

Evaluating the **ADRF5740** 2 dB LSB, 4-Bit, Silicon Digital Attenuator, 10 MHz to 60 GHz

FEATURES

Contains **ADRF5740** device and external components
 RF connectors
 Simple connection to test equipment
 Through line for calibration

EQUIPMENT NEEDED

DC power supply
 Network analyzer

GENERAL DESCRIPTION

The ADRF5740-EVALZ-185 and the ADRF5740-EVALZ-292 are designed to evaluate the features and performance of the **ADRF5740** 10 MHz to 60 GHz, 4-bit digital attenuator manufactured in a silicon process. The ADRF5740-EVALZ-292 is populated with 2.92 mm RF connectors, whereas the ADRF5740-EVALZ-185 (see Figure 1) is populated with 1.85 mm RF connectors.

For full details on the **ADRF5740**, see the **ADRF5740** data sheet, which must be consulted in conjunction with this user guide when using the ADRF5740-EVALZ-185 or the ADRF5740-EVALZ-292.

EVALUATION BOARD PHOTOGRAPH

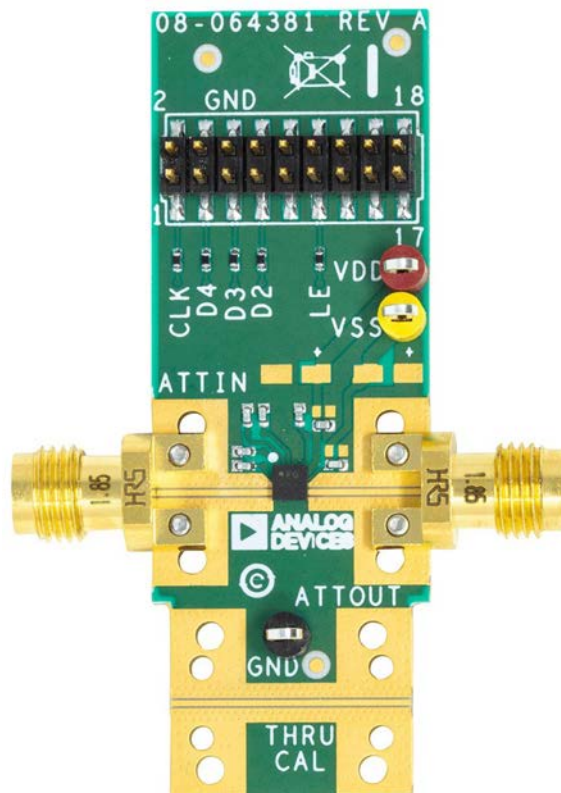


Figure 1. ADRF5740-EVALZ-185

24213-001

TABLE OF CONTENTS

Features	1	RF Inputs and Outputs	3
Equipment Needed.....	1	Power Supply and Control Inputs.....	3
General Description	1	Using the ADRF5740-EVALZ-185 and ADRF5740-EVALZ-292	4
Evaluation Board Photograph.....	1	Evaluation Board Schematic and Artwork.....	5
Revision History	2	Ordering Information.....	6
Evaluation Board Hardware	3	Bill of Materials.....	6
Overview.....	3		
Board Layout.....	3		

REVISION HISTORY

6/2020—Revision 0: Initial Version

EVALUATION BOARD HARDWARE

OVERVIEW

The ADRF5740-EVALZ-185 and the ADRF5740-EVALZ-292 are connectorized evaluation boards assembled with the [ADRF5740](#) and the required application circuitry. All components are located on the primary side of the ADRF5740-EVALZ-185 and the ADRF5740-EVALZ-292 (see Figure 2).

BOARD LAYOUT

Figure 2 shows the topside ADRF5740-EVALZ-185 and ADRF5740-EVALZ-292 layout and component placement locations.

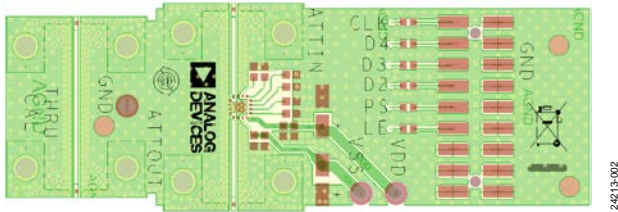


Figure 2. ADRF5740-EVALZ-185 and ADRF5740-EVALZ-292 Layout, Top View

RF INPUTS AND OUTPUTS

The RF input and output ports (ATTIN and ATTOUT) are connected through 50 Ω transmission lines to the 2.92 mm or 1.85 mm RF connectors, J1 and J2, respectively. These high frequency RF launchers are connected by contact and are not soldered onto the board.

