

# OP8900 SLSC Boards General Information

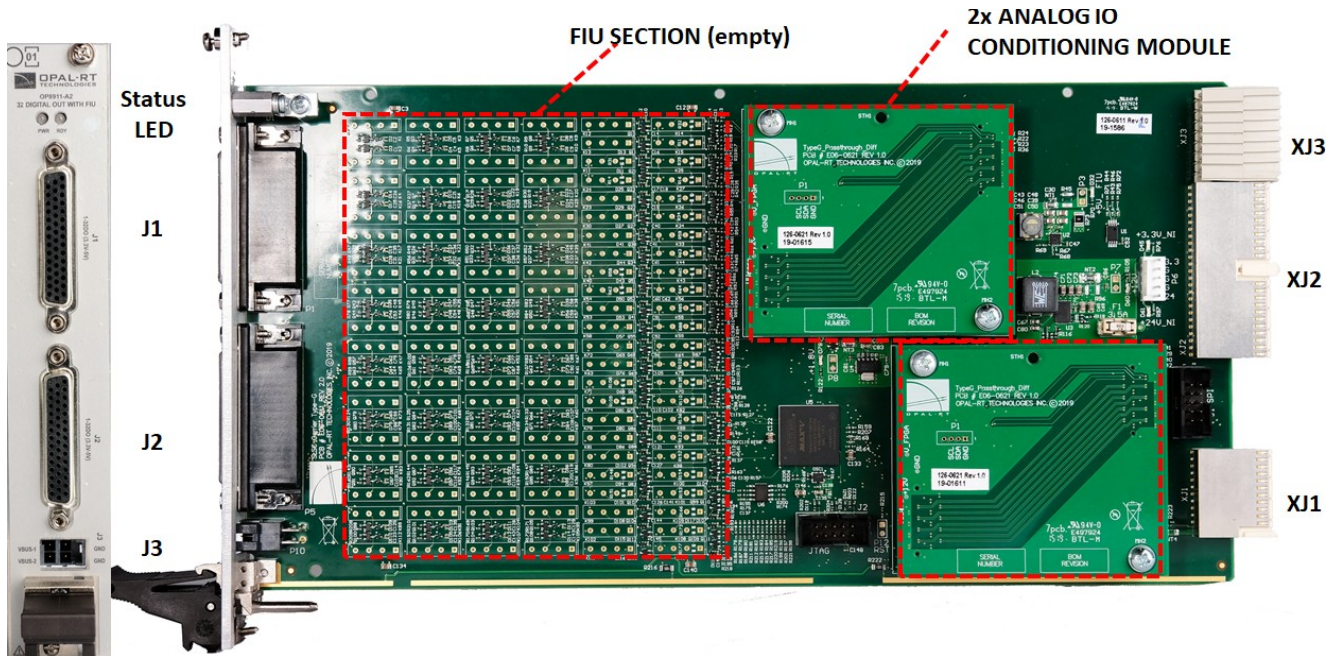
For a description of the OP8900 series FIU (fault insertion unit), [see here](#).

## Form Factor

The SLSC boards are 144.32mm tall (4U) by 281.9mm deep. For detailed information refer to OP8930 Configurations.

## Board Layout

Analog Board and passthrough (OP893x / OP8940)



