Evaluating the AD5766 or the AD5767, 16-Channel, 16-/12-Bit Voltage Output DenseDACs

FEATURES

- Full featured evaluation boards for the AD5766/AD5767 with the ADP5071 power solution
- PC control in conjunction with the Analog Devices, Inc., EVAL-SDP-CK1Z (SDP-K1) controller board
- PC software for control using the **Analysis | Control | Evaluation (ACE) Software**

GENERAL DESCRIPTION

The EVAL-AD5766ARDZ/EVAL-AD5767ARDZ are fully featured evaluation boards designed to easily evaluate all features of the AD5766/AD5767 16-channel, 16-bit/12-bit, voltage output digital-to-analog converters (DACs).

These evaluation boards integrate a power solution using the ADP5071. The ADP5071 switching regulator offers a power solution by generating a bipolar supply of +8 V and −22 V from a +3.3 V input to create a DAC voltage output range of −20 V to +6 V. Alternatively, supplying the DAC with a linear power supply via AVDD_SEL and AVSS_SEL generates all ranges.

The on-board connector, via P6, or the EVALSDP-CK1Z (SDP-K1) system demonstration platform (SDP) board, can control the AD5766/AD5767. The SDP-K1 enables the control of the evaluation boards through the USB port of a Windows®-based PC using the AD5766/AD5767 evaluation software, ACE.

The AD5766/AD5767 are 16-channel, 16-bit/12-bit, voltage output denseDAC® converters. The DACs generate output ranges from a 2.5 V reference. Output buffers permit the AD5766/AD5767 to source or sink up to 20 mA.

The AD5766/AD5767 require four power supplies. AV_{DD} and AV_{SS} are the positive and negative high voltage power supplies, AV_{CC} is the analog supply for the low voltage DAC circuitry, and a V_{LOGIC} supply pin sets the logic levels for the digital interface pins.

The **ACE Software** of the EVAL-AD5766ARDZ/EVAL-AD5767ARDZ has an intuitive graphical user interface (GUI) for the configuration of AD5766/AD5767 modes of operation. Visit the **ACE Software** page to view the plug-in modules for the evaluation boards of many other Analog Devices devices.

Complete specifications for the AD5766/AD5767 are available in the AD5766/AD5767 data sheet, which must be consulted in conjunction with this user guide when using the EVAL-AD5766ARDZ/EVAL-AD5767ARDZ.

EVALUATION BOARD PHOTOGRAPHS

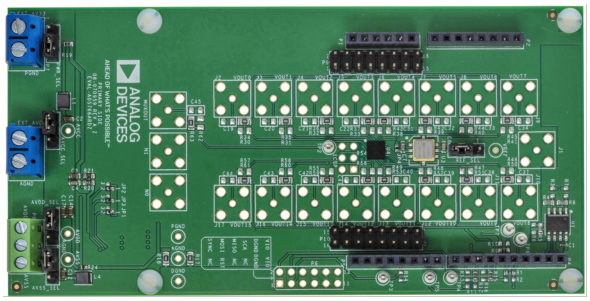

Figure 1. EVAL-AD5766ARDZ Evaluation Board

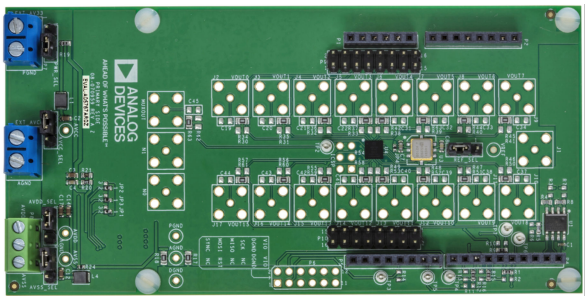

Figure 2. EVAL-AD5767ARDZ Evaluation Board

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REVISION HISTORY

9/2024—Revision 0: Initial Version

EVALUATION BOARD HARDWARE

POWER SUPPLIES AND DEFAULT LINK OPTIONS

The EVAL-AD5766ARDZ/EVAL-AD5767ARDZ evaluation board can be powered using the on-board ADP5071 or from well regulated bench supplies. See Table 1 for the on-board jumper configurations for each power supply solution.

Table 1. Jumper Configurations for the ADP5071 and Bench Supply

Link	ADP5071	Bench Supply
PWR_SEL	Position 1-2	Position 1-2
AVDD_SEL	Position 1-2	Position 2-3
AVSS_SEL	Position 2-3	Position 1-2
AVCC_SEL	Position 1-2	Position 1-2
REF_SEL	Position 2-3	Position 2-3
JP4	Connected	Connected

The on-board ADP5071, supplied with a 3.3 V supply via the PWR_SEL connector, or the supply from the SDP-K1 (in this configuration, make sure to supply AV_{CC} externally; AVCC_SEL: 2-3), can power the EVAL-AD5766ARDZ/EVAL-AD5767ARDZ evaluation boards. Alternatively, the evaluation boards can also be powered externally; AV_{DD} and AV_{SS} through the P8 connector while AV_{CC} uses the EXT_AVCC connector. See Figure 3 for a functional block diagram of the EVAL-AD5766ARDZ/EVAL-AD5767ARDZ evaluation boards.

For either power supply option, place the links in their required operating set up before supplying the evaluation boards (see Table 3).

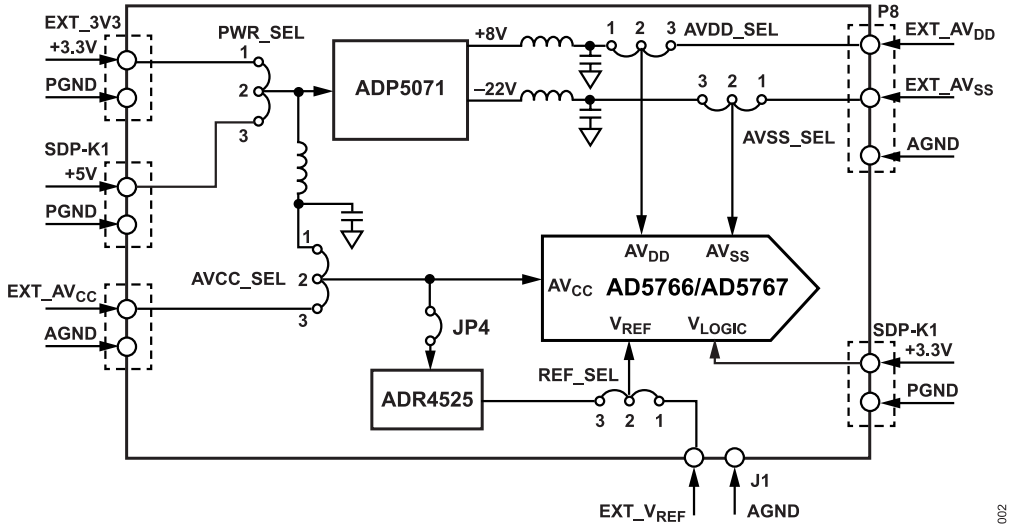

Figure 3. Powering the EVAL-AD5766ARDZ/EVAL-AD5767ARDZ Evaluation Boards

Table 2. Quick Start on Power Supply Requirements for the EVAL-AD5766ARDZ/EVAL-AD5767ARDZ

