

10 GHz to 40 GHz, 2-Way RF Splitter Combiner

FEATURES

- ▶ 2-way RF splitter combiner
- ▶ Frequency range: 10 GHz to 40 GHz
- ▶ Insertion loss (excess of 3 dB):
 - ▶ -1 dB from 10 GHz to 18 GHz
 - ▶ -1.1 dB from 18 GHz to 27 GHz
- ▶ Return loss (Port S1):
 - ▶ -15 dB from 10 GHz to 18 GHz
 - ▶ -12 dB from 18 GHz to 27 GHz
- ▶ Isolation:
 - ▶ -20 dB at 10 GHz to 18 GHz
 - ▶ -23 dB from 18 GHz to 27 GHz
- ▶ 1.460 mm × 1.460 mm × 0.500 mm, wafer level chip-scale package (WLCSP)

APPLICATIONS

- ▶ General-purpose microwave signal distribution
- ▶ Phased-array satellite communication (SATCOM) systems
- ▶ Phased-array radar systems

GENERAL DESCRIPTION

The ADAR5001 is a 1-to-2 Wilkinson power splitter that is designed for space-constrained microwave signal distribution applications. Excess insertion loss ranges from -1.0 dB (from 10 GHz to 18 GHz) and -1.1 dB (from 18 GHz to 27 GHz). The two outputs are matched in both phase and amplitude, making the ADAR5001 ideal for signal distribution applications requiring low time skew between channels. The ADAR5001 can also be used as a combiner, combining input signals at the P1 and P2 ports to an output at the S1 port. The ADAR5001 is housed in a [compact, 1.460 mm × 1.460 mm × 0.500 mm WLCSP](#), which makes it ideal for use in planar, phased-array antenna systems that require a tight pitch between elements.

The ADAR5001 is fabricated on a passive silicon process, and it is specified to operate from -40°C to +85°C.

FUNCTIONAL BLOCK DIAGRAM

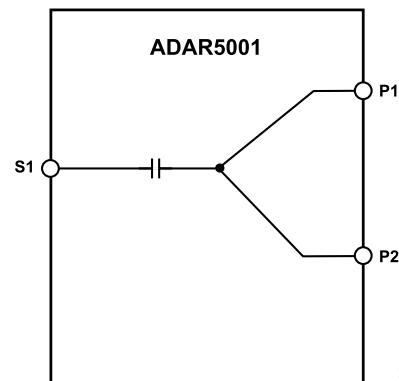


Figure 1. Functional Block Diagram

TABLE OF CONTENTS

| | | | |
|--|---|--|---|
| Features..... | 1 | Pin Configuration and Function Descriptions..... | 5 |
| Applications..... | 1 | Interface Schematics..... | 5 |
| General Description..... | 1 | Typical Performance Characteristics..... | 6 |
| Functional Block Diagram..... | 1 | Theory of Operation..... | 8 |
| Specifications..... | 3 | Outline Dimensions..... | 9 |
| Absolute Maximum Ratings..... | 4 | Ordering Guide..... | 9 |
| Electrostatic Discharge (ESD) Ratings..... | 4 | Evaluation Boards..... | 9 |
| ESD Caution..... | 4 | | |

REVISION HISTORY

3/2024—Revision 0: Initial Version

SPECIFICATIONS

Source and load impedance = 50 Ω , and $T_A = 25^\circ\text{C}$, unless otherwise noted.

Table 1. Specifications

| Parameter | Test Conditions/Comments | Min | Typ | Max | Unit |
|-----------------------------------|--|-----|------------------------------|-----|------|
| OPERATING CONDITIONS | | | | | |
| Frequency Range | | 10 | | 40 | GHz |
| INSERTION LOSS (Excess of 3.0 dB) | S1 to P1, P2 10 GHz to 18 GHz 18 GHz to 27 GHz 27 GHz to 38 GHz 38 GHz to 40 GHz | | -1.0 -1.1 -1.4 -2.0 | | dB |
| INSERT LOSS FLATNESS | S1 to P1, P2 10 GHz to 18 GHz 18 GHz to 27 GHz 27 GHz to 38 GHz 38 GHz to 40 GHz | | 0.4 0.5 0.3 1.0 | | dB |
| INSERTION LOSS MISMATCH | P1 to P2 10 GHz to 18 GHz 18 GHz to 27 GHz 27 GHz to 38 GHz 38 GHz to 40 GHz | | 0.04 0.03 0.08 0.25 | | dB |
| INSERTION PHASE MISMATCH | P1 to P2 10 GHz to 18 GHz 18 GHz to 27 GHz 27 GHz to 38 GHz 38 GHz to 40 GHz | | 0.2 0.2 0.5 2.5 | | dB |
| RETURN LOSS | All other ports terminated | | | | |
| S1 | 10 GHz to 18 GHz 18 GHz to 27 GHz 27 GHz to 38 GHz 38 GHz to 40 GHz | | -15 -12 -14 -20 | | dB |
| P1, P2 | 10 GHz to 18 GHz 18 GHz to 27 GHz 27 GHz to 38 GHz 38 GHz to 40 GHz | | -11 -15 -20 -8 | | dB |
| ISOLATION | P1 to P2, P2 to P1 10 GHz to 18 GHz 18 GHz to 27 GHz 27 GHz to 38 GHz 38 GHz to 40 GHz | | -20 -23 -15 -10 | | dB |