# OP8900 SLSC Boards FIU Description

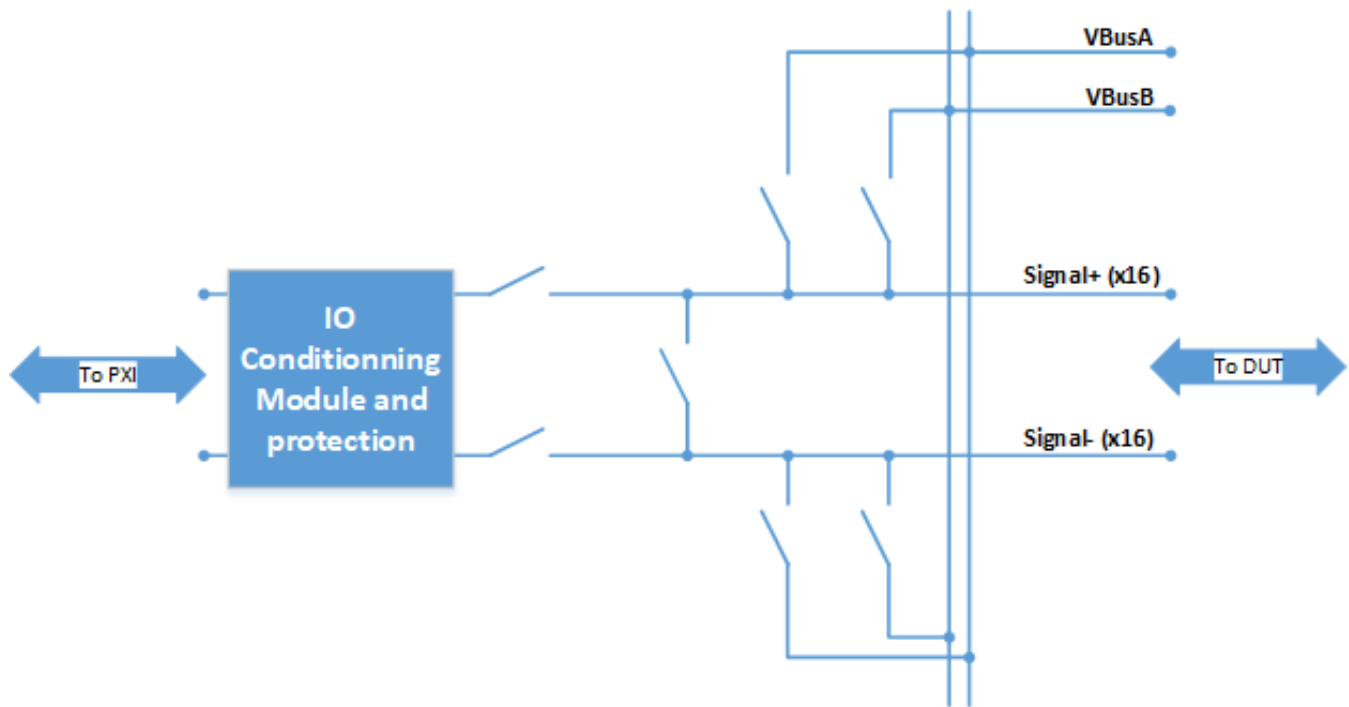
## Topology

The Fault Insertion Unit (FIU) section of the OP8900 boards consists of **seven relays per differential pair** of signals, for a total of 112 relays (7 x16).

Each relay can be controlled individually.

For each group of 7 relays, **the possible faults are**

- **Open-circuit** of the pair
- **Short-circuit** of the two signals of the pair
- Two **fault injection**, with two user-supplied voltage references voltages (VBusA and VBusB), for each signal of the pair.



**Note:** Diagram only shows one channel.

## Embedded Protections

The following protections are implemented:

- In the default state, all relays are open
- All channels are updated simultaneously
- VBusA and VBusB cannot be connected on the same channel at the same time: VBusA and VBusB cannot be shorted
- When the Signal + and Signal - are shorted together, only one other fault is allowed for VBusA or VBusB on that channel pair
- Relays on a channel are always open before closing any other



**The maximum peak current per relay is 1A. There is no over-current protection**

The relay technology used in the FIU allows a higher density and has a fast response time (<0.5ms). However, this technology is very sensitive to peak current, even for a few micro-seconds. It is the customer's responsibility to limit the peak current by adding the resistor on the signal or VBus based on the capacitor and cabling present on the circuit.

Even if the power supply on the VBus is limited to 0.1A, a capacitor is present at the output and the peak current can easily >5A before the internal current limit kick in creating permanent damage to the relay.

If a relay is broken in short mode, an RMA can be issued to repair the card. If the customer has access to a technician with valid IPC-610 certification and experience with a rework of through-hole lead-free and no-clean soldering, OPAL-RT authorizes this technician to replace once a faulty relay.

**Here is a short recap of the process:**

1. Remove the SLSC card out of the SLSC chassis.
2. With a basic multimeter measure the impedance between pin 1 and 4 of all 112 relays. If <100R, the relay needs to be changed.
3. Unsolder the faulty relay. No-clean flux can be used.
4. Solder a new relay: Comus International 3570-1419-054.



**For output signal (analog or digital), always open the load relay (relay in series of the signal) when creating faults to prevent damage on the output circuit.**

Even if some protection is built-in on the output circuit to prevent damage, creating a direct fault to VBus with higher voltage can create permanent damage.

# OP8930 16 Analog IO Conditioning Board

Configurable differential to single-ended analog conditioning, with high bandwidth of 500kHz



# OP8930 Description

The OP8930 is a 16-channel analog input or output board with fault insertion, compatible with the [NI SLSC-12001 Platform](#).

