THE DATASHEET OF

ADA4304-4ACPZ-R7

1:3 and 1:4 Single-Ended, Low Cost, Active RF Splitters

Data Sheet

ADA4304-3/ADA4304-4

FEATURES

- Ideal for CATV and terrestrial applications
- 2.4 GHz, −3 dB bandwidth
  - 1 dB flatness: 54 MHz to 865 MHz
- Low noise figure: 4.6 dB
- Low distortion
  - Composite second-order (CSO): −62 dBc
  - Composite triple beat (CTB): −72 dBc
- Nominal 3 dB gain per output channel
- 25 dB output-to-output isolation, 50 MHz to 1000 MHz
- 75 Ω input and outputs
- Small package size: 16-lead, 3 mm × 3 mm LFCSP

APPLICATIONS

- Set-top boxes
- Residential gateways
- CATV distribution systems
- Splitter modules
- Digital cable ready (DCR) TVs

FUNCTIONAL BLOCK DIAGRAMS

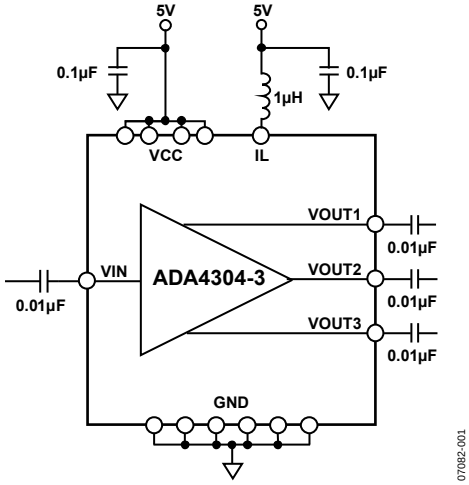

Figure 1.

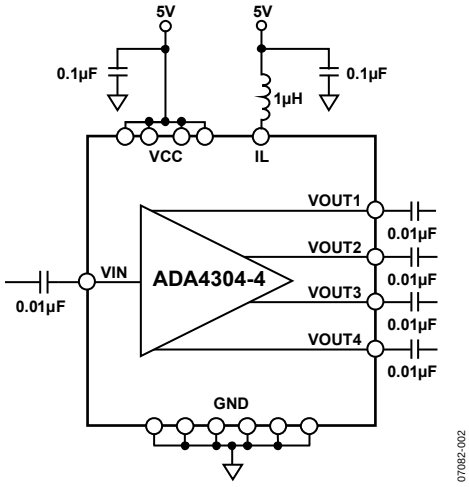

Figure 2.

GENERAL DESCRIPTION

The ADA4304-3/ADA4304-4 are 75 Ω active splitters for use in applications where a lossless signal split is required. Typical applications include multituner digital set-top boxes, cable splitter modules, multituners/digital cable ready (DCR) televisions, and home gateways where traditional solutions require discrete passive splitter modules with separate fixed gain amplifiers.

The ADA4304-3/ADA4304-4 are fabricated using the Analog Devices, Inc., proprietary silicon germanium (SiGe), complementary bipolar process, enabling them to achieve very low levels of distortion with a noise figure of 4.6 dB. The parts provide low cost alternatives that simplify designs and improve system performance by integrating a signal splitter element and a gain block into a single IC. The ADA4304-3/ADA4304-4 are available in a 16-lead LFCSP and operate in the extended industrial temperature range of −40°C to +85°C.

Rev. A

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TABLE OF CONTENTS

Features 1
Applications 1
Functional Block Diagrams 1
General Description 1
Revision History 2
Specifications 3
Absolute Maximum Ratings 4
Thermal Resistance 4
ESD Caution 4
Pin Configurations and Function Descriptions 5
Typical Performance Characteristics 6
Test Circuits 9
Applications 10
Circuit Description 10
Outline Dimensions 11
Ordering Guide 11

REVISION HISTORY

7/2016—Rev. 0 to Rev. A

Changes to Figure 4, Figure 5, Table 4, and Table 5 5
Deleted Evaluation Boards Section, RF Layout Considerations Section, Power Supply Section, and Figure 21; Renumbered Sequentially 10
Deleted Figure 22 and Figure 23 11
Updated Outline Dimensions 12
Changes to Ordering Guide 12

11/2007—Revision 0: Initial Version

SPECIFICATIONS

V_{CC} = 5 V, 75 Ω system, T_A = 25°C, unless otherwise noted.