Board Supply	Compatible Output Voltage Ranges (V)	Power Supplies Required		
		AV_{SS} Maximum (V)	AV_{DD} Minimum (V)	AV_{CC} and V_{LOGIC} Nominal(V)
ADP5071	−20 to 0	Not required	Not required	3.3
	−16 to 0	Not required	Not required	3.3
	−10 to 0	Not required	Not required	3.3
	−10 to +6	Not required	Not required	3.3
	−5 to +5	Not required	Not required	3.3
Bench Supply	−20 to 0	−22	2.97	3.3
	−16 to 0	−18	2.97	3.3
	−10 to 0	−12	2.97	3.3
	−10 to +6	−12	8	3.3
	−12 to +14	−14	16	3.3
	−16 to +10	−18	12	3.3
	−5 to +5	−7	7	3.3
	−10 to +10	−12	12	3.3

EVALUATION BOARD HARDWARE

ADP5071 POWER SOLUTION OPTION

The EVAL-AD5766ARDZ/EVAL-AD5767ARDZ evaluation boards are populated with the ADP5071 switching regulator. This regulator generates +8 V and −22 V supplies. The ADP5071 data sheet recommends 3.3 V for correct operation.

Two ways to power the ADP5071 are available using the PWR_SEL options. First, use an external 3.3 V supply (recommended). This method involves connecting an external 3.3 V supply, which provides a stable and reliable power source, especially for more demanding applications. This method is recommended for most cases to ensure optimal performance. The other option is by using the SDP-K1 as the power supply.

To select the power source for AV_{CC}, use the AVCC_SEL jumper. Position 1-2 on AVCC_SEL ties AV_{CC} and the ADP5071 supplies together to operate from a single 3.3 V supply. Alternatively, Position 2-3 on AVCC_SEL powers AV_{CC} with an external supply via the EXT_AVCC connector. Refer to Table 3 for all the link options. Note that the −12 V to +14 V, −16 V to +10 V, or −10 V to +10 V output voltage ranges are not available with the default configuration of the ADP5071 because a minimum of 2 V headroom is required.

Table 3. Link Options

Link Options	Description
AVCC_SEL	Selects the power supply for the DAC AV_{CC} pin; requires 2.97 V to 3.6 V for correct operation
	Position 1-2: supplied by PWR_SEL connector
	Position 2-3: supplied by external power supply through the EXT_AVCC connector, see Table 4 for more information
AVDD_SEL	Selects the power supply for the DAC AV_{DD} pin; ensure that the voltage between AV_{DD} and AV_{SS} does not exceed 34 V
	Position 1-2: supplied by the ADP5071 power solution
	Position 2-3: supplied by an external power supply through the P8 connector
AVSS_SEL	Selects the power supply for DAC AV_{SS} pin; ensure that the voltage between AV_{DD} and AV_{SS} does not exceed 34 V
	Position 1-2: supplied by an external power supply through the P8 block
	Position 2-3: supplied by the ADP5071 power solution
REF_SEL	Selects the voltage reference source
	Position 1-2: selects an external reference source that can applied at the EXT_VREF SMB connector
	Position 2-3: selects the ADR4525 2.5 V reference
PWR_SEL	Selects the power supply source
	Position 1-2: supplied by an external reference source that can applied at the EXT_3V3 (P7) connector
	Position 2-3: supplied by the SDP-K1 controller board
JP1	Selects the switching frequency of the ADP5071; this link is replaced with a 0 Ω resistor to either position
	Position A: 2.4 MHz switching frequency
	Position B: 1.2 MHz switching frequency
	No link inserted: external clock
JP2	Selects the slew rate of the ADP5071 output; this link is replaced with a 0 Ω resistor to either position
	Position A: normal slew rate
	Position B: slowest slew rate (best noise performance)
	No link inserted: fastest slew rate (best efficiency)
JP3	Selects the start-up sequence of the ADP5071 outputs
	Position A: positive and negative output rails power up simultaneously when EN2 is high
	Position B: positive and negative output rails are sequenced based on the state of the EN1 and EN2 pins
	No link inserted: manual enable mode
JP4	Connected and supplied by the AV_{CC} supply

EVALUATION BOARD HARDWARE

BENCH POWER SUPPLY OPTION

The EVAL-AD5766ARDZ/EVAL-AD5767ARDZ evaluation boards can access all output voltage ranges of the AD5766/AD5767 when powered by a bench supply. A headroom and footroom of at least 2 V is required. Refer to Table 2 for the supply requirements. It is important that the voltage across AV_{DD} to AV_{SS} does not exceed the absolute maximum rating of 34 V. Otherwise, device reliability may be affected.

Following the jumper configuration in Table 1 and Table 3 gives more details about the options offered. For V_{LOGIC}, users can use the 3.3 V provided by the SDP-K1 controller board when interfaced with the USB port of a PC or use an external power supply interfaced with Pin 11 or Pin 12 (VIO) of the peripheral module (PMOD, P6).

ON-BOARD CONNECTORS

The EVAL-AD5766ARDZ/EVAL-AD5767ARDZ evaluation boards have various on-board connectors for the external power supplies and header pins, and these connectors are described in details in Table 4.

Table 4. On-Board Connectors

Connector	Connector Description
EXT_3V3 (P7)	
Pin 1	External power supply that connects to Pin 1 of PWR_SEL
Pin 2	Analog ground
EXT_AVCC	
Pin 1	External power supply that connects to Pin 3 of AVCC_SEL
Pin 2	Analog ground
P8	
Pin 1	External power supply that connects to Pin 3 of AVDD_SEL
Pin 2	Analog ground
J1	External voltage reference supply, SMB Connector
J2 to J17	SMB connectors for VOUT 0 to VOUT 15
P6	Peripheral module (PMOD) connection pins
P9	Header pins for VOUT 0 to VOUT 7 and AGND
P10	Header pins for VOUT 8 to VOUT 15 and AGND

PMOD Connector (P6) Pin Descriptions

The PMOD connector allows the user to control the EVAL-AD5766ARDZ/EVAL-AD5767ARDZ by means of communicating with the AD5766/AD5767 through the 12 pins of P6. For further information on the functionality of the P6 pins, see Table 5.

Table 5. Connector P6 Pin Descriptions

Pin No.	Description
1	No connection (NC)
2	SYNCB
3	RESETB
4	SPI_MOSI
5	NC
6	SPI_MISO
7	NC
8	SPI_SCK
9	DGND
10	DGND
11	VIO
12	VIO

EVALUATION BOARD SOFTWARE

ACE SOFTWARE INSTALLATION

The EVAL-AD5766ARDZ/EVAL-AD5767ARDZ evaluation boards use the Analog Devices **Analysis | Control | Evaluation (ACE) Software**, a desktop software application that allows the evaluation and control of multiple evaluation systems.

The **ACE Software** is available for download from the EVAL-AD5766ARDZ and EVAL-AD5767ARDZ evaluation board pages and must be installed before connecting the EVAL-SDP-CK1Z (SDP-K1) controller board to the USB port of the PC to ensure that the EVAL-SDP-CK1Z (SDP-K1) is recognized when it connects to the PC. The ACE installer installs the necessary SDP drivers and the Microsoft® .NET Framework 4 by default. For full instructions on how to install and use this software, see the **ACE Software** page on the Analog Devices website.

