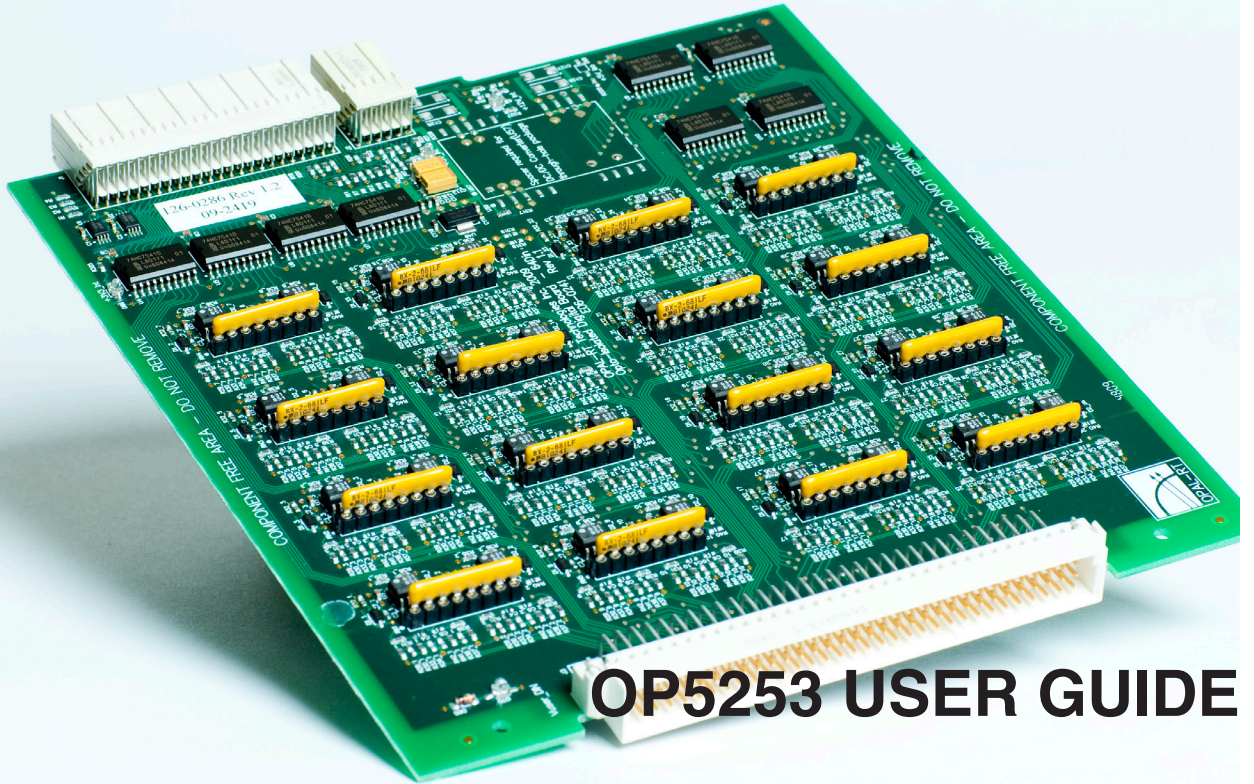




OPAL-RT



# OP5253 USER GUIDE

Optically Isolated  
64 Digital Input Module

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## GETTING STARTED

Before you begin, verify that your system meets the requirements of the OP5253 card:

### SOFTWARE REQUIREMENTS

- RT-LAB 8.4.0 and higher
- MATLAB 32 bits 6.5 and higher
- Windows XP and higher
- RT-XSG 1.3

### HARDWARE REQUIREMENTS

- Opal-RT simulator
- Opal-RT I/O expansion box (only for use with Opal-RT simulators)

### FEATURES

- 64 optically isolated input channels
- All inputs are sampled simultaneously for additional simulation accuracy. They can be sampled up to 5 MHz
- Inputs can be grouped in parallel for any size bus simulation
- User configurable filters, de-bounce time and conditioning inputs
- Choice of sink or source inputs (Factory Options for Common Anode or Common cathode)
- All inputs accept sources from 5V to 30V and limit the current via user interchangeable resistors on sockets grouped in 4 input channels.

