Agilent U2100A Series Digital IO, 32-Terminal

User's Guide

Agilent Technologies

Notices

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Safety Summary

The following general safety precautions must be observed during all phases of operation of this instrument. Failure to comply with these precautions or with specific warnings elsewhere in this manual violates safety standards of design, manufacture, and intended use of the instrument. Agilent Technologies, Inc. assumes no liability for the customer's failure to comply with these requirements.

Safety Notices

WARNING

A WARNING notice denotes a hazard. It calls attention to an operating procedure, practice, or the like that, if not correctly performed or adhered to, could result in personal injury or loss of life. Do not proceed beyond a WARNING notice until the indicated conditions are fully understood and met.

CAUTION

A CAUTION notice denotes a hazard. It calls attention to an operating procedure, practice, or the like that, if not correctly performed or adhered to, could result in damage to the product or loss of important data. Do not proceed beyond a CAUTION notice until the indicated conditions are fully understood and met.

Safety Symbols

The following symbol on the instrument and in the documentation indicates precautions that must be taken to maintain safe operation of the instrument.

	The Instruction Documentation Symbol. The product is marked with this symbol when it is necessary for the user to refer to the instructions in the supplied documentation.

Regulatory Markings

CE ISM 1-A	The CE mark shows that the product complies with all the relevant European Legal Directives.
ICES/NMB-001	ICES/NMB-001 indicates that this ISM device complies with Canadian ICES-001.
	The CSA mark is a registered trademark of the Canadian Standards Association. A CSA mark with the indicators "C" and "US" means that the product is certified for both the U.S. and Canadian markets, to the applicable American and Canadian standards.
	The UL Mark is a registered trademark of Underwriters Laboratories Inc. UL listing mark with the indicators "C" and "US" indicates the product compliance with both Canadian and U.S. requirements.
 N10149	The C-tick mark is a registered trademark of the Spectrum Management Agency of Australia. This signifies compliance with the Australian EMC Framework regulations under the terms of the Radio Communications Act of 1992.

General Safety Information

WARNING

- **Do not load the output terminals above the specified current limits.**
- **Do not use the device if it appears damaged or defective.**
- **Observe all markings on the device before connecting any wiring to the device.**
- **Turn off the device and application system power before connecting any wiring to the IO terminals.**
- **Do no operate the device in the presence of flammable gases or fumes.**
- **Do no install substitute parts or perform any unauthorized modification to the device.**
- **Do not operate the device with the removable cover detached or loosened.**
- **Before removing the device cover, always disconnect the power cable and any external circuit.**

CAUTION

- Applying excessive voltage or overloading the device will cause irreversible damage to the circuitry.
- Use the device with the cables provided.
- Always connect to a USB device that will limit the output current to the maximum rated current of this equipment.

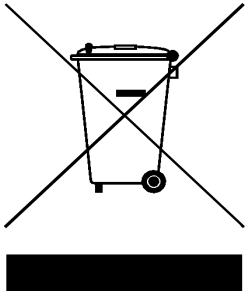
Waste Electrical and Electronic Equipment (WEEE) Directive 2002/96/EC

This instrument complies with the WEEE Directive (2002/96/EC) marking requirement. This affixed product label indicates that you must not discard this electrical/electronic product in domestic hourshold waste.

Product Category:

With reference to the equipment types in the WEEE directive Annex 1, this instrument is classified as a “Monitoring and Control Instrument” product.

The affixed product label is shown as below:



Do not dispose in domestic household waste

To return this unwanted instrument, contact your nearest Agilent office, or visit:

www.agilent.com/environment/product

for more information.

Environmental Conditions

This instrument is designed for indoor use only. Table 1 shows the general environmental requirements for the product.

Table 1 Environmental Requirements

Environmental Conditions	Requirements
Maximum Altitude	3000 meter
Temperature	0 °C to 55 °C (Operating)
	–40 °C to +70 °C (Non-operating)
Humidity	Operating <+90 % RH at 40 °C (Non-condensing)
	Non-operating 90 % RH at 65 °C

CAUTION

This product is designed for use according to Pollution Degree 2 and safety-certified in compliance with:

- IEC 61010-1:2001/EN 61010-1:2001
- USA: UL61010-1: 2004
- Canada: CSA C22.2 No. 61010-1:2004

Agilent Technologies	**DECLARATION OF CONFORMITY** According to ISO/IEC Guide 22 and CEN/CENELEC EN 45014	CE

Manufacturer's Name: Agilent Technologies Microwave Products (M) Sdn. Bhd
Manufacturer's Address: Bayan Lepas Free Industrial Zone,
11900, Bayan Lepas, Penang, Malaysia

Declares under sole responsibility that the product as originally delivered

Product Name: Agilent U2100A Series Digital IO (DAQ)
Models Number: U2121A, U2122A, U2123A
Product Options: This declaration covers all options of the above product(s)

complies with the essential requirements of the following applicable European Directives, and carries the CE marking accordingly:

Low Voltage Directive (73/23/EEC, amended by 93/68/EEC)
EMC Directive (89/336/EEC, amended by 93/68/EEC)

and conforms with the following product standards:

EMC	**Standard**	**Limit**
	IEC 61326-1:1997+A1:1998 / EN 61326-1:1997+A1:1998	
	CISPR 11:1990 / EN55011:1991	Class A Group 1
	IEC 61000-4-2:1995+A1:1998 / EN 61000-4-2:1995	4 kV CD, 8 kV AD
	IEC 61000-4-3:1995 / EN 61000-4-3:1995	3 V/m, 80-1000 MHz
	IEC 61000-4-4:1995 / EN 61000-4-4:1995	0.5 kV signal lines, 1 kV power lines
	IEC 61000-4-5:1995 / EN 61000-4-5:1995	0.5 kV line-line, 1 kV line-ground
	IEC 61000-4-6:1996 / EN 61000-4-6:1996	3 V, 0.15-80 MHz
	IEC 61000-4-11:1994 / EN 61000-4-11:1994	1 cycle / 100%

Canada: ICES-001:1998
Australia/New Zealand: AS/NZS 2064.1

The product was tested in a typical configuration with Agilent Technologies test systems.

Safety IEC 61010-1:2001 / EN 61010-1:2001
Canada: CSA C22.2 No. 61010-1:2004
USA: UL 61010-1: 2004

This DoC applies to above-listed products placed on the EU market after:

16-Feb-2006
Date

Mack Soh
Quality Manager

For further information, please contact your local Agilent Technologies sales office, agent or distributor, or Agilent Technologies Deutschland GmbH, Herrenberger Straße 130, D 71034 Böblingen, Germany.

Product Regulations

		Performance Criteria
EMC		
	IEC 61326-1:1997+A1:1998 / EN 61326-1:1997+A1:1998	
	CISPR 11:1990 / EN 55011:1991 – Group 1 Class A	
	IEC 61000-4-2:1995+A1:1998 / EN 61000-4-2:1995 (ESD 4kV CD, 8kV AD)	B
	IEC 61000-4-3:1995 / EN 61000-4-3:1995 (3V/m, 80% AM)	A
	IEC 61000-4-4:1995 / EN 61000-4-4:1995 (EFT 0.5kV line-line, 1kV line-earth)	B
	IEC 61000-4-5:1995 / EN 61000-4-5:1995 (Surge 0.5kV line-line, 1kV line-earth)	B
	IEC 61000-4-6:1996 / EN 61000-4-6:1996 (3V, 0.15~80 MHz, 80% AM, power line)	A
	IEC 61000-4-11:1994 / EN 61000-4-11:1994 (Dips 1 cycle, 100%)	B
	Canada: ICES-001:1998	
	Australia/New Zealand: AS/NZS 2064.1	
Safety	IEC 61010-1:2001 / EN 61010-1:2001	
	Canada: CSA C22.2 No. 61010-1:2004	
	USA: UL 61010-1: 2004	

Additional Information:
The product herewith complies with the essential requirements of the Low Voltage Directive 73/23/EEC and the EMC Directive 89/336/EEC (including 93/68/EEC) and carries the CE Marking accordingly (European Union).

[1]Performance Criteria:
A Pass - Normal operation, no effect.
B Pass - Temporary degradation, self recoverable.
C Pass - Temporary degradation, operator intervention required.
D Fail - Not recoverable, component damage.
N/A – Not applicable

Models Description:
U2121A – 16-Terminal Digital Input and 16-Terminal Digital Output
U2122A – 32-Terminal Digital Input
U2123A – 32-Terminal Digital Output

Notes:

Regulatory Information for Canada
ICES/NMB-001:1998
This ISM device complies with Canadian ICES-001.
Cet appareil ISM est confomre à la norme NMB-001 du Canada.

Regulatory Information for Australia/New Zealand
This ISM device complies with Australian/New Zealand AS/NZS 2064.1
N10149

In This Guide ...

1 **Getting Started** Chapter 1 introduces the new Agilent U2100A Series Data Acquisition (DAQ) and provides overviews of the product, its dimensions, and accessories.

2 **Features and Functions** Chapter 2 contains details of the product features, applications, and specifications. You will also find information on the U2100A Series DAQ's functionality. From this chapter, you can understand how to program and configure the device via SCPI (Standard Commands for Programmable Instruments) commands.

3 **Installing U2100A Series DAQ** Chapter 3 includes steps and descriptions on how to install the U2100A Series DAQ, Agilent U2121 IVI Driver and Agilent DIO Diagnostics Application software.

4 **Pin Connections** Chapter 4 focuses on detailed connector layout and pin assignment description of all the U2100A Series DAQ. There is also information on input and output terminal equivalent circuits with some application examples.

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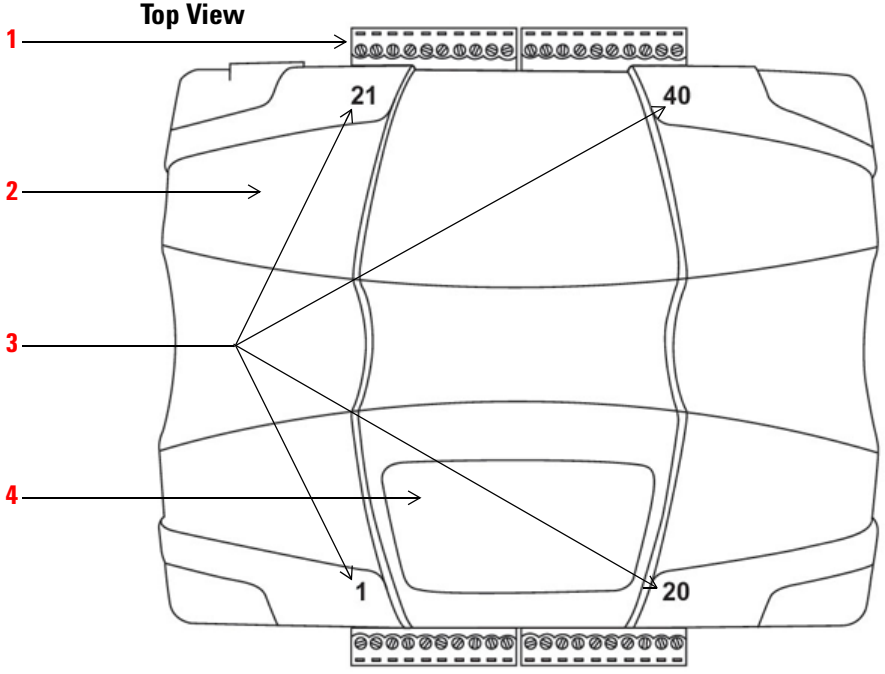
1 Getting Started

This chapter introduces the new Agilent U2100A Series Data Acquisition (DAQ) and provides overviews of the product, its dimensions, and accessories.

