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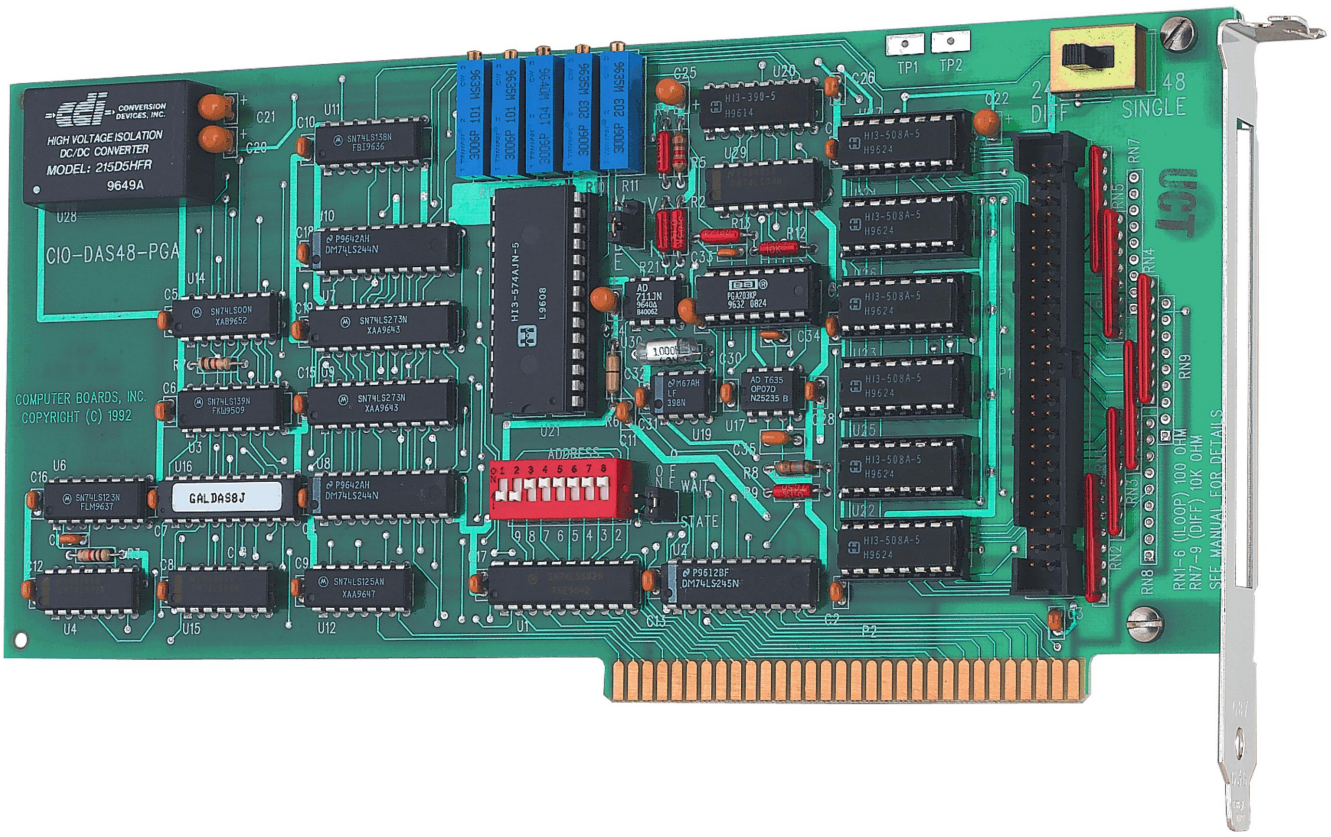
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CIO-DAS48-PGA

Analog Input

User's Guide



MEASUREMENT COMPUTING™

CIO-DAS48-PGA

Analog Voltage Input

User's Guide



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About this User's Guide

What you will learn from this user's guide

This user's guide explains how to install, configure, and use the CIO-DAS48-PGA board so that you get the most out of its analog input features. This user's guide also refers you to related documents available on our web site, and to technical support resources.

Conventions in this user's guide

The following conventions are used in this manual to convey special information:

For more information on …

Text presented in a box signifies additional information and helpful hints related to the subject matter you are reading.

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

<#:#> Angle brackets that enclose numbers separated by a colon signify a range of numbers, such as those assigned to registers, bit settings, etc.

bold text **Bold** text is used for the names of objects on the screen, such as buttons, text boxes, and check boxes. For example:
1. Insert the disk or CD and click the **OK** button.

italic text *Italic* text is used for the names of manuals and help topic titles, and to emphasize a word or phrase. For example:
The *Insta*Cal installation procedure is explained in the *Quick Start Guide*.
Never touch the exposed pins or circuit connections on the board.