### MODULE INSTALLATION

The OP5253 Digital Input Signal Conditioning Module must be inserted into the Opal-RT simulator using great care. Make sure that the card is properly aligned, using the guide tracks, before pressing into place.

## INTRODUCTION

The OP5253 is a part of the OP5000 series of optional, versatile Signal Conditioning Modules for Opal-RT's state of the art HIL (hardware-in-the-loop) systems. Designed for Opal-RT's simulation systems, the OP5253 provides digital input signals with specific voltage conditioning. The optical isolation of the OP5253 inputs make it ideal for environments where voltage isolation is required.

## DESCRIPTION

The OP5253 features 64 optically isolated input channels. All are sampled simultaneously for additional simulation accuracy. It is perfectly suited to interface real life environment signals to TTL or Differential levels for RT-LAB simulator, providing perfect electrical isolation and discharge protection.

## CIRCUIT LAYOUT DIAGRAMS

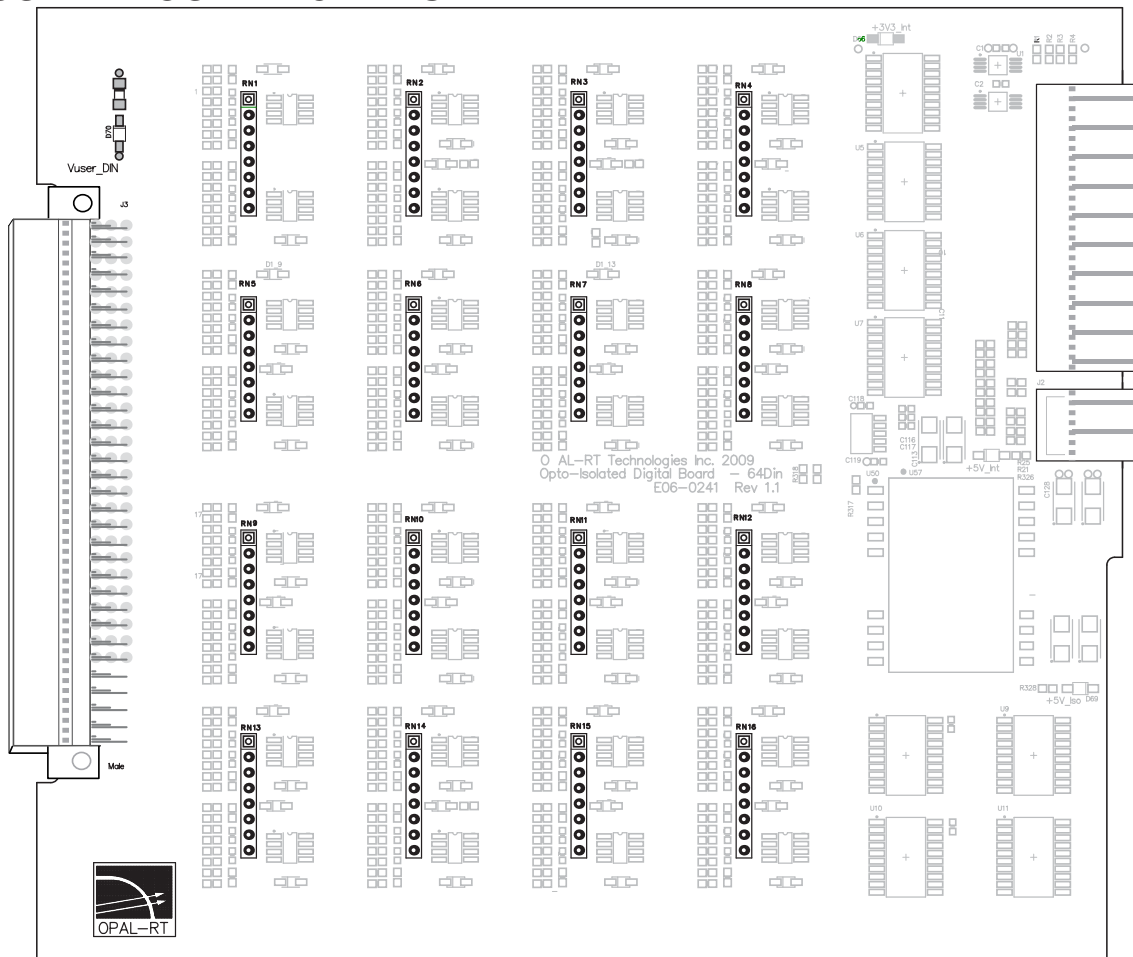


Figure 1: OP5253 Digital Signal Conditioning Module

## INTRODUCTION

### Circuit Layout Diagrams

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## INTERFACES

### Inputs

Each optically isolated output has an open collector transistor. It can sink up to 100 mA continuous, and up to +30V according to user requirements. It is current protected by resettable 150 mA fuse (PTC). The optical isolation circuitry is powered by an internal isolated DC supply.

The optically isolated inputs accept a wide input voltage range, from 5 to 30 Volts, according to user's requirements. They have a low threshold current; typically 6 mA within the 5 to 15 mA range. The inputs are current limited by the interchangeable socket mounted resistor arrays. The resistor value may be changed by the user to enable higher input voltage.

