17 GHz to 32 GHz, 4-Way RF Splitter Combiner

FEATURES

- 4-way RF splitter combiner
- Frequency range: 17 GHz to 32 GHz
- Insertion loss (excess of 6.0 dB): −1.7 dB at 22 GHz to 27 GHz
- Return loss (S1): −17 dB at 22 GHz to 27 GHz
- Isolation: −17 dB at 22 GHz to 27 GHz
- 2.460 mm x 2.460 mm x 0.500 mm, wafer level, chip-scale package

APPLICATIONS

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

GENERAL DESCRIPTION

The ADAR5000 is a 1-to-4 Wilkinson power splitter that is designed for space-sensitive microwave signal distribution applications. Excess insertion loss ranges from −1.5 dB to −2.5 dB from 17 GHz to 32 GHz. The four outputs are matched in both phase and amplitude, making the ADAR5000 ideal for signal distribution applications requiring low time skew between channels. The ADAR5000 can also be used as a combiner, combining input signals at the P1, P2, P3, and P4 ports to an output at the S1 port. The ADAR5000 is housed in a compact, 2.460 mm x 2.460 mm x 0.500 mm WLCSP, which makes it ideal for use in planar, phased-array antenna systems that require a tight pitch between elements.

The ADAR5000 is fabricated on a passive silicon process, and it is specified to operate from −40°C to +85°C.

FUNCTIONAL BLOCK DIAGRAM

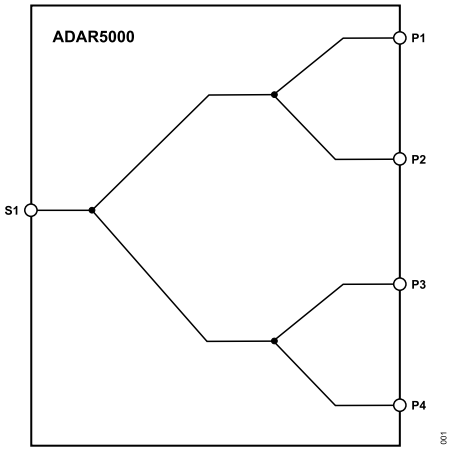

Figure 1. Functional Block Diagram

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REVISION HISTORY

3/2023—Revision 0: Initial Version

SPECIFICATIONS

Source and load impedance = 50 Ω, and T_A = 25°C, unless otherwise noted.

Table 1. Specifications

Parameter	Test Conditions/Comments	Min	Typ	Max	Unit
OPERATING CONDITIONS					
Frequency Range		17		32	GHz
INSERTION LOSS (Excess of 6.0 dB)					
	17 GHz to 22 GHz		−1.5		dB
	22 GHz to 27 GHz		−1.7		dB
	27 GHz to 32 GHz		−2.5		dB
INSERT LOSS FLATNESS	S1 to P1, P2, P3, and P4				
	17 GHz to 22 GHz		0.3		dB
	22 GHz to 27 GHz		0.5		dB
	27 GHz to 32 GHz		0.75		dB
INSERTION LOSS MISMATCH	P1 to P2, and P3 and P4				
	17 GHz to 22 GHz		0.2		dB
	22 GHz to 27 GHz		0.3		dB
	27 GHz to 32 GHz		0.4		dB
INSERTION PHASE MISMATCH	P1 to P2, and P3 and P4				
	17 GHz to 22 GHz		9		Degrees
	22 GHz to 27 GHz		10		Degrees
	27 GHz to 32 GHz		12		Degrees
RETURN LOSS	All other ports terminated				
S1					
	17 GHz to 22 GHz		−20		dB
	22 GHz to 27 GHz		−17		dB
	27 GHz to 32 GHz		−14		dB
P1, P2, P3, and P4					
	17 GHz to 22 GHz		−15		dB
	22 GHz to 27 GHz		−18		dB
	27 GHz to 32 GHz		−18		dB
ISOLATION	Between any two ports, all other ports terminated				
	17 GHz to 22 GHz		−18		dB
	22 GHz to 27 GHz		−17		dB
	27 GHz to 32 GHz		−18		dB

ABSOLUTE MAXIMUM RATINGS

Table 2. Absolute Maximum Ratings

Parameter	Rating
Maximum. Input Power (Any Port)	24 dBm
Maximum Total Power (S1 Port)	30 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 ADAR5000