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.

If you need to program at the register level in your application, refer to the *Register Map for the CIO-DAS48-PGA and CIO-DAS48-I*. This document is available on our website at www.mccdaq.com/registermaps/RegMapCIO-DAS48-PGA-I.pdf.

Introducing the CIO-DAS48-PGA

Overview: CIO-DAS48-PGA features

The CIO-DAS48-PGA provides 48 single-ended analog inputs or 24 differential inputs. The input mode is switch-selectable. Input ranges are software-selectable as either bipolar or unipolar:

- Bipolar: ±10 V, ±5 V, ±2.5 V, ±1.25 V, and ±0.625 V
- Unipolar: 0 to 10 V, 0 to 5 V, 0 to 2.5 V, and 0 to 1.25 V

In differential mode, up to three optional 10 K SIPs can be installed to provide ground reference to the CH LO inputs. The SIPs are installed in banks of 8 inputs each.

An optional current measurement conversion kit (MCC part number CIO-DAS48-ISIP) is available for converting the 24 differential voltage measurements inputs into 24 current measurement inputs. The kit contains six, four-resistor-SIPs that you install on the board. You set the board's input type to current with an on-board jumper.

A DC/DC converter supplies stable ±15 V power to the analog circuitry. It is possible to construct the board without the DC/DC converter. This reduces the cost but limits the ranges of analog inputs. It is available with orders of 10 or more units.

You can enable a wait state generator with an on-board jumper.

Software features

For information on the features of *Insta*Cal and the other software included with your CIO-DAS48-PGA, refer to the *Quick Start Guide* that shipped with your device.

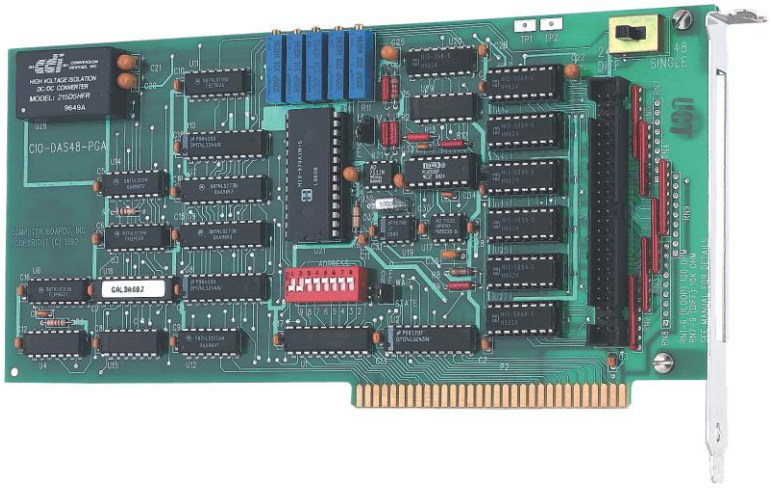
Installing the CIO-DAS48-PGA

What comes with your CIO-DAS48-PGA shipment?

The following items are shipped with the CIO-DAS48-PGA.

Hardware

- CIO-DAS48-PGA



Additional documentation

In addition to this hardware user's guide, you should also receive the *Quick Start Guide* (available in PDF at www.mccdaq.com/PDFmanuals/DAQ-Software-Quick-Start.pdf). This booklet supplies a brief description of the software you received with your CIO-DAS48-PGA and information regarding installation of that software. Please read this booklet completely before installing any software or hardware.

Optional components

You can also order the following MCC product to use with your CIO-DAS48-PGA.

- C50FF-x cable



- Signal termination and conditioning accessories

  MCC provides signal conditioning and termination products for use with the CIO-DAS48-PGA. Refer to Field wiring, signal termination, and conditioning on page 12 for a complete list of compatible accessory products.

Unpacking the CIO-DAS48-PGA

As with any electronic device, you should take care while handling to avoid damage from static electricity. Before removing the CIO-DAS48-PGA 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.

If any components are missing or damaged, notify Measurement Computing Corporation immediately by phone, fax, or e-mail:

- Phone: 508-946-5100 and follow the instructions for reaching Tech Support.
- Fax: 508-946-9500 to the attention of Tech Support
- Email: techsupport@mccdaq.com

Installing the software

Refer to the *Quick Start Guide* for instructions on installing the software on the *Measurement Computing Data Acquisition Software CD*. This booklet is available in PDF at www.mccdaq.com/PDFmanuals/DAQ-Software-Quick-Start.pdf.

