Evaluating the AD7177-2 32-Bit, 10 kSPS, Sigma-Delta ADC with 100 μs Settling and Integrated Analog Input Buffers

FEATURES
Full featured evaluation board for the AD7177-2
PC control in conjunction with the system demonstration platform (SDP), see the EVAL-SDP-CB1Z data sheet for additional information
PC software for control and data analysis (time domain)
Standalone capability

EVALUATION KIT CONTENTS
EVAL-AD7177-2SDZ evaluation board
AD7177-2
AD717x Eval+ evaluation software (CD)
7 V to 9 V ac-to-dc adapter
Plastic screw and washer set

EQUIPMENT NEEDED
DC signal source
PC running Windows® XP, Windows 8, or Windows 10

GENERAL DESCRIPTION
The EVAL-AD7177-2SDZ evaluation kit features the AD7177-2, a 32-bit, 10 kSPS analog-to-digital converter (ADC) with integrated rail to rail analog input buffers, on-board power supply regulation, and an external amplifier section for amplifier evaluation. A 7 V to 9 V ac-to-dc adapter is regulated to 5 V and 3.3 V that supplies the AD7177-2 and supports its components. The EVAL-AD7177-2SDZ evaluation board connects to the USB port of a PC via the EVAL-SDP-CB1Z (SDP-B) controller board.

The AD717x Eval+ software fully configures the AD7177-2 device functionality via an interactive block diagram and a user accessible register interface, and provides dc time domain analysis in the form of waveform graphs, histograms, and associated noise analysis for ADC performance evaluation.

For full specifications, see AD7177-2 data sheet, which must be consulted in conjunction with this user guide when using the evaluation board.

Figure 1.
# TABLE OF CONTENTS

- Features .......................................................................................................................... 1
- Evaluation Kit Contents .................................................................................................. 1
- Equipment Needed ........................................................................................................... 1
- General Description ........................................................................................................ 1
- EVAL-AD7177-2SDZ Functional Block Diagram .......................................................... 1
- Revision History ............................................................................................................. 2
- EVAL-AD7177-2SDZ Quick Start Guide ........................................................................... 4
- Recommended Quick Start Guide .................................................................................... 4
- Quick Start Noise Test ...................................................................................................... 4
- Evaluation Board Hardware ............................................................................................ 5
  - Device Description ....................................................................................................... 5
  - Hardware Link Options ................................................................................................. 5
- Sockets and Connectors ................................................................................................. 6
- Serial Interface ................................................................................................................. 7
- Power Supplies ............................................................................................................... 7
- Power Supply Configurations ........................................................................................ 8
- Analog Inputs .................................................................................................................. 8
- Reference Options .......................................................................................................... 8
- Evaluation Board Software Installation ......................................................................... 9
- Installing the AD717x Eval+ Software .......................................................................... 9
- Installing the Eval+ Dependencies ................................................................................. 10
- Setting Up the System for Data Capture ...................................................................... 11
- Evaluation Board Software Operation ........................................................................... 13
  - Overview of the Main Window .................................................................................... 13
  - Configuration Tab ....................................................................................................... 13
  - Waveform Tab ............................................................................................................ 16
  - Histogram Tab ............................................................................................................ 18
  - Modelled Performance Tab ....................................................................................... 19
  - Registers Tab .............................................................................................................. 22
  - Exiting the Software .................................................................................................. 22
- Evaluation Board Schematics and Artwork .................................................................. 23
- Ordering Information .................................................................................................... 31
- Bill of Materials ............................................................................................................. 31

## REVISION HISTORY

**8/2018 — Rev. 0 to Rev. A**
- Reorganized Layout ........................................................................................................ Universal
- Changes to Evaluation Kit Contents Section, Equipment Needed Section, and General Description Section .......................................................... 1
- Changes to Table 1 ........................................................................................................ 4
- Changes to Table 2 ........................................................................................................ 6
- Changes to Single-Supply (Unregulated) Section, Split Supply (Regulated) Section, Split Supply (Unregulated) Section, and Analog Inputs Section .......................................................... 7
- Deleted Software Installation Section, Figure 4, and Figure 5; Renumbered Sequentially ............................................................................................... 9
- Added Installing the AD717x Eval+ Software Section, Figure 4, and Figure 5; Renumbered Sequentially .......................................................... 9
- Added Figure 6, Figure 7, Installing the Eval+ Dependencies Section, Figure 8, and Figure 9 ................................................................................................................. 10
- Added Figure 10, Installing the .NET Framework 3.5 for Windows 8/Windows 10 Section, Figure 11, and Setting Up the System for Data Capture Section .......................................................... 11
- Added Figure 13, Figure 14, and Figure 15 .................................................................... 12
- Changes to Launching the Software Section ................................................................ 12
- Deleted ADC Reset Section, Functional Block Diagram Section, Pop-Up Button Section, and Channel Configuration Overview Section ................................................................................................................. 13
- Added Select Product/Evaluation Mode Pane Section, Tutorial Icon Section, Functional Block Diagram and Configuration Pop-Up Buttons Section, and Analog and Digital Supply Voltage Section ................................................................................................................. 13
- Changed Software Operation Section Heading to Evaluation Board Software Operation Section .......................................................... 13
- Changes to Figure 16, Overview of the Main Window Section, Configuration Tab Section, and External Reference Section ................................................................................................................. 13
- Added Register Configuration Summary Section, Reset ADC Section, Menu Bar Section, and Device Error Section ................................................................................................................. 13
- Changes to Status Bar Section ....................................................................................... 14
- Added Figure 17, External MCLK Frequency Section, Analog Input Voltage Section, and External SCLK Frequency Section ................................................................................................................. 15
- Deleted CRC Error Section ........................................................................................... 16
- Added Figure 18 and Sampling Mode Section ................................................................ 16
- Changes to Samples Section, Sample Section, Waveform Graph and Controls Section, Channel Selection Section, Noise Analysis Pane Section, and Analysis Channel Section ................................................................................................................. 16
- Changes to Display Units and Axis Controls Section .................................................. 17
- Changes to Histogram Tab Section, Histogram Graph and Controls Section, and Figure 19 ................................................................................................................. 18
- Added Figure 20, Modelled Performance Tab Section, Modelled Performance Analysis Channel Section, Filter Profile Graph Section, Filter Rejection Section, and Filter Performance Section ................................................................................................................. 19
- Added Figure 21, Filter Step Response Section, Step Response Graph Section, Step Configuration Section, Step Response Section, and Graph Units Section ................................................................................................................. 20
- Added Figure 22, Timing Diagram/Power Section, Estimated Power Consumption Section, and Timing Diagram Section ................................................................................................................. 21
- Deleted Register Map Tab Section ................................................................................ 22
- Added Registers Tab Section .......................................................................................... 22
Changes to Figure 23, Register Tree Section, Register Section, Bitfields Section, Documentation Section, Save and Load Section, and Exiting the Software Section .................................................. 22
Added Evaluation Board Schematics and Artwork Section and Figure 24 ................................................................. 23
Added Figure 25 ........................................................................... 24
Added Figure 26 ........................................................................... 25
Added Figure 27 ........................................................................... 26
Added Figure 28 ........................................................................... 27
Added Figure 29 and Figure 30 ..................................................... 28
Added Figure 31 and Figure 32 ..................................................... 29
Added Figure 33 and Figure 34 ..................................................... 30
Added Ordering Information Section, Bill of Materials Section, and Table 4 ................................................................. 31

