Evaluation of the ADRF5203 DC to 12GHz, Differential, Nonreflective, Silicon SPDT Switch

FEATURES

- Full-featured evaluation board for the ADRF5203
- Easy connection to the test equipment
- Thru line for calibration

EQUIPMENT NEEDED

- DC power supplies
- Network analyzer

GENERAL DESCRIPTION

The ADRF5203 is a differential SPDT switch with DC input range ±8V manufactured in the silicon process.

This user guide describes the ADRF5203-EVALZ evaluation board, designed to evaluate the features and performance of the ADRF5203. Figure 1 shows a photograph of the evaluation board.

Full specifications on the ADRF5203 are available in the ADRF5203 data sheet from Analog Devices, Inc. Consult the data sheet with this user guide when using the ADRF5203-EVALZ evaluation board.

ADRF5203-EVALZ EVALUATION BOARD PHOTOGRAPH

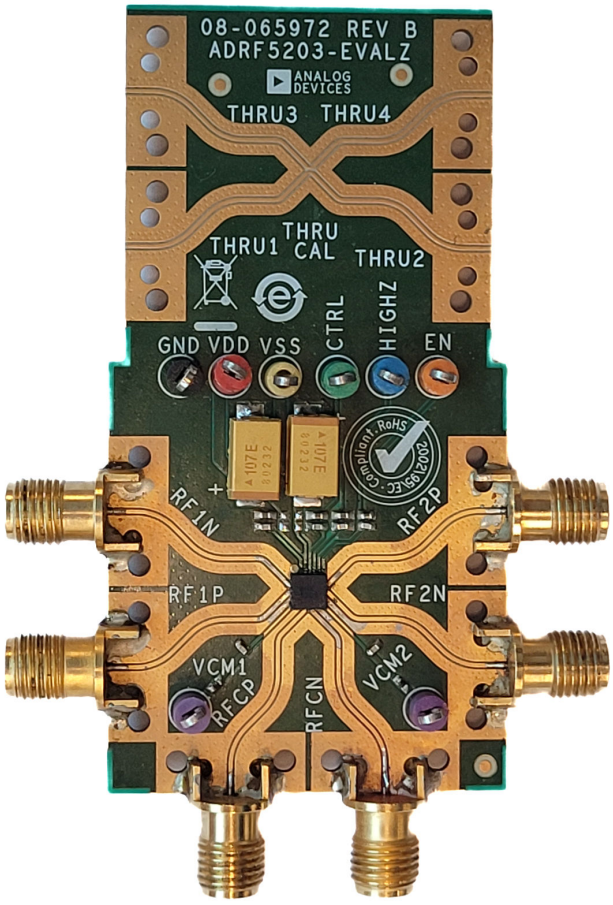

Figure 1. ADRF5203-EVALZ Evaluation Board Photograph

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REVISION HISTORY

10/2025—Revision 0: Initial Version

EVALUATION BOARD HARDWARE

OVERVIEW

The ADRF5203-EVALZ is a connectorized board, assembled with the ADRF5203 and its application circuitry. All components are placed on the primary side of the ADRF5203-EVALZ. An assembly drawing for the ADRF5203-EVALZ is shown in Figure 6, and an evaluation board schematic is shown in Figure 5.

BOARD LAYOUT

The ADRF5203-EVALZ is designed using RF circuit design techniques on a 4-layer printed circuit board (PCB). The PCB stack-up is shown in Figure 2.

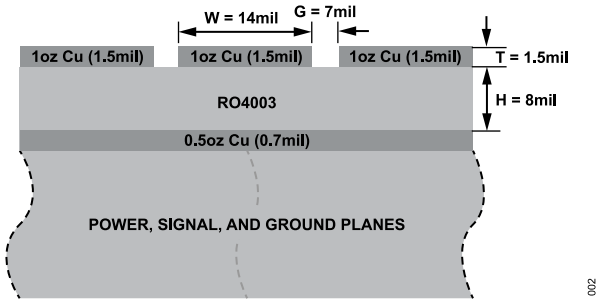

Figure 2. Evaluation Board Stack-Up

The outer copper layers are 1.5mil thick, and the inner layers are 0.7mil thick.

