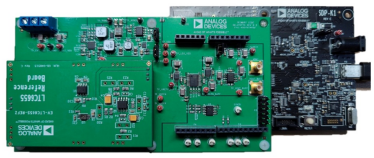
ANALOG DEVICES EVAL-AD5781ARDZ Evaluation Controller Board



ANALOG DEVICES EVAL-AD5781ARDZ Evaluation Controller Board User Guide

Contents

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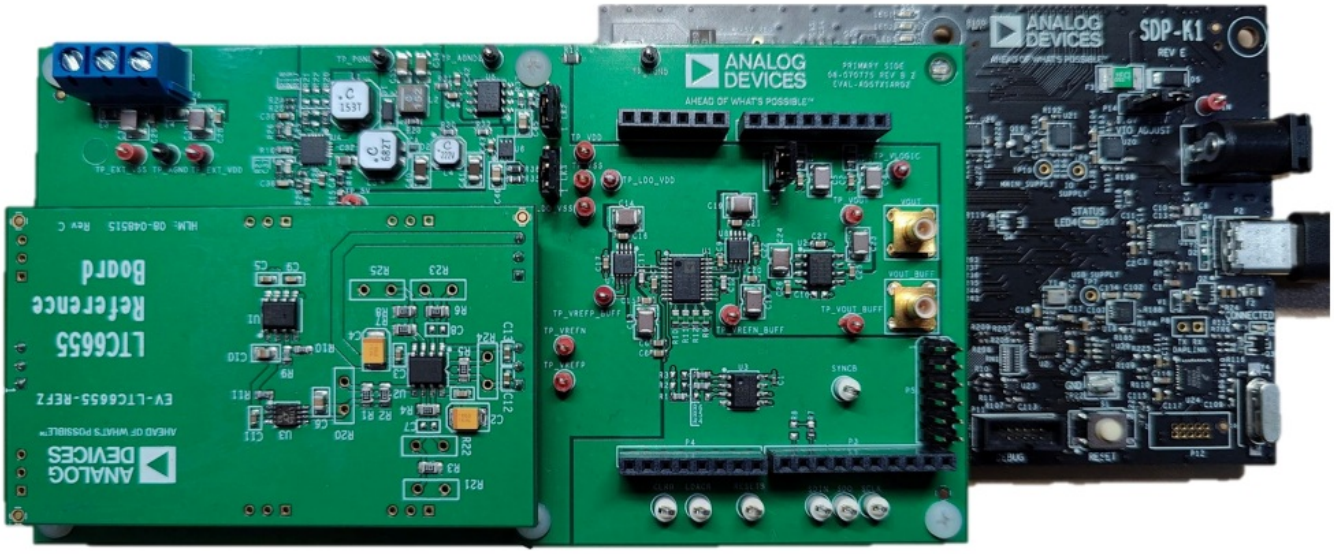

Product Information

- **Specifications:**
  - **Product Name:** EVAL-AD5781ARDZ/EVAL-AD5791ARDZ Output DACs
  - **Power Supply:** Single 5V supply
  - **DAC Resolution:** AD5781 (18-bit), AD5791 (20-bit)
  - **Power Supply on Evaluation Board:** -14V and +14V dual power supply
  - **External Reference Board Output Voltage:** +10V and -10V

Product Usage Instructions

- **Hardware and Software Requirements:**
  - To use the EVAL-AD5781ARDZ or EVAL-AD5791ARDZ, you will need the following:
  - EVAL-SDP-CK1Z (SDP-K1) controller board (purchased separately)
  - Analysis | Control | Evaluation (ACE) Software (available for download)
- **Typical Evaluation Setup:**
  - Refer to the AD5781 or AD5791 data sheets in conjunction with the user guide for a detailed evaluation setup. The evaluation boards are designed to facilitate fast prototyping of circuits.
- **Getting Started:**
  - **Installing the Software:** Download and install the ACE Software from the product page.
  - **Initial Setup:** Connect the EVAL-AD5781ARDZ or EVAL-AD5791ARDZ to the SDP-K1 controller board as shown in Figure 1.
  - **Evaluation Software:** Use the ACE Software for control and analysis of the DACs.
- **Evaluation Board Hardware:**
  - **The evaluation board features:**
    - **Power Supplies:** -14V and +14V dual power supply
    - **Link Options:** Various link options for connectivity
    - **On-Board Connectors:** Connectors for interfacing with external devices
    - **Voltage Reference Daughter Boards:** External reference boards with +10V and -10V output

FAQs

- **Q: What are the main features of the EVAL-AD5781ARDZ/EVAL-AD5791ARDZ?**
  - **A:** The main features include full-featured evaluation boards for the AD5781 and AD5791 DACs, power solution from a single 5V supply, PC control with compatible controller boards, and external reference boards for voltage output.
- **Q: How can I obtain the ACE Software for the evaluation boards?**
  - **A:** The ACE Software can be downloaded from the product page of EVAL-AD5781ARDZ or EVAL-AD5791ARDZ.

FEATURES

- Full-featured evaluation board for the AD5781 and AD5791
- ADP5070 power solution generated from a single 5 V supply
- Various link options
- PC control in conjunction with the Analog Devices Inc., EVALSDP- CK1Z (SDP-K1) controller board

EVALUATION KIT CONTENTS

- EVAL-AD5781ARDZ or EVAL-AD5791ARDZ evaluation board
- EV-ADR445-REFZ reference board

HARDWARE REQUIRED

- EVAL-SDP-CK1Z (SDP-K1) controller board, which must be purchased separately
- PC running on Windows® 10 (32-bit or 64-bit) or later

SOFTWARE REQUIRED

- Analysis | Control | Evaluation (ACE) Software, which is also available for download from the EVAL-AD5781ARDZ or EVALAD5791ARDZ product page

GENERAL DESCRIPTION

- The operation of the EVAL-AD5781ARDZ or EVAL-AD5791ARDZ for the AD5781 (18-bit) and AD5791 (20-bit), bipolar voltage output, digital-to-analog converters (DACs) are detailed in this user guide.
- Both the EVAL-AD5781ARDZ and EVAL-AD5791ARDZ facilitate fast prototyping of the AD5781 and AD5791 circuits, thereby reducing design time. Both the EVAL-AD5781ARDZ or EVAL-AD5791ARDZ provide an on-board −14 V and +14 V dual power supply. The evaluation boards also utilize external reference boards with an output voltage of +10 V and −10 V.
- The EVAL-AD5781ARDZ or EVAL-AD5791ARDZ interface to the USB port of a PC via a system demonstration platform (SDP-K1) controller board. The Analysis | Control | Evaluation (ACE) software is available for download from both the EVAL-AD5781ARDZ and EVAL-AD5791ARDZ product pages.
- This software enables the user to program the AD5781 and AD5791, respectively. A peripheral module interface (PMOD) connection is also available that allows the connection of different microcontrollers to the evaluation boards without the SDP-K1 controller board. Note that when a microcontroller is used through the

PMOD connection, the SDP-K1 controller board must be disconnected, and the user cannot use the ACE software.
- For full details, see the AD5781 or the AD5791 data sheets, which must be used in conjunction with this user guide when using the EVAL-AD5781ARDZ or EVAL-AD5791ARDZ evaluation boards.