Table 1.

Parameter	Conditions	ADA4304-3			ADA4304-4			Unit
		Min	Typ	Max	Min	Typ	Max	
DYNAMIC PERFORMANCE	See Figure 19 for test circuit							
Bandwidth (−3 dB)			2400			2400		MHz
Frequency Range		54		865	54		865	MHz
Gain	f = 100 MHz		3.3			2.9		dB
Gain Flatness	54 MHz to 865 MHz		1.0			1.0		dB
NOISE/DISTORTION PERFORMANCE								
Noise Figure[1]	@ 54 MHz		4.0			4.0		dB
	@ 550 MHz		4.6			4.6		dB
	@ 865 MHz		4.8			4.8		dB
Output IP3	f_1 = 97.25 MHz, f_2 = 103.25 MHz		26			26		dBm
Output IP2	f_1 = 97.25 MHz, f_2 = 103.25 MHz		43			43		dBm
Composite Triple Beat (CTB)	135 channels, 15 dBmV/channel, f = 865 MHz		−72			−72		dBc
Composite Second Order (CSO)	135 channels, 15 dBmV/channel, f = 865 MHz		−62			−62		dBc
Cross Modulation (CXM)	135 channels, 15 dBmV/channel, 100% modulation @ 15.75 kHz, f = 865 MHz		−68			−68		dBc
INPUT CHARACTERISTICS	See Figure 19 for test circuit							
Input Return Loss	@ 54 MHz		−17	−13		−18	−14	dB
	@ 550 MHz		−22	−16		−21	−15	dB
	@ 865 MHz		−12	−8		−12	−8	dB
Output-to-Input Isolation	Any output, 54 MHz to 865 MHz							
	@ 54 MHz		−33	−30		−33	−31	dB
	@ 550 MHz		−33	−30		−33	−31	dB
	@ 865 MHz		−34	−31		−35	−32	dB
OUTPUT CHARACTERISTICS	See Figure 19 and Figure 20 for test circuits							
Output Return Loss	Any output, 54 MHz to 865 MHz							
	@ 54 MHz		−21	−17		−21	−17	dB
	@ 550 MHz		−16	−11		−17	−12	dB
	@ 865 MHz		−14	−9		−14	−9	dB
Output-to-Output Isolation	Any output, 54 MHz to 865 MHz							dB
	@ 54 MHz		−26			−26		dB
	@ 550 MHz		−25			−25		dB
	@ 865 MHz		−25			−25		dB
1 dB Compression (P1dB)	Output referred, f = 100 MHz		9.0			8.7		dBm
POWER SUPPLY								
Nominal Supply Voltage		4.75	5.0	5.25	4.75	5.0	5.25	V
Quiescent Supply Current			92	105		92	105	mA

[1] Characterized with 50 Ω noise figure analyzer.

ABSOLUTE MAXIMUM RATINGS

Table 2.

Parameter	Rating
Supply Voltage	5.5 V
Power Dissipation	See Figure 3
Storage Temperature Range	−65°C to +125°C
Operating Temperature Range	−40°C to +85°C
Lead Temperature (Soldering, 10 sec)	300°C
Junction Temperature	150°C

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

θ_{JA} is specified for the device (including exposed pad) soldered to a high thermal conductivity 4-layer (2s2p) circuit board, as described in EIA/JESD 51-7.

Table 3. Thermal Resistance

Package Type	θ_{JA}	Unit
16-Lead LFCSP (Exposed Pad)	98	°C/W

Maximum Power Dissipation

The maximum safe power dissipation in the ADA4304-3/ADA4304-4 package is limited by the associated rise in junction temperature (T_J) on the die. At approximately 150°C, which is the glass transition temperature, the plastic changes its properties. Even temporarily exceeding this temperature limit can change the stresses that the package exerts on the die, permanently shifting the parametric performance. Exceeding a junction temperature of 150°C for an extended period can result in changes in the silicon devices, potentially causing failure.

The power dissipated in the package (P_D) is essentially equal to the quiescent power dissipation, that is, the supply voltage (V_S) times the quiescent current (I_S). In Table 1, the maximum power dissipation of the ADA4304-3/ADA4304-4 can be calculated as

$$P_{D\,(MAX)} = 5.25\ \text{V} \times 105\ \text{mA} = 551\ \text{mW}$$

Airflow increases heat dissipation, effectively reducing θ_{JA}. In addition, more metal directly in contact with the package leads/exposed pad from metal traces, through-holes, ground, and power planes reduces the θ_{JA}.