All RF and DC traces are routed on the top copper layer, whereas the inner and bottom layers are grounded planes that provide a solid ground for the RF transmission lines. The top dielectric material is 8mil Rogers RO4003, offering optimal high-frequency performance. The middle and bottom dielectric materials provide mechanical strength. The total board thickness is 62mil, which allows edge launch RF connectors to be placed at the board edges.

The RF transmission lines are designed using a coplanar waveguide (CPWG) model with a width of 14mil and a ground spacing of 7mil to have a single-ended characteristic impedance of 50Ω. Ground via fences are arranged on both sides of the CPWG to improve isolation between nearby RF lines and other signal lines.

The exposed ground pad of the ADRF5203, which is soldered on the PCB ground pad, is the main thermal conduit for heat dissipation. The PCB ground pad is densely populated with filled, through vias to provide the lowest possible thermal resistance path from the top to the bottom of the PCB. The connections from the package ground leads to ground are kept as short as possible.

POWER SUPPLY AND CONTROL INPUTS

The ADRF5203-EVALZ has two power-supply inputs, three digital control inputs, and a ground, as shown in Table 1. The DC test points are populated on VDD, VSS, CTRL, EN and HIGHZ. The ground reference must be connected to GND. A 12V supply is connected to the DC test points on VDD, and a −12V supply is connected to the DC test points on VSS. Connect CTRL, EN and HIGHZ to 3.3V or 0V. The typical supply current consumption for the ADRF5203 is +19mA from VDD and −18mA from VSS.

The VDD and VSS supply pins of the ADRF5203 are decoupled with 100µF capacitors.

Table 1. Power-Supply and Control Inputs

Test Points	Description
VDD	Positive supply voltage
VSS	Negative supply voltage
CTRL	Control input voltage
EN	Enable input voltage
HIGHZ	High-Z control voltage
GND	Ground

EVALUATION BOARD HARDWARE

RF INPUTS AND OUTPUTS

The ADRF5203-EVALZ has 10 edge-mounted, 2.92mm connectors for the RF inputs and outputs, as shown in Table 2.

Table 2. RF Inputs and Outputs

2.92mm Connectors	Description
RFCP	RF common positive port
RFCN	RF common negative port
RF1P	RF Throw 1 positive port
RF1N	RF Throw 1 negative port
RF2P	RF Throw 2 positive port
RF2N	RF Throw 2 negative port
THRU1	Thru line input and output
THRU2	Thru line input and output
THRU3	Thru line input and output
THRU4	Thru line input and output

The through calibration line, connecting the THRU1, THRU2, THRU3, and THRU4 RF connectors, calibrates out the board loss effects from the measurement of the ADRF5203-EVALZ to determine the device performance at the pins of the IC. Figure 3 shows the typical board loss for the ADRF5203-EVALZ at room temperature, as well as the embedded and de-embedded insertion loss for the ADRF5203.

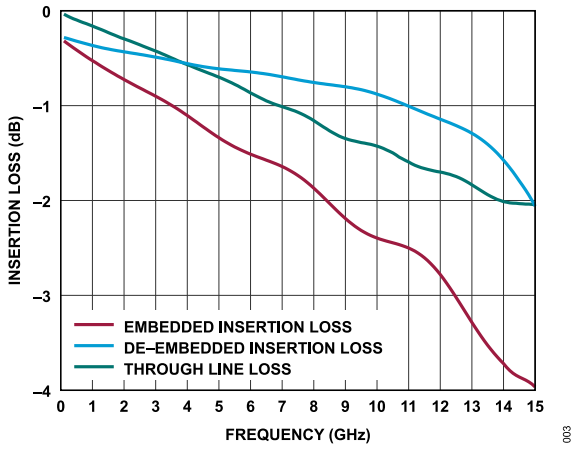

Figure 3. Insertion Loss vs. Frequency

TEST PROCEDURE

BIASING SEQUENCE

To bias up the ADRF5203-EVALZ, perform the following steps:

1. Ground the GND test point.
2. Bias up the VDD test point.
3. Bias up the VSS test point
4. Bias up the CTRL, EN, and HIGHZ test points.
5. Apply the RF input signal.