After the **ACE Software** installation is completed and the user opens this software, the EVAL-AD5766ARDZ or EVAL-AD5767ARDZ evaluation board plug-in appears.

ACE SOFTWARE OPERATION

To use the **ACE Software** with the AD5766 or AD5767, take the following steps:

1. To launch the **ACE Software**, click **Start** > **All Programs** > **Analog Devices** > **ACE**. The **ACE Software** then opens in the **Start** tab and recognizes the EVAL-AD5766ARDZ. Note that the interface is the same for the EVAL-AD5767ARDZ, except for the board name (see Figure 4).
2. Double click the **EVAL-AD5766ARDZ** icon under the **Attached Hardware** section to open the **EVAL-AD5766ARDZ** tab (see Figure 4 and Figure 5).
3. Double click the **AD5766** icon to open the **AD5766** chip tab (see Figure 6). This tab displays the block diagram and allows the user to configure the digital-to-analog converter (DAC) input registers and control registers. The hardware registers on the AD5766/AD5767 are not altered until the **Apply Changes** button is clicked.
4. Click **Proceed to Memory Map** (Label **12** in Figure 8) to open the **AD5766 Memory Map** tab and allow access to all registers (see Figure 7). The hardware registers on the AD5766 or AD5767 are not altered until the **Apply Changes** button is clicked.

For a detailed description of all GUI options, see Figure 8 and Table 6.

