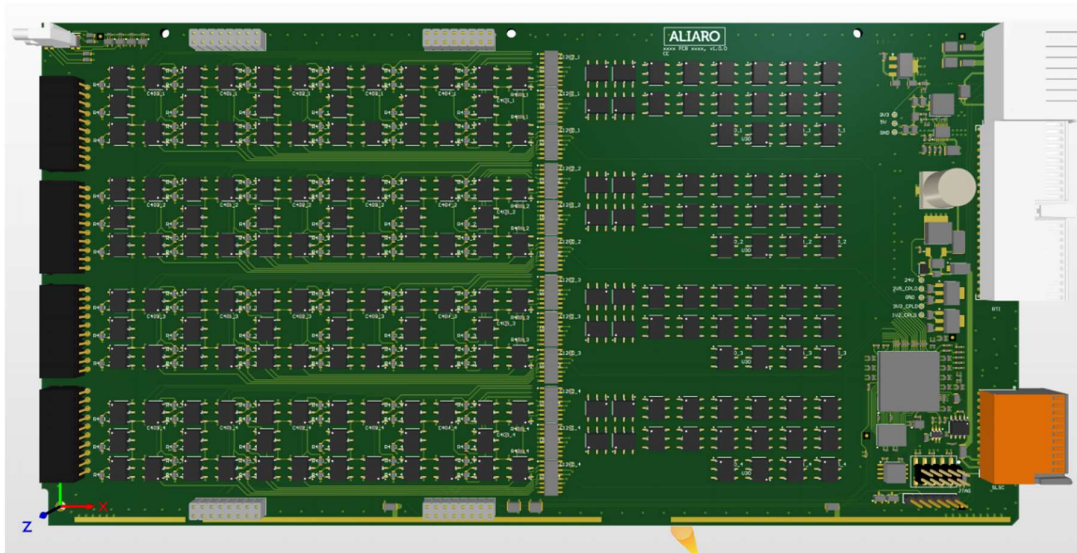


## 16 Channels Bus Switch Board

### AL-2010 for SLSC

This document describes the AL-2010 board for National Instruments SLSC-12001 chassis.



## Definitions

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This document describes the performance of the described module under specific operating conditions which are covered by the module warranty.

These conditions can be classified into two main sections:

- *Typical* specifications describe the performance met by most modules.
- *Nominal* specifications describe an attribute that is based on design, conformance testing, or supplemental testing for this specific module.

Specifications are *Typical* unless otherwise noted.

## Conditions

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Specifications are valid under the following conditions unless otherwise noted.

The AL-2010 module is mounted in a standard NI SLSC chassis. This chassis should conform to the NI recommended cooling requirements and use a standard power supply that meets the specifications provided in the chassis user guide. All aspects of the SLSC chassis should follow NI guidelines.



**Please Note** - These specifications only apply to the product as provided by ALIARO. Modifications to the module may invalidate these.



**Caution** - Observe all instructions, warnings and cautions in the board documentation. Using the module in a manner not specified by this document can damage the module and compromise the built-in safety protection. Return damaged models to ALIARO for repair.

## Overview

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The AL-2010 (Bus Switch Board) board provides fault insertion on all common interfaces used in a vehicle, it also provides enable or bypass for the bus signals to each Device Under Test (DUT).

The AL-2010 board is designed to fit National Instruments (NI) Switch Load Signal Conditioning (SLSC) system together with corresponding computer interface boards and is delivered with LabVIEW driver and a Custom Device for VeriStand.

The main purpose of the board is to be used for test and validation of Devices Under Test (DUTs), testing for both software and hardware failures. This is usually done by incorporating the board as part of Hardware-In-the-Loop (HIL) test system.

For easy board/system configuration, it is recommended to use the board alongside xMove Configurator.

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

## Description

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The AL-2010 (Bus Switch Board) provides fault insertion on all common interfaces used in a vehicle, both serial interfaces such as Ethernet, Automotive Ethernet, RS-232, RS-485 etc. and bus interfaces such as CAN, CAN FD, LIN and Flexray. It is designed for applications where you need to control the bus communication to a Device Under Test (DUT) as part of a test procedure.