By default, the module comes equipped with the resistor value set to 680 Ohms, which is recommended for 5 to 12 Volts input.

Each input has a reverse voltage protection of up to 30 volts provided by a diode.

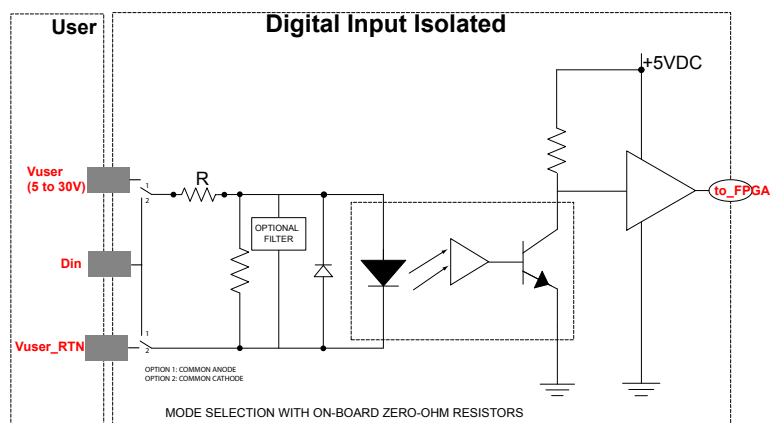


Figure 2: OP5253 Isolated Digital Input Drawing



NOTE: Vuser\_RTN is normally the Vuser\_GND.

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The Signal Conditioning module inputs can be factory ordered to either common anode (default setting) or common cathode.



Figure 3: Common Anode (Push) and Common Cathode (Pull) options

In common anode mode, when the user input Din is LOW, the output of the opto-coupler FPGA is LOW. and, conversely, when the user input Din is HIGH, the output of the opto-coupler to FPGA is HIGH. This maintains the logic of the input.

In Common cathode mode, when the user input Din is HIGH, the output of the opto-coupler is LOW and, conversely, when the user input Din is LOW, the output of the opto-coupler is to FPGA is HIGH. This mode inverts the logic of the input.

The source voltage ( $V_{user}^*$ ) serves as the reference for the positive voltage level (see Voltage Range Selection).

\*  $|V_{user}| - |V_{user\_RTN}| = 30 \text{ V max.}$



Note that if the input is mounted in common cathode mode then the channel becomes a negative logic circuit

## Interconnections

The OP5253 fits directly into the OP5000 series of hardware-in-the-Loop simulators without carriers. Up to four OP5253 modules can be positioned in a Wanda 4U and up to eight in an OPAL-RT Expansion Box.

## POWER CONFIGURATION

The digital input circuit needs a 5 V supply source to power the onboard circuitry. This source is connected to the computer's 5 VDC.

