# Table of Contents

Preface
**About this User's Guide** ..............................................................................................................5
  - What you will learn from this user's guide .................................................................5
  - Conventions in this user's guide .............................................................................5
  - Where to find more information ...........................................................................5

Chapter 1
**Introducing the USB-2627** .......................................................................................................6
  - Functional block diagram .......................................................................................7

Chapter 2
**Installing the USB-2627** .......................................................................................................8
  - Unpacking ...............................................................................................................8
  - Installing the software .........................................................................................8
  - Installing the hardware .......................................................................................8
  - Configuring the hardware ...............................................................................8
  - Calibrating the hardware ................................................................................9
    - Field calibration ..........................................................................................9
    - Factory calibration ....................................................................................9

Chapter 3
**Signal Connections** ..........................................................................................................10
  - 68-pin SCSI connector P1 ................................................................................10
  - Cabling ............................................................................................................11
  - Signal termination .........................................................................................11
  - 40-pin header connectors J2, J4, and J5 ............................................................12
    - Cabling .....................................................................................................13
    - Signal termination ....................................................................................13

Chapter 4
**Functional Details** ............................................................................................................14
  - Analog input modes .........................................................................................14
    - Software paced .........................................................................................14
    - Hardware paced .......................................................................................14
  - Burst mode.......................................................................................................14
  - USB-2627 components ....................................................................................15
    - 68-pin SCSI connector P1 ........................................................................15
    - 40-pin header connectors J2, J4, and J5 ....................................................16
    - USB connector .........................................................................................16
    - LEDs .........................................................................................................16
    - Standoffs ..................................................................................................16
  - Signal descriptions ...........................................................................................16
    - Analog input .............................................................................................16
    - Analog output .........................................................................................17
    - Digital I/O ...............................................................................................17
    - Counter input ..........................................................................................18
    - Trigger input ............................................................................................18
    - Timer output ............................................................................................18
    - Ground ......................................................................................................18
    - Power output ............................................................................................19
  - USB power ........................................................................................................19
  - Mechanical drawing .......................................................................................19
Chapter 5
Specifications .......................................................... 20

Analog input ........................................................................................................... 20
Accuracy .................................................................................................................. 20
  Analog input DC voltage measurement accuracy .................................................. 20
  Noise performance ............................................................................................... 21
  Settling time for Multichannel Measurements ..................................................... 21
Analog output ......................................................................................................... 21
Analog input/output calibration .............................................................................. 22
Digital input/output ............................................................................................... 22
External trigger ....................................................................................................... 23
External clock ......................................................................................................... 23
Counter ................................................................................................................... 23
Timer output .......................................................................................................... 24
Memory .................................................................................................................. 24
Power ..................................................................................................................... 24
USB ........................................................................................................................ 25
Environmental ....................................................................................................... 25
Mechanical ............................................................................................................. 25
Signal connections ............................................................................................... 25
  68-pin SCSI connector (P1) .................................................................................. 26
  40-pin header connectors (J2, J4, J5) ................................................................. 27
Standoff locations ................................................................................................. 28
About this User's Guide

What you will learn from this user's guide

This user's guide describes the Measurement Computing USB-2627 data acquisition device and lists device specifications.

Conventions in this user's guide

For more information
Text presented in a box signifies additional information related to the subject matter.

Caution!
Shaded caution statements present information to help you avoid injuring yourself and others, damaging your hardware, or losing your data.

**bold** text
**Bold** text is used for the names of objects on a screen, such as buttons, text boxes, and check boxes.

*italic* text
**Italic** text is used for the names of manuals and help topic titles, and to emphasize a word or phrase.

Where to find more information

For additional information relevant to the operation of your hardware, refer to the Documents subdirectory where you installed the MCC DAQ software (C:\Program Files\Measurement Computing\DAQ by default), or search for your device on our website at [www.mccdaq.com](http://www.mccdaq.com).
The USB-2627 is a USB 2.0 high-speed device that is supported under the Microsoft® Windows® operating system.

The USB-2627 is compatible with both USB 1.1 and USB 2.0 ports. The speed of the device may be limited when using a USB 1.1 port due to the difference in transfer rates on the USB 1.1 versions of the protocol (low-speed and full-speed).

The USB-2627 device provides the following features:

- 16 single-ended (SE) analog inputs
- 24 DIO channels; bit configurable for input or output
- Four analog outputs
- Four counter inputs
- Four timer outputs
- Digital trigger input
- External AI scan clock input
- External AO scan clock input
- One 68-pin SCSI connector and three 40-pin header connectors for field wiring connections

The USB-2627 is powered by the USB supply from the computer; external power is not required.
Functional block diagram

USB-2627 functions are illustrated in the block diagram shown in Figure 1.

![Functional block diagram of the USB-2627](image)

**Figure 1.** USB-2627 functional block diagram
Chapter 2

Installing the USB-2627

Unpacking

As with any electronic device, you should take care while handling to avoid damage from static electricity. Before removing the device from its packaging, ground yourself using a wrist strap or by simply touching the computer chassis or other grounded object to eliminate any stored static charge.

Contact us immediately if any components are missing or damaged.

Installing the software

Refer to the MCC DAQ Quick Start and the USB-2627 product page on our website for information about the software that supports the device.

<table>
<thead>
<tr>
<th><strong>Install the software before you install your device</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>The driver needed to run the USB-2627 is installed with the software. Therefore, you need to install the software package you plan to use before you install the hardware.</td>
</tr>
</tbody>
</table>

Installing the hardware

To connect a USB-2627 device to your system, turn on your computer and connect the USB cable to an available USB port on the computer or to an externally powered USB hub connected to the computer.

When connected for the first time, a Found New Hardware dialog opens when the operating system detects the device. When the dialog box closes, the installation is complete.

The Power LED (top LED) blinks during device detection and initialization, and then remains on. When the board is first powered on, there is usually a momentary delay before the Power LED blinks or turns on.

Configuring the hardware

All hardware configuration options are programmable with software.

**Caution!** Avoid redundant connections. Ensure that there is no signal conflict between the 68-pin SCSI connector (P1) and the 40-pin connectors (J2 to J5). Failure to do so could possibly cause equipment damage and/or personal injury.

Turn off power to all devices connected to the system before making connections. Electrical shock or damage to equipment can result even under low-voltage conditions.

Always handle components carefully, and never touch connector pins or circuit components unless you are following ESD guidelines in an appropriate ESD-controlled area. These guidelines include using properly-grounded mats and wrist straps, ESD bags and cartons, and related procedures.

Avoid touching board surfaces and onboard components. Only handle boards by their edges. Make sure that the USB-2627 does not come into contact with foreign elements such as oils, water, and industrial particulate.

The discharge of static electricity can damage some electronic components. Semiconductor devices are especially susceptible to ESD damage.
Calibrating the hardware

Field calibration

The USB-2627 supports self-calibration. Run the InstaCal utility to calibrate the USB-2627 whenever the ambient temperature changes by more than ±10 °C from the last self-calibration. The recommended calibration interval is one year. Calibrate the inputs before calibrating the outputs.

Factory calibration

The Measurement Computing Manufacturing Test department performs the initial factory calibration. Return the device to Measurement Computing Corporation if you want the factory calibration restored.
Signal Connections

Board signals are available on the 68-pin SCSI connector P1 and 40-pin header connectors J2, J3, J4, and J5.

**Caution! Avoid redundant connections!** Make sure there is no signal conflict between the SCSI connector pins and header connector pins. Failure to do so could possibly cause equipment damage and/or personal injury.

**Use the SCSI cable for optimal analog input settling time**
To achieve the best analog input channel-channel settling time performance, connect your signals to the SCSI connector (P1). If the J2 to J5 connectors are to be used, keep the interface cable as short as possible to minimize settling errors.

### 68-pin SCSI connector P1
The SCSI connector provides connections to the board signals listed in Figure 2.

![Figure 2. SCSI connector P1 pinout](image)
Cabling

Use a CA-68-3R cable (Figure 3) when connecting signals to the SCSI connector.

![Figure 3. CA-68-3R cable](image)

Signal termination

- **TB-100** – screw terminal board that connects to SCSI connector P1 with a CA-68-3R cable. A 19-inch rack mount kit (RM-TB-100) is also available.

The following table lists how TB-100 screw terminals are mapped to the SCSI connector pins.

