EVAL-AD5766SD2Z/EVAL-AD5767SD2Z User Guide
UG-1070

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

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-CB1Z SDP
Power solution generated from a single 3.3 V supply
PC software for control using ACE software

GENERAL DESCRIPTION

The EVAL-AD5766SD2Z/EVAL-AD5767SD2Z 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 the on-board connector, J9, generates all ranges.

The on-board connector, via J10, or the EVAL-SDP-CB1Z system demonstration platform (SDP) board, via J1, can control the AD5766/AD5767. The SDP enables the control of evaluation boards through the USB port of a Windows® based PC using the AD5766/AD5767 the 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 range is software selectable and any channel can be routed to the monitor pin for external monitoring. The integration of the reference and output buffers creates an easy to use universal solution.

The devices 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-AD5766SD2Z/EVAL-AD5767SD2Z has an intuitive graphic user interface (GUI) for the configuration of AD5766/AD5767 modes of operation through the synchronous serial port (SPORT) interface. Visit the ACE software page to view plug in modules for the evaluation boards and Circuits from the Lab® (CFTL) demo 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-AD5766SD2Z/EVAL-AD5767SD2Z.

PHOTOGRAPH OF THE EVAL-AD5766SD2Z/EVAL-AD5767SD2Z EVALUATION BOARD

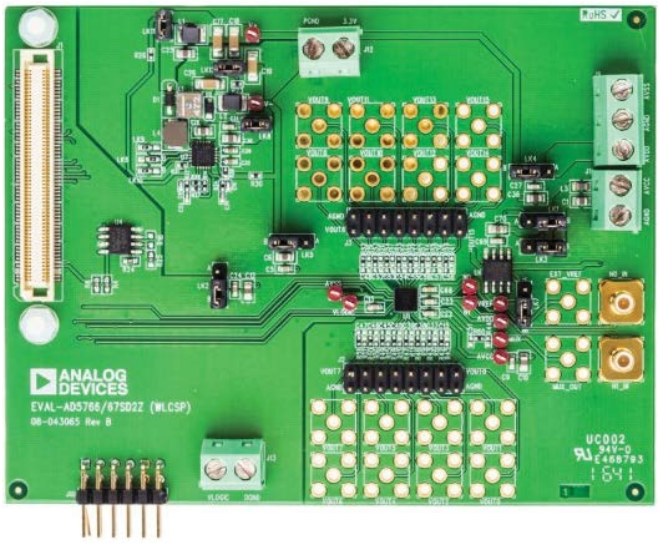

Figure 1.

PLEASE SEE THE LAST PAGE FOR AN IMPORTANT WARNING AND LEGAL TERMS AND CONDITIONS.

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REVISION HISTORY

10/2017—Rev. 0 to Rev. A

Added AD5766 and EVAL-AD5766SD2Z ..... Throughout
Changes to General Description Section 1
Changed Evaluation Board Photograph Section to Photograph of the EVAL-AD5766SD2Z/EVAL-AD6767SD2Z Evaluation Board Section 1
Changes to the Power Supplies/Default Link Options Section, Table 1, Table 2, and Figure 2 3
Changes to the ADP5071 Power Solution Option Section, Bench Power Supply Option Section, and Table 3 4
Changes to the PMOD Connector (J10) Pin Configuration and Descriptions Section and the Filtering the ADP5071 Outputs Section 5
Changes to the Filtered 3.3 V Supply Section and the Changing the ADP5071 Output Voltages Section 6
Changes to the ACE Software Installation Section and the ACE Software Operation Section 7
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Changes to Figure 10 9
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1/2017—Revision 0: Initial Version

EVALUATION BOARD HARDWARE

POWER SUPPLIES/DEFAULT LINK OPTIONS

The EVAL-AD5766SD2Z/EVAL-AD5767SD2Z 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 No.	ADP5071	Bench Supply
LK1	Position A	Position A
LK2	Position A	Position A
LK3	Position A	Position A
LK4	Position B	Position A
LK5	Position B	Position A
LK7	Position A	Position A
LK8	Inserted	Removed
LK11	Removed	Removed
LK12	Removed	Removed

The on-board ADP5071, supplied with a 3.3 V supply via the J12 connector, can power the evaluation boards. However, the J9 connector, intended for use with well regulated bench supplies, can provide power to the evaluation boards instead of the ADP5071. See Figure 2 for a functional block diagram of the EVAL-AD5766SD2Z/EVAL-AD5767SD2Z evaluation boards.

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

Each supply is decoupled to the relevant ground plane with 10 µF and 0.1 µF capacitors. Each device supply pin is again decoupled with a 10 µF and 0.1 µF capacitor pair to the relevant ground plane.

The analog and digital planes are connected at one location close to the DAC. To avoid ground loop problems, do not connect AGND and DGND elsewhere in the system.

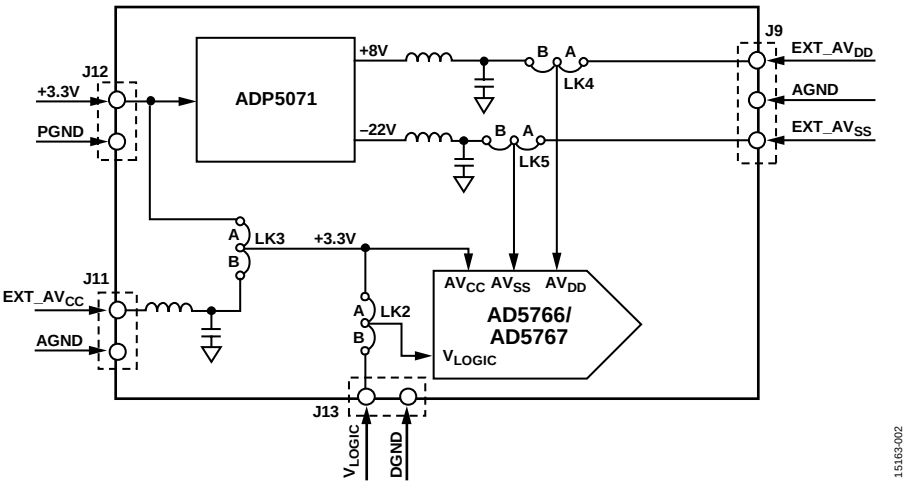

Figure 2. Powering the EVAL-AD5766SD2Z/EVAL-AD5767 SDZ Evaluation Boards

Table 2. Quick Start on Power Supply Requirements for the EVAL-AD5766SD2Z/EVAL-AD5767SD2Z

		Power Supplies Required		
Board Supply	Compatible Output Voltage Ranges (V)	AV_{SS} (J9) Maximum (V)	AV_{DD} (J9) Minimum (V)	J12 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

ADP5071 Power Solution Option

The EVAL-AD5766SD2Z/EVAL-AD5767SD2Z evaluation boards are populated with the ADP5071 switching regulator. This regulator generates 8 V and −22 V supplies from a single 3.3 V supply. The Analog Devices ADIsimPower design tool, which selects the components, generates the schematic and bill of materials, and displays the performance specifications, was used to design the circuit. Visit the ADP5071 product page at www.analog.com/ADP5071 to download the design tool

The ADP5071 requires 3.3 V for correct operation. Replicating the jumper configuration in Table 1, tie AV_{CC}, V_{LOGIC}, and the ADP5071 supplies together to operate from a single 3.3 V supply.

Alternatively, Position B on LK3 and LK2 powers the AV_{CC} header (J11) and the V_{LOGIC} header (J13) with separate supplies. Refer to Table 3 for full link options.

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 ADP5071 default configuration because a minimum of 2 V headroom is required. See the Filtered 3.3 V Supply section for more information.

Bench Power Supply Option

The 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 2, tie AV_{CC} and V_{LOGIC} together to operate from the same 3.3 V supply, or AV_{CC} via J11 and V_{LOGIC} via J13 can be powered with separate supplies by selecting Position B on LK3 and LK2, respectively. Refer to Table 3 for full link options.