The following resistors are used for the OP5253. The part numbers provided are for reference purposes only. Part numbers may differ according to supplier or country:

	Voltage range (Volts - continuous)	Resistor value ( $\Omega$ ) (R)	Resistor Network Bourns Part Number
Digital Input	4-9	470	4608X-102-471 LF / 4308X-102-471 LF
	5-12	680 (default)	4608X-102-681LF / 4308X-102-681 LF
	6-16	1000	4608X-102-102 LF / 4308X-102-102 LF
	12-30	2200	4608H-102-222 LF / 4308H-102-222 LF
	18-30	3300	4308R-102-332LF-

Table 1: Digital Input Voltage and Resistor Values



**WARNING:** ensure that the proper resistor is installed to obtain desired operating voltage. Failure to do so may result in damage to the OP5253 board or host setup.

### Inputs:

Changing the value of resistor network RN1 to RN6 (on the pcb) will configure the digital input voltage range in groups of 4. Using a SIP-8 isolated resistor network, make sure you match the pin 1 indicator with pin 1 on the module. If preferred, you can add an additional resistor in series with the input circuit to increase the supply voltage.

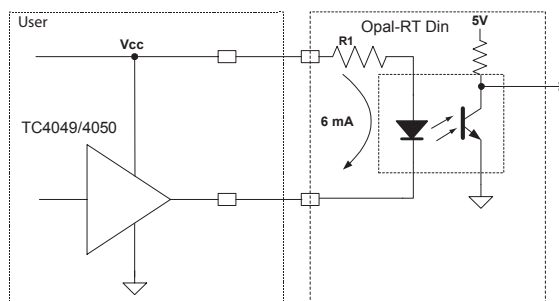
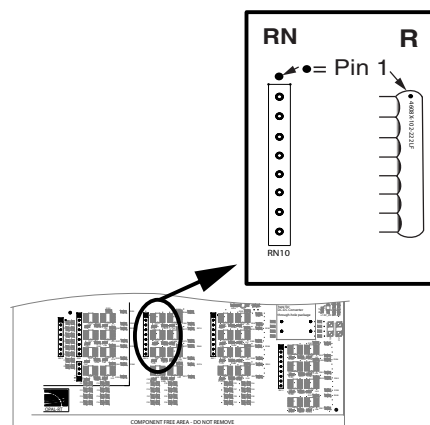


Figure 4: Typical digital input circuit



Each input resistor network contains 4 digital input channels. Refer to the “Resistor Network” table below for the relationship between the resistor network and input channels. To work properly, the Opal-RT digital input optical isolator needs a minimum current of 5 mA and a maximum current of 15 mA. Use the following formula to ensure safe power dissipation:  $V_{user}-1.5 (V)/Resistor (\Omega) = \text{current (A)}$

Resistor network	Channel bank
RN1	Din 00-03
RN2	Din 04-07
RN3	Din 08-11
RN4	Din 12-15
RN5	Din 16-19
RN6	Din 20-23
RN7	Din 24-27
RN8	Din 28-31
RN9	Din 32-35
RN10	Din 36-39
RN11	Din 40-43
RN12	Din 44-47
RN13	Din 48-51
RN14	Din 52-55
RN15	Din 56-59
RN16	Din 60-63

Table 2: Din Resistor Network by Channel Bank

All digital inputs are accessible via a 96 pin, 3 x 32, DIN96 male connector (part number 5650461-5 or 5650462-5).

Pay careful attention to the position diagram and Pin Assignment table to ensure proper and safe function.

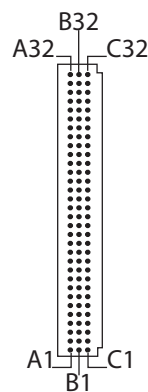


Figure 5: OP5253 DIN96 Pin Assignment (male)