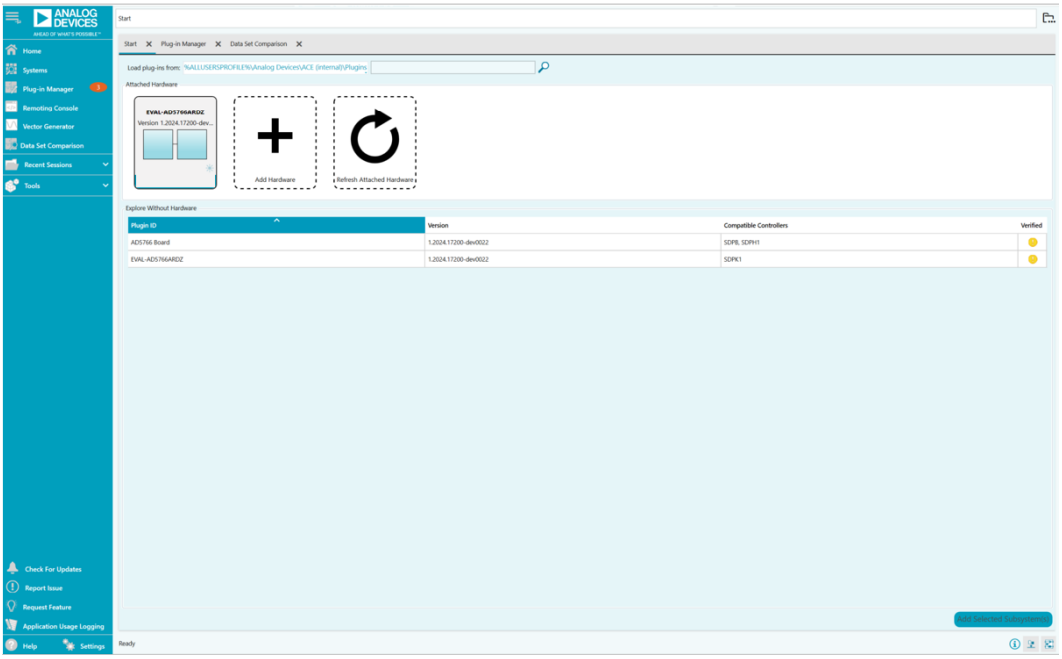

Figure 4. Start Tab for the EVAL-AD5766ARDZ ACE Software

EVALUATION BOARD SOFTWARE

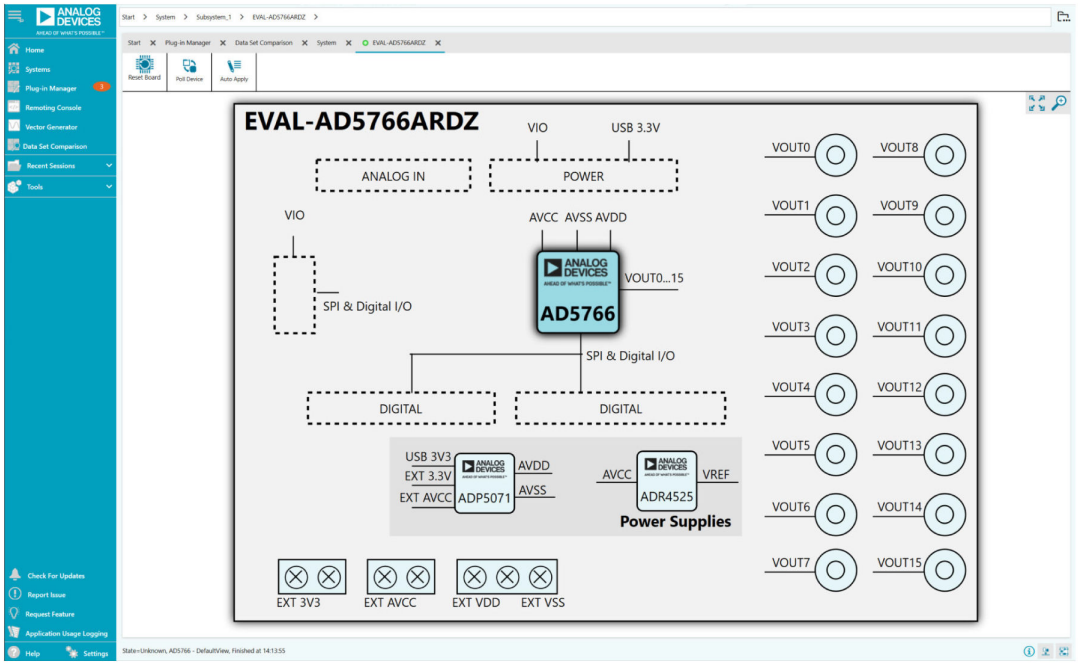

Figure 5. AD5766 Board Tab for the EVAL-AD5766ARDZ ACE Software

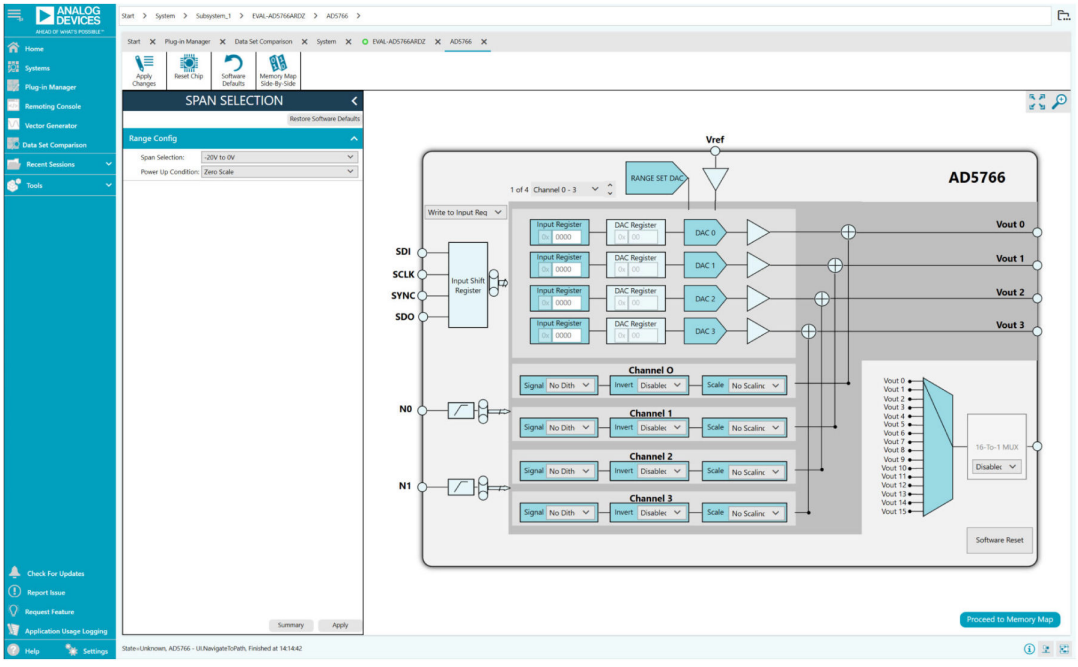

Figure 6. AD5766 Chip Tab the for EVAL-AD5766ARDZ ACE Software

EVALUATION BOARD SOFTWARE

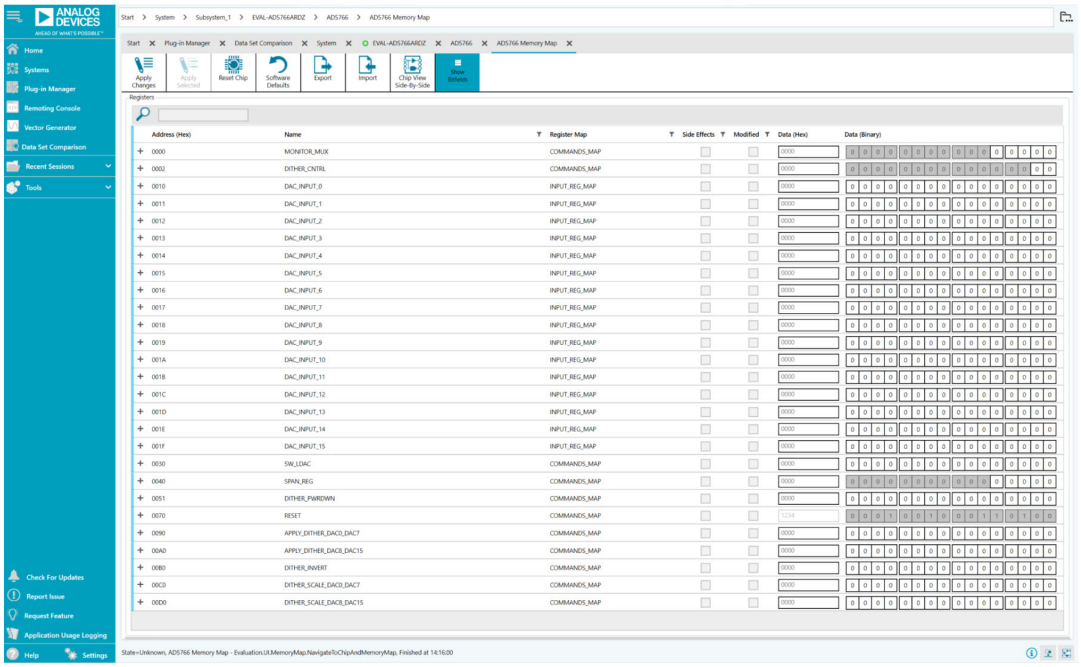

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Figure 7. AD5766 Memory Map Tab for the EVAL-AD5766ARDZ ACE Software

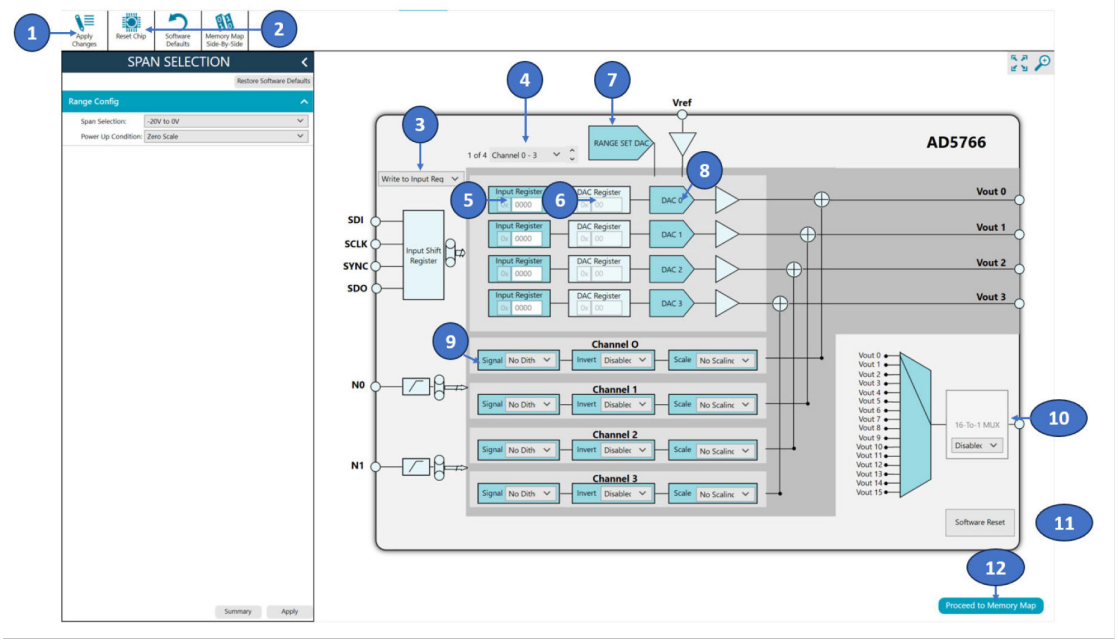

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Figure 8. Main Window for the EVAL-AD5766ARDZ ACE Software

EVALUATION BOARD SOFTWARE

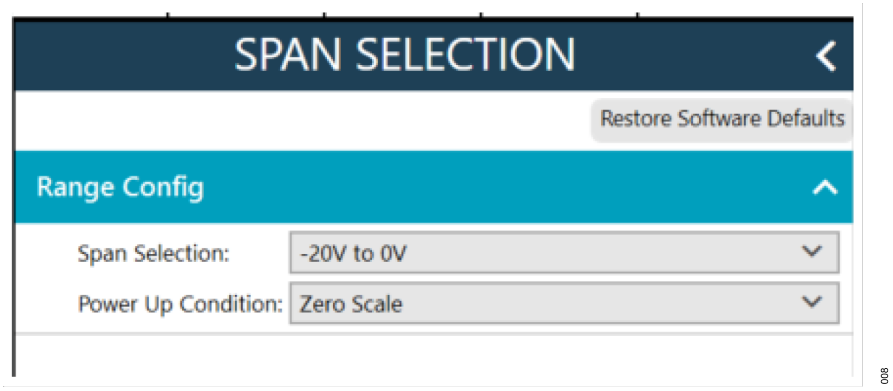

Figure 9. Span Selection Window

Table 6. GUI Options[1]

