

6 Cells Battery Cell Emulator Board

AL-4010 for SLSC

This document describes the SLSC AL-4010 for National Instruments SLSC-12001 chassis.



Figure 1: AL-4010

Overview

This document is a quick start guide on how to use the AL-4010 Battery Cell Emulator / Battery Cell Simulator board from ALIARO. It is intended to be used by industry professionals to:

- Understand what steps need to be taken when purchasing an AL-4010 board
- Provide an overview of what software/hardware is required for the AL-4010 board
- Be a practical step-by-step guide for engineers working with the AL-4010 board

This document is not intended to provide a list of all the product features (this is provided by the device's specification sheet). It is also not a software guide for controlling the board (this is provided by specific software manuals or help documentation).

The AL-4010 is a SLSC module designed to be used with a NI SLSC chassis (SLSC-12001). It provides a total of 6 channels that are capable of emulating 6 battery cells and the dielectric strength between the channels is 60V and the dielectric strength between the board and the NI SLSC chassis is 1500V, so the number of cells connected in series is therefore only limited by the sum of single cell voltages.

The AL-4010 can sink and source in all quadrants and to minimize internal power losses the positive and negative operation voltages are variable and operating dependent on the output voltage.

Cell Voltage Range	Cell Voltage Accuracy	Current Load Range	Current Load Accuracy	Power
0-7V	±1mV	±2A	2mA	±14W

Table 1 - Cell Output Specifications

- In the case of short circuit, the board can handle 5A (10A peak for 100ms).
- In the case when the voltage from external source / BMS is higher than the voltage output in the cell that results in that the current will flow from the external source / BMS to the AL-4010 current sink.
- In the case when the voltage in AL-4010 is higher than the voltage from the external source / BMS that results in that the current will flow from the AL-4010 into the external source / BMS.

It is possible to calibrate the system and calibration and adjustment are both possible without removing the system from its installation. Measurement accuracy is guaranteed within the specified operating- and temperature range. All system channels, referring to cell voltages, and sensing channels (cell voltage and cell current) are synchronized.


Sensing Voltage Range	Sensing Voltage Accuracy	Sensing Current High Range	Sensing Current High Accuracy	Sensing Current Low Range	Sensing Current Low Accuracy
±8V	±1mV	±2.2A	±2mA	<10mA	±10µA

Table 2 - Sensing Specifications

Contents

Overview.....	2
System Architecture	3
Description.....	6
Installation.....	6
Electromagnetic Compatibility	6
Unpacking the module	6
Hardware Installation	7
Maintenance	9
Safety Guidelines	9
Before using the AL-4010.....	10
System Check	10
Calibration	11
Specification.....	12
Definition and conditions	12
Environmental Characteristics	12
Physical characteristics.....	12
Setting Up The AL-4010	13
Software Setup	13
Product Setup.....	13
Verifying The Setup.....	14
Features.....	15
Block Diagram	15
LED Indicator.....	15
Cables and Accessories.....	15
Pinout and Signal Descriptions	16
J1 - DUT Connector (Front)	16
J2 - DUT Connector (Front)	16
J3 - DUT Connector (Front)	16
XJ1 – SLSC Interface Connector (Rear)	16
XJ2 - DUT Connector (Rear).....	17
XJ3 - DUT Connector (Rear).....	17
General Signal Capabilities.....	18
Fault Insertion Capabilities.....	18
Supply and Load Capabilities	18
Sensing / Measuring Capabilities	19
Additional Capabilities.....	19

ALIARO reserve the right to vary from the description given in this data sheet and shall not be liable for any errors.

Configuration and Accessories.....	20
RTI Backplane	20
AL-4010 RTI Backplane	20
Safety Guidelines.....	23
Product Certifications and Declarations.....	23
CE Compliance 	23
Electromagnetic Compatibility Standards.....	23
Environmental Management	24
Waste Electrical and Electronic Equipment (WEEE)	24

Description

The Board provides functions for:

Fault Insertion (All Channels)

- Open Circuit
- Short Circuit
- Reverse polarity (AL-4010 can output negative voltages)

Other features

The board is isolated to keep the test system and DUT separated to provide a high signal integrity and minimize interference.