## OP5253 PIN ASSIGNMENTS

Card Male Terminal	Screw terminal 126-0274	Module pin assignment	Card Male Terminal	Screw terminal 126-0274	Module pin assignment
Section A			Section B		
A32	A32	NC	A16	A16	IN 32
B32	B32	NC	B16	B16	IN 33
C32	C32	NC	C16	C16	IN 34
A31	A31	NC	A15	A15	IN 35
B31	B31	NC	B15	B15	IN 36
C31	C31	NC	C15	C15	IN 37
A30	A30	NC	A14	A14	IN 38
B30	B30	NC	B14	B14	IN 39
C30	C30	NC	C14	C14	IN 40
A29	A29	NC	A13	A13	IN 41
B29	B29	NC	B13	B13	IN 42
C29	C29	NC	C13	C13	IN 43
A28	A28	NC	A12	A12	IN 44
B28	B28	NC	B12	B12	IN 45
C28	C28	Vuser-DIN	C12	C12	IN 46
A27	A27	Vuser-DIN	A11	A11	IN 47
B27	B27	IN 00	B11	B11	NC
C27	C27	IN 01	C11	C11	NC
A26	A26	IN 02	A10	A10	NC
B26	B26	IN 03	B10	B10	NC
C26	C26	IN 04	C10	C10	Vuser_RTN
A25	A25	IN 05	A09	A09	Vuser_RTN
B25	B25	IN 06	B09	B09	Vuser_RTN
C25	C25	IN 07	C09	C09	Vuser_RTN
A24	A24	IN 08	A08	A08	Vuser_RTN
B24	B24	IN 09	B08	B08	Vuser_RTN
C24	C24	IN 10	C08	C08	Vuser_RTN
A23	A23	IN 11	A07	A07	Vuser_RTN
B23	B23	IN 12	B07	B07	Vuser_RTN
C23	C23	IN 13	C07	C07	Vuser_RTN
A22	A22	IN 14	A06	A06	NC
B22	B22	IN 15	B06	B06	NC
C22	C22	IN 16	C06	C06	IN 48
A21	A21	IN 17	A05	A05	IN 49
B21	B21	IN 18	B05	B05	IN 50
C21	C21	IN 19	C05	C05	IN 51
A20	A20	IN 20	A04	A04	IN 52
B20	B20	IN 21	B04	B04	IN 53
C20	C20	IN 22	C04	C04	IN 54
A19	A19	IN 23	A03	A03	IN 55
B19	B19	IN 24	B03	B03	IN 56
C19	C19	IN 25	C03	C03	IN 57
A18	A18	IN 26	A02	A02	IN 58
B18	B18	IN 27	B02	B02	IN 59
C18	C18	IN 28	C02	C02	IN 60
A17	A17	IN 29	A01	A01	IN 61
B17	B17	IN 30	B01	B01	IN 62
C17	C17	IN 31	C01	C01	IN 63

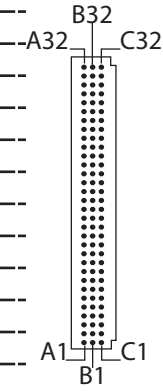


Table 3: Pin Assignments

Pin Assignments for 126-0292 64 D I/O DIN96 4 x 50 adapter

		OP5253	126-0292 (64 DI/O DIN96 4x50)	
I/O Type	Module pin assignment	Din 96 IO	Connector	Pin #
Din	IN00	B27	P1	1
Din	IN01	C27	P1	3
Din	IN02	A26	P1	5
Din	IN03	B26	P1	7
Din	IN04	C26	P1	9
Din	IN05	A25	P1	11
Din	IN06	B25	P1	13
Din	IN07	C25	P1	15
Din	IN08	A24	P1	17
Din	IN09	B24	P1	19
Din	IN10	C24	P1	21
Din	IN11	A23	P1	23
Din	IN12	B23	P1	25
Din	IN13	C23	P1	27
Din	IN14	A22	P1	29
Din	IN15	B22	P1	31
Din	IN16	C22	P2	1
Din	IN17	A21	P2	3
Din	IN18	B21	P2	5
Din	IN19	C21	P2	7
Din	IN20	A20	P2	9
Din	IN21	B20	P2	11
Din	IN22	C20	P2	13
Din	IN23	A19	P2	15
Din	IN24	B19	P2	17
Din	IN25	C19	P2	19
Din	IN26	A18	P2	21
Din	IN27	B18	P2	23
Din	IN28	C18	P2	25
Din	IN29	A17	P2	27
Din	IN30	B17	P2	29
Din	IN31	C17	P2	31
Digital Power	Vuser_DIN	C10	P1-P2	41
Digital Power	Vuser_DIN	A09	P1-P2	42
Digital Power	Vuser_RTN	B09	P1-P2	43
Digital Power	Vuser_RTN	C09	P1-P2	44
Digital Power	Vuser_RTN	A08	P1-P2	47
Digital Power	Vuser_RTN	B08	P1-P2	48
Digital Power	Vuser_RTN	C08	P1-P2	49
Digital Power	Vuser_RTN	A07	P1-P2	50
Din	IN32	A16	P3	1
Din	IN33	B16	P3	3
Din	IN34	C16	P3	5
Din	IN35	A15	P3	7
Din	IN36	B15	P3	9
Din	IN37	C15	P3	11
Din	IN38	A14	P3	13
Din	IN39	B14	P3	15
Din	IN40	C14	P3	17
Din	IN41	A13	P3	19
Din	IN42	B13	P3	21
Din	IN43	C13	P3	23