Table 3. Link Options

Link No.	Description
LK1	Selects the power supply for the ADR4525 reference; requires a minimum of 3 V for correct operation Position A: supplied by the 3.3 V supply (J12) Position B: supplied by the AV_{CC} header (J11)
LK2	Selects the power supply for the DAC V_{LOGIC} pin; requires 1.7 V to 5.5 V for correct operation Position A: supplied by the 3.3 V supply (J12) Position B: supplied by the V_{LOGIC} header (J13)
LK3	Selects the power supply for the DAC AV_{CC} pin; requires 2.97 V to 3.6 V for correct operation Position A: supplied by the 3.3 V supply (J12) Position B: supplied by the AV_{CC} header (J11)
LK4	Selects the power supply for the DAC AV_{DD} pin; ensure the voltage between AV_{DD} and AV_{SS} does not exceed 34 V Position A: supplied by the AV_{DD} header (J9) Position B: supplied by the ADP5071 power solution
LK5	Selects the power supply for DAC AV_{SS} pin; ensure the voltage between AV_{DD} and AV_{SS} does not exceed 34 V Position A: supplied by AV_{SS} header (J9) Position B: supplied by the ADP5071 power solution
LK6	Selects the start-up sequence of the ADP5071 outputs Position A: positive and negative output rails are sequenced based on the state of the EN1 and EN2 pins Position B: positive and negative output rails power up simultaneously when EN2 is high No link inserted: manual enable mode
LK7	Selects the voltage reference source Position A: selects the ADR4525 2.5 V reference Position B: selects an external reference source that can applied at the EXT_VREF SMB connector
LK8	Insert link to connect the ADP5071 to the 3.3 V supply header (J12)
LK9	Selects the switching frequency of ADP5071; this link is replaced with a 0 Ω resistor to Position A Position A: 1.2 MHz switching frequency (default) Position B: 2.4 MHz switching frequency
LK10	Selects the slew rate of the ADP5071 output; this link is replaced with a 0 Ω resistor to Position A Position A: slowest slew rate (best noise performance) Position B: normal slew rate
LK11	Insert link to bypass the LC filter on the ADP5071 positive output
LK12	Insert link to bypass the LC filter on the ADP5071 negative output

ON-BOARD CONNECTORS

There are eight connectors on the EVAL-AD5766SD2Z/EVAL-AD5767SD2Z (see Table 4). For the external supply pins, refer to the Power Supplies/Default Link Options section because AV_{CC} and V_{LOGIC} can be powered using J12, depending on the jumper configuration.

Table 4. On-Board Connectors

Connector	Function
J1	Connection for the EVAL-SDP-CB1Z board
J2	Header pins for $V_{OUT}0$ to $V_{OUT}7$ and AGND
J3	Header pins for $V_{OUT}8$ to $V_{OUT}15$ and AGND
J9	Supplies AV_{DD} and AV_{SS} externally
J10	Peripheral module (PMOD) connection pins
J11	Supplies AV_{CC} pin externally
J12	3.3 V supply for AV_{CC}, V_{LOGIC}, and the ADP5071
J13	Supplies V_{LOGIC} pin externally

PMOD Connector (J10) Pin Configuration and Descriptions

The PMOD connector allows the user to control the EVAL-AD5766SD2Z/EVAL-AD5767SD2Z by means of communicating with the AD5766/AD5767 through its 12 pins. For further information on the functionality and configuration of these pins, see Figure 3and Table 5.

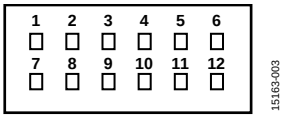

Figure 3. Jumper J10 Pin Configuration

Table 5. Connector J10 Pin Descriptions

Pin No.	Description
1	$\overline{SYNC}$
2	SDIN/MOSI
3	SDO/MISO
4	SCLK
5	DGND
6	V_{LOGIC}
7	No connection
8	$\overline{RESET}$
9	No connection
10	No connection
11	DGND
12	V_{LOGIC}

ADP5071 SWITCHING REGULATOR

Filtering the ADP5071 Outputs

The EVAL-AD5766SD2Z/EVAL-AD5767SD2Z evaluation boards have an LC filter fitted on the ADP5071 positive and negative outputs. The filter can be bypassed by inserting LK11 and LK12.

Figure 4 shows the output frequency spectrum of the AD5766/AD5767 powered by the filtered ADP5071 supply. The dotted red line represents 10% of 1 LSB using the −10 V to +6 V range. For comparison, Figure 5 shows the output frequency spectrum of the AD5766/AD5767 powered by a bench power supply.

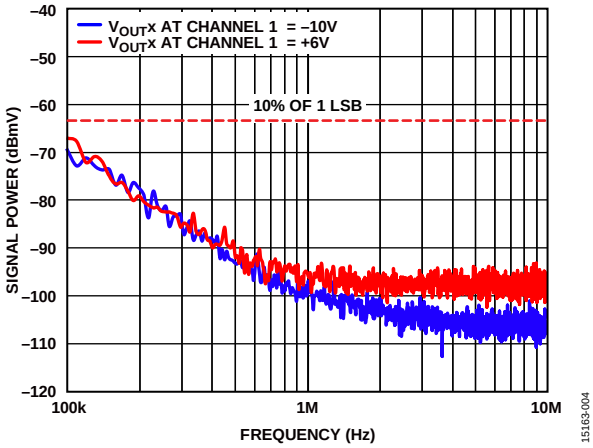

Figure 4. Output of the AD5766/AD5767 with the ADP5071 (LC Filtered)

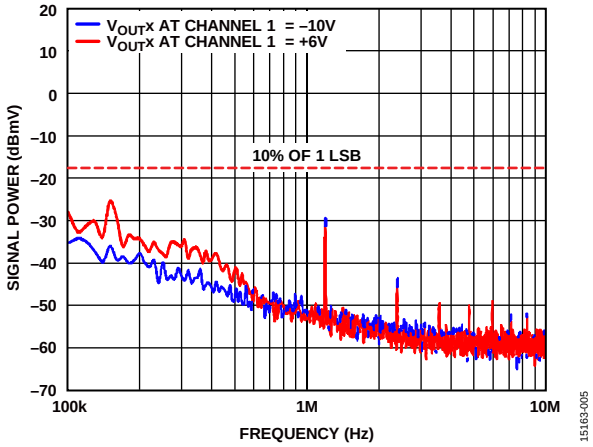

Figure 5. Output of the AD5766/AD5767 with Bench Power Supply

Filtered 3.3 V Supply

The EVAL-AD5766SD2Z/EVAL-AD5767SD2Z evaluation boards contain a filter on J11 that filters the AD5766/AD5767 AV_{CC} rail. Alternatively, users can bypass the filter by using J12. Powering the evaluation boards via the J12 header allows users to evaluate the performance of the boards with their own supply. See Figure 6 for the functional block diagram of the AV_{CC} selection.

When enabled with LK8, the ADP5071 can feed noise back onto the 3.3 V rail. Users can attenuate this noise by connecting J12 and J11 externally.

Changing the ADP5071 Output Voltages

By default, the ADP5071 output voltages are 8 V and −22 V. To provide enough headroom to supply the −12 V to +14 V, −16 V to +10 V, and −10 V to +10 V ranges, different feedback resistors are used. These are R26 and R31 for the positive output and R28 and R30 for the negative output. Based on the output supplies required and load current requirements, the ADIsimPower design tool selects the recommended feedback resistors. The ADIsimPower design tool is available on the ADP5071 product page at www.analog.com/ADP5071.

It is important that the voltage across AV_{DD} to AV_{SS} does not exceed the absolute maximum rating of 34 V. Otherwise, the device reliability is affected.