The board uses the SLSC interface (Ethernet) for setting and reading the status of the board.

The board uses standard industry connectors on the front and the back.

Installation

Electromagnetic Compatibility

This product is intended for use in industrial locations. However, harmful interference may occur in some installations, when the product is connected to a peripheral device or test object, or if the product is used in residential or commercial areas. To minimize interference with radio and television reception and prevent unacceptable performance degradation, install, and use this product in strict accordance with the instructions in the product documentation.

Furthermore, any modifications to the product not expressly approved by ALIARO could void your authority to operate it under your local regulatory rules.



Caution To ensure the specified EMC performance, operate this product only with Shielded cables and accessories.

Unpacking the module

The AL-4010 board ships in an antistatic box to prevent electrostatic discharge (ESD). ESD can damage the device components. Users should be familiar with the steps to prevent ESD damage when handling the device.



Warning - Never touch the exposed pins of the connectors.

To prevent ESD damage when handling the device, please take the following precautions:

- Ground yourself before handling. Use a grounding strap or by touching a grounded object.

- Touch the antistatic package to a grounded metal part before removing the device from the package. A good example would be the metal part of your computer chassis.

Remove the device from the package and inspect it for damages such as loose components. Contact ALIARO if the device appears damaged in any way. Do not use a damaged device with any other components. Store the device in antistatic protection when not in use.

Hardware Installation

The AL-4010 board is shipped with the following components:

- An ESD protection box
- Declaration of conformity

Additional components which connect to the AL-4010 are shipped separately. These could include:

Battery Cell Emulator Cables Cabling to connect the battery cell emulator to the device under test, for an example a battery management system.

Rear Transitional Interfaces (RTIs) These are used to provide connection points on the rear of SLSC boards

To set up and use the module you need the following items:

Hardware

- SLSC-12001 chassis
- SLSC AL-4010 module(s)
- RTI-12344 for AO 37DSUB (P/N 785376-01)
- Cell Power Rear Connector
- Cell Communication Rear Connector

Tools

- Screwdriver as needed for your application
- Wire stripper

Documentation

SLSC-12001 Chassis Getting Started Guide and Specifications

Caution:



Do not touch the contacts or remove the I/O boards or cables while the system is energized.

The SLSC chassis and the AL-4010 do not support hot plug-in. The entire chassis must be powered off when a module is inserted or removed.

Procedure:

1. Power off the main DC power source or disconnect the power source from the chassis before installing any modules or RTIs.
2. Ensure that the chassis is powered off. The POWER LED should be off. If the POWER LED is not off, do not proceed until it is off.
3. Loosen the screws on the upper rear panel of the chassis.
4. Position the RTI backplane at the desired slot and insert the securing screws, but do not fully tighten them.
5. Insert an AL-4010 module into the same slot as its corresponding RTI while firmly holding the RTI in place until the RTI is firmly connected to the module.
6. Repeat steps 4 and 5 for all required RTIs.
7. Fully tighten the screws for all RTIs and the upper rear panel of the chassis. Note Waiting until all RTIs and modules are installed to fully tighten the screws ensures proper alignment for future connections between modules and RTIs.
8. Fully tighten the two module mounting screws on each newly installed module.
9. Power on the SLSC chassis

Maintenance

Power off all connected device before attempting any maintenance. After maintenance is complete, ensure that the device is fully dry and installed correctly, before powering the system back on.



Warning - Many components within the chassis are susceptible to static discharge damage. Service the chassis only in a static-free environment. Observe standard handling precautions for static-sensitive devices while servicing the chassis. Always wear a grounded wrist strap or equivalent while servicing the chassis.

Clean dust from the chassis exterior and interior as needed, based on the operating environment. Periodic cleaning increase's reliability.

Use a dry, low-velocity stream of air to clean the interior of the chassis. Use a soft-bristle brush for cleaning around components

Safety Guidelines

Operate AL-4010 only as described in this document, all warning and precautions must be followed.

Terminology used to describe security levels.