<table>
<thead>
<tr>
<th>TB2 terminal</th>
<th>SCSI pin</th>
<th>TB1 terminal</th>
<th>SCSI pin</th>
</tr>
</thead>
<tbody>
<tr>
<td>+5V</td>
<td>19</td>
<td>ACH0</td>
<td>68</td>
</tr>
<tr>
<td>GND</td>
<td>GND</td>
<td>ACH8</td>
<td>34</td>
</tr>
<tr>
<td>A0</td>
<td>18</td>
<td>AGND</td>
<td>AGND</td>
</tr>
<tr>
<td>A1</td>
<td>52</td>
<td>ACH1</td>
<td>33</td>
</tr>
<tr>
<td>A2</td>
<td>17</td>
<td>ACH9</td>
<td>66</td>
</tr>
<tr>
<td>A3</td>
<td>51</td>
<td>AGND</td>
<td>AGND</td>
</tr>
<tr>
<td>A4</td>
<td>16</td>
<td>ACH2</td>
<td>65</td>
</tr>
<tr>
<td>A5</td>
<td>50</td>
<td>ACH10</td>
<td>31</td>
</tr>
<tr>
<td>A6</td>
<td>15</td>
<td>AGND</td>
<td>AGND</td>
</tr>
<tr>
<td>A7</td>
<td>49</td>
<td>ACH3</td>
<td>30</td>
</tr>
<tr>
<td>B0</td>
<td>14</td>
<td>ACH11</td>
<td>63</td>
</tr>
<tr>
<td>B1</td>
<td>48</td>
<td>AGND</td>
<td>AGND</td>
</tr>
<tr>
<td>B2</td>
<td>13</td>
<td>ACH4</td>
<td>28</td>
</tr>
<tr>
<td>B3</td>
<td>47</td>
<td>ACH12</td>
<td>61</td>
</tr>
<tr>
<td>B4</td>
<td>12</td>
<td>AGND</td>
<td>AGND</td>
</tr>
<tr>
<td>B5</td>
<td>46</td>
<td>ACH5</td>
<td>60</td>
</tr>
<tr>
<td>B6</td>
<td>11</td>
<td>ACH13</td>
<td>26</td>
</tr>
<tr>
<td>B7</td>
<td>45</td>
<td>AGND</td>
<td>AGND</td>
</tr>
<tr>
<td>C0</td>
<td>10</td>
<td>ACH6</td>
<td>25</td>
</tr>
<tr>
<td>C1</td>
<td>44</td>
<td>ACH14</td>
<td>58</td>
</tr>
<tr>
<td>C2</td>
<td>9</td>
<td>AGND</td>
<td>AGND</td>
</tr>
<tr>
<td>C3</td>
<td>43</td>
<td>ACH7</td>
<td>57</td>
</tr>
<tr>
<td>C4</td>
<td>8</td>
<td>ACH15</td>
<td>23</td>
</tr>
<tr>
<td>C5</td>
<td>42</td>
<td>XDAC3</td>
<td>56</td>
</tr>
<tr>
<td>C6</td>
<td>7</td>
<td>SGND</td>
<td>62</td>
</tr>
<tr>
<td>C7</td>
<td>41</td>
<td>NC (Note 1)</td>
<td>20</td>
</tr>
<tr>
<td>TTL TRG</td>
<td>6</td>
<td>XDAC2</td>
<td>55</td>
</tr>
<tr>
<td>GND</td>
<td>GND</td>
<td>GND (Note 2)</td>
<td>GND</td>
</tr>
<tr>
<td>CNT0</td>
<td>5</td>
<td>AGND</td>
<td>AGND</td>
</tr>
<tr>
<td>CNT1</td>
<td>39</td>
<td>XDAC0</td>
<td>22</td>
</tr>
<tr>
<td>CNT2</td>
<td>4</td>
<td>AGND</td>
<td>AGND</td>
</tr>
</tbody>
</table>
### 40-pin header connectors J2, J4, and J5

The header connectors provide alternative connections to the 68-pin connector. Pins 1, 2, 39, and 40 are labeled on each connector.

- **J2** provides analog input connections.
- **J4** provides digital, counter, timer, pacer input, and power output connections.
- **J5** provides analog output, timer, pacer I/O, and power output connections.

**Caution!** Avoid redundant connections! Make sure there is no signal conflict between the SCSI connector pins and header connector pins. Failure to do so could possibly cause equipment damage and/or personal injury.

Figure 4 shows the pinout for J2.

<table>
<thead>
<tr>
<th><strong>J2</strong></th>
<th><strong>J4</strong></th>
<th><strong>J5</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>Analog ground AGND</td>
<td>5</td>
<td>6</td>
</tr>
<tr>
<td>Analog input 3 ACH3</td>
<td>7</td>
<td>8</td>
</tr>
<tr>
<td>Analog input 2 ACH2</td>
<td>9</td>
<td>10</td>
</tr>
<tr>
<td>No connection NC</td>
<td>11</td>
<td>12</td>
</tr>
<tr>
<td>No connection NC</td>
<td>13</td>
<td>NC</td>
</tr>
<tr>
<td>Analog input 1 ACH1</td>
<td>15</td>
<td>16</td>
</tr>
<tr>
<td>Analog input 0 ACH0</td>
<td>17</td>
<td>18</td>
</tr>
<tr>
<td>Analog ground AGND</td>
<td>19</td>
<td>20</td>
</tr>
<tr>
<td>No connection NC</td>
<td>21</td>
<td>NC</td>
</tr>
<tr>
<td>No connection NC</td>
<td>23</td>
<td>NC</td>
</tr>
<tr>
<td>Analog input 7 ACH7</td>
<td>25</td>
<td>26</td>
</tr>
<tr>
<td>Analog input 6 ACH6</td>
<td>27</td>
<td>28</td>
</tr>
<tr>
<td>Analog ground AGND</td>
<td>29</td>
<td>30</td>
</tr>
<tr>
<td>No connection NC</td>
<td>31</td>
<td>NC</td>
</tr>
<tr>
<td>No connection NC</td>
<td>33</td>
<td>NC</td>
</tr>
<tr>
<td>Analog input 13 ACH13</td>
<td>35</td>
<td>36</td>
</tr>
<tr>
<td>Analog input 12 ACH12</td>
<td>37</td>
<td>38</td>
</tr>
<tr>
<td>Analog ground AGND</td>
<td>39</td>
<td>AGND</td>
</tr>
</tbody>
</table>

Figure 4. Header connector J2 pinout

---

<table>
<thead>
<tr>
<th>TB2 terminal</th>
<th>SCSI pin</th>
<th>TB1 terminal</th>
<th>SCSI pin</th>
</tr>
</thead>
<tbody>
<tr>
<td>CNT3</td>
<td>38</td>
<td>XDAC1</td>
<td>21</td>
</tr>
<tr>
<td>TMR0</td>
<td>3</td>
<td>AGND</td>
<td>AGND</td>
</tr>
<tr>
<td>TMR1</td>
<td>37</td>
<td>XAPCR</td>
<td>2</td>
</tr>
<tr>
<td>XDPCR</td>
<td>1</td>
<td>GND</td>
<td>GND</td>
</tr>
<tr>
<td>GND</td>
<td>GND</td>
<td>EGND</td>
<td>SCSI shell</td>
</tr>
</tbody>
</table>

Do not make connections to any terminal labeled NC.

Note 1: Labeled POSREF on the TB-100; not supported on the USB-2627.

Note 2: Labeled NEGREF on the TB-100; not supported on the USB-2627.
Figure 5 shows the pinout for J4 and J5.

