Agilent U2300A Series Multifunction USB Data Acquisition

User's Guide

Agilent Technologies

Notices

Manual Part Number

U2351-90002

Edition

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CAUTION

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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 death. Do not proceed beyond a WARNING notice until the indicated conditions are fully understood and met.

Safety Symbols

	Direct current
	Warning

Regulatory Markings

	The CE mark shows that the product complies with all the relevant European legal Directives (if accompanied by a year, it signifies when the design was proven).
	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.
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	This product complies with the WEEE Directive (2002/96/EC) marking equipment. The affixed product label indicates that you must not discard this electrical/electronic product in domestic household waste.

In This Guide...

This guide contains information of product, theory of operation and calibration, and information to install the Agilent U2300 driver and Agilent Measurement Manager Software.

1 Getting Started

In this chapter you are introduced to an overview of the product features, applications and specifications.

2 Installation

In this chapter you prepare your system for installation, including hardware installation and resource estimation. It describes on how to install the U2300A series DAQ, Agilent Measurement Manager software and other pre- installation software.

3 Signal Connections

In this chapter you learn about the connector's pin assignment and how to connect signals to U2300A series USB DAQ.

4 Features and Functions

In this chapter you are provided with information for better understanding on the features and functions of U2300A series USB DAQ. This includes the operations of the analog input/output, digital input/output and digital counter.

5 Calibration

In this chapter you are guided on how to calibrate the Agilent U2300A series USB DAQ.

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 U2300A Series Multifunction USB Data Acquisition(DAQ) device
Models Number:	U2331A, U2351A, U2352A, U2353A, U2354A, U2355A, U2356A
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:

	Standard	Limit
EMC	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:

20-October-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.

Template: A5971-5302-2, Rev. B.01 U2300 series Rev 1.0

Product Regulations

		Performance Criteria U2331A, U2351A, U2352A U2353A, U2354A, U2355A, U2356A
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%)	C
	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:

U2331A – USB 64SE/32DI, 12bits, 3MSa/s Multifunction USB DAQ
U2351A – USB 16SE/8DI, 16bits, 250kSa/s Multifunction USB DAQ
U2352A – USB 16SE/8DI, 16bits, 250kSa/s Multifunction USB DAQ (without Analog output)
U2353A – USB 16SE/8DI, 16bits, 500kSa/s Multifunction USB DAQ
U2354A – USB 16SE/8DI, 16bits, 500kSa/s Multifunction USB DAQ (without Analog output)
U2355A – USB 64SE/32DI, 16bits, 250kSa/s Multifunction USB DAQ
U2356A – USB 64SE/32DI, 16bits, 500kSa/s Multifunction USB DAQ

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

Contents

1 Getting Started

This chapter gives an introduction and overview of the product features, applications and specifications.

Introduction

The Agilent U2300A series multifunction data acquisition (DAQ) are high performance DAQ modules. High performance design technology makes it ideal for both industrial and scientific environment. The U2300A series is a dual play USB DAQ, that can operate as a standalone or modular. The U2300 series DAQ consists of basic multifunction DAQ (U2351A, U2352A, U2353A and U2354A) and high density multifunction DAQ (U2355A, U2356A and U2331A). The basic multifunction DAQ can sample up to 500 kSa/s with a resolution of 16 bits. Whereas, the high density multifunction DAQ is able to sample up to 3 MSa/s per channel and 1 MSa/s for multi channels. This makes it ideal when dealing with high- density analog input/output signals and different input ranges.

The U2300A series DAQ also features a 24- bit programmable digital I/O and 2 independent 31- bit general purpose digital counter. In addition to that, this series of DAQ is able to perform analog and digital functions at full speed. It has a resolution range of 12 to 16 bits, with no missing codes. It comes with self calibration capability. This enables the device to readjust its offset within the specified accuracies and ranges.

Features

The key features of the U2300A series are as follows:

- Resolution of 12- bit/16- bit with no missing codes
- Up to 64 single- ended (SE) inputs or 32 differential inputs (DI)
- Up to 100 selectable analog input channels for sequencinig scanning.
- Programmable bipolar/unipolar analog input
- Self calibration
- USBTMC 488.2 compliant
- USB 2.0 high speed interface

U2351A/U2352A/U2355A	16- bit analog input resolution with sampling rate of 250 kSa/s
U2353A/U2354A/U2356A	16- bit analog input resolution with sampling rate of 500 kSa/s
U2331A	12- bit analog input resolution with sampling rate up to 3 MSa/s per single channel
Multiple trigger sources	none (intermediate trigger), external analog/digital trigger and SSI/star trigger (used with modular chassis)

Applications

The Agilent U2300A series DAQ is a robust instrument that can be applied to nearly any industrial data acquisition, industrial automation and education environment. The primary advantage is its high versatility due to the high number of input and output channels.

Checking the Contents

Inspect and verify the following items for the standard purchase of U2300A Series DAQ:

- DC power adaptor
- Power cord
- USB extension cable
- L–Mount kit (Refer to the figure in page 15 for more details)
- Quick start guide
- Product Reference CD- ROM
- Agilent Automation- Ready CD
- Certificate of Calibration

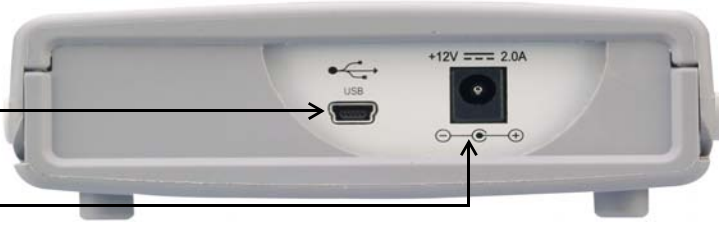
If there are missing items, contact the nearest Agilent Sales Office.

Product Outlook

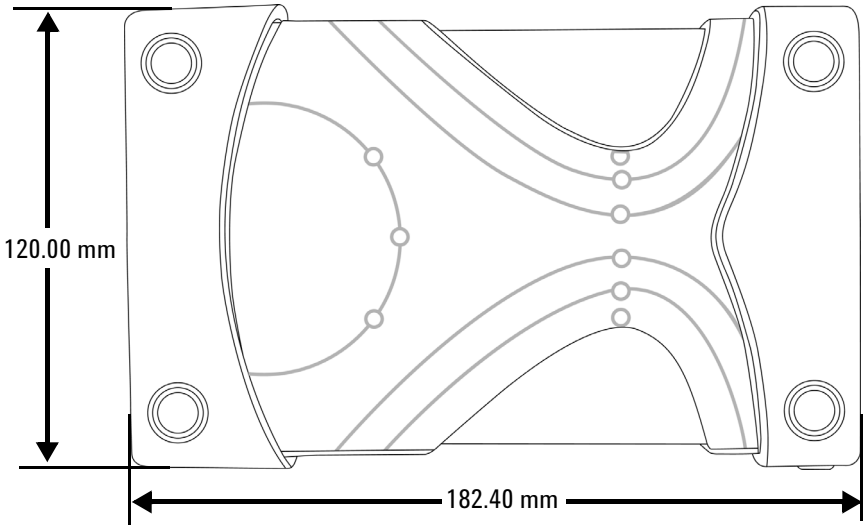
Top View

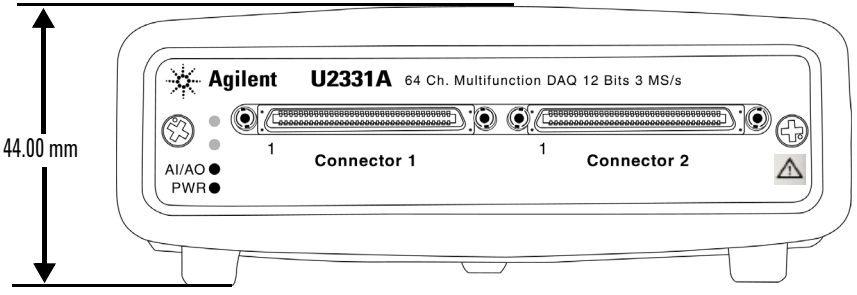
Front View

Rear View



Dimension

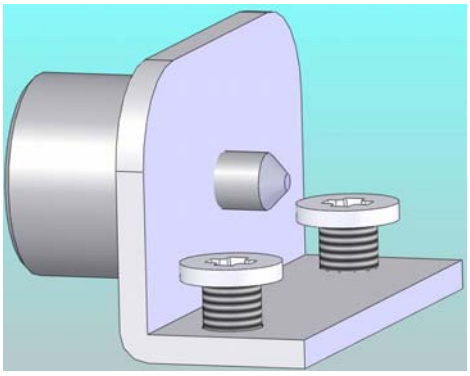

120.00 mm
182.40 mm


44.00 mm
Agilent
U2331A
64 Ch. Multifunction DAQ 12 Bits 3 MS/s
1
Connector 1
1
Connector 2
AI/AO
PWR

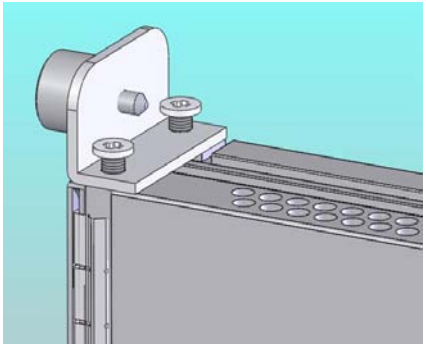
L-Mount Kit Installation

Below are the two simple steps for L- Mount kit installation on U2300A series DAQ.

Step 1



(Install to the DAQ module)



Step 2

NOTE Please keep the L-Mount Kit for installation and to be screwed on both sides of the modules when used in modular instrument chassis.

Product Layout

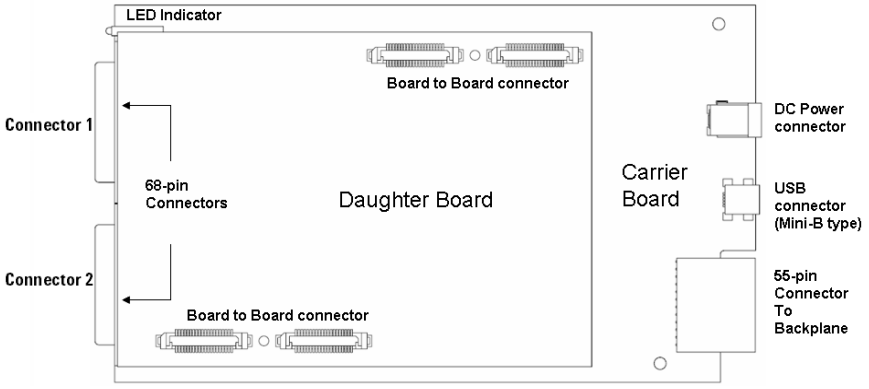


Figure 1-1 Product Layout of U2331A/U2356A/U2355A

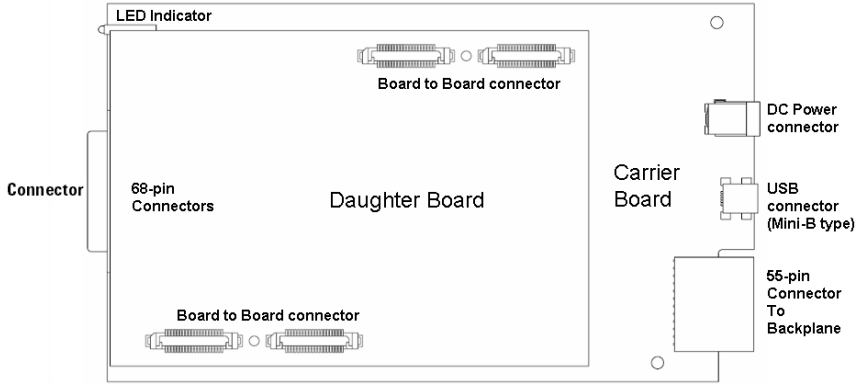


Figure 1-2 Product layout of U2351A/U2352A/U2353A/U2354A

General Specifications

REMOTE INTERFACE

- USB 2.0 High speed
- USBTMC Class Device

POWER CONSUMPTION

- +12 VDC, 550 mA maximum

OPERATING ENVIRONMENT

- Operating temperature from 0 °C to +55 °C
- Relative humidity at 15% to 85% RH (non-condensing)
- Altitude up to 2000 meters

STORAGE COMPLIANCE

- –20 °C to 70 °C

SAFETY COMPLIANCE

Certified with:

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

EMC COMPLIANCE

- IEC/EN 61326-1 1998
- CISPR 11: 1990/EN55011:1991 , Group 1, Class A
- CANADA: ICES-001: 1998
- Australia/New Zealand: AS/NZS 2064.1

SHOCK & VIBRATION

- Tested to IEC/EN 60068-2

IO CONNECTOR

- 68-pin female VHDCI Type

DIMENSION (WxDxH)

- 120.00 mm x 182.40 mm x 44.00 mm (with plastic casing)
- 105.00 mm x 174.54 mm x 25.00 mm (without plastic casing)

WEIGHT

- 565 g (with plastic casing)
- 400 g (without plastic casing)

WARRANTY

- One year

Product Specifications

Basic Multifunction DAQ Specifications

Table 1-1 Product specifications for Agilent Basic Multifunction DAQ (U2351A, U2352A, U2353A, and U2354A)

Analog Input				
Model Number	**U2351A**	**U2352A**	**U2353A**	**U2354A**
Resolution	16 bits, no missing codes			
Number of channels	16 SE/8 DI (software selectable/ch)			
Maximum sampling rate	250 kSa/s		500 kSa/s	
Scan list memory	Up to 100 selectable channels entries			
Programmable bipolar input range	±10 V, ±5 V, ±2.5 V, ±1.25 V			
Programmable unipolar input range	0 to 10 V, 0 to 5 V, 0 to 2.5 V, 0 to 1.25 V			
Input coupling	DC			
Input impedance	1 GΩ / 100 pF			
Operational common mode voltage range	±7.5 V maximum			
Overvoltage protection	Power on: Continuous ±30 V, Power off: Continuous ±15 V			
Trigger sources	External analog/digital trigger, SSI/star trigger[1]			
Trigger modes	Pre- trigger, delay-trigger, post-trigger and middle-trigger			
FIFO buffer size	Up to 8 MSa			