## Features

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- ✓ 100V, 500mA per channel
- ✓ 4 independent bus channels
- ✓ Multiplex bus signals across up to 4 channels (for example, output B1 to B2, 3 and/or 4)
- ✓ Perform several types of fault insertion across all channels
- ✓ 8 independent serial channels
- ✓ LabVIEW driver included

## Detailed description

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Four connectors are available on the front of the board (Connectors 1-4) to be connected to the Device-Under-Test (DUT). This set of connectors comes with Bus specific functionality, such as fault insertion which shorts the two bus lines (+/-) together. These channels are referred to as the Bus channels.

The AL-2010 also provides fault insertion for eight serial (2-pair) communication channels (Channels S1-S8). These communication channels are wired to a piggyback area for optional adapters.

As shown in fig 1 below, the AL-2010 supports four bus channels (B1-B4), each distributed to four DUT outputs.

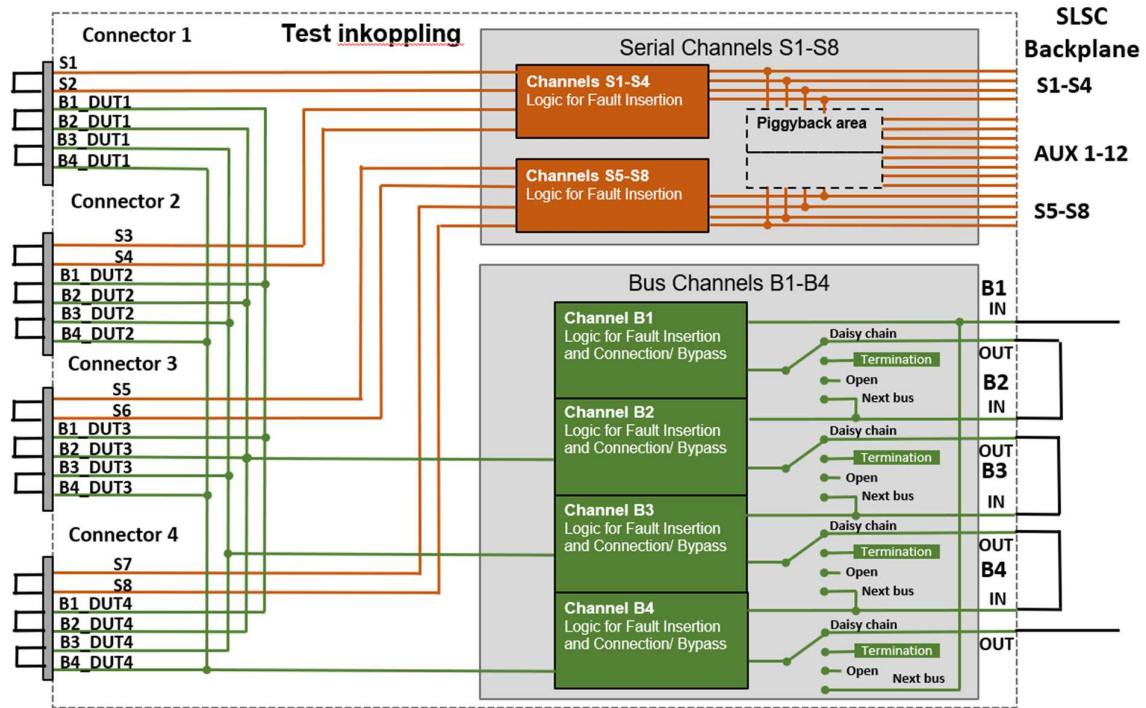


Figure 1: AL-2010 Block diagram

As shown in the diagram below, the AL-2010 supports eight serial channels (S1-B8), each distributed to a corresponding DUT output.