Configuring the CIO-DAS48-PGA

The CIO-DAS48-PGA has a base address switch, an input mode switch, an input type jumper, and a wait state jumper which you must set before installing the board in your computer. Configure the input type jumper only if you have the voltage to current input conversion kit.

The *Insta*Cal calibration and test program included with the CIO-DAS48-PGA will show you how to set the switches and jumpers. Run *Insta*Cal before you open your computer and install the board. The CIO-DAS48-PGA is shipped with the factory-default settings listed below.

Factory-configured default settings

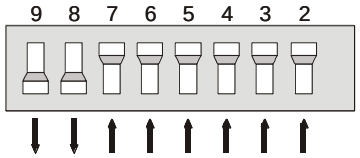
Switch/jumper description	Default setting
Base address DIP switch	300h (768 decimal)
Wait State jumper	Off (disabled)
DIFF/SINGLE (input mode) switch	"48 Single" position
Mode V-I jumper (voltage or current type)	"V" (voltage)

Before installing the CIO-DAS48-PGA, verify that the board is configured with the settings that you want. Review the following information to change the default configuration of a jumper or switch on the CIO-DAS48-PGA board.

Base address

Before you install the CIO-DAS48-PGA in your computer, set the base address by using the dip switch labeled **ADDRESS** located on the board. The easiest way to set the base address switch is to let *Insta*Cal show you the correct settings. However, if are already familiar with setting ISA base addresses, you may use the base address switch description below to guide your base address selection.

Unless there is already another board in your system using address 300 hex (768 decimal), leave the switches as they are set at the factory. The example shown in Figure 1 shows the settings for the factory-default base address of 300 hex.



SW	HEX
A9	200
A8	100
A7	80
A6	40
A5	20
A4	10
A3	08
A2	04

Figure 1. Base address switches

In the default configuration shown in Figure 1, addresses 9 and 8 are DOWN, and all others are UP. Address 9 = 200 hex (512 decimal) and address 8 = 100 hex (256 decimal); when added together they equal 300 hex (768 decimal).

Disregard the numbers printed on the switch

When setting the base address, refer to the numbers printed in white on the printed circuit board.

Wait state

Enable the wait state jumper if you have a computer with an I/O bus transfer rate which is too fast for the CIO-DAS48-PGA, or if the board fails sporadically in random ways.

To enable the wait state, set the jumper to the ON position. This jumper is OFF by default. Enabling the wait state causes the personal computer's bus transfer rate to slow down whenever CIO-DAS48-PGA is written to or read from. This jumper is shown in Figure 2 configured for OFF (wait state is disabled).

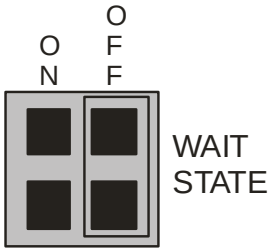


Figure 2. Wait state jumper

Input type (V-I)

The jumper labeled **MODE V-I** sets the input type to either voltage (V) or current (I) (Figure 3). Move the jumper from **V** to **I** *only* if you have installed the CIO-DAS48-ISIP kit.

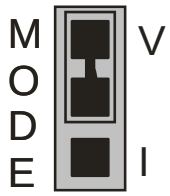


Figure 3. Mode V-I jumper

DIFF/SINGLE

The differential/single ended mode switch (Figure 4) sets board logic for 48 single-ended channels (**48 SINGLE** position) or 24 differential channels (**24 DIFF** position). If the board is configured for current measurements, set the V-I jumper to **I**, and then set the input mode switch to **24 DIFF**.

In voltage mode, (V-I jumper "V" position), the board can be used for either single-ended or differential voltage measurements.

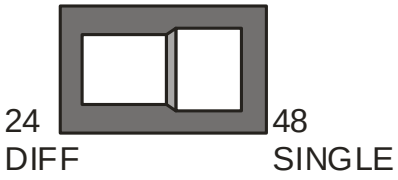


Figure 4. Input mode switch

Installing the CIO-DAS48-PGA

After you configure the board's switches and jumpers, you can install the CIO-DAS48-PGA into your computer. To install your board, follow the steps below.

Install the MCC DAQ software before you install your board

The driver needed to run your board is installed with the MCC DAQ software. Therefore, you need to install the MCC DAQ software before you install your board. Refer to the *Quick Start Guide* for instructions on installing the software.