	DANGER – Warns of imminent danger that might result in serious injury or death.
	WARNING – Potentially hazardous situation that might result in serious injury or death.
	CAUTION – Warns of a potentially dangerous situation that could result in personal injury or property damage.



WARNING - The emulated cells of the AL-4010 (Battery Cell Emulator) are not grounded and the same applies for the Battery Management System (BMS). Neither of the systems can be connected to earth during operation as this results in a severe hazard at high voltages.



CAUTION - Running the system without an earth leakage monitor or with bridged functionality is not allowed, the purpose of the earth leakage monitor (or Bender – Isometer) is to verify and check the galvanic isolation.

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CAUTION - For systems with more than 120 cells the following precautions must be followed.

- Limit the output voltage per cell to 5V.
- Ensure that the Battery Cell Emulator / Battery Cell Simulator System is used in a secured and safe areas where it is not accessible during operation by any humans.



WARNING - Do not operate the device in a manner not specified in this document. Misuse of the device can result in a hazard. You can compromise the safety protection built into the device if the device is damaged in any way. If the device is damaged, contact ALIARO for repairs or replacement.



WARNING - Do not substitute parts or modify the device except as described in this document. Use the device only with the chassis, modules, accessories, and cables specified in the product specification.



WARNING - Do not operate the device in an explosive atmosphere or where there may be flammable gases or fumes. If you must operate the device in such an environment, it must be in a suitably rated enclosure.

Before using the AL-4010

All input characteristics are DC, AC_{RMS} , or a combination unless otherwise specified. Every card provides a fully capable fault insertion with external control during simulations or testing. Relays can be configured with xMove Configurator, VeriStand and LabVIEW



Note Steady state voltages and currents applied to the AL-4010 between any two I/O connector pins more than the voltage- or current specification may damage the module

Note - Signal connections through the AL-4010 are intended to go through the cell output pins and the sensing pins.

System Check

This chapter requires LabVIEW development and installation of LabVIEW drivers.

To identify and control that the cards are inserted and work properly with the right firmware, LabVIEW provides basic VI scripts to check SLSC cards mounted in chassis

1. Open LabVIEW and select “Help” in the top menu bar and press “Find Examples...” (This opens a new window with pre-built VI (Virtual Instruments) for different applications).
2. Switch to the “Search” tab and enter keyword “SLSC” and double click.
3. In the new filtered table (to the right) find and select VI called “Configuration.vi”. This VI can located every card(s) that is online in SLSC chassis.
4. To find the newly inserted cards look for the SLSC chassis IP-address (in the table to the right).

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Count the showing card(s) in the table and make up that there are as many mounted in the SLSC chassis as there are in the VI table for that specific IP address. (Can be 1 up to 11 cards per SLSC chassis)

Calibration

Recommended warm-up time	30 min
Calibration interval	1 year

Contact ALIARO to schedule calibration services. Additionally, you may be entitled to calibration if you have a service agreement.

If you have purchased a calibration system from ALIARO, we recommend using the system with your complete ALIARO test system or device, after the specified interval. If you are interested in purchasing or renting a calibration system, please contact ALIARO.

Specification

Definition and conditions

Warranted specifications describe the performance of a model under stated operating conditions and are covered by the model warranty.

The following characteristic specifications describe values that are relevant to the use of the model under stated operating conditions but are not covered by the model warranty.

- Typical specifications describe the performance met by most models.
- Nominal specifications describe an attribute that is based on design, conformance testing, or supplemental testing.

Specifications are *Typical* unless otherwise noted.

Specifications are valid under the following conditions unless otherwise noted.

The AL-4010 module is mounted in an SLSC chassis with the recommended cooling clearances and using a power supply that meets the specifications provided in the chassis user guide. For the entire temperature range of the chassis.



Note These specifications only apply to the product as provided by ALIARO. Modifications to the module may invalidate these. Be certain to verify the performance of modified modules.



Caution Observe all instructions and cautions in the user documentation. Using the model in a manner not specified can damage the model and compromise the built-in safety protection. Return damaged models to ALIARO for repair.

