Product/Process Change Notice - PCN 23_0127 Rev. -

Analog Devices, Inc. One Analog Way, Wilmington, MA 01887, USA

This notice is to inform you of a change that will be made to certain ADI products (see Appendix A) that you may have purchased in the last 2 years. **Any inquiries or requests with this PCN (additional data or samples) must be sent to ADI within 30 days of publication date.** ADI contact information is listed below.

PCN Title:	HMC395/HMC405 Die and Data Sheet Revision
Publication Date:	28-Jun-2023
Effectivity Date:	30-Sep-2023 *(the earliest date that a customer could expect to receive changed material)*
Revision Description:	Initial Release

Description Of Change:

1)Adding RF ground pads to the die.
2)Updated outline drawing and assembly diagram (page 4 and 6).

Reason For Change:

1)To facilitate RF testing of the die.
2)To correct data sheet to reflect this die change.

Impact of the change (positive or negative) on fit, form, function & reliability:

The device quality, form, function, and performance, as specified by Product Data Sheets, will be unaffected by this change.

Product Identification *(this section will describe how to identify the changed material)*

New material will be identified by date code.

Summary of Supporting Information:

Minor change, no Qualification is required. Changes to the data sheet will be reflected in revision v03.0523 for HMC395 and revision v04.0523 for HMC405.

Supporting Documents

Attachment 1: Type: Revised Datasheet Specification

ADI_PCN_23_0127_Rev_-_hmc395.pdf...

Attachment 2: Type: Revised Datasheet Specification

ADI_PCN_23_0127_Rev_-_hmc405.pdf...

Note: If applicable, the device material declaration will be updated due to material change.

ADI Contact Information:

For questions on this PCN, please send an email to the regional contacts below or contact your local ADI sales representatives.

Americas:	Europe:	Japan:	Rest of Asia:
PCN_Americas@analog.com	PCN_Europe@analog.com	PCN_Japan@analog.com	PCN_ROA@analog.com

Appendix A - Affected ADI Models:

Added Parts On This Revision - Product Family / Model Number (4)

HMC395G / HMC395	HMC395G / HMC395-SX	HMC405G / HMC405	HMC405G / HMC405-SX

Appendix B - Revision History:

Rev	Publish Date	Effectivity Date	Rev Description
Rev. -	28-Jun-2023	30-Sep-2023	Initial Release

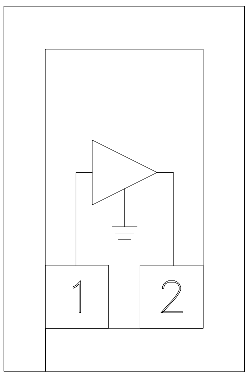
InGaP HBT GAIN BLOCK MMIC AMPLIFIER, DC - 4 GHz

Typical Applications

An excellent cascadable 50 Ohm Gain Block or LO Driver for:

- Microwave & VSAT Radios
- Test Equipment
- Military EW, ECM, C^3I
- Space Telecom

Functional Diagram



Features

Gain: 15 dB

P1dB Output Power: +16 dBm

Stable Gain Over Temperature

50 Ohm I/O's

Small Size: 0.38 x 0.58 x 0.1 mm

General Description

The HMC395 die is a GaAs InGaP Heterojunction Bipolar Transistor (HBT) Gain Block MMIC DC - 4 GHz amplifier. This amplifier die can be used as either a cascadable 50 Ohm gain stage or to drive the LO of HMC mixers with up to +17 dBm output power. The HMC395 offers 16 dB of gain and an output IP3 of +31 dBm while requiring only 54 mA from a +5V supply. The Darlington feedback pair used results in reduced sensitivity to normal process variations and yields excellent gain stability over temperature while requiring a minimal number of external bias components. The HMC395 can easily be integrated into Multi-Chip-Modules (MCMs) due to its small ($0.22mm^2$) size. All data is with the chip in a 50 Ohm test fixture connected via 0.025mm (1mil) diameter wire bonds of minimal length 0.5mm (20mils).

Electrical Specifications, Vs= +5.0V, Rbias= 22 Ohm, T_A = +25° C

Parameter		Min.	Typ.	Max.	Units
Gain	DC - 1.0 GHz 1.0 - 4.0 GHz		16 15		dB dB
Gain Variation Over Temperature	DC - 1.0 GHz 1.0 - 4.0 GHz		0.004 0.008		dB/ °C dB/ °C
Input Return Loss	DC - 1.0 GHz 1.0 - 4.0 GHz		18 15		dB dB
Output Return Loss	DC - 1.0 GHz 1.0 - 4.0 GHz		17 10		dB dB
Reverse Isolation	DC - 4.0 GHz		19		dB
Output Power for 1 dB Compression (P1dB)	DC - 1.0 GHz 1.0 - 2.0 GHz 2.0 - 4.0 GHz		16 15 10		dBm dBm dBm
Output Third Order Intercept (IP3)	DC - 1.0 GHz 1.0 - 2.0 GHz 2.0 - 4.0 GHz		31 28 22		dBm dBm dBm
Noise Figure	DC - 4.0 GHz		4.5		dB
Supply Current (Icq)			54		mA

Note: Data taken with broadband bias tee on device output.