<table>
<thead>
<tr>
<th>Digital ground</th>
<th>GND 1</th>
<th>2</th>
<th>XAPCR</th>
<th>Al scan clock</th>
<th>No connection</th>
<th>NC 1</th>
<th>2</th>
<th>NC</th>
<th>No connection</th>
</tr>
</thead>
<tbody>
<tr>
<td>Port A bit 0</td>
<td>A0 3</td>
<td>4</td>
<td>A4</td>
<td>Port A bit 4</td>
<td>No connection</td>
<td>NC 3</td>
<td>4</td>
<td>NC</td>
<td>No connection</td>
</tr>
<tr>
<td>Port A bit 1</td>
<td>A1 5</td>
<td>6</td>
<td>A5</td>
<td>Port A bit 5</td>
<td>Analog ground</td>
<td>AGND 5</td>
<td>6</td>
<td>AGND</td>
<td>Analog ground</td>
</tr>
<tr>
<td>Port A bit 2</td>
<td>A2 7</td>
<td>8</td>
<td>A6</td>
<td>Port A bit 6</td>
<td>Analog output 0</td>
<td>DAC0 7</td>
<td>8</td>
<td>DAC1</td>
<td>Analog output 2</td>
</tr>
<tr>
<td>Port A bit 3</td>
<td>A3 9</td>
<td>10</td>
<td>A7</td>
<td>Port A bit 7</td>
<td>Analog output 1</td>
<td>DAC1 9</td>
<td>10</td>
<td>DAC3</td>
<td>Analog output 3</td>
</tr>
<tr>
<td>Digital ground</td>
<td>GND 11</td>
<td>12</td>
<td>TTLTRG</td>
<td>Dig. trigger input</td>
<td>Analog ground</td>
<td>AGND 11</td>
<td>12</td>
<td>AGND</td>
<td>Analog ground</td>
</tr>
<tr>
<td>Port B bit 0</td>
<td>B0 13</td>
<td>14</td>
<td>B4</td>
<td>Port B bit 4</td>
<td>No connection</td>
<td>NC 13</td>
<td>14</td>
<td>AGND</td>
<td>Analog ground</td>
</tr>
<tr>
<td>Port B bit 1</td>
<td>B1 15</td>
<td>16</td>
<td>B5</td>
<td>Port B bit 5</td>
<td>Analog ground</td>
<td>AGND 15</td>
<td>16</td>
<td>AGND</td>
<td>Analog ground</td>
</tr>
<tr>
<td>Port B bit 2</td>
<td>B2 17</td>
<td>18</td>
<td>B6</td>
<td>Port B bit 6</td>
<td>Dig. trigger input</td>
<td>TTLTRG 17</td>
<td>18</td>
<td>XPCR</td>
<td>AO scan clock</td>
</tr>
<tr>
<td>Port B bit 3</td>
<td>B3 19</td>
<td>20</td>
<td>B7</td>
<td>Port B bit 7</td>
<td>Al scan clock</td>
<td>XAPCR 19</td>
<td>20</td>
<td>GND</td>
<td>Digital ground</td>
</tr>
<tr>
<td>Digital ground</td>
<td>GND 21</td>
<td>22</td>
<td>+V0</td>
<td>Power output</td>
<td>Digital ground</td>
<td>GND 21</td>
<td>22</td>
<td>GND</td>
<td>Digital ground</td>
</tr>
<tr>
<td>Port C bit 0</td>
<td>C0 23</td>
<td>24</td>
<td>C4</td>
<td>Port C bit 4</td>
<td>No connection</td>
<td>NC 23</td>
<td>24</td>
<td>NC</td>
<td>No connection</td>
</tr>
<tr>
<td>Port C bit 1</td>
<td>C1 25</td>
<td>26</td>
<td>C5</td>
<td>Port C bit 5</td>
<td>Power output</td>
<td>+V0 25</td>
<td>26</td>
<td>NC</td>
<td>No connection</td>
</tr>
<tr>
<td>Port C bit 2</td>
<td>C2 27</td>
<td>28</td>
<td>C6</td>
<td>Port C bit 6</td>
<td>No connection</td>
<td>NC 27</td>
<td>28</td>
<td>NC</td>
<td>No connection</td>
</tr>
<tr>
<td>Port C bit 3</td>
<td>C3 29</td>
<td>30</td>
<td>C7</td>
<td>Port C bit 7</td>
<td>Digital ground</td>
<td>GND 29</td>
<td>30</td>
<td>NC</td>
<td>No connection</td>
</tr>
<tr>
<td>Digital ground</td>
<td>GND 31</td>
<td>32</td>
<td>TMR1</td>
<td>Timer output 1</td>
<td>Digital ground</td>
<td>GND 33</td>
<td>32</td>
<td>NC</td>
<td>No connection</td>
</tr>
<tr>
<td>Timer output 0</td>
<td>TMR0 33</td>
<td>34</td>
<td>CNT1</td>
<td>Counter input 1</td>
<td>Digital ground</td>
<td>GND 33</td>
<td>34</td>
<td>NC</td>
<td>No connection</td>
</tr>
<tr>
<td>Counter input 0</td>
<td>CNT0 35</td>
<td>36</td>
<td>CNT3</td>
<td>Counter input 3</td>
<td>Timer output 1</td>
<td>TMR1 35</td>
<td>36</td>
<td>NC</td>
<td>No connection</td>
</tr>
<tr>
<td>Counter input 2</td>
<td>CNT2 37</td>
<td>38</td>
<td>GND</td>
<td>Digital ground</td>
<td>Digital ground</td>
<td>GND 37</td>
<td>38</td>
<td>NC</td>
<td>No connection</td>
</tr>
<tr>
<td>Digital ground</td>
<td>GND 39</td>
<td>40</td>
<td>GND</td>
<td>Digital ground</td>
<td>Digital ground</td>
<td>GND 39</td>
<td>40</td>
<td>NC</td>
<td>No connection</td>
</tr>
</tbody>
</table>

Figure 5. Header connector J4 and J5 pinout

For more information about signal connections
For more information about analog input connections, refer to the Guide to DAQ Signal Connections (available for download on our website at www.mccdaq.com/support/DAQ-Signal-Connections.aspx).

Cabling

Use a C40FF-x cable (Figure 6) when connecting signals to a 40-pin header connector.

Connecting a C40FF-x cable to each 40-pin connector provides greater signal connectivity than what is provided by the SCSI connector.

Signal termination

- **CIO-MINI40** – 40-pin screw terminal board that connects to the J2, J4, or J5 header connector with the C40FF-x cable.
- **TB-103** – screw terminal board that mounts directly onto the header connectors.
Chapter 4

Functional Details

Analog input modes

The USB-2627 can acquire analog input data in two modes – software paced and hardware paced.

Software paced

You can acquire one analog sample at a time in software paced mode. You initiate the A/D conversion with a software command. The analog value is converted to digital data and returned to the computer. Repeat this procedure until you have the total number of samples that you want.

The sample rate in software paced mode is system-dependent and can range from 33 S/s to 4000 S/s.

Hardware paced

You can acquire data from up to 16 channels in hardware paced mode. The analog data is continuously acquired, converted to digital values, and written into the 4k FIFO buffer on the device until you stop the scan. The FIFO buffer is serviced in blocks as the data is transferred from the FIFO buffer to the computer memory buffer. You start a continuous scan with either a software command or with an external hardware trigger event.

The maximum sampling rate in hardware paced mode from one to 16 channels is 1,000 kS/s, max.

Burst mode

Burst mode is an optional scan mode used with the onboard pacer to obtain more precise timing between samples. When burst mode is enabled, each successive channel in a scan is sampled at the maximum A/D rate. This ensures that samples from each channel are taken as close as possible to the same absolute point in time. When burst mode is disabled, data is sampled at evenly spaced intervals, allowing you to increase the sample period time; doing so can improve settling time and overall measurement accuracy.

Multi-channel scanning with burst mode enabled and disabled is shown in Figure 7.

![Figure 7. Multi-channel scan with burst mode enabled and disabled](image)

The burst mode sample period is 1 µs.

You can trigger the acquisition with the external trigger and control the clock period with the internal A/D pacer clock.
USB-2627 components

These USB-2627 components are shown in Figure 8.

- 68-pin SCSI connector (P1)
- 40-pin header connectors (J2, J4, and J5)
- USB connector
- LED indicators (USB and Power)

![USB-2627 components diagram](image)

Figure 8. USB-2627 components

68-pin SCSI connector P1

The 68-pin SCSI connector provides the following connections:

- 16 single-ended analog inputs (ACH0 to ACH15)
- Four analog outputs (XDAC0 to XDAC3)
- 24 digital I/O (A0 to A7, B0 to B7, C0 to C7)
- Four counter inputs (CNT0 to CNT3)
- Two timer outputs (TMR0 to TMR1)
- External AI scan clock input (XAPCR)
- External AO scan clock input (XDPCR)
- External digital trigger input (TTLTRG)
- Power output (+VO)
- Analog ground and digital ground (AGND and GND)

Refer to Figure 2 on page 10 for the SCSI connector pinout.
40-pin header connectors J2, J4, and J5

The header connectors provide alternative connections to the SCSI connector.

- J2 provides connections for the analog inputs.
- J4 provides connections for the DIO, counter inputs, timer outputs, input scan clock, and power output.
- J5 provides connections for the analog outputs, timer outputs, I/O scan clocks, and power output.

Refer to Figure 4 and Figure 5 on page 12 for header connector pinouts.

USB connector

The USB connector provides +5 V power and communication. No external power supply is required.

LEDs

The USB-2627 has two LEDs – Power and Activity.

- The Power LED (top) turns on when the device is detected and installed on the computer.
- The Activity LED (bottom) blinks when data is transferred and is off otherwise.

Standoffs

The board is shipped with standoffs that can be used for mounting onto a metal frame.