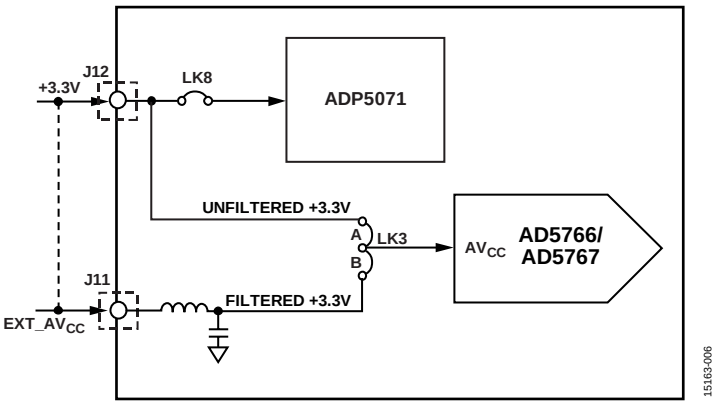

Figure 6. AV_{CC} Selection

EVALUATION BOARD SOFTWARE

ACE SOFTWARE INSTALLATION

The ACE software enables configuration of the AD5766/AD5767 over a USB port. Each device, the AD5766 and the AD5767, has separate ACE software that is identical in functionality and design except for its device number. The ACE Software Operation section introduces the key features of the ACE software for the AD5767.

To download the ACE software and obtain detailed documentation on the platform, visit www.analog.com/ACE. The installer also includes the drivers for the SDP-B board and plugins for multiple Analog Devices evaluation boards, including the EVAL-AD5766SD2Z/EVAL-AD5767SD2Z.

After the ACE software is installed, connect the evaluation boards and SDP controller board together and plug the USB cable from the PC to the SDP-B controller board. Allow a few moments for the Windows operating system to recognize the SDP board.

ACE SOFTWARE OPERATION

To operate the ACE software using the AD5767, follow these steps:

1. To launch the ACE software, click **Start** > **All Programs** > **Analog Devices** > **ACE**. The software opens in the **Start** tab and recognizes the EVAL-AD5767SD2Z (see Figure 7).
2. Double click the **AD5767 Board** icon under **Attached Hardware** to open the **AD5767 Board** tab (see Figure 7 and Figure 8).
3. Double click the **AD5767** icon under **Explore Local Plugins** shown in Figure 7 to open the **AD5767** chip tab (see Figure 9). This tab displays the block diagram and allows the user to configure the 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 the **Proceed to Memory Map** button (Label 12 in Figure 11) to open the **AD5767 Memory Map** tab and allow access to all registers (see Figure 10). The hardware registers on the AD5766/AD5767 are not altered until the **Apply Changes** button is clicked.

For a detailed description of all GUI options, see Table 6 and Figure 11.