Analog Output				
Model Number	**U2351A**	**U2352A**	**U2353A**	**U2354A**
Resolution	16 bits	N/A	16 bits	N/A
Number of channels	2	N/A	2	N/A
Maximum update rate	1 MSa/s	N/A	1 MSa/s	N/A
Output ranges	0 to 10 V, ±10 V, 0 to AO_EXT_REF, ±AO_EXT_REF[2]	N/A	0 to 10 V, ±10 V, 0 to AO_EXT_REF, ±AO_EXT_REF[2]	N/A
Output coupling	DC	N/A	DC	N/A
Output impedance	0.1 Ω Typical	N/A	0.1 Ω Typical	N/A

Stability	Any passive load up to 1500 pF	N/A	Any passive load up to 1500 pF	N/A
Power on state	0 V steady state	N/A	0 V steady state	N/A
Trigger sources	External analog/digital trigger, SSI/star trigger[1]	N/A	External analog/digital trigger, SSI/star trigger[1]	N/A
Trigger modes	Post-trigger and delay-trigger	N/A	Post-trigger and delay-trigger	N/A
FIFO buffer size	1 channel: Maximum 8 MSa 2 channels: Maximum 4 MSa/ch	N/A	1 channel: Maximum 8 MSa 2 channels: Maximum 4 MSa/ch	N/A
Function generation mode	Sine-wave, square-wave, triangle, sawtooth and noise waveform	N/A	Sine-wave, square-wave, triangle, sawtooth and noise waveform	N/A

Digital I/O				
Model Number	**U2351A**	**U2352A**	**U2353A**	**U2354A**
Number of bits	24-bit programmable input/output			
Compatibility	TTL			
Input voltage	V_{IL} = 0.7 V max, I_{IL} = 10 µA max V_{IH} = 2.0 V min, I_{IH} = 10 µA max			
Input voltage range	–0.5 V to +5.5 V			
Output voltage	V_{OL} = 0.45 V max, I_{OL} = 8 mA max V_{OH} = 2.4 V min, I_{OH} = 400 µA max			

General Purpose Digital Counter				
Model Number	**U2351A**	**U2352A**	**U2353A**	**U2354A**
Maximum count	(2^{31}-1) bits			
Number of channels	2 independent up/down counter			
Compatibility	TTL			
Clock source	Internal or external			
Base clock available	48 MHz			
Maximum clock source frequency	12 MHz			
Input frequency range	0.1 Hz to 6 MHz at 50% duty cycle			
Pulse width measurement range	0.167 µs to 178.956 s			

Analog Trigger				
Model Number	**U2351A**	**U2352A**	**U2353A**	**U2354A**
Trigger source	All analog input channels, External analog trigger (EXTA_TRIG)			
Trigger level	±Full Scale for internal; ±10 V for external			
Trigger conditions	Above high, below low and window (software selectable)			
Trigger level resolution	8 bits			
Bandwidth	400 kHz			
Input Impedance for EXTA_TRIG	20 kΩ			
Coupling	DC			
Overvoltage Protection	Continuous for ± 35 Vmaximum			

Digital Trigger				
Model Number	**U2351A**	**U2352A**	**U2353A**	**U2354A**
Compatibility	TTL/CMOS			
Response	Rising or falling edge			
Pulse width	20 ns minimum			

Calibration[3]				
Model Number	**U2351A**	**U2352A**	**U2353A**	**U2354A**
On board reference voltage	5 V			
Temperature drift	±2 ppm/°C			
Stability	±6 ppm/1000 hrs			

General				
Model Number	**U2351A**	**U2352A**	**U2353A**	**U2354A**
Remote interface	USB 2.0 High Speed			
Device class	USBTMC Class Device			
Programmable interface	Standard Commands for Programmable Instruments (SCPI) and IVI-COM			

[1] System Scynchronous Interface (SSI) and Star-trigger commands are used when modular devices are used in instrument chassis.

[2] Maximum external reference voltage for analog output (AO_EXT_REF) is ±10 V.

[3] 20 minutes warm-up time is recommended.

High Density Multifunction DAQ Specifications

Table 1-2 Product specifications for Agilent High Density Multifunction DAQ (U2355A, U2356A and U2331A)

Analog Input			
Model Number	**U2355A**	**U2356A**	**U2331A**
Resolution	16 bits, no missing codes		12 bits, no missing codes
Number of channels	64 SE/32 DI (software selectable/ch)		
Maximum sampling rate	250 kSa/s	500 kSa/s	3 MSa/s (single channel) 1 MSa/s (multi channels)
Scan list memory	Up to 100 selectable channels entries		
Programmable bipolar input range	±10 V, ±5 V, ±2.5 V, ±1.25 V		±10 V, ±5 V, ±2.5 V, ±1.25 V, ±1 V, ±0.5 V, ±0.25 V, ±0.2 V, ±0.05 V
Programmable unipolar input range	0 to 10 V, 0-5 V, 0-2.5 V, 0-1.25 V		0-10 V, 0-5 V, 0-4 V, 0-2.5 V, 0-2 V, 0-1 V, 0-0.5 V, 0-0.4 V, 0-0.1V
Input coupling	DC		
Input impedance	1 GΩ / 100 pF		
Operational common mode voltage range	±7.5 V maximum		
Overvoltage protection	Power on: Continuous ±30 V, Power off: Continuous ±15 V		
Trigger sources	External analog/digital trigger, SSI/star trigger[1]		
Trigger modes	Pre-trigger, delay-trigger, post-trigger and middle-trigger		
FIFO buffer size	Up to 8 MSa		

Analog Output			
Model Number	**U2355A**	**U2356A**	**U2331A**
Resolution	12 bits		
Number of channels	2		
Maximum update rate	1 MSa/s		
Output ranges	0 to 10 V, ±10 V, 0 to AO_EXT_REF, ±AO_EXT_REF[2]		
Output coupling	DC		
Output impedance	0.1 Ω Typical		
Stability	Any passive load up to 1500 pF		
Power on state	0 V steady state		
Trigger sources	External analog/digital trigger, SSI/star trigger[1]		
Trigger modes	Post-trigger and delay-trigger		
FIFO buffer size	1 channel: Maximum 8 MSa 2 channels: Maximum 4 MSa/ch		
Function generation mode	Sine-wave, square-wave, triangle, sawtooth and noise waveform		

Digital I/O			
Model Number	**U2355A**	**U2356A**	**U2331A**
Number of bits	24-bit programmable input/output		
Compatibility	TTL		
Input voltage	V_{IL} = 0.7 V max, I_{IL} = 10 µA max V_{IH} = 2.0 V min, I_{IH} = 10 µA max		
Input voltage range	–0.5 V to +5.5 V		
Output voltage	V_{OL} = 0.45 V max, I_{OL} = 8 mA max V_{OH} = 2.4 V min, I_{OH} = 400 µA max		

General Purpose Digital Counter			
Model Number	**U2355A**	**U2356A**	**U2331A**
Maximum count	$(2^{31}-1)$ bits		
Number of channels	2 independent up/down counter		
Compatibility	TTL		
Clock source	Internal or external		
Base clock available	48 MHz		
Maximum clock source frequency	12 MHz		
Input frequency range	0.1 Hz to 6 MHz at 50% duty cycle		
Pulse width measurement range	0.167 µs to 178.956 s		

Analog trigger			
Model Number	**U2355A**	**U2356A**	**U2331A**
Trigger source	All analog input channels, External analog trigger (EXTA_TRIG)		
Trigger level	±Full Scale for internal; ±10 V for external		
Trigger conditions	Above high, below low and window (software selectable)		
Trigger level resolution	8 Bits		
Bandwidth	400 kHz		
Input Impedance for EXTA_TRIG	20 kΩ		
Coupling	DC		
Overvoltage Protection	Continuous for ±35 V maximum		

Digital Trigger			
Model Number	**U2355A**	**U2356A**	**U2331A**
Compatibility	TTL/CMOS		
Response	Rising or falling edge		
Pulse width	20 ns minimum		

Calibration[3]			
Model Number	**U2355A**	**U2356A**	**U2331A**
On board reference	5 V		
Temperature drift	±2 ppm/°C		
Stability	±6 ppm/1000 hrs		

General			
Model Number	**U2355A**	**U2356A**	**U2331A**
Remote interface	USB 2.0 High Speed		
Device class	USBTMC Class Device		
Programmable interface	Standard Commands for Programmable Instruments(SCPI) and IVI-COM		

[1] System Scynchronous Interface (SSI) and Star-trigger commands are used when modular devices are used in instrument chassis.

[2] Maximum external reference voltage for analog output (AO_EXT_REF) is ±10 V.

[3] 20 minutes warm-up time is recommended.

Electrical Measurement Specifications

Basic Multifunction USB DAQ

Analog Input Measurement[1]				
Model Number	**U2351A/U2352A**		**U2353A/U2354A**	
Function	**23 °C ± 5 °C**	**0 °C - 18 °C 28 °C - 45 °C**	**23°C ± 5°C**	**0°C - 18°C 28°C - 45°C**
Offset Error	±1 mV	±5mV	±1 mV	±5mV
Gain Error	±2 mV	±5mV	±2mV	±5mV
–3dB small signal bandwidth	760 kHz		1.5 MHz	
1% THD large signal bandwidth	300 kHz		300 kHz	
System noise	1 mVrms	2 mVrms	1 mVrms	2.5 mVrms
CMRR	62 dB		62 dB	
Spurious-free dynamic range (SFDR)	88 dB		82 dB	
Signal-to-noise and distortion ratio (SINAD)	80 dB		78 dB	
Total harmonic distortion (THD)	–90 dB		–88 dB	
Signal-to-noise ration (SNR)	80 dB		78 dB	
Effective number of bits (ENOB)	13		12.6	

Analog Output Measurement[1]		
Model Number	**U2351A/U2353A**	
Function	**23 °C ± 5 °C**	**0 °C - 18 °C 28 °C - 45 °C**
Offset Error	±1 mV	±4 mV
Gain Error	±4mV	±5 mV
Slew rate	19 V/µs	
Rise time	0.7 µs	0.8 µs
Fall time	0.7 µs	0.8 µs
Settling time to 1% output error	4 µs	
Driving capability	5 mA	
Glitch energy	5 ns-V(Typical), 80 ns-V (Maximum)	

[1] Specifications are for 20 minutes of warm-up time, calibration temperature at 23 °C and input range of ±10 V.

High Density Multifunction USB DAQ

Analog Input Measurement[1]						
Model Number	**U2355A**		**U2356A**		**U2331A**	
Function	**23 °C ± 5 °C**	**0 °C - 18 °C 28 °C - 45 °C**	**23°C ± 5°C**	**0°C - 18°C 28°C - 45°C**	**23°C ± 5°C**	**0°C - 18°C 28°C - 45°C**
Offset Error	±1 mV	±2mV	±1 mV	±2mV	±2mV	±3mV
Gain Error	±2 mV	±3mV	±2mV	±6mV	±6mV	±7.5mV
–3dB small signal bandwidth	760 kHz		1.3 MHz		1.2 MHz	
1% THD large signal bandwidth	400 kHz		400 kHz		N/A	
System noise	1 mVrms	2 mVrms	1 mVrms	4 mVrms	3 mVrms	5 mVrms
CMRR	64 dB		61 dB		62 dB	
Spurious-free dynamic range (SFDR)	88 dB		86 dB		71 dB	
Signal-to-noise and distortion ratio (SINAD)	80 dB		78 dB		72 dB	
Total harmonic distortion (THD)	–90 dB		–90 dB		–76 dB	
Signal-to-noise ration (SNR)	80 dB		78 dB		72 dB	
Effective number of bits (ENOB)	13		12.6		11.6	

Analog Output Measurement[1]				
Model Number	**U2355A/U2356A**		**U2331A**	
Function	**23 °C ± 5 °C**	**0 °C - 18 °C 28 °C - 45 °C**	**23 °C ± 5 °C**	**0 °C - 18 °C 28 °C - 45 °C**
Offset Error	±1 mV	±4 mV	±1.5 mV	±3mV
Gain Error	±4 mV	±5 mV	±4 mV	±5 mV
Slew rate	19 V/µs		19 V/µs	
Rise time	0.7 µs	0.8 µs	0.7 µs	0.8 µs
Fall time	0.7 µs	0.8 µs	0.7 µs	0.8 µs
Settling time to 1% output error	4 µs		4 µs	
Driving capability	5 mA		5 mA	
Glitch energy	5 ns-V(Typical), 80 ns-V (Maximum)		5 ns-V(Typical), 80 ns-V (Maximum)	

[1] Specifications are for 20 minutes of warm-up time, calibration temperature at 23 °C and input range of ±10 V.

Test Conditions

Dynamic Range Test	Model Number	Test Conditions[1]	
SFDR, THD, SINAD, SNR, ENOB	U2351A U2352A U2355A	Sampling Rate: Fundamental Frequency: Number of points: Fundamental input voltage:	250 kSa/s 2.4109 kHz 8192 FSR –1dB FS
	U2353A U2354A U2356A	Sampling Rate: Fundamental Frequency: Number of points: Fundamental input voltage:	500 kSa/s 4.974 kHz 16384 FSR –1dB FS
	U2331A	Sampling Rate: Fundamental Frequency: Number of points: Fundamental input voltage:	3 MSa/s 29.892 kHz 65536 FSR –1dB FS

Dynamic Range Test	Model Number	Test Conditions[1]	
• –3dB small signal bandwidth • 1% THD large signal bandwidth	U2351A U2352A U2355A	Sampling Rate: Input voltage: 1. –3dB small signal bandwidth 2. 1% THD large signal bandwidth	250 kSa/s 10% FSR FSR –1dB FS
	U2353A U2354A U2356A	Sampling Rate: Input voltage: 1. –3dB small signal bandwidth 2. 1% THD large signal bandwidth	500 kSa/s 10% FSR FSR –1dB FS
	U2331A	Sampling Rate: Input voltage: 1. –3dB small signal bandwidth 2. 1% THD large signal bandwidth	3 MSa/s 10% FSR FSR –1dB FS

[1] DUT setting at ±10 V bipolar.