Signal descriptions

Analog input

The USB-2627 has a 16-bit A/D converter and provides 16 single-ended analog inputs. The input voltage range is fixed at ±10 V. Analog input connections are available on the SCSI connector and on header connector J2:

- SCSI connector P1 provides connections for ACH0 to ACH15
- Header connector J2 provides connections for ACH0 to ACH15

Input pacer clock

You can pace input scanning operations using the input scan clock on the board or with an external signal connected to XAPCR. The sampling rate is software-selectable for 0.0149 Hz to 1 MHz.

Channel-Gain queue

The USB-2627 channel-gain queue feature allows you to configure a list of channels to scan. The settings are stored in a channel-gain queue list that is written to local memory on the device.

The channel-gain queue list can contain up to 16 elements. The channels can be listed in any order. An example of a 4-element list is shown in the table below.

<table>
<thead>
<tr>
<th>Sample channel-gain queue list</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Element</strong></td>
</tr>
<tr>
<td>0</td>
</tr>
<tr>
<td>1</td>
</tr>
<tr>
<td>2</td>
</tr>
<tr>
<td>3</td>
</tr>
</tbody>
</table>
Analog output

The USB-2627 has four 16-bit, 1 MHz analog output channels (XDAC0 to XDAC3). The output range is fixed at ±10 V. All outputs can be updated at 1 MS/s, regardless of the number of channels in a scan. Analog output connections are available on the SCSI connector and header connector J5.

Output pacer clock

You can pace the output waveform using the DAC scan clock on the board or with an external signal connected to XDPCR.

The on-board programmable clock can generate updates ranging from 0.0149 Hz to 1 MHz.

Digital I/O

The USB-2627 has 24 TTL-level digital I/O lines that are configured as three 8-bit ports. Each bit is configurable as either input or output. Digital I/O connections are available on the SCSI connector and header connector J4.

You can read digital input ports asynchronously before, during, or after an analog input scan. Digital outputs can be updated asynchronously before, during, or after an acquisition.

Pull-up/down configuration

Each digital port has 47 kΩ resistors that are jumper configurable as pull-up or pull-down (default). Jumper W7 configures Port A, W6 configures Port B, and W5 configures Port C.

Caution!  Turn off power to all devices connected to the system before making connections. Electrical shock or damage to equipment can result even under low-voltage conditions.

Always handle components carefully, and never touch connector pins or circuit components unless you are following ESD guidelines in an appropriate ESD-controlled area. These guidelines include using properly-grounded mats and wrist straps, ESD bags and cartons, and related procedures.

Avoid touching board surfaces and onboard components. Only handle boards by their edges. Make sure that the USB-2627 does not come into contact with foreign elements such as oils, water, and industrial particulate.

The discharge of static electricity can damage some electronic components. Semiconductor devices are especially susceptible to ESD damage.

Figure 9 shows the location of each jumper on the board.
Figure 10 shows the pull-up and pull-down configuration for each jumper.

![Pull-up/down jumper configurations](image)

**Counter input**

The four counter inputs (CNT0 to CNT3) are 32-bit event counters that can accept frequency inputs up to 20 MHz.

![Counter input](image)

Counter input connections are available on the SCSI connector and header connector J4.

**Trigger input**

The external digital trigger input (TTLTRIG) is software selectable for edge or level sensitive.

- Edge sensitive mode is configurable for rising or falling edge.
- Level sensitive mode is configurable for high or low level.

The default setting at power up is edge sensitive, rising edge. The trigger input connection is available on the SCSI connector and header connectors J4 and J5.

**Timer output**

The four timer outputs (TMR0 to TMR3) are pulse width modulation (PWM) outputs that can generate a square wave with a programmable frequency in the range of 0.015 Hz to 32 MHz. Figure 12 shows the timer output schematic.

![Timer output](image)

Timer output connections are available on the SCSI connector and header connectors J4 and J5. TMR0 and TMR1 are available on the SCSI connector and header connector J4. TMR2 and TMR3 are available on header connector J5.

**Ground**

The analog ground (AGND) pins provide a common ground for all analog channels. The digital ground (GND) pins provide a common ground for the digital, counter, timer, and clock channels and the power terminal.
Power output

The +VO pin can output up to 10 mA maximum. Use this terminal to power external devices or circuitry. Power output connections are available on the SCSI connector and header connectors J4 and J5.

**Caution!** The +VO (+5V) terminal is an output. Do not connect to an external power supply or you may damage the device and possibly the computer.

USB power

The maximum current that can be drawn by the device is 500 mA. This maximum applies to most personal computers and self-powered USB hubs. Bus-powered hubs and notebook computers may limit the maximum available output current to 100 mA. If the current requirement of the device exceeds the current available from the computer, connect to a self-powered hub or power the computer with an external power adapter.

Mechanical drawing

![Figure 13. USB-2627 board dimensions](image)
Specifications

All specifications are subject to change without notice.
Typical for 25 °C unless otherwise specified.
Specifications in italic text are guaranteed by design.

Analog input

Table 1. General analog input specifications

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Condition</th>
<th>Specification</th>
</tr>
</thead>
<tbody>
<tr>
<td>A/D converter type</td>
<td></td>
<td>Successive approximation</td>
</tr>
<tr>
<td>ADC resolution</td>
<td></td>
<td>16 bits</td>
</tr>
<tr>
<td>Number of channels</td>
<td></td>
<td>16 single-ended</td>
</tr>
<tr>
<td>Input voltage range</td>
<td></td>
<td>±10 V</td>
</tr>
<tr>
<td>Absolute maximum input voltage</td>
<td>CHs relative to AGND</td>
<td>±25 V max (power on)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>±10.5 V max (power off)</td>
</tr>
<tr>
<td>Input impedance</td>
<td></td>
<td>1 GΩ (power on)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>390 Ω (power off)</td>
</tr>
<tr>
<td>Input bias current</td>
<td></td>
<td>±100 pA</td>
</tr>
<tr>
<td>Input bandwidth</td>
<td>Small signal (~3 dB)</td>
<td>3.1 MHz</td>
</tr>
<tr>
<td>Input capacitance</td>
<td></td>
<td>40 pf</td>
</tr>
<tr>
<td>Maximum working voltage</td>
<td></td>
<td>±10.1 V max relative to AGND</td>
</tr>
<tr>
<td>Crosstalk</td>
<td>Adjacent channels, DC to 10 kHz</td>
<td>~80 dB</td>
</tr>
<tr>
<td>Input coupling</td>
<td></td>
<td>DC</td>
</tr>
<tr>
<td>Sampling rate</td>
<td></td>
<td>0.0149 Hz to 1,000 kHz; software selectable</td>
</tr>
<tr>
<td>Trigger source</td>
<td></td>
<td>TTLTRG</td>
</tr>
<tr>
<td>A/D pacing</td>
<td></td>
<td>Internal input scan clock</td>
</tr>
<tr>
<td></td>
<td></td>
<td>External input scan clock (XAPCR)</td>
</tr>
<tr>
<td>Burst mode</td>
<td></td>
<td>Burst rate = 1 µs, software selectable</td>
</tr>
<tr>
<td>Throughput</td>
<td>Software paced</td>
<td>33 S/s to 4,000 S/s typ; system dependent</td>
</tr>
<tr>
<td></td>
<td>Hardware paced</td>
<td>1 MS/s max</td>
</tr>
<tr>
<td>Channel queue</td>
<td></td>
<td>Up to 16 element list of random channels</td>
</tr>
<tr>
<td>Warm-up time</td>
<td></td>
<td>15 minutes min</td>
</tr>
</tbody>
</table>

Accuracy

Analog input DC voltage measurement accuracy

Table 2. DC Accuracy components and specifications. All values are (±)

<table>
<thead>
<tr>
<th>Range</th>
<th>Gain error (% of reading)</th>
<th>Offset error (µV)</th>
<th>INL error (% of range)</th>
<th>Absolute accuracy at Full Scale (µV)</th>
<th>Gain temperature coefficient (% reading/°C)</th>
<th>Offset temperature coefficient (µV/°C)</th>
</tr>
</thead>
<tbody>
<tr>
<td>±10 V</td>
<td>0.031</td>
<td>915</td>
<td>0.0076</td>
<td>4775</td>
<td>0.0013</td>
<td>35</td>
</tr>
</tbody>
</table>
Noise performance

For the peak-to-peak noise distribution test, a single-ended input channel is connected to AGND at the input terminal block, and 32,000 samples are acquired at the maximum rate.

Table 3. Noise performance specifications

<table>
<thead>
<tr>
<th>Range</th>
<th>Counts</th>
<th>LSBrms</th>
</tr>
</thead>
<tbody>
<tr>
<td>±10 V</td>
<td>8</td>
<td>1.21</td>
</tr>
</tbody>
</table>

Settling time for Multichannel Measurements

Settling time is defined as the accuracy that can be expected after one conversion when switching from a channel with a DC input at one extreme of full scale to another channel with a DC input at the other extreme of full scale.

