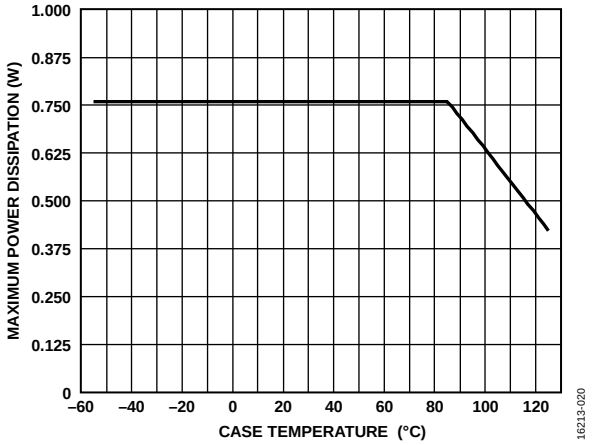

Figure 2. Maximum Power Dissipation vs. Case Temperature

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

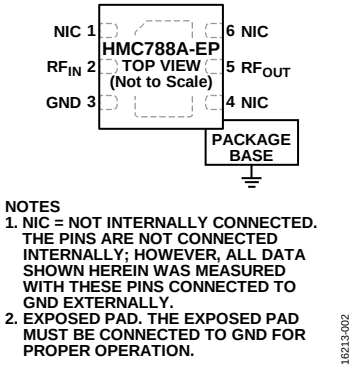

Figure 3. Pin Configuration

Table 4. Pin Function Descriptions

Pin No.	Mnemonic	Description
1, 4, 6	NIC	Not Internally Connected. The pins are not connected internally; however, all data shown herein was measured with these pins connected to GND externally.
2	RF_{IN}	RF Input. This pin is dc-coupled and ac matched to 50 Ω. An external dc blocking capacitor is required on this pin.
3	GND	Ground. This pin must be connected to ground.
5	RF_{OUT}	RF Output. This pin is ac matched to 50 Ω and supplies dc bias for the output stage.
	EPAD	Exposed Pad. The exposed pad must be connected to GND for proper operation.