The ADRF5203-EVALZ is shipped fully assembled and tested. Figure 4 provides a basic test setup diagram to evaluate the s-parameters using a network analyzer. Perform the following steps to complete the test setup and to verify the operation of the ADRF5203-EVALZ:

1. Connect the GND test point to the ground terminal of the power supply.
2. Connect the VDD test point to the voltage-output terminal of the +12V DC power supply.
3. Connect the VSS test point to the voltage-output terminal of the −12V DC power supply.
4. Connect the CTRL, EN, and HIGHZ test points to the voltage-output terminal of the 3.3V DC power supply. The ADRF5203 can be configured in different modes by connecting the CTRL test point to 3.3V or 0V, as shown in Table 3.
5. Connect a calibrated network analyzer to the RFCP, RFCN, RF1P, RF1N, RF2P, and RF2N 2.92mm connectors. If the network analyzer port count is not enough, terminate unused RF ports with 50Ω. Sweep the frequency from 10MHz to 15GHz and set the power to –10dBm.

Additional test equipment is required to fully evaluate the functions and performance of the ADRF5203.

For third-order intercept point evaluation, use two signal generators and a spectrum analyzer. A high-isolation balun power combiner is also recommended.

For power compression evaluation and power handling evaluation, use a 2-channel power meter and a signal generator. A high enough power amplifier is also recommended at the input. Test accessories, such as baluns, couplers, and attenuators, must have enough power handling.

Note that the measurements performed at the 2.92mm connectors of the ADRF5203-EVALZ include the losses of the 2.92mm connectors and the PCB. The thru line must be measured to calibrate out the effects on the ADRF5203-EVALZ. The thru line is the summation of an RF input line and an RF output line that are connected to the ADRF5203-EVALZ and equal in length.

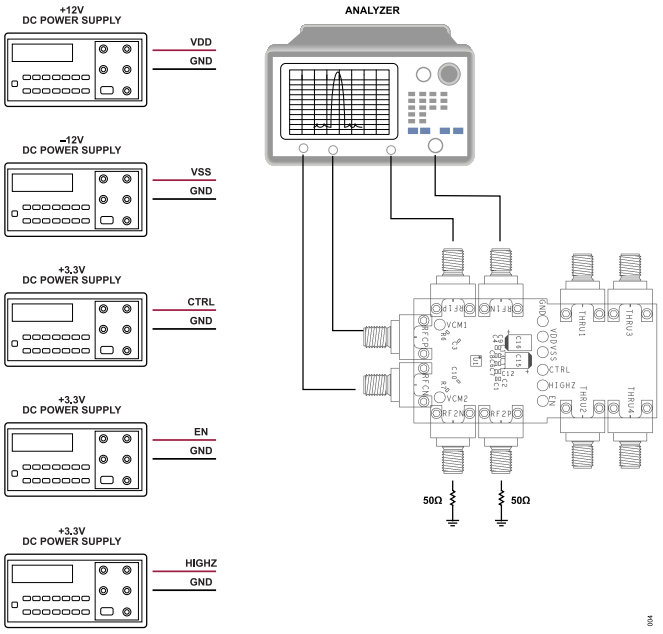

Figure 4. Test Setup Diagram

Table 3. Control Voltage Truth Table

Digital Control Inputs		RF Paths[1]	
EN	**CTRL**	**RF1 to RFC**	**RF2 to RFC**
Low	Low	Isolation (off)	Insertion loss (on)
Low	High	Insertion loss (on)	Isolation (off)
High	Low	Isolation (off)	Isolation (off)
High	High	Isolation (off)	Isolation (off)

[1] RF1 refers to the RF1P and RF1N differential pair, RF2 refers to the RF2P and RF2N differential pair, and RFC refers to the RFCP and RFCN differential pair.