Table 3. ADAR5000, 20-Ball WLCSP

ESD Model	Withstand Threshold (V)	Class
HBM	1000	1C

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

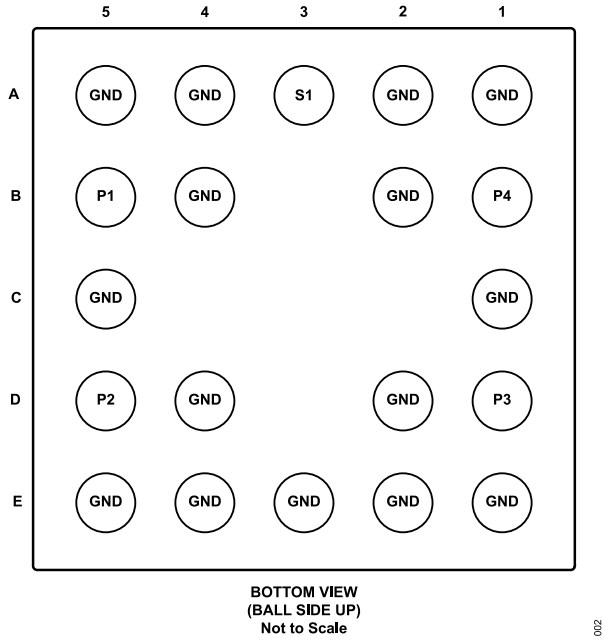

Figure 2. Pin Configuration (Bottom View)

Table 4. Pin Function Descriptions

Pin No.	Mnemonic	Description
A1, A2, A4, A5, B2, B4, C1, C5, D2, D4, E1 to E5	GND	Ground. Connect to a low impedance ground plane on the printed circuit board (PCB).
A3	S1	Sum and/or Split. The input port when the device is used as a splitter, and the output port when the devices is used as a combiner. S1 is AC-coupled in the signal path but has a DC path to ground.
B1	P4	Port 4. The RF output when the device is used as a splitter, and the RF input when the device is used as a combiner. P4 has a DC path to ground.
B5	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.
D5	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.
D1	P3	Port 3. The RF output when the device is used as a splitter, and the RF input when the device is used as a combiner. P3 has a DC path to ground.