INTERFACE SCHEMATICS

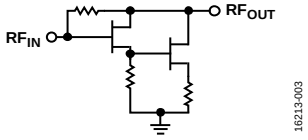

Figure 4. RF_{IN}, RF_{OUT} Interface Schematic

Figure 5. GND Interface Schematic

TYPICAL PERFORMANCE CHARACTERISTICS

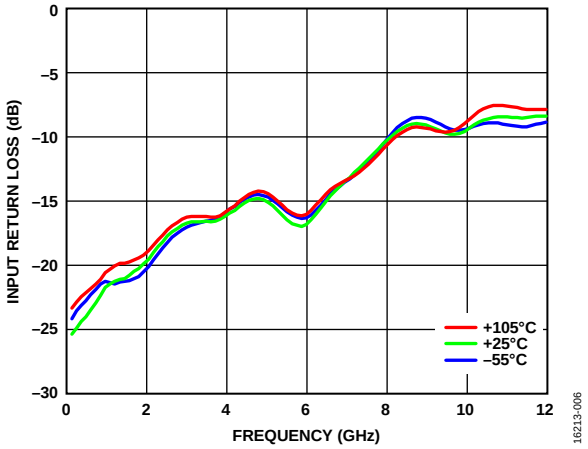

Figure 6. Input Return Loss vs. Frequency at Various Temperatures

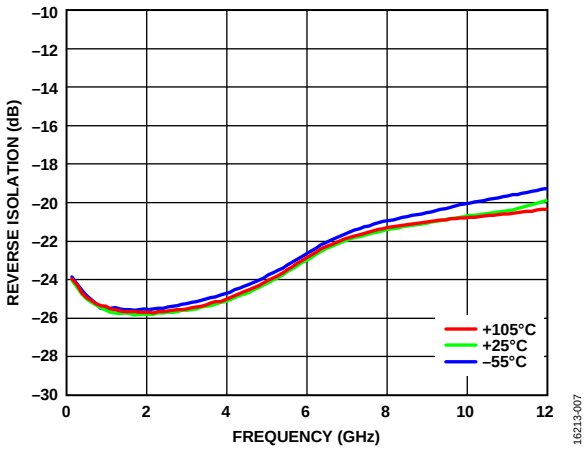

Figure 7. Reverse Isolation vs. Frequency at Various Temperatures

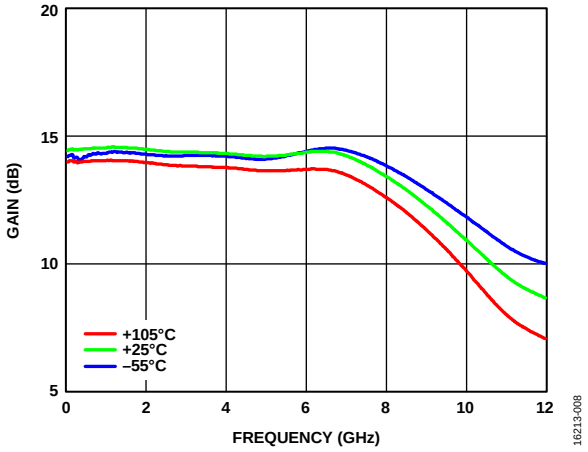

Figure 8. Gain vs. Frequency at Various Temperatures

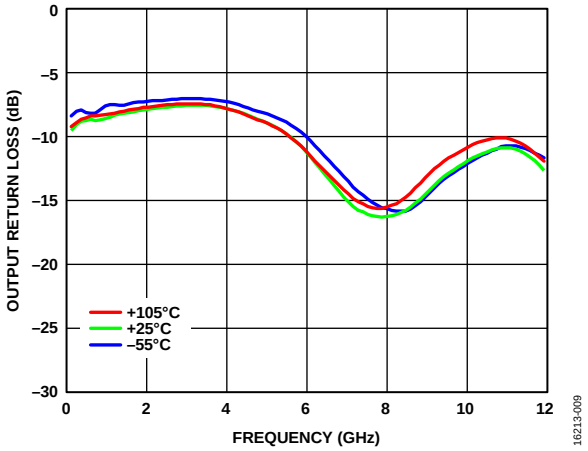

Figure 9. Output Return Loss vs. Frequency at Various Temperatures

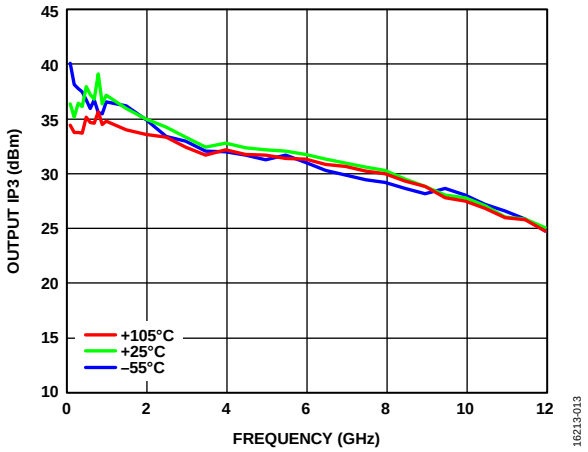

Figure 10. Output IP3 vs. Frequency at Various Temperatures; 5 dBm per Tone Output Power