The ADRF5740-EVALZ-292 is populated with 2.92 mm RF connectors and is recommended for use up to 40 GHz. The ADRF5740-EVALZ-185 is populated with 1.85 mm RF connectors and is recommended for use up to 67 GHz.

A through calibration line, THRU CAL, connects the unpopulated J3 and J4 launchers. This transmission line estimates the loss of the printed circuit board (PCB) over the environmental conditions being evaluated. The through calibration line calibrates out the

board loss effects from the ADRF5740-EVALZ-185 and the ADRF5740-EVALZ-292 measurements to determine the device performance at the pins of the IC. Figure 3 shows the through calibration line loss and embedded insertion loss for the ADRF5740-EVALZ-185 and the ADRF5740-EVALZ-292 at room temperature, as well as the de-embedded insertion loss for the [ADRF5740](#).

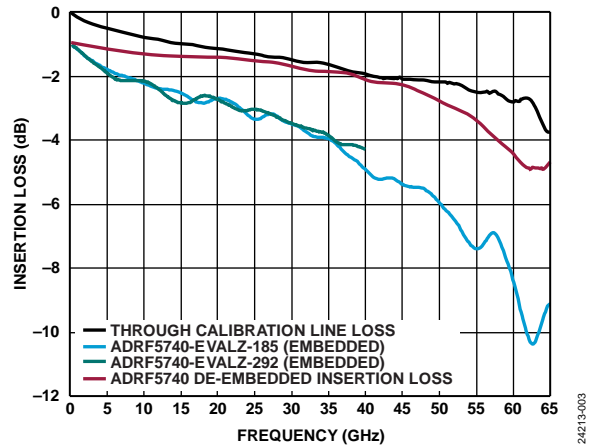


Figure 3. Insertion Loss vs. Frequency

POWER SUPPLY AND CONTROL INPUTS

Two power supply ports are connected to the VDD and VSS test points, TP1 and TP2, on the ADRF5740-EVALZ-185 and the ADRF5740-EVALZ-292, and the ground reference is connected to the GND test point, TP4. On the VDD and VSS supply traces, use a 100 pF bypass capacitor to filter high frequency noise. Unpopulated component positions are available for applying extra bypass capacitors.

All of the digital control pins are connected through digital signal traces to the 18-pin header, P1. There are provisions for an RC filter to eliminate dc-coupled noise. The [ADRF5740](#) was evaluated with 0 Ω series resistors and 100 pF shunt capacitors.

USING THE ADRF5740-EVALZ-185 AND ADRF5740-EVALZ-292

The ADRF5740-EVALZ-185 and the ADRF5740-EVALZ-292 are shipped assembled and tested. Figure 4 provides a basic test setup diagram for the ADRF5740-EVALZ-185 to measure the scattering parameter response of the ADRF5740 in direct parallel mode. To complete the test setup and verify the operation of the ADRF5740-EVALZ-185 or the ADRF5740-EVALZ-292, take the following steps:

1. Connect the GND test point to the ground terminal of the power supply.
2. Connect the VDD and VSS test points to the voltage output terminal of the power supplies. See Table 2 for the power supply connections.
3. Connect the D2, D3, D4, D5, and LE header pins to the power supplies. See Table 2 for the power supply connections.
4. Connect the ATTIN and ATTOUT ports to a calibrated network analyzer.
5. Turn on the VDD and VSS power supplies connected to the ADRF5740-EVALZ-185 or the ADRF5740-EVALZ-292. See Table 2 for the nominal voltage and current conditions.
6. Turn on the D2, D3, D4, D5, and LE power supplies. Use D2 to D5 to control the state of the attenuator. See Table 1 for the control voltage truth table.
7. Measure the scattering parameters.