EVALUATION BOARD SCHEMATIC AND ASSEMBLY DIAGRAM

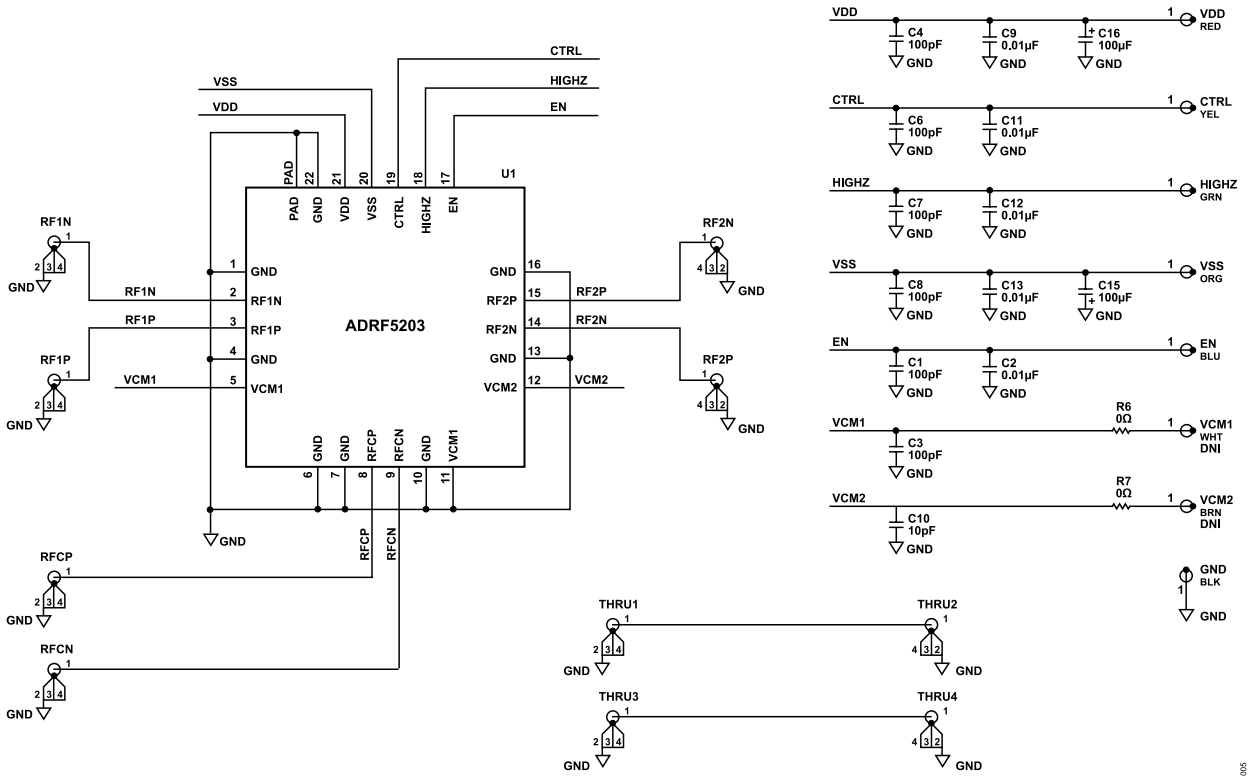

Figure 5. ADRF5203-EVALZ Evaluation Board Schematic

EVALUATION BOARD SCHEMATIC AND ASSEMBLY DIAGRAM

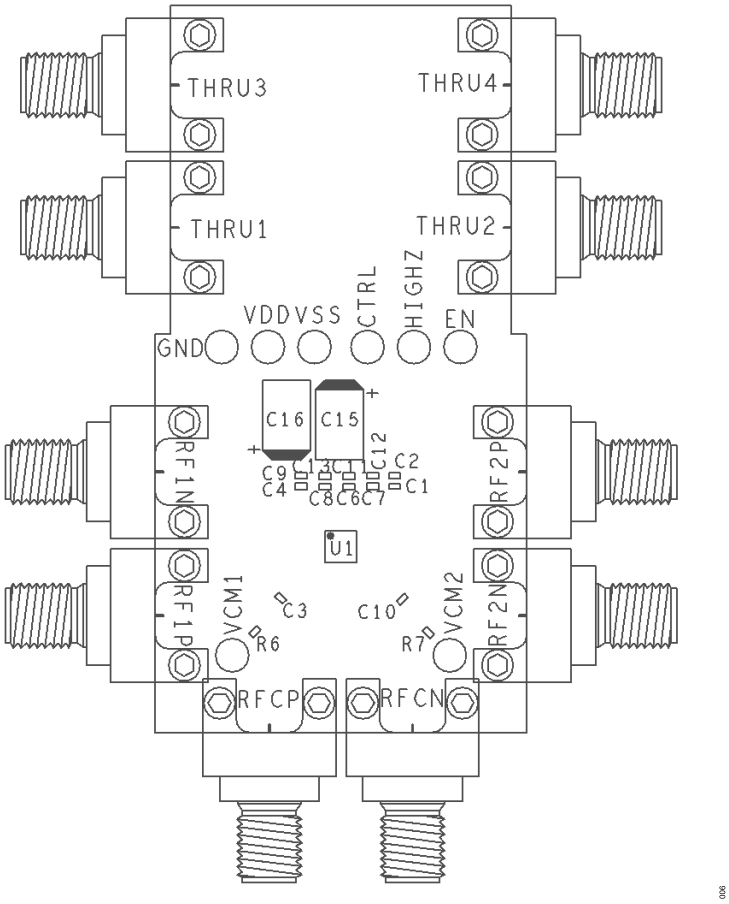

Figure 6. ADRF5203-EVALZ Evaluation Board Assembly Diagram

ORDERING INFORMATION

EVALUATION BOARDS

Table 4. Evaluation Boards

Model[1]	Description
ADRF5203-EVALZ	Evaluation Board

[1] Z = RoHS-Compliant Part.

BILL OF MATERIALS

Table 5. Bill of Materials for ADRF5203-EVALZ

Quantity	Reference Designator	Description	Manufacturer	Part Number
2	R6, R7	0Ω resistors, surface-mounted device (SMD), jumper, 1/10W, 0402, AEC-Q200	Panasonic	ERJ-2GE0R00X
5	C1, C4, C6, C7, C8	100pF ceramic capacitors, 50V, 5%, C0G, 0402, AEC-Q200	Murata	GCM1555C1H101JA16D
5	C2, C9, C11, C12, C13	0.01µF ceramic capacitors, 50V, 10%, X7R, 0402, AEC-Q200	Murata	GCM155R71H103KA55D
2	C3, C10	10pF ceramic capacitors, 50V, 5%, C0G, 0402	Yageo	CC0402JRNPO9BN100
2	C15, C16	100µF tantalum capacitors, 25V, 20%, 7343-43, 0.3Ω	Avx	TAJE107M025RNJ
4	CTRL, EN, HIGHZ, VCM1, VCM2, VDD, VSS, GND	Connector, PCB test points	Components Corporation	TP104-01-xx
6	RFCP, RFCN, RF1P, RF1N, RF2P, RF2N	Edge-mount 2.92mm connectors	SRI Connector Gage Co.	25-146-1000-92
1	U1	DC to 12GHz, differential,nonreflective, silicon SPDT switch	Analog Devices, Inc	ADRF5203BCPZN
1	PCB	ADRF5203-EVALZ	Analog Devices	BR-065972
4	THRU1, THRU2, THRU3, THRU4	Edge-mount 2.92mm connectors, do not install (DNI)	SRI Connector Gage Co.	25-146-1000-92

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.