## Features

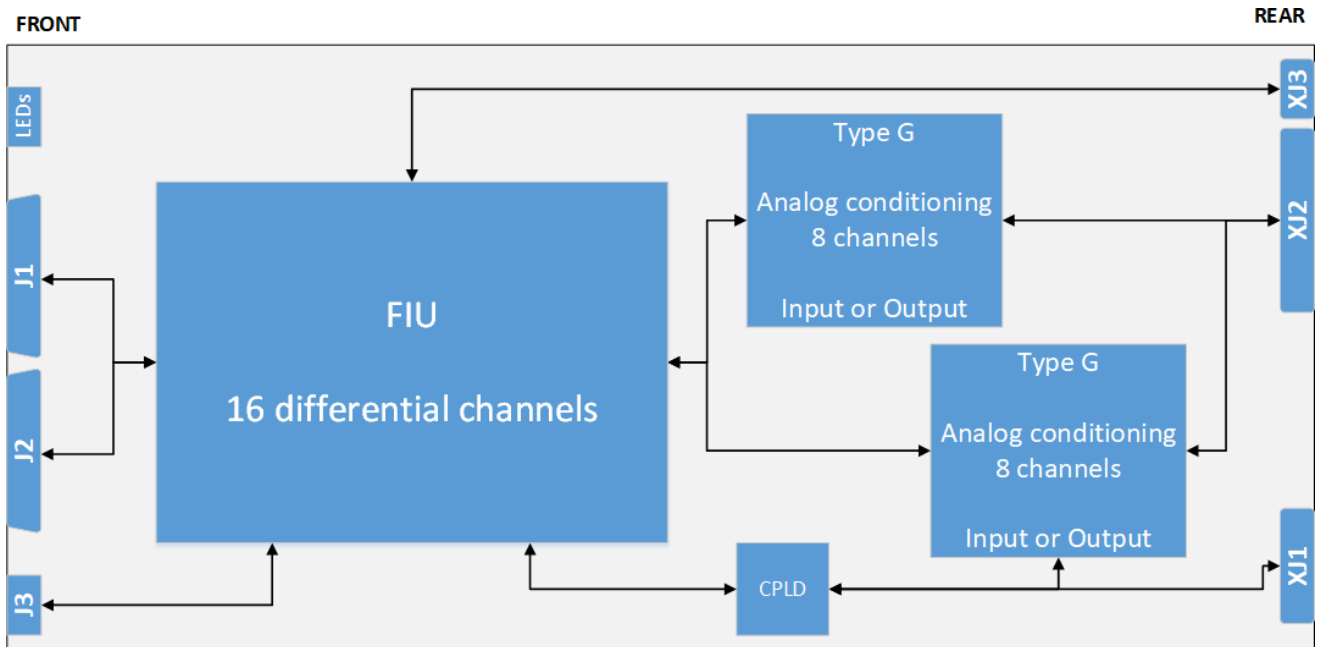
- Analog signal conditioning & FIU on a single board
- 16 channel on two 8-channel OP8Gxx modules
- Ain and Aout user-configurable conditioning circuit
- Fault insertions module FIU as an option

For a full description of the OP8900 series boards' FIU (fault insertion) unit, [see here](#).

## Board Architecture

The board features two groups of 8 channels and a set of relays adding fault insertion capability for each signal.

The general layout of the board is as follows, with the [Front Interface](#) connectors on the left and the SLSC backplane connectors on the right:



The input/output conditioning is managed by a combination of these two OP8Gxx (also called Type-G) modules:

- OP8G01: 8-channel analog Input conditioning module
- OP8G03: 8-channel analog Output conditioning module

A CPLD is used to configure the fault insertion unit (FIU) section and the OP8G01 and OP8G03 modules. It is responsible for the communication of the SLSC card within the NI environment for identification, error reporting, etc. It also receives configuration from the software and applies it to the FIU and to some of the I/Os.

The [FIU specification and topology](#) is common to all OP8900 boards.

# Channels description

## Analog Inputs

The OP8G01 module (P/N 126-0612) conditions **±10V or ±30V differential analog input signals** coming from the unit under test into **±10V** single-ended analog signals to be connected to the PXI chassis.

