Evaluating the ADMV8809 0.5GHz to 9GHz, Digitally Tunable, High-Pass Filters and Low-Pass Filters

FEATURES

- Fully featured evaluation board for the ADMV8809
- On-board system demonstration platform (EVAL-SDP-CS1Z (SDP-S)) connector for SPI
- Evaluation using on-board LDO regulators power by the USB
- **ACE Software** interface for SPI control

EQUIPMENT NEEDED

- Network analyzer
- USB cable
- SDP-S controller board

DOCUMENTS NEEDED

- ADMV8809 data sheet

SOFTWARE NEEDED

- **ACE Software**

GENERAL DESCRIPTION

The ADMV8809-EVALZ is an evaluation board available for evaluating the ADMV8809 digitally tunable, high-pass filter and low-pass filter. The evaluation board incorporates the ADMV8809 chip, as well as a negative voltage generator, low dropout (LDO) regulators, and an interface to the SDP-S controller board to allow for simple and efficient evaluation. The negative voltage generator and LDO regulators allow the ADMV8809 to be powered by either the 5 V USB supply voltage from the PC via the SDP-S controller board or by using two external power supplies.

The ADMV8809 is an IC that features a digitally selectable, operating frequency. The chip can be programmed using a 4-wire serial port interface (SPI). The SDP-S controller board allows the user to interface with the ADMV8809 SPI through the Analog Devices, Inc., **Analysis, Control Evaluation (ACE) Software**.

For full details on the ADMV8809, see the ADMV8809 data sheet, which must be consulted in conjunction with this user guide when using the ADMV8809-EVALZ.

EVALUATION BOARD PHOTOGRAPH

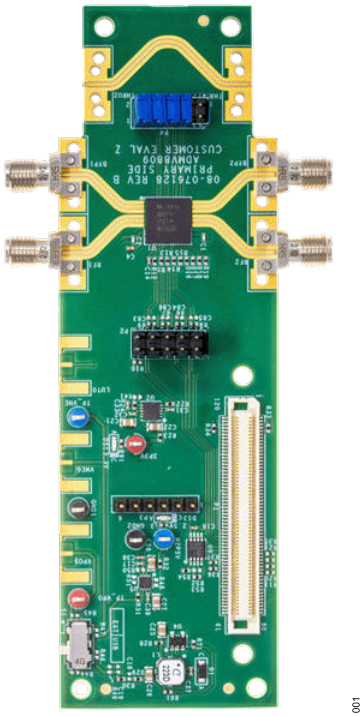

Figure 1. ADMV8809-EVALZ Evaluation Board Photograph

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REVISION HISTORY

10/2025—Revision 0: Initial Version

EVALUATION BOARD HARDWARE

The ADMV8809-EVALZ evaluation board has the ADMV8809 chip on-board. The evaluation board also includes a negative voltage generator and LDO regulators to provide the necessary supply voltages for the chip. The regulators can be entirely powered by the 5 V USB supply voltage from the PC via SDP-S controller board.

To power the ADMV8809-EVALZ by using the 5V USB supply, slide the S1 switch down (as shown in Figure 2) to power the on-board negative voltage generator and LDO regulators. Alternatively, the evaluation board can be powered externally by sliding the S1 switch up and then by connecting power supplies to the VPOS and VNEG Subminiature Version A (SMA) ports or test points. The applicable voltage range for the positive input VPOS is between +3.5V to +5.5V, and the applicable voltage range for the negative input VNEG is between −5.5V to −2.7V.

Figure 2 shows an example lab bench setup for the board. To observe the filter response from the ADMV8809-EVALZ, connect the RF1 and RF2 ports to a network analyzer (or similar instrument). Typically, these would be connected to ports 1 and 2 on the network analyzer, as shown in Figure 2.