ABSOLUTE MAXIMUM RATINGS

Table 2. Absolute Maximum Ratings

| Parameter | Rating |
|--------------------------------|-----------------|
| Maximum Input Power (Any Port) | 34 dBm |
| Maximum Total Power (S1 Port) | 37 dBm |
| Temperature | |
| Operating Range | -40°C to +85°C |
| Storage Range | -40°C to +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.

ELECTROSTATIC DISCHARGE (ESD) RATINGS

The following ESD information is provided for handling of ESD-sensitive devices in an ESD protected area only.

Human body model (HBM) per ANSI/ESDA/JEDEC JS-001.

ESD Ratings for the ADAR5001

Table 3. ADAR5001, 8-Ball WLCSP

| ESD Model | Withstand Threshold (V) | Class |
|-----------|-------------------------|-------|
| HBM | 2000 | 2 |

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

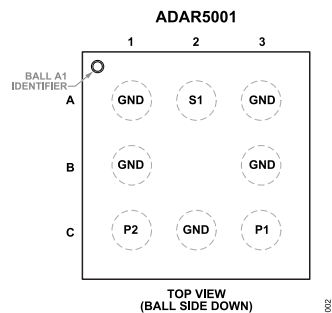


Figure 2. Pin Configuration (Top View)

Table 4. Pin Function Descriptions

| Pin No. | Mnemonic | Description |
|--------------------|----------|---|
| A1, A3, B1, B3, C2 | GND | Ground. Connect to a low impedance ground plane on the printed circuit board (PCB). |
| A2 | S1 | Sum and/or Split. The input port when the device is used as a splitter, and the output port when the device is used as a combiner. S1 is AC-coupled in the signal path but has a DC path to ground. |
| C1 | P2 | Port 2. The RF output when the device is used as a splitter, and the RF input when the device is used as a combiner. P2 has a DC path to ground. |
| C3 | P1 | Port 1. The RF output when the device is used as a splitter, and the RF input when the device is used as a combiner. P1 has a DC path to ground. |