Table 4. Input settling time specifications in µS, typical

<table>
<thead>
<tr>
<th>Range</th>
<th>1 µS settling accuracy (% FSR)</th>
<th>5 µS settling accuracy (% FSR)</th>
<th>10 µS settling accuracy (% FSR)</th>
</tr>
</thead>
<tbody>
<tr>
<td>±10 V</td>
<td>0.0152</td>
<td>0.0061</td>
<td>0.0015</td>
</tr>
</tbody>
</table>

Analog output

Table 5. Analog output specifications

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Condition</th>
<th>Specification</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of channels</td>
<td></td>
<td>4</td>
</tr>
<tr>
<td>Resolution</td>
<td></td>
<td>16 bits</td>
</tr>
<tr>
<td>Output ranges</td>
<td>Calibrated</td>
<td>±10 V</td>
</tr>
<tr>
<td>Output transient</td>
<td>Host computer is reset, powered on, suspended,</td>
<td>Duration: 100 ms Amplitude: 2 V p-p</td>
</tr>
<tr>
<td></td>
<td>or a reset command is issued to the device</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Powered off</td>
<td>Duration: 100 ms Amplitude: 5 V peak</td>
</tr>
<tr>
<td>Output transient</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Output transient</td>
<td>XDACx pins</td>
<td>±0.25 LSB typ</td>
</tr>
<tr>
<td>Output transient</td>
<td></td>
<td>±1 LSB max</td>
</tr>
<tr>
<td>Output transient</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Output current</td>
<td>XDACx connected to AGND</td>
<td>±3.5 mA max</td>
</tr>
<tr>
<td>Output short-circuit protection</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Output coupling</td>
<td></td>
<td>DC</td>
</tr>
<tr>
<td>Power on and reset state</td>
<td></td>
<td>DACs cleared to zero-scale: 0 V, ±150 mV</td>
</tr>
<tr>
<td>Pacer source</td>
<td></td>
<td>Two programmable sources:</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Internal output scan clock</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• External output scan clock (XDPCR), independent of external</td>
</tr>
<tr>
<td></td>
<td></td>
<td>input scan clock (XAPCR)</td>
</tr>
<tr>
<td>Trigger sources</td>
<td></td>
<td>TTLTRIG (see External trigger on page 23)</td>
</tr>
<tr>
<td>Output update rate</td>
<td></td>
<td>1 MS/s max (Note 3)</td>
</tr>
<tr>
<td>Settling time</td>
<td>To rated accuracy, 10 V step</td>
<td>2 µs</td>
</tr>
<tr>
<td>Slew rate</td>
<td></td>
<td>20 V/µs</td>
</tr>
<tr>
<td>Throughput</td>
<td>Software paced</td>
<td>33 S/s to 4,000 S/s typ, system dependent</td>
</tr>
<tr>
<td></td>
<td>Hardware paced</td>
<td>1 MS/s max, system dependent</td>
</tr>
</tbody>
</table>

Note 1: Leave unused XDACx output channels disconnected.

Note 2: XDACx defaults to 0 V whenever the host computer is reset, powered on, suspended, or a reset command is issued to the device.

Note 3: The DAC update rate is not affected by the number of channels in the scan.
Table 6. Calibrated absolute accuracy specifications

<table>
<thead>
<tr>
<th>Range</th>
<th>Absolute accuracy (±LSB)</th>
</tr>
</thead>
<tbody>
<tr>
<td>±10 V</td>
<td>16.0</td>
</tr>
</tbody>
</table>

Table 7. Calibrated absolute accuracy components specifications

<table>
<thead>
<tr>
<th>Range</th>
<th>% of reading</th>
<th>Offset (±mV)</th>
<th>Offset tempco (µV/°C)</th>
<th>Gain tempco (ppm of range/°C)</th>
</tr>
</thead>
<tbody>
<tr>
<td>±10 V</td>
<td>±0.0183</td>
<td>1.831</td>
<td>12.7</td>
<td>13</td>
</tr>
</tbody>
</table>

Table 8. Relative accuracy specifications (±LSB)

<table>
<thead>
<tr>
<th>Range</th>
<th>Relative accuracy (INL)</th>
</tr>
</thead>
<tbody>
<tr>
<td>±10 V</td>
<td>4.0 typ</td>
</tr>
</tbody>
</table>

**Analog input/output calibration**

Table 9. Analog input/output calibration specifications

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Specification</th>
</tr>
</thead>
<tbody>
<tr>
<td>Recommended warm-up time</td>
<td>15 minutes min</td>
</tr>
<tr>
<td>Calibration method</td>
<td>Self-calibration (firmware)</td>
</tr>
<tr>
<td>Calibration interval</td>
<td>1 year (factory calibration)</td>
</tr>
<tr>
<td>AI calibration reference</td>
<td>+5 V, ±2.5 mV max. Actual measured values stored in EEPROM. Tempco: 5 ppm/°C max. Long term stability: 15 ppm/1,000 hours</td>
</tr>
<tr>
<td>AO calibration procedure</td>
<td>The analog output pins are internally routed to the analog input circuit. For best calibration results, disconnect any XDACx connections at the I/O connectors prior to performing AOUT calibration.</td>
</tr>
</tbody>
</table>

**Digital input/output**

Table 10. Digital input/output specifications

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Specification</th>
</tr>
</thead>
<tbody>
<tr>
<td>Digital type</td>
<td>TTL</td>
</tr>
<tr>
<td>Number of I/O</td>
<td>24</td>
</tr>
<tr>
<td>Configuration</td>
<td>Three banks of 8. Each bit may be configured as input (power on default) or output.</td>
</tr>
<tr>
<td>Pull-up configuration</td>
<td>Each port has 47 kΩ resistors that are configurable as pull-up or pull-down (default) using an onboard jumper (W5, W6, W7).</td>
</tr>
<tr>
<td>Digital I/O transfer rate (system-paced, asynchronous)</td>
<td>33 to 4,000 port reads/writes or single bit reads/writes per second typ; system dependent</td>
</tr>
<tr>
<td>Input high voltage</td>
<td>2.0 V min</td>
</tr>
<tr>
<td></td>
<td>5.0 V absolute max</td>
</tr>
<tr>
<td>Input low voltage</td>
<td>0.8 V max</td>
</tr>
<tr>
<td></td>
<td>0 V recommended min</td>
</tr>
<tr>
<td>Output high voltage</td>
<td>4.4 V min (IOH = −50 µA)</td>
</tr>
<tr>
<td></td>
<td>3.76 V min (IOH = −24 mA)</td>
</tr>
<tr>
<td>Output low voltage</td>
<td>0.1 V max (IOL = 50 µA)</td>
</tr>
<tr>
<td></td>
<td>0.44 V max (IOL = 24 mA)</td>
</tr>
<tr>
<td>Output current</td>
<td>60 mA max, not to exceed 24 mA for one bit, resulting in 2.5 mA max when all 24 bits are enabled.</td>
</tr>
</tbody>
</table>

---

22
## External trigger

Table 11. External trigger specifications

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Specification</th>
</tr>
</thead>
<tbody>
<tr>
<td>Trigger source</td>
<td>TTLTRG</td>
</tr>
<tr>
<td>Trigger mode</td>
<td>Software programmable for edge or level sensitive, rising or falling edge, high or low level. Power on default is edge sensitive, rising edge.</td>
</tr>
<tr>
<td>Trigger latency</td>
<td>1 µs + 1 clock cycle max</td>
</tr>
<tr>
<td>Trigger pulse width</td>
<td>100 ns min</td>
</tr>
<tr>
<td>Input type</td>
<td>33 Ω series resistor and 49.9 kΩ pull-down to GND</td>
</tr>
<tr>
<td>Input high voltage</td>
<td>2.2 V min, 5.5 V absolute max</td>
</tr>
<tr>
<td>Input low voltage</td>
<td>1.5 V max, -0.5 V absolute min, 0 V recommended min</td>
</tr>
</tbody>
</table>

## External clock

Table 12. External clock I/O specifications

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Specification</th>
</tr>
</thead>
<tbody>
<tr>
<td>Terminal names</td>
<td>XAPCR, XDPCR</td>
</tr>
<tr>
<td>Terminal types</td>
<td>Input, active on rising edge</td>
</tr>
<tr>
<td>Terminal descriptions</td>
<td>Receives pacer clock from external source</td>
</tr>
<tr>
<td>Input clock rate</td>
<td>1 MHz max</td>
</tr>
<tr>
<td>Clock pulse width</td>
<td>100 ns min</td>
</tr>
<tr>
<td>Input type</td>
<td>33 Ω series resistor, 47 kΩ pull-down to GND</td>
</tr>
<tr>
<td>Input high voltage</td>
<td>2.2 V min, 5.5 V absolute max</td>
</tr>
<tr>
<td>Input low voltage</td>
<td>1.5 V max, -0.5 V absolute min, 0 V recommended min</td>
</tr>
</tbody>
</table>