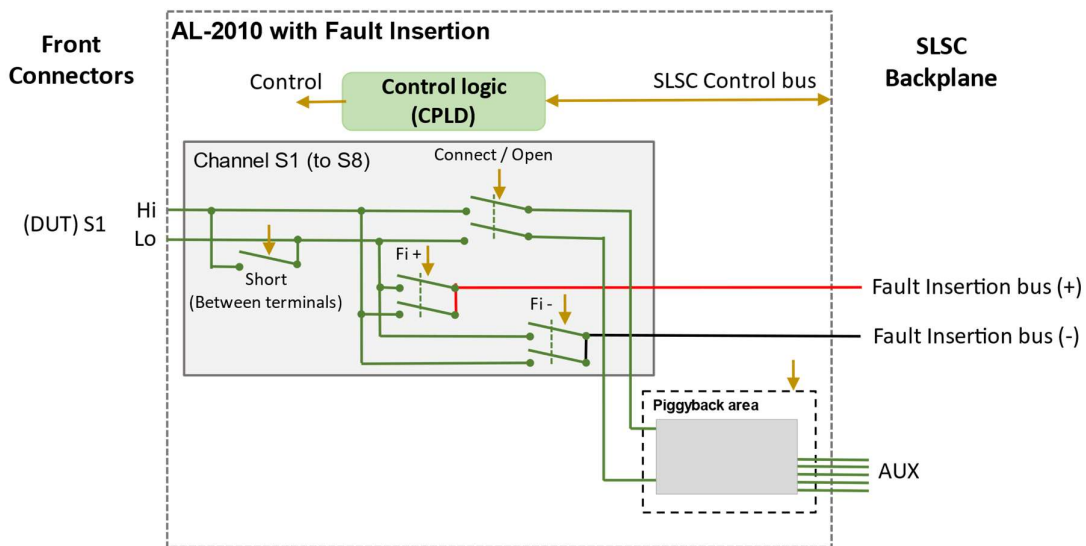


Figure 2: AL-2010 Block diagram, Serial interfaces

See fig 2, For the serial interfaces the AL-2010 provides fault insertion features such as:

- Connect / Opening circuits
- Shorting signals between Hi / Lo of the serial lines
- Fault insertion outputting Hi or Lo to axillary signals + / -

The boards features can be further expanded using the expansion area on the board, see the example in fig 3 below.