**Power Configuration**  
 OP5253 Pin Assignments

		OP5253	126-0292 (64 DI/O DIN96 4x50)	
I/O Type	Module pin assignment	Din 96 IO	Connector	Pin #
Din	IN44	A12	P3	25
Din	IN45	B12	P3	27
Din	IN46	C12	P3	29
Din	IN47	A11	P3	31
Din	IN48	C06	P4	1
Din	IN49	A05	P4	3
Din	IN50	B05	P4	5
Din	IN51	C05	P4	7
Din	IN52	A04	P4	9
Din	IN53	B04	P4	11
Din	IN54	C04	P4	13
Din	IN55	A03	P4	15
Din	IN56	B03	P4	17
Din	IN57	C03	P4	19
Din	IN58	A02	P4	21
Din	IN59	B02	P4	23
Din	IN60	C02	P4	25
Din	IN61	A01	P4	27
Din	IN62	B01	P4	29
Din	IN63	C01	P4	31

Table 4: Pin assignments for 126-0292

## SPECIFICATIONS

INPUT SECTION	
Product name	OP5253
Part number	126-0286
Number of inputs	64
Isolation	Optical isolator
Connection mode	Common anode or Common cathode (factory configured, on request)
Input current	Minimum: 5 mA Maximum: 15 mA
Input current resistor network	Socket mounted
Detection threshold	Separate Schmitt Trigger
Voltage range	5 to 30 Vdc
Delay Low-to-High	110 ns
Delay High-to-Low	60 ns
Rise/Fall times	6 ns/6 ns

## ACCESSORIES

The following accessories are available for use with the OP5253:

- 126-0274: Female 96DIN screw terminal
- 126-0292: 64 D I/O DIN96 4 x 50 adapter
- 113-0374L (optional) 2 x 50-pins IDC50, round shielded cable, 25 pair

### 126-0274: Female 96DIN screw terminal

Connecting directly into the OP5253, the 96DIN screw terminals allow quick and precise customized connections to specific pins (listed in “Table 3: Pin Assignments”)