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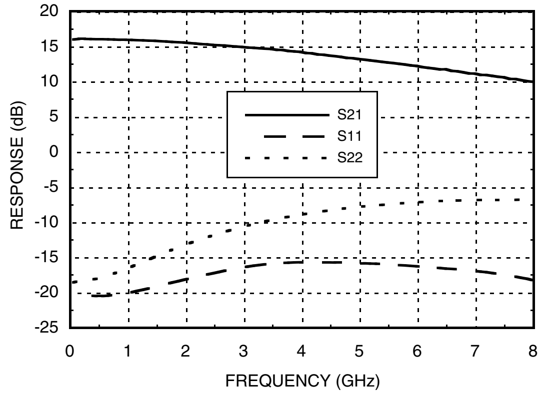
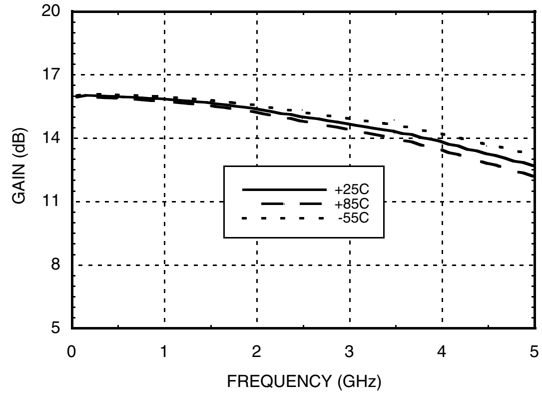
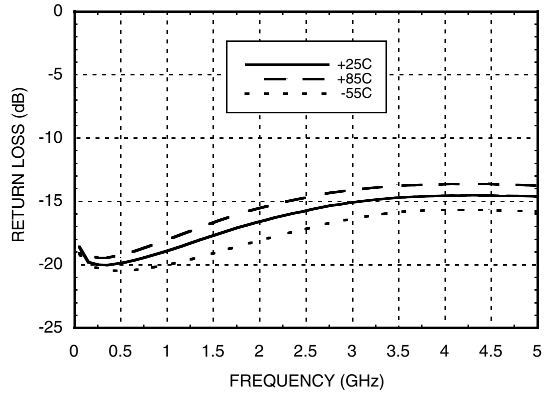
Gain & Return Loss