Environmental Characteristics

Temperature and Humidity

Operating temperature	10°C to 35 °C
Storage temperature range	-40 °C to 85 °C
Operating relative humidity range	10% to 90%, noncondensing
Storage relative humidity range	5% to 95%, noncondensing

Physical characteristics

Category	Condition	Value
Module Dimensions	Excluding front handle	144.32mm x 30.48mm x 281 mm (H x W x D)
Front Panel Connector		1 x female Weidmüller 24 (2x12) high density 2 x RJ45

Table 3 - Physical characteristics AL-4010

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Setting Up The AL-4010

Complete the following steps to get started with the AL-4010 Board.

Software Setup

The AL-4010 Battery Cell Emulator/Simulator Board is intended to be used with the following pieces of control software:

NI VeriStand The NI VeriStand application software helps you configure I/O channels, data logging, stimulus generation, and host communication for NI real-time hardware. If using VeriStand to control the AL-4010 Board, install the ALIARO SLSC Plugin from ALIARO's website. NI VeriStand can be installed from NI's website.

xMove Configurator
(Optional) xMove Configurator is a configuration tool used to quickly configure test systems and test system components such as the AL-4010 Board. It achieves this by defining/editing VeriStand System definition files. We recommend using xMove with either of these software platforms for maximum efficiency. xMove can be download from NI's website. Contact ALIARO for more information.

Product Setup

When using the AL-4010 Board, the following hardware components are required:

- NI SLSC Chassis (SLSC-12001) and all associated components listed in the SLSC Chassis manual. This manual is located on NI's website.
- Cross Connection Board
- Rear Transitional Interface (RTI)

Use the following steps to setup the AL-4010 Board in an SLSC Chassis:



Warning – Please complete the following steps with all devices powered off and with users and systems being safely grounded. F

Choose a slot in the SLSC Chassis to install the AL-4010 Board. Before inserting the board, any RTIs and cross connection boards must first be mounted on the rear of the SLSC chassis. Both components are optional and are not required to use the AL-4010 board.

Now that all optional components have been installed into the chassis, the module can be inserted. Please refer to the specific SLSC Chassis Getting Started Guide and Specifications from NI to understand how to Install and Remove SLSC modules safely.

In addition to the mentioned guide, the module should also align with the RTI on the rear of the chassis. All pins should firmly connect to the corresponding position on the module without great resistance or the pins/connectors being bent.

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Connect the RTI and the AL-4010 Board to any DAQ devices as defined by their manufacturer, all communication through the RTI is done through SPI, for information about how to read from / write to registers on the AL-4010 please read the AL-4010 Software Manual.

Verifying The Setup

The diagram below provides an overview of all product components required and optional for performing verification. Please note, some components are only optional based on the SLSC modules being used and the requirements of your system.

To verify that all software and product components have been correctly installed, perform the following actions:

- Power on the SLSC Chassis and observe the front of the AL-4010 Board. The AL-4010 Board has 2 LEDs which are described in the LED Indicator section of this document. Verify that both LEDs power solid green when the chassis is powered on. This verifies that the AL-4010 Board has been installed in the chassis successfully.
- **Using VeriStand** – Once the custom device has been installed, add the SLSC chassis to the system definition file under the Custom Devices section. Add the AL-4010 Board into this chassis configuration. Deploy the configuration to a target and use the parameters for the AL-4010 Board created by the VeriStand custom device.

This concludes the verification process

Features

Block Diagram

The figure below shows the key functional components of the AL-4010 Board.