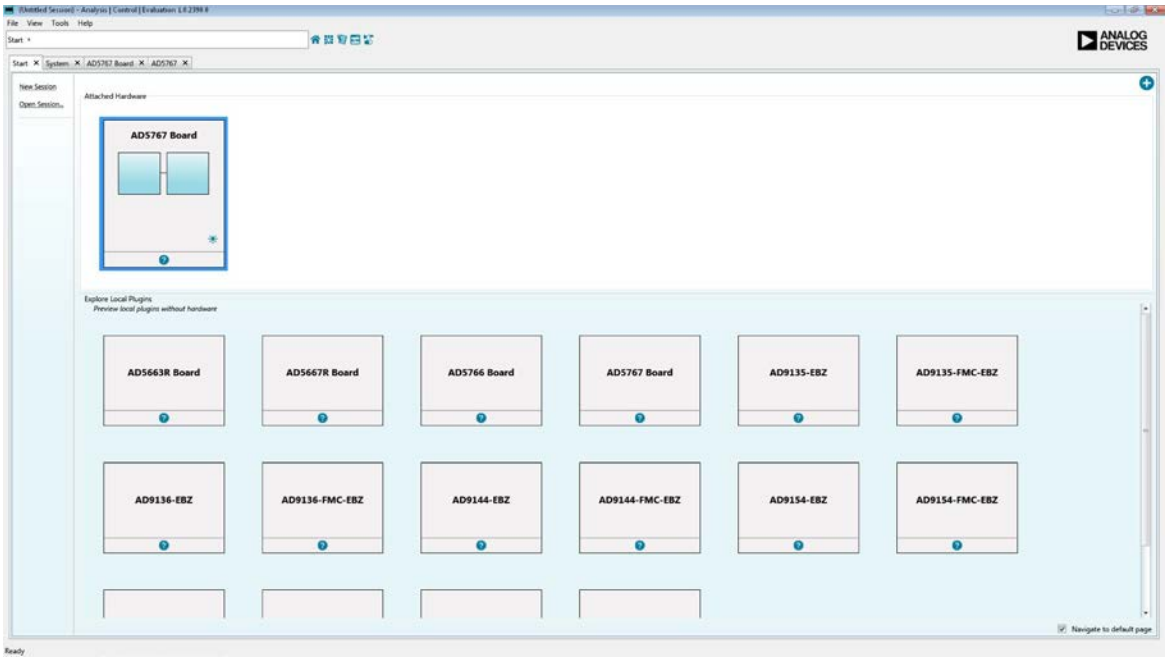

*Figure 7. **Start** Tab for the EVAL-AD5767SD2Z ACE Software*

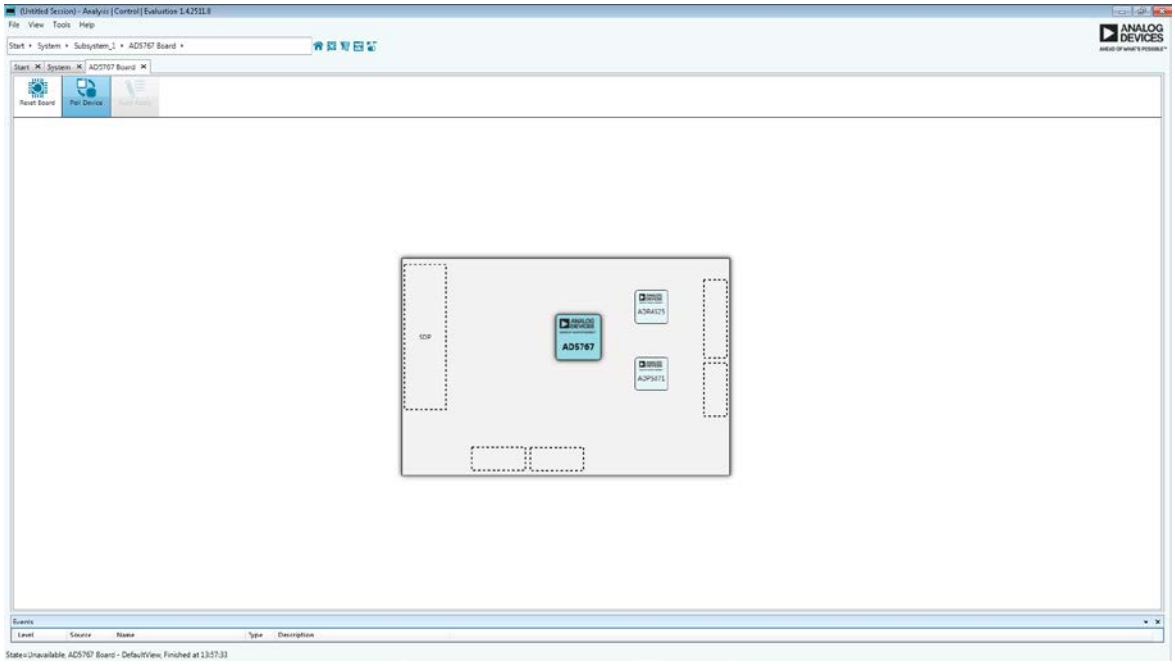

*Figure 8. **AD5767 Board** Tab for the EVAL-AD5767SD2Z ACE Software*

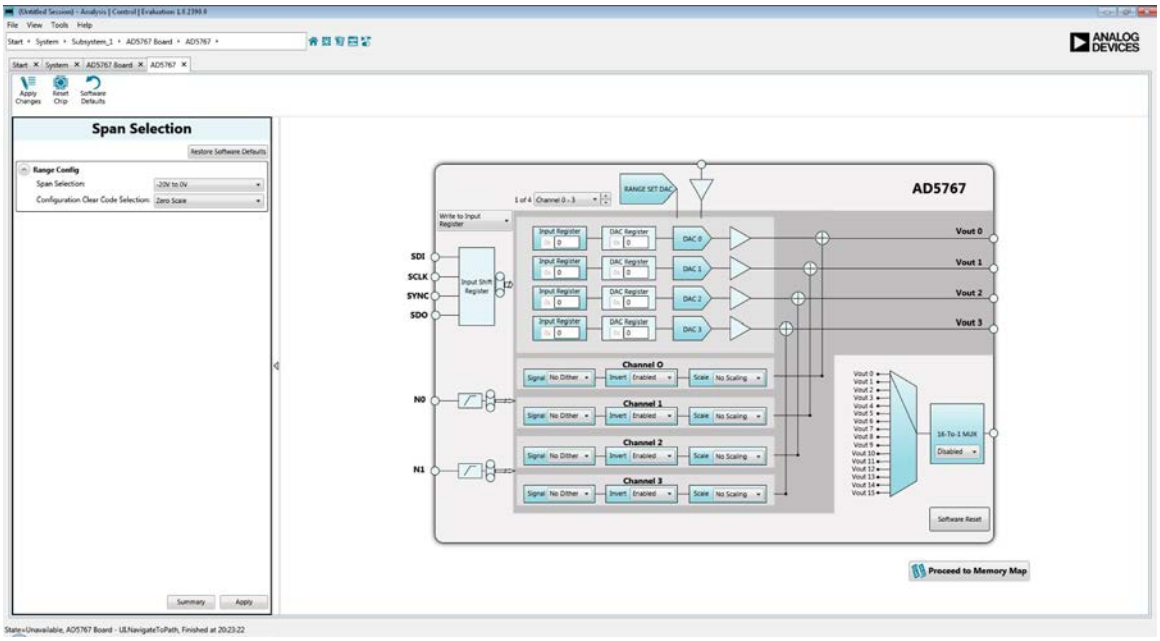

*Figure 9. **AD5767** Chip Tab the for EVAL-AD5767SD2Z ACE Software*

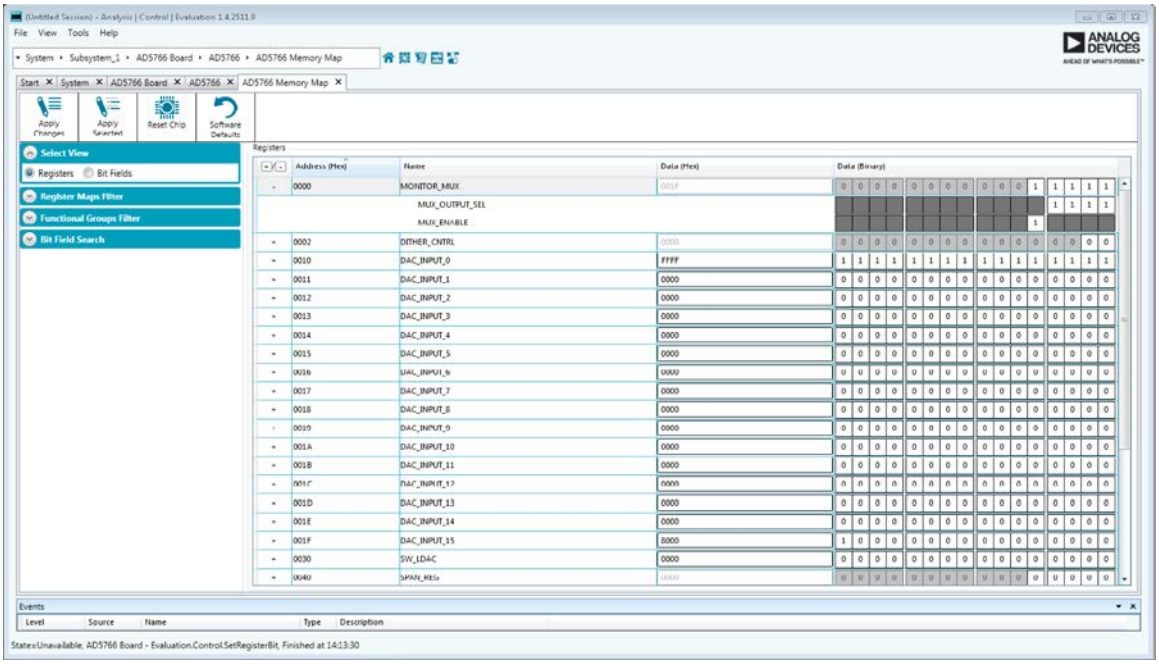

*Figure 10. **AD5767 Memory Map** Tab for the EVAL-AD5767SD2Z ACE Software*

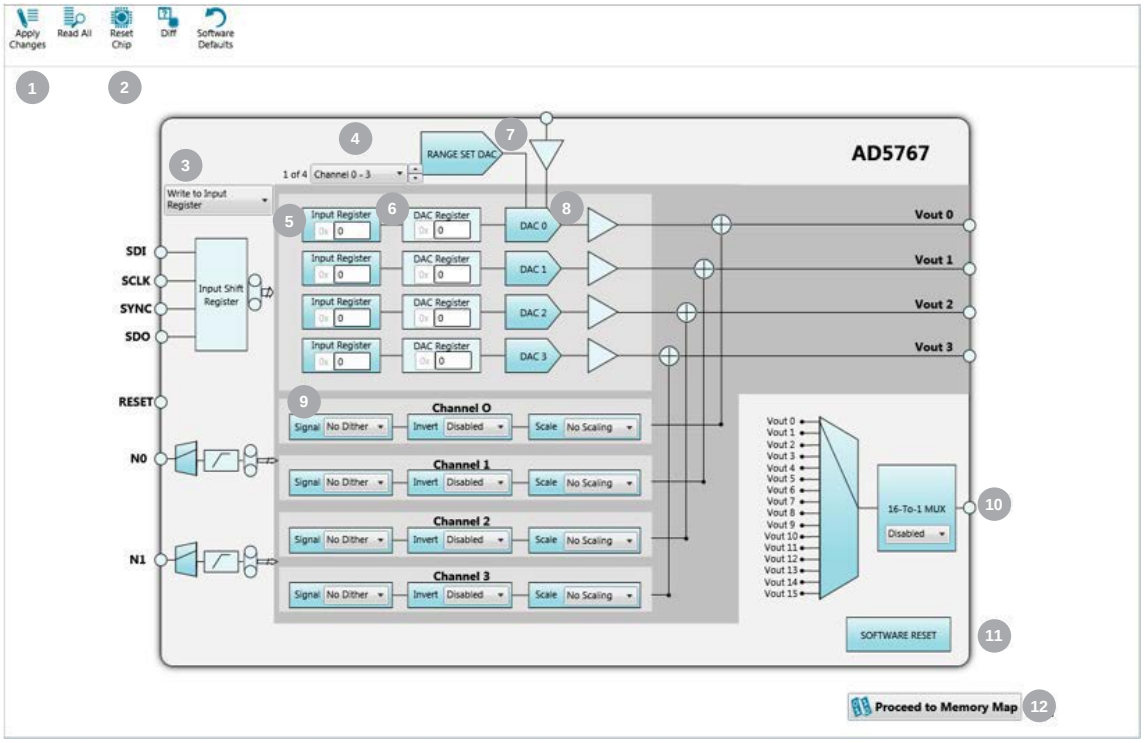

Figure 11. Main Window for the EVAL-AD5767SD2Z ACE Software

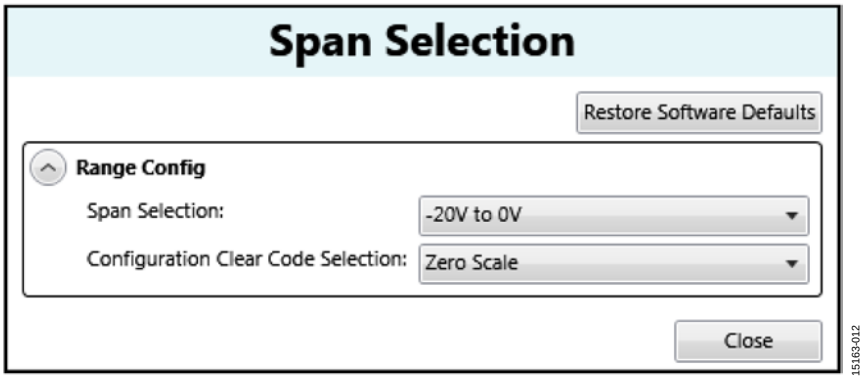

*Figure 12. **Span Selection** Window*

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**	Issues a hardware reset and reverts the software and hardware registers to their default settings.
3	**Write to Input Register**	Allows the user 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 displayed. Allows the user to show Channel 0 to Channel 3, Channel 4 to Channel 7, Channel 8 to Channel 11, or Channel 12 to Channel 15 for V_{OUT} in the **AD5767** chip tab.
5	**Input Register**	The user can input data to write to the input register. There is one input register per channel.
6	**DAC Register**	This is a graphical representation of the DAC register. There is one DAC register per channel.
7	**RANGE SET DAC** button	Click **RANGE SET DAC** to select the output voltage range from the **Span Selection** window (see Figure 12).
8	**DAC 0 to DAC 3**	Click the DAC to apply a dither signal or to enable/disable the update for the selected DAC register with data from the corresponding input register (software load DAC).
9	**Signal, Invert,** and **Scale**	Allows the user to select the dither options for each channel.
10	**16-To-1 MUX**	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 to open the **AD5767 Memory Map** tab (see Figure 10).

[1] See Figure 11.