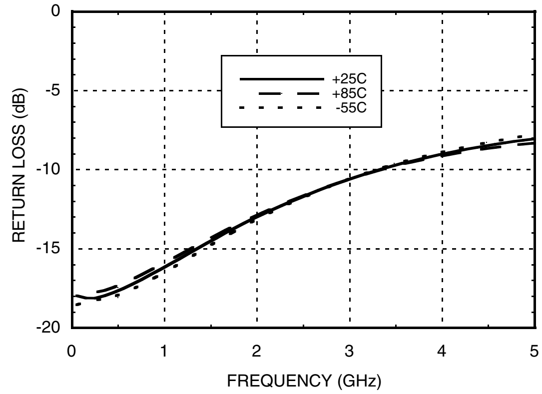
Gain vs. Temperature



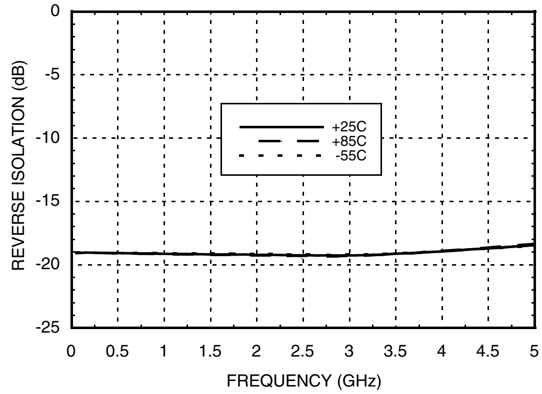
Input Return Loss vs. Temperature



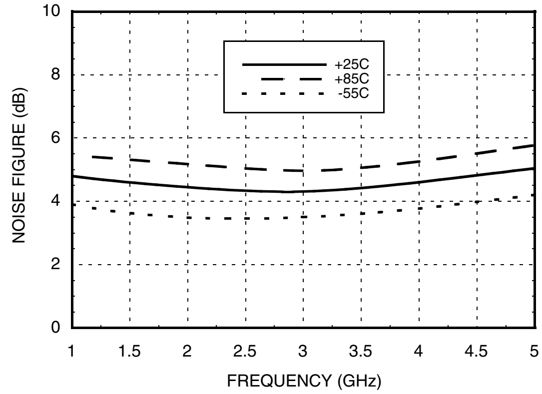
Output Return Loss vs. Temperature



Reverse Isolation vs. Temperature

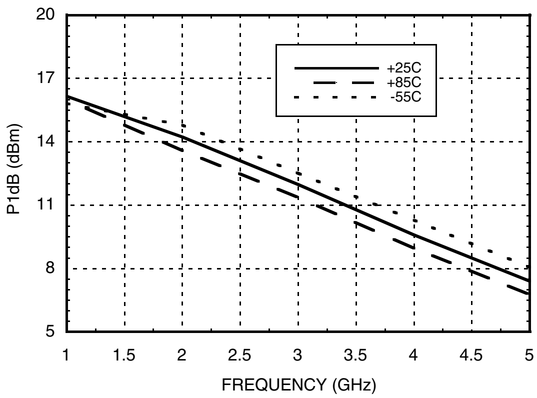


Noise Figure vs. Temperature

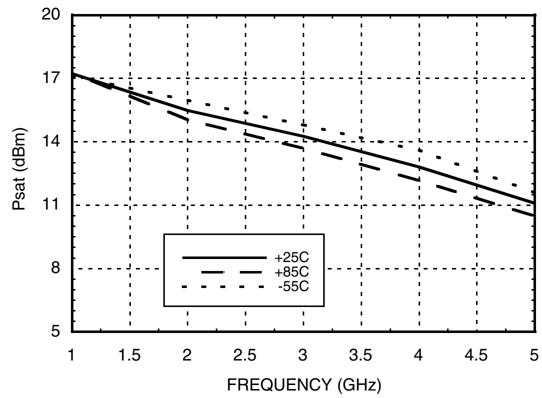


InGaP HBT GAIN BLOCK MMIC AMPLIFIER, DC - 4 GHz

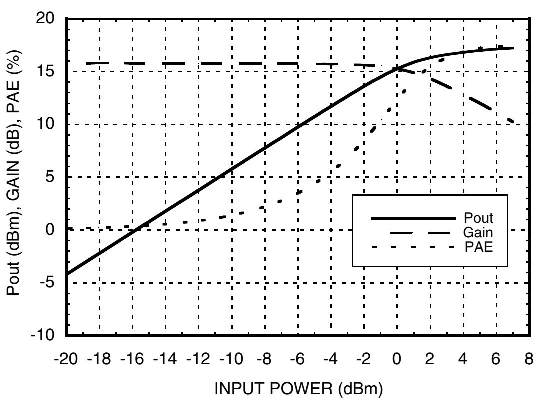
P1dB vs. Temperature



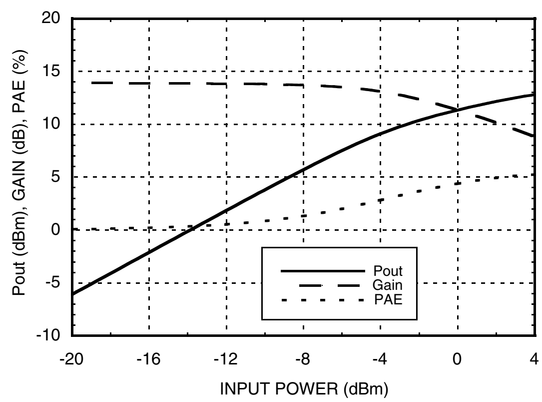
Psat vs. Temperature



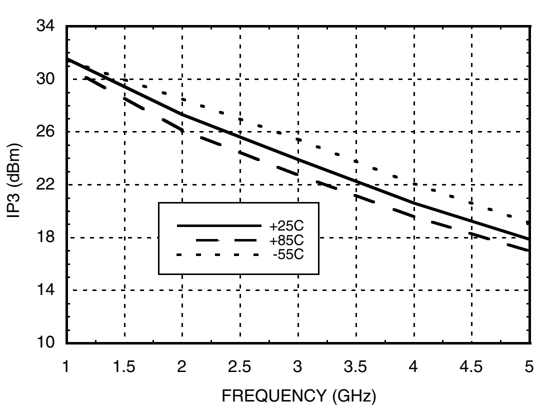
Power Compression @ 1 GHz



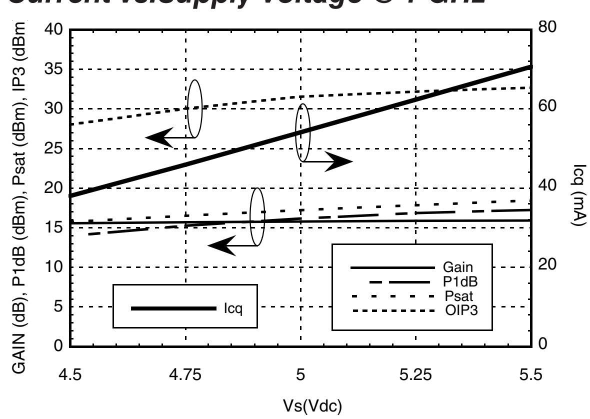
Power Compression @ 4 GHz



Output IP3 vs. Temperature



Gain, Power, Output IP3 & Supply Current vs.Supply Voltage @ 1 GHz

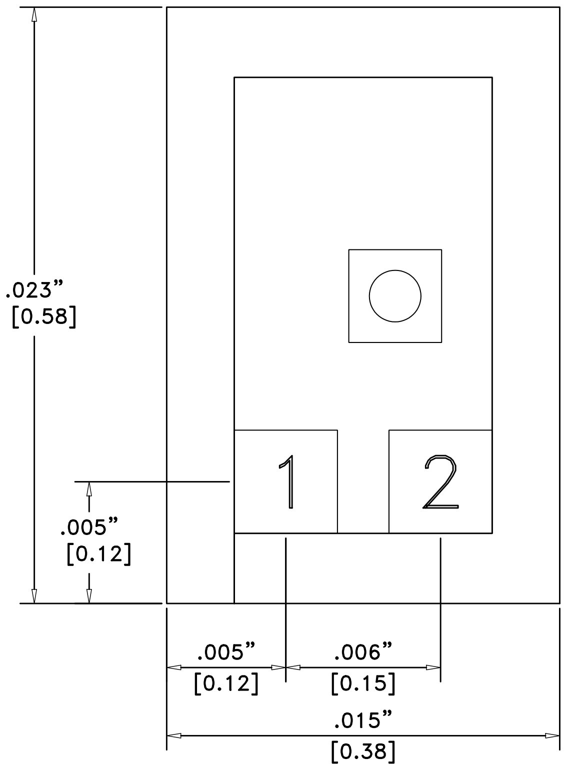


Absolute Maximum Ratings

Collector Bias Voltage (Vcc)	+7.0 Vdc
RF Input Power (RFIN)(Vcc = +5.0 Vdc)	+10 dBm
Junction Temperature	150 °C
Continuous Pdiss (T = 85 °C) (derate 7.3 mW/°C above 85 °C)	0.475 W
Thermal Resistance (junction to die bottom)	137 °C/W
Storage Temperature	-65 to +150 °C
Operating Temperature	-55 to +85 °C