Figure 3 shows the maximum safe power dissipation in the package vs. the ambient temperature for the 16-lead LFCSP (98°C/W) on a JEDEC standard 4-layer board.

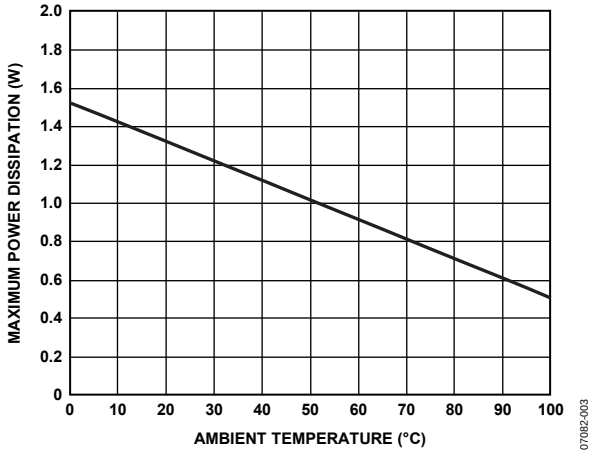

Figure 3. Maximum Power Dissipation vs. Temperature for a 4-Layer Board

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 CONFIGURATIONS AND FUNCTION DESCRIPTIONS

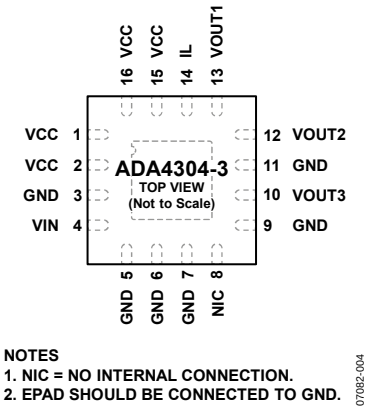

Figure 4. ADA4304-3 Pin Configuration

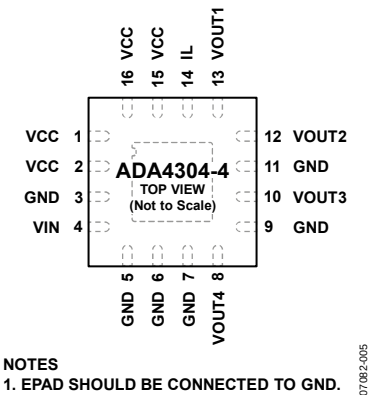

Figure 5. ADA4304-4 Pin Configuration

Table 4. ADA4304-3 Pin Function Descriptions

Pin No.	Mnemonic	Description
1, 2, 15, 16	VCC	Supply Pin.
3, 5 to 7, 9, 11	GND	Ground.
4	VIN	Input.
8	NIC	No Internal Connection.
10	VOUT3	Output 3.
12	VOUT2	Output 2.
13	VOUT1	Output 1.
14	IL	Bias Pin.
	EPAD	Exposed Pad. Exposed pad should be connected to GND.

Table 5. ADA4304-4 Pin Function Descriptions

Pin No.	Mnemonic	Description
1, 2, 15, 16	VCC	Supply Pin.
3, 5 to 7, 9, 11	GND	Ground.
4	VIN	Input.
8	VOUT4	Output 4.
10	VOUT3	Output 3.
12	VOUT2	Output 2.
13	VOUT1	Output 1.
14	IL	Bias Pin.
	EPAD	Exposed Pad. Exposed pad should be connected to GND.

TYPICAL PERFORMANCE CHARACTERISTICS

V_{CC} = 5 V, 75 Ω system, T_A = 25°C, unless otherwise noted.