Label No.	GUI Element	Description
1	**Apply Changes**	Click this button to submit any changes on the GUI to the hardware of the evaluation boards.
2	**Reset Chip**	Click this button to issue a hardware reset and revert the software and hardware registers to their default settings.
3	**Write to Input Reg**	This dropdown menu allows users to write to the input register, write to the input register and the DAC register, or write to the input register and update all DAC registers.
4	Select output	Channels display. This dropdown menu allows users to select **Channel 0 - 3**, **Channel 4 - 7**, **Channel 8 - 11**, or **Channel 12 - 15** for V_{OUT} in the **AD5766 Chip** tab.
5	**Input Register**	The user can input data to write to the input register. Note that there is one input register per channel.
6	**DAC Register**	This is a graphical representation of the DAC register. Note that there is one DAC register per channel.
7	**RANGE SET DAC**	Click **RANGE SET DAC** to select the output voltage range from the **SPAN SELECTION** window (see Figure 9).
8	**DAC 0** to **DAC 3**	Click the DAC x to apply a dither signal or to enable or disable the update for the selected DAC register with data from the corresponding input register (software load DAC).
9	**Signal** , **Invert**, and **Scale**	These dropdown menus allow users to select the dither options for each channel.
10	**16-To-1 MUX**	Use this area to select which channel to route to the AD5766/AD5767 MUX_OUT pin.
11	**SOFTWARE RESET**	Issues a software reset and reverts the software and hardware registers to their default settings.
12	**Proceed to Memory Map**	Click this button to open the **AD5766 Memory Map** tab (see Figure 7).

[1] See Figure 8

EVALUATION BOARD SCHEMATICS AND ARTWORK

Note that an x on a reference designator stands for do not install (DNI) in Figure 10 through Figure 13.