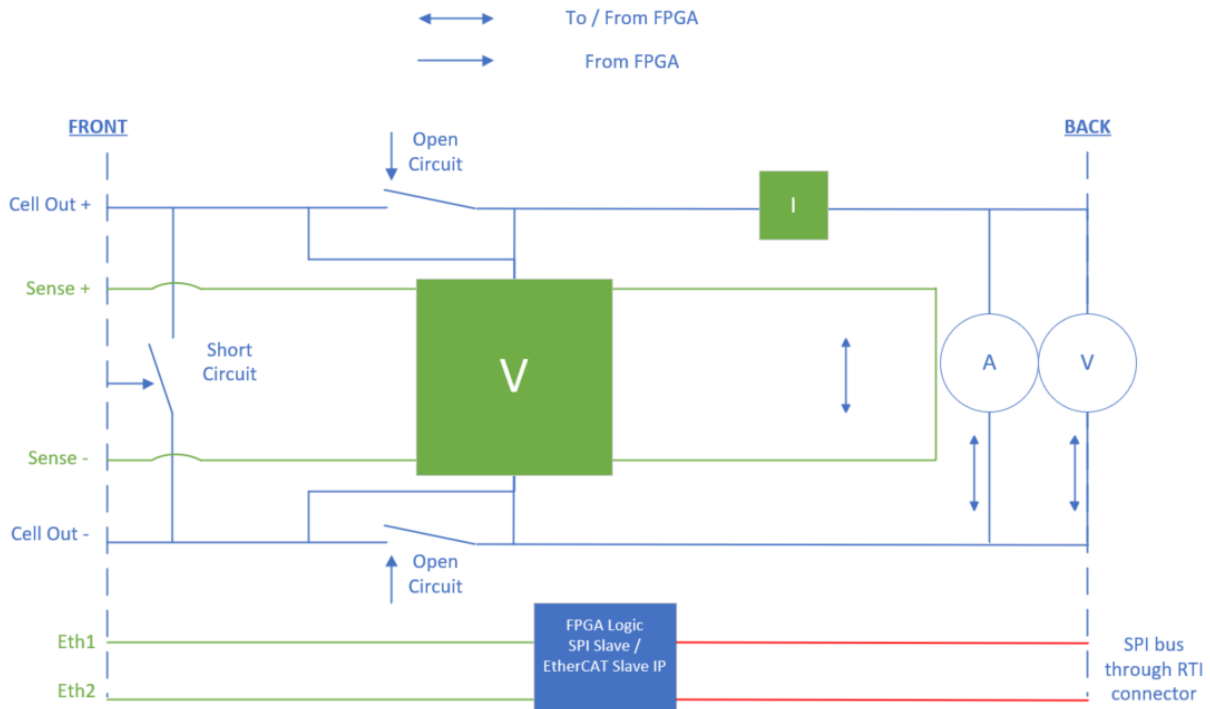


Figure 4: AL-4010 Simplified Block Diagram

LED Indicator

The AL-4010 Board has 2 LEDs which indicate the status of the board. All states are shown in the table below.

LED Name	LED Behavior	Definition of Behavior
Power	Off	No power present on module
	Solid Green	Module powered
	Solid Red	Module fault
Ready	Off	Module is not powered
	Solid Green	Module is ready to be used
	Solid Red	Module fault

Table 4 - LED Indicator States

Cables and Accessories

The table below contains information about all cables and accessories available for the AL-4010.

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Accessory	Description
Piggyback Boards	N/A
Rear Transitional Interfaces (RTIs)	RTI-12344 for AO 37DSUB (P/N 785376-01)
Cross Connection Boards	N/A

Table 5 - Compatible Cables and Accessories

Pinout and Signal Descriptions

The following section describes the connectors located on the AL-4010 Board. Please note that Connector XJ3 and XJ2 are primarily designed with a Rear Transitional Interface in mind. Connector XJ1 will connect with the SLSC Chassis and does not require any action from the user.

J1 - DUT Connector (Front)

This is the connector used to access the cell outputs and sensing lines available on each cell, see pinout below.

Pin	Left	Right
1	Cell 1, Sense -	Cell 1, Sense +
2	Cell 1, Out -	Cell 1, Out +
3	Cell 2, Sense -	Cell 2, Sense +
4	Cell 2, Out -	Cell 2, Out +
5	Cell 3, Sense -	Cell 3, Sense +
6	Cell 3, Out -	Cell 3, Out +
7	Cell 4, Sense -	Cell 4, Sense +
8	Cell 4, Out -	Cell 4, Out +
9	Cell 5, Sense -	Cell 5, Sense +
10	Cell 5, Out -	Cell 5, Out +
11	Cell 6, Sense -	Cell 6, Sense +
12	Cell 6, Out -	Cell 6, Out +

Table 6 - Front Connector Pinout

J2 - DUT Connector (Front)

This is a RJ45 Ethernet port, currently not used by the AL-4010 board. Prepared for EtherCAT slave functionality.