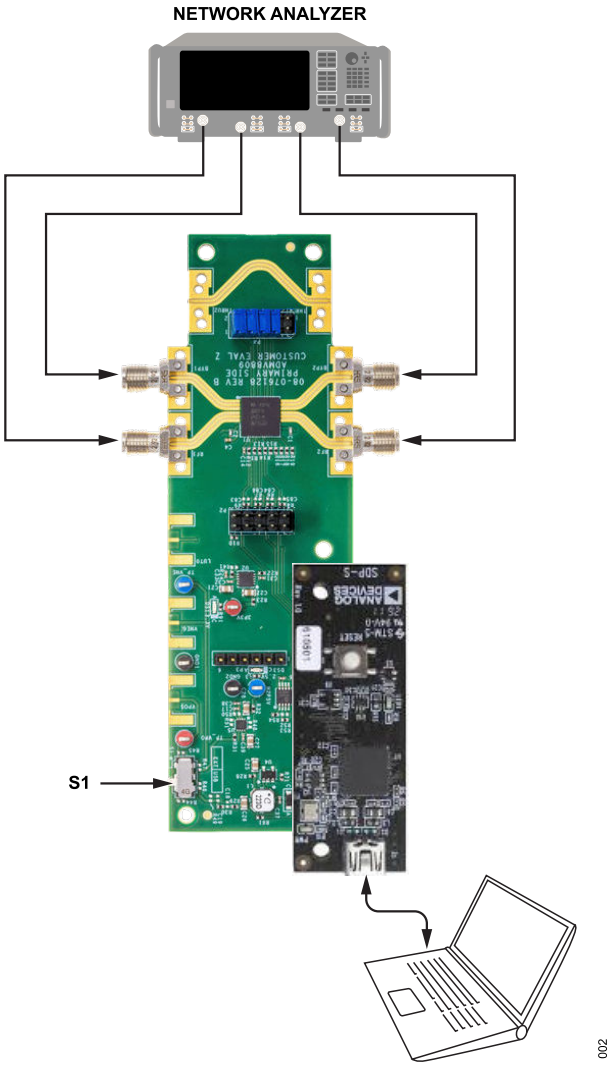

Figure 2. ADMV8809-EVALZ Lab Bench Setup

EVALUATION BOARD SOFTWARE

INSTALLING THE ACE SOFTWARE, ADMV8809 PLUG-INS, AND ADMV8809 DRIVERS

The ADMV8809-EVALZ uses the Analog Devices **ACE Software**. For instructions on how to install and use the **ACE Software**, go to www.analog.com/ACE.

If the **ACE Software** is already installed on the PC, ensure that the installed software is the latest version, as shown on the www.analog.com/ACE software page. If the previously installed **ACE Software** is not the latest version, take the following steps to install the updated **ACE Software**:

1. Uninstall the current version of the **ACE Software** on the PC.
2. Delete the ACE folder found at this path **C:\ProgramData\Analog Devices**.
3. Install the latest version of the **ACE Software** from the software web page. During installation, ensure that the **.Net 40 Client**, **SDP Drivers**, the **LRF Drivers** components are checked off as well (see Figure 3).

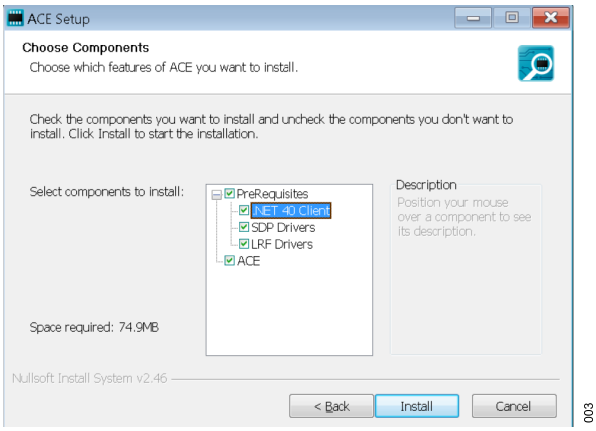

Figure 3. Required Driver Installations with the ACE Software

Once the installation is completed, the **ADMV8809 Board** plug-in appears when the **ACE Software** is opened (see Figure 4).

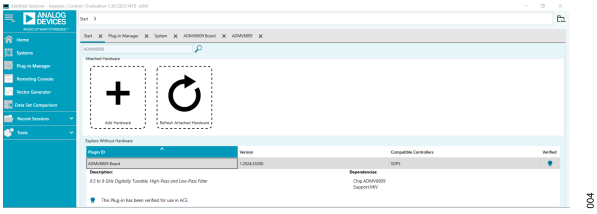

Figure 4. ADMV8809 Board Plug-In Window after Opening the ACE Software

BOARD PLUG-IN OVERVIEW

The **ADMV8809 Board** plug-in view (see Figure 5) includes the following items:

- The **Reset Board** button, which must be clicked for chip reset.
- The **ADMV8809** chip button, which opens the chip plug-in when clicked.

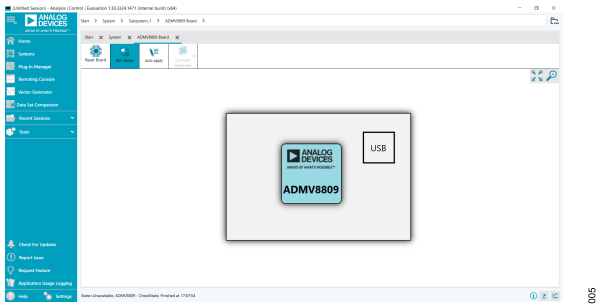

Figure 5. ADMV8809 Board Plug-In View

CHIP PLUG-IN OVERVIEW AND DETAILS

The **ADMV8809 Chip** plug-in view (see Figure 6) includes the following features (see Figure 7 for additional information on these items):

- An internal filter block diagram
- User controls for adjusting chip parameters
- A **Navigate to LUT Mode** button for using LUT mode

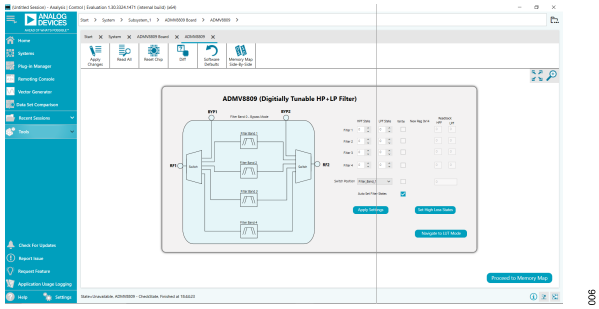

Figure 6. ADMV8809 Chip Plug-In

The full screen **ADMV8809 Chip** plug-in with labels is shown in Figure 7. These labels correspond to the items listed in Table 1, and this table describes the functionality of each section. For additional detailed programming, refer to the ADMV8809 data sheet.