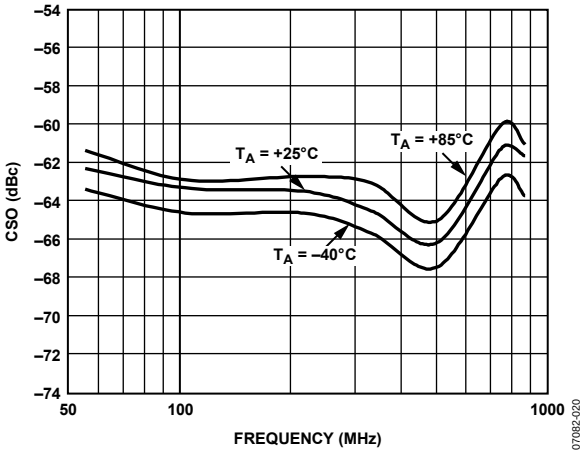

Figure 6. Composite Second Order (CSO) vs. Frequency

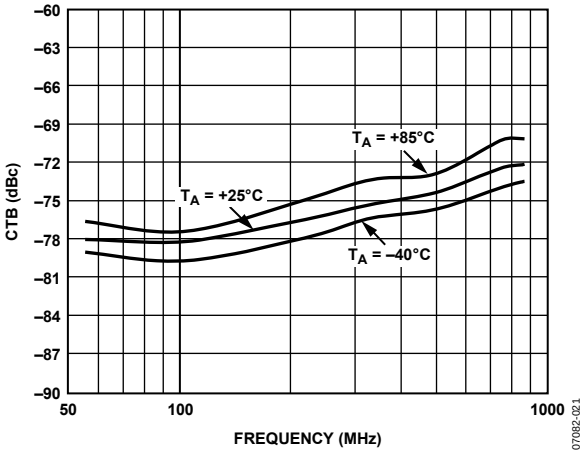

Figure 7. Composite Triple Beat (CTB) vs. Frequency

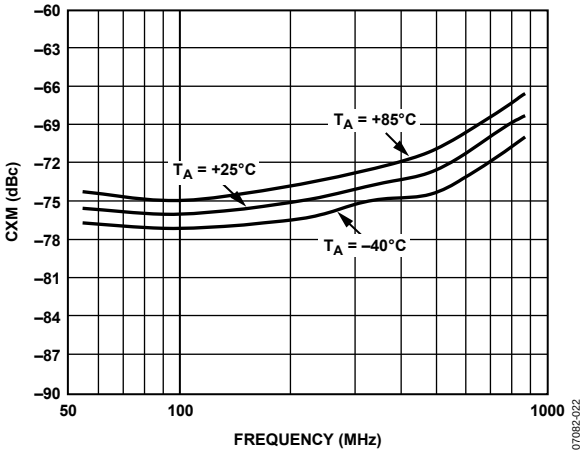

Figure 8. Cross Modulation (CXM) vs. Frequency

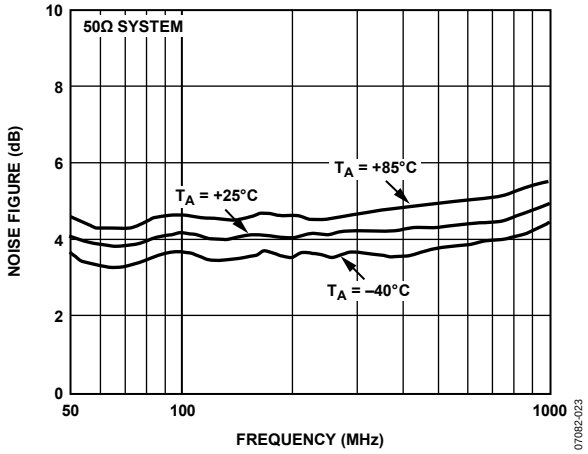

Figure 9. Noise Figure vs. Frequency

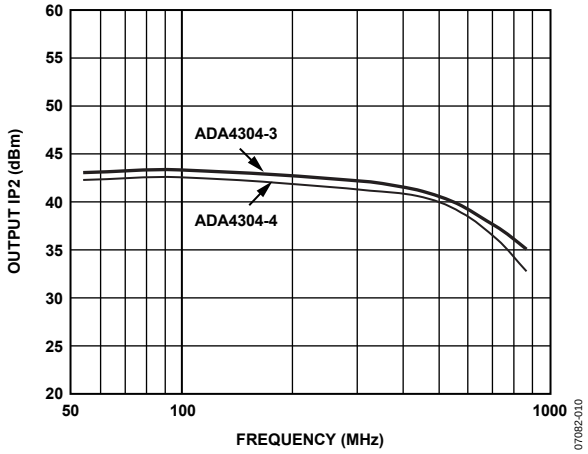

Figure 10. Output IP2 vs. Frequency

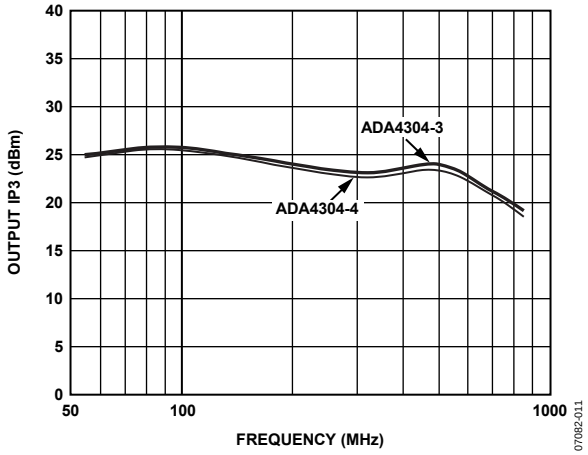

Figure 11. Output IP3 vs. Frequency

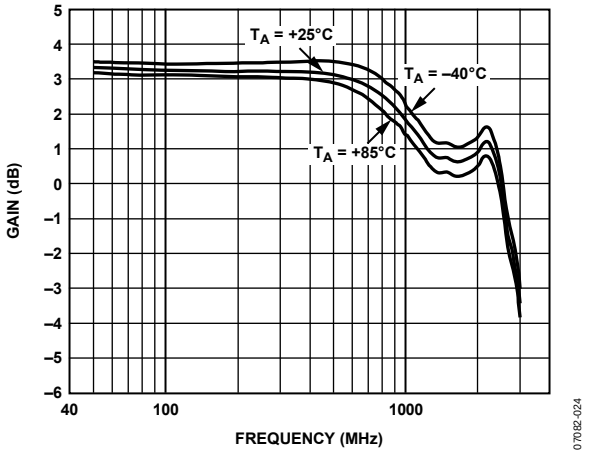

Figure 12. ADA4304-3 Gain vs. Frequency

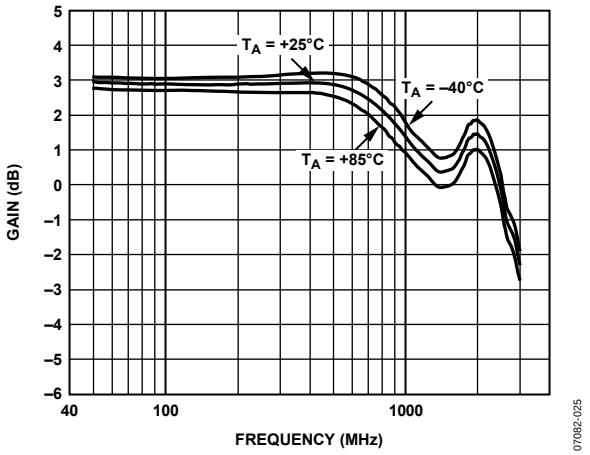

Figure 13. ADA4304-4 Gain vs. Frequency