ELECTROSTATIC SENSITIVE DEVICE
OBSERVE HANDLING PRECAUTIONS

Outline Drawing



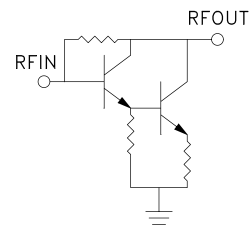
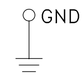
NOTES:
1. ALL DIMENSIONS IN INCHES [MILLIMETERS]
2. ALL TOLERANCES ARE ±0.001 (0.025)
3. DIE THICKNESS IS 0.004” (0.100) BACKSIDE IS GROUND
4. BOND PADS ARE 0.004” (0.100) SQUARE
5. BOND PAD SPACING, CTR-CTR: 0.006 (0.150)
6. BACKSIDE METALLIZATION: GOLD
7. BOND PAD METALLIZATION: GOLD

Die Packaging Information [1]

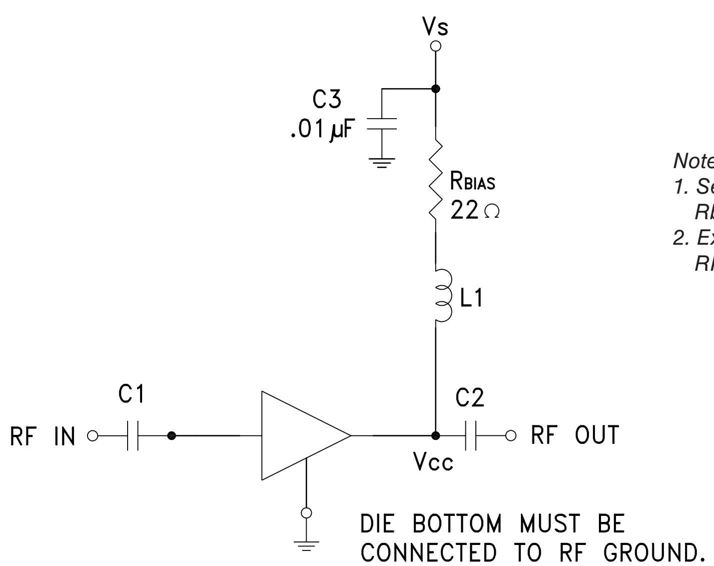
Standard	Alternate
GP-3 (Gel Pack)	[2]

[1] Refer to the “Packaging Information” section for die packaging dimensions.
[2] For alternate packaging information contact Analog Devices, Inc.

Pad Descriptions

Pad Number	Function	Description	Interface Schematic
1	RFIN	This pin is DC coupled. An off chip DC blocking capacitor is required.	
2	RFOUT	RF output and DC Bias for the output stage.	
Die Bottom	GND	Die bottom must be connected to RF/DC ground.	

Application Circuit



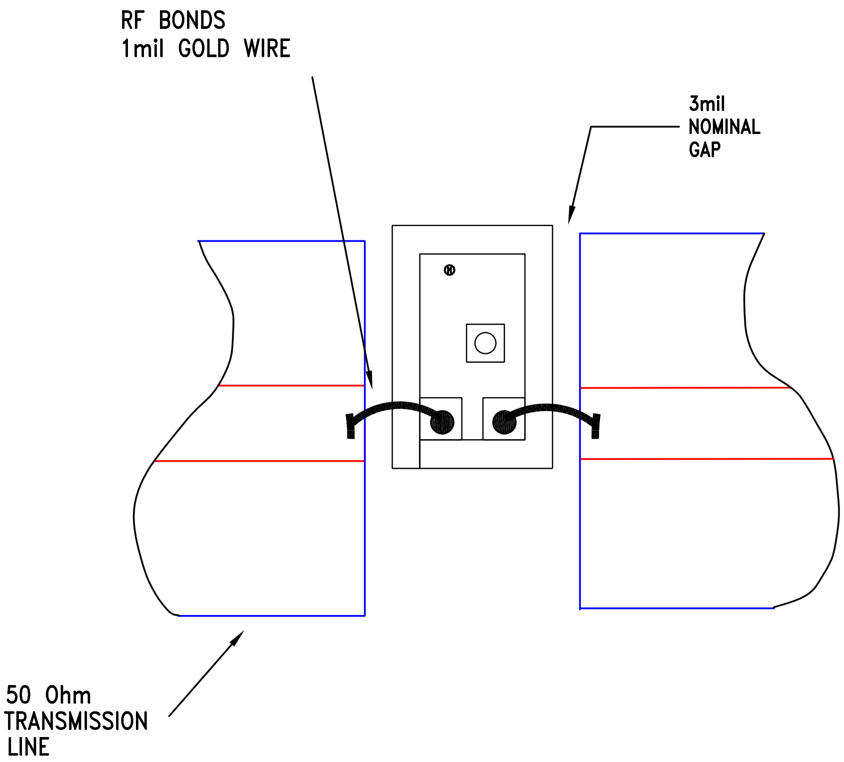
Note:
1. Select Rbias to achieve Icq using equation below, Rbias ≥ 22 Ohm.
2. External blocking capacitors are required on RFIN and RFOUT.

$$Icq = \frac{Vs - 3.9}{Rbias}$$

Recommended Component Values

Component	Frequency (MHz)				
	50	100	500	1000	4000
L1	270 nH	270 nH	100 nH	56 nH	8.2 nH
C1, C2	0.01 µF	0.01 µF	500 pF	100 pF	100 pF

Assembly Diagram



Handling Precautions

Follow these precautions to avoid permanent damage.

Storage: All bare die are placed in either Waffle or Gel based ESD protective containers, and then sealed in an ESD protective bag for shipment. Once the sealed ESD protective bag has been opened, all die should be stored in a dry nitrogen environment.

Cleanliness: Handle the chips in a clean environment. DO NOT attempt to clean the chip using liquid cleaning systems.

Static Sensitivity: Follow ESD precautions to protect against ESD strikes.