## Counter

Table 13. Counter specifications

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Specification</th>
</tr>
</thead>
<tbody>
<tr>
<td>Terminal names</td>
<td>CNT0, CNT1, CNT2, CNT3</td>
</tr>
<tr>
<td>Number of channels</td>
<td>4 channels</td>
</tr>
<tr>
<td>Resolution</td>
<td>32-bit</td>
</tr>
<tr>
<td>Counter type</td>
<td>Event counter</td>
</tr>
<tr>
<td>Input type</td>
<td>33 Ω series resistor, 47 kΩ pull-down to GND</td>
</tr>
<tr>
<td>Input source</td>
<td>68-pin SCSI: CNT0 (pin 5), CNT1 (pin 39), CNT2 (pin 4), CNT3 (pin 38) 40-pin (J4): CNT0 (pin 35), CNT1 (pin 34), CNT2 (pin 37), CNT3 (pin 36)</td>
</tr>
<tr>
<td>Counter read/writes rates (software paced)</td>
<td>33 to 8,000 reads/writes per second typ; system dependent</td>
</tr>
<tr>
<td>Input high voltage</td>
<td>2.2 V min</td>
</tr>
<tr>
<td>Input low voltage</td>
<td>1.5 V max</td>
</tr>
<tr>
<td>Maximum input voltage range</td>
<td>-5 V to +10 V max</td>
</tr>
<tr>
<td>Input frequency</td>
<td>20 MHz max</td>
</tr>
<tr>
<td>High pulse width</td>
<td>25 ns min</td>
</tr>
<tr>
<td>Low pulse width</td>
<td>25 ns min</td>
</tr>
</tbody>
</table>
Timer output

Table 14. Timer output specifications

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Specification</th>
</tr>
</thead>
<tbody>
<tr>
<td>Terminal name</td>
<td>TMR0, TMR1, TMR2, TMR3</td>
</tr>
<tr>
<td>Number of channels</td>
<td>4 channels</td>
</tr>
<tr>
<td>Timer type</td>
<td>PWM output with count, period, delay, and pulse width registers</td>
</tr>
<tr>
<td>Output value</td>
<td>Default state is idle low with pulses high, software selectable, output invert</td>
</tr>
<tr>
<td>Input source</td>
<td>68-pin SCSI: TMR0 (pin 3), TMR1 (pin 37)</td>
</tr>
<tr>
<td></td>
<td>40-pin (J4): TMR0 (pin 33), TMR1 (pin 32)</td>
</tr>
<tr>
<td></td>
<td>40-pin (J5): TMR2 (pin 31), TMR3 (pin 35)</td>
</tr>
<tr>
<td>Internal clock frequency</td>
<td>64 MHz</td>
</tr>
<tr>
<td>Register widths</td>
<td>32-bit</td>
</tr>
<tr>
<td>High pulse width</td>
<td>10.42 ns min</td>
</tr>
<tr>
<td>Low pulse width</td>
<td>10.42 ns min</td>
</tr>
<tr>
<td>Output high voltage</td>
<td>4.4 V min (IOH = –50 µA)</td>
</tr>
<tr>
<td></td>
<td>3.76 V min (IOH = –1.0 mA)</td>
</tr>
<tr>
<td>Output low voltage</td>
<td>0.1 V max (IOL = 50 µA)</td>
</tr>
<tr>
<td></td>
<td>0.44 V max (IOL = 1.0 mA)</td>
</tr>
<tr>
<td>Output waveform</td>
<td>Square wave</td>
</tr>
<tr>
<td>Output rate</td>
<td>64 MHz base rate divided by 2(^{12}); software selectable</td>
</tr>
</tbody>
</table>

Memory

Table 15. Memory specifications

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Specification</th>
</tr>
</thead>
<tbody>
<tr>
<td>Data FIFO</td>
<td>4 kS analog input/2 kS analog output</td>
</tr>
<tr>
<td>Non-volatile memory</td>
<td>32 KB (30 KB firmware storage, 2 KB calibration/user data)</td>
</tr>
</tbody>
</table>

Power

Table 16. Power specifications

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Condition</th>
<th>Specification</th>
</tr>
</thead>
<tbody>
<tr>
<td>Supply current (Note 4, Note 5)</td>
<td>Quiescent current</td>
<td>360 mA</td>
</tr>
<tr>
<td>+VO output voltage range</td>
<td>Quiescent current</td>
<td>4.25 V to 5.25 V</td>
</tr>
<tr>
<td>+VO output current</td>
<td>Quiescent current</td>
<td>10 mA max</td>
</tr>
</tbody>
</table>

Note 4: This is the total quiescent current requirement for the device that includes up to 10 mA for the Status LED. This value does not include potential loading of the DIO bits, +VO pin, or the XDACx outputs.

Note 5: USB 2.0 ports are required by USB 2.0 standards to supply 2500 mW (nominal at 5 V, 500 mA). Self-powered hubs and externally-powered root port hubs provide up to 500 mA of current for a USB device. Battery-powered root port hubs, such as in a laptop PC, provide 100 mA or 500 mA, depending on the manufacturer. If your laptop is constrained to the 100 mA maximum, you need to purchase a self-powered hub.
USB

Table 17. USB specifications

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Specification</th>
</tr>
</thead>
<tbody>
<tr>
<td>USB device type</td>
<td>USB 2.0 (high-speed)</td>
</tr>
<tr>
<td>Device compatibility</td>
<td>USB 1.1, USB 2.0</td>
</tr>
<tr>
<td>USB cable type</td>
<td>A-B cable, UL type AWM 2725 or equivalent. (min 24 AWG VBUS/GND, min 28 AWG D+/D–)</td>
</tr>
<tr>
<td>USB cable length</td>
<td>3 m (9.84 ft) max</td>
</tr>
</tbody>
</table>

Environmental

Table 18. Environmental specifications

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Specification</th>
</tr>
</thead>
<tbody>
<tr>
<td>Operating temperature range</td>
<td>0 °C to 55 °C max</td>
</tr>
<tr>
<td>Storage temperature range</td>
<td>–40 °C to 85 °C max</td>
</tr>
<tr>
<td>Humidity</td>
<td>0% to 90% non-condensing max</td>
</tr>
</tbody>
</table>

Mechanical

Table 19. Mechanical specifications

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Specification</th>
</tr>
</thead>
<tbody>
<tr>
<td>PCB dimensions (L × W)</td>
<td>152.4 × 150.62 mm (6.00 × 5.93 in.)</td>
</tr>
</tbody>
</table>

Signal connections

Table 20. Board connectors, cables, and compatible hardware

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Specification</th>
</tr>
</thead>
<tbody>
<tr>
<td>Connector type</td>
<td>P1: 68-pin standard SCSI TYPE III female connector</td>
</tr>
<tr>
<td></td>
<td>J2, J4, J5: Three 40-pin header connectors AMP# 2-103328-0</td>
</tr>
<tr>
<td>Compatible cables</td>
<td>P1: CA-68-3R ribbon cable; 3 feet.</td>
</tr>
<tr>
<td></td>
<td>J2, J4, J5: C40FF-x ribbon cable; x is length in feet.</td>
</tr>
<tr>
<td>Compatible terminal boards</td>
<td>TB-100: Connects to a CA-68-3R cable</td>
</tr>
<tr>
<td></td>
<td>TB-103: Mounts directly onto the header connectors</td>
</tr>
<tr>
<td></td>
<td>CIO-MINI40: Connects to a C40FF-x cable</td>
</tr>
</tbody>
</table>
## 68-pin SCSI connector (P1)