EVALUATION BOARD SOFTWARE

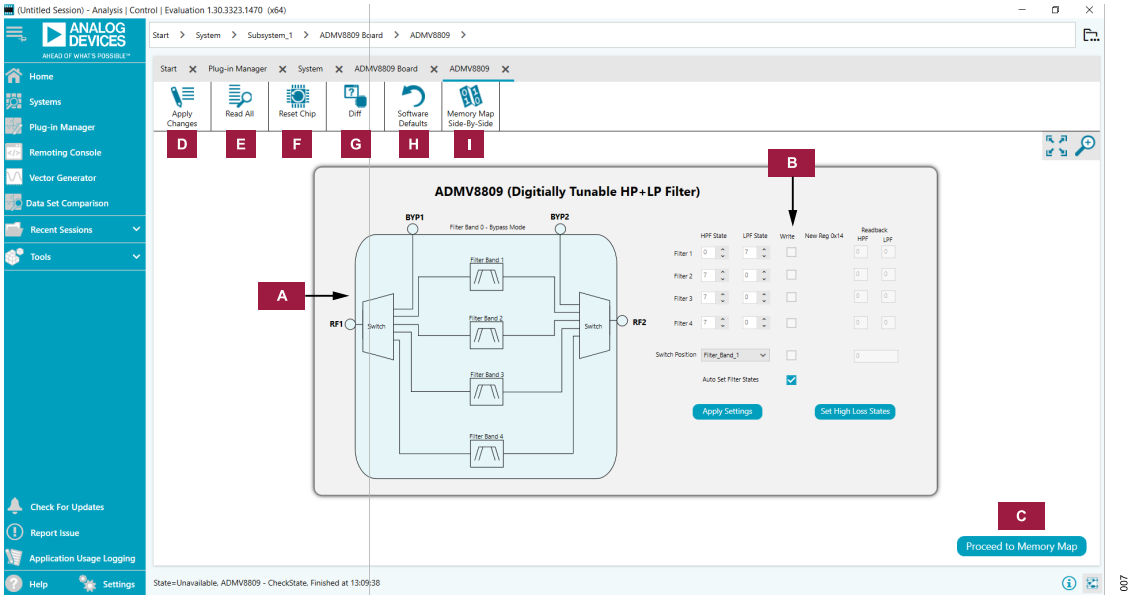

Figure 7. ADMV8809 Block Diagram with Labels

Table 1. ADMV8809 Block Diagram Label Functions (See Figure 7)

Label	Function
A	The **Displayed Block Diagram** section shows the block diagram for the ADMV8809.
B	In the **HPF State** section,: scroll up or scroll down using the dropdown menus to select the high-pass filter state from 0 to 7 for Filter 1 through Filter 4. In the **LPF State** section, scroll up or scroll down using the dropdown menu to select the low-pass filter state from 0 to 7 for Filter 1 through Filter 4. Select the **Write** check box to select which filter bands require updating of their states. In the **New Reg 0x14** section, it shows the hexadecimal value of Register 0x14 before it writes; you must check the **Write** check box to activate this feature. In the **Readback HPF** section and **Readback LPF section**, the readback state for the HPF and LPF is shown per filter band. Use the **Switch Position** dropdown menu to select the desired filter band. The filter operates in bypass mode when Filter Band 0 is selected. The box to the right of the **Switch Position** dropdown menu will show the readback state value for the switch. Select the **Auto Set Filter States** check box allows the unchecked filter bands to be set to isolation mode. See the ADMV8809 data sheet for additional details. Click **Set High Loss States** to set all the filter bands to isolation mode.
C	Click **Proceed to Memory Map** to open the ADMV8809 memory map (see Figure 8).
D	All changes, except within the **Configuration** section, will not take effect until **Apply Changes** is clicked. If **Auto Apply** is highlighted in the **ADMV8809 Board** tab, the **Apply Changes** feature continuously runs every few seconds, and **Apply Changes** does not have to be clicked to apply the block diagram settings.
E	To read back all the SPI registers of the ADMV8809 chip, click **Read All**.
F	Click **Reset Chip** to reset the ADMV8809 chip.
G	Click **Diff** to show registers that are different on the ADMV8809 chip.
H	Click **Software Defaults** to restore the software defaults to the ADMV8809 chip, and then click **Apply Changes**.
I	Click **Memory Map Side-By-Side** to enable the side-by-side memory map view.