EVALUATION BOARD SCHEMATICS AND ARTWORK

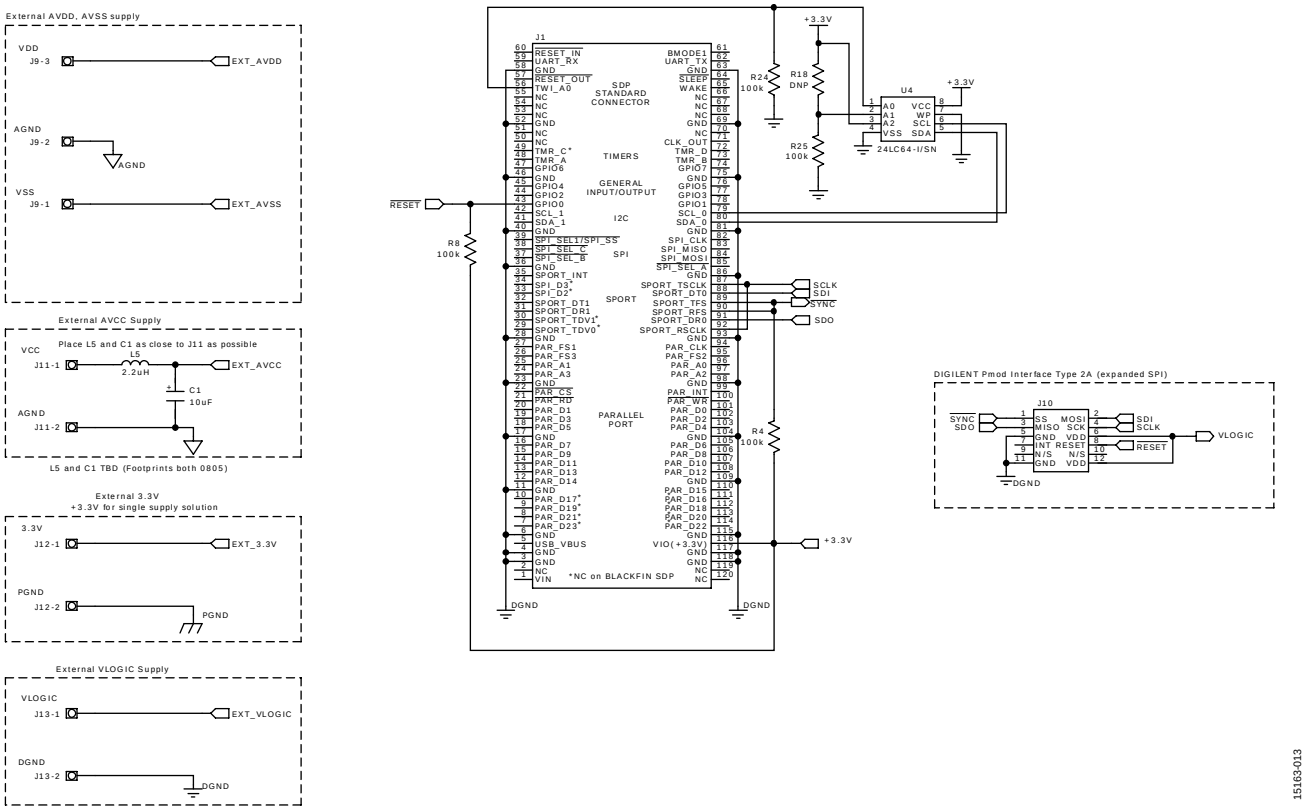

Figure 13. SDP Connector and Power Supply

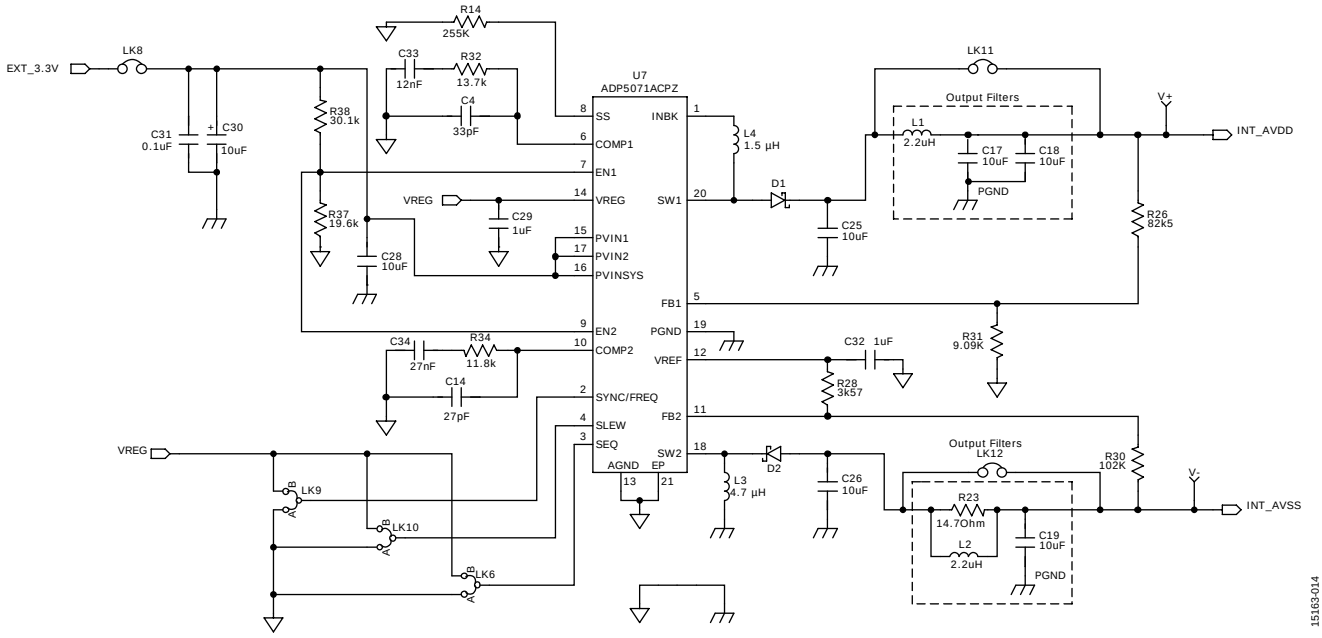

Figure 14. ADP5071 Power Solution

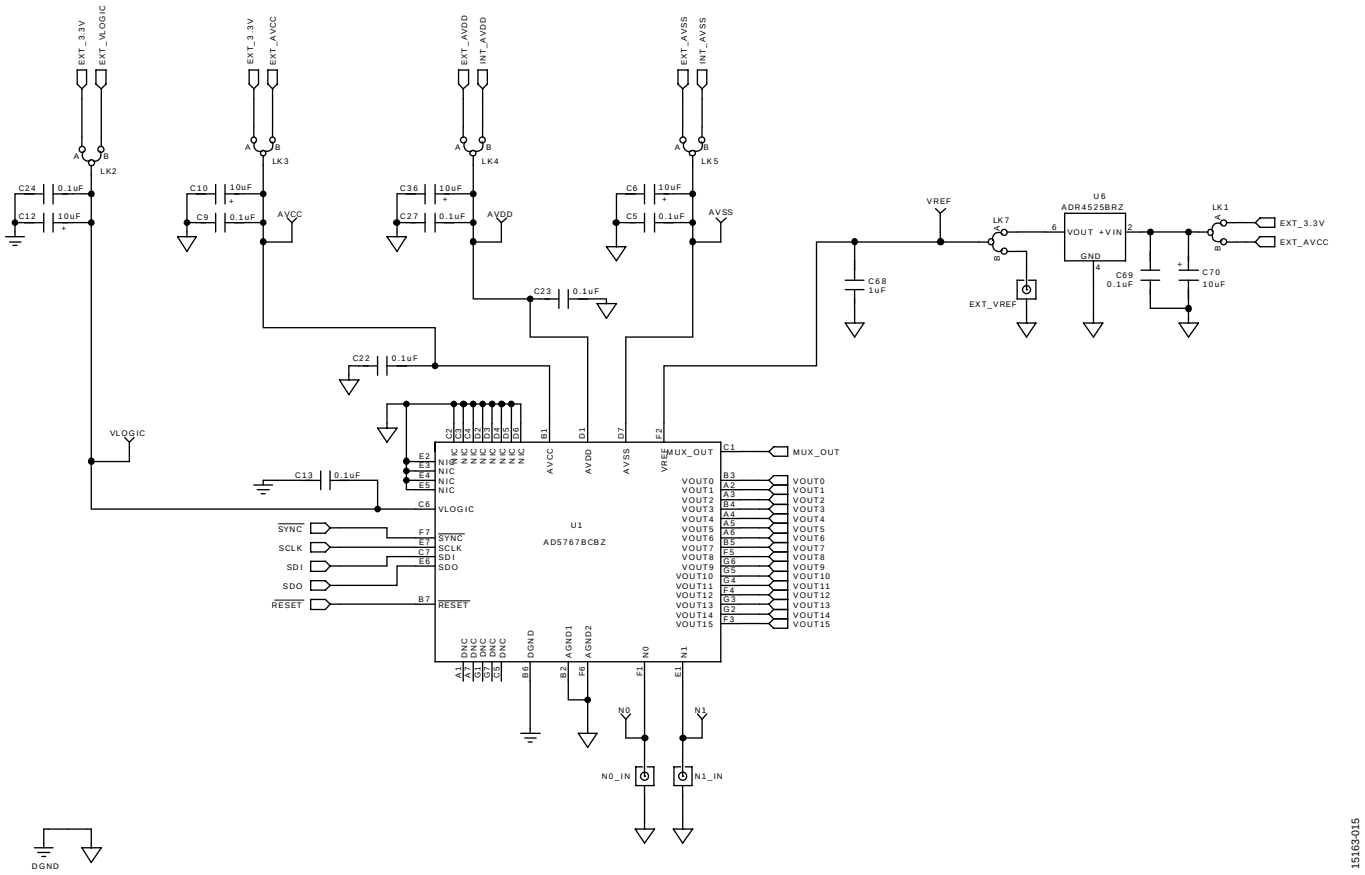

Figure 15. AD5766/AD5767 (AD5767BCBZ Shown as Example) Wafer Level Chip Scale Packaging (WLCSP) and External Reference