2 Installation

This chapter describes both the software and hardware installations of the Agilent U2300A series multifunction USB DAQ. It covers the pre- installation requirements of Agilent U2300A series multifunction USB DAQ and Agilent measurement manager software.

System Requirements

Prior to installing the Agilent Measurement Manager software and the USB DAQ driver, make sure your PC meets the following minimum system requirements.

Hardware Requirements

Processor 500 MHz Pentium III or higher required
(1 GHz is recommended)

Operating system Windows 2000/XP

Browser Microsoft Internet Explorer 5.01 and above

Available RAM 256 MB above is recommended

Available disk space

225 MB required for installation
160 MB for Microsoft .NET Framework
65 MB for Agilent IO Libraries Suite
8118 KB for Agilent U2300A DAQ Driver
5125 KB for Agilent Measurement Manager Software

175 MB required for operation
110 MB for Microsoft .NET Framework
65 MB for Agilent IO Libraries Suite
8118 KB for Agilent U2300A DAQ Driver
5125 KB for Agilent Measurement Manager Software

Video Super VGA (800x600) 256 colors or more

Software Requirements

Software requirements Agilent IO Libraries Suite, T&M Toolkit and Microsoft .NET Framework version 1.0 and 2.0

The Agilent IO Libraries Suite version 14.2 and above is recommended. If possible, you should use the current version of the Agilent IO Libraries Suite. Alternatively, you can install the Agilent IO Libraries Suite with the required version directly from the *Agilent Automation-Ready CD*.

NOTE You are required to install the Agilent IO Libraries and DAQ Hardware Driver before installing the Agilent Measurement Manager Software. You are recommended to follow in sequence.

Agilent IO Libraries Suite Installation

Pre-installation of Agilent IO Libraries Suite

- The Agilent IO Libraries Suite version 14.2 and above is recommended. If possible, you should use the current version of the Agilent IO Libraries Suite. Alternatively, you can install the Agilent IO Libraries Suite with the required version directly from the *Agilent Automation-Ready CD*.
- Disconnect any USB instruments that are connected to your PC.
- Shut down all other applications that are running on your PC.

Installing Agilent IO Libraries Suite from the Automation-Ready CD

1. Go to **Start > Run** and type `<drive>:\Autorun`.
2. Click OK to open the Autorun folder.
3. Double- click the auto.exe icon to launch the installation.

Installing Agilent IO Libraries Suite from the Web

1. Go to http://www.agilent.com/find/iolib to obtain the Agilent IO Libraries Suite.
2. Download the IO Libraries Suite self- extrating zip file (*.exe) to any location on your hard disk.
3. Double- click the downloaded installation file (*.exe) to launch the installation.

- After the installation is completed, reconnect any devices that you disconnected prior to installing.
- For detailed installation instructions, refer to the *Agilent IO Libraries Suite Getting Started Guide*, which is available online.

DAQ Driver Installation

NOTE The USB DAQ driver only compatible with Windows 2000 and Windows XP.

NOTE Ensure that the U2300A series USB DAQ is disconnected from PC before installing the driver.

Pre-installation of USB DAQ driver

- Verify that your PC meets the minimum hardware requirements as stated in System Requirements.
- Disconnect and unplug the U2300A USB DAQ from your PC.
- Ensure that Agilent IO Libraries Suite is installed before proceeding.

Installing the USB DAQ driver

1. Unpack the U2300A series USB DAQ.
2. Insert the *Product Reference CD-ROM* into the CD- ROM drive.

3 Installer will automatically execute the Agilent U2300 Series Installation Menu. Click **Hardware Driver** to begin the installation of USB DAQ driver.

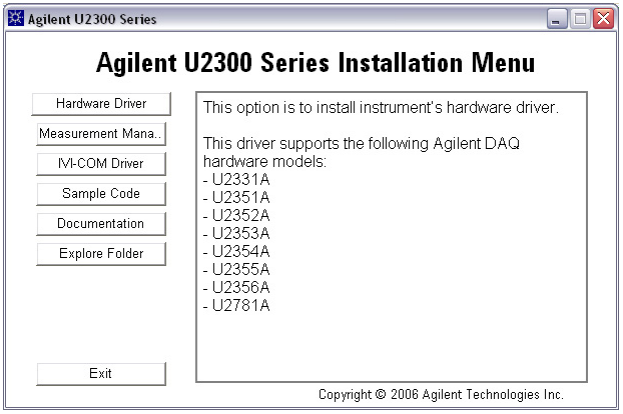


Figure 2-1

4 If it does not auto execute, go to **Start > Run** (on the Windows Start menu) and type `<drive>:\Driver\Hardware\setup_hw.exe`, where <drive> is your CD- ROM drive. Click **OK** to begin installation.

5 The Agilent USB DAQ Driver dialog box will appear as shown in figure 2- 2. Click **Next** to proceed.

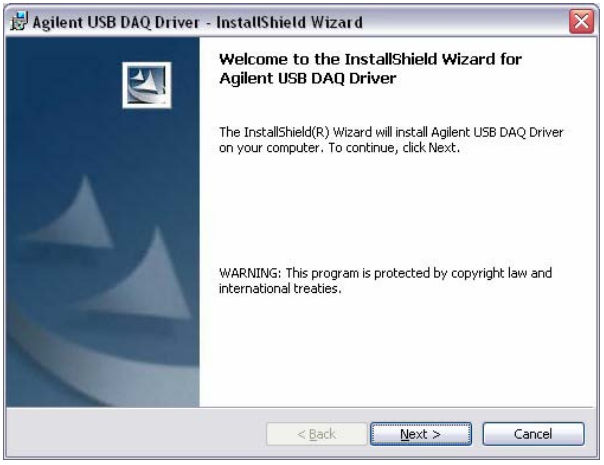


Figure 2-2

6 Click **Install** to begin installation.

Figure 2-3

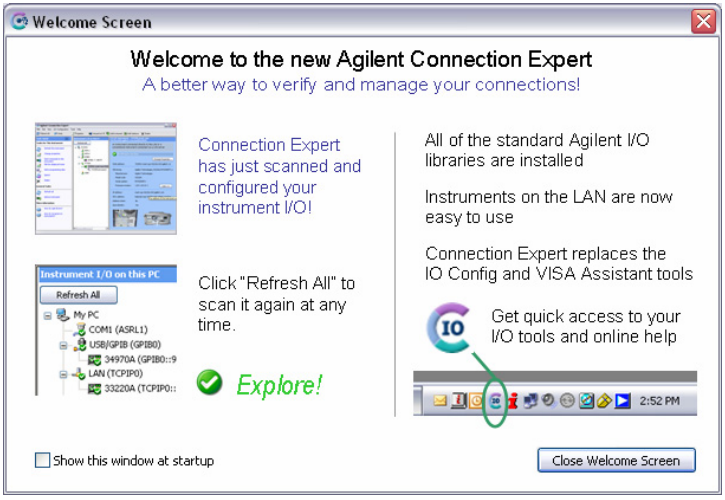
7 Click **Finish** when the installation is completed.

Figure 2-4

Hardware Verification

To verify that the hardware plugged in and installed is connected properly, run the Agilent Connection Expert to do the hardware verification

Agilent Connection Expert is one of the utility files in the Agilent IO Libraries. The Connection Expert configures connected instruments and enables communication. Connection Expert will automatically detect the USB instruments when connected.



1 Click **Start > All Programs > Agilent IO Libraries Suite > Agilent Connection Expert** to start Agilent Connection Expert .

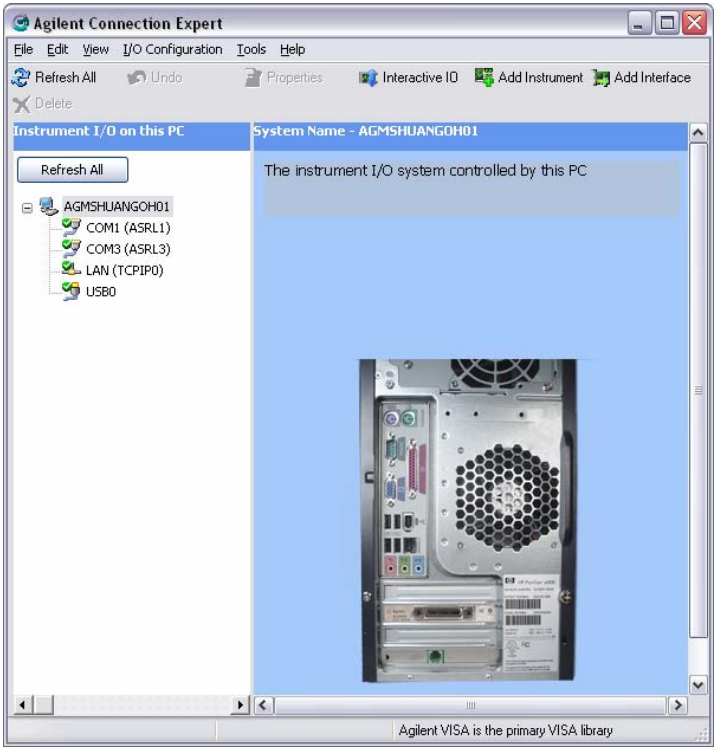


Figure 2-5

2 The connected DAQ device is now visible on the Connection Expert tree under the interface to which it is connected as shown in Figure 2- 6.

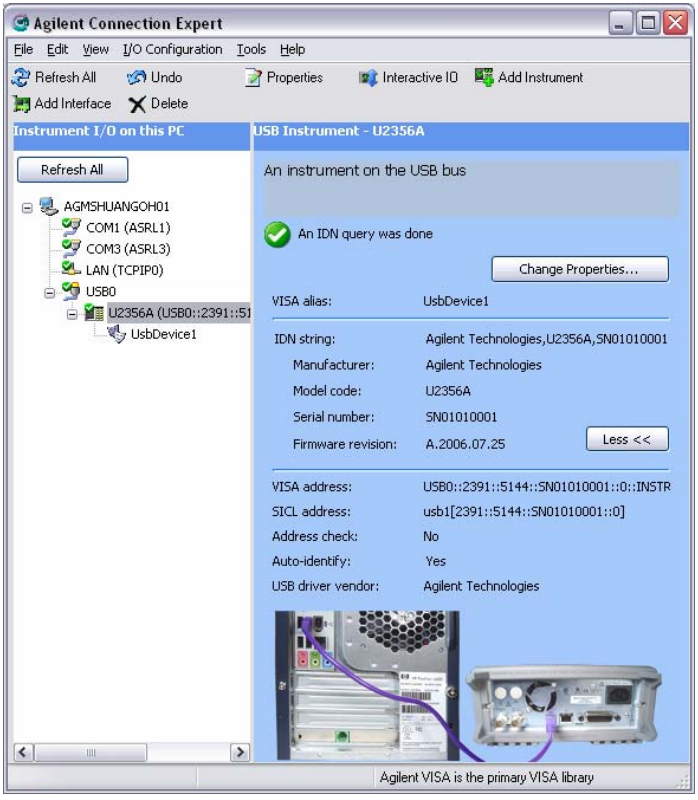


Figure 2-6

3 Click on the connection interface where the DAQ is connected to view the advanced properties of the DAQ as shown in Figure 2- 6:

- model code
- serial number
- firmware revision

4 To send a command to the connected instrument, click **Interactive IO** from the tools panel as highlighted in Figure 2- 7.

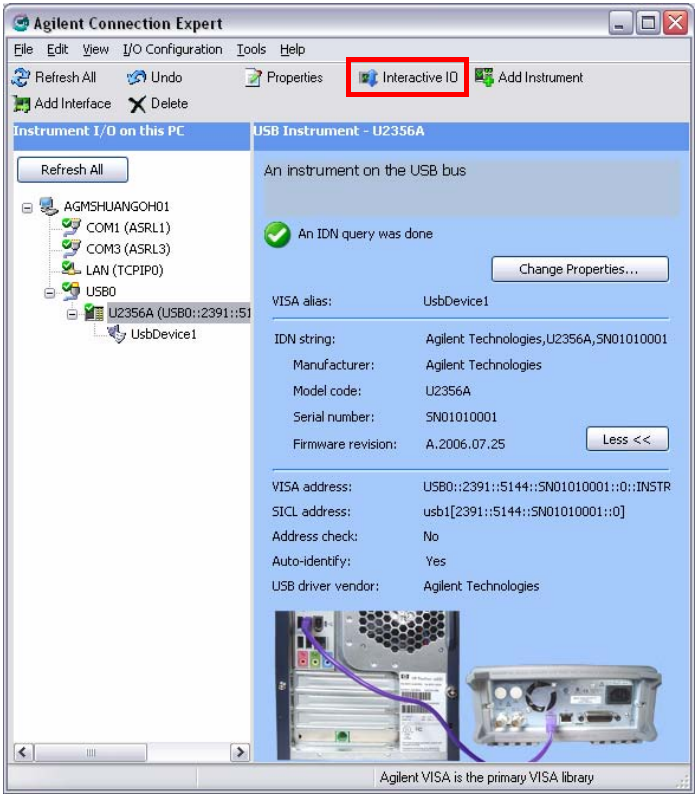


Figure 2-7

5 Agilent Interactive IO interface will appear. Click the **Send & Read** to send the `*IDN?` default command. The instrument's response should appear in the Instrument Session History section as shown in Figure 2- 8.

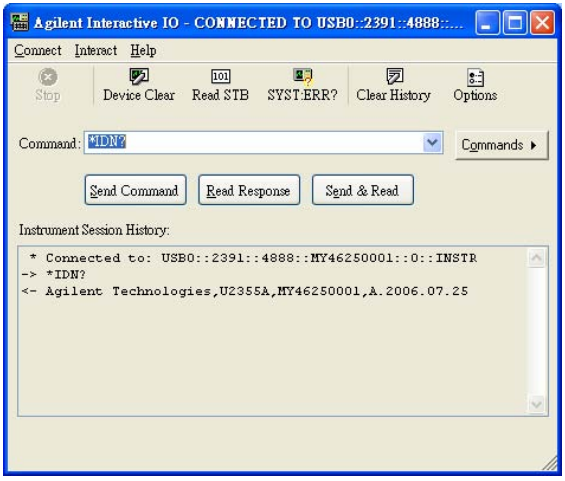


Figure 2-8

Agilent Measurement Manager Software Installation

1 Verify that your PC meets the minimum requirements as stated in System Requirements. Close all other applications on your PC and insert the *Product Reference CD-ROM* into your CD-ROM drive.