Introduction to the Agilent U2100A

Agilent U2100A Series Data Acquisition (DAQ) is a portable USB Digital IO that is affordable and delivers reliable data acquisition solution for digital signals. It is ideal for a broad variety of applications in both industrial and scientific environments. The U2100A Series DAQ comes with USB plug- and- play connectivity. Hence, it is easy to use and compatible with any system that provides USB connectivity. It is robust, cost- effective, high speed, user friendly and easy to implement for any test and measurement application.

Product at a Glance



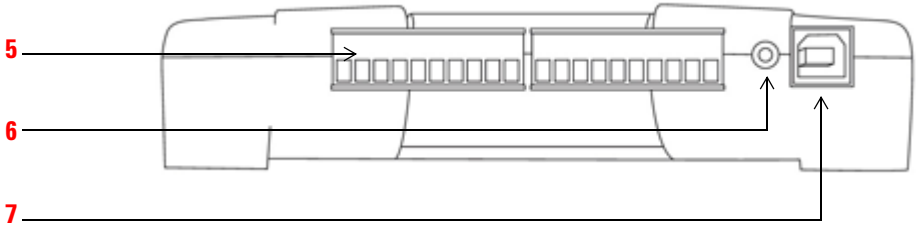
1 Terminal Block

2 Plastic Casing

3 Pin Number

4 Name Plate

Front View

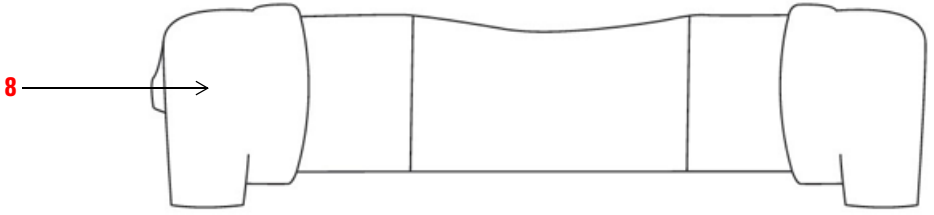


5 Terminal Block

6 USB Power Indicator

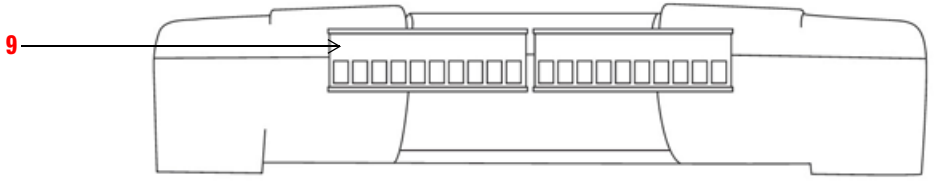
7 USB Interface Connector

Side View



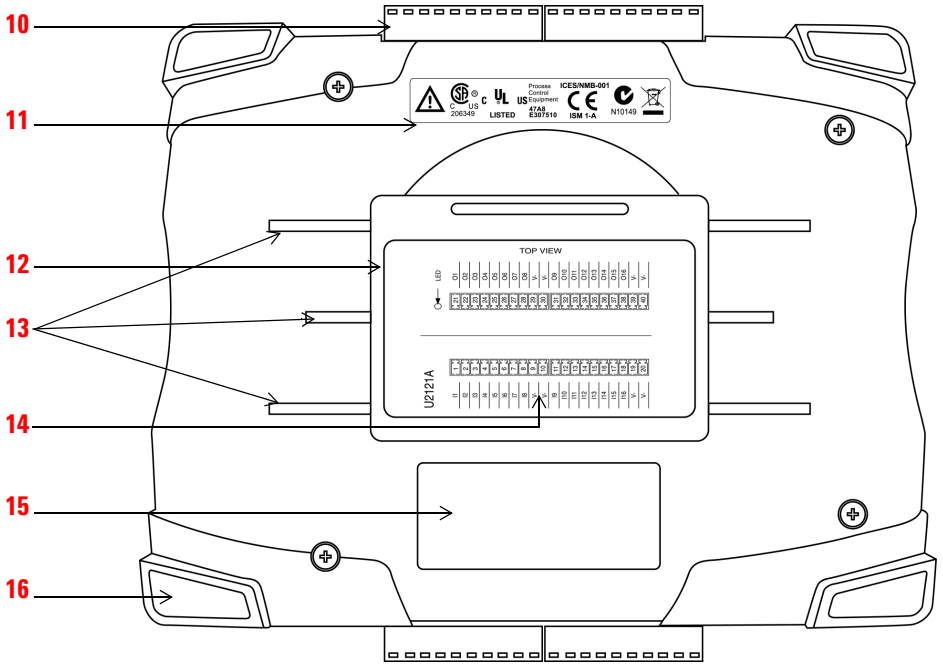
8 Plastic Casing

Back View



9 Terminal Block

Bottom View



10 Terminal Block

11 Markings

12 Removable Cover **WARNING**

13 DIN Rail Clamp Slot

14 Pin Assignment Diagram

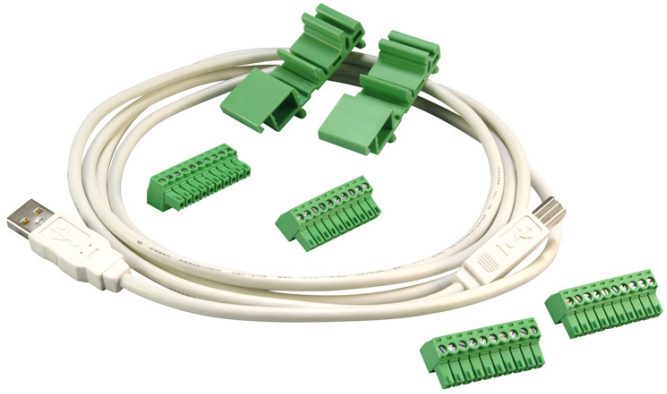
15 Model & Serial Number Label

16 Grommet

WARNING

- **Do not operate the device with the removable cover detached or loosened.**
- **Before removing the device cover, always disconnect the power cable and any external circuit.**

Accessories



- ✔ USB Interface Cable
- ✔ Terminal Block
- ✔ DIN Rail Clamp
- ✔ Quick Start Guide
- ✔ Product Reference CD- ROM
- ✔ Agilent Automation- Ready CD (contains the Agilent IO Libraries Suite)

Dimensions

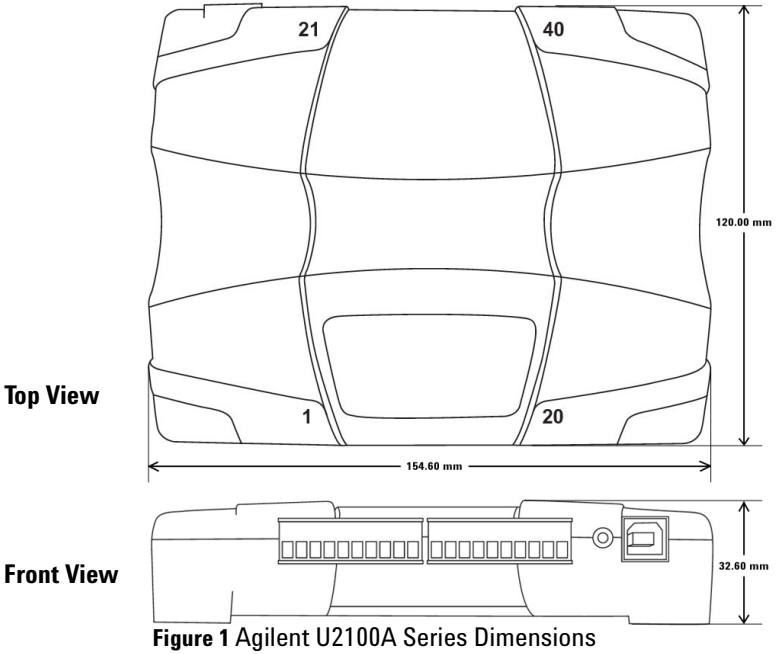


Figure 1 Agilent U2100A Series Dimensions

Product Overview

2
Features and Functions

This chapter contains details of the product features, applications, and specifications. You will also find information on the U2100A Series DAQ's functionality. From this chapter, you can understand how to program and configure the device via SCPI (Standard Commands for Programmable Instruments) commands.

NOTE For complete details on the SCPI commands, see the *Agilent U2100A Series Digital IO, 32-Terminal Programming Guide* included in the *Agilent USB Digital IO, 32-Terminal U2100A Series Product Reference CD-ROM*.

Features

There are three models featured in the Agilent U2100A Series DAQ:

- **U2121A** 16- Terminal Digital Input and 16- Terminal Digital Output
- **U2122A** 32- Terminal Digital Input
- **U2123A** 32- Terminal Digital Output

The U2100A Series DAQ provides the following features:

- ✔ Up to 32 input terminals and 32 output terminals
- ✔ Supports input voltage ranging from 0 V – 24 V
- ✔ 5 V – 24 V external supply for external load
- ✔ USB Full Speed (12 Mbps)
- ✔ USBTMC USB488 1.0 Standards compliant
- ✔ SCPI compatible
- ✔ IVI- C and IVI- COM Drivers for WinXP and Win2K
- ✔ IVI- C and IVI- COM compatibility with National Instruments LabVIEW
- ✔ Terminal block connection for ease of wiring
- ✔ Optional DIN rail clamp for ease of mounting
- ✔ Opto- isolated IO channels
- ✔ Controlled in Bit, Byte, Word and Long Word
- ✔ Dry contact input channels
- ✔ Fuse protected output channels (shared by 8 terminals)
- ✔ High load current

Applications

The U2100A Series DAQ is designed for robust and demanding industrial applications. This product is suitable for a wide range of applications inclusive of:

- ✔ Driving relays, actuator, valve and so forth
- ✔ Interface to industrial sensors, limit switches and transducers
- ✔ Industrial control and automation
- ✔ Isolated data communication
- ✔ Logic level interface
- ✔ Laboratory automation

Product Specifications

Table 2 Electrical Specifications

	Agilent U2121A	Agilent U2122A	Agilent U2123A
Digital IO lines	16 I, 16 O	32 I	32 O
INPUT CHARACTERISTICS			
Input voltage	0 V to 24 V	0 V to 24 V	-
Input logic low voltage	< 1.3 V	< 1.3 V	-
Input logic low current source	3 mA max	3 mA max	-
Input logic high voltage	> 3.5 V	> 3.5 V	-
Maximum rating			
Input voltage	26 V max	26 V max	-
Input propagation delay	100 µs (Opto-isolator)	100 µs (Opto-isolator)	-
OUTPUT CHARACTERISTICS			
Output load voltage	24 V max	-	24 V max
Output low voltage	1.2 V max	-	1.2 V max
Max output sink current per terminal with only one terminal "on"	400 mA max	-	400 mA max
Max output sink current per terminal for all terminals "on" in a channel	100 mA per terminal	-	100 mA per terminal
Max output sink current per channel (8 terminals per channel)	800 mA (max 1600 mA for 2 channels)	-	800 mA (max 3200 mA for 4 channels)
Maximum rating			
Max voltage	26 V max	-	26 V max
Fuse protected	1.5 A per channel (nominal)	-	1.5 A per channel (nominal)
Output propagation delay	100 µs (Opto-isolator)	-	100 µs (Opto-isolator)
OTHER FEATURES			
Device type	Software timed	Software timed	Software timed
Additional features	• Programmable power-up states • Watchdog timer • Edge detection • Digital filter	- - • Edge detection • Digital filter	• Programmable power-up states • Watchdog timer - -