1. Turn your computer off, open it up, and insert your board into an available ISA slot.
2. Close your computer and turn it on.
3. To test your installation and configure your board, run the *Insta*Cal utility you installed in the previous section. Refer to the *Quick Start Guide* that came with your board www.mccdaq.com/PDFmanuals/DAQ-Software-Quick-Start.pdf for information on how to initially set up and load *Insta*Cal.

Connecting the board for I/O operations

Connectors, cables – main I/O connector

The table below lists the board connector, applicable cables, and compatible accessory products.

Board connector, cables, and accessory equipment

Connector type	50-pin header connector
Compatible cable	C50FF-x
Compatible accessory products with the C50FF-x cable	CIO-MINI50 CIO-SPADE50

Information on signal connections

General information regarding signal connection and configuration is available in the *Guide to Signal Connections* (available at www.mccdaq.com/signals/signals.pdf).

Pinout – main I/O connector

The CIO-DAS48-PGA I/O connector is a standard 50-pin header connector that is accessible from the rear of the computer through the expansion backplate.

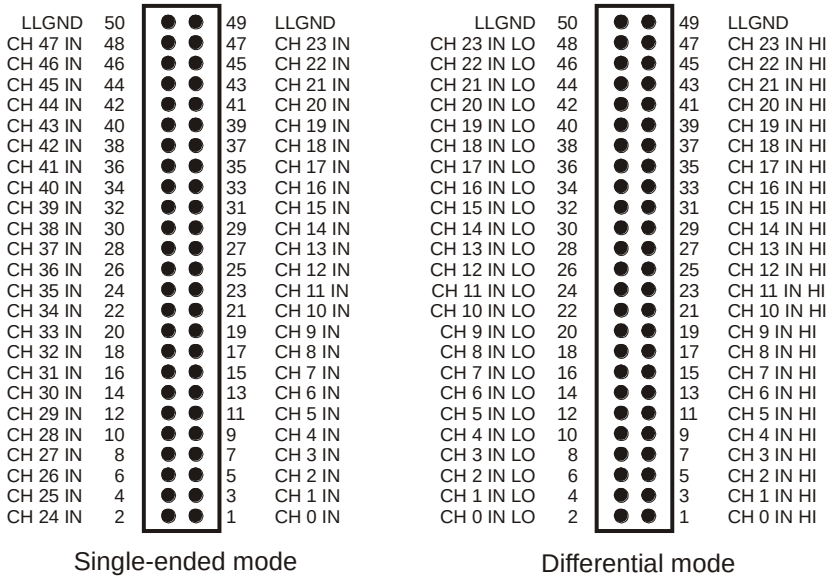


Figure 5. I/O connector pin-out

Current connections are made between CH# HI and CH# LOW. The positive terminal of the current to be measured must be connected to CH# HI (refer to Current loop measurements on page 13).

Cabling

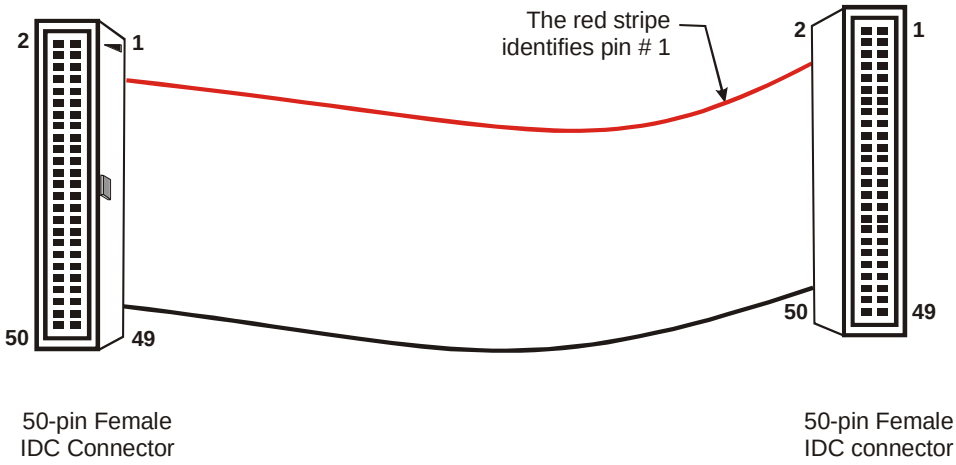


Figure 2-1. C50FF-x cable

Field wiring, signal termination, and conditioning

You can use the following cabling, screw termination, and signal conditioning products with the CIO-DAS48-PGA.