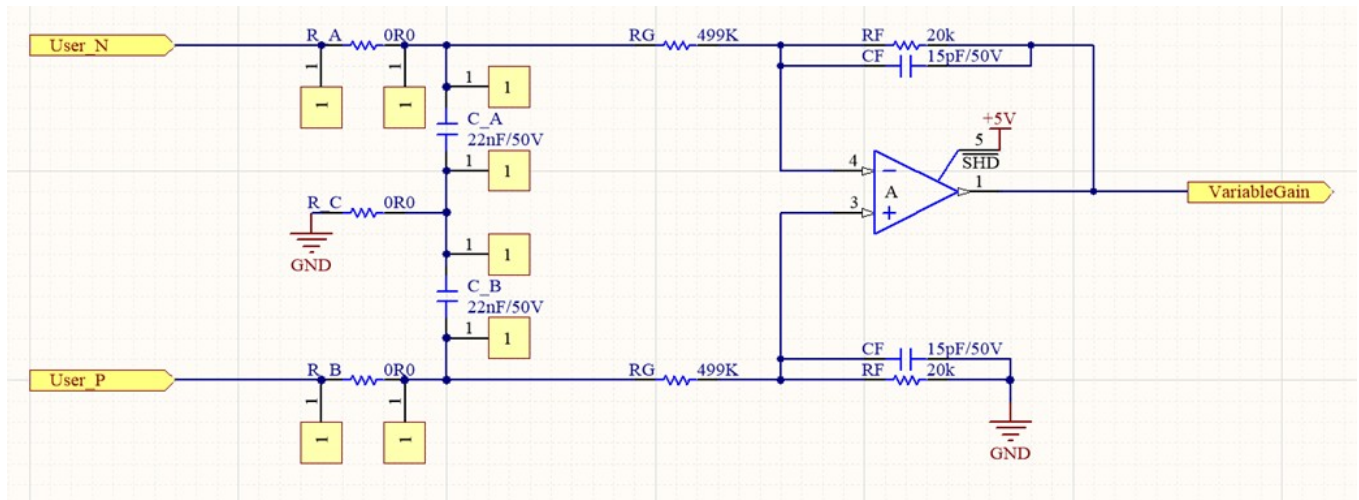
Special request to set other input voltage ranges (**±60V**).

## Conditioning circuit configuration

The **conditioning circuit is user-configurable** by using passive components on through-hole sockets. Each channel is configurable independently. This feature allows adapting the module for:

- Custom impedance matching
- Custom analog filter
- Custom analog divider

The configurable elements consist of a set of three resistors (**R\_A, R\_B, R\_C**) and two capacitors (**C\_A, C\_B**) as shown below:



By default **R\_C, C\_A** and **C\_B** are not installed, and **R\_A** and **R\_B** are 0 Ohm.

Use the table below to locate these elements on the board:

Channel	R_A	R_B	R_C	C_A	C_B
1	R9	R3	R75	C5	C1
2	R23	R21	R108	C18	C12
3	R12	R4	R67	C7	C2
4	R26	R24	R107	C19	C13
5	R37	R35	R144	C27	C20
6	R53	R51	R173	C34	C30
7	R43	R36	R137	C28	C21
8	R55	R52	R170	C35	C33

## Analog Outputs

The OP8G03 module (P/N 126-0642) condition  $\pm 10V$  single-ended analog signals coming from the PXI chassis into  **$\pm 20V$  differential analog output signals (OP8934/OP8935) or  $\pm 10V$  differential analog output signals (OP8931/OP8933)** to be connected to the unit under test.