	Agilent U2121A	Agilent U2122A	Agilent U2123A
USB POWER REQUIREMENTS			
USB	USB FS	USB FS	USB FS
USB voltage	5 V (4.75 to 5.25 V)	5 V (4.75 to 5.25 V)	5 V (4.75 to 5.25 V)
USB current consumption	100 mA min, 500 mA max, 120 mA nominal	100 mA min, 500 mA max, 120 mA nominal	100 mA min, 500 mA max, 120 mA nominal
USB suspend	200 µA min, 2.5 mA max, 250 µA nominal	200 µA min, 2.5 mA max, 250 µA nominal	200 µA min, 2.5 mA max, 250 µA nominal

General Specifications

Table 3 General Specifications

OPERATING ENVIRONMENT
- Full accuracy at 0 °C to 55 °C
- Full accuracy up to 90 % RH at 40 °C (Non-condensing)
- Altitude up to 3000 m

STORAGE COMPLIANCE
- –40 °C to 70 °C

SAFETY COMPLIANCE

Certified by: IEC 61010-1:2001 / EN 61010-1:2001 (2nd Edition), USA: UL61010-1: 2004, Canada: CSA C22.2 No.61010-1:2004

ENVIRONMENTAL CONTROL
- Pollution Degree 2

EMC COMPLIANCE
- Certified to IEC/EN 61326: 1998 / CISPR 11, Group 1, Class A

SHOCK & VIBRATION
- Tested to IEC / EN 60086-2

PHYSICAL CHARACTERISTICS
- ***I/O connectors:*** USB series B receptacle, 10 position terminal block (4 pieces)
- ***Terminal block I/O wiring:*** AWG 18 to 26 conductor wires with insulation stripped from the end by 7 mm. Use suitable ferrule for multistranded wires (do not solder).
- ***Terminal block screw torque:*** 2 kg-cm

DIMENSION (HxWxD)
- 154.60 mm x 120.00 mm x 32.60 mm

WEIGHT 270 g / 0.595 lbs

WARRANTY 3 years

Digital IO Functionality

Digital Input/Output

The input terminal of the device is active low sourcing type input port. The input terminal will be read as 0 when the terminal is connected to a voltage level lower or equivalent to Vil. Alternately, input terminal will be read as 1 when the terminal is connected to voltage level greater or equivalent to Vih or left open.

The output terminal of the device is an active low sinking output type also known as an open drain driver. When 1 is written to the particular bit, the driver will be activated and current will be sank into the driver to pull the bit low. When 0 is written to the bit, the driver will be deactivated and left floating as open drain connection.

Configuring IO Features

The Agilent U2100A Series DAQ product family comes with additional versatile features such as:

- ✔ Watchdog Timer
- ✔ Digital Filtering
- ✔ Edge Detection
- ✔ Programmable Power- Up States

U2121A/U2123A Watchdog Timer

The watchdog timer is incorporated into U2121A/U2123A as a fail- safe feature. In case of software or operating system crash, or the USB communication link is lost, the watchdog function will allow user to set critical output lines to a known state.

Before enabling a watchdog timer, user will have to program the desired watchdog timeout period to the watchdog timer register. At the same time, watchdog data must be configured to the logic state that the user would like the output lines to be updated when watchdog timer overflow.

After the watchdog timer is enabled, the user will have to reset the watchdog timer periodically within the pre- programmed timeout period. This is to make sure that the watchdog data will not be written to the output lines.

The watchdog timer is clocked by a 12 MHz clock generator. The watchdog timer value program to the watchdog timer register will be decreased at every 83.333 ns interval. If the watchdog timer is decreased to 0 before it receives any watchdog reset command, all the output lines will be updated with the data in watchdog data register. On top of that, the Watchdog Interrupt Flag bit (Bit 0) of the Status Byte will be set to '1' when the watchdog timer expires.

Before the watchdog timer is able to function, the user has to turn on the Watchdog Enable bit (Bit 0) located in the master Enable register by writing value '1' to that particular bit.

NOTE The user can enable the watchdog timer service request upon watchdog timeout to the host. This is done by setting '1' to Watchdog Interrupt Enable bit (Bit 1) of the Service Request Enable register. When the watchdog timer overflows, the Watchdog Interrupt Flag bit will be set to '1' and a service request will be issued by the device to the PC Host.

See formula below on how to calculate the watchdog timer register value based on the required watchdog interval:

$$\text{Watchdog Timer} = 2^{32} - (\text{Watchdog Interval}^{*} \times 12\ \text{MHz})$$

* ***Watchdog Interval*** - Watchdog timeout interval

NOTE The minimum value for Watchdog Timer is 1 and maximum value is 4294967295.

You can specify the amount of time that must elapse before the watchdog timer expires by setting the watchdog timeout period. The counter on the watchdog timer is configurable up to $(2^{32} - 1) \times 1/12$ MHz (approximately six minutes) before it expires.

Example:

The following command segment configures the watchdog data to be 123 for channel 1 and 2. In other words, data value of 123 will be updated to the output channel 1 and 2 upon watchdog overflow if watchdog timer is turned ON. Watchdog timer value is then programmed to be 1s. The host must keep sending `CONFigure:DIGital:WDOG:RESet` in order to reset the watchdog counter so that the watchdog data will not be written to the output channels. If the host does not send any `CONFigure:DIGital:WDOG:RESet` command for longer or equal 1s, data value of 123 will be written to the output channel 1 and 2.

Watchdog Timer $= 2^{32} - (\text{Watchdog Interval} \times 12\ \text{MHz})$

$= 2^{32} - (1\text{s} \times 12\ \text{MHz})$

$= 4294967296 - 12000000$

$= 4282967296$

```
CONF:DIG:WDD:BYTE 123,(@0001,0002)
CONF:DIG:WDOG:LWOR 4282967296, (@0001)
CONF:DIG:ENAB:BIT 1, 0, (@0001)
```

U2121A/U2122A Digital Filtering

U2121A/U2122A input lines has a versatile digital filtering functionality. This allows the user to filter out undesired glitches or unwanted pulses entering the input lines.

NOTE All the input lines share the same filter timing interval.

Digital filtering can be configured to filter out pulses that are shorter than the pre- programmed timing interval. Pulses that are longer than double of the specified timing interval will be allowed to pass through and be read by the device.

NOTE Pulses that are longer than the interval and shorter than double the interval will either be filtered or passed through.

All the digital signals that are interfaced to the input lines of the device will go through optocouplers for isolation purpose. In general, optocouplers will turn on faster than they turn off. This results to the fact that input signal falling edge will be detected earlier as compared to rising edge signal. The variation is typically recorded as 100 µs or less.

The user will have to write the relevant timer value to the Filter Timer register before enabling the digital filter function.

See Table 4 and 5 below for the Filter timer register value based on the $t_{interval}$ of the pulse width that you intend to block or allow to pass through the filter.

Table 4 Pulse Width Blocked

High Pulse	$t_{interval}$ – 100 µs	Filter Timer
Low Pulse	$t_{interval}$ + 100 µs	Register Value

Table 5 Pulse Width Passed

High Pulse	($t_{interval}$ – 100 µs) / 2	Filter Timer
Low Pulse	($t_{interval}$ + 100 µs) / 2	Register Value

NOTE The 100 µs delay is not a guaranteed timing. For Filter timer value, the user needs to estimate and evaluate a suitable interval for the signal to be blocked or allowed to pass through.

The digital filter timing is based on a built- in timer that will run once the digital filter is enabled. The timer is clocked by a 12 MHz clock generator. On every rising edge, the filter timer counter is decremented. When it reaches 0, the timer auto reloads and the device will check for any valid change of state. Simultaneously, input lines are sampled on every rising clock as well. If a change to a new state holds for at least 2 consecutive occurrences that the filter timer reaches 0, the new state will be registered and read as a valid state.

The user can configure the filter timing interval by setting the correct value for the Filter timer register. Any changes that are shorter than the filter timer interval will never be detected or registered as a valid state.

Before the digital filter can function, the user needs to turn on the Filter Enable bit (Bit 1) located in the master Enable register by writing value '1' to that particular bit.

See formulas below on how to calculate the Filter timer register value based on the required blocked and passed pulse width interval:

$$\text{Block Filter Timer} = 2^{32} - (\text{Pulse Width Blocked Interval}^{*} \times 12\ \text{MHz})$$

$$\text{Pass Filter Timer} = 2^{32} - (\text{Pulse Width Passed Interval}^{**} / 2 \times 12\ \text{MHz})$$

* ***Pulse Width Blocked Interval*** - Pulse width that will certainly be blocked

** ***Pulse Width Passed Interval*** - Pulse width that will certainly be passed through

NOTE The minimum value for Filter Timer register is 1 and maximum value is 4294967295.

Examples:

1 The following command segment configures the filter timer to block any digital input state changes less than 500 µs.

$$\begin{aligned}\text{Block Filter Timer} &= 2^{32} - (\text{Pulse Width Blocked Interval} \times 12\ \text{MHz}) \\ &= 2^{32} - (500\ \mu\text{s} \times 12\ \text{MHz}) \\ &= 4294967296 - 6000 \\ &= 4294961296\end{aligned}$$

```
CONF:DIG:FILT:LWOR 4294961296, (@0001)
CONF:DIG:ENAB:BIT 1, 1, (@0001)
```

2 The following command segment configures the filter timer to pass any digital input state changes more than 500 µs. Any signal that changes states and last for more than 500 µs will be detected by the digital input on the module.

Pass Filter Timer = 2^{32} – (Pulse Width Passed Interval / 2 × 12 MHz)

= 2^{32} – (500 µs / 2 × 12 MHz)

= 4294967296 – 3000

= 4294964296

```
CONF:DIG:FILT:LWOR 4294964296, (@0001)
CONF:DIG:ENAB:BIT 1, 1, (@0001)
```

U2121A/U2122A Edge Detection

All the input lines of U2121A/U2122A provide edge detection capability for the user to monitor the change of state on the input signal. Each of the edge detection input lines can be configured individually for detecting positive edge, negative edge or both edges at the same time.

Before any input lines perform any edge detections on the input signal, the user will have to configure the individual Interrupt Enable register and the desired Positive Edge and/or Negative Edge detection register mask. After configuring all the individual input lines, master Edge Detection Enable bit (Bit 2) located in master Enable register must be set to ‘1’ in order for the edge detection functionality to work. Any changes detected will turn on the corresponding Interrupt Flag bit in the Interrupt Flag register.

The user can also enable the edge detection interrupt service request by turning on the Edge Detection Interrupt Enable bit (Bit 0) in the Service Request Enable register. When a valid edge detection is triggered, the master Edge Detection Interrupt Flag bit (Bit 0) of the Status Byte will be set to ‘1’ and a service request will be issued by the device to the PC Host.

The edge detection might not be suitable for detecting frequent signal state changes.

NOTE The performance of the service request will vary from system to system.

If multiple edge detections have been registered, all the individual Interrupt Flag will be or- ed together to represent the Edge Detection Interrupt Flag bit (Bit 0) of the Status Byte register.