- CIO-MINI50 – 50-pin screw terminal board
- CIO-SPADE50 — 16" X 4" termination panel which mates with both 37-pin and 50-pin connectors.

Functional Details

Single ended inputs

Single-ended inputs are two-wire connections between the signal source and the A/D board. A single wire carries the signal, and is connected from the signal source to Channel *n* HI. The ground from the signal source must be connected to LLGND (pins 49 or 50).

Differential inputs

Differential inputs are 3-wire analog hookups consisting of a signal high, signal low and chassis ground. The signal source high is connected to Channel *n* HI, the signal source low is connected to Channel *n* LO, and the signal source GND is connected to LLGND.

The benefits of differential inputs are the ability to reject noise which affects both signal high and low, and the ability to compensate for ground loops or potentials between signal low and chassis ground.

Modified differential

Modified differential inputs for voltage measurements provide much of the environmental-noise immunity and common mode rejection of fully differential inputs with the convenience of a two wire hookup.

Although differential inputs are often preferable to single-ended inputs, there are occasions when the floating nature of a differential input can prevent making a valid reading. In those cases, the CIO-DAS48-PGA inputs can be converted to modified differential.

Near the 50-pin connector on the board are positions for optional Single Inline Packages (SIP) of 10 K resistors. Installing the SIP in RN7, RN8 and RN9 converts the analog inputs from fully differential to modified differential with a 10 K reference to ground.

Notes: All three sips must be installed. It is not possible to mix channels.

After the SIPs are installed, signal connections require on Signal Source Hi be connected to Channel *n* HI and signal source low be connected to Channel *n* LOW. No connection to LLGND is needed.

Special instructions and solder are packaged with the 10K SIP. Follow the installation instructions carefully and use the solder provided. Use of other solder, or failure to follow instructions will probably result in a degradation of the analog input's accuracy and will require out-of-warranty repair.

Current loop measurements

If you are configuring a CIO-DAS48-PGA for current measurements, do the following operations:

1. Remove (clip off) the SIPs from RN7, RN8, and RN9, if installed. These SIPs must not be installed if the board is to be used for current measurement.
2. Install the resistor "CIO-DAS48-ISIP" kit. Install ISIPs in RN1, RN2, RN3, RN4, RN5, and RN6.

   Special instructions and solder are packaged with the CIO-DAS48-ISIP kit. Follow the installation instructions carefully and use the solder provided. Use of other solder, or failure to follow instructions will probably result in a degradation of the analog input's accuracy and will require out-of-warranty repair.

The selection of the ISIPs is critical. Variations in either value or tolerance from those supplied in the CIO-DAS48-ISIP will result in inaccurate measurements.

3. Set the input type jumper to the "**I**" position (see page **Error! Bookmark not defined.**).
4. Set the DIFF/SINGLE switch to the "**24 DIFF**" position (see page 11).
5. Install the board and run the *Insta*Cal calibration procedure for current mode.

After installation, the inputs are committed to current measurement and cannot be used for voltage measurement.

- To restore the inputs to voltage measurement remove the ISIPs (clip off the SIPs). If you want to de-solder the SIPs, you must return the board to the factory.
- If you want to re-install the 10k SIPs in RN7, RN8, and RN9 (to have "Modified-Differential" inputs), you must return the board to the factory.

It is not possible to install only a portion of the ISIPs and have a mixture of current and voltage inputs. You must install all six SIPs from the CIO-DAS48-ISIP package, and set the input type jumper to the "**I**" position.

Specifications

Typical for 25°C unless otherwise specified.

Specifications in *italic text* are guaranteed by design.