6/2015—Revision 0: Initial Version
EVAL-AD7177-2SDZ QUICK START GUIDE

RECOMMENDED QUICK START GUIDE

To set up the evaluation board, take the following steps:

1. Disconnect the SDP-B board from the USB port of the PC.
2. Install the AD717x Eval+ software from the enclosed CD.
3. Restart the PC after installation.
4. Connect the SDP-B board to the EVAL-AD7177-2SDZ evaluation board, as shown in Figure 2.
5. Fasten the two boards together with the enclosed plastic screw and washer set.
6. Connect the external 9 V power supply to the J5 connector of the evaluation board as shown in Figure 2. Set Link LK2 to Position B.
7. Connect the SDP-B board to the PC via the USB cable. For Windows® XP, search for the SDP-B drivers. If prompted by the Windows operating system, choose to automatically search for the SDP-B drivers.
8. Launch the AD717x Eval+ software from the Analog Devices subfolder in the Programs menu.

QUICK START NOISE TEST

To test the noise performance, take the following steps:

1. Insert Link LK8 to Link LK12 to initiate the noise performance test mode. In this mode, the analog input channels short to the REFOUT pin.
2. Click Sample to acquire samples from the ADC (see Figure 16).

The Samples text field in the top right corner of the main window sets the number of samples collected in each batch (see Figure 16).

Figure 2. Hardware Configuration, Setting Up the EVAL-AD7177-2SDZ Evaluation Board
EVALUATION BOARD HARDWARE

DEVICE DESCRIPTION

The AD7177-2 is a highly accurate, high resolution, multiplexed, 2-/4-channel (fully differential/single-ended) Σ-Δ ADC. The AD7177-2 has a maximum channel-to-channel scan rate of 10 kSPS (100 µs) for fully settled data. The output data rates range from 5 SPS to 10 kSPS. The device includes integrated rail-to-rail analog input and reference input buffers, an integrated precision 2.5 V reference, and an integrated oscillator.

See the AD7177-2 data sheet for complete specifications. Full details for the SDP-B board are available on the SDP-B product page on the Analog Devices website.

HARDWARE LINK OPTIONS

See Table 1 for default link options. By default, the EVAL-AD7177-2SDZ is configured to operate from the supplied 9 V ac-to-dc adapter connected to the J5 connector. The 5 V supply required for the AD7177-2 comes from the ADP7118 on-board, low dropout (LDO) regulator. The ADP7118, with a 5 V output voltage, receives its input voltage from the J3 connector or the J5 connector, depending on the position of LK2, and generates a 5 V output.

<table>
<thead>
<tr>
<th>Link</th>
<th>Default Option</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>LK1</td>
<td>A</td>
<td>Selects the voltage applied to the power supply sequencer circuit (U3); dependent on AVDD1. Place in Position A if using 5 V supply for AVDD1, or Position B if using 2.5 V supply for AVDD1.</td>
</tr>
<tr>
<td>LK2</td>
<td>B</td>
<td>Selects the external power supply from Connector J3 (Position A) or Connector J5 (Position B).</td>
</tr>
<tr>
<td>LK3 to LK7</td>
<td>Not inserted</td>
<td>Prior to inserting SL8 to SL11, inserting these links sets up the on-board noise test to short the on-board amplifiers, U8 and U9. In this mode, all inputs short to REFOUT.</td>
</tr>
<tr>
<td>LK8 to LK12</td>
<td>Inserted</td>
<td>Inserting these links sets up the on-board noise test close to the ADC analog inputs. In this mode, all inputs short to REFOUT.</td>
</tr>
<tr>
<td>SL1</td>
<td>A</td>
<td>Sets the voltage applied to the AVDD2 pin. Operates using the AVDD1 supply (default). Position B sets the AVDD2 voltage to the 3.3 V supply from the ADP7118 (3.3 V) (U10) regulator.</td>
</tr>
<tr>
<td>SL2</td>
<td>A</td>
<td>Selects between an external (Position B) or on-board (Position A) AVDD1 source. Supplies AVDD1 from the ADP7118 (5 V) (U7) (default).</td>
</tr>
<tr>
<td>SL3</td>
<td>A</td>
<td>Selects between an external (Position B) or on-board (Position A) AVSS source. Supplies AVSS from the ADP7182 (−2.5 V) (U4) (default).</td>
</tr>
<tr>
<td>SL4</td>
<td>C</td>
<td>Connects AIN4 to: A4/J6 (Position A), REFOUT pin on the AD7177-2 (Position B), or AVSS (Position C). Position B and Position C are used to simplify the input using a single-ended input source.</td>
</tr>
<tr>
<td>SL5</td>
<td>B</td>
<td>Selects between an external or on-board IOVDD source. Supplies IOVDD from the ADP7118 (3.3 V) (U10) (default). The evaluation board operates with a 3.3 V logic.</td>
</tr>
<tr>
<td>SL8</td>
<td>A</td>
<td>Routes A0 to: AIN0 pin on the AD7177-2 (Position A), Buffer/In-Amp U8 (Position B), Funnel Amp U9 with gain of 0.8× (Position C), or J10-7 (Position D).</td>
</tr>
<tr>
<td>SL9</td>
<td>A</td>
<td>Routes A2 to: AIN2 pin on the AD7177-2 (Position A), Buffer U12 (Position B), or Funnel Amp U9 with gain of 0.4× (Position C).</td>
</tr>
<tr>
<td>SL10</td>
<td>A</td>
<td>Routes A3 to: AIN3 pin on the AD7177-2 (Position A), Buffer U12 (Position B), or Funnel Amp U9 with gain of 0.4× (Position C).</td>
</tr>
<tr>
<td>SL11</td>
<td>A</td>
<td>Routes A1 to: AIN1 pin on the AD7177-2 (Position A), Buffer/In-amp U8 (Position B), Funnel Amp U9 with gain of 0.8× (Position C), or J10-7 (Position D).</td>
</tr>
<tr>
<td>G16</td>
<td>Inserted</td>
<td>Sets the on-board in-amp (U8) to a gain of 16. Insert only one of the G16, G32, G64, or G128 links at a time.</td>
</tr>
<tr>
<td>G32</td>
<td>Not inserted</td>
<td>Sets the on-board in-amp (U8) to a gain of 32. Insert only one of the G16, G32, G64, or G128 links at a time.</td>
</tr>
<tr>
<td>G64</td>
<td>Not inserted</td>
<td>Sets the on-board in-amp (U8) to a gain of 64. Insert only one of the G16, G32, G64, or G128 links at a time.</td>
</tr>
<tr>
<td>G128</td>
<td>Not inserted</td>
<td>Sets the on-board in-amp (U8) to a gain of 128. Insert only one of the G16, G32, G64, or G128 links at a time.</td>
</tr>
<tr>
<td>R49 to R51</td>
<td>Inserted</td>
<td>Connects AVSS and AGND for single-supply operation. To operate in split supply mode, remove these links.</td>
</tr>
</tbody>
</table>
## SOCKETS AND CONNECTORS