In order to clear the master Edge Detection Interrupt Flag bit (Bit 0) of the Status Byte, user will have to clear all the individual edge detection Interrupt Flags by writing the value of the Interrupt Flag register data back to the Interrupt Flag register.

Example:

```
CONF:DIG:IFL:BYTE? (@0001)          // Read interrupt flag value
```

Typical Response: 254

```
CONF:DIG:IFL:BYTE 254,(@0001)       // Write back the value read back in order
                                    // to clear the interrupt flag
```

On every write command to the individual Interrupt Flag register, the corresponding interrupt flag bit, which is set to '1', will be turned off. When service request is generated from the device, user will have to clear the interrupt flag in order for new edge to be detected. If all the individual interrupt flags are not cleared in a single write command, a new service request will be re- issued. To ensure that the service request is not re- issued due to the same edge that has triggered the service request previously, it is recommended to always use the largest data width available for that particular device when reading and writing to the individual Interrupt Flag register.

Examples:

1 For U2121A with 16 input terminals

```
CONF:DIG:IFL:WORD? (@0001)          // Read interrupt flag value
```

Typical Response: 3672

```
CONF:DIG:IFL:WORD 3672,(@0001)      // Write back the value read back in order
                                    // to clear the interrupt flag
```

2 For U2122A with 32 input terminals

```
CONF:DIG:IFL:LWORD? (@0001)         // Read interrupt flag value
```

Typical Response: 3672456

```
CONF:DIG:IFL:LWORD
3672456,(@0001)                     // Write back the value read back
                                    // in order  to clear the interrupt
                                    // flag
```

Any change of state on the input line before the individual Interrupt Flag is cleared would not be recognized as a new change of state. The user must clear the corresponding Interrupt Flag bits in order for the input lines to detect new edge on the input lines.

A new service request will be issued only when all of these conditions are met:

1 Individual Interrupt enable bit is turned on

2 Corresponding positive and/or negative Edge Detection Enable bit is turned on

3 Master Edge Detection Enable bit (Bit 2) in Enable register is turned on

4 Edge Detection Interrupt Enable bit(Bit 0) in Service Request Enable register is turned on

5 A valid change of state occur

Example:

The following command segment configures digital input bit 1, channel 1 for positive edge detection. The individual Interrupt Flag must be cleared before the individual Interrupt Enable bit is turned on. Once the Interrupt Flag is cleared, the next positive edge will cause the module to set the Interrupt Flag

again. The subsequent command enables the digital input bit 1, channel 1 interrupt. The last command turns on the master Edge Detection Enable bit to allow the Edge Detection Interrupt Flag to be updated to (bit 0) of Status Byte if Interrupt Flag for the corresponding enable input bit is 1. This interrupt could generate service request if bit- 0 of the Service Request Enable Register is set to 1. (*SRE 1)

SCPI Commands	Descriptions
`CONF:DIG:IPED:BYTE 2,(@0001)`	// Configure positive edge detection for // bit 1, channel 1
`CONF:DIG:IFL:BYTE 2,(@0001)`	// Clear interrupt flag of bit 1 // input channel 1
`CONF:DIG:IEN:BYTE 2, (@0001)`	// Enable interrupt of bit 1 // input channel 1
`CONF:DIG:ENAB:BIT 1, 2, (@0001)`	// Enable master interrupt of input // channels
`*SRE 1`	// Enable edge detection service request

U2121A/U2123A Programmable Power-Up States

The programmable power- up state is an important function that allows the user to pre- configure the state of all the output lines of the device to a desired state upon power up. This will place the application system to a known state when the USB device is powered up and configured.

Agilent Diagnostic application tools or specific SCPI commands can be used to program the power- up states. If the value is not altered by the user, the power- up data will remain static once it is programmed. The power- up state will be stored in non- volatile memory in order to retain the data even after the device is powered down or unplugged from USB port.

NOTE The power-up state will only be updated when the device is configured by the USB Host (PC).

Examples:

1 The following command configures an 8- bit hexadecimal pattern 0xA5 to output channels 1 and 2 of Power Up Data register on the device. The value will be stored in non- volatile memory of the module. The next time when the module is powered up, the value of 0xA5 will be written to the output channels 1 and 2.

```
CONF:DIG:PUD:BYTE #HA5, (@0001,0002)
```

2 The following command configures an 16- bit decimal value 65535 to output channels 1 of Power Up Data register on the device. The value will be stored in non- volatile memory of the device. The next time when the module is powered up, the value of 65535 will be written to the output channels 1, which mean that all the lower 16 bits will be turned ON.

```
CONF:DIG:PUD:WORD 65535, (@0001)
```

IVI-COM Drivers

The Agilent IVI- COM drivers simplify instrument control when you are working in a COM- compatible environment. IVI- COM allows you to programmatically control your instrumentation and make measurements while providing a greater degree of instrument interchangeability and code reuse. The Agilent IVI- COM drivers support the use of IntelliSense for even greater ease- of- use within a Microsoft development environment.

The Agilent IVI- COM driver supports all the U2100A Series DAQ (U2121A, U2122A, U2123A). The Agilent U2100A Firmware Revision: 1.0.0 is the minimum revision required for full driver functionality.

An IVI- COM driver can program a particular set of instrument models. It implements an instrument- specific interface tuned to the capabilities of those models. The driver may also implement an IVI class- compliant interface which implements a limited set of functionality common to all instruments of the class. Instrument class- compliant interfaces are defined by the IVI Foundation. The application writer must choose whether to use the instrument- specific interface or the class- compliant interface.

The IVI inherent capabilities, through the IIviDriver interface, are available in both the instrument- specific interface and class- compliant interface. The general programming techniques are also the same.

Choosing Instrument-Specific Interface

With this interface, you have the benefit of full access to the instrument's capabilities. All capabilities in the class- compliant interface are also covered by the instrument- specific interface, but you will find some capabilities in the instrument- specific interface that are not available through the class- compliant interface. You may also see some performance enhancements, as the driver can be tuned to use efficient programming methods for that particular instrument.

Choosing Class-Compliant Interface

By limiting your program to the class- compliant interface, you have the potential advantage of syntactic interchangeability. Hence, another IVI- COM driver (and instrument) which supports the same class could be substituted for the original driver, if the prior IVI- COM driver supports all the capability groups used in the original driver. In this case, the application will compile,

link, and execute without error. The test results, however, may be quite different because different instruments measure and generate signals differently. For more information on class- compliant interfaces and capability groups, visit www.ivifoundation.org.

Using Both Interfaces

Generally, you gain no advantage from using both interfaces over using just the instrument- specific interface. However, if you can isolate the usage of the instrument- specific interface, however, you may see some advantages. Replacing the IVI- COM driver then involves fixing the syntactic incompatibilities in the isolated code.

Both IVI- C and IVI- COM drivers will be provided to users. The drivers can also be used in a variety of development environments. For more information on IVI, visit www.ivifoundation.org.

Below are the IVI- C and IVI- COM drivers provided:

- ✔ AgilentVEE support through COM mechanism using IVI- COM
- ✔ Visual Basic 6 support through COM mechanism using IVI- COM
- ✔ C++ support through COM mechanism using IVI- COM
- ✔ Visual Basic 7 support through COM Interop mechanism using IVI- COM
- ✔ C# support through COM Interop mechanism using IVI- COM
- ✔ National Instruments LabVIEW support through COM mechanism using IVI- COM
- ✔ LabWindows support through IVI- C

Features in the *Agilent DIO Diagnostics Application* software allow users to perform the following:

- ✔ Configure the various settings of the instrument
- ✔ Perform simple diagnostics on the instrument
- ✔ Set certain non- volatile features on the instrument

Other features include the following:

- ✔ Triggering digital output signals
- ✔ Monitoring digital input signals
- ✔ Setting watchdog timer
- ✔ Configuring digital change detection
- ✔ Setting power- up states (for non- volatile feature)

The Agilent firmware update utility is provided to allow users to update firmware on instruments. Update is made available through Agilent Developer Network (ADN) website:

www.agilent.com/find/adn

Programming Environments

An IVI- COM driver works well in a variety of application development environments (ADEs) below:

- ✔ Agilent VEE
- ✔ Microsoft® Visual Basic® 6
- ✔ Visual Studio C++
- ✔ Visual Basic 7
- ✔ C#
- ✔ National Instruments LabVIEW
- ✔ ANSI- C and National Instruments LabWindows

3
Installing U2100A Series DAQ

This chapter includes steps and descriptions on how to install the U2100A Series DAQ, Agilent U2121 IVI Driver and Agilent DIO Diagnostics Application software.

Receiving and Unpacking Unit

Be sure to carefully inspect the shipment cartons for damage prior to opening them. Inspect the contents of the shipment to verify that you have received all the items listed in the *'Shipment Contents'* below. If anything is missing, contact your nearest Agilent Technologies Sales Office. If the shipment is damaged, contact the carrier, then contact the nearest Agilent Technologies Sales Office.

Agilent Sales and Service Offices
To obtain warranty, service or technical support assistance, you can contact Agilent Technologies at the following telephone numbers:

UNITED STATES	1 800 829 4444
CANADA	1 877 894 4414
EUROPE	(31 20) 547 2000
JAPAN	(81) 426 56 7832
LATIN AMERICA	(305) 267 4245
AUSTRALIA & NEW ZEALAND	1 800 629 4852 (Australia)
	0 800 738 378 (New Zealand)
ASIA PACIFIC	(852) 3197 7777

Or contact Agilent worldwide through the following Web link:
www.agilent.com/find/assist

Shipment Contents

Before you install the U2100A Series DAQ, you should inspect your shipment contents. The U2100A Series DAQ package is inclusive of the following items:

- ✔ U2121A/U2122A/U2123A USB Digital IO Module
- ✔ USB Interface Cable
- ✔ Terminal Blocks - 4 pcs

- ✔ DIN Rail Clamp - 2 pcs
- ✔ Agilent U2100A Series Digital IO, 32- Terminal Quick Start Guide
- ✔ Product Reference CD- ROM
- ✔ Agilent IO Libraries Suite CD- ROM

System Requirements

Before installing the *Agilent U2121 Software*, you need to make sure your PC meets the minimum system requirements as listed below:

Processor	450 MHz Pentium II or higher required, 800 MHz recommended
Operating system (One of the following Microsoft Windows Version)	• Windows XP Professional or Home Edition, Service Pack 1 or later • Windows 2000 Professional, Service Pack 4 or later
Browser	Microsoft Internet Explorer 5.01 or greater
Available memory	128 MB (256 MB or greater recommended)
Available disk space	**236 MB** required for installation: • 160 MB for Microsoft .NET Framework • 65 MB for Agilent IO Libraries Suite • 5632 kB for Agilent U2100A IVI Driver • 5125 kB for Agilent DIO Diagnostics Application **186 MB** required for operation: • 110 MB for Microsoft .NET Framework • 65 MB for Agilent IO Libraries Suite • 5632 kB for Agilent U2100A IVI Driver • 5125 kB for Agilent DIO Diagnostics Application
Video	Super VGA (800x600) 256 colors or more

NOTE You must have Administrator privileges to install the *Agilent U2121 Software*.

Installing Agilent IO Libraries Suite

Before you begin installation, check for previously installed Agilent IO Libraries software. If a version of the Agilent IO Libraries Suite is installed on your PC, an IO icon is displayed on the Windows taskbar. Click on the icon and select **About Agilent IO Control** to view the version installed.