J3 - DUT Connector (Front)

This is a RJ45 Ethernet port, currently not used by the AL-4010 board. Prepared for EtherCAT slave functionality.

XJ1 – SLSC Interface Connector (Rear)

This is the SLSC interface connector, and we highly recommend not connecting directly to this connector and instead use a RTI backplane such as RTI-12344 for AO 37DSUB (P/N 785376-01).

XJ2 - DUT Connector (Rear)

This is one of the I/O connectors and we highly recommend not connecting directly to this connector and instead use a RTI backplane such as RTI-12344 for AO 37DSUB (P/N 785376-01).

Through this connector various signals are sent to the AL-4010 / received from the AL-4010, for an example the SPI communication interface takes place through this connector. It is most easily accessed by using an optional RTI Board. ALIARO do not recommend soldering or attaching jumpers directly to these pins, as this may cause damage to the AL-4010 Board.

Row	E	D	C	B	A
1		SPI_MOSI		SPI_CS _n	SPI_Clk
2					
3					
4					SPI_MISO
5					
6					
7					
8					
9					
10					
11					
12					
13					
14					
15					
16					
17					
18					
19					
20					
21					
22					
23					
24					
25					

Table 7 - Pinout on XJ2 Connector.

XJ3 - DUT Connector (Rear)

This is one of the I/O connectors and we highly recommend not connecting directly to this connector and instead use a RTI backplane such as RTI-12344 for AO 37DSUB (P/N 785376-01). Power provides the supply and load capabilities on the board.

XJ3 Pin	
H	Positive Voltage 1
G	Negative Voltage 1
F	Positive Voltage 2
E	Negative Voltage 2
D	Positive Voltage 3
C	Negative Voltage 3
B	Positive Voltage 4
A	Negative Voltage 4

Table 8 - Pinout on XJ3 Connector.

General Signal Capabilities

- The AL-4010 Board is isolated to keep the test system and DUT electrically separated. This ensures high signal integrity and minimizes interference.
- The board utilizes the SLSC interface for setting and reading the status of the board.
- The board utilizes a SPI bus through the RTI backplane for setting and reading desired cell voltages, sense voltages and currents etcetera in a deterministic and fast manner.
- EtherCAT through the RJ45 connectors on the front of the card will be added later, potentially in a new revision of the card.

Parameter	Value	Comments/Additional
Synchronization between cells	<50 μ s	
Control Interface	SPI EtherCAT	EtherCAT support will be added in the future.

Table 9 - General Properties

Fault Insertion Capabilities

Fault insertion is the process of sending a known error (fault) to a Device Under Test (DUT) to understand the reaction from the device. This includes several types of simulated failures such as short or open circuits.

AL-4010 supports the following fault insertion mechanisms, short circuit, open circuit, and reverse polarity.

Parameter	Value	Comments/Additional
Current, short circuit	5A (10A peak for 100ms)	

Table 10 - Fault Insertion Properties

Supply and Load Capabilities

AL-4010 has the following supply and load capabilities:

Parameter	Value	Comments/Additional
Voltage Supply, Range	0-7V	
Voltage Supply, Accuracy	\pm 1mV	
Voltage Supply, Ripple	2mVrms	

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Voltage, Step Response 1-4V	0.1ms	
Voltage, Step Response 4-1V	<1ms	Dependent on load
Maximum External Load	2000mA	
Current Load, Range	0-2000mA	
Current Load, Accuracy	2mA	
Current Load, Step Response (10-90%)		

Table 11 - Supply and Load Properties

Sensing / Measuring Capabilities

The AL-4010 has the following sensing / measuring capabilities:

Parameter	Value	Comments/Additional
Voltage Measurement, Range	±8V	
Voltage Measurement, Accuracy	±1mV	
Current Measurement, Range (Low Range)	±10mA	
Current Measurement, Accuracy (Low Range)	±10µA	
Current Measurement, Range (High Range)	±2200mA	
Current Measurement, Accuracy (High Range)	±2mA	
Coulomb Measurement, Samples / Calculation	100 Samples, 250 Samples, 500 Samples, or 1000 Samples	Number of samples for Coulomb Measurement
Coulomb Measurement, Accuracy		Needs to be calculated and verified.