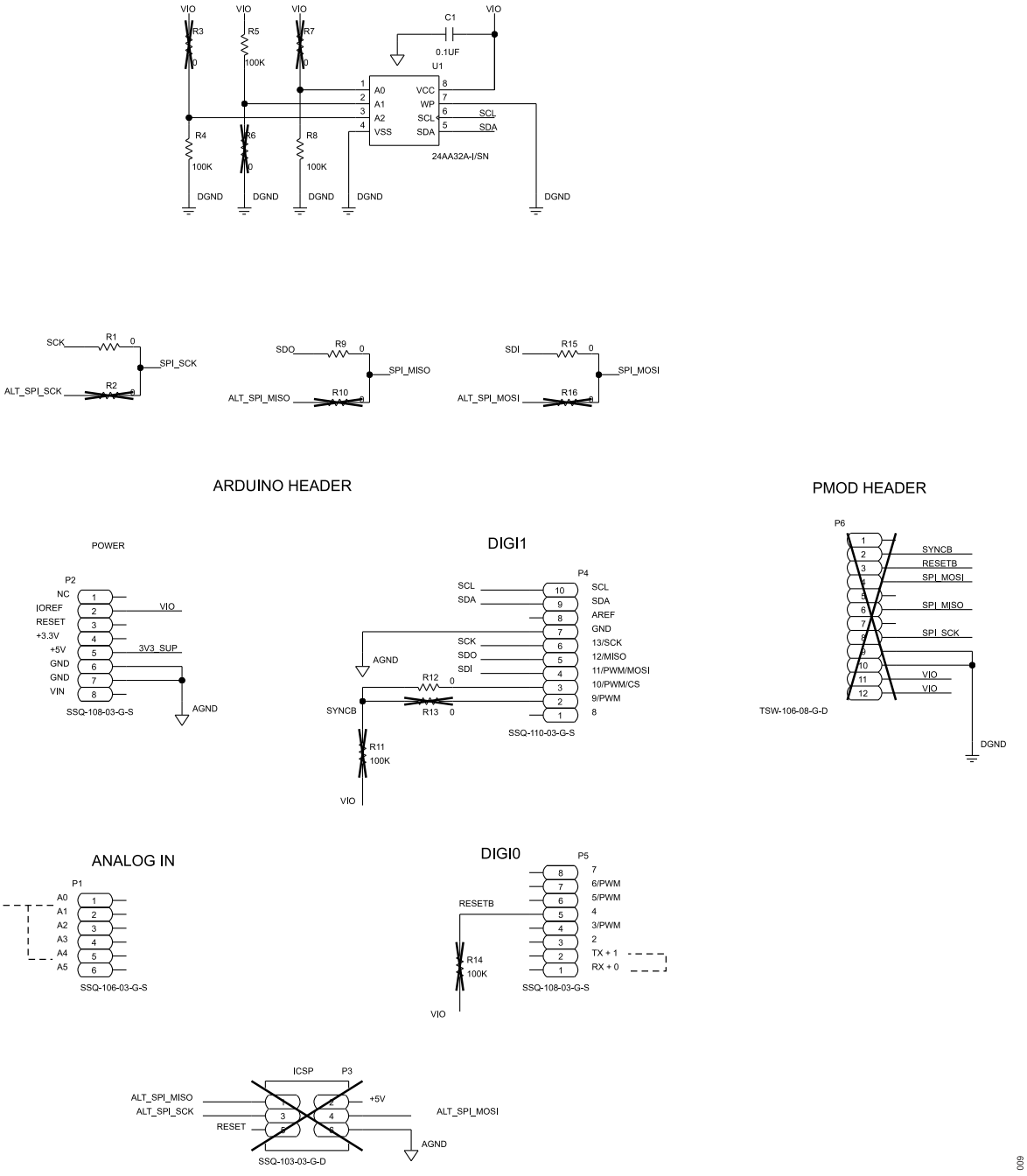

Figure 10. SDP-K1, EEPROM and PMOD Connections

EVALUATION BOARD SCHEMATICS AND ARTWORK

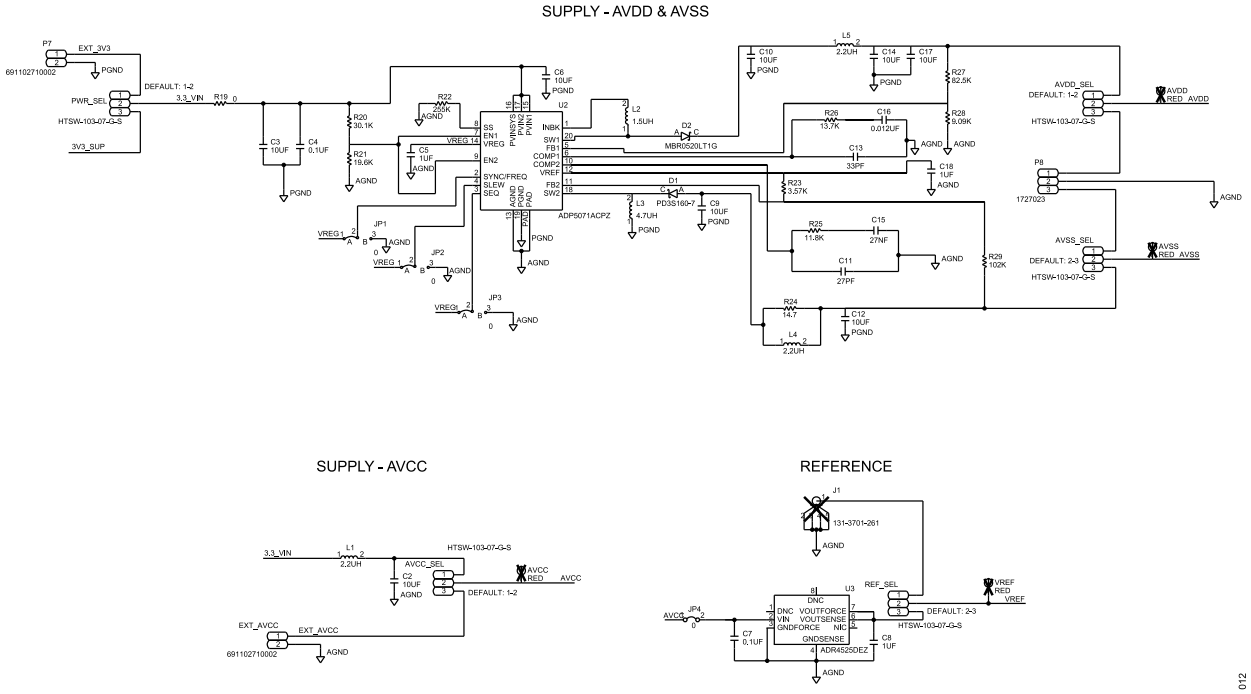

Figure 11. ADP5071 Power Solution, AV_{CC}, AV_{DD}, AV_{SS}, and Reference Power Supply Selection