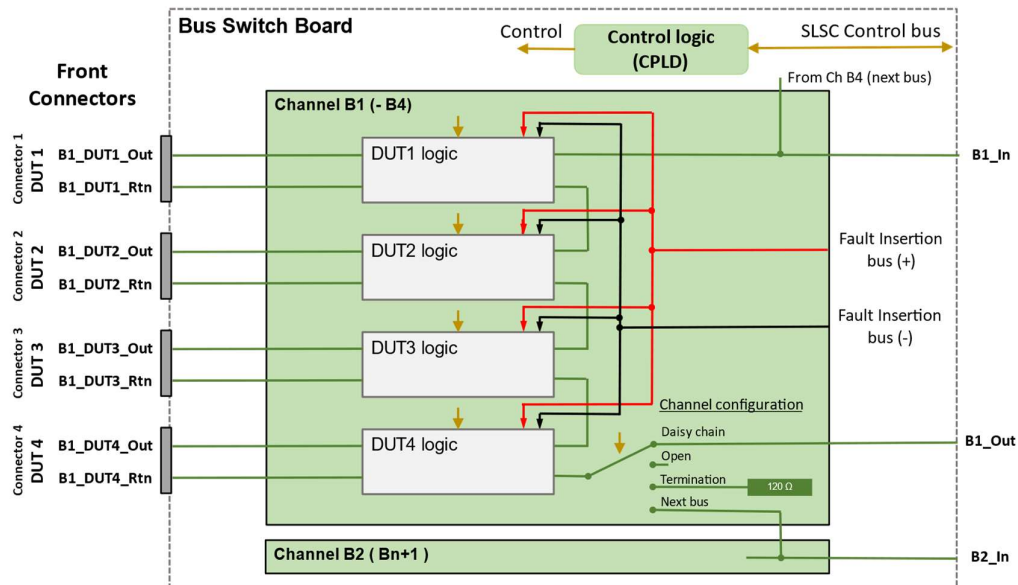


Figure 3: AL-2010 Block diagram, Bus interfaces for Bus B1

In fig 1 and 3, the AL-2010 provides four buses, each of which can output signals to the four DUT interfaces (B1-4) on the front of the board. The expansion area (marked B2\_In in Figure 3), allows an additional AL-2010 card to be connected. The buses outputs in the additional card can be linked by software to the outputs from the first AL-2010 board.

This functionality allows for a maximum of four boards to be connected in series and for one bus to output to 16 DUT interfaces. Each bus can be terminated (120 ohm) at the end by software.

CAN FD is supported up to 5MBit/s, and Automotive Ethernet is supported up to 100Mbit/s. Note that the available speeds are dependent on the wiring and cable lengths should be kept as short as possible. The number of nodes should also be considered when using CAN FD, it will not work running on 16 nodes.

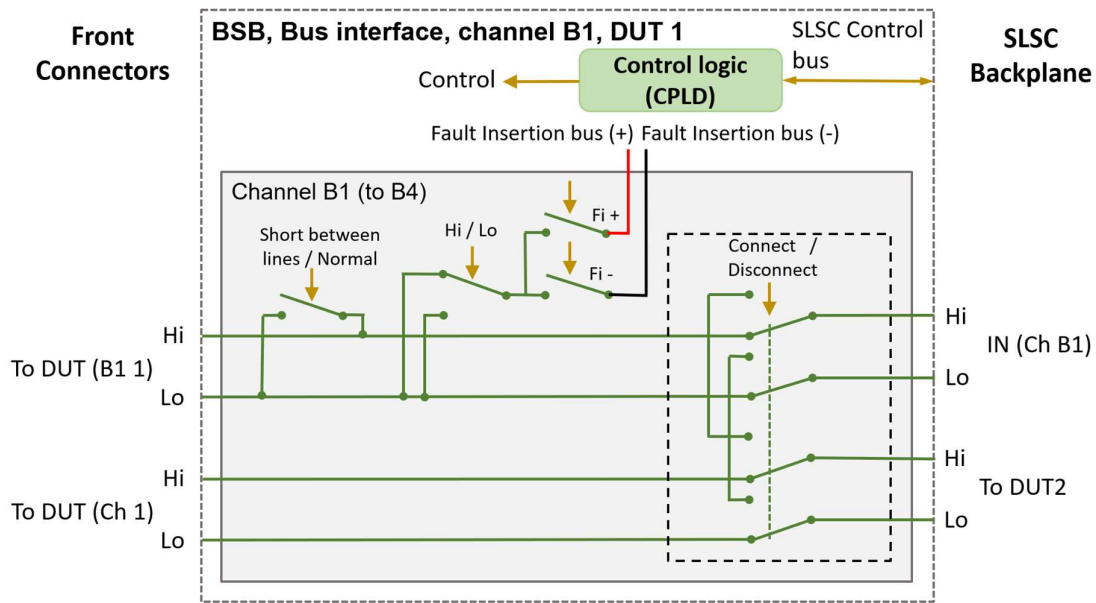


Figure 4: AL-2010 Block diagram, Bus interfaces for Bus B1

See fig 4, BUS interfaces the AL-2010 provides fault insertion features such as:

- Connect / Opening circuits
- Shorting signals between Hi / Lo of the serial lines
- Fault insertion outputting Hi or Lo to axillary signals + / -

## Front Connector Pinout

The AL-2010 has four connectors each consisting of twenty terminals.