Table 2. Connector Details

<table>
<thead>
<tr>
<th>Connector</th>
<th>Function</th>
<th>Connector Type</th>
<th>Manufacturer</th>
<th>Manufacturer Number</th>
<th>Stock Code1</th>
</tr>
</thead>
<tbody>
<tr>
<td>J1</td>
<td>Connector to the SDP-B</td>
<td>120-way connector, 0.6 mm pitch</td>
<td>Hirose</td>
<td>FX8-1205-SV(21)</td>
<td>FEC1324660</td>
</tr>
<tr>
<td>J2</td>
<td>External MCLK input</td>
<td>Straight PCB mount SMB/SMA jack</td>
<td>TE Connectivity</td>
<td>1-1337482-0</td>
<td>Not applicable</td>
</tr>
<tr>
<td>J3</td>
<td>External bench top voltage supply for the EVAL-AD7177-2SDZ</td>
<td>Power socket block, 3-pin, 3.81 mm pitch</td>
<td>Phoenix Contact</td>
<td>MC 1.5/3-G-3.81</td>
<td>FEC3704737</td>
</tr>
<tr>
<td>J5</td>
<td>External ac-to-dc adapter input for the EVAL-AD7177-2SDZ, 7 V to 9 V</td>
<td>DC power connectors, 2 mm SMT power jack</td>
<td>Lumberg</td>
<td>161314</td>
<td>FEC1243245</td>
</tr>
<tr>
<td>J6</td>
<td>Analog input terminal block; wired connection to external source or sensor</td>
<td>Power socket block, 8-pin, 3.81 mm pitch</td>
<td>Phoenix Contact</td>
<td>MC 1.5/8-G-3.81</td>
<td>FEC3704774</td>
</tr>
<tr>
<td>J9</td>
<td>External bench top voltage supply option for AVDD1/AVDD2, IOVDD, and AVSS inputs on the AD7177-2</td>
<td>Screw terminal block, 3.81 mm pitch</td>
<td>Phoenix Contact</td>
<td>1727036</td>
<td>FEC3704592</td>
</tr>
<tr>
<td>J10</td>
<td>Optional header</td>
<td>7-way, 2.54 mm pin header</td>
<td>Samtec</td>
<td>SSW-107-01-T-S</td>
<td>FEC1803478</td>
</tr>
<tr>
<td>J13</td>
<td>Optional header</td>
<td>7-way, 2.54 mm socket</td>
<td>Samtec</td>
<td>TLW-107-05-G-S</td>
<td>FEC1668499</td>
</tr>
<tr>
<td>A0 to A4</td>
<td>Analog inputs to ADC</td>
<td>Straight PCB mount SMB/SMA jack</td>
<td>TE Connectivity</td>
<td>1-1337482-0</td>
<td>Not applicable</td>
</tr>
<tr>
<td>A7</td>
<td>PMOD-compatible header</td>
<td>6-Pin single inline (SIL) header (0.1 inch pitch)</td>
<td>Harwin</td>
<td>20-9990646</td>
<td>FEC1022255</td>
</tr>
</tbody>
</table>

1 FEC stands for Farnell Electronic Component Distributors.
SERIAL INTERFACE

The EVAL-AD7177-2SDZ evaluation board connects to the Blackfin® ADSP-BF527 on the SDP-B via the serial peripheral interface (SPI). The SPI has four primary signals: the CS, SCLK, and DIN input signals, and the DOUT/RDY output signal.

To operate the evaluation board in standalone mode, disconnect the evaluation board from the SDP-B controller board. Use the test points to connect the signals to an alternative digital capture setup or the PMOD-compatible header (A7).

POWER SUPPLIES

Power the evaluation board from the ac-to-dc adapter connected to J5, or from an external bench top supply applied to J3 or J9. Linear LDOs generate the required voltages from the applied input voltage (Vin) rail when using J3 or J5. Use J9 to bypass the on-board regulators. An ADP7118 regulator generates the 5 V (single supply) and 2.5 V (split supply) supplies for the AVDD1 and AVDD2 rails to the ADC; a second ADP7118 generates 3.3 V for the IOVDD rail. The ADP7104 supplies +5 V for the SDP-B controller board, as well as +5 V for the ADM660 voltage converter to generate −5 V to supply the ADP7182. The ADP7182 generates the −2.5 V supply for AVSS when operating in split supply mode. Each supply is decoupled where it enters the board and at each device in accordance with the schematics shown in Figure 24 to Figure 28. Table 3 shows the various power supply configurations available, including split supply operation.

<table>
<thead>
<tr>
<th>Configuration (Regulated)</th>
<th>Input Voltage Range</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Single Supply</td>
<td>7 V to 9 V</td>
<td>The 7 V to 9 V input is regulated to 5 V for AVDD1/AVDD2 and 3.3 V for IOVDD. This input also powers the external 5 V reference. See the Single Supply (Regulated) section in the Power Supply Configurations section.</td>
</tr>
<tr>
<td>Single Supply (Unregulated)</td>
<td>7 V to 9 V, 5 V, and 3.3 V</td>
<td>The input is unregulated and connects directly to AVDD1/AVDD2 and IOVDD from J5. The 7 V to 9 V input powers the external 5 V reference. See the Single Supply (Unregulated) section in the Power Supply Configurations section.</td>
</tr>
</tbody>
</table>

| Split Supply (Regulated) | 7 V to 9 V | The 7 V to 9 V input is regulated to +2.5 V for AVDD1/AVDD2, −2.5 V for AVSS and +3.3 V for IOVDD. The 7 V to 9 V input powers the external 5 V reference. See the Split Supply (Regulated) section in the Power Supply Configurations section. |
| Split Supply (Unregulated) | +7 V to +9 V, ±2.5 V, and +3.3 V | The input is unregulated and connects directly to AVDD1/AVDD2 and IOVDD from J5. The 7 V to 9 V input powers the external 5 V reference. See the Split Supply (Unregulated) section in the Power Supply Configurations section. |

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1 Only one configuration can be used at a time.
POWER SUPPLY CONFIGURATIONS

Single Supply (Regulated)
There are two available power supply options for the single supply (regulated) configuration.