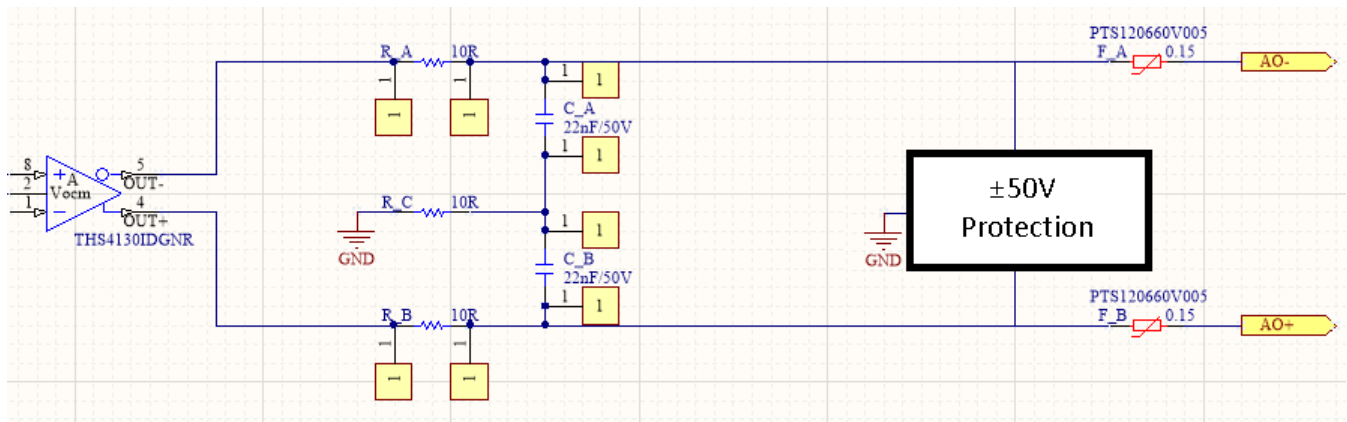
The maximum current per channel is  $\pm 50mA$  continuous, for a maximum of 250 mA per OP8930 board.

## Conditioning circuit configuration

The **conditioning circuit is user-configurable** by using passive components on through-hole sockets. Each channel is configurable independently. This feature allows adapting the module for:

- Custom impedance matching
- Custom analog filter
- Custom analog divider

The configurable elements consist of a set of three resistors (**R\_A**, **R\_B**, **R\_C**) and two capacitors (**C\_A**, **C\_B**) as shown below:



By default **C\_A** and **C\_B** are not installed, and **R\_A**, **R\_B** and **R\_C** are 10 Ohm.

Use the table below to locate these elements on the board:

	R_A	R_B	R_C	C_A	C_B
1	R11	R5	R77	C7	C3
2	R12	R6	R76	C8	C4
3	R24	R19	R87	C21	C16
4	R25	R20	R86	C22	C17
5	R38	R32	R104	C33	C31
6	R39	R33	R103	C34	C32
7	R52	R46	R125	C50	C46
8	R53	R47	R124	C51	C47

## OP8930 Configurations

Several assemblies of the OP8930 are available, as listed below, with different counts of inputs and outputs, and with or without the FIU section populated.

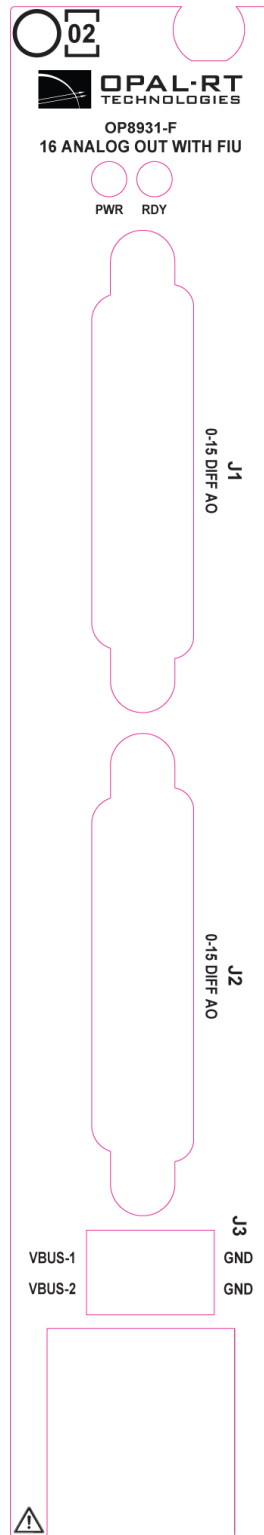
Part Number	Description	Input	Output	FIU
OP8931-F	<b>** REPLACED BY OP8934 ***</b> 16 Aout differential from single-ended input with FIU SLSC Conditioning Board		Single-to diff	16 diff. FIU
OP8931-N	<b>** REPLACED BY OP8934 ***</b> 16 Aout differential from single-ended input SLSC Conditioning Board		Single-to diff	N/A
OP8932-F	16 Ain differential to single-ended with FIU SLSC Conditioning Board	Diff-to-Single		16 diff. FIU
OP8932-N	16 Ain differential to single-ended SLSC Conditioning Board	Diff-to-Single		N/A
OP8933-F	<b>** REPLACED BY OP8935 ***</b> 8 Ain/8 Aout with FIU SLSC Conditioning Board	Diff-to-Single	Single-to diff	16 diff. FIU
OP8933-N	<b>** REPLACED BY OP8935 ***</b> 8 Ain/8 Aout SLSC Conditioning Board	Diff-to-Single	Single-to diff	N/A
OP8934-F	16 Aout differential from single-ended input with FIU SLSC Conditioning Board		Single-to diff	16 diff. FIU
OP8934-N	16 Aout differential from single-ended input SLSC Conditioning Board		Single-to diff	N/A
OP8935-F	8 Ain/8 Aout with FIU SLSC Conditioning Board	Diff-to-Single	Single-to diff	16 diff. FIU
OP8935-N	8 Ain/8 Aout SLSC Conditioning Board	Diff-to-Single	Single-to diff	N/A