INTERFACE SCHEMATICS

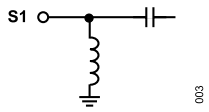

Figure 3. S1 Interface Schematic

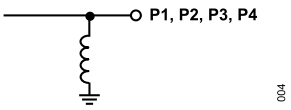

Figure 4. P1, P2, P3, and P4 Interface Schematic

TYPICAL PERFORMANCE CHARACTERISTICS

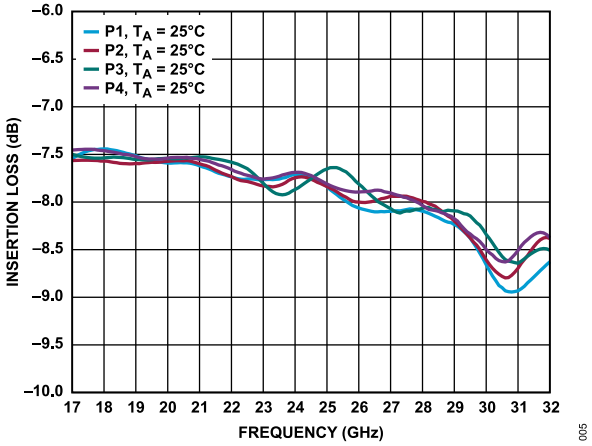

Figure 5. Insertion Loss vs. Frequency

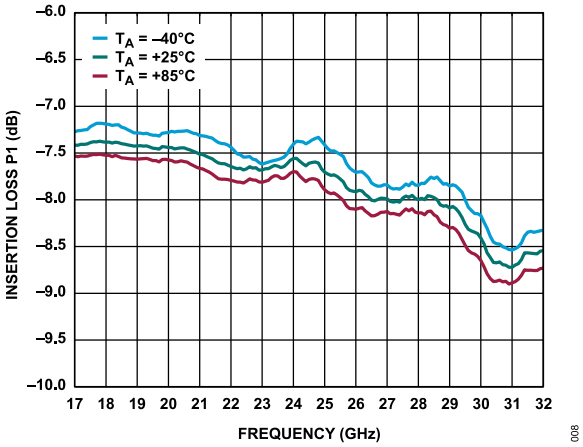

Figure 8. Insertion Loss P1 vs. Frequency over Temperature

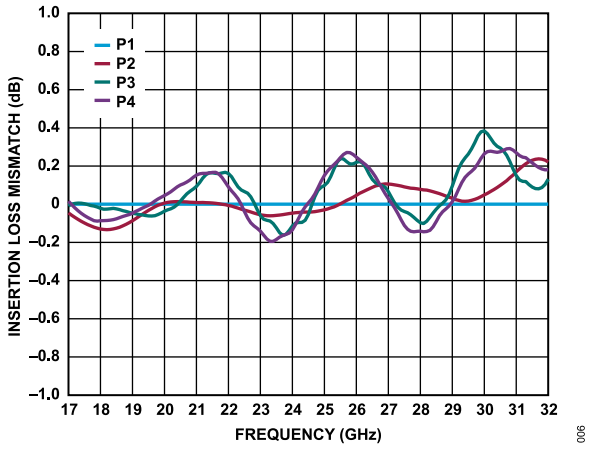

Figure 6. Insertion Loss Mismatch vs. Frequency, All Paths Normalized to P1

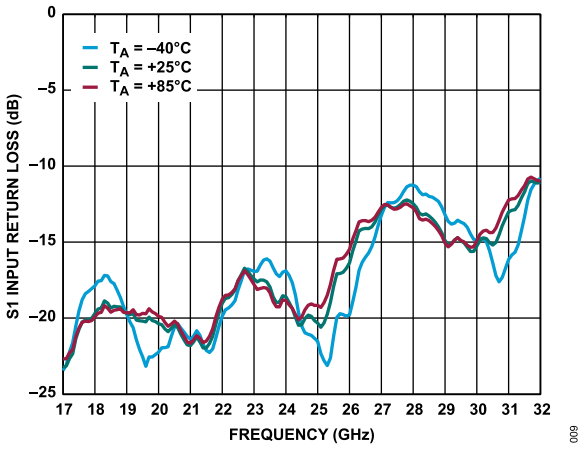

Figure 9. S1 Input Return Loss vs. Frequency over Temperature

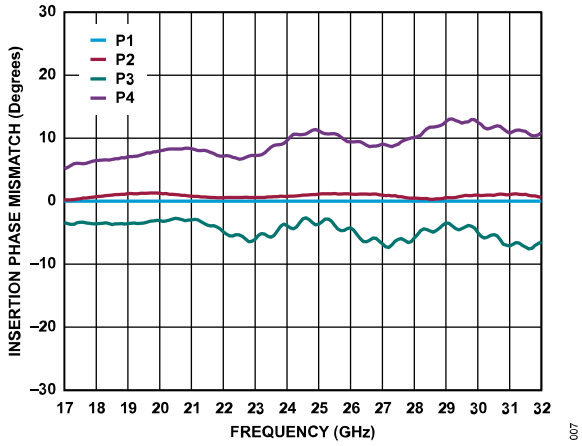

Figure 7. Insertion Phase Mismatch vs. Frequency, All Paths Normalized to P1

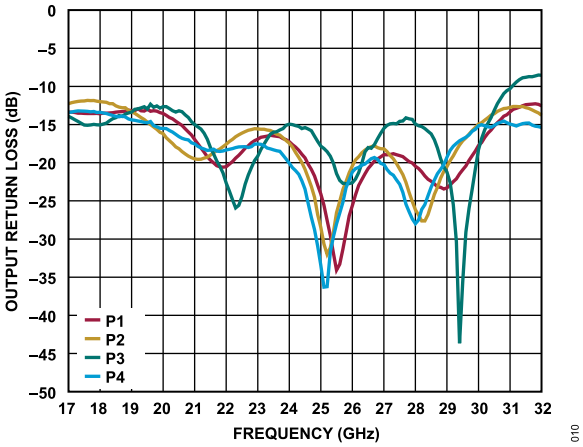

Figure 10. Output Return Loss vs. Frequency (P1, P2, P3, and P4)