- An ac-to-dc adapter (included) connected to J5. Set LK2 to Position B.
- A bench top power supply connected to J3. Set LK2 to Position A, and ensure that AVSS = AGND = 0 V.

Set all other links and solder links to the default settings as outlined in Table 1.

Single Supply (Unregulated)
To set up the evaluation board, use the following procedure:
1. Move SL2 to Position B and move SL5 to Position A.
2. Connect the two terminals of J9 labeled AGND and AVSS.
3. Connect 0 V (GND) to J9 at the terminal labeled AGND.
4. Connect 5 V to J9 at the terminal labeled AVDD.
5. Connect 3.3 V to J9 at the terminal labeled IOVDD.
6. Connect the 7 V to 9 V input to J5.

Set all other links and solder links to the default settings as outlined in Table 1.

Split Supply (Regulated)
To set up the EVAL-AD7177-2SDZ evaluation board, use the following procedure:
1. Move SL2 and SL3 to Position B and move SL5 to Position A.
2. Remove R49 to R52.
3. Insert a 0 Ω resistor at R67 and R85.
4. Connect 0 V (GND) to J9 at the terminal labeled AGND.
5. Connect 2.5 V to J9 at the terminal labeled AVDD.
6. Connect −2.5 V to J9 at the terminal labeled AVSS.
7. Connect 3.3 V to J9 at the terminal labeled IOVDD.
8. Connect 7 V to 9 V to J5.
9. Set LK1 to Position B. This sets the input to the power monitor circuitry to work with the lower AVDD1 supply of 2.5 V.

Set all other links and solder links set to the default settings as outlined in Table 1.

ANALOG INPUTS
The primary analog inputs of the EVAL-AD7177-2SDZ evaluation board can be applied in two separate ways.

- J6 connector on the left side of the board
- A0 to A4 SMB/SMA footprints on the evaluation board

The analog inputs route directly to the associated analog input pins on the AD7177-2, provided that the LK5 to LK9 links (on-board noise test) are removed. The AD717x Eval+ software is set up to analyze dc inputs to the ADC. The AD7177-2 input buffers work for dc input signals.

REFERENCE OPTIONS
The EVAL-AD7177-2SDZ evaluation board includes an external 5 V reference, the ADR445. The AD7177-2 includes an internal 2.5 V reference. The default operation is to use the external reference input, which is set to accept the 5 V ADR445 on the evaluation board.
EVALUATION BOARD SOFTWARE INSTALLATION

Install the AD717x Eval+ software before connecting the evaluation board and the SDP-B board to the USB port of the PC to ensure that the evaluation system is correctly recognized when connected to the PC.

There are two parts to the software installation, noted by the following:

1. AD717x Eval+ software installation
2. AD717x Eval+ Dependencies installation
   a. SDP-B board drivers
   b. Ssrc SVG plug-in
   c. Microsoft .NET Framework 3.5

INSTALLING THE AD717x Eval+ SOFTWARE

To install the AD717x Eval+ software, take the following steps:

1. Ensure that the SDP-B board is disconnected from the USB port of the PC and insert the CD into the CD-ROM drive.
2. Double click the setup.exe file to begin the evaluation board software installation. The default installation location for the software is C:\Program Files\Analog Devices\AD717x Eval+.
3. A dialogue box appears asking for permission to allow the program to make changes to the PC (See Figure 3). Click Yes.
4. Select a location to install the software and click Next>>. Figure 4 shows the default locations displayed when the dialogue box opens. To select another location click Browse.
5. A license agreement appears. Read the agreement, select I accept the License Agreement, and click Next>> (see Figure 5).
6. A summary of the installation displays. Click Next>> to continue (see Figure 6).

7. The message shown in Figure 7 appears when the installation is complete.

### INSTALLING THE Eval+ DEPENDENCIES

After the installation of the evaluation software is complete, a welcome window displays to install the **Eval+ Dependencies**.

1. Ensure that the **SDP-B** board is still disconnected from the USB port of the PC and that all other applications are closed, and then click **Install** (see Figure 8).

2. The Ssrc SVG plug-in installs first, then the **SDP-B** drivers, and finally, the .NET Framework 3.5.

3. If using Windows 8 or Windows 10, see the Installing .NET Framework 3.5 for Windows 8/Windows 10 section.

4. To complete the **SDP-B** drivers installation and close the installation setup wizard, click **Close** (see Figure 9).
5. Before using the evaluation board, restart the PC (see Figure 10).

![Figure 10. Restarting the PC](image)

**Installing .NET Framework 3.5 for Windows 8/Windows 10**

Windows 8 and Windows 10 have a built-in installer for the .NET Framework 3.5. To run this installer, an internet connection is required, and administrator privileges can be required. Contact a system administrator if the following steps do not work.

1. When the Eval+ Dependencies installer reaches the .NET Framework 3.5 installation step, a window appears, as shown in Figure 11.

![Figure 11. Windows 8/Windows 10 .NET Framework 3.5 Installation](image)

2. Follow the steps shown in the installation wizard to complete the installation.

3. If the window shown in Figure 11 does not appear, the .NET Framework 3.5 may already be installed on the PC. To confirm that the software is installed, open the Control Panel > Programs > Programs and Features, and then select Turn Windows features on or off. In the pop up window, find .NET Framework 3.5 and confirm that the software is enabled.

**SETTING UP THE SYSTEM FOR DATA CAPTURE**

After completing the steps in the Installing the AD717x Eval+ Software section and the Installing the Eval+ Dependencies section, take the following steps to set up the system for data capture:

1. Connect the SDP-B board to the PC and allow the Found New Hardware Wizard to run. If using Windows XP, search for the SDP-B drivers and choose to automatically search for the drivers if prompted by the operating system.
2. Use the Device Manager to confirm that the board is properly connecting to the PC.
3. Access the Device Manager by completing the following steps:
   a) From the Start menu, right-click My Computer and then click Manage.
   b) A dialog box appears asking for permission to allow the program to make changes to the PC. Click Yes.
   c) The Computer Management window appears. Click Device Manager from the list of System Tools (see Figure 12).
   d) The SDP-B board appears under ADI Development Tools, indicating that the driver software has installed and the board is connecting to the PC properly.

![Figure 12. Device Manager](image)
Launching the Software

After completing the steps in the Setting Up the System for Data Capture section, take the following steps to launch the AD717x Eval+ software:

1. From the Start menu, click Programs > Analog Devices > AD717x EVAL+ > AD717x Eval+.
2. The dialogue box in Figure 13 appears; select AD7177-2 Evaluation Board and click the Select button. The main window of the software box displays as shown in Figure 16.