TYPICAL EVALUATION SETUP

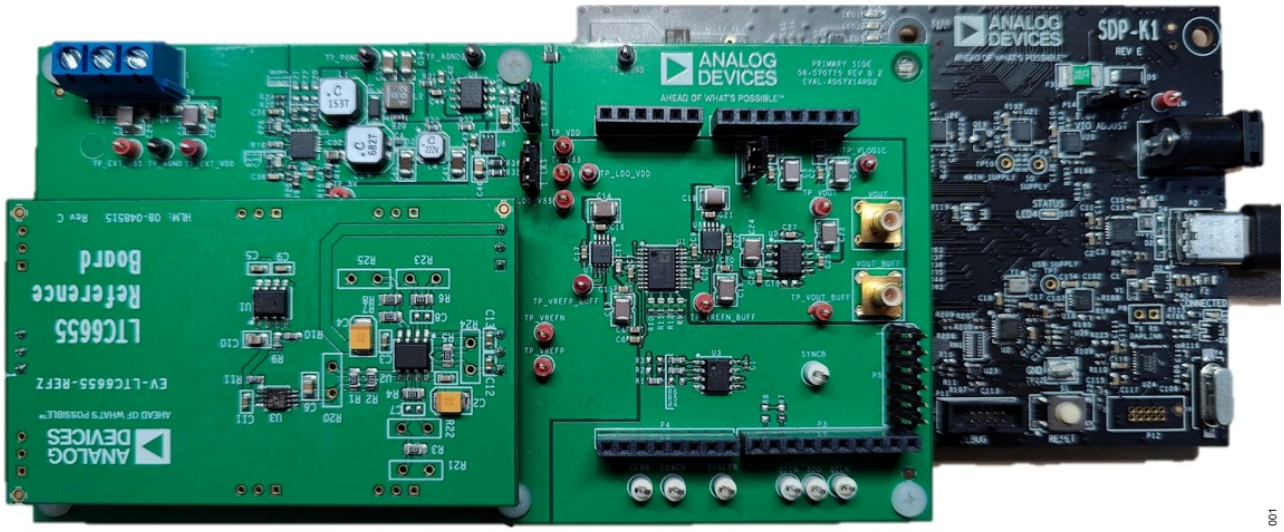

Figure 1. The EVAL-AD5781ARDZ Connected to the SDP-K1 Controller Board

- **DOCUMENT FEEDBACK**.
- **TECHNICAL SUPPORT**.

REVISION HISTORY

- **5/2024—Revision 0:** Initial Version

GETTING STARTED

INSTALLING THE SOFTWARE

- The EVAL-AD5781ARDZ and EVAL-AD5791ARDZ use the ACE Software, a software application that allows the evaluation and control of multiple evaluation systems.
- The ACE Software is available for download from the EVALAD5781ARDZ and EVAL-AD5791ARDZ product page or the ACE Software web page.
- The ACE Software installer installs the necessary SDP drivers and the Microsoft®.
- NET Framework 4 by default. The ACE Software must be installed before connecting the SDP-K1 controller board to the USB port of the PC to ensure that the SDP-K1 controller board is recognized when connected to

the PC. For full instructions on how to install and use this software, see the ACE Software web page on the Analog Devices, Inc., website.

- After the installation is finished, run the ACE Software and the EVAL-AD5781ARDZ or EVAL-AD5791ARDZ plug-in appears automatically.

INITIAL SETUP

To set up the EVAL-AD5781ARDZ or EVAL-AD5791ARDZ, take the following steps:

1. Connect the evaluation board to the SDP-K1 controller board, and then connect the USB cable between the SDP-K1 controller board and the PC.
2. Run the ACE Software application. The EVAL-AD5781ARDZ or EVAL-AD5791ARDZ plug-ins appear in the attached hardware section of the Start tab, as shown in Figure 2.
3. Double-click the board plug-in to open the Board View seen in Figure 3.
4. Double-click the AD5781 or the AD5791 chip to access the chip block diagram shown in Figure 4. This view provides a basic representation of the functionality of the board, together with the INITIAL CONFIGURATION view. See Figure 5 and Table 1 for details on the registers of the board.

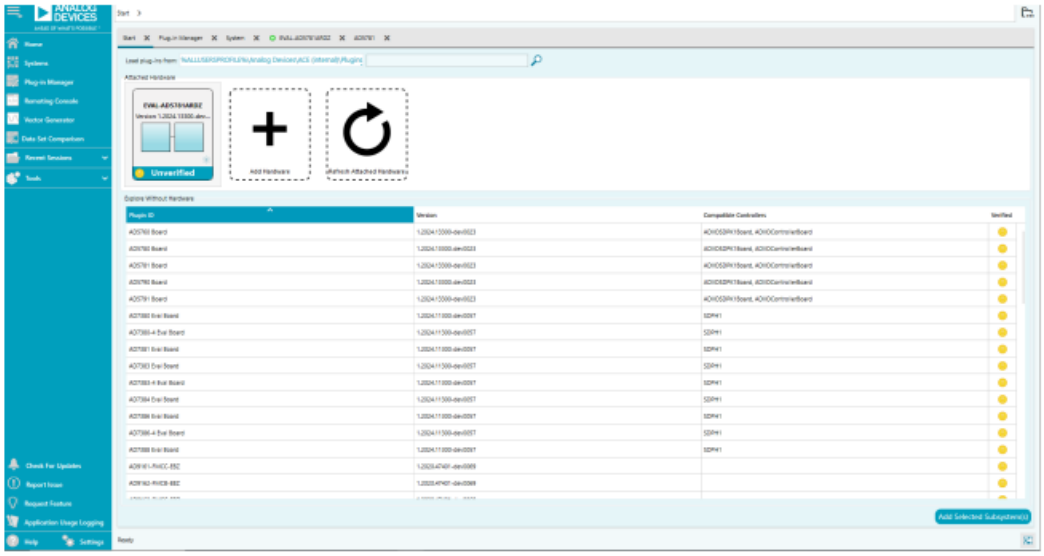

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Figure 2. ACE Software Main Window