NOTE

You will have to install the Agilent IO Libraries Suite first before installing the *Agilent U2121 Software*. The Agilent IO Libraries Suite, version 14.2.8931 or later is recommended. Whenever possible, you should use the latest version of the Agilent IO Libraries Suite. See the *Agilent IO Libraries Getting Started Guide* on your *Automation-Ready CD* for a full description of installation options and installation troubleshooting information.

If the Agilent IO Libraries Suite has not been installed on your PC, follow the installation steps below to install the Agilent IO Libraries Suite software:

1. Disconnect any USB instrument that is connected to your PC.
2. Insert the *Automation- Ready CD* into your CD- ROM drive. Wait a few seconds for the auto- run window to appear.
3. If the auto- run window does not appear automatically, do the following:
   a. Click **Start > Run** (on Windows **Start** menu)
   b. Type `<drive>:\autorun\auto.exe`, where `<drive>` is your CD drive alphabet.
4. When the auto- run window appears, follow the instructions on that window to install the Agilent IO Libraries Suite.

Installing Agilent U2121 Software

There are two software available for installation:

Agilent U2121 IVI Driver

1. Verify that your PC meets the minimum system requirements. (See *'System Requirements'* on page 31.)
2. Close all other applications on your PC.

3 Insert the *Agilent USB Digital IO, 32- Terminal U2100A Series Product Reference CD* into the CD- ROM drive of your PC.

a Wait for a few seconds for the auto- run window to appear.

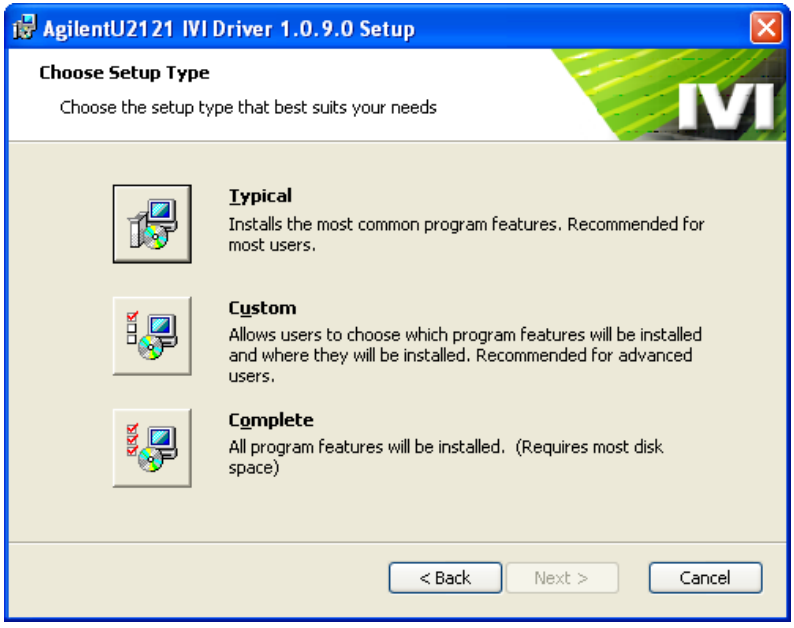
b If the auto- run window does not appear automatically, click **Start > Run**, then type `<drive>:\autorun.exe`, where `<drive>` is your CD drive alphabet.

4 When the auto- run window appears, click **IVI Driver** once, and wait for the Installation Dialog to appear.

5 When the Installation Dialog appears, click **Next** to begin the IVI Driver installation.

6 Read the License Agreement(s). To accept the terms, click on the radio button labeled **I accept the terms of the license agreement** then click **Next** to continue.

7 When the **Setup Type** dialog box appears, as shown below, clicking **Install** will install all features for your configuration in standard locations on your PC.



8 If you choose a **Custom** setup, the **Select Features** dialog box will appear.

a Click on any feature in the list to see the feature's description and space requirement. It is recommended that you install the sample programs if you plan to program with the IVI driver. However, you may omit this recommendation to save space.

b Select the check box for each feature to be installed. Clear the check box to omit the feature selection.

c Click **Next**.

9 When the **Ready to Install** dialog box appears, click **Install** to confirm your choices and begin copying files.

10 When the **Complete** dialog box appears, click **Finish**.

Agilent DIO Diagnostics Application

1 Verify that your PC meets the minimum system requirements. (See *'System Requirements'* on page 31.)

2 Close all other applications on your PC.

3 Insert the *Agilent USB Digital IO, 32- Terminal U2100A Series Product Reference CD* into the CD- ROM drive of your PC.

a Wait for a few seconds for the auto- run window to appear.

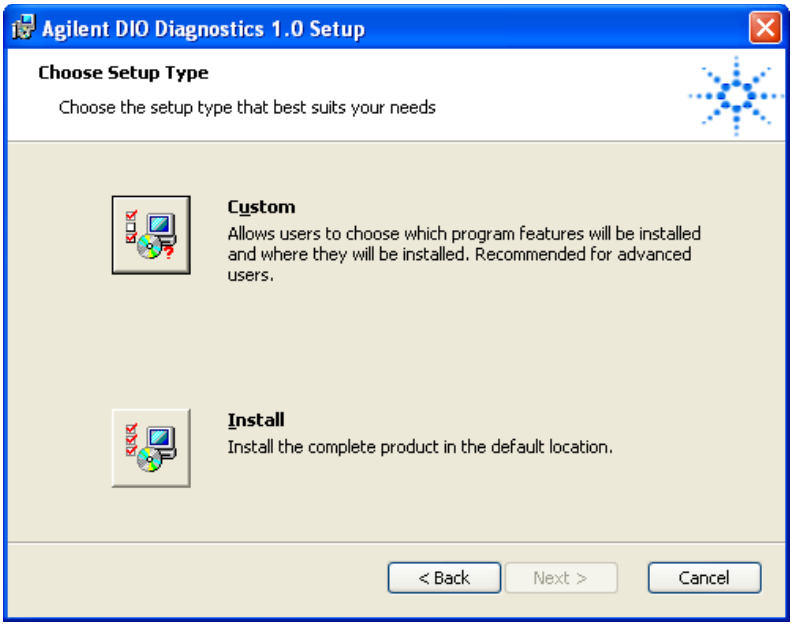
b If the auto- run window does not appear automatically, click **Start > Run**, then type `<drive>:\autorun.exe`, where `<drive>` is your CD drive alphabet.

4 When the auto- run window appears, click **Application**, and wait for the **Installation** dialog box to appear.

5 When the **Installation** dialog box appears, click **Next** to begin the **Agilent DIO Diagnostics Setup**.

6 Read the License Agreement(s). To accept the terms, click on the radio button labeled **I accept the terms of the license agreement** then click **Next** to continue.

7 When the **Setup Type** dialog box appears, as shown below, click **Install** or **Custom**. The **Install** setup installs all the features for your configuration in standard locations on your PC.



8 If you choose a **Custom** setup, the **Select Features** dialog box will appear.

- **a** Click on any feature in the list to see the feature's description and the space requirement.
- **b** Select the check box for each feature to be installed. Clear the check box to omit the feature selection.
- **c** Click **Browse** to select the specific destination folder for the application.
- **d** Click **Next**.

9 When the **Install Confirmation** dialog box appears, click **Install** to confirm your choices and begin copying files.

10 When the **Complete** dialog box appears, click **Finish**.

Connecting the U2100A Series DAQ

After the Agilent IO Libraries Suite, Agilent DIO Diagnostics Application software, and the Agilent U2121 IVI Driver have been installed, you can start the U2100A Series DAQ installation. The steps include:

1. Unpack the USB Digital IO Module (U2121A/U2122A/U2123A).
2. Connect the upstream USB port of the Agilent U2100A Series DAQ to any PC USB downstream port (USB 1.1/2.0) with the bundled USB Cable.
3. The device is USB bus- powered and does not require any external power for the internal circuitry of the device.
4. After the device is connected, the yellow USB power indicator will blink a few times to show that the module is being powered up.
5. Windows will prompt for the device driver installation if the device is plugged in for the first time to that particular USB downstream port.
6. The USB power indicator will always be on after the device driver is successfully installed.

NOTE External power supply is only applicable for external load.

Installation Troubleshooting

If you encounter problems while installing the *Agilent U2121 Software*, the following steps may help.

1. Close or cancel all Installation dialogs and other *Agilent U2121 Software* windows. Exit all other applications on your system.
2. Browse the autorun folder of your *Product Reference CD* and double- click to run **autorun.exe**. This restarts the installation process.
3. If you see the standard Installation dialog, step through the installation process as described in this chapter.
4. If you see **Modify**, **Repair**, and **Remove** options, select **Repair**. This will reinstall all installed features of *Agilent U2121 Software*. If this does not solve the problem, select **Remove**, then reinstall the product.

Changing Your Installation or Removing Agilent U2121 Software

Agilent U2121 IVI Driver

1 Click **Start > Control Panel > Add or Remove Programs**

2 Select **Agilent U2121 IVI Driver 1.0.8.0**

3 If you click **Change**, select the action you want to take:

- **Modify**: Adds, replaces, or removes selected features
- **Repair**: Reinstalls all features that are currently installed
- **Remove**: Removes the product from your PC

4 If you click **Remove**, a **Confirmation** dialog will appear. Click **Yes** to remove the product from your PC.

Agilent DIO Diagnostics Application

1 Click **Start > Control Panel > Add or Remove Programs**

2 Select **Agilent DIO Diagnostics Application 1.0**

3 If you click **Change**, select the action you want to take:

- **Repair**: Reinstalls all features that are currently installed
- **Remove**: Removes the product from your PC

4 If you click **Remove**, a **Confirmation** dialog will appear. Click **Yes** to remove the product from your PC.

NOTE

USING THE LICENSED MATERIALS INDICATES YOUR ACCEPTANCE OF THE LICENSE TERMS. IF YOU DO NOT AGREE TO ALL OF THESE TERMS, YOU MAY RETURN ANY UNOPENED LICENSED MATERIALS FOR A FULL REFUND. IF THE LICENSED MATERIALS ARE BUNDLED OR PRE-LOADED WITH ANOTHER PRODUCT, YOU MAY RETURN THE ENTIRE UNUSED PRODUCT FOR A FULL REFUND.

Communicating with U2100A Series DAQ

You can use either the Agilent U2121 IVI Driver or SCPI commands (in any programming environment) to communicate with the U2100A. However, Agilent has designed drivers that work best in recommended environments as shown in the table below. To install drivers and their associated Help files, refer to the *Agilent USB Digital IO, 32- Terminal U2100A Series Product Reference CD- ROM*, which is bundled with the *Agilent U2100A Series Digital IO, 32- Terminal User's Guide*. This CD- ROM also contains a collection of sample programs for your reference.

Programming Environment	Drivers
Microsoft® Visual C® version 6.0, Visual C++®, and ANSI C	IVI-C, IVI-COM
Microsoft® Visual Basic® version 6.0	IVI-C, IVI-COM
Microsoft® Visual Studio® .NET for C#, C, and Visual Basic	IVI-COM
Agilent VEE	IVI-C, IVI-COM
National Instruments LabVIEW	IVI-C, IVI-COM
National Instruments LabWindows/CVI®	IVI-C

Keeping Your Software Up To Date

Web resource for the latest software:
www.agilent.com/find/U2100A

This website includes firmwares, IVI drivers and Application software for the U2100A Series DAQ products.

Websites

More information about IVI- COM drivers is available on the Agilent website and worldwide Web.