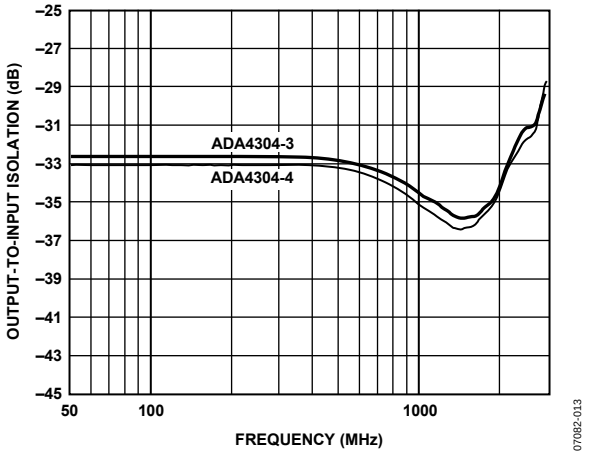

Figure 14. Output-to-Input Isolation vs. Frequency

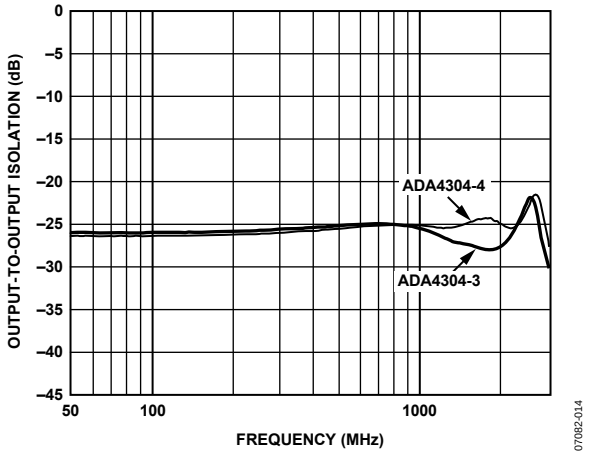

Figure 15. Output-to-Output Isolation vs. Frequency

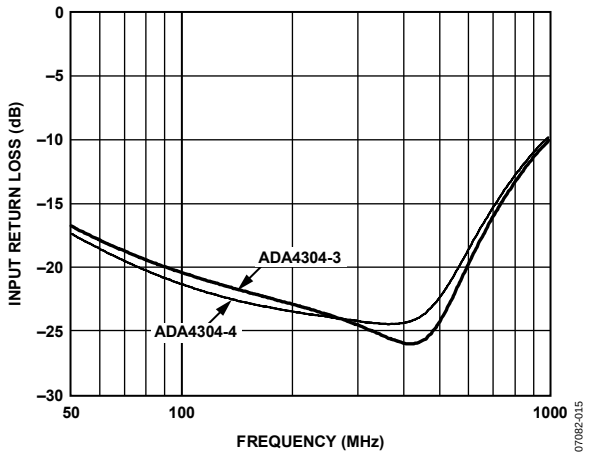

Figure 16. Input Return Loss vs. Frequency

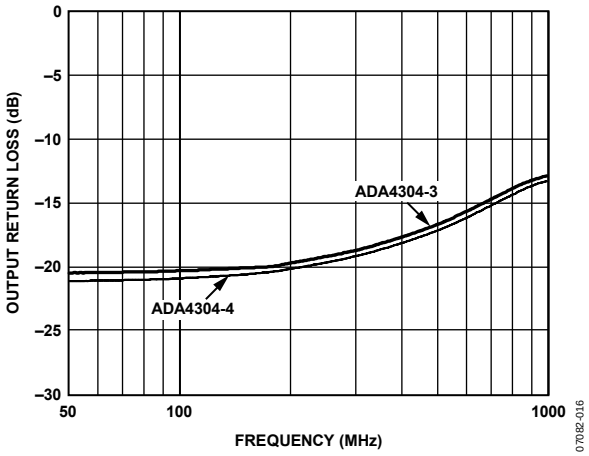

Figure 17. Output Return Loss vs. Frequency

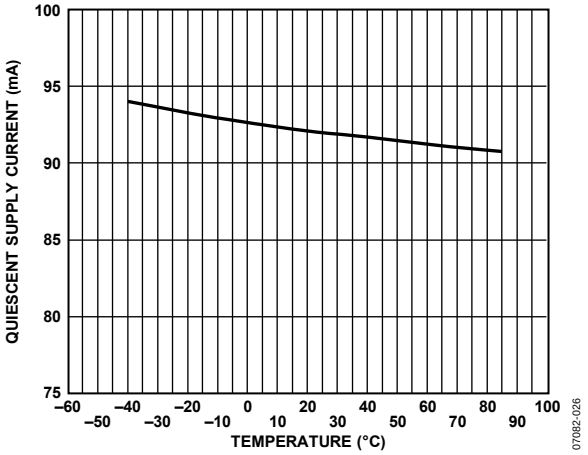

Figure 18. Quiescent Supply Current vs. Temperature

TEST CIRCUITS

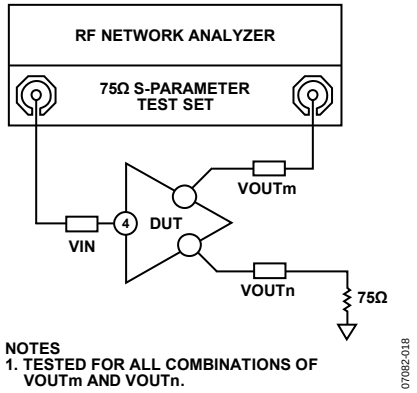

Figure 19. Test Circuit for Transmission, Isolation, and Reflection Measurements

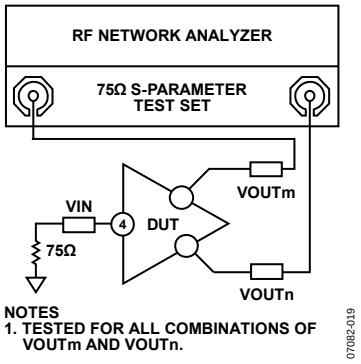

Figure 20. Test Circuit for Output-to-Output Isolation Measurements

APPLICATIONS

The ADA4304-3/ADA4304-4 active splitters are primarily intended for use in the downstream path of television set-top boxes (STBs) that contain multiple tuners. They are typically located directly after the diplexer in a bidirectional CATV customer premise unit. The ADA4304-3/ADA4304-4 provide a single-ended input and three or four single-ended outputs that allow the delivery of the RF signal to multiple signal paths. These paths can include, but are not limited to, a main picture tuner, the picture-in-picture (PIP) tuner, an out-of-band (OOB) tuner, a digital video recorder (DVR), and a cable modem (CM).