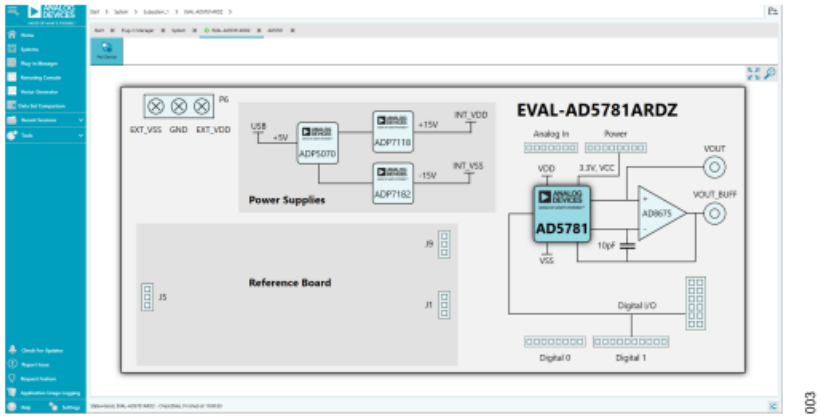


Figure 3. Board View of the EVAL-AD5781ARDZ

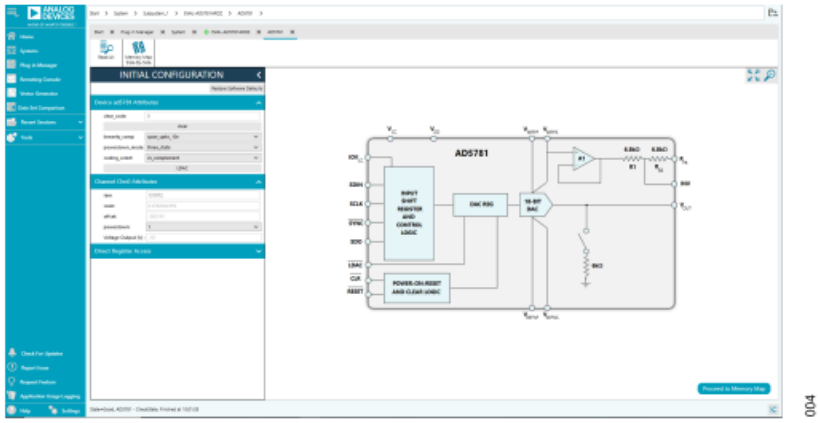


Figure 4. Chip View of the EVAL-AD5781ARDZ

EVALUATION SOFTWARE

INITIAL CONFIGURATION TAB AND DESCRIPTION

- The EVAL-AD5781ARDZ and EVAL-AD5791ARDZ software has an INITIAL CONFIGURATION tab. This tab provides access to the software attributes that align to the registers of the AD5781 or AD5791, as outlined in the AD5781 or AD5791 data sheets.
- This tab simplifies the process of understanding how the attributes of the software directly relate to the registers found in the data sheets. For a full description of each register and its settings, see the AD5781 or AD5791 data sheet.
- Some of the functions are described in this section as these functions pertain to the evaluation board. Changes made in the registers of the INITIAL CONFIGURATION tab are automatically reflected in the EVAL-AD5781ARDZ or EVAL-AD5791ARDZ.

Figure 5. AD5781 Block Diagram with the INITIAL CONFIGURATION Tab

Table 1. Register Functions

Button/Function Name	Function
INITIAL CONFIGURATION Tab	Users can initially set the default configuration for the device within this tab. These settings can be modified at any stage while evaluating the EVAL-AD5781ARDZ or EVAL-AD5791ARDZ. The registers reflected in this window depend on the loaded firmware.
Clear_code	The clear_code register sets the value of the DAC register when the **clear** button is asserted. The input range for the AD5781 is from 0 to 262143 (0x0 to 0x3FFFF). The input range for the AD5791 is from 0 to 1048575 (0x0 to 0xFFFFF).
clear	Click this button for external GPIO pulses to be sent to the CLR pin.
linearity_comp	This attribute compensates for varying reference input to improve performance. AD5781 settings: **span_upto_10V** or **span_10V_to_20V.** AD5791 settings: **span_upto_10V**, **span_12V_to_16V**, **span_16V_to_19V**, or **span_19V_to_20V**.
powerdown_mode	This attribute relates to the **power-down** attribute. This selects the type of power down when **power down** is 1. Selecting **three_state** sets the DAC output to tristate mode. Selecting **6kohm_to_gnd** sets the DAC output to be clamped to the ground through a 6 kΩ resistance and is placed in tristate mode.
coding_select	Use this pull-down menu to set the coding scheme of the DAC register.
LDAC	Click this button for external GPIO pulses to be sent to the LDAC pin. The **LDAC** button pushes data from the input register to the DAC register. In the software, this button is only required if the **Direct Register Access** section is used.

Button/Function Name	Function
raw	This field allows users to set the value of the DAC register. The input is decimal by default; however, the hexadecimal value can also be used by inserting **0x** as the prefix. The input range for the AD5781 is from 0 to 262143 (0x0 to 0x3FFFF). The input range for the AD5791 is from 0 to 1048575 (0x0 to 0xFFFFF).
scale	This field allows users to represent the value of the DAC LSB in mV. This field is a read-only attribute. Note that this field is only applicable if a reference board is used.
offset	This field allows users to set the position of the zero-scale. The unit is in code. This field is a read-only attribute. Note that this field is only applicable if a reference board is used.
power down	This pulldown menu allows users to power down the output stage of the device based on the setting of the **powerdown_mode** attribute.
Voltage Output (V)	This field represents the calculated value across the output of the DAC. This value can be computed by (**raw** + **offset**) × **scale**. This field is a read-only attribute. Note that this is only applicable if a reference board is used.
Direct Register Access	This section can be used to manually write to or read from a register in the AD5781 or AD5791. It is recommended to use this tab for debugging purposes only, which may cause inconsistency between the value of the attributes and the DAC registers

MEMORY MAP

- All registers are fully accessible from the AD5781 Memory Map or AD5791 Memory Map tab, see Figure 6. This tab allows registers to be edited at the bit level. The bits shaded in dark grey are read-only and cannot be accessed from the ACE Software. All other bits are toggled.
- Click Apply Changes to transfer data to the device. All changes or configurations made in the AD5781 Memory Map or AD5791 Memory Map tab are not reflected in the INITIAL CONFIGURATION tab. Any bits or registers that are shown in bold in the AD5781 Memory Map or AD5791 Memory Map tab are modified values that have not been transferred to the evaluation board (see Figure 7). Click Apply Changes to transfer the data to the EVAL-AD5781ARDZ or EVAL-AD5791ARDZ.
- The AD5781 Memory Map or AD5791 Memory Map and bit field tabs serve as tools for debugging purposes only. These tabs can cause glitches in the INITIAL CONFIGURATION tab functions in the user interface. The INITIAL CONFIGURATION tab is still the recommended tab for use for quick evaluation of the EVALAD5781ARDZ or EVAL-AD5791ARDZ.