2 Click **Measurement Manager** on the Agilent U2300 Series Installation Menu to begin the installation of Agilent Measurement Manager Software.

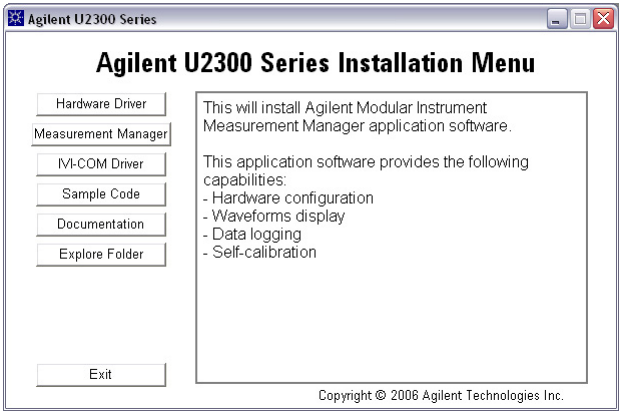


Figure 2-9

3 If the installation menu does not appear after a few seconds, select **Start > Run** (on the Windows Start menu) and type `<drive>:\autorun.exe`, where <drive> is your CD-ROM drive. Click **OK** to begin installation.

4 InstallationShield Wizard dialog box will show pre-requisite software as shown in Figure 2-10 if your PC does not meet

thesoftware requirements stated in *Chapter 2: Software Requirements*.

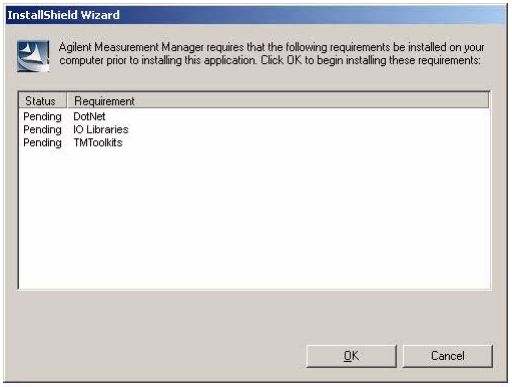


Figure 2-10

5 Click **OK** to begin installing the first requirement. If you do not have missing requirements in your system, proceed to step 25 to begin Agilent Measurement Manager software installation.

6 Click **Next** on the Microsoft .NET Framework 2.0 Setup dialog box to proceed with the installation of .NET framework.

Figure 2-11

7 Read the End- User License Agreement and select “I accept the terms of the License Agreement” to accept the agreement.

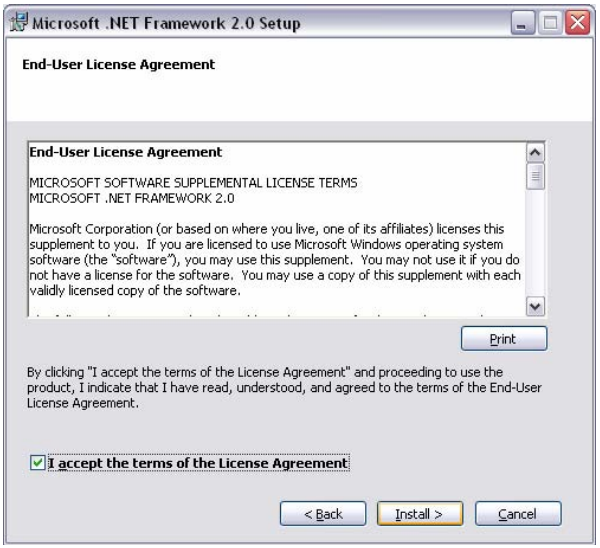


Figure 2-12

8 Click **Install** to begin installation.

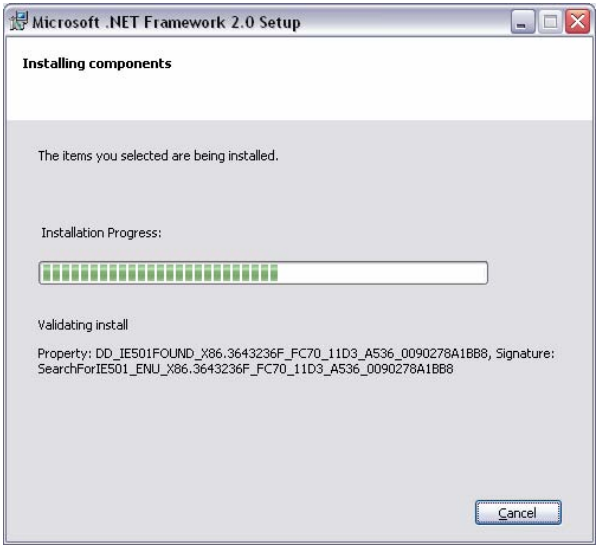


Figure 2-13

9 Click **Finish** when the installation has successfully installed.

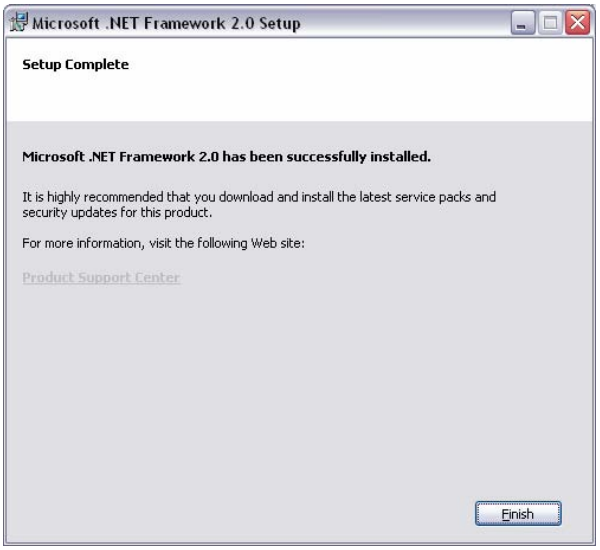


Figure 2-14

10 Wait for a few seconds to allow the wizard to begin the second requirement setup.

11 The Agilent IO Libraries Suite 14.2 InstallShield dialog box will appear as shown in Figure 2- 15. Click **Next** to begin installation.

Figure 2-15

12 Read the License Agreement and select “I accept the terms of License Agreement” to accept the agreement. You may click **Print** to print out the license agreement for reference.

Figure 2-16

13 Click **Next** to proceed with the setup. Then select **Typical** to install recommended features for your configuration. Click **Next** to proceed.

Figure 2-17

14 Review your settings on the settings dialog box as shown in Figure 2- 18, then click **Install** to begin installation.

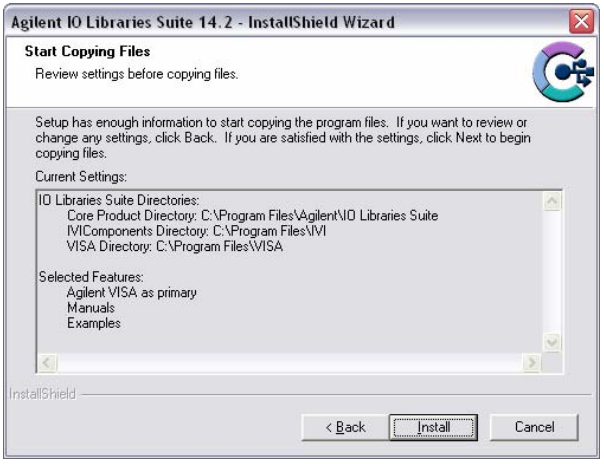


Figure 2-18

15 Click **Finish** when installation successfully completed. You may select “Yes, I want to view the Read Me” file to open the Read Me file or “Yes, I want to connect to my instrument” to launch the Agilent Connection Expert. Then click **Finish** to launch your selection.

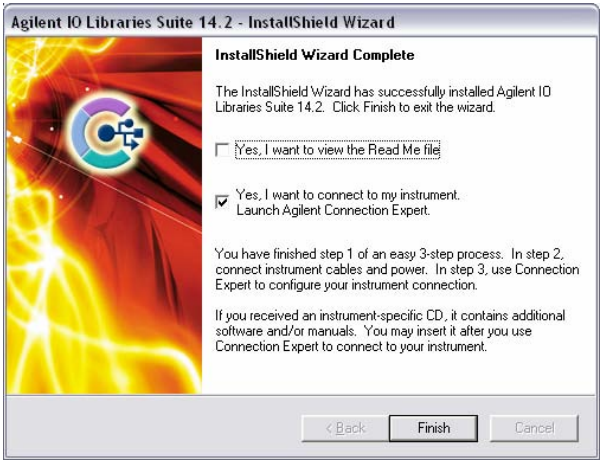


Figure 2-19

16 Wait for a few seconds after the Agilent IO Libraries Suite installation. InstallShield Wizard will begin the Agilent T&M Toolkit Redistributable Package 2.1 Setup

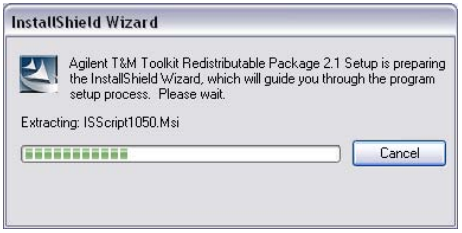


Figure 2-20

17 Click **Next** to begin the installation.

Figure 2-21

18 Read the License Agreement and click **Yes** to accept the agreement.

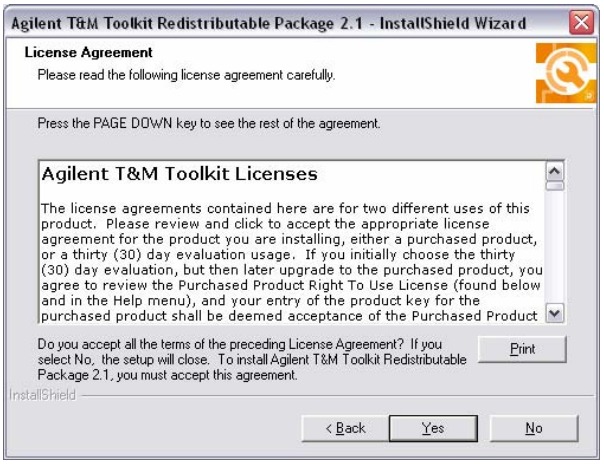


Figure 2-22

19 Key in the information in the Customer Information dialog box as shown in Figure 2- 23 accordingly and click **Next** to proceed.

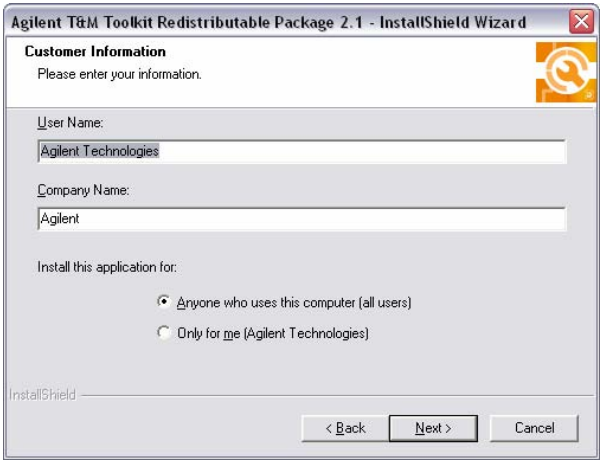


Figure 2-23

20 Click **Next** to install to the stated folder as shown in Figure 2- 24 or click **Browse** to install to a different folder.

Figure 2-24

21 Review the setup settings as shown in Figure 2- 25 then click **Next** to proceed.

Figure 2-25

22 Agilent T&M Toolkit Redistributable Package 2.1 will begin installing as shown in Figure 2- 26.

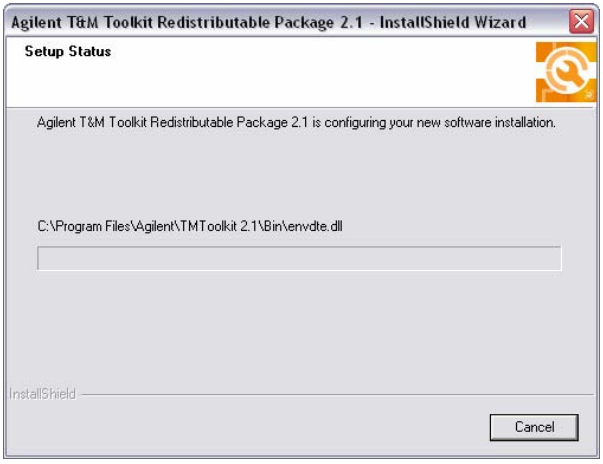


Figure 2-26

23 Click **Finish** when the installation is completed.

Figure 2-27

24 After installing Agilent T&M Toolkit Redistributable Package 2.1 wait for a few seconds to allow the Agilent Measurement Manager Software setup to begin.

25 Once you have all the software requirements installed, the Agilent Measurement Manager software installation dialog box as shown on Figure 2- 28 will appear. Click **Next** to begin.

Figure 2-28

26 Read the License Agreement and select "I accept the terms in the License Agreement" to accept the agreement. You may click **Print** to print out the Agilent License Terms for reference. Click **Next** to proceed.