Analog input

Table 1. Analog input specifications

Parameter	Specification	
A/D converter type	AD574	
Resolution	12 bits	
Number of channels	48 single-ended, 24 differential (configurable as 24 modified differential via installation of SIP resistor)	
Input type	Voltage input or current input, configurable by jumper and installation of SIP resistors for current configuration	
Input ranges	±10 V, ±5 V, ±2.5 V, ±1.25 V, ±0.625 V, 0 to 10 V, 0 to 5 V, 0 to 2.5 V, 0 to 1.25 V, software selectable	
Polarity	Unipolar/Bipolar, software selectable	
A/D pacing	Software polled	
Data transfer	Software polled	
A/D conversion time	25µs	
Throughput	20 kS/s, PC dependent	
Accuracy	±0.01% of reading ±1 LSB	
Differential linearity error	±1 LSB	
Integral linearity error	±0.5 LSB	
No missing codes guaranteed	12 bits	
Gain drift (A/D specs)	±25 ppm/°C	
Zero drift (A/D specs)	±10 µV/°C	
Common mode range	±10 V	
CMRR	72 dB	
Input leakage current (@ 25 °C)	100 nA	
Input impedance	10 Meg Ohms min	
Absolute maximum input voltage	±35V	
Noise distribution (Rate = 1-10 kHz, Average % +/- 2 bins, Average % +/- 1 bin, Average # bins)		
Bipolar	10V	100% / 100% / 3 bins
	5V	100% / 98.8% / 4 bins
	2.5V	100% / 96.8% / 4 bins
	1.25V	100% / 98.2% / 5 bins
	0.625V	100% / 99% / 5 bins
Unipolar	10V	100% / 98.6% / 4 bins
	5V	100% / 98.8% / 4 bins
	2.5V	100% / 97.4% / 4 bins
	1.25V	100% / 98.2% / 4 bins

Power consumption

Table 2. Power consumption specifications

+5 V	620 mA typical, 800 mA max

Environmental

Table 3. Environmental specifications

Operating temperature range	0 to 50 °C
Storage temperature range	-20 to 70 °C
Humidity	0 to 90% non-condensing

Main connector and pin out

Table 4. Main connector specifications

Connector type	50-pin D type connector
Compatible cable	C50FF-x
Compatible accessory products with the C50FF-x cable	CIO-MINI50 CIO-SPADE50

Table 5. Single-ended mode pin out

Pin	Signal name	Pin	Signal name
50	LLGND	49	LLGND
48	CH 47 IN	47	CH 23 IN
46	CH 46 IN	45	CH 22 IN
44	CH 45 IN	43	CH 21 IN
42	CH 44 IN	41	CH 20 IN
40	CH 43 IN	39	CH 19 IN
38	CH 42 IN	37	CH 18 IN
36	CH 41 IN	35	CH 17 IN
34	CH 40 IN	33	CH 16 IN
32	CH 39 IN	31	CH 15 IN
30	CH 38 IN	29	CH 14 IN
28	CH 37 IN	27	CH 13 IN
26	CH 36 IN	25	CH 12 IN
24	CH 35 IN	23	CH 11 IN
22	CH 34 IN	21	CH 10 IN
20	CH 33 IN	19	CH 9 IN
18	CH 32 IN	17	CH 8 IN
16	CH 31 IN	15	CH 7 IN
14	CH 30 IN	13	CH 6 IN
12	CH 29 IN	11	CH 5 IN
10	CH 28 IN	9	CH 4 IN
8	CH 27 IN	7	CH 3 IN
6	CH 26 IN	5	CH 2 IN
4	CH 25 IN	3	CH 1 IN
2	CH 24 IN	1	CH 0 IN

Table 6. Differential mode pin out

Pin	Signal name	Pin	Signal name
50	LLGND	49	LLGND
48	CH 23 IN LO	47	CH 23 IN HI
46	CH 22 IN LO	45	CH 22 IN HI
44	CH 21 IN LO	43	CH 21 IN HI
42	CH 20 IN LO	41	CH 20 IN HI
40	CH 19 IN LO	39	CH 19 IN HI
38	CH 18 IN LO	37	CH 18 IN HI
36	CH 17 IN LO	35	CH 17 IN HI
34	CH 16 IN LO	33	CH 16 IN HI
32	CH 15 IN LO	31	CH 15 IN HI
30	CH 14 IN LO	29	CH 14 IN HI
28	CH 13 IN LO	27	CH 13 IN HI
26	CH 12 IN LO	25	CH 12 IN HI
24	CH 11 IN LO	23	CH 11 IN HI
22	CH 10 IN LO	21	CH 10 IN HI
20	CH 9 IN LO	19	CH 9 IN HI
18	CH 8 IN LO	17	CH 8 IN HI
16	CH 7 IN LO	15	CH 7 IN HI
14	CH 6 IN LO	13	CH 6 IN HI
12	CH 5 IN LO	11	CH 5 IN HI
10	CH 4 IN LO	9	CH 4 IN HI
8	CH 3 IN LO	7	CH 3 IN HI
6	CH 2 IN LO	5	CH 2 IN HI
4	CH 1 IN LO	3	CH 1 IN HI
2	CH 0 IN LO	1	CH 0 IN HI

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