- Agilent Technologies IVI- COM
  www.agilent.com/find/ivi- com
- Agilent Developer Network (Knowledge Library, Forums, Downloads, Support)
  www.agilent.com/find/adn
- Introducing IVI- COM Drivers
  www.agilent.com/find/adnivicominfo
- IVI- COM Briefs and Papers
  www.agilent.com/find/adnivicompapers
- IVI- COM Drivers and Components Downloads
  www.agilent.com/find/adnivicomdrivers
- Drivers and Software Downloads
  www.agilent.com/find/adndownloads
- Agilent IO Libraries Suite
  www.agilent.com/find/iolibsforivicom
- Agilent Test & Measurement Software and Connectivity
  www.agilent.com/find/connectivity
- Agilent Technologies Home Page
  www.agilent.com
- IVI Foundation
  www.ivifoundation.org
- MSDN Online
  www.msdn.microsoft.com
- U2100A Driver Updates
  www.agilent.com/find/U2100A

4
Pin Connections

This chapter focuses on detailed connector layout and pin assignment description of all the U2100A Series DAQ. There is also information on input and output terminal equivalent circuits with some application examples.

IO Descriptions

The Agilent U2121A, U2122A, and U2123A have five main connectors as depicted in the Figure 1, inclusive of one USB - B type connector and four terminal blocks for IO connection.

This chapter will discuss more on the terminal blocks connection and application examples. The terminal blocks provided with the products are the pluggable type (3.5 mm pitch) terminal blocks which greatly ease wiring effort and installation. Each terminal block has 10 connection points inclusive of eight IO and two connection points allocated for external GND (V–) or return path. In other words, every terminal block is defined as a single channel with eight IO terminal connections. See Figure 3 - Figure 5.

All the external GND (V–) are common and connected together internally. The external GND (V–) act as a return path or reference for external application system. There are altogether eight external GND (V–) terminals on the USB digital IO device. Users need to ensure to connect the application system GND or return path to the external GND (V–) terminal.

NOTE Each of the input and output terminal is not configurable.

Each of the respective series comes with dedicated input and output terminals as follow:

- **U2121A** 16- Terminal Digital Input & 16- Terminal Digital Output (Figure 3)
- **U2122A** 32- Terminal Digital Input (Figure 4)
- **U2123A** 32- Terminal Digital Output (Figure 5)

U2100A Series Functional Block Diagram

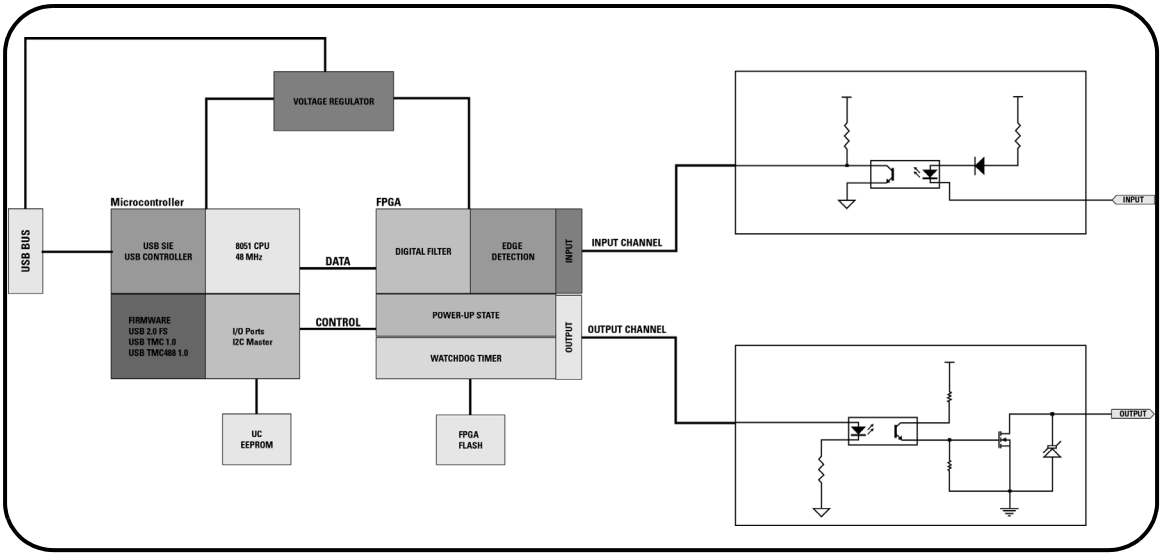


Figure 2 U2100A Series Functional Block Diagram

Pin Assignments

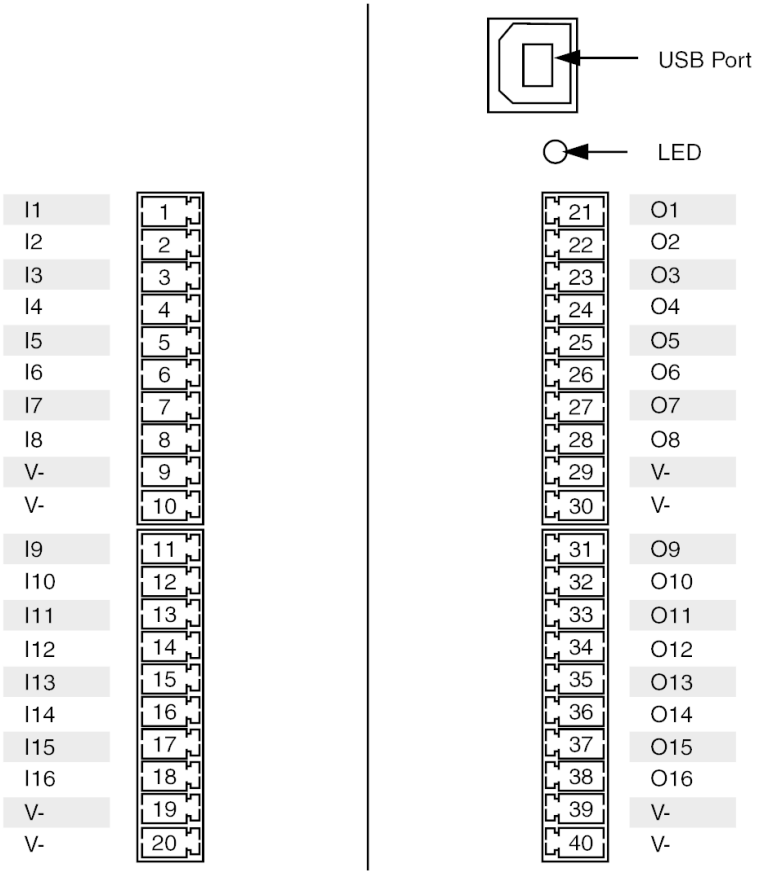


Figure 3 U2121A Pin Assignment

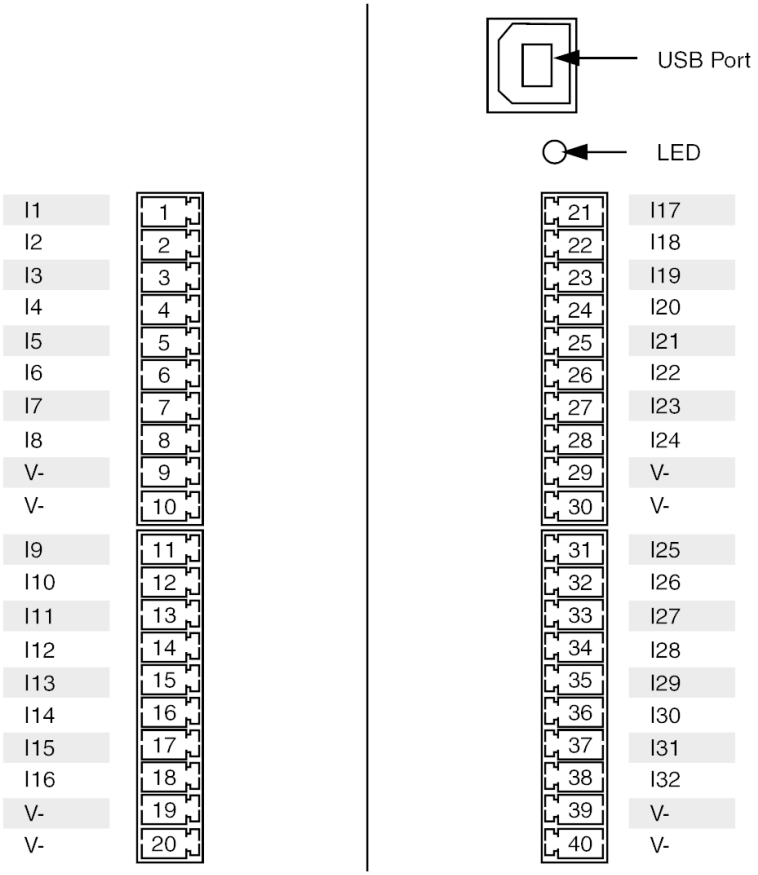


Figure 4 U2122A Pin Assignment

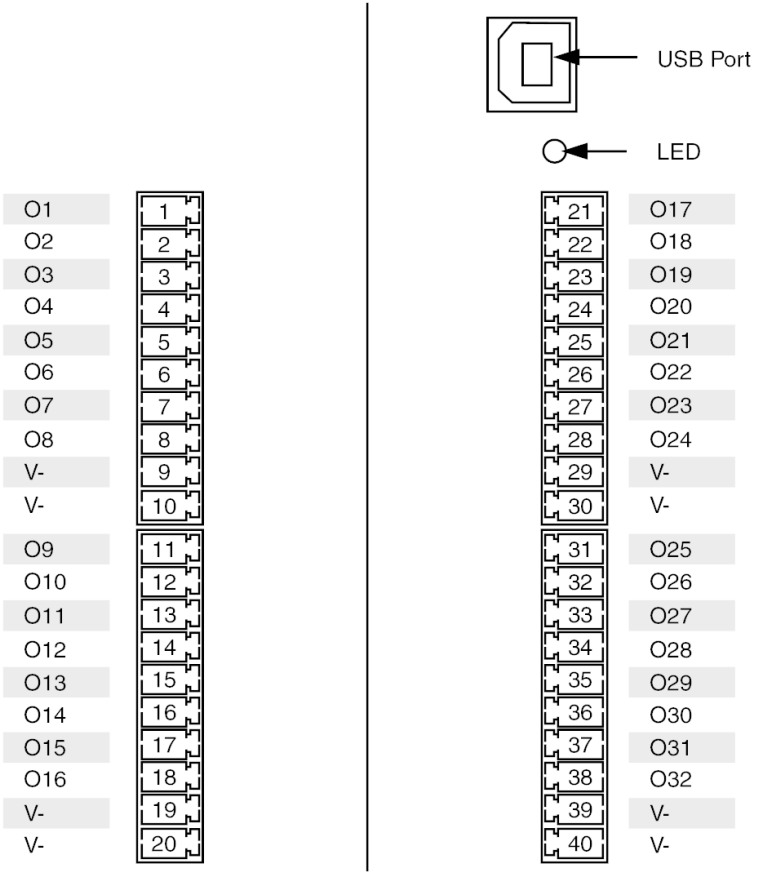


Figure 5 U2123A Pin Assignment

Circuit Diagrams

Input Equivalent Circuit

The input terminal is active low. When a logic level low is applied at the terminal point (≤Vil), the terminal will source current.