Connector 1		Connector 2		Connector 3		Connector 4	
Pin	Signal name	Pin	Signal name	Pin	Signal name	Pin	Signal name
1	B1 DUT Out Hi	1	B1 DUT2 Out Hi	1	B1 DUT3 Out Hi	1	B1 DUT4 Out Hi
2	B1 DUT1 Out Lo	2	B1 DUT2 Out Lo	2	B1 DUT3 Out Lo	2	B1 DUT4 Out Lo
3	B2 DUT1 Out Hi	3	B2 DUT2 Out Hi	3	B2 DUT3 Out Hi	3	B2 DUT4 Out Hi
4	B2 DUT1 Out Lo	4	B2 DUT2 Out Lo	4	B2 DUT3 Out Lo	4	B2 DUT4 Out Lo
5	S1 A Out	5	S3 A Out	5	S5 A Out	5	S7 A Out
6	B3 DUT1 Out Hi	6	B3 DUT2 Out Hi	6	B3 DUT3 Out Hi	6	B3 DUT4 Out Hi
7	B3 DUT1 Out Lo	7	B3 DUT2 Out Lo	7	B3 DUT3 Out Lo	7	B3 DUT4 Out Lo
8	B4 DUT1 Out Hi	8	B4 DUT2 Out Hi	8	B4 DUT3 Out Hi	8	B4 DUT4 Out Hi
9	B4 DUT1 Out Lo	9	B4 DUT2 Out Lo	9	B4 DUT3 Out Lo	9	B4 DUT4 Out Lo
10	S2 A Out	10	S4 A Out	10	S6 A Out	10	S8 A Out
11	B1 DUT1 Rtn Hi	11	B1 DUT2 Rtn Hi	11	B1 DUT3 Rtn Hi	11	B1 DUT4 Rtn Hi
12	B1 DUT1 Rtn Lo	12	B1 DUT2 Rtn Lo	12	B1 DUT3 Rtn Lo	12	B1 DUT4 Rtn Lo
13	B2 DUT1 Rtn Hi	13	B2 DUT2 Rtn Hi	13	B2 DUT3 Rtn Hi	13	B2 DUT4 Rtn Hi
14	B2 DUT1 Rtn Lo	14	B2 DUT2 Rtn Lo	14	B2 DUT3 Rtn Lo	14	B2 DUT4 Rtn Lo
15	S1 B Out	15	S3 B Out	15	S5 B Out	15	S7 B Out
16	B3 DUT1 Rtn Hi	16	B3 DUT2 Rtn Hi	16	B3 DUT3 Rtn Hi	16	B3 DUT4 Rtn Hi
17	B3 DUT1 Rtn Lo	17	B3 DUT2 Rtn Lo	17	B3 DUT3 Rtn Lo	17	B3 DUT4 Rtn Lo
18	B4 DUT1 Rtn Hi	18	B4 DUT2 Rtn Hi	18	B4 DUT3 Rtn Hi	18	B4 DUT4 Rtn Hi
19	B4 DUT1 Rtn Lo	19	B4 DUT2 Rtn Lo	19	B4 DUT3 Rtn Lo	19	B4 DUT4 Rtn Lo
20	S2 B Out	20	S4 B Out	20	S6 B Out	20	S8 B Out

Figure 5: AL-2010 Front Connector Pinout



## RTI Backplane

For communication between the AL-2010 and the bus communication board such as CAN, LIN, FlexRay or any other serial bus you need to connect a RTI backplane to the SLSC chassis. The AL-2010 works with the AL-2010 RTI backplane