INTERFACE SCHEMATICS

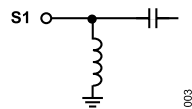


Figure 3. S1 Interface Schematic

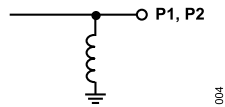


Figure 4. P1, P2 Interface Schematic

TYPICAL PERFORMANCE CHARACTERISTICS

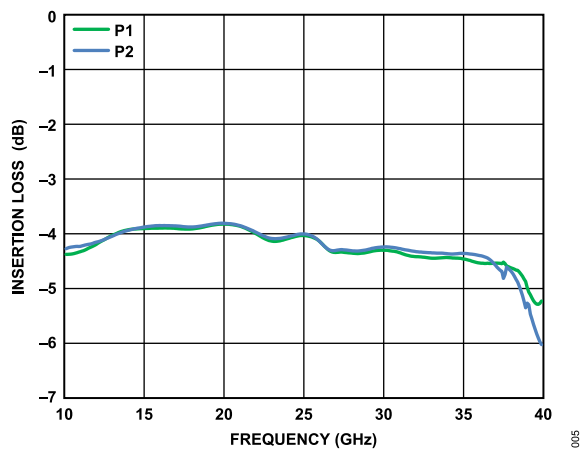


Figure 5. Insertion Loss vs. Frequency

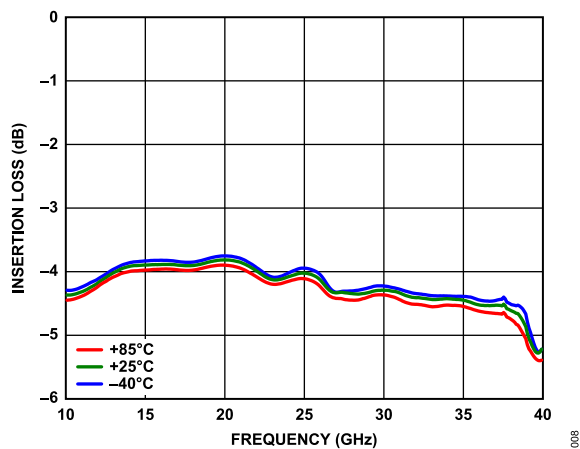


Figure 8. Insertion Loss P1 vs. Frequency and Temperature

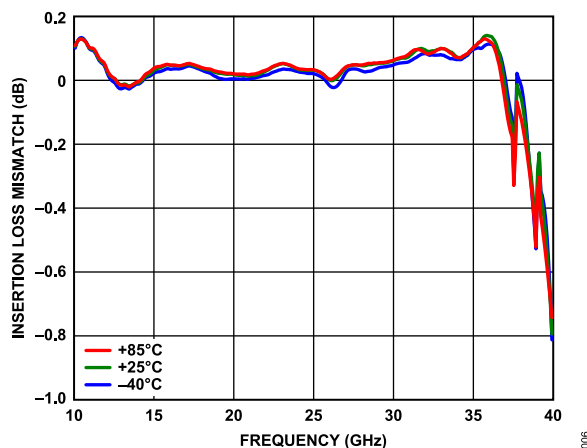


Figure 6. Insertion Loss Mismatch vs. Frequency and Temperature, Normalized to P1 at Same Temperature

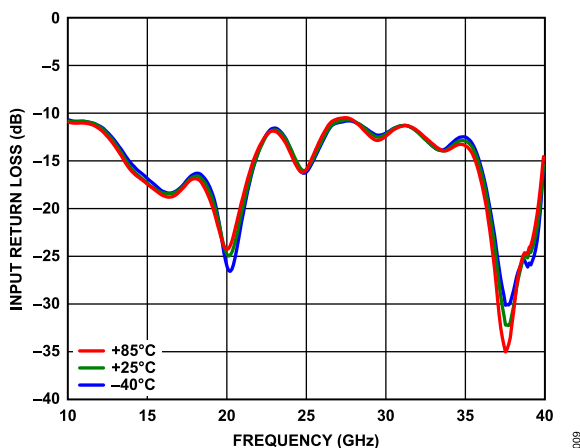


Figure 9. S1 Input Return Loss vs. Frequency and Temperature

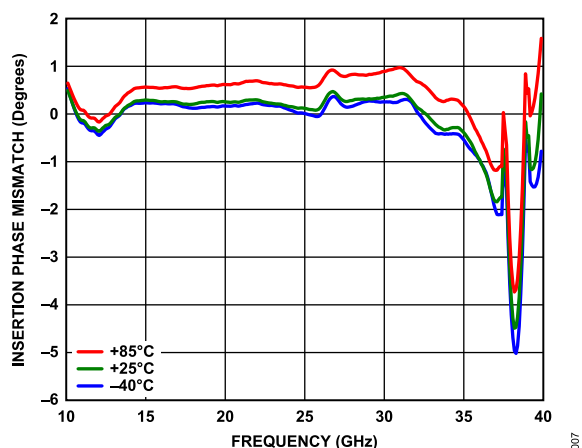


Figure 7. Insertion Phase Mismatch vs. Frequency and Temperature, Normalized to P1 at Same Temperature

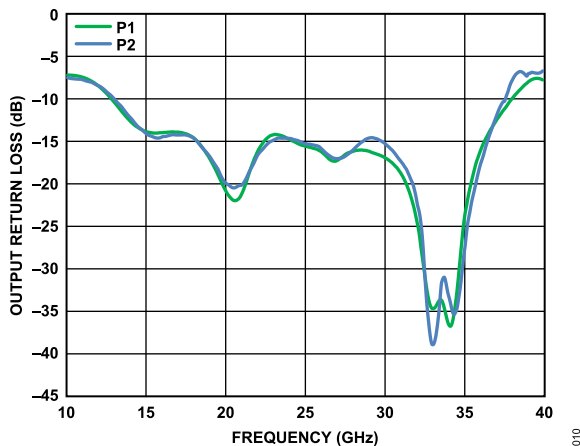


Figure 10. Output Return Loss vs. Frequency (P1, P2)