Transients: Suppress instrument and bias supply transients while bias is applied. Use shielded signal and bias cables to minimize inductive pick-up.

General Handling: Handle the chip along the edges with a vacuum collet or with a sharp pair of bent tweezers. The surface of the chip has fragile air bridges and should not be touched with vacuum collet, tweezers, or fingers.

Mounting

The chip is back-metallized and can be die mounted with AuSn eutectic preforms or with electrically conductive epoxy. The mounting surface should be clean and flat.

Epoxy Die Attach: Apply a minimum amount of epoxy to the mounting surface so that a thin epoxy fillet is observed around the perimeter of the chip once it is placed into position. Cure epoxy per the manufacturer's schedule.

Wire Bonding

Ball or wedge bond with 0.025mm (1 mil) diameter pure gold wire. Thermosonic wirebonding with a nominal stage temperature of 150 deg. C and a ball bonding force of 40 to 50 grams or wedge bonding force of 18 to 22 grams is recommended. Use the minimum level of ultrasonic energy to achieve reliable wirebonds. Wirebonds should be started on the chip and terminated on the package or substrate. All bonds should be as short as possible <0.31mm (12 mils).

InGaP HBT GAIN BLOCK MMIC AMPLIFIER, DC - 10 GHz

Typical Applications

An excellent cascadable 50 Ohm Gain Block or LO Driver for:

- Microwave & VSAT Radios
- Test Equipment
- Military EW, ECM, C^3I
- Space Telecom

Features

Gain: 16 dB

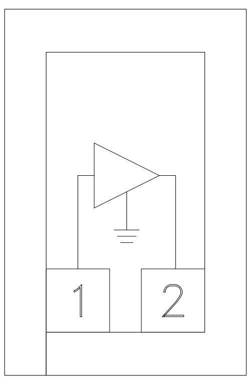
P1dB Output Power: +13 dBm

Stable Gain Over Temperature

50 Ohm I/O's

Small Size: 0.38 x 0.58 x 0.1 mm

Functional Diagram



General Description

The HMC405 die is a GaAs InGaP Heterojunction Bipolar Transistor (HBT) Gain Block MMIC DC to 10 GHz amplifier. This amplifier can be used as either a cascadable 50 Ohm gain stage or to drive the LO of HMC mixers with up to +17 dBm output power. The HMC405 offers 16 dB of gain and an output IP3 of +32 dBm while requiring only 50 mA from a +5V supply. The Darlington feedback pair used results in reduced sensitivity to normal process variations and yields excellent gain stability over temperature while requiring a minimal number of external bias components. The HMC405 can easily be integrated into Multi-Chip-Modules (MCMs) due to its small ($0.22mm^2$) size. All data is with the chip in a 50 Ohm test fixture connected via 0.025mm (1 mil) diameter wire bonds of minimal length 0.5mm (20 mils).

Electrical Specifications, Vs= +5 V, Rbias= 22 Ohm, T_A = +25° C

Parameter		Min.	Typ.	Max.	Units
Gain	DC - 3.0 GHz 3.0 - 7.0 GHz 7.0 - 10.0 GHz		16 15 13		dB dB dB
Gain Variation Over Temperature	DC - 3.0 GHz 3.0 - 7.0 GHz 7.0 - 10.0 GHz		0.004 0.015 0.02		dB/ °C dB/ °C dB/ °C
Input Return Loss	DC - 3.0 GHz 3.0 - 10.0 GHz		10 11		dB dB
Output Return Loss	DC - 3.0 GHz 3.0 - 10.0 GHz		9 10		dB dB
Reverse Isolation	DC - 7.0 GHz 7.0 - 10.0 GHz		20 17		dB dB
Output Power for 1 dB Compression (P1dB)	DC - 3.0 GHz 3.0 - 7.0 GHz 7.0 - 10.0 GHz		15 13 10		dBm dBm dBm
Output Third Order Intercept (IP3)	DC - 3.0 GHz 3.0 - 7.0 GHz 7.0 - 10.0 GHz		30 25 22		dBm dBm dBm
Noise Figure	DC - 7.0 GHz 7.0 - 10.0 GHz		4 4.5		dB dB
Supply Current (Icq)			50		mA

Note: Data taken with broadband bias tee on device output.

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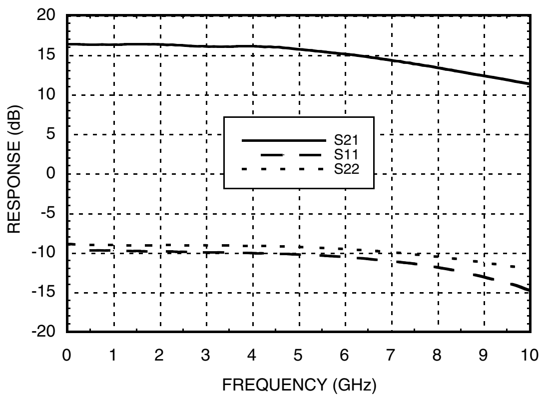
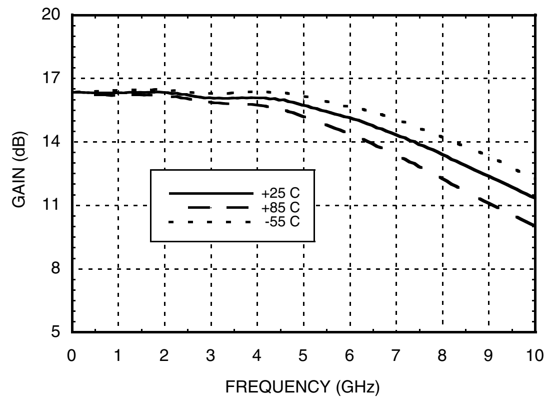
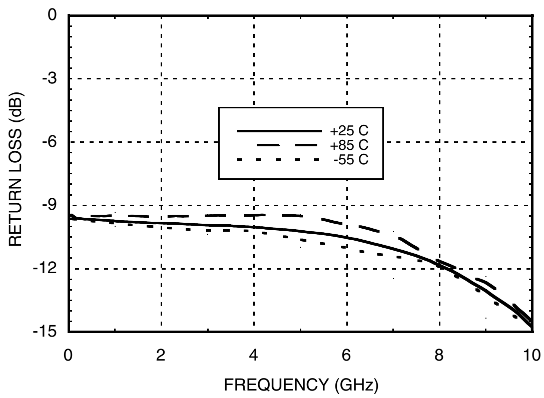
Gain & Return Loss