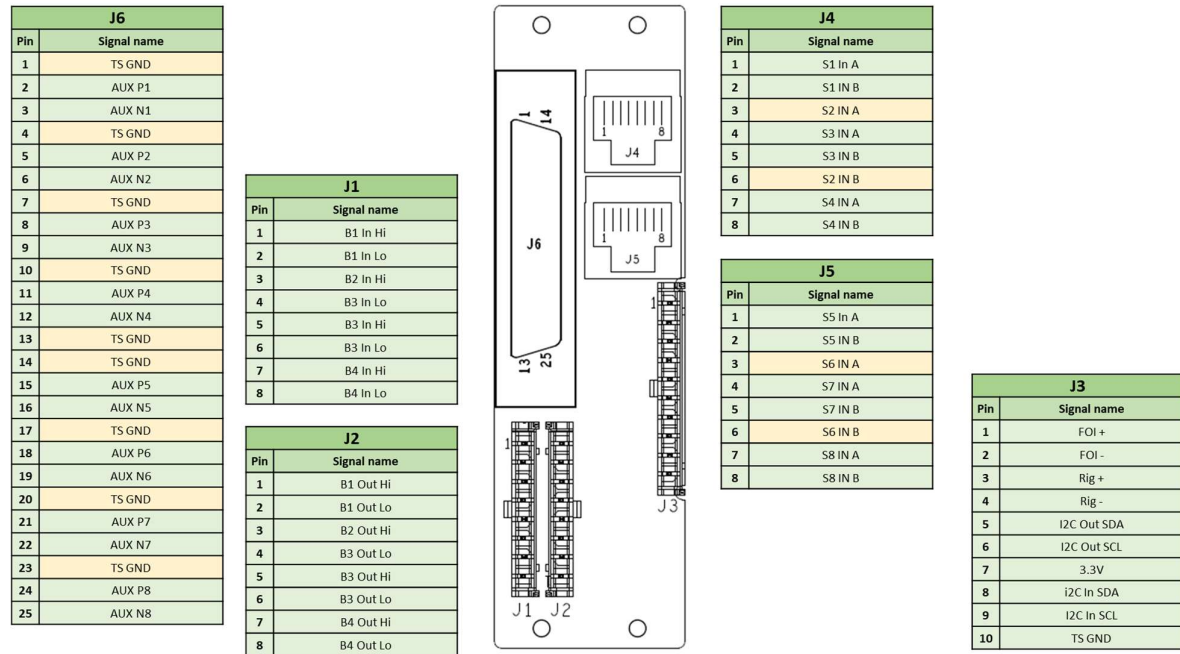


Figure 6: AL-2010 Backplane

The RTI backplane support RJ-45 for Ethernet and Molex connector for the serial bus connections.

## Installation

### Electromagnetic Compatibility (EMC)

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This product is intended for use in industrial locations. Harmful interference may occur in certain installations, such as if the product is used in residential or commercial areas. This may also occur when the product is connected to a peripheral device or test object that outputs electromagnetic noise or other interference.

To minimize interference with radio and television reception and prevent unacceptable performance degradation, install, and use this product in strict accordance with the instructions of the product documentation.

Furthermore, any modifications to the product not expressly approved by ALIARO may void your warranty and 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

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The AL-2010 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.

### What You Need to Get Started

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

Hardware

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

- SLSC-12001 chassis
- SLSC module(s)
- Power cable
- Power input connector
- Grounding wire
- Grounding lug

## Tools

- Screwdriver as needed for your application
- Wire stripper

## Documentation

- SLSC-12001 Chassis Getting Started Guide and Specifications



**Warning** - Do not touch the contacts or remove the I/O boards or cables while the system is energized. The SLSC chassis and the AL-2010 do not support hot plug-in. The entire chassis must be powered off when a module is inserted or removed.

## Installing the AL-2010

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

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.



**Please Note** - The SLSC chassis and the AL-2010 do not support hot plug-in. The entire chassis must be powered off when a module is inserted or removed.

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 a AL-2010 module into the same slot as its corresponding RTI while firmly holding the RTI in place until the RTI is fully 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. Wait until all RTIs and modules are installed before fully tightening the screws. This ensures the proper alignment for future connections between modules and RTIs.