# OP8930 Hardware Interface

## Face plate

The face plate provides two HDB44 connectors (J1, J2), one 4-pin Molex connector (J3) and two LEDs:



## J1, J2 Connectors

The 16 analog I/O signals are routed to both J1 and J2 connectors. This allows, for example, splitting the input and output signals into two different cables.

If the harnessing uses only one connector, it is recommended to use J2 (bottom one).

The connectors' pin assignment is detailed in [OP8930 Pin assignment](#)

### J1-J2 Recommended mating connector

Manufacturer	Part number	Description
Norcomp	180-044-173L000	D-SUB Housings
Norcomp	180-001-170L001	Crimps for 24 to 26 wire gauge
Norcomp	979-025-030R121	

## J3 Connector

J3 is used to connect the two external reference voltages for fault insertion.

### J3 Mating connector with crimps

Manufacturer	Part number	Description
Molex	538-172258-1004	Headers and Wire Housings
Molex	538-172253-3023-LP	Crimps for 16 to 18 wire gauge

## LEDs definition

LED Name	LED Behavior	Definition of Behavior
Power	Off	No power present on module (from SLSC Interface nor external power)
	Solid Green	Power Good State
	Blinking Red	Module Fault State
Ready	Off	Module is not powered or in Rdy/Rst# is driven low by the chassis.
	Solid Green	Module in default configuration, recognized by the chassis and ready to configure (The Rdy/Rst# signal has been pulled high by the chassis.)
	Blinking Amber	Module is active (in a non-default configuration and/or communicating with the chassis).

# OP8930 Pin Assignment

## J1/J2 HDB44 Connector Pinout

As explained in [OP8930 Hardware Interface](#), both HDB44 connectors J1 and J2 share the same pin-out. The 16 analog I/O signals are routed to both J1 and J2 connectors. This allows, for example, splitting the input and output signals into two different cables.

8930	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Pin															
Signal Name	A0+	A1+	A2+	GND	A4+	A5+	A6+	GND	A8+	A9+	A10+	GND	A12+	A13+	A14+

Pin	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
Signal Name	A0-	A1-	A2-	GND	A4-	A5-	A6-	GND	A8-	A9-	A10-	GND	A12-	A13-	A14-

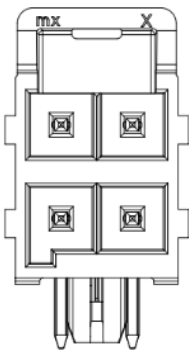
  

Pin	31	32	33	34	35	36	37	38	39	40	41	42	43	44	
Signal Name	A3-	A3+	GND	GND	A7-	A7+	GND	GND	A11-	A11+	GND	GND	A15-	A15+	

The direction of the signals A0 to A15 depend on the OP8930 assembly selected :