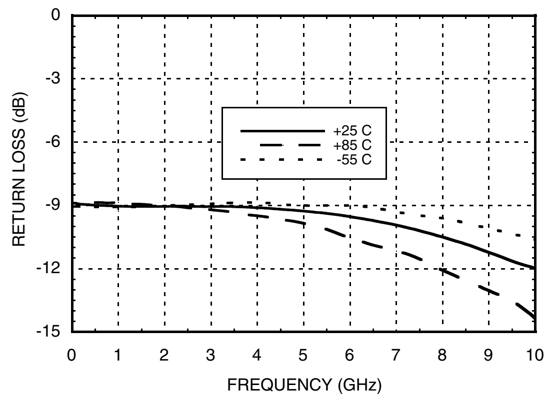
Gain vs. Temperature



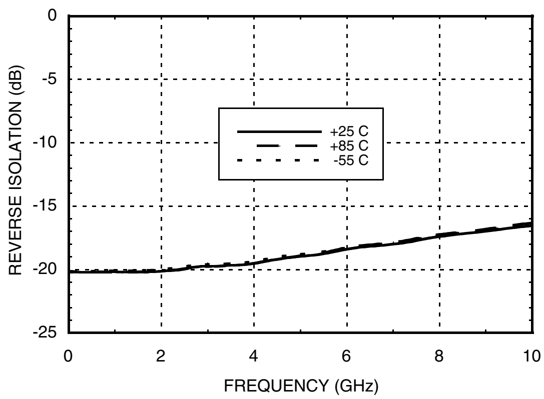
Input Return Loss vs. Temperature



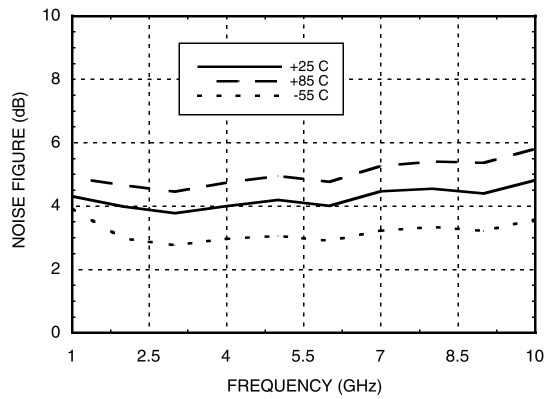
Output Return Loss vs. Temperature



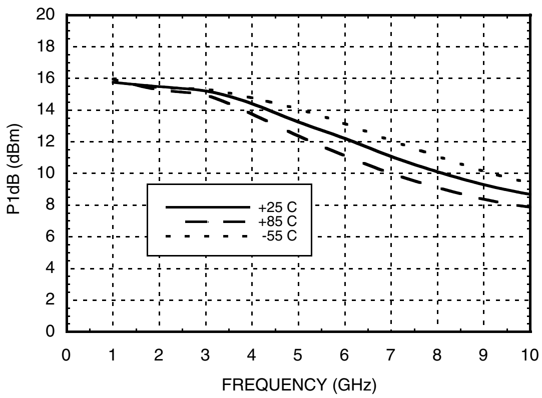
Reverse Isolation vs. Temperature



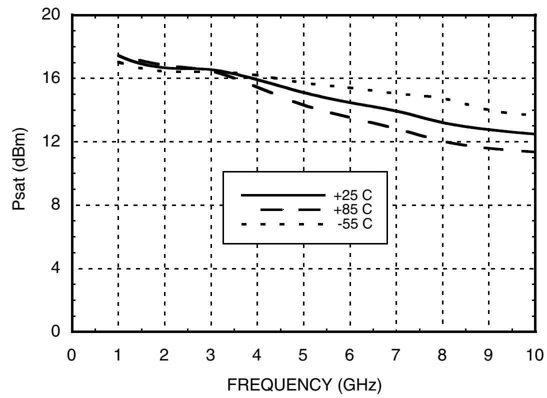
Noise Figure vs. Temperature



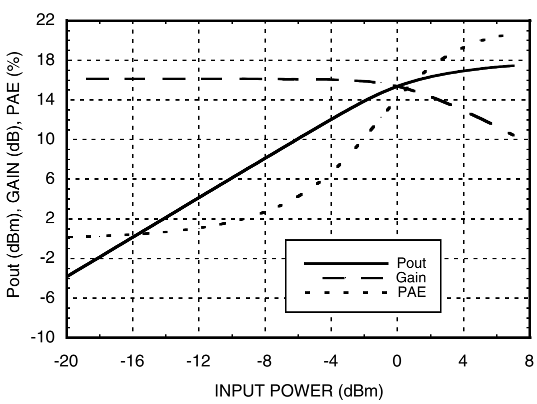
P1dB vs. Temperature



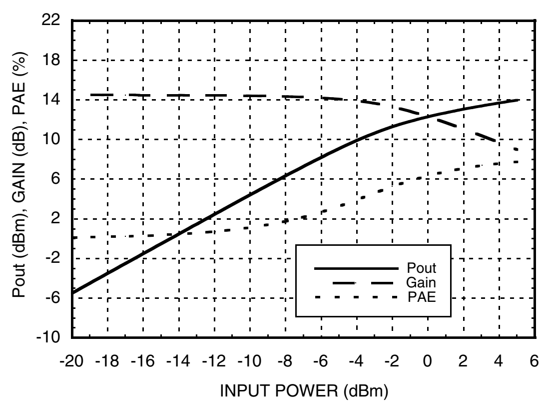
Psat vs. Temperature



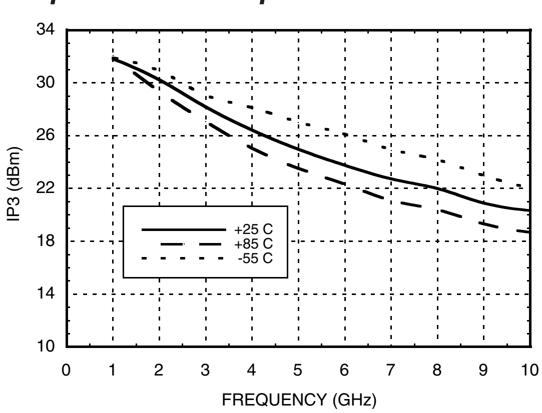
Power Compression @ 1 GHz



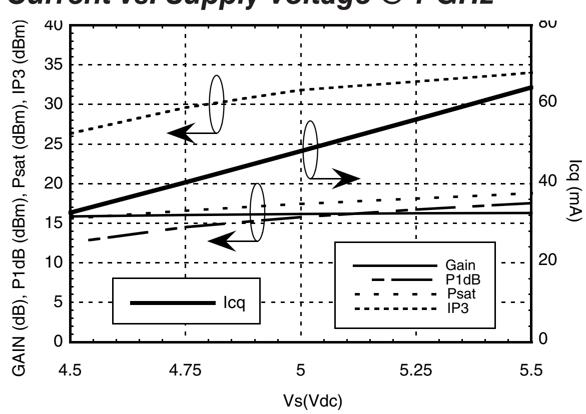
Power Compression @ 7 GHz



Output IP3 vs. Temperature



Gain, Power, Output IP3 & Supply Current vs. Supply Voltage @ 1 GHz

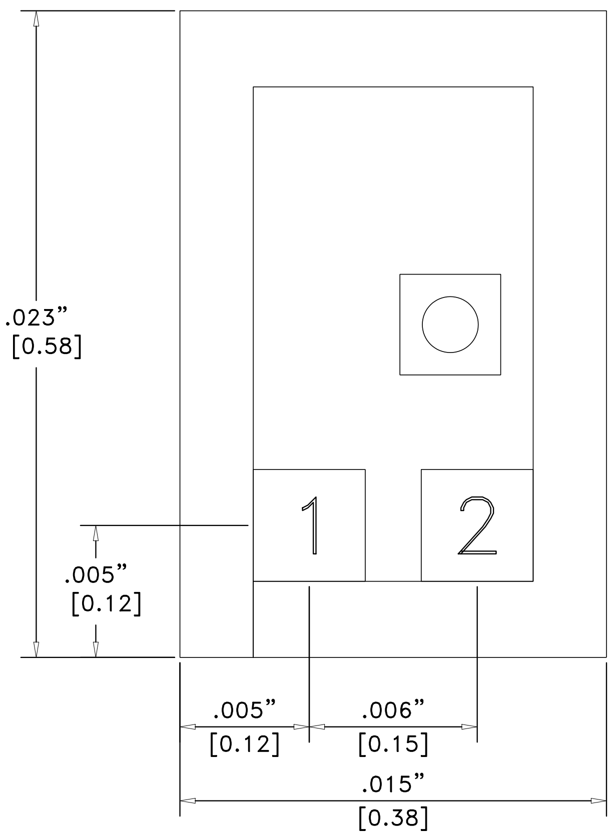