Table 1. Control Voltage Truth Table

Digital Control Input (V)				Attenuation State (dB)
D5	D4	D3	D2	
0	0	0	0	0 (reference)
0	0	0	3.3	2
0	0	3.3	0	4
0	0	3.3	3.3	6
0	3.3	0	0	8
0	3.3	0	3.3	10
0	3.3	3.3	0	12
0	3.3	3.3	3.3	14
3.3	3.3	0	0	16
3.3	3.3	0	3.3	18
3.3	3.3	3.3	0	20
3.3	3.3	3.3	3.3	22

Table 2. Power Supply and Digital Inputs

Test Points	Description	Nominal Voltage (V)	Nominal Current (µA)
TP1	VDD	3.3	2 to 52
TP2	VSS	-3.3	-110
TP4	AGND	Ground	Not applicable
P1	D2	0 or 3.3	-10 or <1
P1	D3	0 or 3.3	-10 or <1
P1	D4	0 or 3.3	-10 or <1
P1	D5	0 or 3.3	-10 or <1
P1	LE	3.3	<1

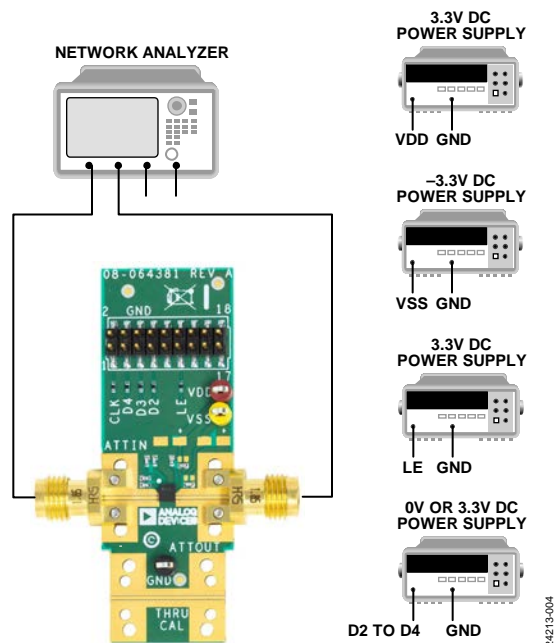


Figure 4. Scattering Parameter Test Setup Diagram for the ADRF5740-EVALZ-185

EVALUATION BOARD SCHEMATIC AND ARTWORK

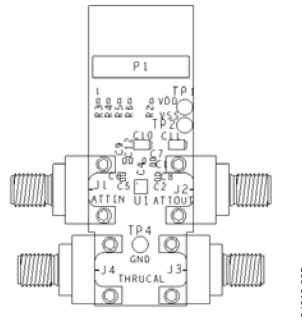


Figure 5. ADRF5740-EVALZ-185 and ADRF5740-EVALZ-292 Assembly Diagram

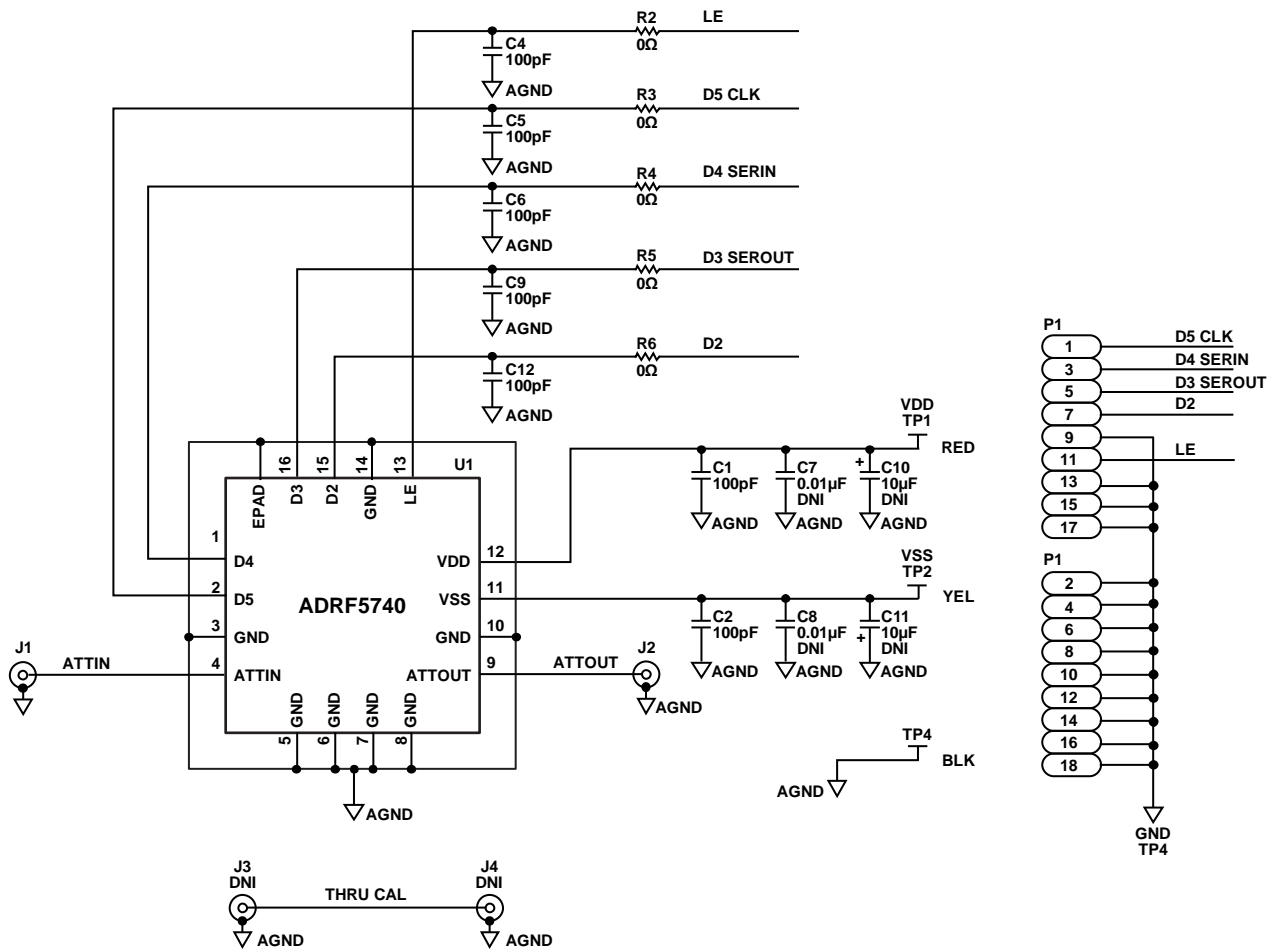


Figure 6. ADRF5740-EVALZ-185 and ADRF5740-EVALZ-292 Schematic

ORDERING INFORMATION

BILL OF MATERIALS

Table 3. Bill of Materials for ADRF5740-EVALZ-185 and ADRF5740-EVALZ-292

Qty	Reference Designator	Description	Manufacturer	Part Number