3. If the EVAL-AD7177-2SDZ evaluation system is not connected to the USB port via the SDP-B when the software is launched, the software displays the dialog box shown in Figure 14. Connect the evaluation board to the USB port of the PC; wait a few seconds, click Refresh and the option shown in Figure 13 appears.

4. The AD717x Eval+ software can also be used without connecting hardware. Click the Simulation button and the options shown in Figure 15 appear. This option uses a software model and allows the AD7172-2, AD7172-4, AD7173-8, AD7175-2, AD7175-8, AD7176-2, or AD7177-2 to be evaluated.
EVALUATION BOARD SOFTWARE OPERATION

OVERVIEW OF THE MAIN WINDOW

The main window of the AD717x Eval+ software displays the significant control buttons and analysis indicators of the AD717x Eval+ software. This window is divided into five tabs: Configuration, Waveform, Histogram, Modelled Performance, and Registers.

CONFIGURATION TAB

Figure 16 shows the Configuration (1) tab when Hardware mode is selected and Figure 17 shows the Configuration tab when Simulation mode is selected. The controls highlighted in Figure 17 are only available in Simulation mode.

Select Product/Evaluation Mode Pane

The Evaluation Mode (2) pane displays the evaluation mode in use. To switch between modes, click the Select Product… button, and the dialog box shown in Figure 13 appears.

Tutorial Icon

Click the tutorial icon (3) to open a tutorial and view additional information on using the AD717x Eval+ software.

Functional Block Diagram and Configuration Pop-Up Buttons

The functional block diagram (4) of the ADC shows each of the separate functional blocks within the ADC. Click a configuration button (5) on any of the functional blocks to open the configuration pop-up window for the block selected. Not all blocks have a configuration button.

Analog and Digital Supply Voltage

The text fields labeled 6, 7, and 14 in Figure 16 and Figure 17 are input fields that are used to take the supply voltage levels selected for the AD7177-2. Checks are performed to ensure that the power supply voltage levels entered are within the specified limits. These power supply voltage levels are also used for the modelled performance to calculate the power dissipation.

External Reference

The Ext. REF-(V) and Ext. REF+(V) (8) text fields set the positive and negative external reference voltage values. The difference of these fields is used to calculate the results for both the Waveform and Histogram tabs. The evaluation board has an external 5 V ADR445 reference, which can be bypassed by removing R32. Change the external reference voltage value in the external reference text fields to ensure the correct calculation of results in the Waveform and Histogram tabs.
Register Configuration Summary

Click the Summary (9) button to display the selected configuration of the AD7177-2, which includes channel configuration, information on each of the individual setups, as well as, information on any error present.

Reset ADC

Click the Reset ADC (10) button to perform a software reset of the AD7177-2. The AD7177-2 does not have a hardware reset pin. To perform a hard reset, the power must be removed from the AD7177-2. The software reset has the same effect as a hard reset.

Menu Bar

The menu bar (11) has three sections: File, Edit, and Help.

File

Three options are available in the File menu: Save, Load, and Exit.

The Save option allows the user to save register configurations or waveform data. Register configurations can be saved as a JavaScript Object Notation (JSON) file or a header file. If the configuration is only used in the AD717x Eval+ software environment, it is recommended to use the JSON setting. Waveforms are saved as .csv files and the user is prompted to save the register configuration.

The Load option allows the user to load saved register configurations or waveform data. To load a header file into the AD717x Eval+ software, the file must be in the same format as the file that is saved from the AD717x Eval+ software. The header file can be used when developing firmware. When loading the waveform data, the user is prompted to load the register configuration. This step is so the software can correctly analyze the data.

Click Exit to close the AD717x Eval+ software.

Edit

There are two options available in the Edit dropdown menu, Change Product Selection and Reset ADC. The Change Product Selection option performs the same action as the Select Product button and Reset ADC performs the same action as the Reset ADC button.

Help

The Help dropdown menu provides links to extra information about the AD7177-2, which includes links to the product page, the evaluation board user guide, the datasheet, and the No-OS Drivers.

Selecting the AD717x Eval+ Tutorial

To open this tutorial, click the tutorial icon (3). For details on the version of the software, the About option opens a dialog box displaying the current version of the software and the relevant licenses.

Status Bar

The status bar (12) displays the busy indicator and status updates, such as Analysis Completed and Reset Completed during software use.

Device Error

The Device Error (13) LED icon illuminates when a when an ADC error is detected or when a cyclic redundancy check (CRC) error occurs. The CRC functionality on the AD7177-2 is disabled by default and must be enabled for this indicator to work. More specific information on the error can be found in the Register Configuration Summary section.
**External MCLK Frequency**

The Ext. MCLK(Hz) text field (15) sets the external MCLK frequency. The Ext. MCLK(Hz) control is only visible in the **Configuration** tab when an external clock source is selected by the ADC. The value entered in this field is used by the functional model shown in the **Modelled Performance** tab.

**Analog Input Voltage**

The input fields shown in the **Simulated Input** pane (16) are only available when the AD717x Eval+ software is executed in simulation mode. These simulated inputs allow the analog input voltages to be set and can be changed at any time when the device is in simulation mode.

**External SCLK Frequency**

The SCLK(Hz) text field (17) sets the external SCLK frequency for the SPI interface. This text field is only available in simulation mode to determine if the SCLK frequency is within the permitted range.
Figure 18. Waveform Tab of the AD717x Eval+ Software

WAVEFORM TAB

Figure 18 shows the Waveform tab (18) of the AD717x Eval+ Software.

Sampling Mode

The Sampling Mode control (19) is unrelated to the ADC mode. This control can be set to capture a defined sample set (single capture), or continuously gather batches of samples (repeated capture). The user can also select data logging, which runs in a similar manner to the repeated capture option; however, selecting data logging posts the results to a .csv file. When saving the results, the .csv file prompts the user to save the register configuration, which is necessary to load the analysis of the data back into the software.

Samples

The Samples text field (20) sets the number of samples gathered per batch. The Single Capture option selected from the Sampling Mode dropdown list returns the number of samples entered in the Samples text field. The Repeated Capture option continues to return batches of the number entered in the Samples text field until sampling is stopped by the user.

Sample

Click the Sample button (21) to start gathering ADC results. Results appear in the waveform graph (22).

Waveform Graph and Controls

The waveform graph (22) shows each successive sample of the ADC output. Zoom in on the data using the control toolbar (23). Click the x-axis and y-axis to change the scales on the graph.

Channel Selection

The channel selection control (24) allows the user to choose which channels display on the data waveform graph. These controls only affect the display of the channels and do not have any effect on the channel settings in the ADC register map.

Noise Analysis Pane

The Noise Analysis pane (25) displays the results of the noise analysis for the selected analysis channel; this includes both noise and resolution measurements.
Analysis Channel

The noise analysis dropdown list (26) and histogram graph show the analysis of the channel selected.