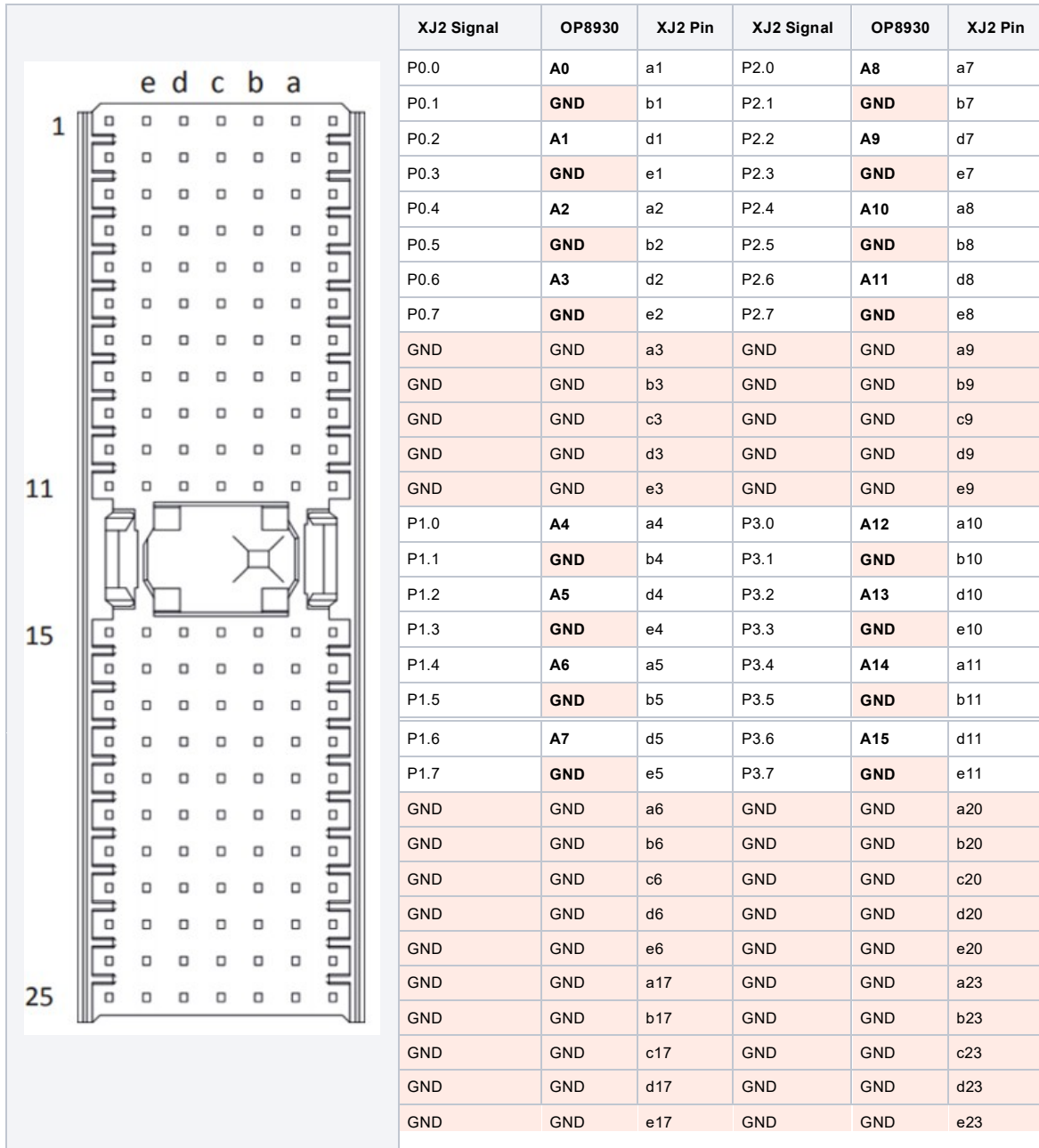
Part Number	Description	Analog In	Analog Out
OP8931	** REPLACED BY OP8934 *** 16 Aout differential from single ended input SLSC Conditioning Board		A0-A15
OP8932	16 Ain differential to single ended SLSC Conditioning Board	A0-A15	
OP8933	** REPLACED BY OP8935 *** 8 Ain/8 Aout SLSC Conditioning Board	A0-A7	A8-A15
OP8934	16 Aout differential from single ended input SLSC Conditioning Board		A0-A15
OP8935	8 Ain/8 Aout SLSC Conditioning Board	A0-A7	A8-A15

## J3

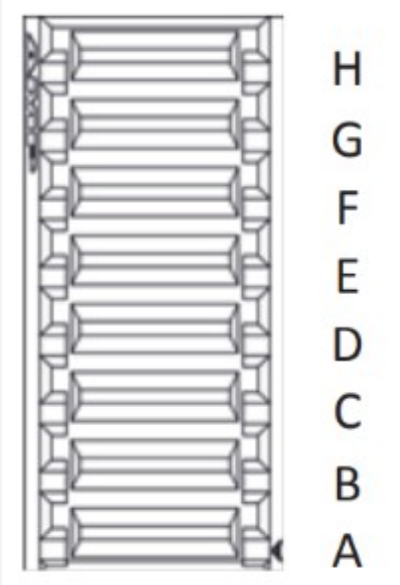
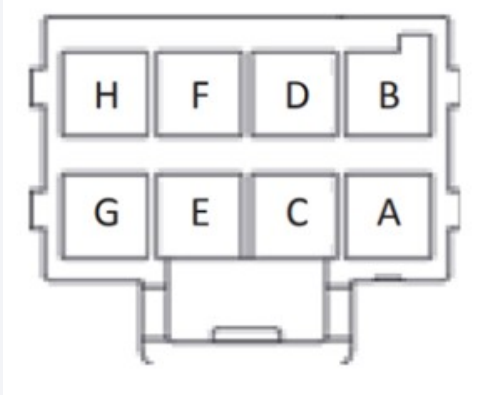