7	C1, C2, C4, C5, C6, C9, C12	Capacitors, 100 pF, 50 V, 0402 package	Murata	GCM1555C1H101FA16D
2	C7, C8	Capacitors, 0.01 μ F, 25 V, 0402 package (do not insert)	AVX	04023D103KAT2A
2	C10, C11	Capacitors, 10 μ F, 3216 package (do not insert)	AVX	TAJA106K010RNJ
1	P1	18-pin male header, double row	Molex	87759-1850
5	R2 to R6	Resistors, 0 Ω , 1/16 W, 0402 package	Yageo	RC0402JR-070RL
3	TP1, TP2, TP4	Through hole, hold mount test points	Components Corp.	TP-104-01-00
1	U1	Digital step attenuator (DSA) IC	Analog Devices, Inc.	ADRF5740
1	PCB	Evaluation PCB	Analog Devices, Inc.	BR-064381

Table 4. RF Connectors for ADRF5740-EVALZ-185

Qty	Reference Designator	Description	Manufacturer	Part Number
2	J1, J2	1.85 mm RF connectors	Hirose Electric Co.	HV-LR-SR2(12)
2	J3, J4	1.85 mm RF connectors (do not insert)	Hirose Electric Co.	HV-LR-SR2(12)

Table 5. RF Connectors for ADRF5740-EVALZ-292

Qty	Reference Designator	Description	Manufacturer	Part Number
2	J1, J2	2.92 mm RF connectors	Hirose Electric Co.	HK-LR-SR2(12)
2	J3, J4	2.92 mm RF connectors (do not insert)	Hirose Electric Co.	HK-LR-SR2(12)



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.

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