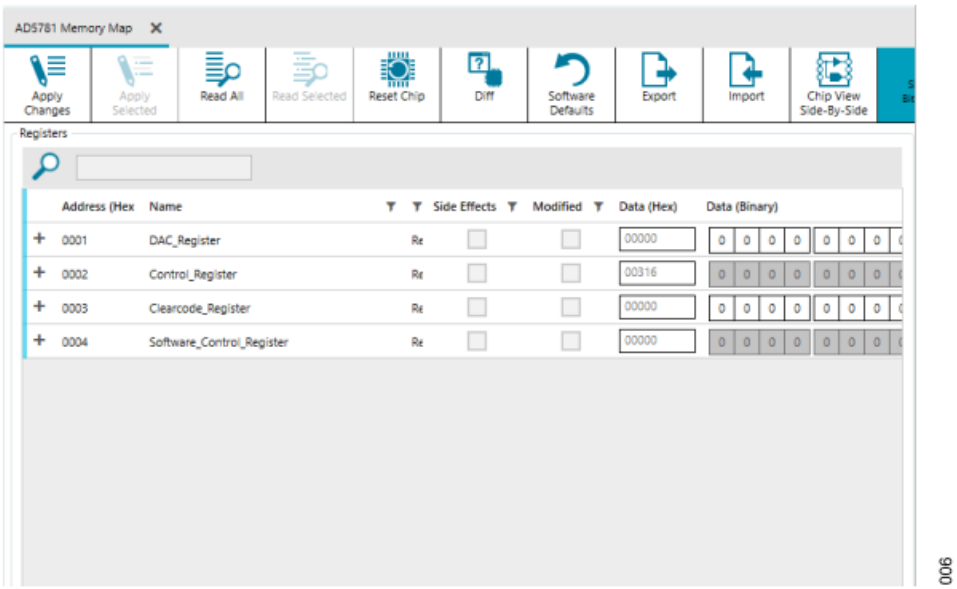


Figure 6. AD5781 Memory Map Tab

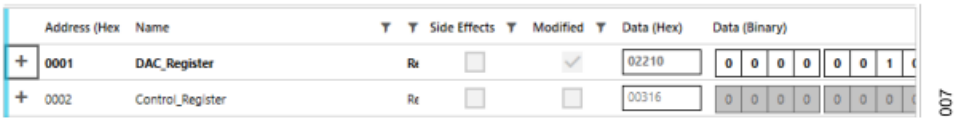


Figure 7. AD5781 Memory Map with Unapplied Changes in the DAC_Register

EVALUATION BOARD HARDWARE

POWER SUPPLIES

- The EVAL-AD5781ARDZ and EVAL-AD5791ARDZ provide –14 V and +14 V supplies using the on-board ADP5070 from a single 5
- V supply sourced from the SDP-K1 controller board. If a different supply is required or if the evaluation board is controlled through the PMOD connector, an external supply must be provided by the external supply voltage (EXT_VDD and EXT_VSS) connector. See

- Table 2 for more details.
- Every supply is decoupled to ground with 10 µF and 0.1 µF capacitors.
- Note that when supplying beyond the 14 V to 16 V range across EXT_VDD, it is recommended to use an external voltage reference.

Table 2. Power Supply Connectors

Connector Label	External Voltage Supplies Description
EXT_VDD	External analog positive power supply. Recommended
	supply is +15 V.
AND	Analog ground.
EXT_VSS	External analog negative power supply. Recommended
	supply is –15 V.

LINK OPTIONS

Several link options are incorporated on the EVALAD5781ARDZ or EVAL-AD5791ARDZ and must be set for the required operating conditions before using the board. The functions of these link options are described in Table 3.

Table 3. Link Functions

Link	Description
LK1	This link connects the 5 V supply from SDP-K1 to the on-board **ADP5070** DC-to-DC converter supply. This link is connected by default.
LK2	This link selects the VDD power supply source. Two options are available, as follows: Position 1-2 selects the on-board power supply, LDO_VDD (default). Position 2-3 selects the external power supply, EXT_VDD.
LK3	This link selects the VSS power supply source. Two options are available, as follows: Position 1-2 selects the on-board power supply, LDO_VSS (default). Position 2-3 selects the external p ower supply, EXT_VSS.

ON-BOARD CONNECTORS

Table 4 shows the connectors on the EVAL-AD5781ARDZ or EVALAD5791ARDZ.

Table 4. On-Board Connectors

Table 4. On-Board Connectors

Connector	Function
J1 to J9	Voltage reference daughter board connectors
VOUT	DAC output
VOUT_BUFF	DAC output with amplifier

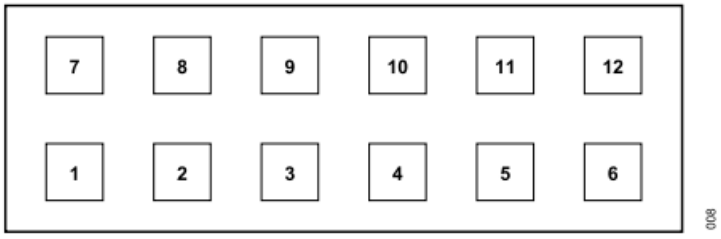


Figure 8. PMOD Pin Layout

Table 5. PMOD Connector Pin Descriptions

Pin Number	Descriptions
1	SYNCB
2	SDIN
3	SDO
4	SCLK
5, 11	DGND
6, 12	VLOGIC
7	$\overline{\text{LDAC}}$
8	$\overline{\text{RESET}}$
9	$\overline{\text{CLR}}$
10	NC

VOLTAGE REFERENCE DAUGHTER BOARDS

- The daughter boards inserted into the J1, J4 and J9 connectors include a voltage reference. The voltage supplied by the voltage references is gained up and inverted to provide both the positive and negative reference voltages required by the **AD5781** and **AD5791**.
- The EVAL-AD5781ARDZ and EVAL-AD5791ARDZ evaluation kits include the **EV-ADR445-REFZ** reference board to complete the hardware required to evaluate the AD5781 and AD5791, respectively.
- The **ADR445** is a 5 V low noise reference with 3 ppm/°C maximum temperature drift and 2.25 µV p-p noise specifications across the operating temperature range.
- The **EV-LTC6655-REFZ** and **EV-LTZ1000-REFZ** reference boards including the **LTC6655** and **LTZ1000** voltage references, respectively, are also available to evaluate the AD5781 and AD5791. These boards can be purchased separately via the **EVAL-AD5781** and **EVAL-AD5791** web pages.
- The LTC6655 reference board offers improved noise and temperature drift performance over the ADR445 solution. The LTC6655 is a low noise, low drift precision reference with 2 ppm/°C temperature drift and 1.25 µV p-p noise.
    - The LTZ1000 reference board components maintain the accuracy of the AD5781 and AD5791. The LTZ1000 is a 7.2 V ultraprecision reference specified with 0.05 ppm/°C temperature drift and ultralow 1.2 µV p-p noise. the LTZ1000 voltage reference is used in conjunction with low-drift amplifiers (**ADA4077-2**) and a low-drift, thermally matched resistor for the scaling and gain circuits. Place a cover over the reference board to reduce thermal errors due to air current flowing over the reference board.