EVALUATION BOARD SOFTWARE

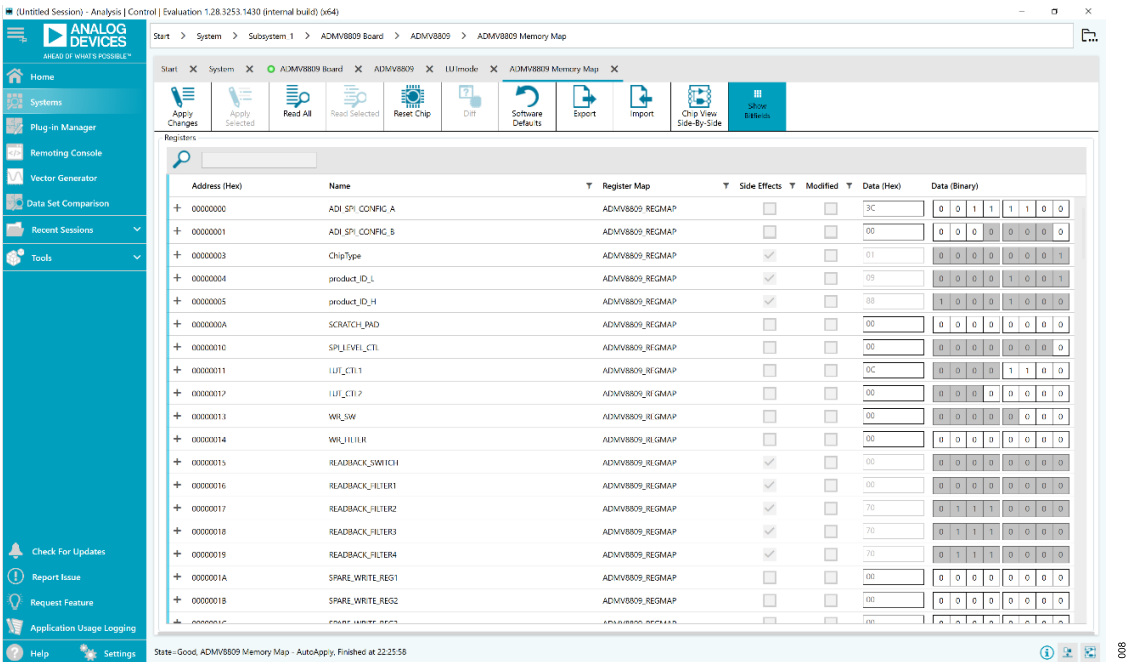

Figure 8. ADMV8809 Memory Map in the ACE Software

PERFORMING EVALUATION

ADMV8809-EVALZ QUICK START

To set up the ADMV8809-EVALZ evaluation board, take the following steps:

1. Connect the RF1 and RF2 ports to a network analyzer (or similar instrument). Typically, these ports are connected to Port 1 and Port 2 on the network analyzer, as shown in Figure 2.
2. Connect the SDP-S controller board to the 120-pin connector on the ADMV8809-EVALZ evaluation board. Leave the SDP-S unconnected to the PC until after completing Step 4 or Step 5.
3. Connect the DUT_ADD0, DUT_ADD1, DUT_ADD2, and DUT_ADD3 pins of P4 to GND. The DUT_ADDx pins must be set to Logic 0 to communicate by using the SDP-S controller board (see Figure 10).
4. On the evaluation boardADMV8809-EVALZ, slide the S1 switch down (as shown in Figure 2) to select powering the device using the 5 V USB supply voltage from the PC via the SDP-S controller board.
5. Alternatively to Step 4, slide the S1 switch up and connect the power supplies to the VPOS and VNEG ports. The applicable voltage range for VPOS is between +3.5V to +5.5V, and the applicable voltage range for VNEG is between −5.5V to −2.7V. The external supply current limits must be set to 20mA. The expected supply current drawn for VPOS is 12mA to 14mA and for VNEG is 2mA to 3mA. The ADMV8809 chip current drawn per supply pin is typically 10s of microamps or less. Most of the current drawn of the ADMV8809-EVALZ comes from the LDO regulators, and the status indicator light emitting diodes (LEDs), DS1 and DS3.
6. Connect a USB cable to the PC and then to the SDP-S controller board.
7. Open the **ACE Software**. The **ADMV8809 Board** appears in the **Attached Hardware** section (see Figure 5). Click **Auto Apply** at the top and double-click on the plug-in to see the ADMV8809 chip plug-in on screen.

NETWORK ANALYZER SETTINGS

When evaluating the ADMV8809-EVALZ evaluation board, a good starting point for configuring the network analyzer is as follows:

- The starting frequency = 0.100GHz
- The stop frequency = 40GHz
- The number of points = 400
- The step size = 100MHz
- The power level = −10dBm
- The measure types = the S-parameters (S21, S31, S42, S11, S22, S33, S44)
- The format = the log magnitude (S21, S31, S42) and phase (S11, S22, S33, S44)
- The calibration = full 2-port

AUTOMATIC CHIP RESET

If a reset of the ADMV8809 chip is required on the ADMV8809-EVALZ evaluation board, click **Reset Chip** (see Figure 7, Label F and Table 1 for additional information). This automated sequence performs the following actions:

- Toggles all SDP-S general-purpose input/output (GPIO) logic pins to a low state, which brings the $\overline{\text{RST}}$ pin low to initiates a hard reset of the ADMV8809.
- Toggles the **RST** pin high to bring the ADMV8809 chip back to the normal operating state.
- Programs Register 0x00 to 0x81, which also resets the ADMV8809. This step covers any legacy boards that did not have the $\overline{\text{RST}}$ pin connected.
- Programs Register 0x00 to 0x3C to enable the SDO pin on the ADMV8809 and to allow SPI streaming with Endian register ascending order.
- Reads back the register settings of the ADMV8809.