The ADA4304-3/ADA4304-4 exhibit composite second-order (CSO) and composite triple beat (CTB) products that are −62 dBc and −72 dBc, respectively. The use of the SiGe bipolar process also allows the ADA4304-3/ADA4304-4 to achieve a noise figure (NF) of 4.6 dB at 550 MHz.

CIRCUIT DESCRIPTION

The ADA4304-3/ADA4304-4 consist of a low noise buffer amplifier followed by a resistive power divider. This arrangement provides 3.3 dB (ADA4304-3) or 2.9 dB (ADA4304-4) of gain relative to the RF signal present at the input of the device. The input and each output must be properly matched to a 75 Ω environment for distortion and noise performance to match the data sheet specifications. AC coupling capacitors of 0.01 µF are recommended for the input and outputs.

A 1 µH RF choke (Coilcraft chip inductor 0805LS-102X) is required to correctly bias the internal nodes of the ADA4304-3/ADA4304-4. It should be connected between the 5 V supply and the IL pin (Pin 14). The choke should be placed as close as possible to the ADA4304-3/ADA4304-4 to minimize parasitic capacitance on the IL pin, which is critical for achieving the specified bandwidth and flatness.

OUTLINE DIMENSIONS

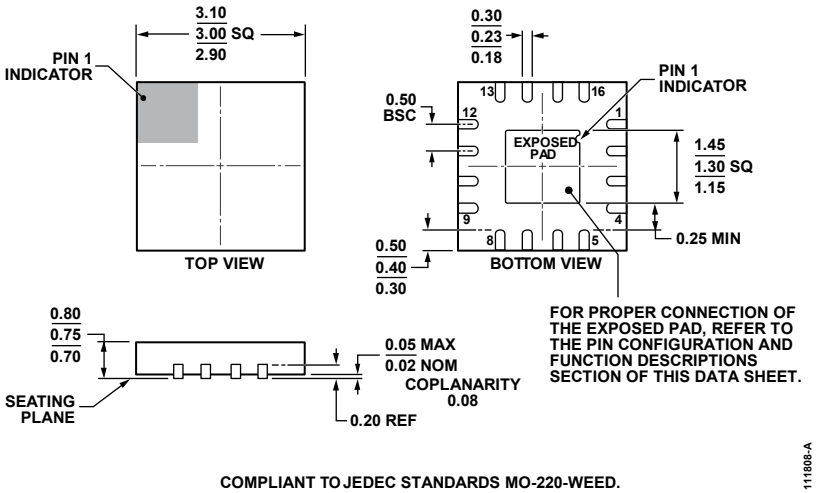

Figure 21. 16-Lead Lead Frame Chip Scale Package [LFCSP]
3 mm × 3 mm Body and 0.75 mm Package Height
(CP-16-21)
Dimensions shown in millimeters

ORDERING GUIDE

Model[1]	Temperature Range	Package Description	Package Option	Ordering Quantity	Branding
ADA4304-3ACPZ-RL	−40°C to +85°C	16-Lead LFCSP	CP-16-21	5,000	H16
ADA4304-3ACPZ-R7	−40°C to +85°C	16-Lead LFCSP	CP-16-21	1,500	H16
ADA4304-3ACPZ-R2	−40°C to +85°C	16-Lead LFCSP	CP-16-21	250	H16
ADA4304-4ACPZ-RL	−40°C to +85°C	16-Lead LFCSP	CP-16-21	5,000	H10
ADA4304-4ACPZ-R7	−40°C to +85°C	16-Lead LFCSP	CP-16-21	1,500	H10
ADA4304-4ACPZ-R2	−40°C to +85°C	16-Lead LFCSP	CP-16-21	250	H10

[1] Z=RoHS Compliant Part

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- Shortage Management
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