EVALUATION BOARD SCHEMATICS

Figure 9. EVAL-AD5781ARDZ and EVAL-AD5791ARDZ Schematic, SDP, Arduino-Compatible, and PMOD Connectors

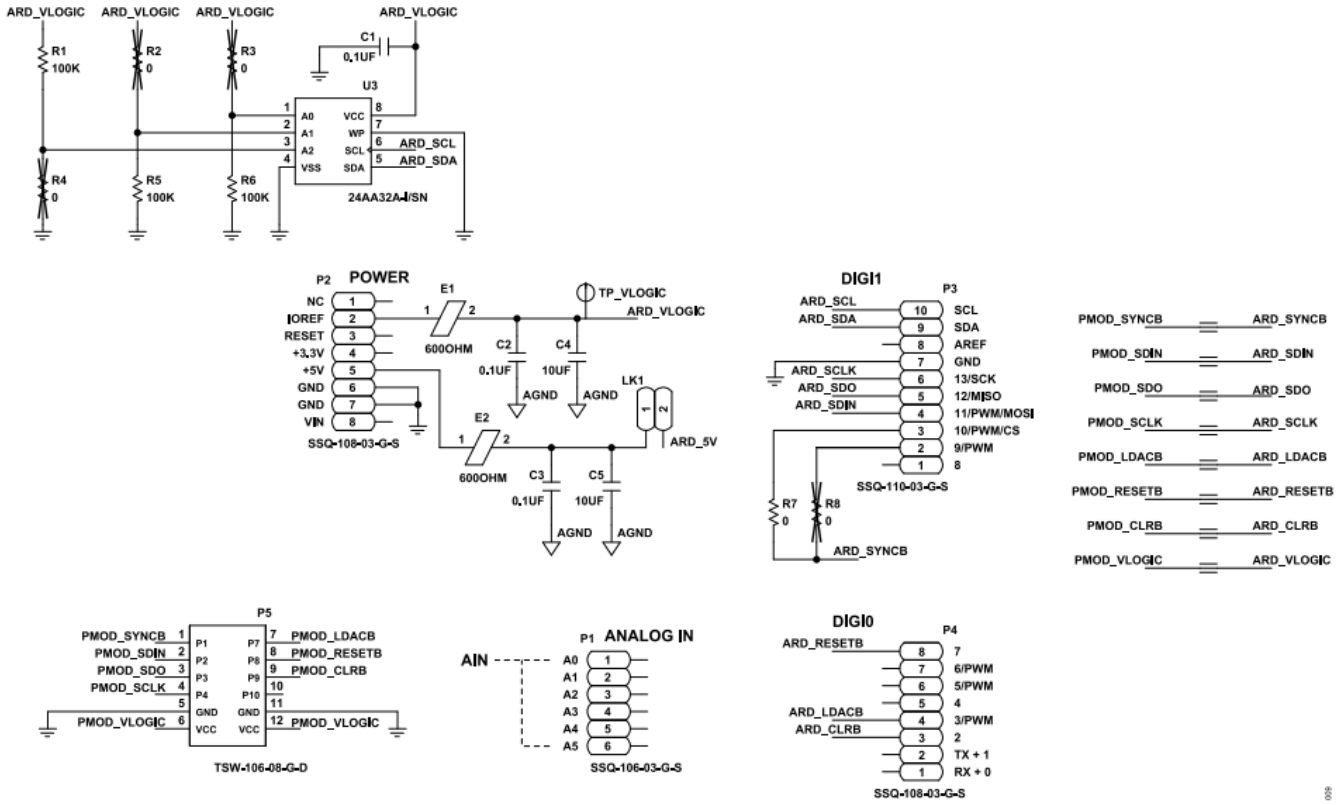


Figure 10. EVAL-AD5781ARDZ Schematic, Main Circuitry