LOSS OF BOARD COMMUNICATION

When the ADMV8809 is turned off and then on, or if the USB cable is unplugged and plugged back in while the **ACE Software** is open, communication with the ADMV8809 may be lost. To regain communication, click the **System** tab, then click the USB symbol in the **SDP-S Controller** subsystem, and then click **Acquire**. If this step does not work, restart the **ACE Software** to reinitiate communication with the ADMV8809-EVALZ evaluation board.

REGULATOR BYPASS

The ADMV8809-EVALZ evaluation board has a negative voltage generator and two LDO regulators on-board that allow the user to operate by using the 5V USB supply voltage from the PC via the SDP-S controller board. The two on-board LDO regulators, U2 and U5, also provide the necessary supply voltages of +3.3V and −2.5V, respectively. If desired, these two LDO regulators can be bypassed by removing two 0Ω registers (R23 and R32) from the ADMV8809-EVALZ and then by injecting each voltage independently by using the corresponding test points. Bypassing the on-board regulators can be useful for measuring the ADMV8809 supply current; however, noted that each supply pin is also connected to a status indicator LED (DS1 or DS3), and each draws approximately 2mA of current. Remove the R3 and R91 resistors to disable these status indicators. See the Evaluation Board Schematics and Artwork section for further details.

ISOLATION MODE

Isolation mode is applied to unused filter bands by configuring these filter bands to a HPF State 7 and LPF State 0. This configuration ensures that unwanted signals are effectively blocked from passing through inactive filter paths

PERFORMING EVALUATION

PLUG-IN SPI REGISTER CONTROLLER

The **ADMV8809** plug-in utilizes a SPI register controller for communicating to the ADMV8809. When using the ADMV8809 in a system, it is recommended to follow a similar methodology for implementing SPI communication. The following is a summary of the customer register controller:

1. Determine if Register 0x00 is not set to 0x3C.
2. If Step 1 is true, then set Register 0x00 to 0x3C to enable the SDO pin on the ADMV8809 and to allow SPI streaming with Endian register ascending order.
3. Determine if the values have changed for any of the LUT controls (Register 0x11 and Register 0x12) and SPI write registers (Register 0x13 to Register 0x14).
4. If Step 3 is true, then write to Register 0x11 thru Register 0x14 by pointing to Register 0x11 and streaming out 4 bytes of data. The transaction will be 48 bits in total (R/W bit + two don't care + four address bits + nine register address bits + 32 data bits). Streaming out the data in this order ensures that the switch position priority is WR_SW to WR_FILTER.
5. If Step 4 has occurred, then write dummy data to Register 0x0A. This step is microcontroller architecture dependent and can be ignored in most cases. However, it is required for the SDP-S controller board to clear the SPI bus and reconfigure for standard 24-bit SPI transaction.
6. Determine if the values have changed for any of the lookup table (LUT) registers (Register 0x20 to Register 0x9F).
7. If Step 6 is true, then write to Register 0x20 through Register 0x9F by doing the following:
    a. Pointing to Register 0x20 and streaming out 64 bytes of data.
    b. Pointing to Register 0x60 and streaming out 64 bytes of data.
8. If Step 7 has occurred, then Step 5 is repeated.
9. Write out any remaining registers that may have changed.