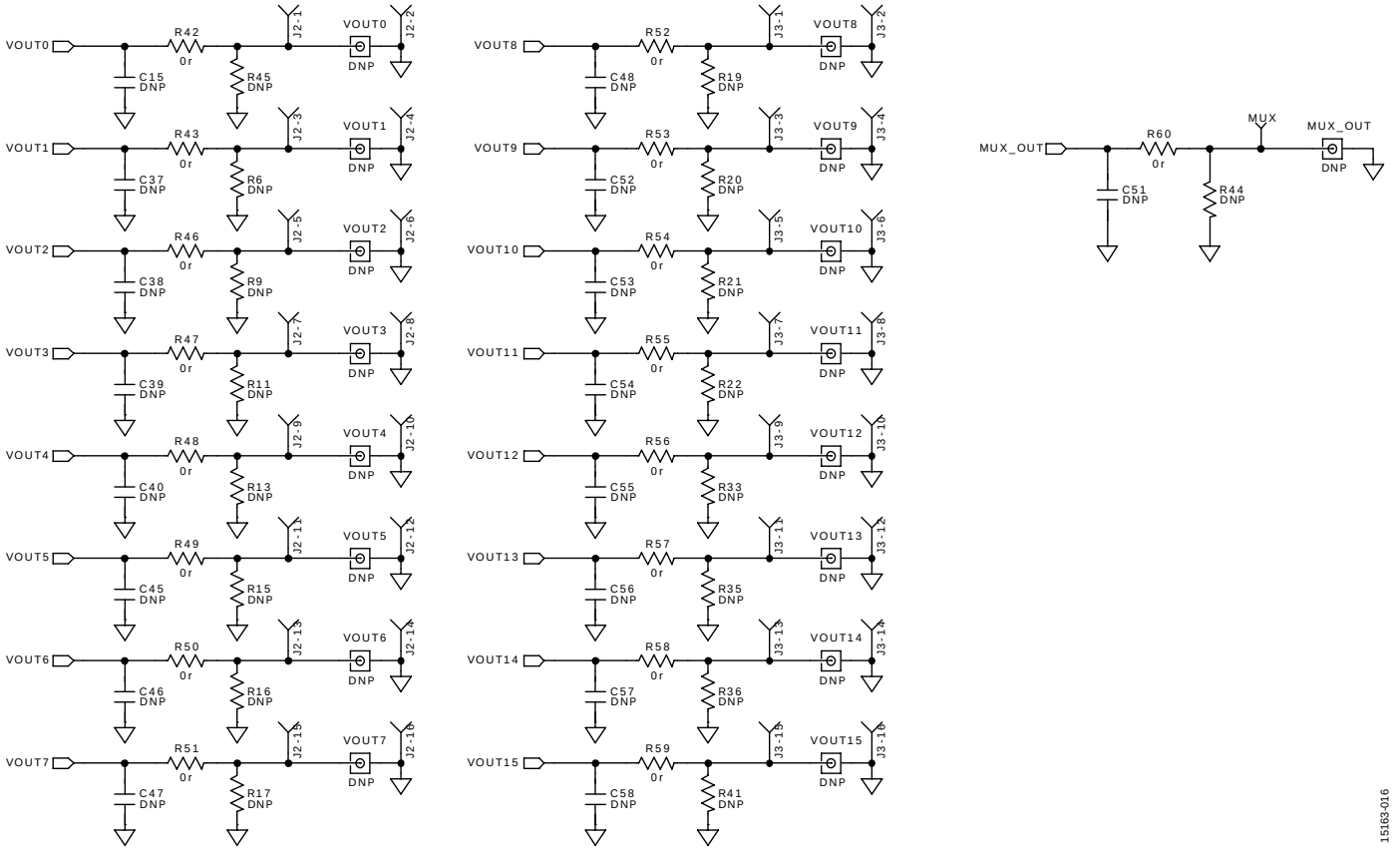

Figure 16. Channel Outputs

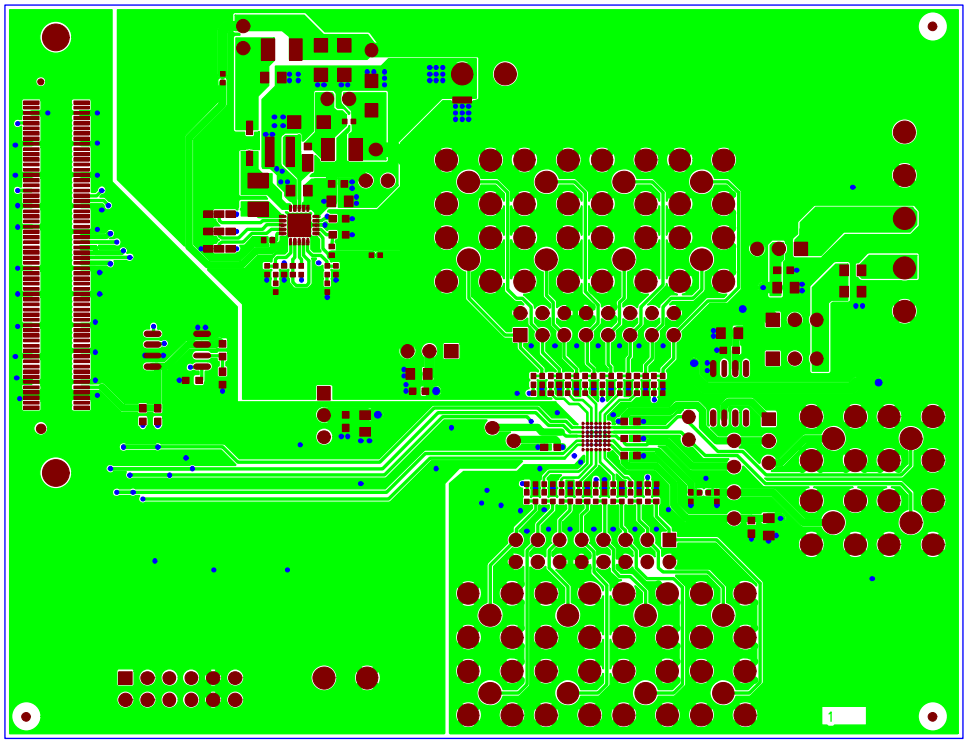

Figure 17. Top PCB Layer

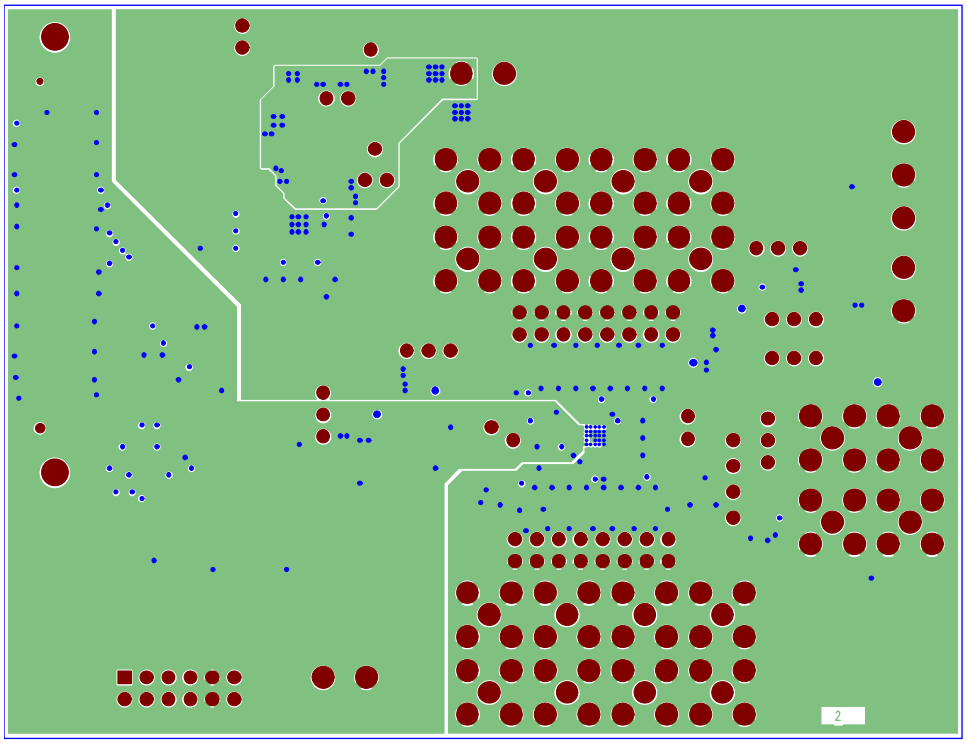

Figure 18. Inner First PCB Layer

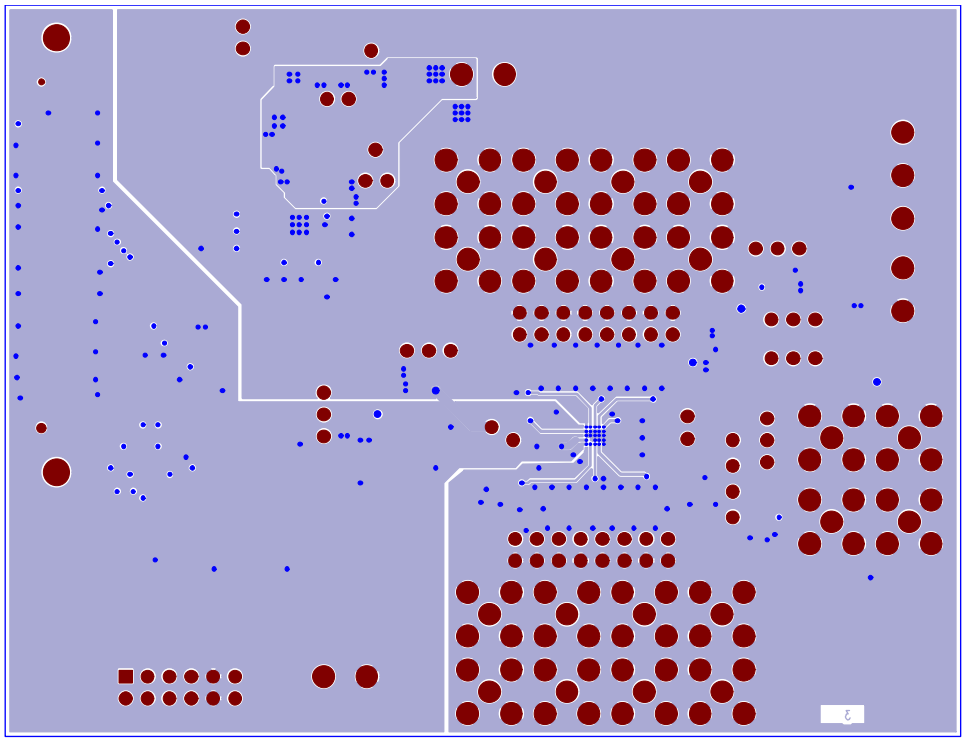

Figure 19. Inner Second PCB Layer

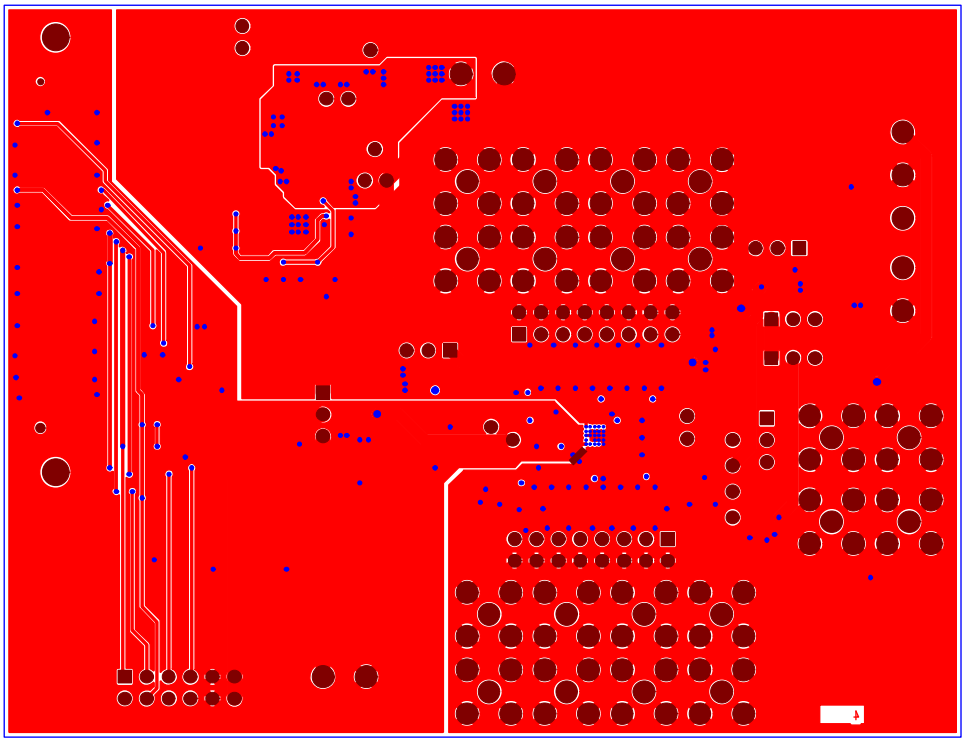

Figure 20. Bottom PCB Layer

ORDERING INFORMATION

BILL OF MATERIALS

Table 7.

Reference Designator	Description	Part Number	Stock Code
C1	Capacitor, 0805, X5R, 10 V, 10 µF, ±10%	GRM219R61A106KE44D	FEC 2346905
C4	Capacitor, 1210, C0G, 50 V, 33 pF, ±10%	MC0402N330K500CT	FEC 1845741
C5 C9, C13, C22, C23, C24, C27, C31, C69	Capacitors, 0603, C0G, 50 V, 0.1 µF, ±10%	GRM188R71H104KA93D	FEC 8820023
C6, C10, C12, C30, C36, C70,	Capacitors, 0805, C0G, 50 V, 0.1 µF, ±10%	GRM21BR71A106KE51L	FEC 1828828
C14	Capacitor, 0402, C0G, 50 V, 27 pF, ±10%	C0402C270K5GACTU	Digi-Key 399-8960-1-ND
C17, C18	Capacitors, 1206, X5R, 10 V, 10 µF, ±10%	C3216X5R1A106K160AB	FEC 1844306
C19, C26	Capacitors, 1206, X5R, 35 V, 10 µF, ±10%	GRM31CR6YA106KA12L	FEC 1797011
C25, C28	Capacitors, 0805, X5R, 10 V, 10 µF, ±10%	GRM21BR61A106KE19L	FEC 1828805
C29, C32	Capacitors, 0603, X5R, 6.3 V, 1 µF, ±10%	GRM188R60J105KA01D	FEC 9527699
C33	Capacitor, 0402, X7R, 16 V, 0.012 µF, ±10%	MC0402B123K160CT	FEC 1758886
C34	Capacitor, 0402, X5R, 16 V, 0.027 µF, ±10%	MC0402X273K160CT	FEC 1759382
C68	Capacitor, 0805, X7R, 50 V, 1 µF, ±10%	GRM21BR71H105KA12L	FEC 1735541
D1	Rectifier diode, single, 20 V, 500 mA, SOD-123, 2, 385 mV	MBR0520L	FEC 1467521
D2	Schottky diode	PD3S160-7	FEC 1843697
J1	120-way connector, 0.6 mm pitch	FX8-120S-SV(21)	FEC 1324660
J2, J3	16-pin (2× 8), 0.1 inch pitch, single inline (SIL) headers	M20-9980846	FEC 1022240
J9	3-pin terminal block (5 mm pitch)	CTB5000/3	FEC 151790
J10	PMOD connector	68021-212HLF	Digi-Key 609-3345-ND
J11, J12, J13	2-pin terminal blocks (5 mm pitch)	CTB5000/2	FEC 151789
L1, L2	Fixed inductors, 2.2 µH, 1.6 A, 76 MΩ SMD	LQH32PN2R2NN0L	Digi-Key 490-5336-2-ND