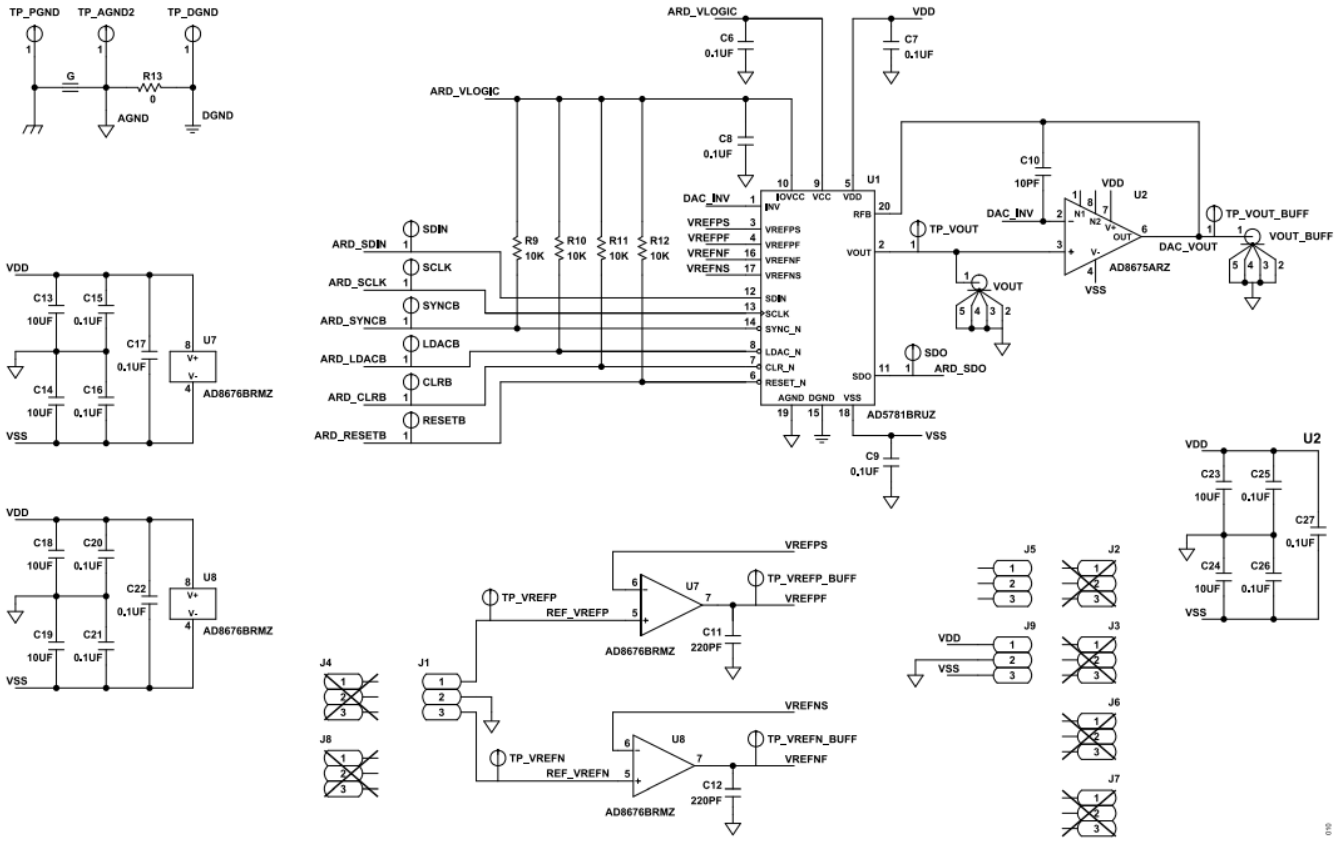


Figure 11. EVAL-AD5791ARDZ Schematic, Main Circuitry

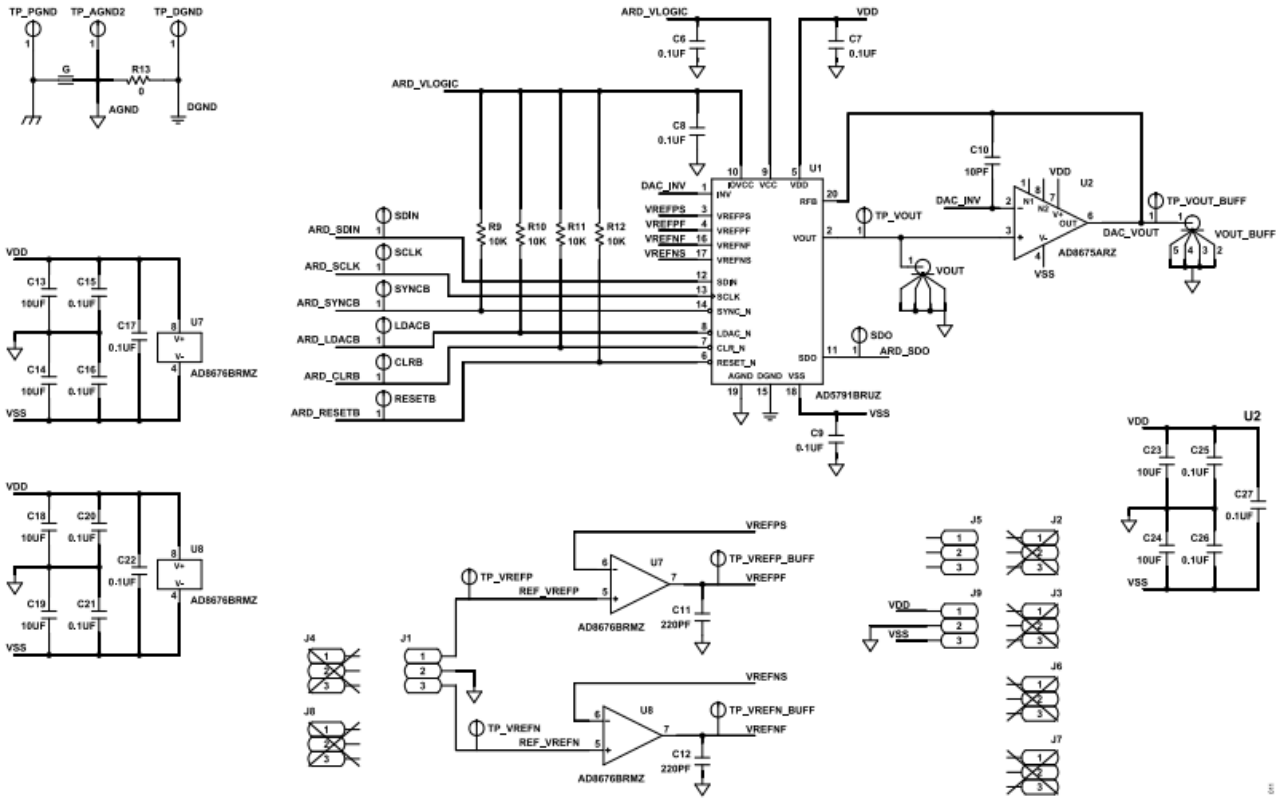


Figure 12. EVAL-AD5781ARDZ and EVAL-AD5791ARDZ Schematic, Power Circuitry

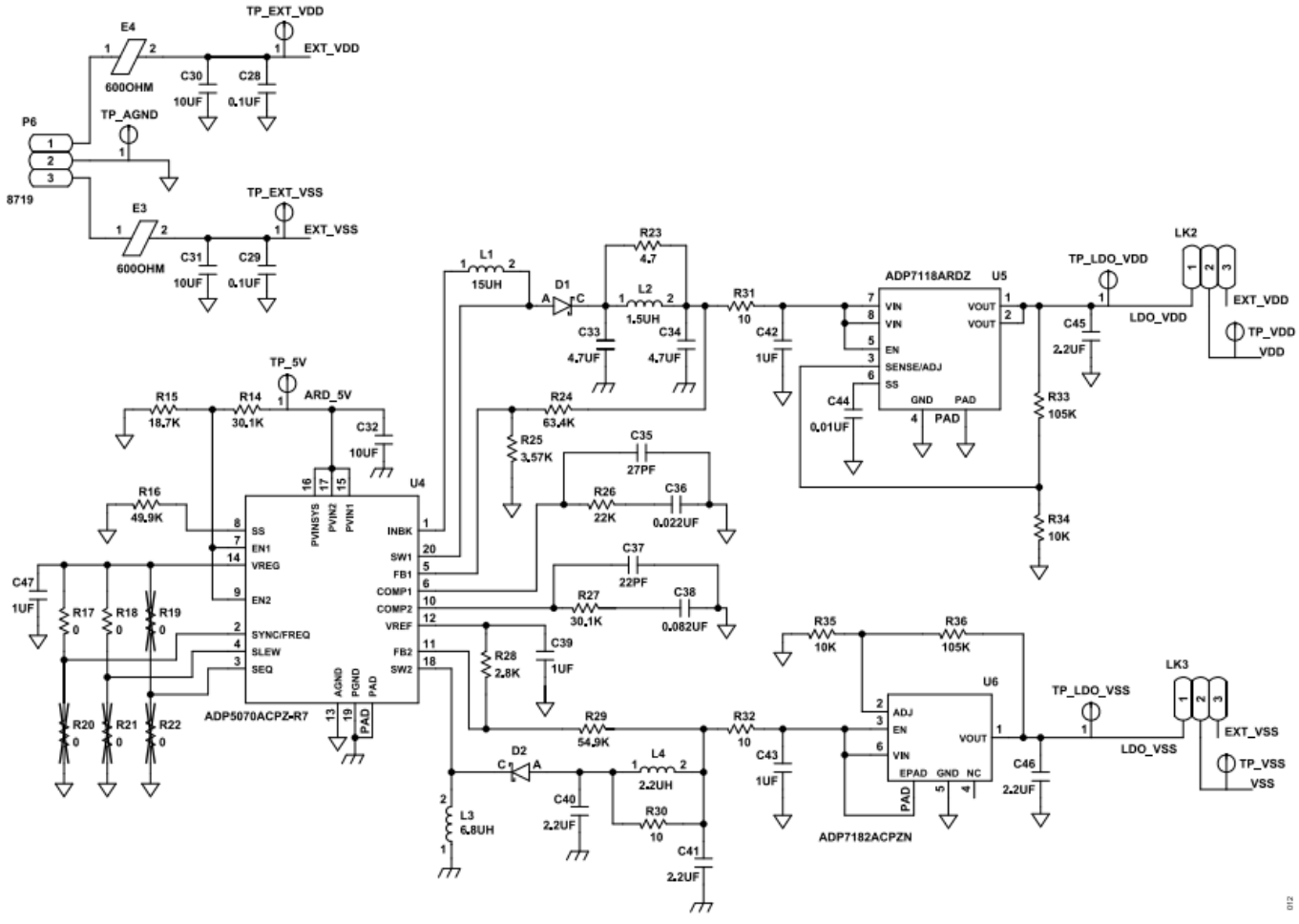