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8. Fully tighten the two module mounting screws on each newly installed module.
9. Power on the SLSC Chassis

## Software Installation - SLSC LabVIEW Drivers

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When the module is used with LabVIEW or TestStand, the ALIARO drivers need to be installed. Contact ALIARO support for the most recent version of our drivers: [support@ALIARO.com](mailto:support@ALIARO.com)

## Software Installation - ALIARO Custom Devices

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When AL-2010 is used with VeriStand, Custom Devices needs to be installed. Contact ALIARO support for the most recent version of our Custom Devices: [support@ALIARO.com](mailto:support@ALIARO.com)

## Software Installation - ALIARO xMove Configurator (Optional)

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xMove Configurator is a tool for defining and editing VeriStand System definition files for HIL (Hardware-in-the-loop) test systems. It is specifically aimed at configuring ALIARO SLSC Multi-Purpose boards and NI modules.

The configurator uses a Predefined System Configuration file containing the system mapping and a VeriStand System Definition file defining all hardware. It empowers users to configure and reconfigure User Channels, Aliases and System Mappings for HIL systems.

For more information on xMove Configurator, check the xMove Configurator webpage on NI.com.

## System Check

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Finish the installation by conducting a system check, see the chapter *Operation*.

## Operation

### Safety Guidelines

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Operate the ALIARO AL-2010 only as described in this document.



**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.

## System check using LabVIEW

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This chapter requires the LabVIEW Development Environment and installation of the ALIARO LabVIEW drivers.

To identify that the cards are correctly 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 listing pre-made LabVIEW examples.
2. Switch to the “*Search*” tab and enter keyword “*SLSC*” and search.
3. In the new filtered table (to the right) find and select VI called “*Configuration.vi*”. This VI can locate all cards that are online in a SLSC chassis.
4. To find the newly inserted cards look for the SLSC chassis IP-address (in the table to the right).
5. Count the card(s) in the table and verify that all installed cards are being located by the program (this can be 1 to 11 cards per SLSC chassis).

## Maintenance

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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

## Calibration

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Recommended warm-up time	10 min
Calibration interval	Not required

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

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



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.

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[www.aliaro.com](http://www.aliaro.com)

## Specification

### Definition and conditions

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This document describes the performance of the described module under specific operating conditions which are covered by the module warranty.

These conditions can be classified into two main sections:

- *Typical* specifications describe the performance met by most modules.
- *Nominal* specifications describe an attribute that is based on design, conformance testing, or supplemental testing for this specific module.

Specifications are *Typical* unless otherwise noted.

Specifications are valid under the following conditions unless otherwise noted.

The AL-2010 module is mounted in a standard NI SLSC chassis. This chassis should conform to the NI recommended cooling requirements and use a standard power supply that meets the specifications provided in the chassis user guide. All aspects of the SLSC chassis should follow NI guidelines.



**Please Note** - These specifications only apply to the product as provided by ALIARO. Modifications to the module may invalidate these.



**Caution** - Observe all instructions, warnings and cautions in the board documentation. Using the module in a manner not specified by this document can damage the module and compromise the built-in safety protection. Return damaged models to ALIARO for repair.

### Environmental Characteristics

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#### Temperature and Humidity

Operating temperature	0 °C to 40 °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

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SLSC slots	1
Dimensions	144.32mm x 30.48mm x 281 mm (H x W x D)
Weight	300g
Front I/O Connector	4 x Phoenix 1844808 20-pins

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

## Technical characteristics

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2-pair Impedance	Channel 1-4: 120Ohm Channel 5-12: 100 Ohm
Bandwidth	Channel 1-4: 50MHz Differential Channel 5-12: 400MHz Differential
Isolation	In open circuit Between channels
Voltage	100V
Short circuit current:	500mA (protected by current limiter circuit)
Path resistance	Channel 1-4: In to Out 2 $\Omega$ Channel 5-12: In to Out 1 $\Omega$

## Safety Guidelines

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



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



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



**Caution** - All wiring must be insulated for the highest voltage used.

## Product Certifications and Declarations

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

To obtain product certifications and the DoC for ALIARO products, please contact our support team at [support@ALIARO.com](mailto:support@ALIARO.com)

## CE Compliance

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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

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





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

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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](http://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)

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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](http://ALIARO.com/environment/weee)