Display Units and Axis Controls

In the Graph Configuration pane (27), select the Units: V/mV/uV/nV dropdown menu to select the unit that the data displays in the graph. This control affects the waveform graph and the histogram graph. The axes controls can be switched between dynamic and fixed. When the dynamic control is selected, the axes automatically adjust to show the entire range of the ADC results after each batch of samples. When fixed is selected, the user can program the axes ranges. These ranges do not automatically adjust after each batch of samples.
HISTOGRAM TAB

Figure 19 shows the **Histogram** tab (28) of the AD717x Eval+ software.

**Histogram Graph and Controls**

The histogram graph (29) shows the number of times each sample of the ADC output occurs. The control toolbar (30) in the histogram graph allows you to zoom in on the data (see Figure 19). Click the x-axis and y-axis to change the scales on the graph.

![Figure 19. Histogram Tab of the AD717x Eval+ Software](image-url)
The Modelled Performance tab (31) shows a number of ADC performance parameters, which are calculated using the ADC functional model.

There are three main options in the Modelled Performance tab: Filter Profile, Filter Step Response, and Timing Diagram/Power. These options can be selected from the dropdown list (33). Figure 20 shows this tab when Filter Profile is selected.

Analysis Channel
The analysis channel dropdown list (32) selects the channel to be evaluated by the functional model.

Filter Profile Graph
This graph (34) shows the frequency response for the selected digital filter. The graph controls allow the user to zoom in on the data. Click the x-axis and y-axis to change the scales on the graph.

Filter Rejection
The Filter Rejection pane (35) shows the rejection/attenuation of the digital filter over the rejection bandwidth for f1 and f2 in decibels. The f1, f2, and Bandwidth values can be changed.

Filter Performance
The Filter Performance pane (36) shows timing information for the data rate of the selected output. This pane shows the ADC initial settling time (Tsettle), the first frequency notch (Fnotch), and the actual sampling frequency (fADC).
Filter Step Response

The Filter Step Response dropdown list (37) allows the user to switch between the three sections of the Modelled Performance tab. Figure 21 shows this tab when Filter Step Response is selected from the dropdown list.

Step Response Graph

This graph (38) shows how long the filter takes to settle when the voltage is stepped from one voltage to the next. For this analysis, it is assumed the ADC is continuously converting on only one channel.

Step Configuration

The controls in the Step Configuration pane (39) allow the user to set the voltage before and after the step, as well as the step position. The Step Position text field is set as a percentage where 0% is $1/f_{ADC}$ and 100% is $2/f_{ADC}$.

Step Response

The controls in the Step Response pane (40) provide timing information for the data rate of the selected output. This pane shows the actual sampling frequency ($f_{ADC}$), the ADC initial settling time ($t_{settle}$), and the settling time between conversions ($1/f_{ADC}$).

Graph Units

Use the controls in the Graph Units pane (41) to switch the step response between Percentage, Volts, and Codes.

Figure 21. Filter Step Response of the AD717x Eval+ Software
**Timing Diagram/Power**

This dropdown list (42) allows the user to switch between the three sections of the Modelled Performance tab. Figure 22 shows the tab when Timing Diagram/Power is selected from the dropdown list.

**Estimated Power Consumption**

The Estimated Power Consumption pane (43) shows the total power consumption of the device in the selected configuration, as well as the current consumption on each of the power supply rails. Note that the estimated power consumption is for continuous conversion mode, only. No other mode of operation is supported by this control.

**Timing Diagram**

The graph shown in the Timing Diagram pane (44) shows the digital interface timing diagram for the current configuration. The graph shows the timing for the configuration of the ADC and the subsequent data reads from the ADC.
Figure 23. Registers Tab of the AD717x Eval+ Software

REGISTERS TAB

Figure 23 shows the Registers tab (45).

Register Tree
This register list control (46) shows the full register map in a tree control format. Each register is shown; click the expand button next to each register to show all of the bit fields contained within that register.

Register
The Register pane (47) allows the user to change the individual bit of the register selected in the register tree by clicking the bits or by entering the register value directly into the text field on the right side of the pane.

Bitfields
The Bitfields pane (48) shows the bit fields of the register selected in the register tree. Change the values in this pane by using the Setting dropdown lists or by directly entering a value into the value text fields.

Documentation
The Documentation pane (49) contains the documentation for the register or bit field selected in the register tree.

Save and Load
The Save (50) and Load (51) buttons allow the user to save the current configuration of the AD7177-2 by saving the register map settings to a file and loading the settings from the same file. When using these buttons, the register configurations are saved and loaded as JSON files.

EXITING THE SOFTWARE
To exit the software, click the close button at the top right corner of the AD717x Eval+ software.
ATTENUATING SINGLE ENDED TO DIFFERENTIAL DRIVER

BY DEFAULT, R64 AND R74 ARE DNI (AMP NOT CONNECTED TO ADC)
POPULATE WITH 10Ω RESISTORS IF USING THE AD8475 AMPLIFIERS CONNECTED TO ADC USING 0Ω LINKS.

SELECTABLE GAIN INAMP FIRST STAGE

U8-C ADA4528-2ARMZ
C60 0.1µF
C68 1nF

1 -IN_0.8X
2 -IN_0.4X
3 +VS
4 VOCM
5+OUT
6–OUT
7 NC
8 –VS
9 +IN_0.4X
10 +IN_0.8X
U9 AD8475
C37 0.1µF
C41 DNI
R69 75kΩ
R63 DNI
R72 DNP
R86
C69 DNI
R73 DNP
R78 0Ω
R64 DNP
R65 10kΩ
R74 DNP

Figure 25. Amplifier Schematic
GROUND STAR POINT PLACE NEAR TO V_IN JACK PLUG J5
POWER SUPPLY

POWER SEQUENCE CONTROL
5V LDO TO POWER SDP
POWER SUPPLY FOR SDP BOARD
LK1 A: 5V AVDD1
LK1 B: 2.5V AVDD1

VIN
GND
AVSS
CONNECT SDP_GND AND AGND FOR ADP7104 RETURN CURRENTS
INSERT FOR ±2.5V OPERATION
–5V FOR –2.5V LDO

Figure 26. Power Supply Sequencing Schematic
Figure 27. Regulator Schematic
VIO: USE TO SET IO VOLTAGE MAX DRAW 20mA
VIN: USE THIS PIN TO POWER THE SDP REQUIRES 4V TO 7V 200mA
BMODE1: PULL UP WITH A 10kΩ RESISTOR TO SET SDP TO BOOT FROM A SPI FLASH ON THE DAUGHTER BOARD
EEPROM-SW/USB ID

SDP CONNECTOR
VIO: USE TO SET IO VOLTAGE MAX DRAW 20mA
VIN: USE THIS PIN TO POWER THE SDP REQUIRES 5V 200mA
I2C BUS 1 IS COMMON ACROSS BOTH CONNECTORS ON SDP - PULL UP RESISTORS REQUIRED
(CONNECTED TO BLACKFIN GPIO - USE I2C_0 FIRST)

BOARD ID EEPROM (24LC32)
MUST BE ON I2C BUS 0,
MAIN I2C BUS (CONNECTED BLACKFIN TWI.
PULL UP RESISTORS NOT REQUIRED)

Figure 28. SDP-B Connector Schematic
Figure 29. Top Printed Circuit Board (PCB) Silkscreen

Figure 30. Bottom PCB Silkscreen
Figure 33. Layer 3, Power/Ground Plane

Figure 34. Layer 4, Solder Side
# ORDERING INFORMATION

## BILL OF MATERIALS

Table 4.