EVALUATION BOARD SCHEMATICS AND ARTWORK

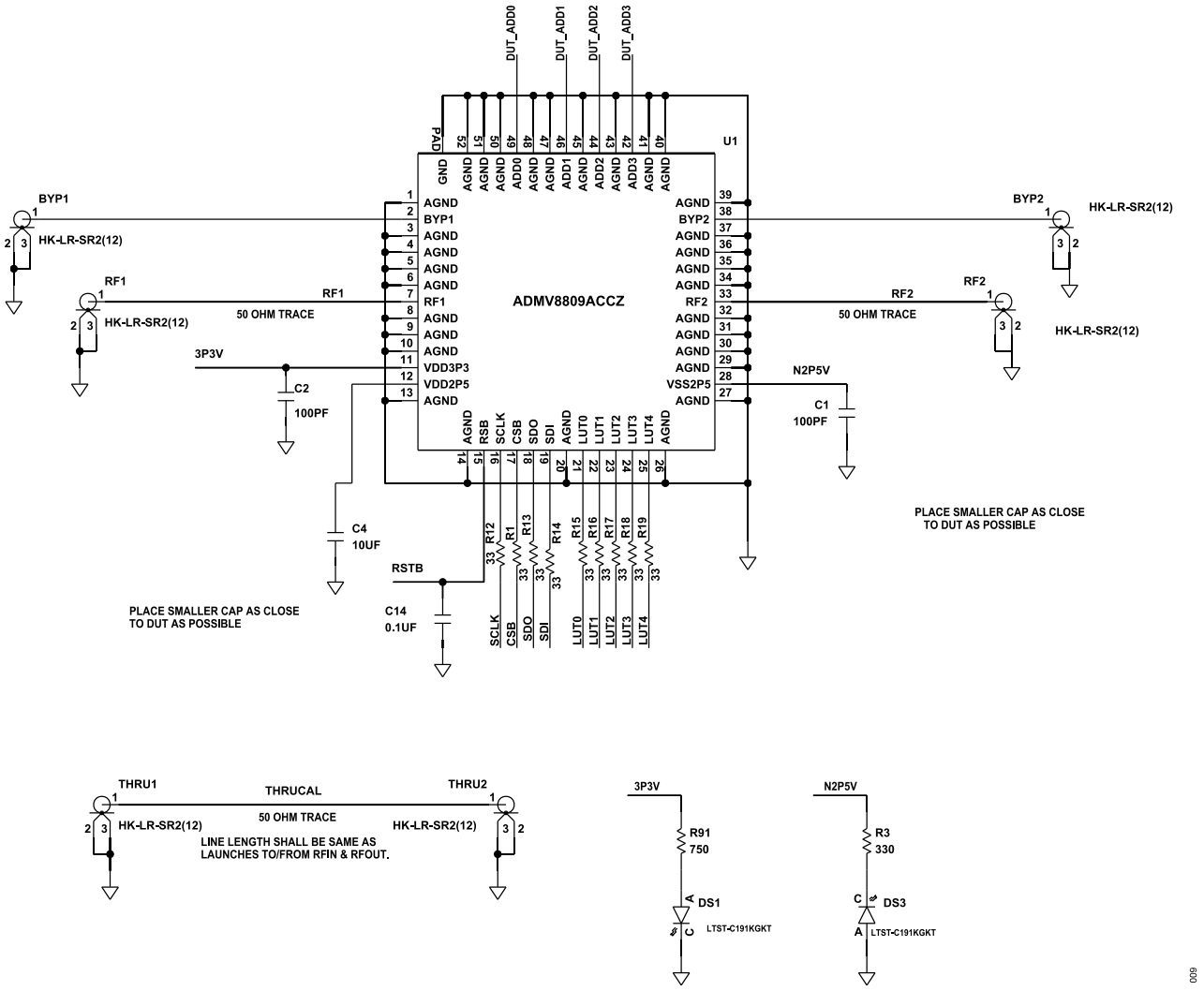

Figure 9. ADMV8809-EVALZ Evaluation Board Schematic, Page 1

EVALUATION BOARD SCHEMATICS AND ARTWORK

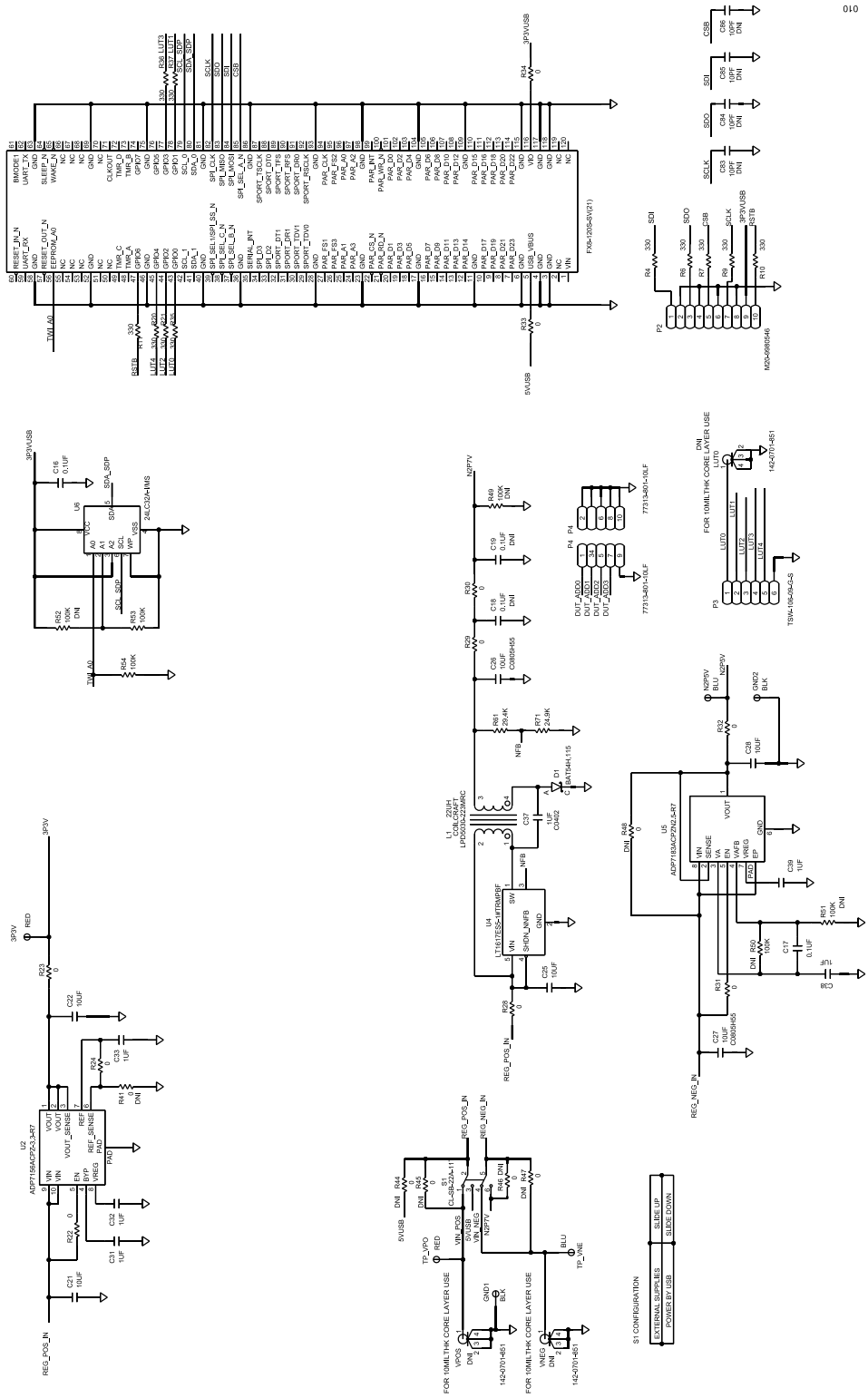

Figure 10. ADMV8809-EVALZ Evaluation Board Schematic, Page 2

EVALUATION BOARD SCHEMATICS AND ARTWORK

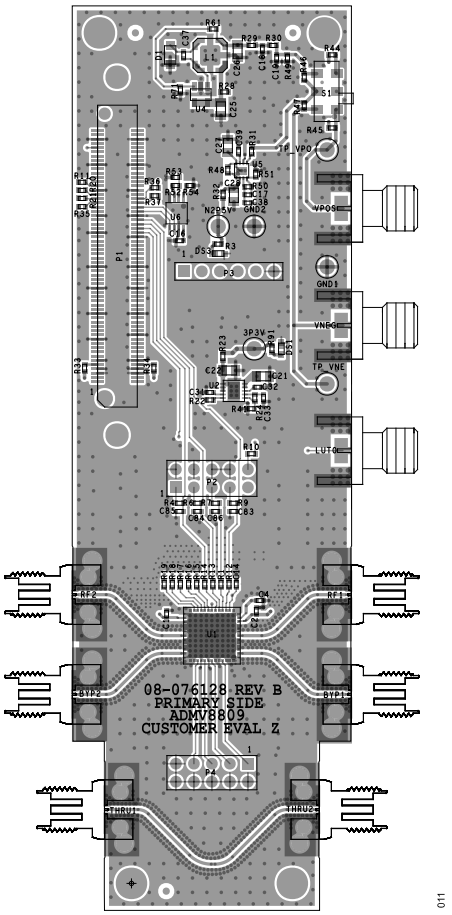

Figure 11. ADMV8809-EVALZ Evaluation Board Layer 1

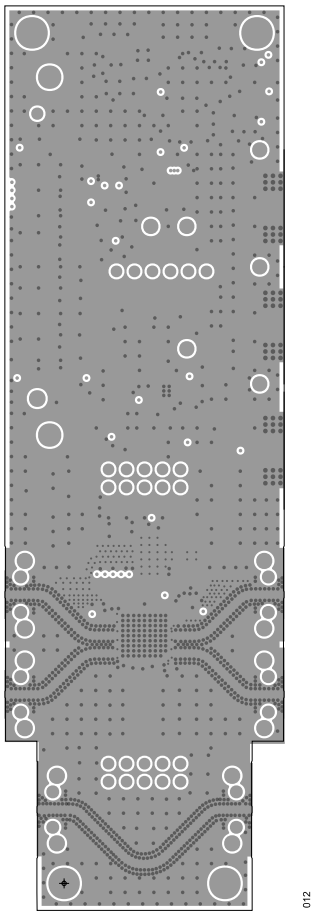

Figure 12. ADMV8809-EVALZ Evaluation Board Layer 2

EVALUATION BOARD SCHEMATICS AND ARTWORK

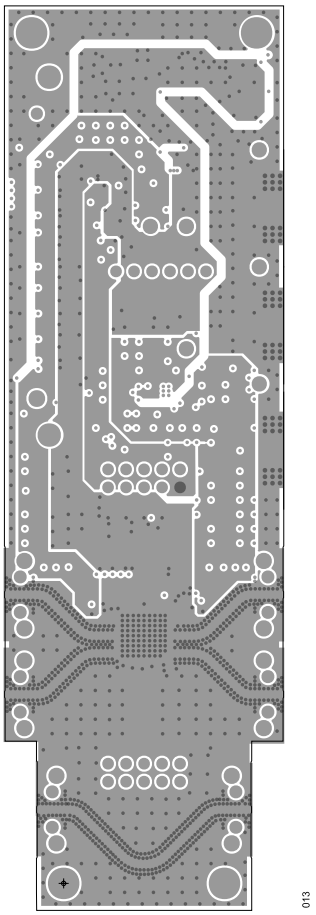

Figure 13. ADMV8809-EVALZ Evaluation Board Layer 3

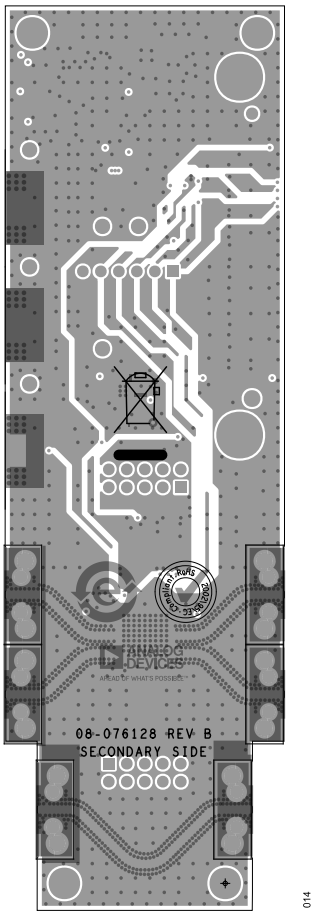

Figure 14. ADMV8809-EVALZ Evaluation Board Layer 4

ORDERING INFORMATION

EVALUATION BOARDS

Table 2. Evaluation Boards

Model[1]	Description
ADMV8809-EVALZ	Evaluation Board

[1] Z = RoHS-Compliant Part.

BILL OF MATERIALS

Table 3. ADMV8809-EVALZ Bill of Materials

Quantity	Reference Designator	Description	Manufacturer	Part Number
2	3P3V, TP_VPO	Test points, red	Components Corporation	TP-104-01-02
2	GND1, GND2	Test points, black	Components Corporation	TP-104-01-00