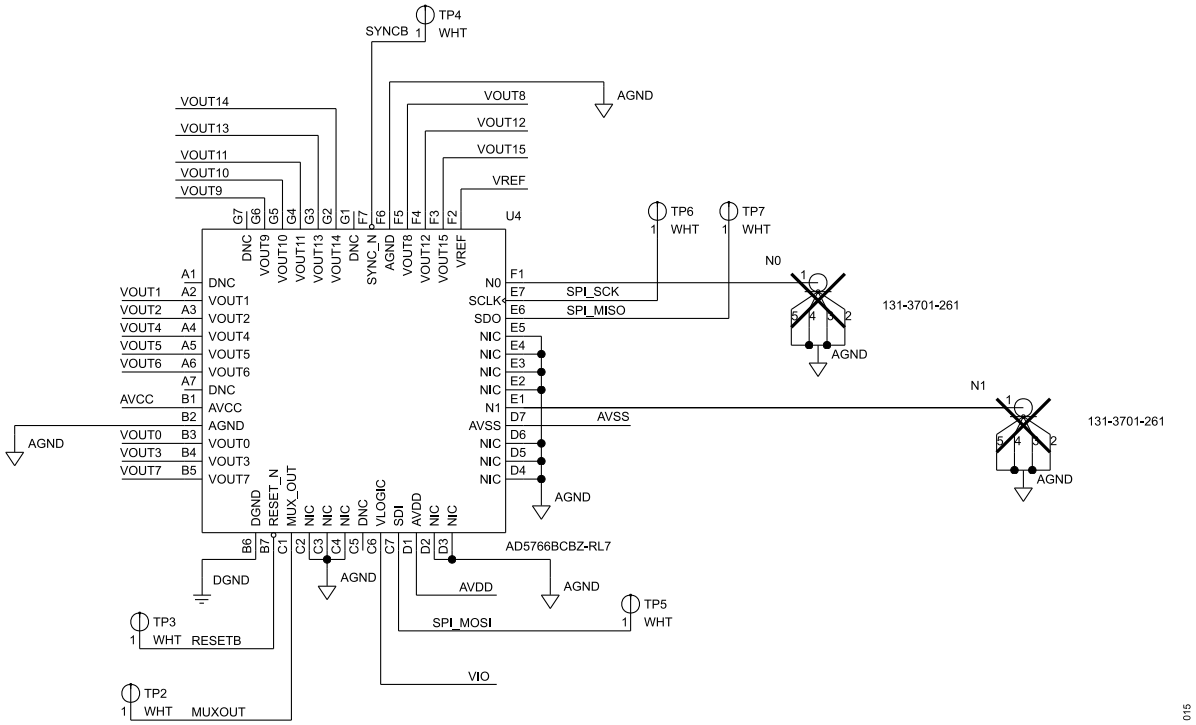

Figure 12. AD5766/AD5767 49-Ball WLCSP

EVALUATION BOARD SCHEMATICS AND ARTWORK

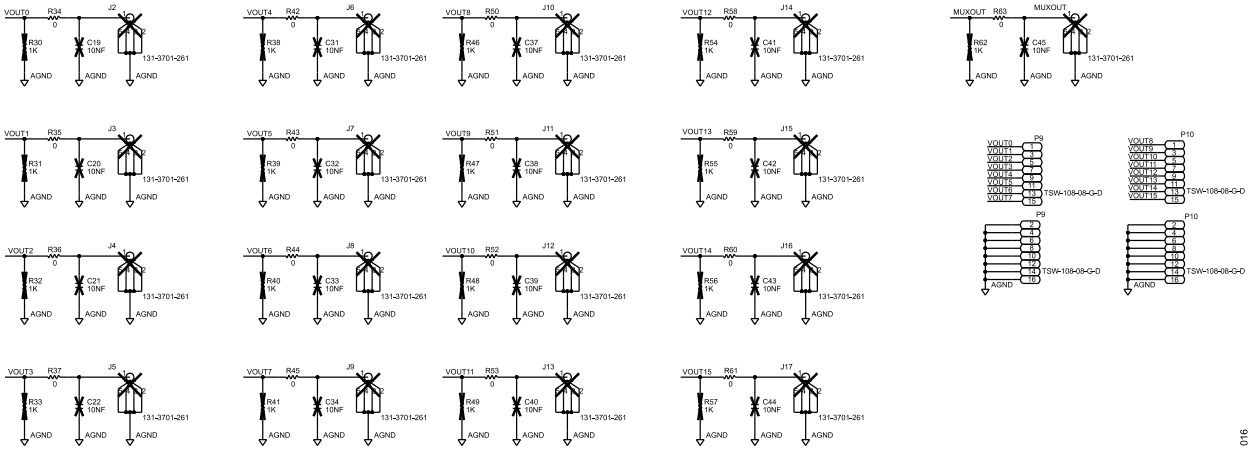

Figure 13. Channel Outputs

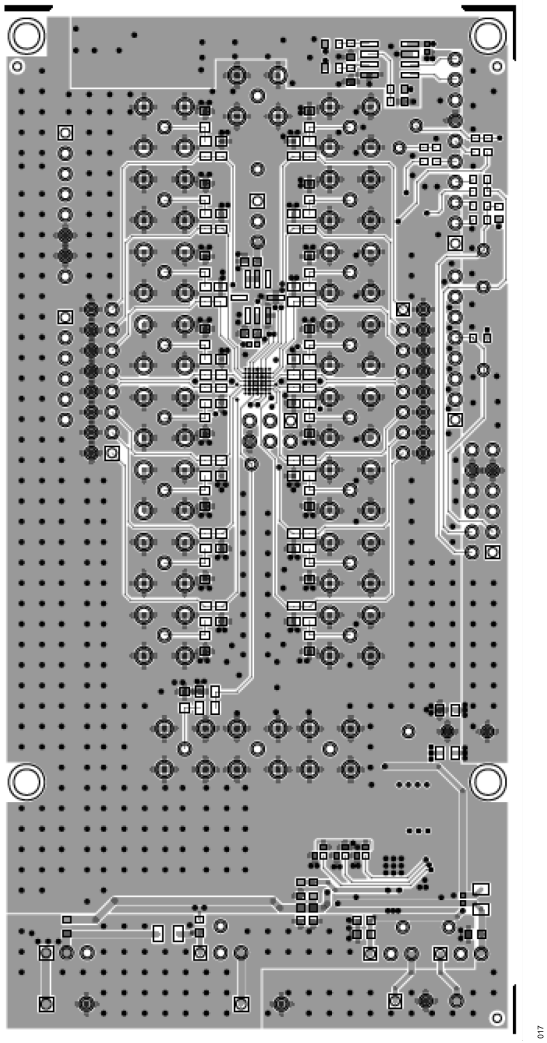

Figure 14. PCB Top Layer

EVALUATION BOARD SCHEMATICS AND ARTWORK

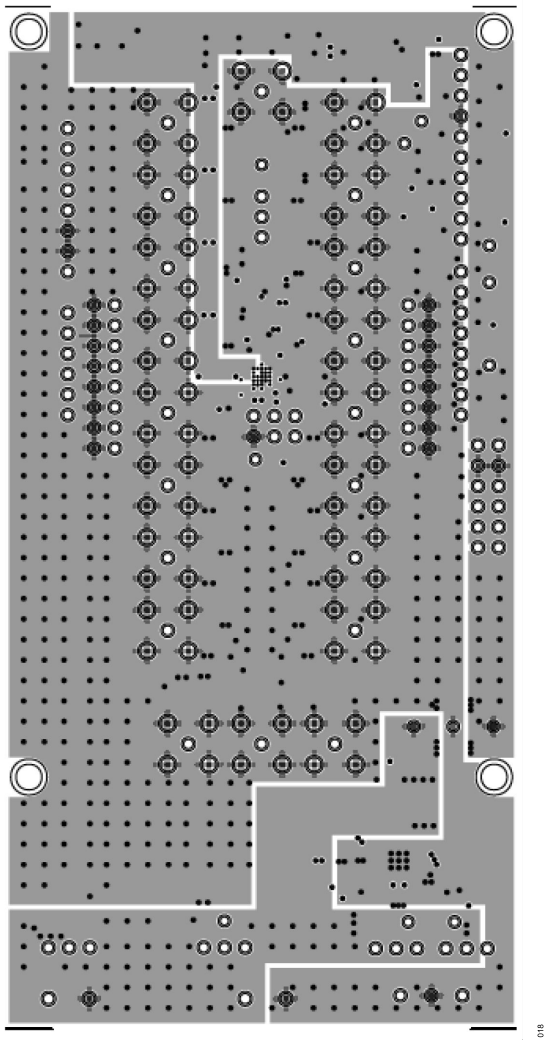

Figure 15. PCB GND Plane

EVALUATION BOARD SCHEMATICS AND ARTWORK

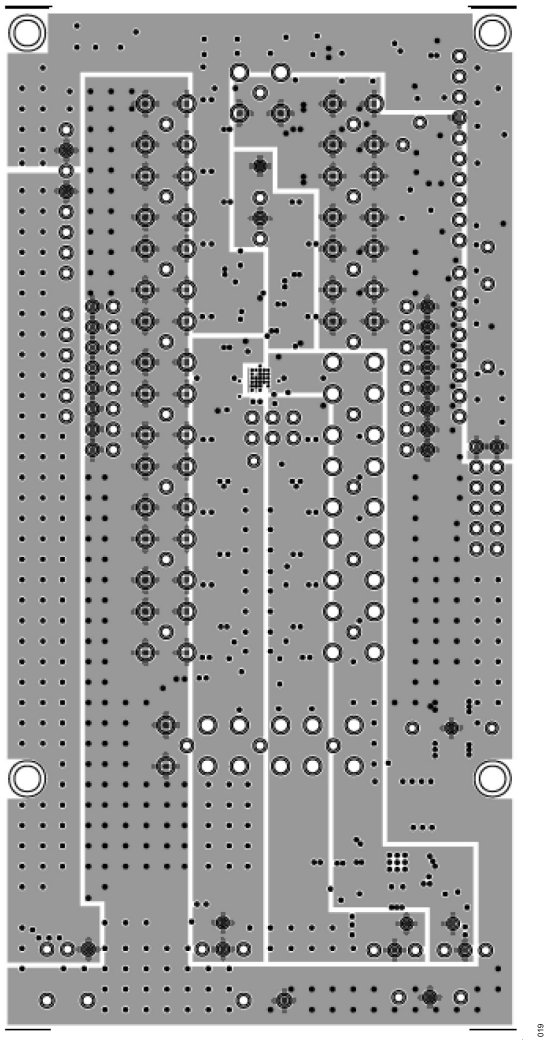

Figure 16. PCB Power Plane

EVALUATION BOARD SCHEMATICS AND ARTWORK

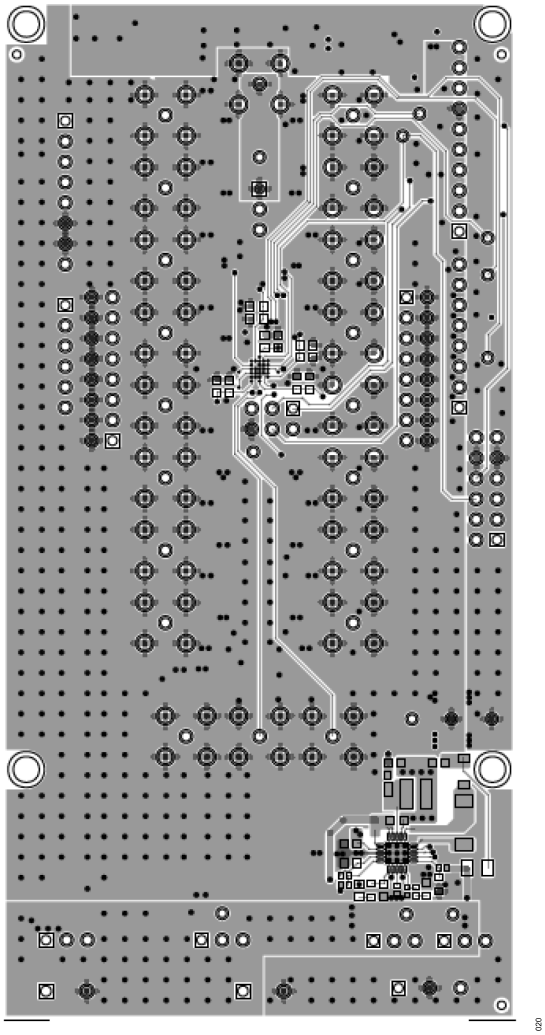

Figure 17. PCB Bottom Layer

ORDERING INFORMATION

BILL OF MATERIALS

Table 7. Bill of Materials

Reference Designator	Description	Part Number
AVCC_SEL, AVDD_SEL, AVSS_SEL, PWR_SEL, REF_SEL	Connectors, printed circuit board (PCB), 3-position male header, unshrouded, single row straight, 2.54 mm pitch, 5.84 mm post height, 2.54 mm solder tail	HTSW-103-07-G-S
C1	Ceramic capacitor, 0.1 µF, 16 V, 10%, X7R, 0402, AEC-Q200	GCM155R71C104KA55D
C2, C3, C6, C9, C10, C12, C14, C17, C23, C24, C27, C28, C35	Ceramic capacitors, 10 µF, 10V, 20%, X5R, 0603	GRM188R61A106ME69D
C4, C25, C26, C29, C30, C36	Ceramic capacitors, 0.1 µF, 16 V, 10%, X7R, 0603	0603YC104KAT2A
C5, C18	Ceramic capacitors, 1 µF, 25 V, 10%, X5R, 0603	CC0603KRX5R8BB105
C7	Ceramic capacitor, 0.1 µF, 50 V, 10%, X7R, 0603	C0603R104K5RACT500
C8	Ceramic capacitor, 1 µF, 16 V, 10%, X7R, 0603	0603YC105KAT2A
C11	Ceramic capacitor, 27 pF, 50 V, 5%, C0G, 0603	2238 867 15279
C13	Ceramic capacitor, 33 pF, 50 V, 5%, C0G, 0402	CL05C330JB5NNNC
C15	Ceramic capacitor, 27 nF, 50 V, 10%, X7R, 0603	06035C273KAT2A
C16	Ceramic capacitor, 0.012 µF, 50 V, 5%, X7R, 0603	06035C123JAT2A
D1	Schottky diode, barrier rectifier	PD3S160-7
D2	Schottky diode, power rectifier surface-mounted device (SMD)	MBR0520LT1G
EXT_AVCC, P7	Connector, PCB, 2-position terminal, block side entry, 5 mm pitch	6.91103E+11
JP1 to JP3	Resistor, SMD, 0 Ω, jumpers, 1/10 W, 0402, AEC-Q200	ERJ-2GE0R00X
JP4	Resistor, SMD, 0 Ω, jumper, 1/10 W, 0402, AEC-Q200	ERJ-2GE0R00X
L1, L4, L5	Inductors, power shielded, wire wound, 1.6 A, 0.0912 Ω, DC resistance (DCR)	LQH32PN2R2NN0L
L2	Inductor, power shielded, 0.016 Ω DCR, 4.1A	SLF6045T-1R5N4R0-3PF
L3	Inductor, power shielded, DCR, 0.0522 Ω, 2.7 A	XFL4020-472MEC
P1	Connector, PCB, receptacle, 25 mil, square post, 2.54 mm pitch	SSQ-106-03-G-S
P2, P5	Connector, PCB, receptacles, 25 mil, square post, 2.54 mm pitch	SSQ-108-03-G-S
P4	Connector, PCB, receptacle, 25 mil, square post, 2.54 mm pitch	SSQ-110-03-G-S
P8	Connector, PCB, term block, 3-position	1727023