Table 12 - Sensing / Measuring Properties

Additional Capabilities.

The AL-4010 Board can do everything in a bipolar fashion, in other words output positive, negative voltages, and measure the same, this results in that we offer reverse polarity on all cells.

Configuration and Accessories

For most applications, the AL-4010 needs to be configured with a backplane.

RTI Backplane

RTIs are used to format signals into common bus types and are mounted onto SLSC chassis using screws. These screws will be provided with the RTI board and will have a corresponding threaded hole on the top rear of the SLSC chassis. The RTI board will have several holes which the screws will fit through.

Mount the RTI with the external connectors (to measurement devices) and external references, facing away from the chassis. The available connectors will vary depending on which RTI is being used. The figure below shows an example RTI and how it is mounted on the SLSC Chassis.

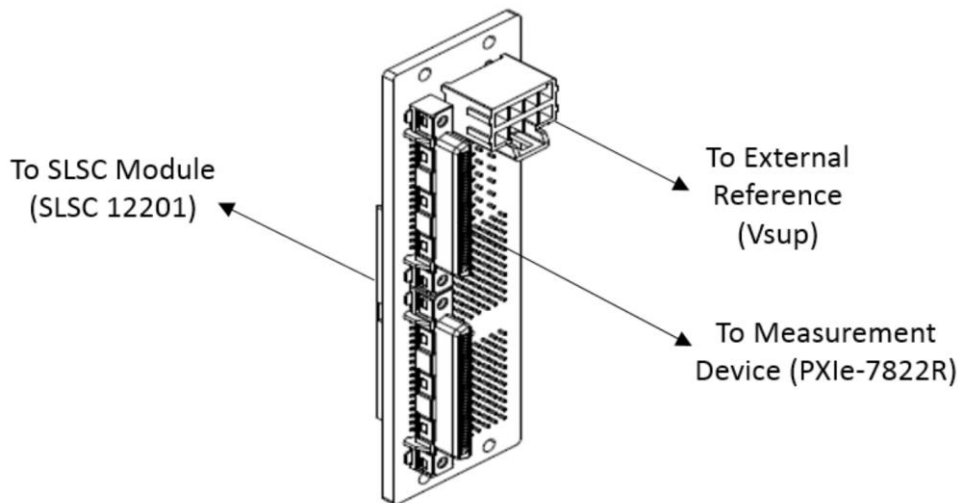


Figure 5: Example RTI

Cross connection boards are used to route/reorganize signals before being sent to DAQ equipment. They are placed over RTI boards and connect onto bus terminal points. Please refer to your specific cross connection board instructions to install the board.

AL-4010 RTI Backplane

For AL-4010 use the SET-12344 backplane, it passes on all signals from the XJ2 and XJ3 connectors on the AL-4010 to connectors that are easier to interface with.

- **JR1 connector**, handles power, positive voltages upper row, negative voltages lower row.
- **JR2 connector**, SPI bus
 - SPI_Clk = RTI_IO_1 = A1 = P0.0 = DSUB Pin 1, Signal is low when idle
 - SPI_CS_n = RTI_IO_2 = B1 = P0.1 = DSUB Pin 20, Signal is high when idle

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- SPI_MOSI = RTI_IO_3 = D1 = P0.2 = DSUB Pin 2, Signal is do not care when idle
- SPI_MISO = RTI_IO_9 = A4 = P1.0 = DSUB Pin 5, Signal is low when idle