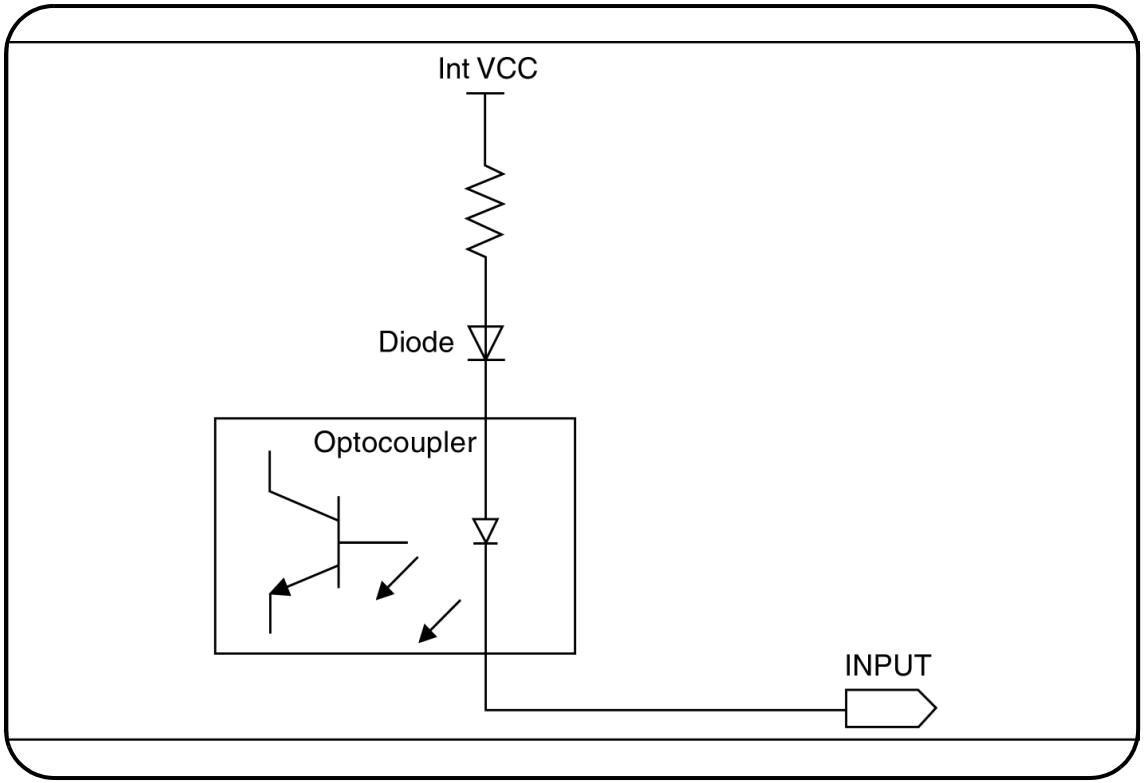


Figure 6 Input Equivalent Circuit

Input Example Circuit

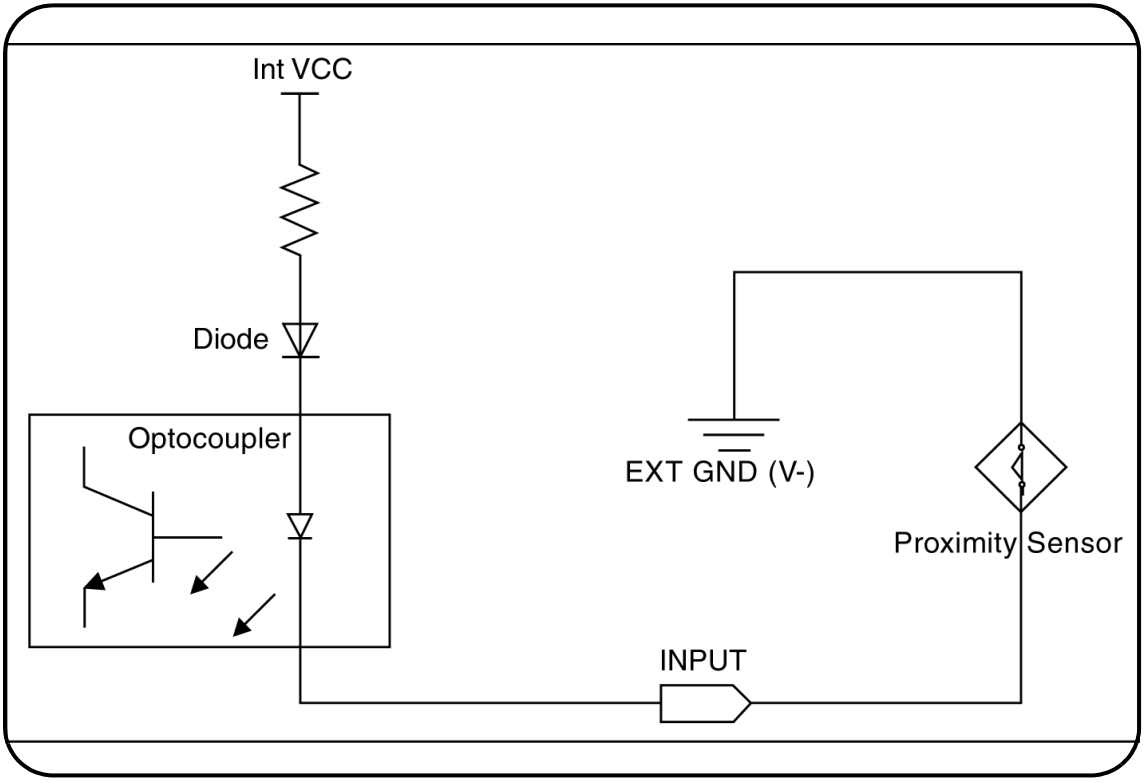


Figure 7 Input Example using Proximity Sensor

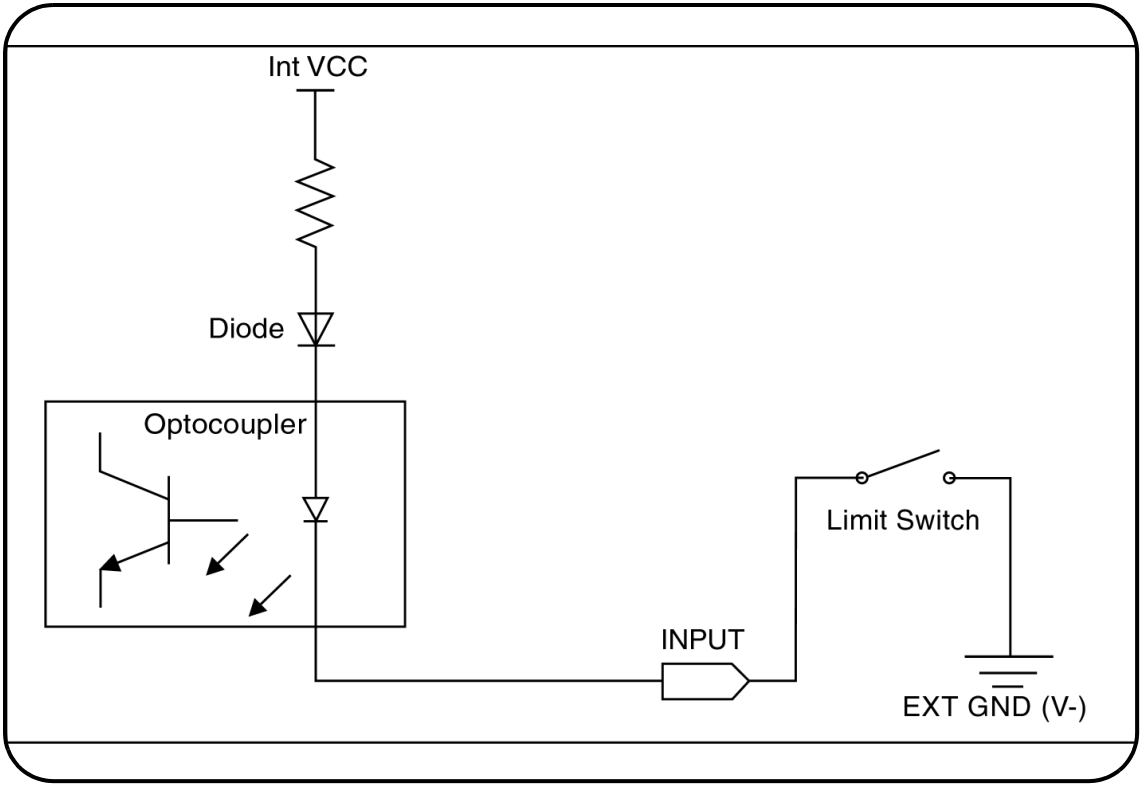


Figure 8 Input Example using Limit Switch

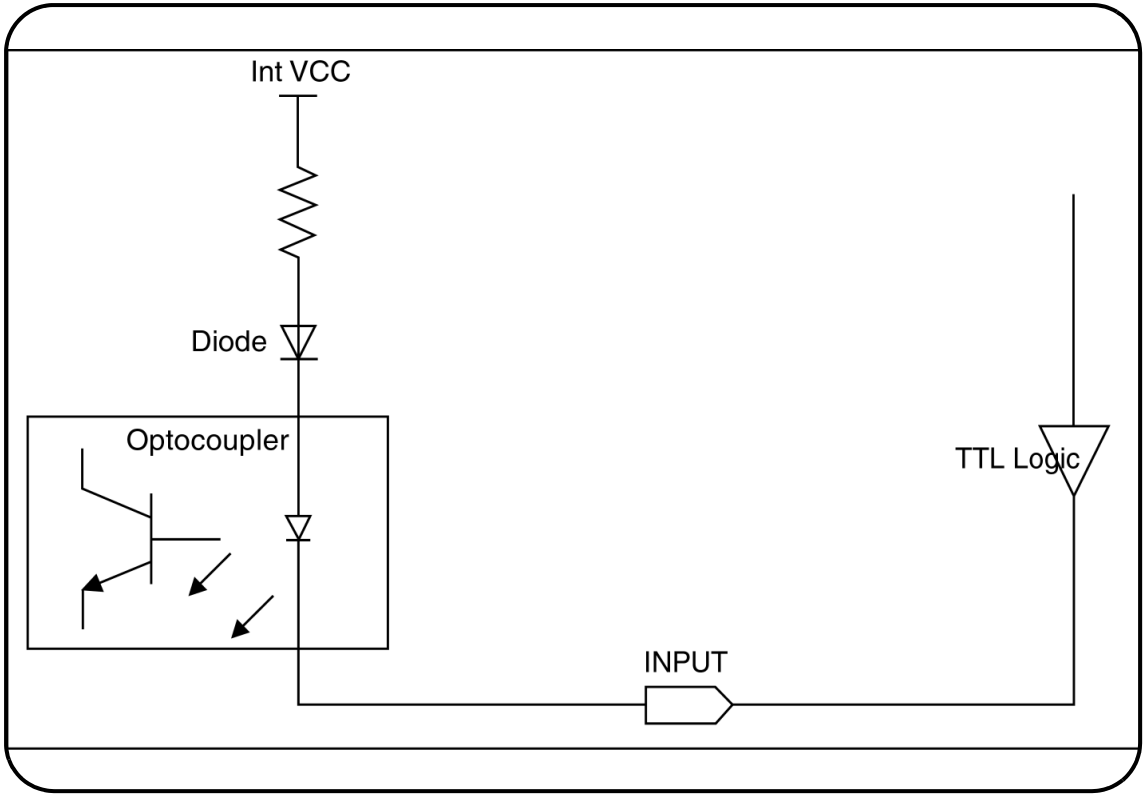


Figure 9 Input Example using TTL Logic

Output Equivalent Circuit

The output terminal is active low. When activated with logic level 1, the driver will drive output terminal point low (≤Vol) and the terminal will sink current.