<table>
<thead>
<tr>
<th>Qty.</th>
<th>Reference Designator</th>
<th>Description</th>
<th>Manufacturer</th>
<th>Part Number</th>
<th>Stock Code</th>
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<tr>
<td>5</td>
<td>A0 to A6</td>
<td>Straight PCB mount SMB jack, keep hole clear of solder, do not insert</td>
<td>TE Connectivity</td>
<td>1-1337482-0</td>
<td>Do not insert</td>
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<td>A7</td>
<td>6-pin SIL header, 0.1 inch pitch</td>
<td>Harwin</td>
<td>20-9990646</td>
<td>FEC102255</td>
</tr>
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<td>C1, C17</td>
<td>Ceramic capacitor, 6.3 V, X5R, 0603, 4.7 μF</td>
<td>Murata</td>
<td>GRM188R60J475K</td>
<td>FEC173-5527</td>
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<td>Murata</td>
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<td>C0603C475K8PACTU</td>
<td>FEC157-2625</td>
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<td>FEC1735541</td>
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<td>C5, C7, C9, C16, C24, C25, C29, C41, C42, C61 to C63, C65, C66, C69, C70, C78 to C82</td>
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<td>C12 to C14, C18, C20 to C22, C33, C34, C37, C40, C44, C52 to C54, C58, C60, C72, C73, C75, C87, C89, C91</td>
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<td>Murata</td>
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<td>FEC1734627</td>
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<td>Yageo</td>
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<td>FEC722170</td>
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<td>FEC671915 and FEC510944</td>
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<td>Not applicable</td>
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<td>Hirose Electric Group</td>
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<td>FEC1324660</td>
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<td>1-1337482-0</td>
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<td>FEC370-4737</td>
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<td>1727023</td>
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<td>Lumberg</td>
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<td>FEC3704774</td>
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<td>J10</td>
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<td>Samtec</td>
<td>SSW-107-01-T-S</td>
<td>FEC1803478</td>
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<td>MKDS1/4-3.81</td>
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<td>FEC370-4749 and FEC370-4920</td>
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<td>Samtec</td>
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<td>L1 to L4</td>
<td>Ferrite bead, 0.3 Ω at dc, 1000 Ω at 100 MHz, 350 mA, 0.0805</td>
<td>TE Connectivity</td>
<td>BMB2A1000LN2</td>
<td>FEC119-3421</td>
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<td>3-pin (3 × 1) header and shorting block in, 0.1 inch pitch, Position A</td>
<td>Harwin</td>
<td>M20-9990346 and M7566-05</td>
<td>FEC1022249 and FEC150-411</td>
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<td>FEC1022247 and FEC150-411</td>
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<td>Vishay</td>
<td>SI2304DDS-T1-GE3</td>
<td>FEC1858939</td>
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<td>ON Semiconductor</td>
<td>MMBT3904LT1G</td>
<td>FEC1459100</td>
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<td>Newark</td>
<td>MC0063W06031100K</td>
<td>FEC9330402</td>
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<tr>
<td>7</td>
<td>R2 to R4, R7, R48, R66, R75</td>
<td>Resistor, 100 kΩ, 0.063 W, 1%, 0603</td>
<td>Newark</td>
<td>MC00625W04021010K</td>
<td>FEC1358069</td>
</tr>
<tr>
<td>3</td>
<td>R5, R6, R77</td>
<td>Resistor, 10 kΩ, 0.063 W, 1%, 0402</td>
<td>Newark</td>
<td>MC00625W04021010K</td>
<td>FEC1358069</td>
</tr>
<tr>
<td>3</td>
<td>R8, R71</td>
<td>Resistor, 0.063 1%, 0402</td>
<td>Yageo</td>
<td>CRCW040210KOFKEAHP</td>
<td>FEC173-8864</td>
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<td>31</td>
<td>R9 to R13, R27, R30, R32, R41, R63, R78, R81 to R84, R87, R95, R99, R101, R103, R105, R107, R111, R114, R117, R121, R124, R128 to R131</td>
<td>Resistor, 0603 1%, OR</td>
<td>Newark</td>
<td>MC0063W06030R</td>
<td>FEC9331662</td>
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<td>1</td>
<td>R14</td>
<td>Resistor, 0402, 1%, 39 kΩ</td>
<td>Newark</td>
<td>MC 0.0625W 0402 1% 39K</td>
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<td>4</td>
<td>R15, R17, R18, R24</td>
<td>Resistor, SMD</td>
<td>Newark</td>
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<tr>
<td>1</td>
<td>R16</td>
<td>Resistor, 0402, 1%, 69K8</td>
<td>Newark</td>
<td>MC 0.0625W 0402 1% 69K8</td>
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<td>15</td>
<td>R19 to R22, R35 to R38, R40, R58, R59, R61, R62, R70, R116</td>
<td>Resistor, 0402</td>
<td>Vishay</td>
<td>CRCW04020000Z0ED</td>
<td>FEC146-9661</td>
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<td>1</td>
<td>R23</td>
<td>Resistor, 0402, 1%, 86K6</td>
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<td>R25, R57</td>
<td>Resistor, 0402, 1%, 30k1</td>
<td>Newark</td>
<td>MC 0.0625W 0402 1% 30k1</td>
<td>FEC1803699</td>
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<td>32</td>
<td>R26, R28, R29,</td>
<td>Resistor, SMD, 0603, do not insert</td>
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<td>R31, R33, R56,</td>
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<td>R64, R67, R72,</td>
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<td>R74, R76, R80,</td>
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<td>R108 to R110,</td>
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<td>R118 to R120,</td>
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<td>R122, R123, R125,</td>
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<td>R126, R132</td>
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<td>R34, R39, R46, R47</td>
<td>Resistor, 10 kΩ, 0.063 W, 1%, 0603</td>
<td>Newark</td>
<td>MC0063W0603110R</td>
<td>FEC9330429</td>
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<td>4</td>
<td>R42 to R45</td>
<td>Resistor, thick film, 10 kΩ, 62.5 mW, 5%</td>
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<td>RC0402JR-1310KL</td>
<td>FEC179-9316</td>
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<td>R49 to R52</td>
<td>Resistor, 1206</td>
<td>Newark</td>