TYPICAL PERFORMANCE CHARACTERISTICS

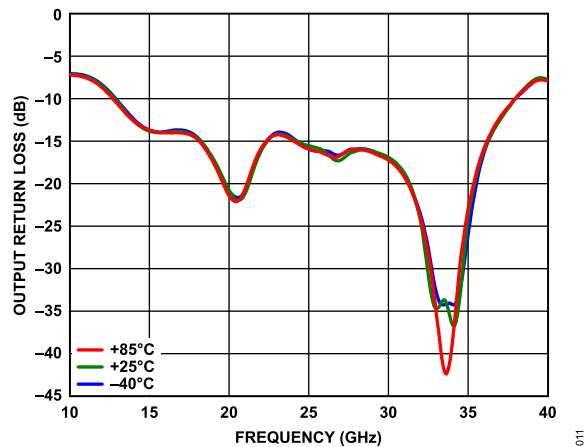


Figure 11. Output Return Loss P1 vs. Frequency and Temperature

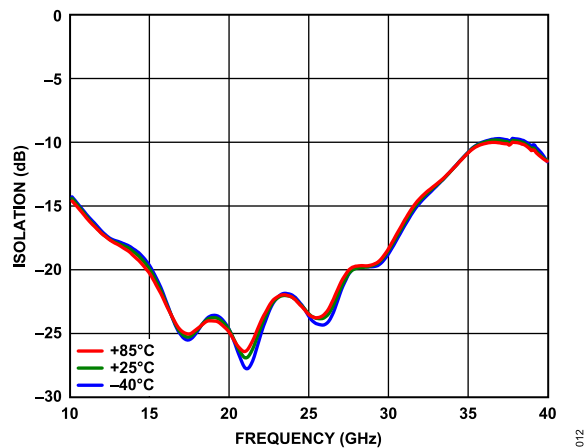


Figure 12. Isolation P2 to P1 vs. Frequency and Temperature

THEORY OF OPERATION

The ADAR5001 is a 1-to-2 Wilkinson power splitter and combiner. While the S1 port is AC-coupled in the signal path, it has a DC path to ground.

The P1 and P2 ports also have DC paths to ground. As a result, if the DC bias level on any of the ports is not equal to zero, the ports must be externally AC-coupled.

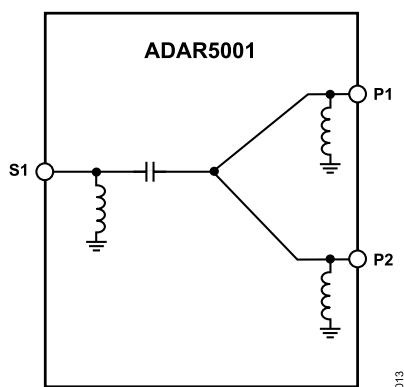


Figure 13. ADAR5001 Simplified Block Diagram

OUTLINE DIMENSIONS

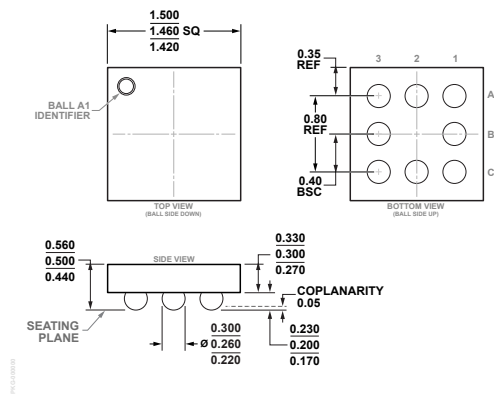


Figure 14. 8-Ball Wafer Level Chip Scale Package [WLCSP]
(CB-8-8)
Dimensions shown in millimeters

Updated: February 17, 2024

ORDERING GUIDE

| Model ¹ | Temperature Range | Package Description | Packing Quantity | Package Option |
|--------------------|-------------------|----------------------------|------------------|----------------|
| ADAR5001ACBZ | –40°C to +85°C | CHIPS W/SOLDER BUMPS/WLCSP | Reel, 1 | CB-8-8 |
| ADAR5001ACBZ-R7 | –40°C to +85°C | CHIPS W/SOLDER BUMPS/WLCSP | Reel, 3000 | CB-8-8 |

¹ Z = RoHS Compliant Part.

EVALUATION BOARDS

Table 5. Evaluation Boards

| Model ¹ | Description |
|--------------------|------------------|
| ADAR5001-EVALZ | Evaluation Board |

¹ Z = RoHS Compliant Part.