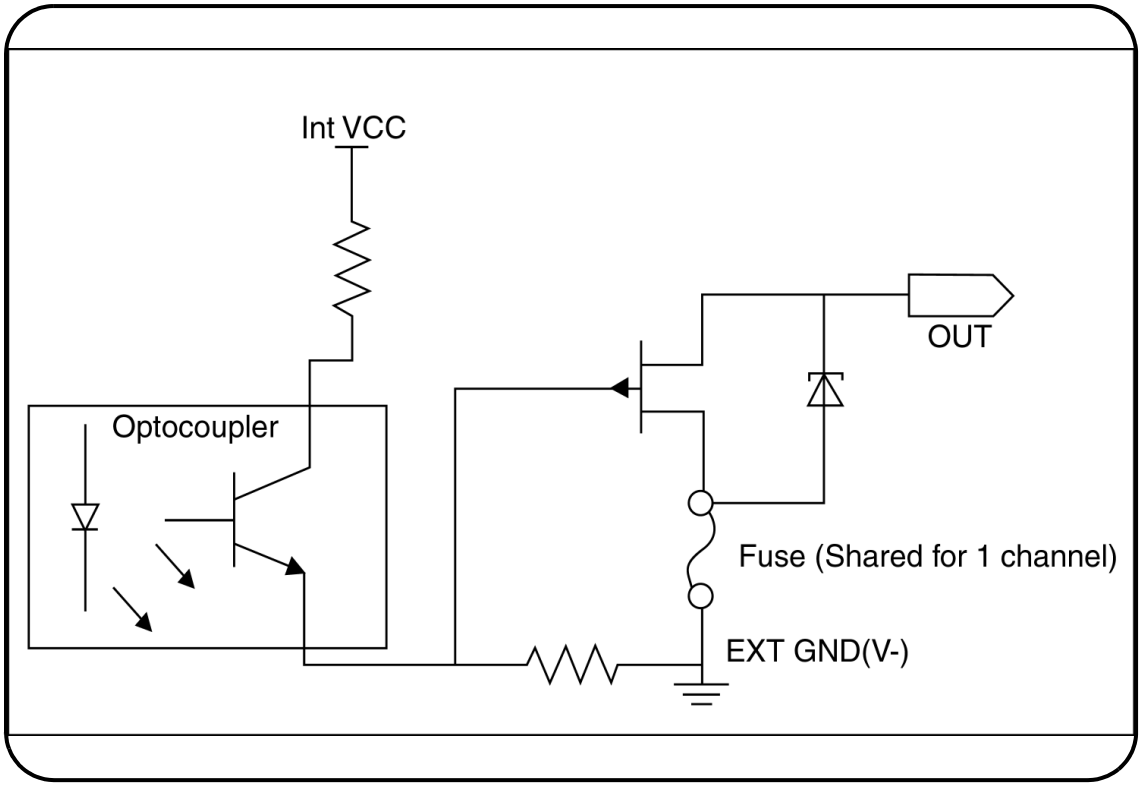


Figure 10 Output Equivalent Circuit

Output Example Circuit

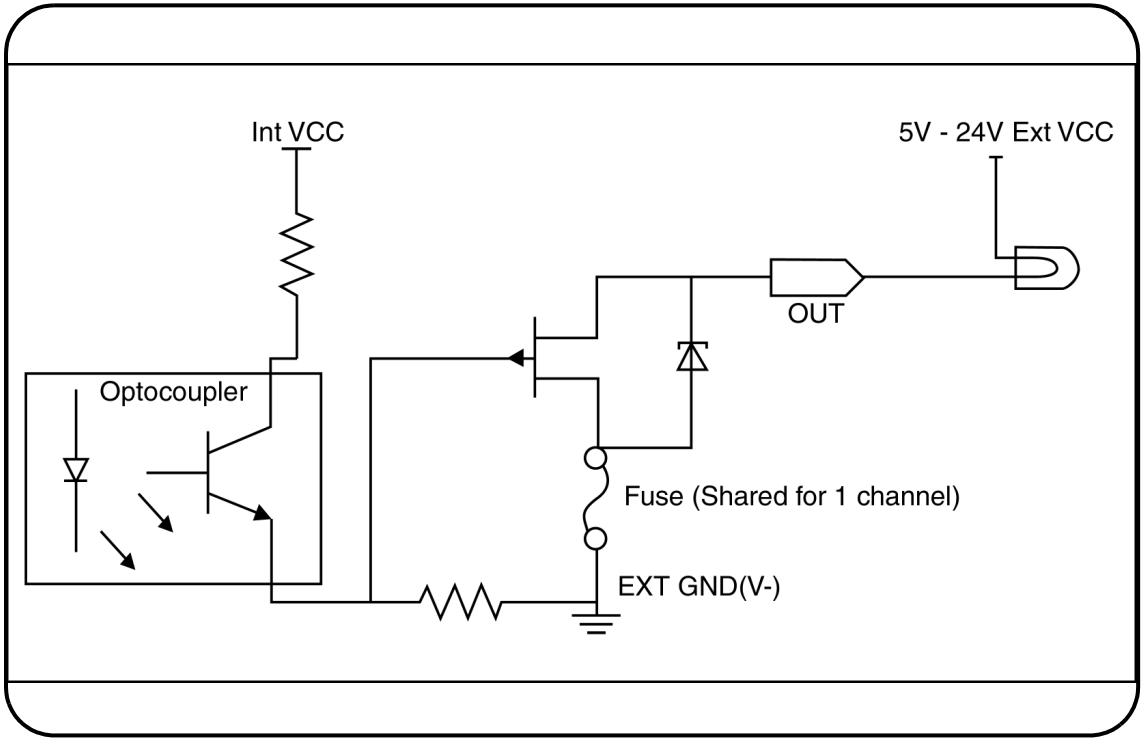


Figure 11 Output Example using Incandescent Lamp

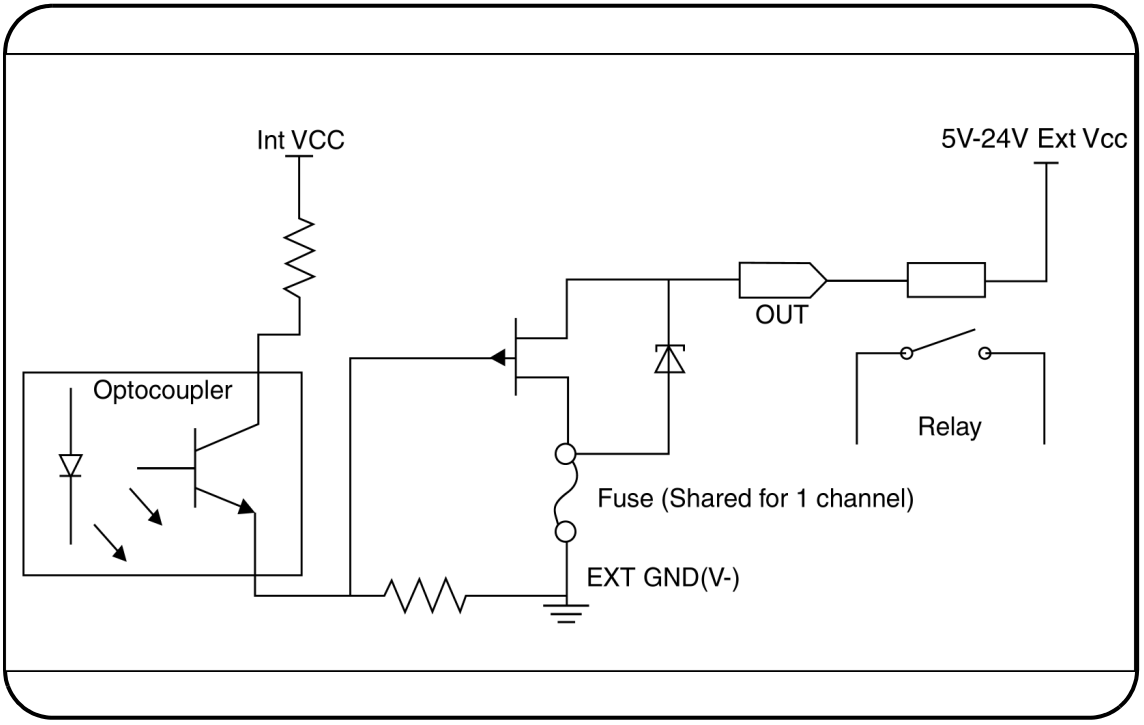


Figure 12 Output Example using Relay

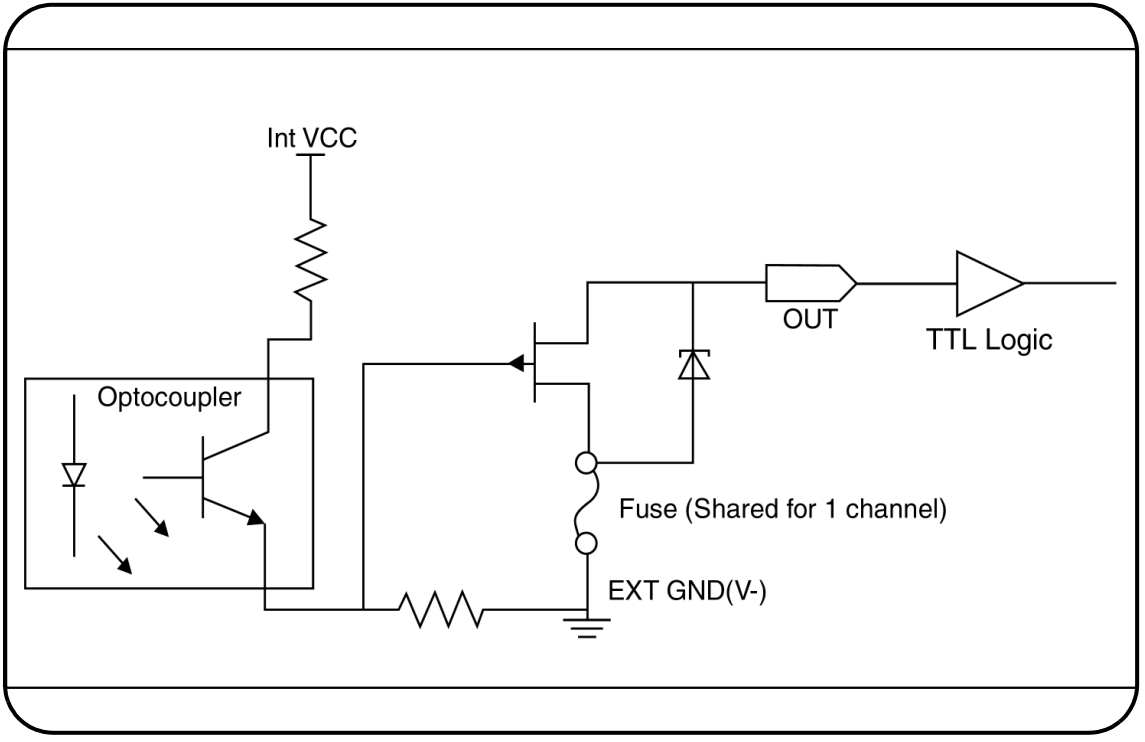


Figure 13 Output Example using TTL Logic

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