Table 21. P1 connector pinout

<table>
<thead>
<tr>
<th>Pin</th>
<th>Signal name</th>
<th>Pin description</th>
<th>Pin</th>
<th>Signal name</th>
<th>Pin description</th>
</tr>
</thead>
<tbody>
<tr>
<td>68</td>
<td>ACH0</td>
<td>Analog input 0</td>
<td>34</td>
<td>ACH8</td>
<td>Analog input 8</td>
</tr>
<tr>
<td>67</td>
<td>AGND</td>
<td>Analog ground</td>
<td>33</td>
<td>ACH1</td>
<td>Analog input 1</td>
</tr>
<tr>
<td>66</td>
<td>ACH9</td>
<td>Analog input 9</td>
<td>32</td>
<td>AGND</td>
<td>Analog ground</td>
</tr>
<tr>
<td>65</td>
<td>ACH2</td>
<td>Analog input 2</td>
<td>31</td>
<td>ACH10</td>
<td>Analog input 10</td>
</tr>
<tr>
<td>64</td>
<td>AGND</td>
<td>Analog ground</td>
<td>30</td>
<td>ACH3</td>
<td>Analog input 3</td>
</tr>
<tr>
<td>63</td>
<td>ACH11</td>
<td>Analog input 11</td>
<td>29</td>
<td>AGND</td>
<td>Analog ground</td>
</tr>
<tr>
<td>62</td>
<td>AGND</td>
<td>Analog ground</td>
<td>28</td>
<td>ACH4</td>
<td>Analog input 4</td>
</tr>
<tr>
<td>61</td>
<td>ACH12</td>
<td>Analog input 12</td>
<td>27</td>
<td>AGND</td>
<td>Analog ground</td>
</tr>
<tr>
<td>60</td>
<td>ACH5</td>
<td>Analog input 5</td>
<td>26</td>
<td>ACH13</td>
<td>Analog input 13</td>
</tr>
<tr>
<td>59</td>
<td>AGND</td>
<td>Analog ground</td>
<td>25</td>
<td>ACH6</td>
<td>Analog input 6</td>
</tr>
<tr>
<td>58</td>
<td>ACH14</td>
<td>Analog input 14</td>
<td>24</td>
<td>AGND</td>
<td>Analog ground</td>
</tr>
<tr>
<td>57</td>
<td>ACH7</td>
<td>Analog input 7</td>
<td>23</td>
<td>ACH15</td>
<td>Analog input 15</td>
</tr>
<tr>
<td>56</td>
<td>XDAC3</td>
<td>Analog output channel 3</td>
<td>22</td>
<td>XDAC0</td>
<td>Analog output 0</td>
</tr>
<tr>
<td>55</td>
<td>XDAC2</td>
<td>Analog output channel 2</td>
<td>21</td>
<td>XDAC1</td>
<td>Analog output 1</td>
</tr>
<tr>
<td>54</td>
<td>AGND</td>
<td>Analog ground</td>
<td>20</td>
<td>NC</td>
<td>No connection</td>
</tr>
<tr>
<td>53</td>
<td>GND</td>
<td>Digital ground</td>
<td>19</td>
<td>+VO</td>
<td>Power output</td>
</tr>
<tr>
<td>52</td>
<td>A1</td>
<td>Port A bit 1</td>
<td>18</td>
<td>A0</td>
<td>Port A bit 0</td>
</tr>
<tr>
<td>51</td>
<td>A3</td>
<td>Port A bit 3</td>
<td>17</td>
<td>A2</td>
<td>Port A bit 2</td>
</tr>
<tr>
<td>50</td>
<td>A5</td>
<td>Port A bit 5</td>
<td>16</td>
<td>A4</td>
<td>Port A bit 4</td>
</tr>
<tr>
<td>49</td>
<td>A7</td>
<td>Port A bit 7</td>
<td>15</td>
<td>A6</td>
<td>Port A bit 6</td>
</tr>
<tr>
<td>48</td>
<td>B1</td>
<td>Port B bit 1</td>
<td>14</td>
<td>B0</td>
<td>Port B bit 0</td>
</tr>
<tr>
<td>47</td>
<td>B3</td>
<td>Port B bit 3</td>
<td>13</td>
<td>B2</td>
<td>Port B bit 2</td>
</tr>
<tr>
<td>46</td>
<td>B5</td>
<td>Port B bit 5</td>
<td>12</td>
<td>B4</td>
<td>Port B bit 4</td>
</tr>
<tr>
<td>45</td>
<td>B7</td>
<td>Port B bit 7</td>
<td>11</td>
<td>B6</td>
<td>Port B bit 6</td>
</tr>
<tr>
<td>44</td>
<td>C1</td>
<td>Port C bit 1</td>
<td>10</td>
<td>C0</td>
<td>Port C bit 0</td>
</tr>
<tr>
<td>43</td>
<td>C3</td>
<td>Port C bit 3</td>
<td>9</td>
<td>C2</td>
<td>Port C bit 2</td>
</tr>
<tr>
<td>42</td>
<td>C5</td>
<td>Port C bit 5</td>
<td>8</td>
<td>C4</td>
<td>Port C bit 4</td>
</tr>
<tr>
<td>41</td>
<td>C7</td>
<td>Port C bit 7</td>
<td>7</td>
<td>C6</td>
<td>Port C bit 6</td>
</tr>
<tr>
<td>40</td>
<td>GND</td>
<td>Digital ground</td>
<td>6</td>
<td>TTLTRG</td>
<td>External digital trigger input</td>
</tr>
<tr>
<td>39</td>
<td>CNT1</td>
<td>Counter input 1</td>
<td>5</td>
<td>CNT0</td>
<td>Counter input 0</td>
</tr>
<tr>
<td>38</td>
<td>CNT3</td>
<td>Counter input 3</td>
<td>4</td>
<td>CNT2</td>
<td>Counter input 2</td>
</tr>
<tr>
<td>37</td>
<td>TMR1</td>
<td>Timer output 1</td>
<td>3</td>
<td>TMR0</td>
<td>Timer output 0</td>
</tr>
<tr>
<td>36</td>
<td>GND</td>
<td>Digital ground</td>
<td>2</td>
<td>XAPCR</td>
<td>External analog input scan clock</td>
</tr>
<tr>
<td>35</td>
<td>GND</td>
<td>Digital ground</td>
<td>1</td>
<td>XDPCR</td>
<td>External analog output scan clock</td>
</tr>
</tbody>
</table>
40-pin header connectors (J2, J4, J5)

Table 22. J2 connector pinout

<table>
<thead>
<tr>
<th>Pin</th>
<th>Signal name</th>
<th>Pin description</th>
<th>Pin</th>
<th>Signal name</th>
<th>Pin description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>NC</td>
<td>No connection</td>
<td>2</td>
<td>NC</td>
<td>No connection</td>
</tr>
<tr>
<td>3</td>
<td>NC</td>
<td>No connection</td>
<td>4</td>
<td>NC</td>
<td>No connection</td>
</tr>
<tr>
<td>5</td>
<td>AGND</td>
<td>Analog ground</td>
<td>6</td>
<td>AGND</td>
<td>Analog ground</td>
</tr>
<tr>
<td>7</td>
<td>ACH3</td>
<td>Analog input 3</td>
<td>8</td>
<td>ACH11</td>
<td>Analog input 11</td>
</tr>
<tr>
<td>9</td>
<td>ACH2</td>
<td>Analog input 2</td>
<td>10</td>
<td>ACH10</td>
<td>Analog input 10</td>
</tr>
<tr>
<td>11</td>
<td>NC</td>
<td>No connection</td>
<td>12</td>
<td>NC</td>
<td>No connection</td>
</tr>
<tr>
<td>13</td>
<td>NC</td>
<td>No connection</td>
<td>14</td>
<td>NC</td>
<td>No connection</td>
</tr>
<tr>
<td>15</td>
<td>ACH1</td>
<td>Analog input 1</td>
<td>16</td>
<td>ACH9</td>
<td>Analog input 9</td>
</tr>
<tr>
<td>17</td>
<td>ACH0</td>
<td>Analog input 0</td>
<td>18</td>
<td>ACH8</td>
<td>Analog input 8</td>
</tr>
<tr>
<td>19</td>
<td>AGND</td>
<td>Analog ground</td>
<td>20</td>
<td>AGND</td>
<td>Analog ground</td>
</tr>
<tr>
<td>21</td>
<td>NC</td>
<td>No connection</td>
<td>22</td>
<td>NC</td>
<td>No connection</td>
</tr>
<tr>
<td>23</td>
<td>NC</td>
<td>No connection</td>
<td>24</td>
<td>NC</td>
<td>No connection</td>
</tr>
<tr>
<td>25</td>
<td>ACH7</td>
<td>Analog input 7</td>
<td>26</td>
<td>ACH15</td>
<td>Analog input 15</td>
</tr>
<tr>
<td>27</td>
<td>ACH6</td>
<td>Analog input 6</td>
<td>28</td>
<td>ACH14</td>
<td>Analog input 14</td>
</tr>
<tr>
<td>29</td>
<td>AGND</td>
<td>Analog ground</td>
<td>30</td>
<td>NC</td>
<td>No connection</td>
</tr>
<tr>
<td>31</td>
<td>NC</td>
<td>No connection</td>
<td>32</td>
<td>NC</td>
<td>No connection</td>
</tr>
<tr>
<td>33</td>
<td>NC</td>
<td>No connection</td>
<td>34</td>
<td>ACH5</td>
<td>Analog input 5</td>
</tr>
<tr>
<td>35</td>
<td>ACH13</td>
<td>Analog input 13</td>
<td>36</td>
<td>ACH4</td>
<td>Analog input 4</td>
</tr>
<tr>
<td>37</td>
<td>ACH12</td>
<td>Analog input 12</td>
<td>38</td>
<td>AGND</td>
<td>Analog ground</td>
</tr>
<tr>
<td>39</td>
<td>AGND</td>
<td>Analog ground</td>
<td>40</td>
<td>AGND</td>
<td>Analog ground</td>
</tr>
</tbody>
</table>