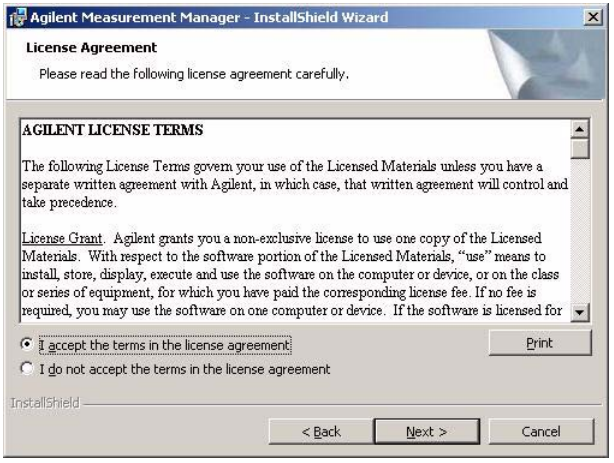


Figure 2-29

27 Key in your information accordingly in the Customer Information dialog box, then click **Next**.

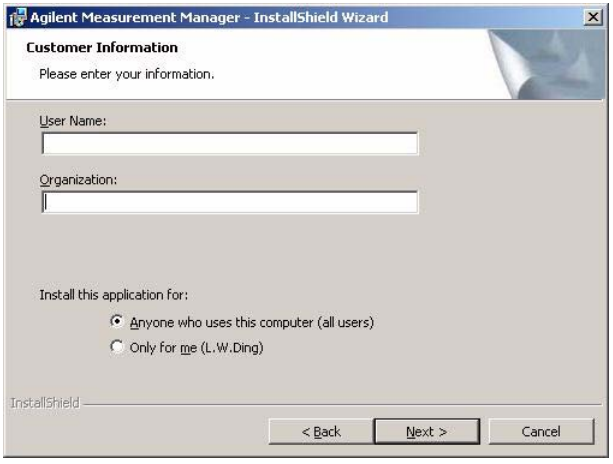


Figure 2-30

28 Click **Next** to install to the folder specified as shown in Figure 2-31 or click **Change** to install to a different folder.

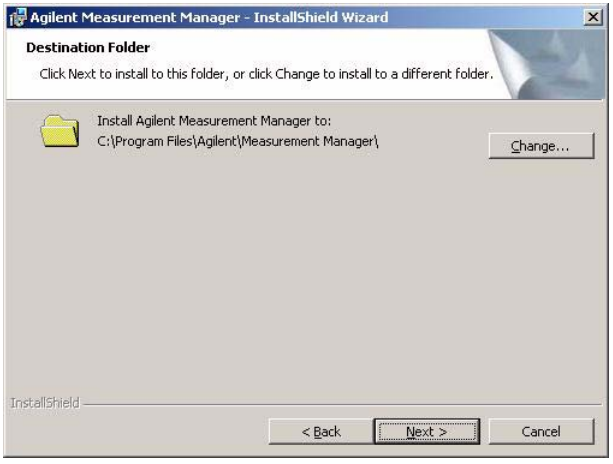


Figure 2-31

29 Click **Install** to begin the installation.

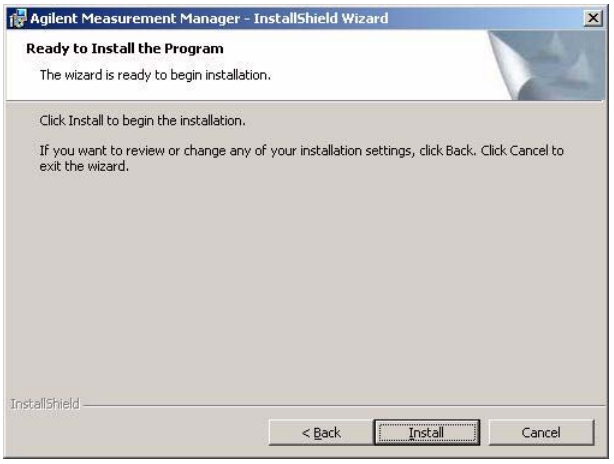


Figure 2-32

30 Click **Finish** when the installation is completed.

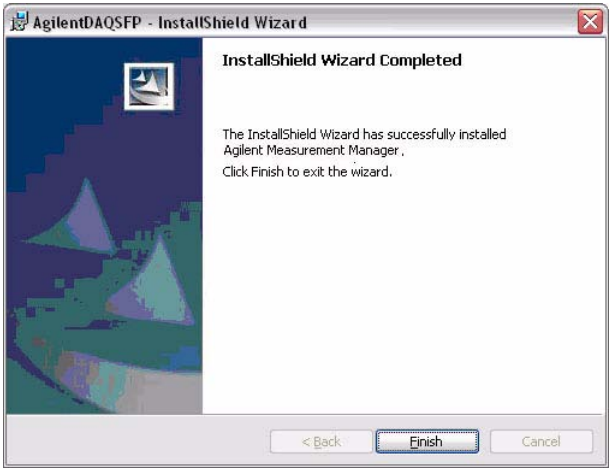


Figure 2-33

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.

IVI-COM Installation

Ensure that Agilent IO Libraries Suite is installed before proceeding.

1 Click **IVI-COM Driver** on Agilent U2300 Series Installaton Menu to install the IVI- COM.

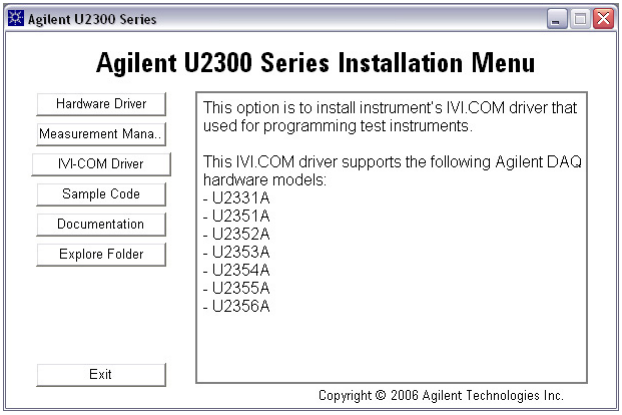


Figure 2-34

2 Ensure that IVI Shared Components version 1.2.1.0 and above is installed before installing the driver. You can find the IVI Shared Components on the IVI website at http://www.ivifoundation.org.

3 Setup wizard will alert if the VISA- COM is not installed on your system. VISA- COM is required for the driver to communicate with your instrument. It is not a setup requirements for IVI- COM, therefore you may choose to install them at a later time. You can

obtain VISA- COM from the *Agilent Automation-Ready CD* that comes with Agilent U2300 standard purchase. Click **Next** to begin.

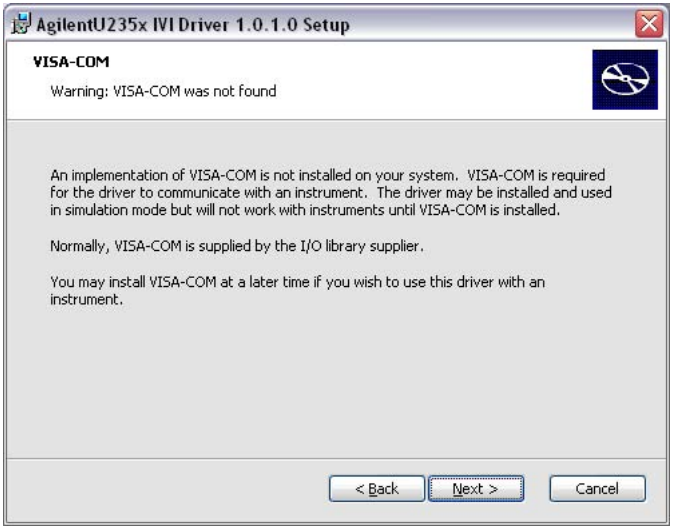


Figure 2-35

4 When the Agilent U23xx IVI Driver 1.0.0.0 Setup Wizard begin, click **Next** to begin installation.

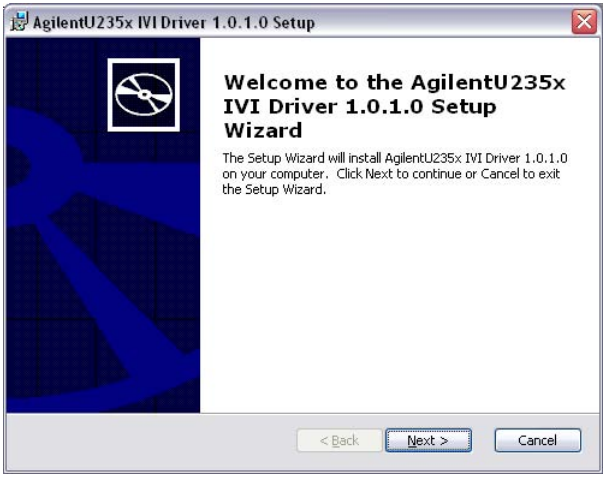


Figure 2-36

5 Read the End- User License Agreement and select “I accept the terms in the License Agreement” to proceed. Then click **Next**.

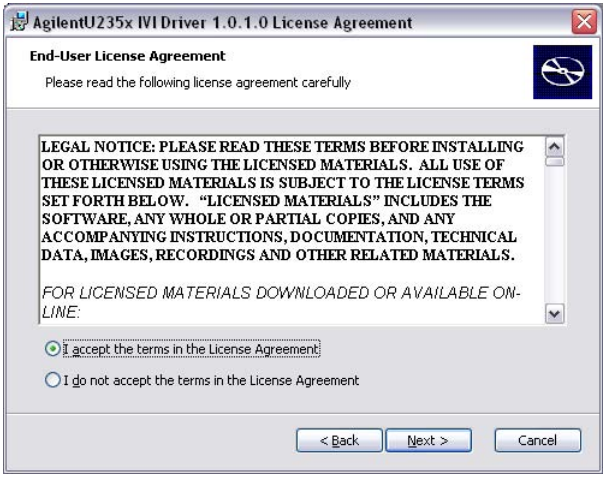


Figure 2-37

6 Select **Typical** to install the most common program features that is recommended for most users. You may click **Custom** to customize your installation, which is recommended only for advance users.

You may click **Complete** to install full features in your system which requires more disk space.

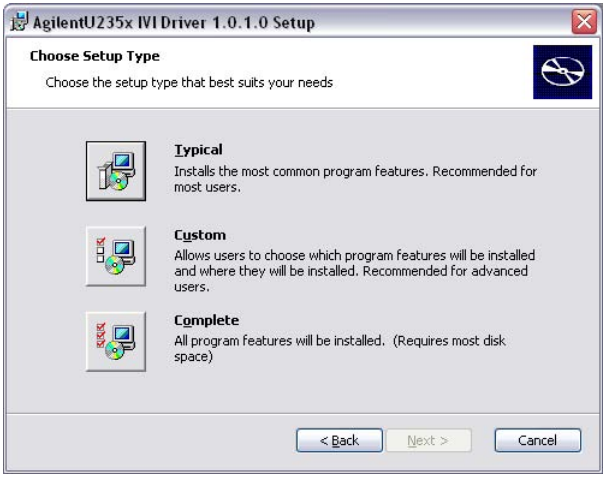


Figure 2-38

7 Click **Install** to begin installation.

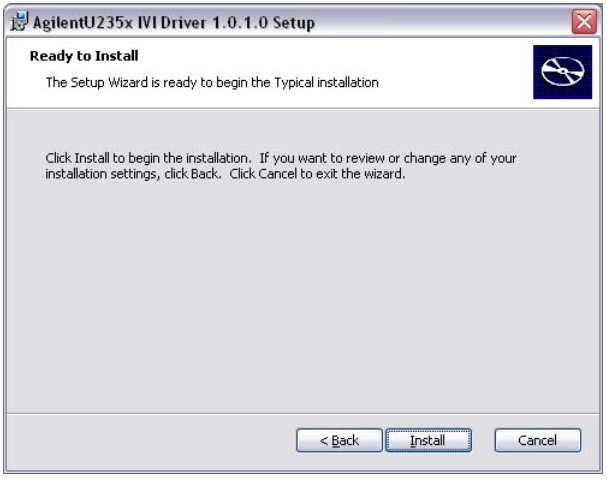


Figure 2-39

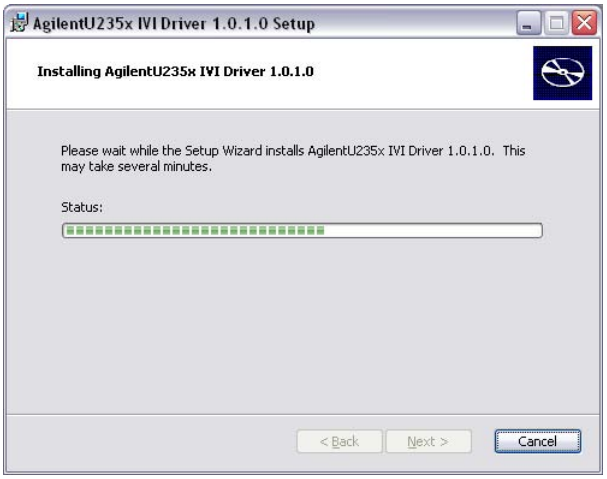


Figure 2-40

8 Click **Finish** when installation completed.

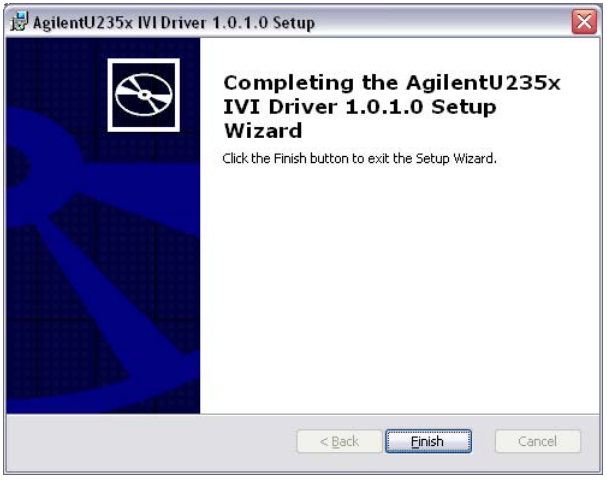


Figure 2-41

3
Pin Connection

This chapter describes the U2300A series USB DAQ pin connections and the signal connection between the U2300A and external devices.

Connector Pin Assignment

The U2300A series DAQ is equipped with 68–pin Very High Density Cable Interconnect (VHDCI) type connectors. These connector pins are used for digital input/output, analog input/output, counters and other external reference/trigger signal.