L3	Surface-mount power inductor	XFL4020-472MEC	FEC 2289218
L4	Fixed inductor 1.5 µH, 4.1 A, 46.8 MΩ	SPM4020T-1R5M	Digi-Key 445-172371-1-ND
L5	2.2 µH shielded multilayer inductor	AIML-0805-2R2K-T	Digi-Key 535-11631-2-ND
LK1 to LK5, LK7	3-pin SIL headers and shorting link	M20-9990345 & M7567-05	FEC 1022248 and FEC 150410
LK6, LK9, LK10	2-way resistor link options	MC 0.063W 0603 0R	FEC 9331662
LK8, LK11, LK12	2-pin (0.1 inch pitch) headers and shorting shunt	M20-9990246	FEC 1022247 and FEC 150-411
R4, R8, R24, R25	Resistors, 100 kΩ, 0.063 W, 1%, 0603	MC0063W06031100K	FEC 9330402
R14	Surface-mount chip resistor, ceramic, MCMR series, 255 kΩ, 62.5 mW, ±1%, 50 V	MCMR04X2553FTL	FEC 2072839
R23	Surface-mount chip resistor, thick film, AEC-Q200 CRCW series, 14.7 Ω, 63 mW, ±1%, 50 V	CRCW040214R7FKED	FEC 2140591
R26	Resistor, 82.5 kΩ, 0.0625 W, 1%, 0402	MC00625W0402182K5	FEC 1803742
R28	Resistor, 3.57 kΩ, 0.0625 W, 1%, 0402	MC00625W040213K57	FEC 1803091
R30	Resistor, 102 kΩ, 0.0625 W, 1%, 0402	MC00625W04021102K	FEC 1803752
R31	Resistor, 9.09 kΩ, 0.0625 W, 1%, 0402	MC00625W040219K09	FEC 1803134
R32	Resistor, 13.7 kΩ, 0.0625 W, 1%, 50 V, 0402	MCMR04X1372FTL	FEC 2072621
R34	Resistor, 11.8 kΩ, 0.063 W, 1%, 50 V, 0402	CRCW040211K8FKED	FEC 2140865
R37	Resistor, 19.6 kΩ, 0.0625 W, 1%, 50 V, 0402	MC00625W0402119K6	FEC 1803680
R38	Resistor, 30.1 kΩ, 0.063 W, 1%, 50 V, 0402	CRCW040230K1FKED	FEC 1469704
R42, R43, R46 to R60	Resistors, 0402, 1%, 0 Ω	MC00625W040210R	FEC 1357983
U1	16-channel, 12-bit voltage output denseDAC converters on EVAL-AD5767SD2Z	AD5767	AD5767BCBZ-WP
U1	16-channel, 16-bit voltage output denseDAC converters on EVAL-AD5766SD2Z	AD5766	AD5766BCBZ-WP
U4	64 kb I^2C serial EEPROM	24LC64-I/SN	FEC 9758070

Reference Designator	Description	Part Number	Stock Code
U6	2.5 V voltage reference	ADR4525BRZ	ADR4525BRZ
U7	2 A/1.2 A dc to dc switching regulator with independent positive and negative outputs	ADP5071ACPZ	ADP5071ACPZ

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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