2	N2P5V, TP_VNE	Test points, blue	Components Corporation	TP-104-01-06
6	BYP1, BYP2, RF1, RF2, THRU1, THRU2	Connectors, 2.92mm, 40GHz	Hirose Electric Co.	HK-LR-SR2(12)
2	C1 and C2	Capacitors, 100pF, 50V, 5%, 0402	Johanson Dielectrics	500R07N101JV4T
1	C4	Capacitor, 47µF, 10V, 10%, 1210	Murata	GRM32ER71A476KE15L
3	C14, C16, C17	Capacitors, 0.1µF, 16V, 5%, 0402	Kemet	C0402C104J4RACTU
6	C21, C22, C25 to C28	Capacitors, 10µF, 16V, 10%, 0805	Samsung	CL21B106KOQNNNE
6	C31 to C33, C37 to C39	Capacitors, 1µF, 6.3V, 10%, 0402	Murata	GRM155R70J105KA12D
1	D1	Diode, BAT54H, 30V, SOD123F	NXP Semiconductor	BAT54H,115
2	DS1, DS3	LED, LTST-C190GKT, green, 0603	Lite-On Technology	LTST-C190GKT
1	L1	Coupled inductor, 22µH, 20%	Coilcraft	LPD5030-223MRC
1	P1	Connector, vertical, surface-mount technology (SMT), 120-pin	Hirose Electric Co.	FX8-120S-SV(21)
1	P2	Connector, vertical, header, 10-pin	Harwin Inc.	M20-9980546
1	P3	Connector, vertical, header, 6-pin	Samtec	TSW-106-09-G-S
1	P4	Connector, vertical, header, 10-pin	Amphenol	77313-801-10LF
9	R1, R12 to R19	Resistors, 33Ω, 1/10W, 1%, 0402	Panasonic	ERJ-2RKF33R0X
12	R3, R4, R6, R7, R9 to R11, R20, R21, R35 to R37	Resistors, 330Ω, 1/10W, 5%, 0402	Panasonic	ERJ-2GEJ331X