AI101	(AIH101)	1	35	(AIL101)	AI133
AI102	(AIH102)	2	36	(AIL102)	AI134
AI103	(AIH103)	3	37	(AIL103)	AI135
AI104	(AIH104)	4	38	(AIL104)	AI136
AI105	(AIH105)	5	39	(AIL105)	AI137
AI106	(AIH106)	6	40	(AIL106)	AI138
AI107	(AIH107)	7	41	(AIL107)	AI139
AI108	(AIH108)	8	42	(AIL108)	AI140
AI109	(AIH109)	9	43	(AIL109)	AI141
AI110	(AIH110)	10	44	(AIL110)	AI142
AI111	(AIH111)	11	45	(AIL111)	AI143
AI112	(AIH112)	12	46	(AIL112)	AI144
AI113	(AIH113)	13	47	(AIL113)	AI145
AI114	(AIH114)	14	48	(AIL114)	AI146
AI115	(AIH115)	15	49	(AIL115)	AI147
AI116	(AIH116)	16	50	(AIL116)	AI148
	AI_SENSE	17	51	AI_GND	
AI117	(AIH117)	18	52	(AIL117)	AI149
AI118	(AIH118)	19	53	(AIL118)	AI150
AI119	(AIH119)	20	54	(AIL119)	AI151
AI120	(AIH120)	21	55	(AIL120)	AI152
AI121	(AIH121)	22	56	(AIL121)	AI153
AI122	(AIH122)	23	57	(AIL122)	AI154
AI123	(AIH123)	24	58	(AIL123)	AI155
AI124	(AIH124)	25	59	(AIL124)	AI156
AI125	(AIH125)	26	60	(AIL125)	AI157
AI126	(AIH126)	27	61	(AIL126)	AI158
AI127	(AIH127)	28	62	(AIL127)	AI159
AI128	(AIH128)	29	63	(AIL128)	AI160
AI129	(AIH129)	30	64	(AIL129)	AI161
AI130	(AIH130)	31	65	(AIL130)	AI162
AI131	(AIH131)	32	66	(AIL131)	AI163
AI132	(AIH132)	33	67	(AIL132)	AI164
	EXTA_TRIG	34	68	AI_GND	

Figure 3-1 Connector 1 pin assignment for U2355A/U2356A/U2331A

NOTE (AIH101..132) and (AIL101..132) are for differential mode connection pair.

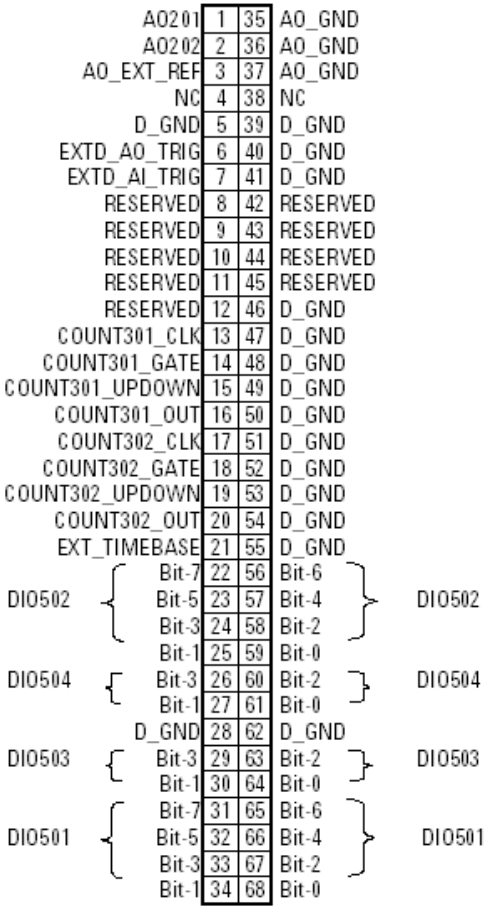


Figure 3-2 Connector 2 pin assignment for U2355A/U2356A/U2331A

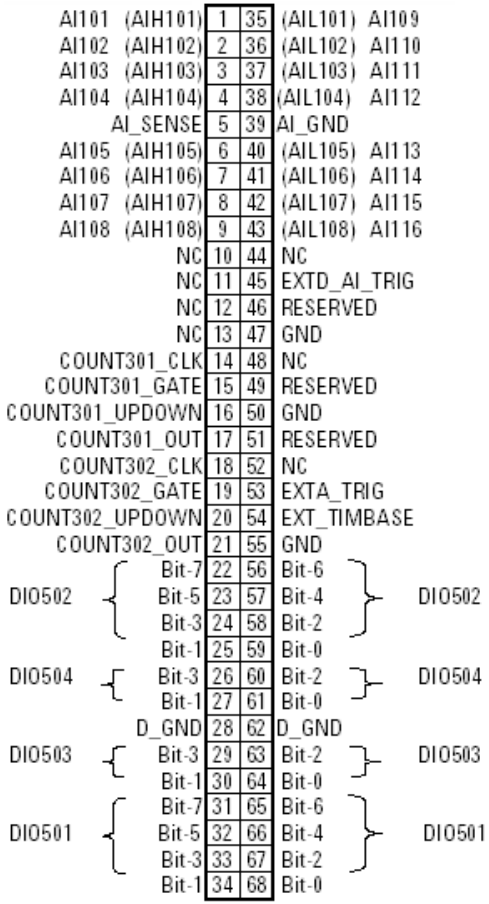


Figure 3-3 Connector pin assignment for U2352A/U2354A

NOTE (AIH101..108) and (AIL101..108) are for differential mode connection pair.

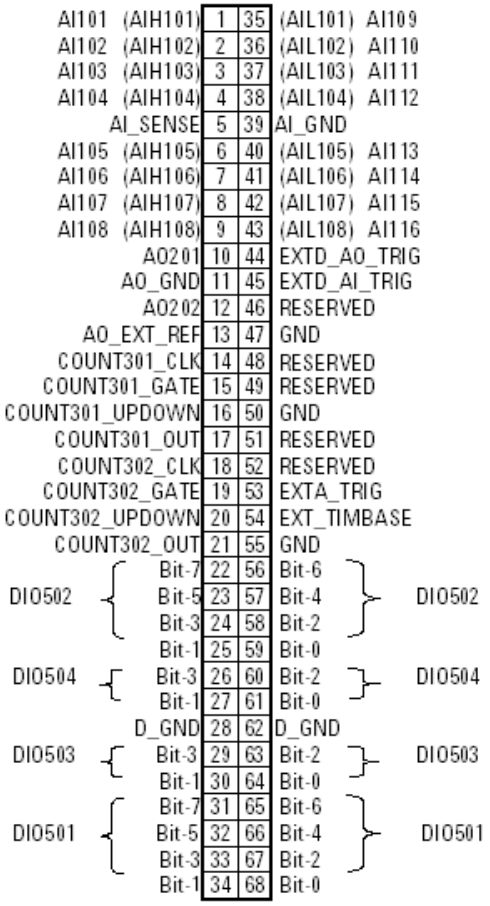


Figure 3-4 Connector pin assignment for U2351A/U2353A

NOTE (AIH101..108) and (AIL101..108) are for differential mode connection pair.

Table 3-1 Pin connection information of 68-pin VHDCI connectors

Signal Name	Direction	Reference Ground	Description
AI_GND	N/A	N/A	Analog input (AI) ground. All three ground references(AI_GND, AO_GND, and D_GND) are connected together on board.
For 16 Channels: AI<101..116> For 64 Channels: AI<101..164>	Input	AI_GND	**U2351A/U2352A/U2353A/U2354A** Analog input channels 101~116. Each channel pair, AI<i, i+8>(i = 101..108), can be configured either as two single-ended inputs or one differential input (marked as AIH<101..108> and AIL<101..108>). **U2331A/U2356A/U2355A** Analog input channels 101~164). Each channel pair, AI<i, i+32> (i = 101..132), is configured either as two single-ended inputs or one differential input (marked as AIH<101..132> and AIL<101..132>)
AI_SENSE	Input	AI_GND	Analog input sense. The reference pin for any AI<101..116> or AI<101..164> channels in NRSE input configuration.
EXTA_TRIG	Input	AI_GND	External AI analog trigger
AO201	Output	AO_GND	Analog output channel 1
AO202	Output	AO_GND	Analog output channel 2
AO_EXT_REF	Input	AO_GND	External reference for AO channels
AO_GND	N/A	N/A	Analog ground for AO
EXTD_AO_TRIG	Input	D_GND	External AO waveform trigger
EXTD_AI_TRIG	Input	D_GND	External AI digital trigger
RESERVED	Output	N/A	Reserved pins. Do not connect them to any signal.
COUNT<301,302>_CLK	Input	D_GND	Source of counter <301,302>
COUNT<301,302>_GATE	Input	D_GND	Gate of counter <301,302>
COUNT<301,302>_OUT	Input	D_GND	Output of counter <301,302>
COUNT<301,302>_UPDOWN	Input	D_GND	Up/Down of counter <301,302>
EXT_TIMEBASE	Input	D_GND	External Timebase
D_GND	N/A	N/A	Digital ground
DIO501<7,0>	PIO	D_GND	Programmable DIO of Channel 501
DIO502<7,0>	PIO	D_GND	Programmable DIO of Channel 502
DIO503<4,0>	PIO	D_GND	Programmable DIO of Channel 503
DIO504<4,0>	PIO	D_GND	Programmable DIO of Channel 504

11	GND	+12V	+12V	GND	USB_D+	USB_D-	GND
10	GND	+12V	+12V	+12V	GND	GND	GND
9	GND	+12V	+12V	+12V	GND	USB_VBUS	GND
8	GND	LBL0	BRSV	GND	TRIG0	LBR0	GND
7	GND	LBL1	GA0	TRIG7	GND	LBR1	GND
6	GND	LBL2	GA1	GND	TRIG1	LBR2	GND
5	GND	LBL3	GA2	TRIG6	GND	LBR3	GND
4	GND	LBL4	STAR_TRIG	GND	TRIG2	LBR4	GND
3	GND	LBL5	GND	TRIG5	GND	LBR5	GND
2	GND	LBL6	CLK10M	GND	TRIG3	LBR6	GND
1	GND	LBL7	GND	TRIG4	GND	LBR7	GND
	Z	A	B	C	D	E	F

Figure 3-5 55-pin backplane connector pin assignment

NOTE The 55-pin backplane connector is used when the DAQ devices are used as modular with the modular instrument chassis. For more detail, refer to Agilent U2781A Modular Instrument Chassis User's Guide.

Table 3-2 Pin information of SSI connector

SSI timing signal	Functionality
+12V	+12 V power from backplane
GND	Ground
BRSV	Reserved pin
TRIG0~TRIG7	Trigger bus 0 ~ 7
STAR_TRIG	Star trigger
CLK10M	10MHz reference clock
USB_VBUS	USB bus power, +5 V
USB_D+, USB_D-	USB differential pair
LBL <0..7> and LBR <0..7>	Reserved pin
GA0, GA1, GA2	Geographical address pin

Analog Input Signal Connection

The Agilent U2300A series DAQ provides up to 64 single–ended (SE) or 32 differential analog input (DI) channels. The analog signal is converted to digital represented value by the A/D converter. In order to obtain a more accurate measurement from the A/D conversion, it is important to understand the type of signal source of analog input modes RSE, NRSE and DIFF.

Types of Signal Sources

Ground-Referenced Signal Sources

A ground- referenced signal source is defined as signal source that is connected in some way to the building ground system. This means the signal source is connected to a common ground point with respect to the U2300A series DAQ (assume the host PC which is connected with DAQ is in the same power ground).

Floating Signal Sources

A floating signal source is a signal that is not connected to the building ground system. It is also a device with an isolated output. Example of floating signal sources are optical isolator output, transformer output and thermocouple.

Input Configurations

Single-ended Connections

A single- ended connection is applicable when the analog input signal is referenced to a ground and can be shared with other analog input signals. There are two different types of single- ended connections, which are RSE and NRSE configuration.

Referenced Single-ended (RSE) Mode In referenced single- ended mode, all the input signals are connected to the ground provided by the U2300A series DAQ and suitable for connections with floating signal sources. Figure 3- 6 illustrates the RSE mode.

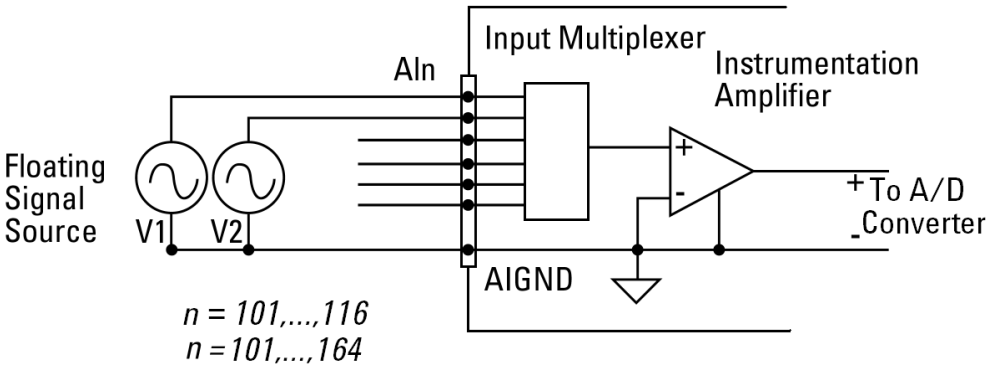


Figure 3-6 Floating source and RSE input connections

NOTE When more than two floating sources are connected, these sources are referenced to the same common ground.

Non-Referenced Single-ended (NRSE) Mode In NRSE mode, the DAQ device does not provide the grounding point. The ground reference point is provided by the external analog input signal. You can connect the signals in NRSE mode to measure ground- referenced signal sources, which are connected to the same grounding point. Figure 3- 7 illustrates the connection. The signal local ground reference is connected to the negative input of the instrumentation Amplifier (AI_SENSE pin on connector1). Hence, any potential difference of the common mode ground between signal ground and the signal ground on DAQ board will be be rejected by the instrumentation amplifier.