Absolute Maximum Ratings

Collector Bias Voltage	+7 Vdc
RF Input Power (RFiIN)(Vcc = +5 Vdc)	+10 dBm
Junction Temperature	150 °C
Continuous Pdiss (T= 85 °C) (derate 5.21 mW/°C above 85 °C)	0.339 W
Thermal Resistance (junction to die bottom)	192 °C/W
Storage Temperature	-65 to +150 °C
Operating Temperature	-55 to +85 °C

ELECTROSTATIC SENSITIVE DEVICE
OBSERVE HANDLING PRECAUTIONS

Outline Drawing



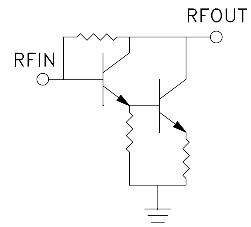
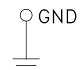
NOTES:
1. ALL DIMENSIONS IN INCHES [MILLIMETERS]
2. ALL TOLERANCES ARE ±0.001 (0.025)
3. DIE THICKNESS IS 0.004 (0.100) BACKSIDE IS GROUND
4. BOND PADS ARE 0.004 (0.100) SQUARE
5. BOND PAD SPACING, CTR-CTR: 0.006 (0.150)
6. BACKSIDE METALLIZATION: GOLD
7. BOND PAD METALLIZATION: GOLD

Die Packaging Information [1]