Figure 13. EV-ADR445-REFZ Schematic

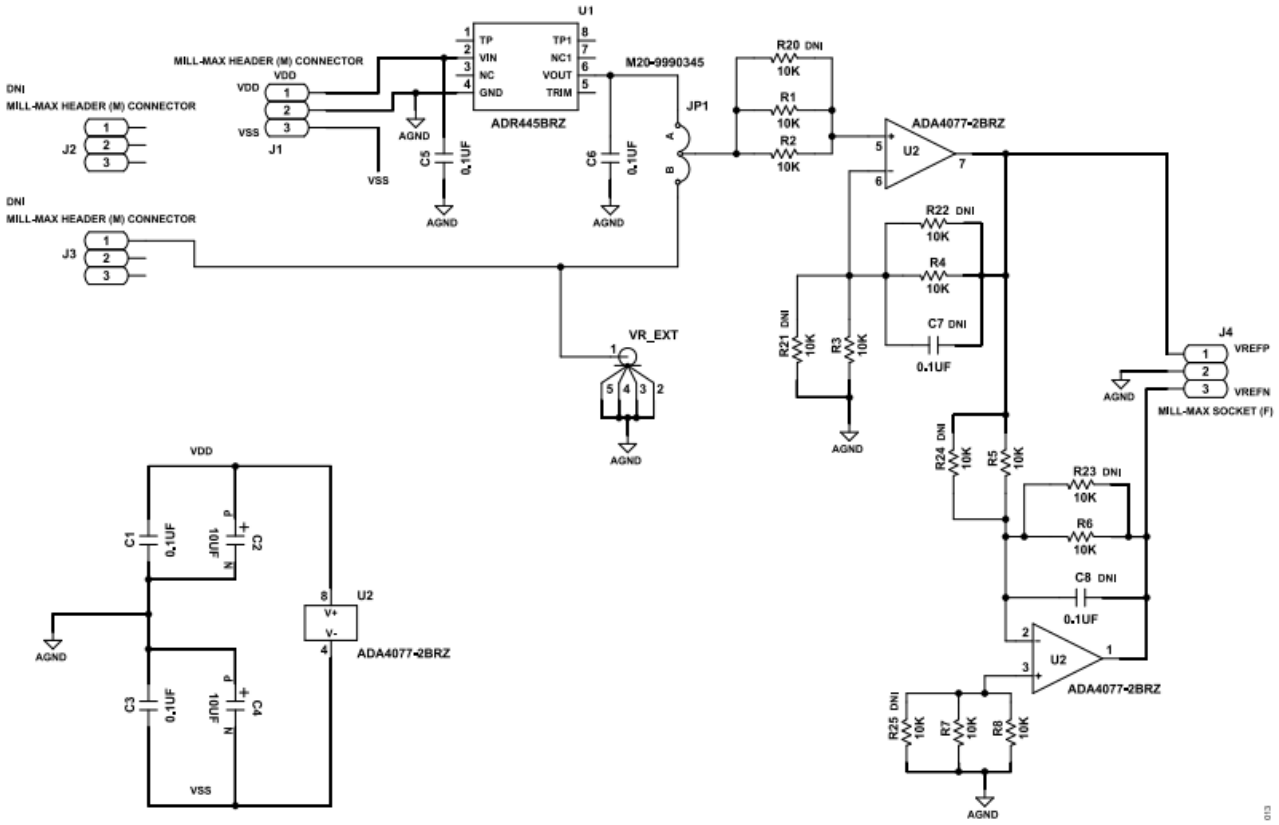


Figure 14. EV-LTC6655-REFZ Schematic

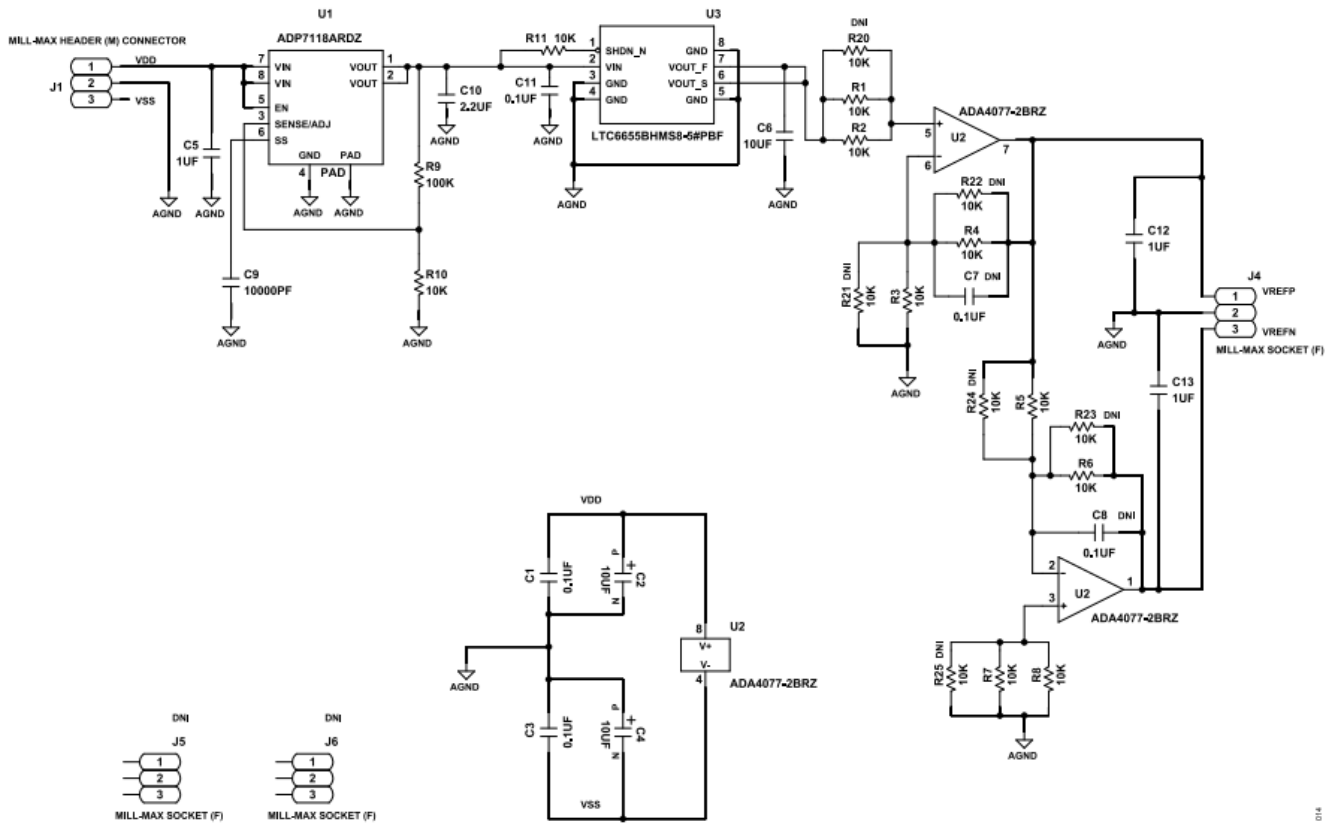
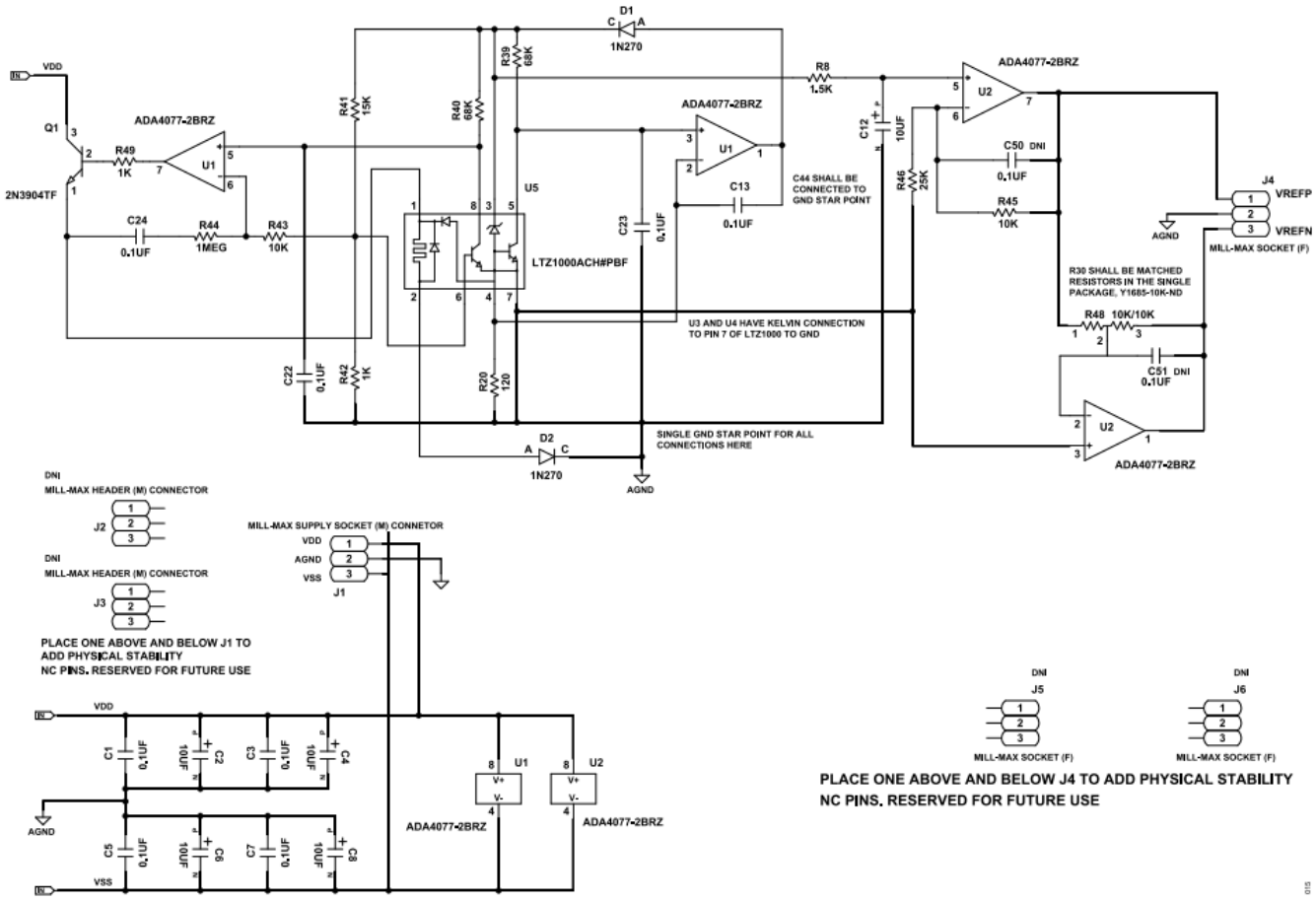


Figure 15. EV-LTZ1000-REFZ Schematic



Documents / Resources

	ANALOG DEVICES EVAL-AD5781ARDZ Evaluation Controller Board [pdf] User Guide AD5781, AD5791, EVAL-AD5781ARDZ Evaluation Controller Board, EVAL-AD5781ARDZ, Evaluation Controller Board, Controller Board, Board

References

- User Manual