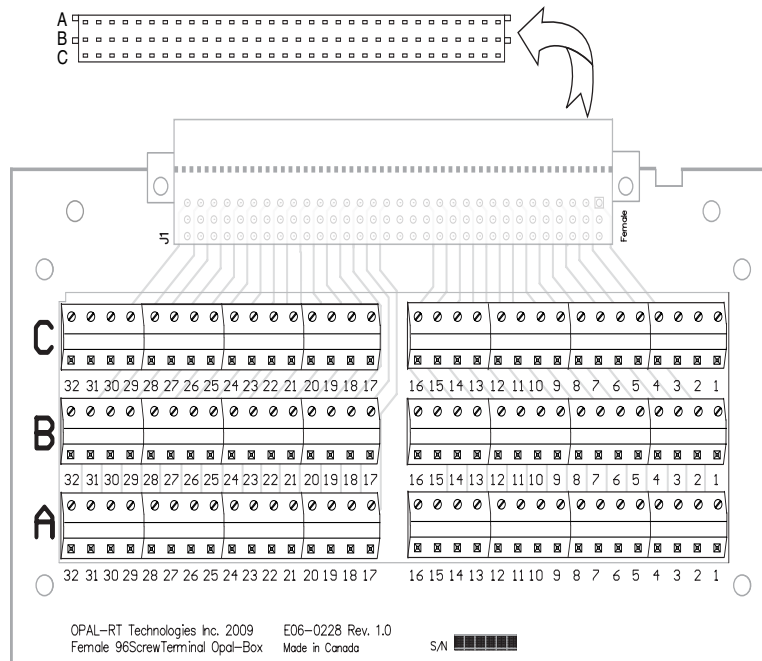


Figure 6: Female DIN96 screw terminal

### 126-0292: 64 D I/O DIN96 4 x 50 adapter

This adapter is used to connect flat cable and allows for quick connections to digital Input/Output boards (patch panel) using four 50-pin (2x25) connectors. (See Table 4 for pin assignments.)

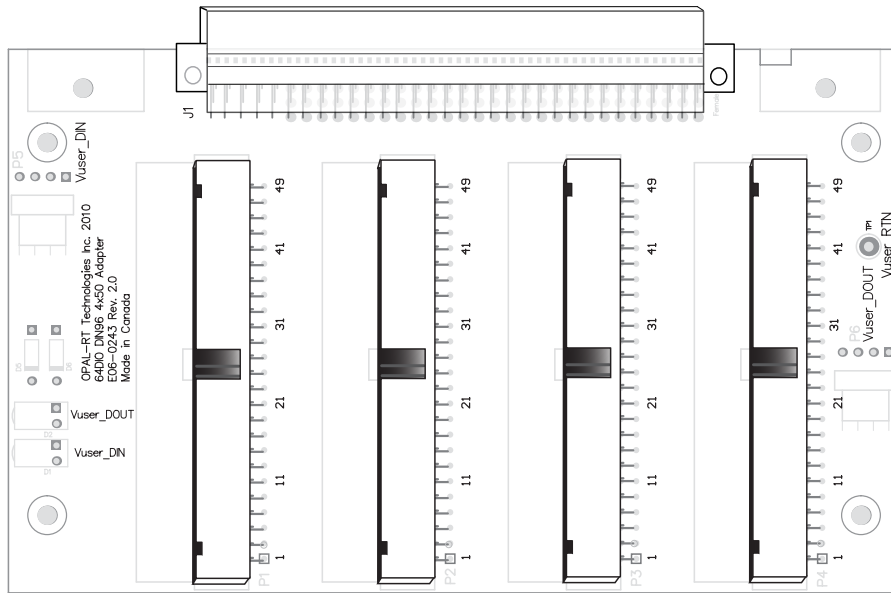


Figure 7: 64 D I/O DIN96 adapter

### 113-0374L (optional) 2 x 50-pins IDC50

Round shielded cable, 25 twisted pair (for use with part number 126-0292, 64 D I/O DIN96 4 x 50 adapter)

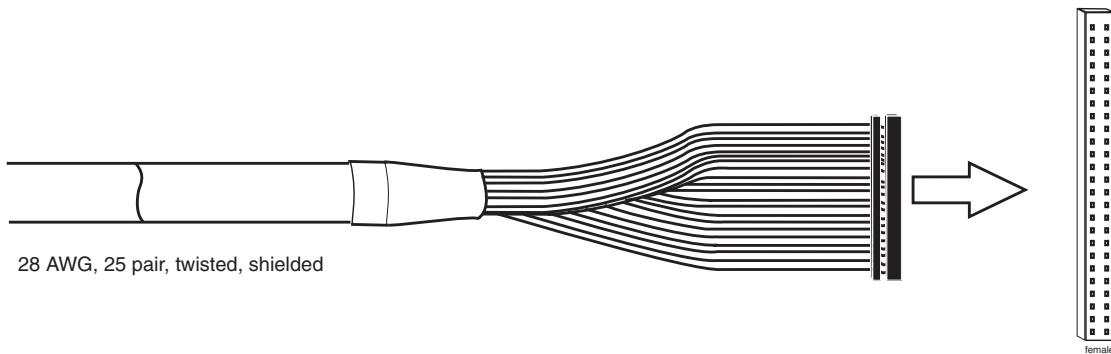


Figure 8: 2 x 50 pin connector cable

## TYPICAL APPLICATIONS

The diagrams below illustrate typical application examples.