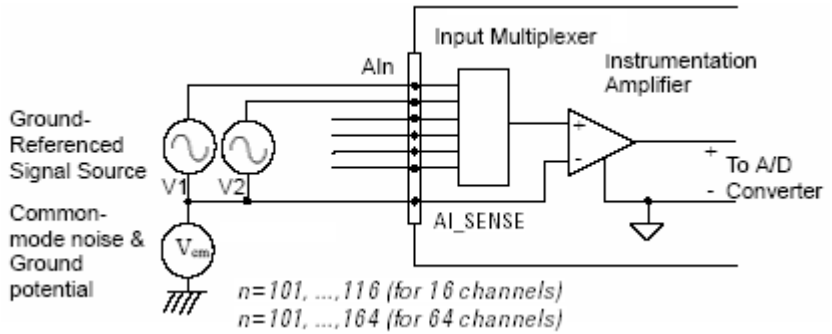


Figure 3-7 Ground-referenced sources and NRSE input connections

Differential Input Mode

The differential input mode provides two inputs that respond to the difference of the signal voltage. The analog input of the U2300A series DAQ has its own reference ground or signal return path. The differential mode can be used for the common- mode noise rejection if the signal source is ground- referenced. Figure 3- 8 shows the connection of ground- referenced signal sources under differential input mode.

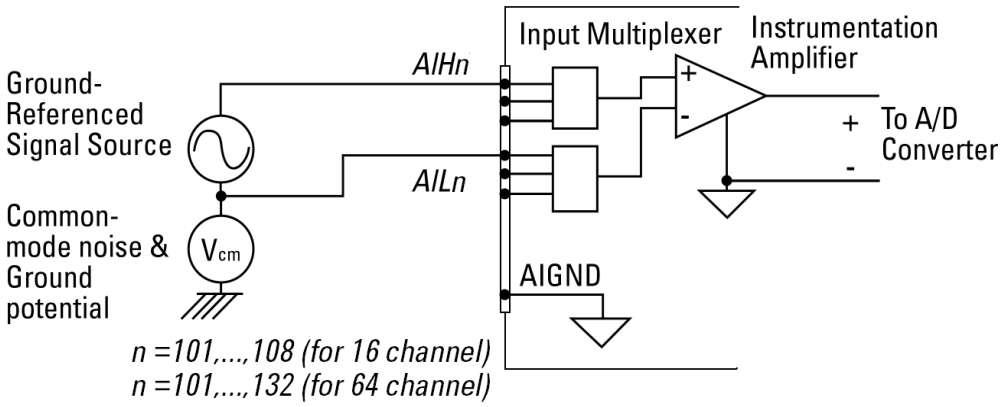


Figure 3-8 Ground–referenced source and differential input mode

Figure 3- 9 illustrates the connection of a floating signal source to the U2300A series DAQ in differential input mode. For floating signal sources, additional resistor is needed at each channel to provide a bias return path. The resistor value is equivalent to about 100 times the source impedance. If the source impedance is less than 100 Ω, you can connect the negative polarity of the signal directly to AI_GND, as well as the negative input of the Instrumentation Amplifier. The noise couples in differential input mode are less compared to the single- ended mode.

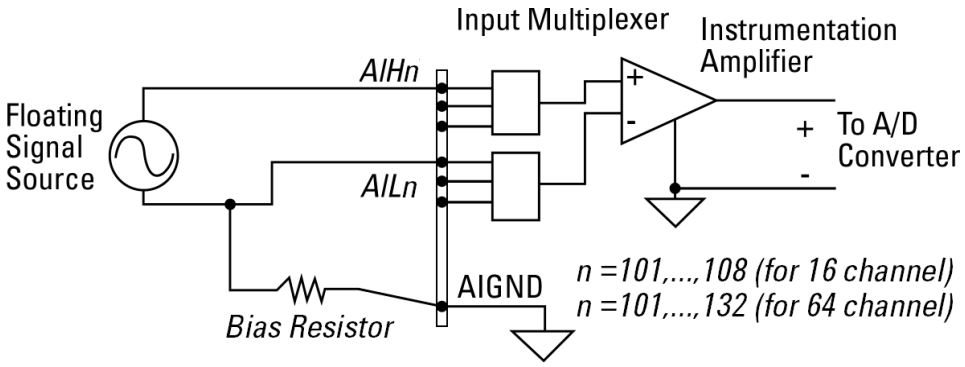


Figure 3-9 Floating source and differential input

NOTE

- Agilent 2300A series DAQ is designed as high input impedance. Please make sure that all the connection are connected properly before acquiring any data. Failing to do so may cause data fluctuation or erroneous readings.
- Unused pin at multiplexing DAQ inputs can be treated as floating source with infinite output impedance. Therefore necessary grounding system is required in user application system.

4
Features and Functions

This chapter describes the features and functions of the Agilent U2300A series multifunction USB DAQ. This includes the operations of the analog input operation mode, analog output operation mode, Digital I/O and General Purpose Digital Counter. This chapter also explains the trigger sources.

Analog Input Operation Mode

Analog- to- Digital (A/D) conversion converts analog voltage into digital information, which enables the computer to process or to store the signals. Before using an A/D converter, you should define the properties of the measured signals, which are the range, polarity (Unipolar/Bipolar) and signal type. You can also set the desired channels.

The A/D acquisition requires a trigger source. Once the trigger condition is matched, only then the data acquisition begins. The measured signal is buffered in a Data FIFO. The analog inputs are able to provide input voltages between ±1.25 V to ±10 V (16- bit ADC), except for U2331A with ±0.05 V to ±10 V (12- bit ADC). Figure 1 illustrates the functional block diagram of the U2300A series DAQ.

In Figure 1, when the U2300A series DAQ is switched on, the calibration constants is loaded from the on- board EEPROM to ensure both the Calibration DACs and PGA circuit functioning correctly. Users are required to set the input configuration in the Scan List, trigger source and trigger mode using the SCPI commands. The DAQ will start with different scan data acquisition timing when the trigger condition is matched and trigger event will take place. The data will be transferred to the system memory using suitable data transfer mode. The input signal types are single- ended and differential.

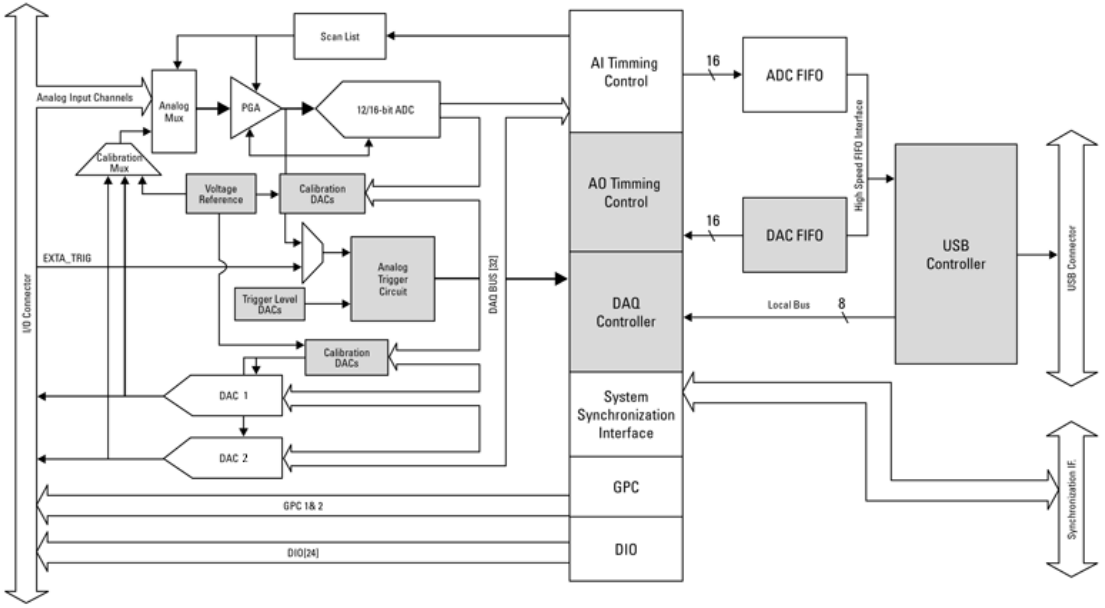


Figure4-1 Functional block diagram of U2300A series DAQ

There are two different modes of analog input operation, which are the polling and continuous.

Polling mode

This is the easiest way to acquire a single A/D data. The A/D converter starts converting one reading whenever the dedicated software command is executed. This mode is well suited in applications that need to process A/D data in real time. In this mode, the timing of the A/D conversion is fully controlled by software. However, it is difficult to control the A/D conversion rate.

In polling mode, the properties of the measured signal should be defined. The properties are range, polarity (unipolar/bipolar) and signal type. Signal type consists of RSE, NRSE and DIFF.

The default polarity is bipolar. The SCPI command for performing the polling mode measurement is under MEASure subsystem.

NOTE For more information on MEASure subsystem, refer to the Agilent U2300A Series Programming Guide.

Continuous mode

Continuous mode is divided into two types, single- shot and continuous acquisition. In single- shot acquisition, the data is acquired at a specified sample points and processed once. On the other hand, the continuous acquisition allows you to acquire data continuously until a STOP command is sent. The SCPI commands below are used to start the acquisition process:

- Single shot acquisition - SCPI: `DIGitize`
- Continuous acquisition - SCPI: `RUN`

In continuous mode, there are two parameters that need to be specified:

- **Sampling rate**

  Specify the sampling rate of each AI channel. Since U2300A series DAQ are with multiplexing analog input, the maximum sampling rate depends on the ADC's sampling rate and the entry number in scan list.

  For example, if four channels are specified in the scan list of U2356A, the maximum sampling rate is actually 500 kSa/s divided by four, which is 125 kSa/s. Meanwhile in U2331A, the maximum sampling rate is only up to 1 MSa/s when switching of multiple channels is enabled.

- **Sample points**

  Specify the number of acquisition points for the channel. For example, if 800 sample points and four channels are specified in scan list, there will be total of 3200 samples to be acquired.

NOTE The maximum sample points are 8 MSa.

Scan List (For Continuous Mode only)

You are required to set up the scan list to include all desired analog input channels. By default, the U2300A series scans only the CH101 with the following settings:

- Range: ±10 V
- Input signal type: Single- ended
- Polarity: Bipolar

The settings in channel configuration entry remain unchanged when the desired data is sampled. You do not need to reconfigure the channel configuration entry if you wish to sample new data using the same order and settings. The maximum number of entries you can set is 100. Table 4- 1 shows the structure of a scan list.

Table 4-1 Structure of a scan list with four entries

CHANNEL	RANGE	POLARITY	SIGNAL TYPE
108	10	UNIP	SING
101	± 5	BIP	NRS
103	± 10	BIP	NRS
102	± 2.5	BIP	DIFF

To Build a Scan List

To build a scan list, follow the steps below:

- Use the `ROUTe:SCAN` command to define the list of channels in the scan list. To determine what channels are currently in the scan list, use the `ROUTe:SCAN?` query command.
- Use the `ROUTe:SCAN` command if you wish to overwrite the initial setting of the scan list.
- To initiate a scan sequence, use either the `DIGitize` or `RUN` command.

To stop a scan initiated by the `RUN` command, use the `STOP` command.

Burst Mode

The DAQ is equipped with BURST mode. This mode enables the DAQ to simulate in simultaneous mode. It would do the sampling measurement for the highest speed of the product capability. Figure 4- 2 illustrates an example of burst mode.

Example:

Sampling rate: 1 kSa/s

Number of sampling channles: three

Scan list sequence: 101, 102, 103

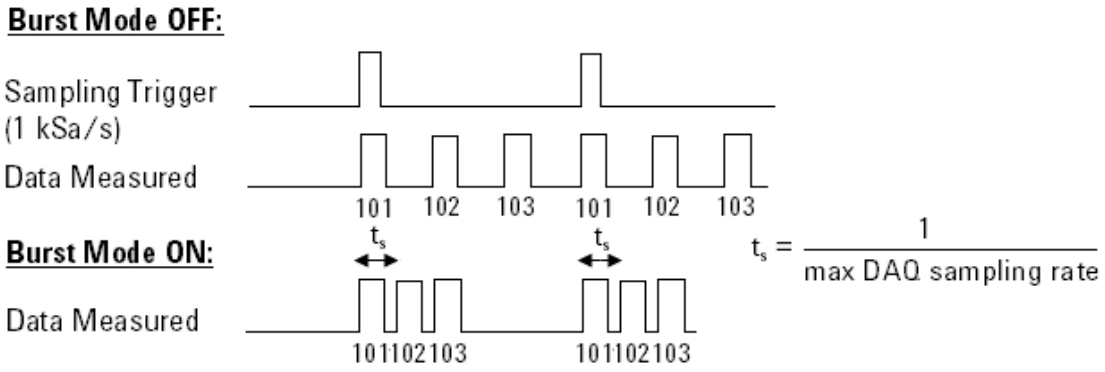


Figure4-2 Burst mode

A/D Data Conversion

The A/D data conversion involves the following processes:

- Acquired/raw data
- Raw data conversion

Acquired/raw data

Below is the illustrated example of scan list for CH 101, CH 102 and CH 103.

#800000200	<byte>	<byte>	<byte>	<byte>	<byte>	<byte>	<byte>	<byte>	...
Data length indicator, The next 8 bytes (0000 0200) specifying the actual data length only, not actual data. Data length (200 bytes long)	1st data LSB	1st data MSB	1st data LSB	1st data MSB	1st data LSB	1st data MSB	2nd data LSB	2nd data MSB	...
	CH 101		CH 102		CH 103		CH 101		...

16- bit Data Format:

LSB	MSB
DDDD DDDD	DDDD DDDD

12- bit Data Format:

LSB	MSB
DDDD XXXX	DDDD DDDD

D - Data bits

X - Unused bits

Raw data conversion

To convert the data into actual float number, we need the voltage range and polarity information. Below are the calculations on the raw data conversion for both bipolar and unipolar.

Bipolar:

$$\text{Converted value} = \left[\frac{2 * \text{Int16 value}}{2^{\text{resolution}}} \right] \text{x Range}$$

NOTE The converted value is of float type. As such, you may need to type cast the Int16 value to float in your programming environment.