GND	GND
VBus_A	VBus_B

## XJ2 connector pinout



## XJ3 connector pinout

XJ3 connector	Molex connector (on standard RTI)	XJ3 pin	OP8910
		H	VBus_A
		G	GND
		F	VBus_B
		E	GND
		D	VUser_1
		C	GND
			VUser_2
		A	GND

# OP8930 Specification

## General

<b>Product Name</b>	<b>OP8930</b>
<b>Part Numbers</b>	see <a href="#">OP8930 configurations options</a>
<b>Board Type</b>	Analog input/output conditioning
<b>Form Factor</b>	SLSC
<b>SLSC Module Design Specifications</b>	Version 1.2.1
<b>SLSC Compliance Level</b>	OP8931/OP8932/OP8934: 1 OP8933/OP8935: 2
<b>Rear I/O Compatibility</b>	OP8931/OP8934: [02] (Up to 16 output differential channels) OP8932: [03] (Up to 16 input differential channels) OP8933/OP8935: [P5] (Up to 8 input channels on bank 1-2 and Up to 8 output channels on bank 3-4)
<b>Hot-Plug support</b>	No

## Characteristics

	PCB Rev. 1	PCB Rev. 2
<b>Number of channels</b>	16 input or output channels  Number of input /outputs depend on assembly selected. See <a href="#">OP8930 configurations options</a>	16 input or output channels  Number of input /outputs depend on assembly selected. See <a href="#">OP8930 configurations options</a>
<b>Max peak current with FIU</b>	1A, see <a href="#">OP8900 SLSC Boards - FIU Description</a>	1A, see <a href="#">OP8900 SLSC Boards - FIU Description</a>
<b>Analog Inputs</b>		
<ul style="list-style-type: none"> <li>Voltage Range</li> </ul>	From unit under test: $\pm 10V$ or $\pm 30V$ differential (fix range) To PXI chassis: $\pm 10V$ single-ended	From unit under test: $\pm 10V$ or $\pm 30V$ differential (software selectable) To PXI chassis: $\pm 10V$ single-ended
<ul style="list-style-type: none"> <li>Bandwidth (-3dB)</li> </ul>	500 kHz	250 kHz
<ul style="list-style-type: none"> <li>Differential Input Impedance</li> </ul>	1M $\Omega$	1M $\Omega$
<ul style="list-style-type: none"> <li>Voltage Protection</li> </ul>	100V	100V

<b>Analog Outputs</b>		
• Voltage Range	From PXI chassis: $\pm 10V$ single-ended To unit under test: $\pm 20V$ differential (OP8934/OP8935) To unit under test: $\pm 10V$ differential (OP8931/OP8933)	From PXI chassis: $\pm 10V$ single-ended To unit under test: $\pm 20V$ differential (OP8934/OP8935) To unit under test: $\pm 10V$ differential (OP8931/OP8933)
• Maximum current	$\pm 50mA$ /channel, 250mA/board	$\pm 50mA$ /channel, 250mA/board
• Bandwidth (-3dB)	500 kHz	250 kHz
• Output Impedance	25 Ohms	<2 Ohms
• Voltage Protection	50VDC and 50VAC	40VDC and 40VAC
• Short-circuit Protection (continuous)	150mA max	150mA max

## Environmental

### ? Unknown Attachment

The OP8930 is designed for **indoor use only**.

<b>Module operating temperature</b>	0 °C to 85 °C
<b>Storage temperature</b>	-40 °C to 85 °C
<b>Operating humidity</b>	10% to 90% non-condensing
<b>Storage humidity</b>	5% to 95% non-condensing
<b>Pollution Degree</b>	2
<b>Maximum altitude</b>	2,000 m
<b>Power requirement</b>	OP8931/OP8934 : 25W OP8932 : 10W OP8933/OP8935 : 18W