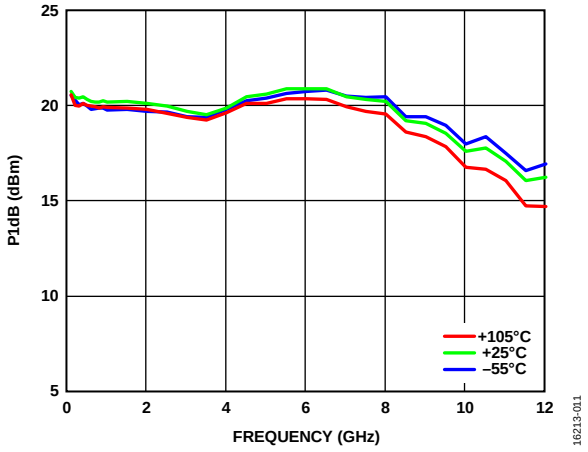

Figure 11. P1dB vs. Frequency at Various Temperatures

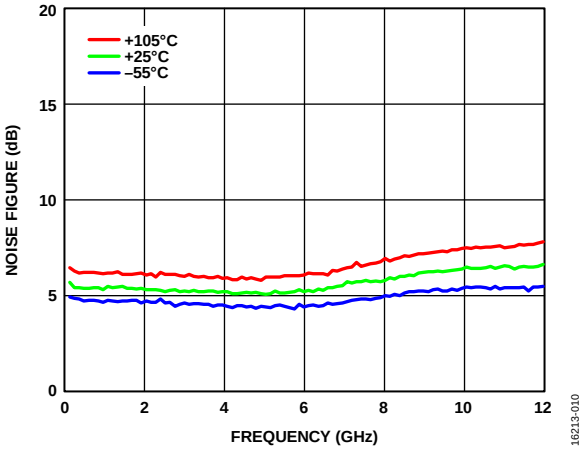

Figure 12. Noise Figure vs. Frequency at Various Temperatures

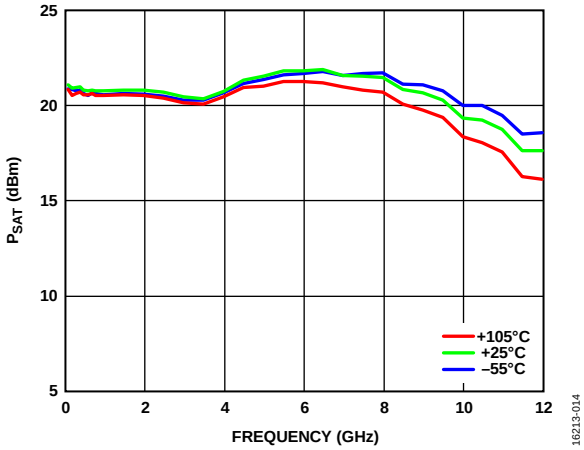

Figure 13. Saturation Power (P_{SAT}) vs. Frequency at Various Temperatures

OUTLINE DIMENSIONS

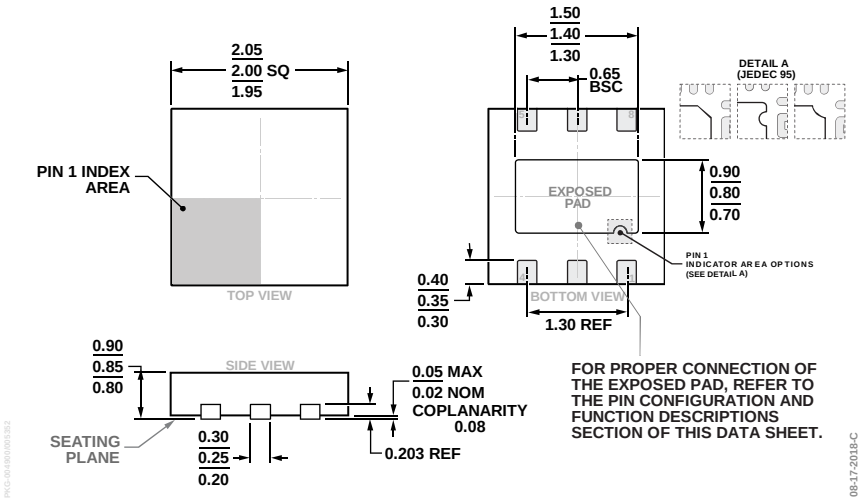

Figure 14. 6-Lead Lead Frame Chip Scale Package [LFCSP]
2 mm × 2 mm Body and 0.85 mm Package Height
(CP-6-10)
Dimensions shown in millimeters

ORDERING GUIDE

Model[1]	Temperature Range	MSL Rating[2]	Package Description	Package Option
HMC788ACPSZ-EP-PT	−55°C to +105°C	MSL1	6-Lead Lead Frame Chip Scale Package [LFCSP]	CP-6-10
HMC788ACPSZ-EP-R7	−55°C to +105°C	MSL1	6-Lead Lead Frame Chip Scale Package [LFCSP]	CP-6-10

[1] Z = RoHS Compliant Part.
[2] See the Absolute Maximum Ratings section.

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