10	R22 to R24, R28 to R34	Resistors, 0Ω, 1/16W, 0402	Stackpole	RMCF0402ZT0R00
2	R53, R54	Resistors, 100kΩ, 1/16W, 5%, 0402	Yageo	RC0402JR-07100KL
1	R61	Resistor, 29.4kΩ, 1/10W, 1%, 0402	Panasonic	ERJ-2RKF2942X
1	R71	Resistor, 24.9kΩ, 1/16W, 1%, 0402	Panasonic	ERJ-2RKF2492X
1	R91	Resistor, 750Ω, 1/16W, 5%, 0402	Panasonic	ERJ-2GEJ751X
1	S1	Switch, mechanical, slide, DPDT, 0.2A	Nidec Copal Electronics	CL-SB-22A-11T
1	U1	IC, digitally tunable HPFs and LPFs, 0.5GHz to 9GHz	Analog Devices	ADMV8809ACCZ
1	U2	IC, LDO regulator, 3. V	Analog Devices	ADP7156ACPZ-3.3-R7
1	U4	IC, inverting DC/DC converter	Analog Devices	LT1617ES5-1#PBF
1	U5	IC, LDO regulator, −2.5V	Analog Devices	ADP7183ACPZN2.5-R7
1	U6	IC, 24LC32A, EEPROM, I^2C	Microchip Technology	24LC32A-I/MS
3	LUT0, VNEG, VPOS	Connectors, edge launch, SMA do not install (DNI)	Cinch Connectivity	142-0701-851
2	C18, C19	Capacitors, 0.1µF, 16V, 5%, 0402, DNI	Kemet	C0402C104J4RACTU
4	C83 to C86	Capacitor, 10pF, 50V, 5%, 0402, DNI	Yageo	CC0402JRNPO9BN100
6	R41, R44 to R48	Resistors, 0Ω, 1/16W, 0402, DNI	Stackpole	RMCF0402ZT0R00
4	R49 to R52	Resistors, 100kΩ, 1/16W, 5%, 0402, DNI	Yageo	RC0402JR-07100KL

NOTES

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.