<td>MC 0.125W 1206 OR</td>
<td>FEC9336974</td>
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<td>2</td>
<td>R53, R65</td>
<td>Resistor, 10 kΩ, 0.063 W, 1%, 0603</td>
<td>Newark</td>
<td>MC0063W0603110K</td>
<td>FEC9330399</td>
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<td>R54</td>
<td>Resistor, thick film, 4.53 kΩ, 63 mW, 1%</td>
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<td>CRCW0402K53FKED</td>
<td>FEC1151244</td>
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<td>R55</td>
<td>Resistor, 0402, 1%, 61R9</td>
<td>Newark</td>
<td>MC 0.0625W 0402 1% 61R9</td>
<td>FEC1802915</td>
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<td>R60</td>
<td>Resistor, thick film, 2.4 kΩ, 0603, 100 mW, 1%</td>
<td>Yageo</td>
<td>RC0603FR-072K4L</td>
<td>FEC1799329</td>
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<td>1</td>
<td>R68</td>
<td>Resistor, 0603, 4K75, 0.1%, 0.1 W</td>
<td>Panasonic</td>
<td>ERA3AR84751V</td>
<td>FEC209-4611</td>
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<td>R69, R104</td>
<td>Resistor, 0603, 0.1%, 0.1 W, 75 kΩ</td>
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<td>R73</td>
<td>Resistor, 8R87, 0.063 W, 0.1%, 0402</td>
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<td>RN73C1E88R7B</td>
<td>FEC173-7900</td>
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<td>R79</td>
<td>Resistor, 121 kΩ, 0.063 W, 0.1%, 0603</td>
<td>TE Connectivity</td>
<td>RN73C1J121RBTG</td>
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<td>R90</td>
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<td>R91</td>
<td>Resistor, 2K26, 0.063 W, 0.1%, 0402</td>
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<td>R92</td>
<td>Resistor, 51R1, 0.063 W, 0.1%, 0603</td>
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<td>RN73C1J51R1BTG</td>
<td>FEC114-0465</td>
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<td>2</td>
<td>R93, R106</td>
<td>Resistor, 0603</td>
<td>Vishay</td>
<td>CRCW0603000020EA</td>
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<td>R94</td>
<td>Resistor, 0603, 1K13, 0.1%, 0.1 W</td>
<td>Panasonic</td>
<td>ERA3AR81131V</td>
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<td>R96</td>
<td>Resistor, 1K07, 0.063 W, 1%, 0603</td>
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<td>MC0063W0603110K07</td>
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<td>R97</td>
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<td>Newark</td>
<td>MC0063W0603110K02</td>
<td>FEC1170889</td>
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<td>R127</td>
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<td>Vishay</td>
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<td>1</td>
<td>SL1</td>
<td>2-way solder link option</td>
<td>Newark</td>
<td>MC 0.063W 0603 OR</td>
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<td>2</td>
<td>SL2, SL3</td>
<td>2-way solder link, use OR 0603 resistor, insert link in Position A</td>
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<td>SL4</td>
<td>3-way solder link, use OR 0603 resistor, insert link in Position C</td>
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<td>SL5</td>
<td>2-way solder link, use OR 0603 resistor, insert link in Position B</td>
<td>Not applicable</td>
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<td>SL8</td>
<td>4-way solder link, use OR 0603 resistor, insert link in Position A</td>
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<td>2</td>
<td>SL9, SL10</td>
<td>3-way solder link, use OR 0603 resistor, insert link in Position A</td>
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<td>1</td>
<td>SL11</td>
<td>4-way solder link, use OR 0603 resistor, insert link in Position A</td>
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<td>1</td>
<td>STAR3</td>
<td>Ground link, copper short</td>
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<td>1</td>
<td>U1</td>
<td>Serial EEPROM, 32 kΩ, 1C</td>
<td>Microchip</td>
<td>24LC32A-1/MS</td>
<td>FEC1331330</td>
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<td>U2</td>
<td>Linear regulator, 5 V, 20 V, 500 mA, ultralow noise, CMOS</td>
<td>Analog Devices, Inc.</td>
<td>ADP7104ARDZ-5.0</td>
<td>ADP7104ARDZ-5.0</td>
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<td>1</td>
<td>U3</td>
<td>Quad voltage monitor and sequencer</td>
<td>ADI</td>
<td>ADM118SARMZ-1</td>
<td>ADM118SARMZ-1</td>
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<tr>
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<td>U4</td>
<td>Linear regulator, 8 V, −200 mA, low noise</td>
<td>ADI</td>
<td>ADP7182AUJZ</td>
<td>ADP7182AUJZ-R7</td>
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<tr>
<td>1</td>
<td>U5</td>
<td>ADC</td>
<td>ADI</td>
<td>AD7172-2BRUZ</td>
<td>AD7172-2BRUZ</td>
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<tr>
<td>1</td>
<td>U6</td>
<td>Reference, 5 V, XFET</td>
<td>ADI</td>
<td>ADR445BRZ</td>
<td>ADR445BRZ</td>
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<td>1</td>
<td>U7</td>
<td>Linear regulator 2.5 V, ultralow noise, CMOS</td>
<td>ADI</td>
<td>ADP7118ARDZ-2.5</td>
<td>ADP7118ARDZ-2.5-R7</td>
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<td>1</td>
<td>U8</td>
<td>Dual op amp, 5.0 V, ultralow noise, zero drift, rail-to-rail input/output (RRIO)</td>
<td>ADI</td>
<td>ADA4528-2ARMZ</td>
<td>ADA4528-2ARMZ</td>
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<td>Funnel amplifier, fully differential</td>
<td>ADI</td>
<td>AD8475ARMZ</td>
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<td>Linear regulator 3.3 V, ultralow noise, CMOS</td>
<td>ADI</td>
<td>ADP7118ARDZ-3.3</td>
<td>ADP7118ARDZ-3.3-R7</td>
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<td>Voltage converter, switched capacitor, CMOS</td>
<td>ADI</td>
<td>ADM660ARZ</td>
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<td>5.0 V ultralow noise, zero-drift, RRIO, dual op-amp</td>
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<td>V1 to V4</td>
<td>1206 place holder, do not insert</td>
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<td>Y1</td>
<td>Crystal, miniature, SMD, 16 MHz, 10 ppm, 9 pF</td>
<td>Epson</td>
<td>FA-20H</td>
<td>FEC 71-2814</td>
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I^2C refers to a communications protocol originally developed by Philips Semiconductors (now NXP Semiconductors).

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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Rev. A | Page 34 of 34