Table 23. J4 connector pinout

<table>
<thead>
<tr>
<th>Pin</th>
<th>Signal name</th>
<th>Pin description</th>
<th>Pin</th>
<th>Signal name</th>
<th>Pin description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>GND</td>
<td>Digital ground</td>
<td>2</td>
<td>XAPCR</td>
<td>External analog input scan clock</td>
</tr>
<tr>
<td>3</td>
<td>A0</td>
<td>Port A bit 0</td>
<td>4</td>
<td>A4</td>
<td>Port A bit 4</td>
</tr>
<tr>
<td>5</td>
<td>A1</td>
<td>Port A bit 1</td>
<td>6</td>
<td>A5</td>
<td>Port A bit 5</td>
</tr>
<tr>
<td>7</td>
<td>A2</td>
<td>Port A bit 2</td>
<td>8</td>
<td>A6</td>
<td>Port A bit 6</td>
</tr>
<tr>
<td>9</td>
<td>A3</td>
<td>Port A bit 3</td>
<td>10</td>
<td>A7</td>
<td>Port A bit 7</td>
</tr>
<tr>
<td>11</td>
<td>GND</td>
<td>Digital ground</td>
<td>12</td>
<td>TTLTRG</td>
<td>External digital trigger input</td>
</tr>
<tr>
<td>13</td>
<td>B0</td>
<td>Port B bit 0</td>
<td>14</td>
<td>B4</td>
<td>Port B bit 4</td>
</tr>
<tr>
<td>15</td>
<td>B1</td>
<td>Port B bit 1</td>
<td>16</td>
<td>B5</td>
<td>Port B bit 5</td>
</tr>
<tr>
<td>17</td>
<td>B2</td>
<td>Port B bit 2</td>
<td>18</td>
<td>B6</td>
<td>Port B bit 6</td>
</tr>
<tr>
<td>19</td>
<td>B3</td>
<td>Port B bit 3</td>
<td>20</td>
<td>B7</td>
<td>Port B bit 7</td>
</tr>
<tr>
<td>21</td>
<td>GND</td>
<td>Digital ground</td>
<td>22</td>
<td>+VO</td>
<td>Power output</td>
</tr>
<tr>
<td>23</td>
<td>C0</td>
<td>Port C bit 0</td>
<td>24</td>
<td>C4</td>
<td>Port C bit 4</td>
</tr>
<tr>
<td>25</td>
<td>C1</td>
<td>Port C bit 1</td>
<td>26</td>
<td>C5</td>
<td>Port C bit 5</td>
</tr>
<tr>
<td>27</td>
<td>C2</td>
<td>Port C bit 2</td>
<td>28</td>
<td>C6</td>
<td>Port C bit 6</td>
</tr>
<tr>
<td>29</td>
<td>C3</td>
<td>Port C bit 3</td>
<td>30</td>
<td>C7</td>
<td>Port C bit 7</td>
</tr>
<tr>
<td>31</td>
<td>GND</td>
<td>Digital ground</td>
<td>32</td>
<td>TMR1</td>
<td>Timer output 1</td>
</tr>
<tr>
<td>33</td>
<td>TMRO</td>
<td>Timer output 0</td>
<td>34</td>
<td>CNT1</td>
<td>Counter input 1</td>
</tr>
<tr>
<td>35</td>
<td>CNT0</td>
<td>Counter input 0</td>
<td>36</td>
<td>CNT3</td>
<td>Counter input 3</td>
</tr>
<tr>
<td>37</td>
<td>CNT2</td>
<td>Counter input 2</td>
<td>38</td>
<td>GND</td>
<td>Digital ground</td>
</tr>
<tr>
<td>39</td>
<td>GND</td>
<td>Digital ground</td>
<td>40</td>
<td>GND</td>
<td>Digital ground</td>
</tr>
</tbody>
</table>
Table 24. J5 connector pinout

<table>
<thead>
<tr>
<th>Pin</th>
<th>Signal name</th>
<th>Pin description</th>
<th>Pin</th>
<th>Signal name</th>
<th>Pin description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>NC</td>
<td>No connection</td>
<td>2</td>
<td>NC</td>
<td>No connection</td>
</tr>
<tr>
<td>3</td>
<td>NC</td>
<td>No connection</td>
<td>4</td>
<td>NC</td>
<td>No connection</td>
</tr>
<tr>
<td>5</td>
<td>AGND</td>
<td>Analog ground</td>
<td>6</td>
<td>AGND</td>
<td>Analog ground</td>
</tr>
<tr>
<td>7</td>
<td>XDAC0</td>
<td>Analog output 0</td>
<td>8</td>
<td>XDAC2</td>
<td>Analog output 2</td>
</tr>
<tr>
<td>9</td>
<td>XDAC1</td>
<td>Analog output 1</td>
<td>10</td>
<td>XDAC3</td>
<td>Analog output 3</td>
</tr>
<tr>
<td>11</td>
<td>AGND</td>
<td>Analog ground</td>
<td>12</td>
<td>AGND</td>
<td>Analog ground</td>
</tr>
<tr>
<td>13</td>
<td>NC</td>
<td>No connection</td>
<td>14</td>
<td>AGND</td>
<td>Analog ground</td>
</tr>
<tr>
<td>15</td>
<td>AGND</td>
<td>Analog ground</td>
<td>16</td>
<td>AGND</td>
<td>Analog ground</td>
</tr>
<tr>
<td>17</td>
<td>TTLTRG</td>
<td>External digital trigger input</td>
<td>18</td>
<td>XDPCR</td>
<td>External analog output scan clock</td>
</tr>
<tr>
<td>19</td>
<td>XAPCR</td>
<td>External analog input scan clock</td>
<td>20</td>
<td>GND</td>
<td>Digital ground</td>
</tr>
<tr>
<td>21</td>
<td>GND</td>
<td>Digital ground</td>
<td>22</td>
<td>GND</td>
<td>Digital ground</td>
</tr>
<tr>
<td>23</td>
<td>NC</td>
<td>No connection</td>
<td>24</td>
<td>NC</td>
<td>No connection</td>
</tr>
<tr>
<td>25</td>
<td>+VO</td>
<td>Power output</td>
<td>26</td>
<td>NC</td>
<td>No connection</td>
</tr>
<tr>
<td>27</td>
<td>NC</td>
<td>No connection</td>
<td>28</td>
<td>NC</td>
<td>No connection</td>
</tr>
<tr>
<td>29</td>
<td>GND</td>
<td>Digital ground</td>
<td>30</td>
<td>NC</td>
<td>No connection</td>
</tr>
<tr>
<td>31</td>
<td>TMR2</td>
<td>Timer output 2</td>
<td>32</td>
<td>NC</td>
<td>No connection</td>
</tr>
<tr>
<td>33</td>
<td>GND</td>
<td>Digital ground</td>
<td>34</td>
<td>NC</td>
<td>No connection</td>
</tr>
<tr>
<td>35</td>
<td>TMR3</td>
<td>Timer output 3</td>
<td>36</td>
<td>NC</td>
<td>No connection</td>
</tr>
<tr>
<td>37</td>
<td>GND</td>
<td>Digital ground</td>
<td>38</td>
<td>NC</td>
<td>No connection</td>
</tr>
<tr>
<td>39</td>
<td>NC</td>
<td>No connection</td>
<td>40</td>
<td>NC</td>
<td>No connection</td>
</tr>
</tbody>
</table>

**Standoff locations**

The board is designed with standoff holes labeled TL1 to TL8.

- **TL1**: Standoff hole TL1 is connected directly to the J1 USB connector shield.
- **TL2**: Standoff hole TL2 is connected directly to the P1 SCSI connector shield (pin 69, pin 70). The SCSI connector shield and TL2 can also be connected to the board chassis ground guard trace using the R21 (OPEN by default) resistor location.
- **TL4-8**: Standoff holes TL4-TL8 are electrically isolated from the PCB.

Refer to the mechanical drawing in the hardware user guide for the location of these standoff holes.