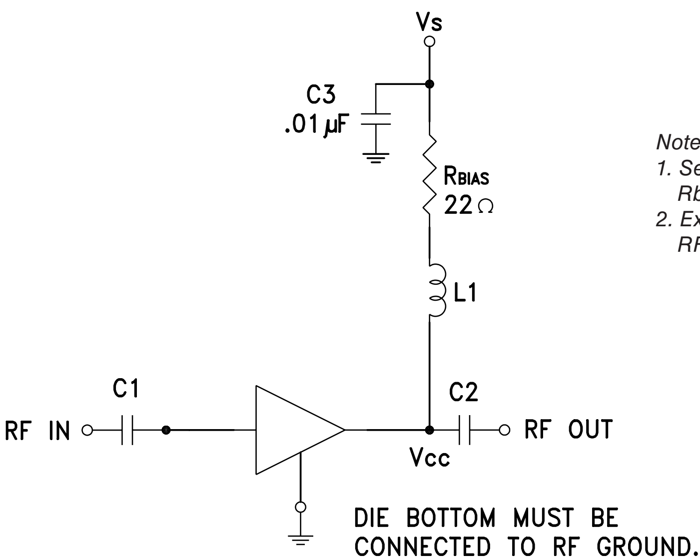
Standard	Alternate
GP-3 (Gel Pack)	[2]

[1] Refer to the “Packaging Information” section for die packaging dimensions.
[2] For alternate packaging information contact Analog Devices, Inc.

Pad Descriptions

Pad Number	Function	Description	Interface Schematic
1	RFIN	This pin is DC coupled. An off chip DC blocking capacitor is required.	
2	RFOUT	RF output and DC Bias for the output stage.	
Die Bottom	GND	Die bottom must be connected to RF/DC ground.	

Application Circuit



Note:
1. Select Rbias to achieve Icq using equation below, Rbias ≥ 22 Ohm.
2. External blocking capacitors are required on RFIN and RFOUT.

$$Icq = \frac{Vs - 3.9}{Rbias}$$

Recommended Component Values

Component	Frequency (MHz)			
	50	1000	3000	7000
L1	270 nH	56 nH	8.2 nH	2.2 nH
C1, C2	0.01 µF	100 pF	100 pF	100 pF

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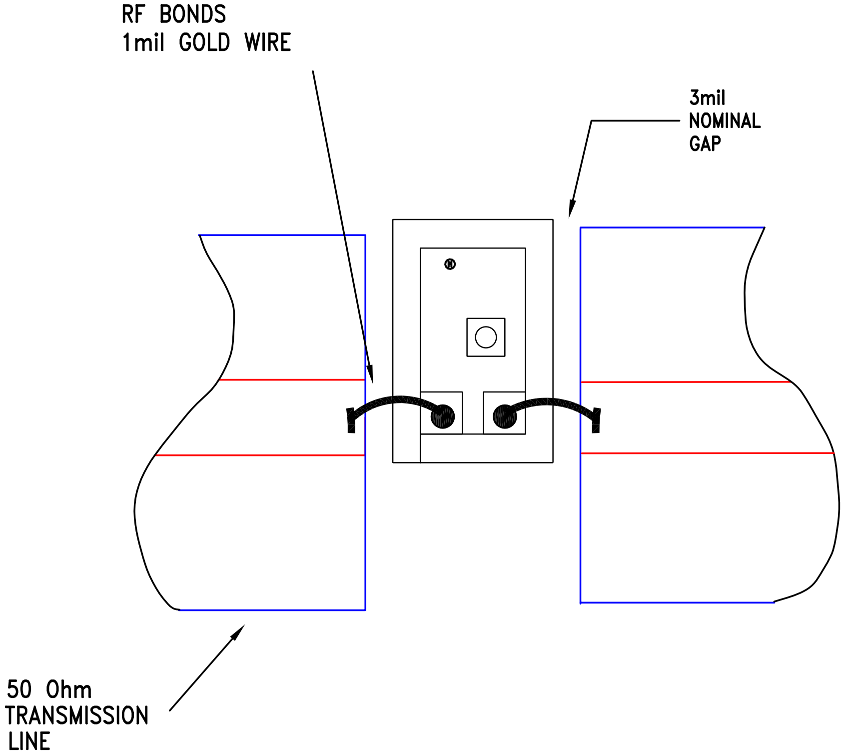
Application Support: Phone: 1-800-ANALOG-D

InGaP HBT GAIN BLOCK MMIC AMPLIFIER, DC - 10 GHz

Assembly Diagram



Handling Precautions

Follow these precautions to avoid permanent damage.

Storage: All bare die are placed in either Waffle or Gel based ESD protective containers, and then sealed in an ESD protective bag for shipment. Once the sealed ESD protective bag has been opened, all die should be stored in a dry nitrogen environment.

Cleanliness: Handle the chips in a clean environment. DO NOT attempt to clean the chip using liquid cleaning systems.

Static Sensitivity: Follow ESD precautions to protect against ESD strikes.

Transients: Suppress instrument and bias supply transients while bias is applied. Use shielded signal and bias cables to minimize inductive pick-up.

General Handling: Handle the chip along the edges with a vacuum collet or with a sharp pair of bent tweezers. The surface of the chip has fragile air bridges and should not be touched with vacuum collet, tweezers, or fingers.

Mounting

The chip is back-metallized and can be die mounted with electrically conductive epoxy. The mounting surface should be clean and flat.

Epoxy Die Attach: Apply a minimum amount of epoxy to the mounting surface so that a thin epoxy fillet is observed around the perimeter of the chip once it is placed into position. Cure epoxy per the manufacturer’s schedule.

Wire Bonding

Ball or wedge bond with 0.025mm (1 mil) diameter pure gold wire. Thermosonic wirebonding with a nominal stage temperature of 150 deg. C and a ball bonding force of 40 to 50 grams or wedge bonding force of 18 to 22 grams is recommended. Use the minimum level of ultrasonic energy to achieve reliable wirebonds. Wirebonds should be started on the chip and terminated on the package or substrate. All bonds should be as short as possible <0.31mm (12 mils).