TYPICAL PERFORMANCE CHARACTERISTICS

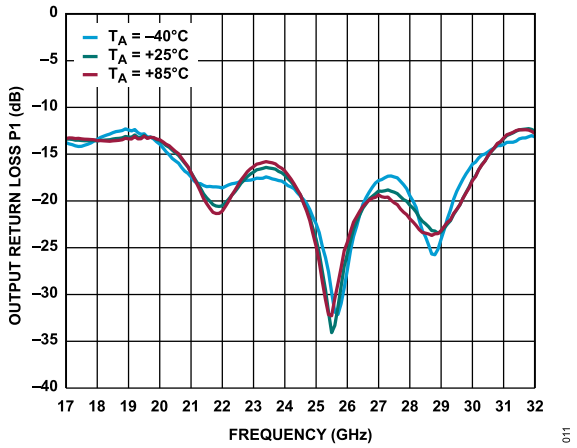

Figure 11. Output Return Loss P1 vs. Frequency over Temperature

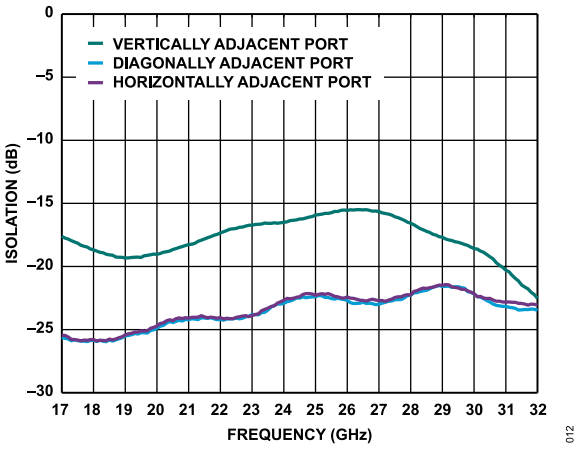

Figure 12. Isolation vs. Frequency

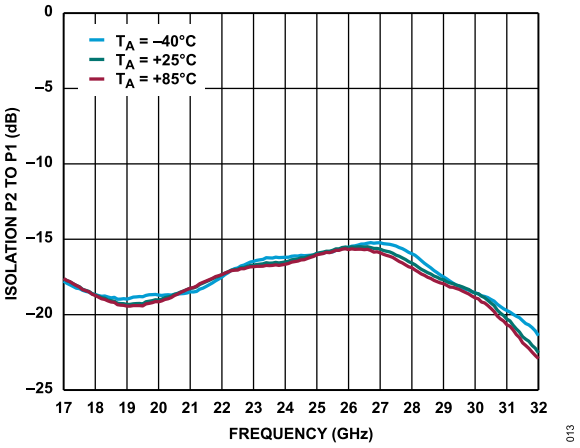

Figure 13. Isolation P2 to P1 vs. Frequency over Temperature

THEORY OF OPERATION

The ADAR5000 is a 1-to-4 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, P2, P3, and P4 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.

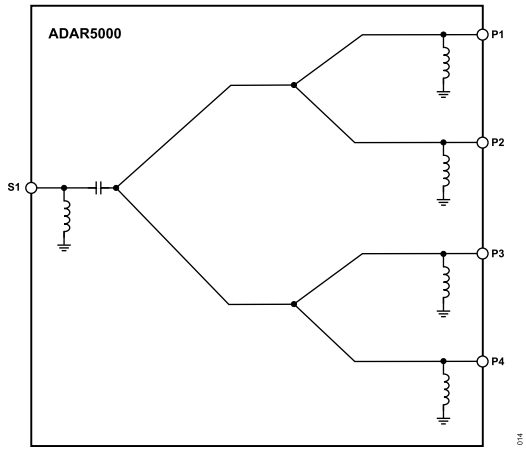

Figure 14. ADAR5000 Simplified Block Diagram

OUTLINE DIMENSIONS

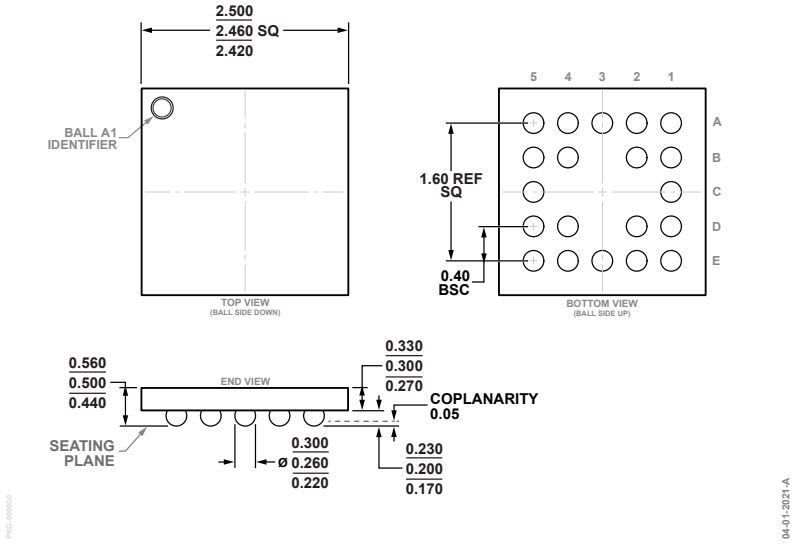

Figure 15. 20-Ball Wafer Level Chip Scale Package [WLCSP]
(CB-20-17)
Dimensions shown in millimeters

Updated: February 17, 2023

ORDERING GUIDE

Model[1]	Temperature Range	Package Description	Packing Quantity	Package Option
ADAR5000ACBZ	-40°C to +85°C	20-Ball Wafer Level Chip Scale Package [WLCSP]	Reel, 1	CB-20-17
ADAR5000ACBZ-R7	-40°C to +85°C	20-Ball Wafer Level Chip Scale Package [WLCSP]	Reel, 1500	CB-20-17

[1] Z = RoHS Compliant Part.

EVALUATION BOARDS

Table 5. Evaluation Boards

Model[1]	Description
ADAR5000-EVALZ	Evaluation Board

[1] Z = RoHS Compliant Part.