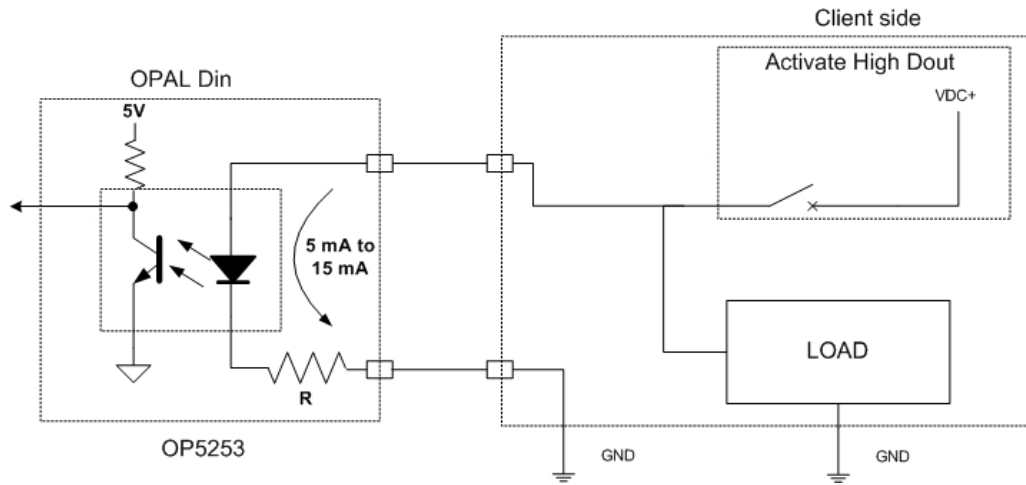


Figure 9: Typical high side acquisition (client high Dout)

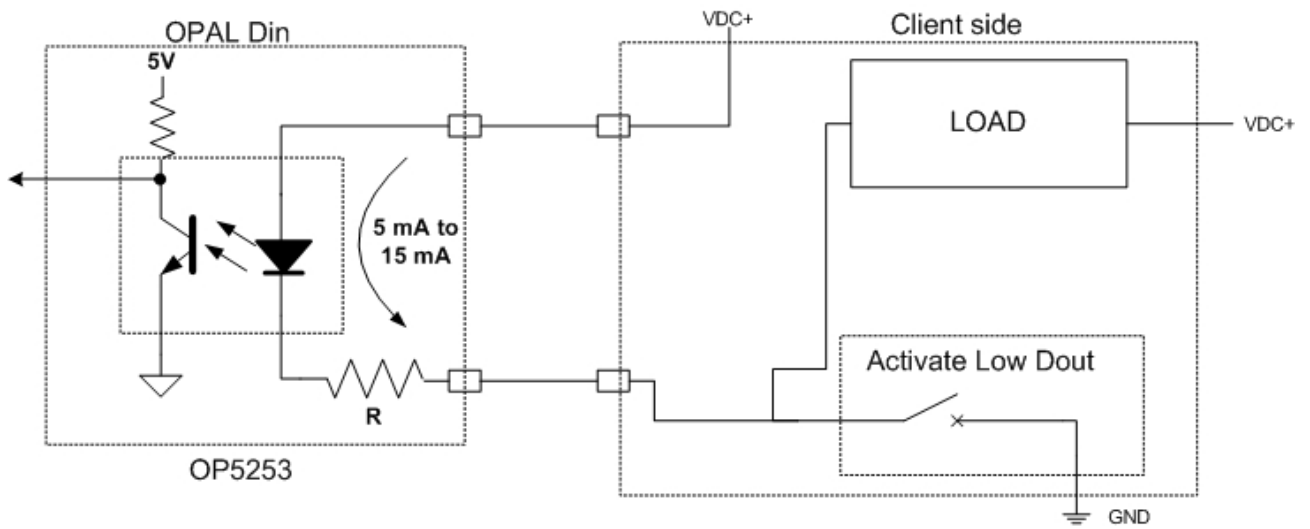


Figure 10: Typical low side acquisition (client low Dout)

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