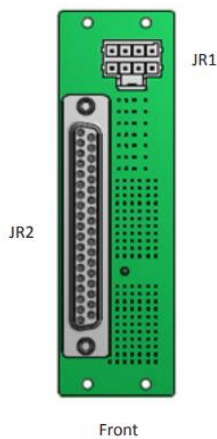


Figure 6 - SET-12344 RTI

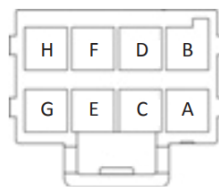


Figure 7 - SET-12344 JR1 Connector

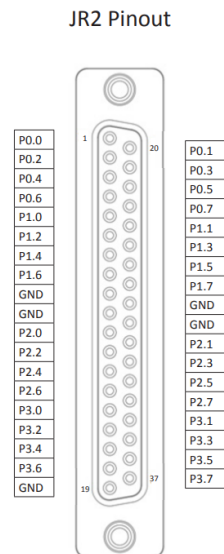


Figure 8 - SET-12344 RTI JR2 Pinout

JR1 Pin	
H	Positive Voltage 1
G	Negative Voltage 1
F	Positive Voltage 2
E	Negative Voltage 2
D	Positive Voltage 3
C	Negative Voltage 3
B	Positive Voltage 4
A	Negative Voltage 4

Table 13 - SET-12344 JR1 Pinout

JR2 Pin	Signal	Functionality
1	P0.0	SPI_Clk
2	P0.2	SPI_MOSI
3	P0.4	
4	P0.6	
5	P1.0	SPI_MISO
6	P1.2	
7	P1.4	
8	P1.6	
9	GND	
10	GND	
11	P2.0	
12	P2.2	
13	P2.4	
14	P2.6	
15	P3.0	
16	P3.2	

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17	P3.4	
18	P3.6	
19	GND	
20	P0.1	SPI_CS _n
21	P0.3	
22	P0.5	
23	P0.7	
24	P1.1	
25	P1.3	
26	P1.5	
27	P1.7	
28	GND	
29	GND	
30	P2.1	
31	P2.3	
32	P2.5	
33	P2.7	
34	P3.1	
35	P3.3	
36	P3.5	
37	P3.7	

Table 14 - SET-12344 JR2 Pinout

Safety Guidelines



Cautions

Ensure that hazardous voltage wiring is performed only by qualified personnel adhering to local electrical standards.

Do not mix hazardous voltage circuits and human-accessible circuits on the same module.

When device terminals are hazardous voltage LIVE, you must ensure that devices and circuits connected to the device are properly insulated from human contact.

All wiring must be insulated for the highest voltage used.

Product Certifications and Declarations

Refer to the product Declaration of Conformity (DoC) for additional regulatory compliance information.

To obtain product certifications and the DoC for ALIARO products, visit ALIARO.com/certification.

CE Compliance

This product meets the essential requirements of applicable European Directives, as follows:

- 2014/35/EU; Low-Voltage Directive (safety)
- 2014/30/EU; Electromagnetic Compatibility Directive (EMC)
- 2011/65/EU; Restriction of Hazardous Substances (RoHS)

Electromagnetic Compatibility Standards

This product meets the requirements of the following EMC standards for electrical equipment for measurement, control, and laboratory use:

- EN 55011-2009 Industrial, scientific, and medical equipment - Radio-frequency disturbance characteristics - Limits and methods of measurement CISPR 11:2009
- EN 55032:2012 Electromagnetic compatibility of multimedia equipment - Emission requirements CISPR 32:2012
- EN 61326-1-2013 Electrical equipment for measurement, control, and laboratory use - EMC requirements - Part 1: General requirements IEC 61326-1:2012



Environmental Management

ALIARO is committed to designing and manufacturing products in an environmentally responsible manner. ALIARO recognizes that eliminating certain hazardous substances from our products is beneficial to the environment and to ALIARO customers. For additional environmental information, refer to the Minimize Our Environmental Impact web page at ALIARO.com/environment.

This page contains the environmental regulations and directives with which ALIARO complies, as well as other environmental information not included in this document.

Waste Electrical and Electronic Equipment (WEEE)

EU Customers At the end of the product life cycle, all ALIARO products must be disposed of according to local laws and regulations.

For more information about how to recycle ALIARO products in your region, visit ALIARO.com/environment/weee