P9, P10	Connector, PCB, 16-pin headers, straight	TSW-108-08-G-D
R1, R9, R12, R15, R19	Resistors, SMD, 0 Ω jumper, 1/10 W, 0603	RC0603JR-070RL
R4, R5, R8	Resistors, SMD, 100 kΩ, 1%, 1/16 W, 0603	MC 0.063W 0603 1% 100K
R17, R18	Resistors, SMD, 0 Ω, 1/8 W, 0805, for combination footprint use ALT_SYMBOLS	RCG08050000Z0EA
R20	Resistor, SMD, 30.1 kΩ, 1%, 1/10 W, 0603, AEC-Q200	ERJ-3EKF3012V
R21	Resistor, 19.6 kΩ, 0.5%, 1/10 W, 0603, AEC-Q200	RNCF0603DTE19K6
R22	Resistor, SMD, 255 kΩ, 1%, 1/10 W, 0402, AEC-Q200	ERJ-2RKF2553X
R23	Resistor, SMD, 3.57 kΩ, 1%, 1/10 W, 0402, AEC-Q200	ERJ-2RKF3571X
R24	Resistor, SMD, 14.7 Ω, 1%, 1/16 W, 0402, AEC-Q200	CRCW040214R7FKED
R25	Resistor, SMD, 11.8 kΩ, 1%, 1/10 W, 0603	RC0603FR-0711K8L
R26	Resistor, SMD, 13.7 kΩ, 1%, 1/16 W, 0402, AEC-Q200	CRCW040213K7FKED
R27	Resistor, SMD, 82.5 kΩ, 1%, 1/16 W, 0402	RC0402FR-0782K5L
R28	Resistor, SMD, 9.09 kΩ, 1%, 1/10 W, 0603, AEC-Q200	ERJ-3EKF9091V
R29	Resistor, SMD, 102 kΩ, 1%, 1/10 W, 0402, AEC-Q200	ERJ-2RKF1023X
R34 to R37, R42 to R45, R50 to R53, R58 to R61, R63	Resistors, SMD, 0 Ω jumper, ½ W, 0805, AEC-Q200, pulse proof	CRCW08050000Z0EAHP
TP2 to TP7	Connector, PCB, white test points	5002
U1	IC, 32 KBIT serial electrically erasable programmable read-only memory (EEPROM)	24AA32A-I/SN
U2	2 A/1.2 A dc-to-dc switching regulator with independent positive and negative outputs	ADP5071ACPZ-R7

ORDERING INFORMATION

Table 7. Bill of Materials (Continued)

Reference Designator	Description	Part Number
U3	Ultralow noise, high-accuracy 2.5 V voltage reference	ADR4525DEZ-R7
U4	16-channel, 16-bit/12-bit voltage output denseDAC	AD5766BCBZ-RL7/ AD5767BCBZ-RL7
AVCC, AVDD, AVSS, VREF	Connector, PCB, red test points, DNI	Not applicable
C19 to C22, C31 to C34, C37 to C45	Ceramic capacitors,10 nF, 200 V, 10%, X7R, 0805, FLEXITERM, DNI	Not applicable
J1 to J17, MUXOUT, N0, N1	Connector, PCB, coax, Subminiature Version B (SMB), jacks, RF vertical, gold, DNI	Not applicable
P3	Connector, PCB, receptacle, 25 mil, square post, dual-row, 2.54 mm pitch, DNI	Not applicable
P6	Connector, PCB, Berg, header, straight male, 12-position, DNI	Not applicable
R2, R10, R13, R16	Resistors, SMD, 0 Ω, jumper, 1/10 W, 0603, DNI	Not applicable
R11, R14	Resistors, SMD,100 kΩ, 1%, 1/10 W, 0603, AEC-Q200, DNI	Not applicable
R3, R6, R7	Obsoleted: resistors, SMD, 0 Ω, 1%, 1/16 W, 0603, DNI	Not applicable
R30 to R33, R38 to R41, R46 to R49, R54 to R57, R62	Resistors, SMD, 1 kΩ, 1%, 1/8 W, 0805, AEC-Q200, DNI	Not applicable

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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