Example:

For U2356A, the resolution is 16 bit and take the range as 10 V. The Int16b value calculated using conversion algorithm is 12768. Hence, the calculation will be:

$$\text{Converted value} = \left[\frac{2 * 12768}{2^{16}} \right] \text{x } 10$$

$$= 3.896 \text{ V}$$

Unipolar:

$$\text{Converted value} = \left[\frac{\text{Int16 value}}{2^{\text{resolution}}} + 0.5 \right] \text{x Range}$$

Example:

For U2356A, resolution is 16 bits and take the range as 10 V. The Int16b value calculated using conversion algorithm is 12768. The converted value will be:

$$\text{Converted value} = \left[\frac{12768}{2^{16}} + 0.5 \right] \text{x } 10$$
$$= 6.948 \text{ V}$$

NOTE For U2331A, there is a need to perform a 4-bit right shift operation. This is because it is equipped with 12-bit ADC and the last 4 bits are truncated.

AI Data Format

12-bit AI range

Table 4- 2 and 4- 3 describe the U2331A ideal transfer characteristics of the bipolar and unipolar analog input ranges.

NOTE The AI resolution of U2331A is 12 bits. The four lowest bits are truncated. In the tables below, X refers to four unused bits.

Table 4-2 Analog input range and digital code output for bipolar

Description	Bipolar analog input range				Digital code output
Full-scale Range (FSR)	±10 V	±5 V	±2.5 V	±1.25 V	
Least significant bit (LSB)	4.88 mV	2.44 mV	1.22 mV	0.61 mV	
FSR–1LSB	9.9951 V	4.9976 V	2.4988 V	1.2494 V	7FFX
Midscale +1LSB	4.88 mV	2.44 mV	1.22 mV	0.61 mV	001X
Midscale	0 V	0 V	0 V	0 V	000X
Midscale –1LSB	–4.88 mV	–2.44 mV	–1.22 mV	–0.61 mV	FFFX
–FSR	–10 V	–5 V	–2.5 V	–1.25 V	800X

Table 4-3 Analog input range and digital code output for unipolar

Description	Unipolar analog input range			Digital code output
Full-scale Range (FSR)	0 V to 10 V	0 V to +5 V	0 V to +2.5 V	
Least significant bit (LSB)	2.44 mV	1.22 mV	0.61 mV	
FSR–1LSB	9.9976 V	4.9988 V	2.9994 V	7FFX
Midscale +1LSB	5.00244 V	2.50122 V	1.25061 V	001X
Midscale	5 V	2.5 V	1.25 V	000X
Midscale –1LSB	4.9976 V	2.4988 V	1.2494 V	FFFX
–FSR	0 V	0 V	0 V	800X

16-bit AI range

Table 4- 4 and 4- 5 show the ideal transfer characteristics of bipolar and unipolar input ranges (U2351A/U2352A/U2353A/U2354A/U2355A/U2356A).

Table 4-4 Analog input range and digital code output for bipolar

Description	Bipolar analog input range				Digital code output
Full-scale Range (FSR)	±10 V	±5 V	±2.5 V	±1.25 V	
Least significant bit (LSB)	305.2 µV	152.6 µV	76.3 µV	38.15 µV	
FSR–1LSB	9.999695 V	4.999847 V	2.499924 V	1.249962 V	7FFF
Midscale+1LSB	305.2 µV	152.6 µV	76.3 µV	38.15 µV	0001
Midscale	0 V	0 V	0 V	0 V	0000
Midscale–1LSB	–305.2 µV	–152.6 µV	–76.3 µV	–38.15 µV	FFFF
–FSR	–10 V	–5 V	–2.5 V	–1.25 V	8000

Table 4-5 Analog input range and digital code output for unipolar

Description	Unipolar analog input range				Digital code output
Full-scale Range (FSR)	0 V to 10 V	0 V to +5 V	0 V to +2.5 V	0 V to +1.25 V	
Least significant bit (LSB)	152.6 µV	76.3 µV	38.15 µV	19.07 µV	
FSR –1LSB	9.999847 V	4.999924 V	2.499962 V	1.249981 V	7FFF
Midscale +1LSB	5.000153 V	2.500076 V	1.250038 V	0.625019 V	0001
Midscale	5 V	2.5 V	1.25 V	0.625 V	0000
Midscale –1LSB	4.999847 V	2.499924 V	1.249962 V	0.624981 V	FFFF
–FSR	0 V	0 V	0 V	0 V	8000

Analog Output Operation Mode

There are two D/A channels that are available in the U2300A series DAQ. The two analog outputs are capable of supplying output voltages in the range of 0 to 10 V and ±10 V (12- bit for U2355A/U2356A/U2331A and 16- bit for U2351A/U2353A). Each DAC channel drives a maximum current of 5 mA. The two analog outputs can be used as voltage sources to your DUT. In addition to this, the analog outputs are also used to output predefined function generators or any arbitrary waveform.

Analog output operation mode consists of voltage output and continuous output. Continuous output mode is divided into function generator and arbitrary.

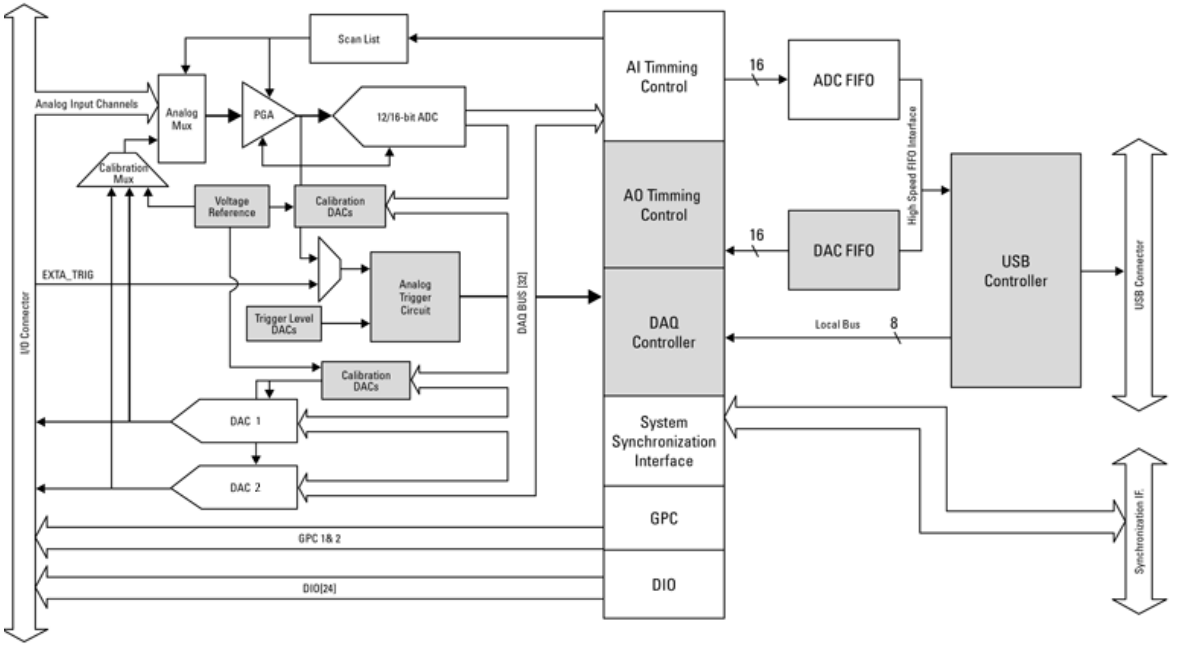


Figure4-3 Analog output operation mode

Voltage Output Mode

The following SCPI commands show the example of outputting a DC voltage level for the specified DA channels.

Example 1: To output a DC voltage via Ch201

```
-> *RST;*CLS
-> SOUR:VOLT 2.5, (@201)        // Reference is AO_GND
-> SOUR:VOLT 3.2, (@201)        // Changes output from 2.5 VDC
                                   to 3.2 VDC
-> SOUR:VOLT -3.2, (@201)       // Changes output from 3.2 VDC to
                                   -3.2 VDC
-> SOUR:VOLT? (@202)
<- 0                            // By default, Ch202 is 0 VDC.
```

Example 2: To output two DC voltages via Ch201 and Ch202

```
-> *RST;*CLS
-> SOUR:VOLT 3.5, (@201)
-> SOUR:VOLT 8.1, (@202)
```

Continuous Output Mode

The continuous output mode consists of function generator and arbitrary. You can use the following SCPI commands in arbitrary mode:

```
DATA[:USER]
APPLy:USER
```

NOTE For further information, refer to the U2300A series DAQ programming guide.

Example 3: To output a sine wave via Ch201

```
-> *RST;*CLS
-> ROUT:ENAB ON, (@201)  //Enable Ch 201
-> APPL:SIN 5, 0, (@201) //Sine wave with 5 Vp (10
                          Vpp) and 0 VDC offset
-> SYST:ERR?
<- +0, "No Error"
-> OUTP ON               //Turn on output
-> OUTP:WAV:FREQ? (@201)
<- 4000                  //Default output waveform is
                          at 4 kHz
-> OUTP OFF              //Turn off output (both Ch201
                          & Ch202 at 0 VDC).
-> OUTP:WAV:FREQ 5000    //Change output frequency to
                          5 kHz
-> OUTP ON               // Turn on output
```

Example 4: To output a sine wave and square wave via Ch201 and Ch202 respectively

```
-> *RST;*CLS
-> ROUT:ENAB ON,(@201,202)//Enable Ch201 and Ch202
-> APPL:SIN 5, 0, (@201)  //Sine wave with 5 Vp
                           (10 Vpp) and 0 VDC offset
-> ROUT:SQU 3, -1, (@202) //Square wave with 3 Vp
                           (6 Vpp) at –1 VDC offset
-> OUTP:WAV:FREQ 3500     //Set both channels' output to
                            3.5 kHz
-> SYST:ERR?
<- +0, "No Error"

-> OUTP ON               //Turn on output
```

D/A Reference Voltage

By default, the internal reference voltage is 10 V. However, external reference can be supplied through the external reference input pin (AO_EXT_REF). The range of the DAC output is directly related to the reference. The analog output voltage can be generated by multiplying the digital codes that are updated with the 10 V as internal reference.Therefore, when 10 V is taken as the internal reference, the full range would be –10 V to +9.9951 V in bipolar output mode, while 0 V to 9.9976 V in unipolar output mode.

While using an external reference, the different output voltage ranges can be achieved by connecting different reference voltage. For example, if connecting a 5 VDC with the external reference (AO_EXT_REF), then the range from –4.9976 V to +5 V in the bipolar output can be achieved. The tables below illustrates the relationship between digital code and output voltages.

AO Data Format

Data format for single channels arbitrary AO (when either one channel is enabled and USER mode)

#800000200	**<byte>**	**<byte>**	**<byte>**	**<byte>**	**<byte>**	**<byte>**	**<byte>**	**<byte>**	**...**
Data length indicator, The next 8 bytes (0000 0200) specifying the actual data length only, not actual data. Data length (200 bytes long)	1st data LSB	1st data MSB	2nd data LSB	2nd data MSB	3rd data LSB	3rd data MSB	4th data LSB	4th data MSB	...
	CH 201/202		CH 201/202		CH 201/202		CH 201/202		...

Data format for two channels arbitrary AO (when two channels are enabled and USER mode)

#800000200	<byte>	<byte>	<byte>	<byte>	<byte>	<byte>	<byte>	<byte>	...
Data length indicator, The next 8 bytes (0000 0200) specifying the actual data length only, not actual data. Data length (200 bytes long)	1st data LSB	1st data MSB	1st data LSB	1st data MSB	2nd data LSB	2nd data MSB	2nd data LSB	2nd data MSB	...
	CH 201		CH 202		CH 201		CH 202		...

16- bit Data Format:

LSB	MSB
DDDD DDDD	DDDD DDDD

12- bit Data Format:

LSB	MSB
DDDD DDDD	XXXX DDDD

D - Data bits

X - Unused bits

Table 4-6 Digital code and voltage output table for bipolar setting (U2331A/U2356A/U2355A)

Digital Code (Hex)	Analog Output	Voltage output (with internal reference of +10 V)
0x0FFF	Vref * (2047/2048)	9.9951 V
0x0801	Vref * (1/2048)	0.0048 V
0x0800	0 V	0.0000 V
0x07FF	–Vref * (1/2048)	–0.0048 V
0x0000	–Vref	–10.000 V

Table 4-7 Digital code and voltage output table for unipolar setting (U2331A/U2355A/U2356A)

Digital Code (Hex)	Analog Output	Voltage output (with internal reference of +10 V)
0x0FFF	Vref * (4095/4096)	9.9975 V
0x0800	Vref * (2048/4096)	5.000 V
0x0001	Vref * (1/4096)	0.0024 V
0x0000	Vref * (0/4096)	0.000 V

Table 4-8 Digital code and voltage output table for bipolar setting (U2351A/U2353A)

Digital Code (Hex)	Analog Output	Voltage output (with internal reference of +10 V)
0xFFFF	Vref * (32767/32768)	9.999694 V
0x8001	Vref * (1/32768)	0.000305 V
0x8000	0 V	0 V
0x7FFF	–Vref * (1/32768)	–0.000305 V
0x0000	–Vref	–10.000 V

Table 4-9 Digital code and voltage output table for unipolar setting (U2351A/U2353A)

Digital Code (Hex)	Analog Output	Voltage output (with internal reference of +10 V)
0xFFFF	Vref * (65535/65536)	9.999847 V
0x8000	Vref * (32768/65536)	5.00000 V
0x0001	Vref * (1/65536)	0.000152 V
0x0000	Vref * (0/65536)	0 V

Digital I/O

The U2300A series DAQ provides 24–bit of general–purpose digital I/O (GPIO), which is TTL compatible.

The 24–bit GPIO are segmented into four channels (CH 501 to 504). Channel 501 and 502 consists of 8 data bit while Channel 503 and 504 consists of 4 data bit. All four channels are programmable as input and output. As the system starts up and reset, all the I/O pins are reset to the input configuration and in high impedance.

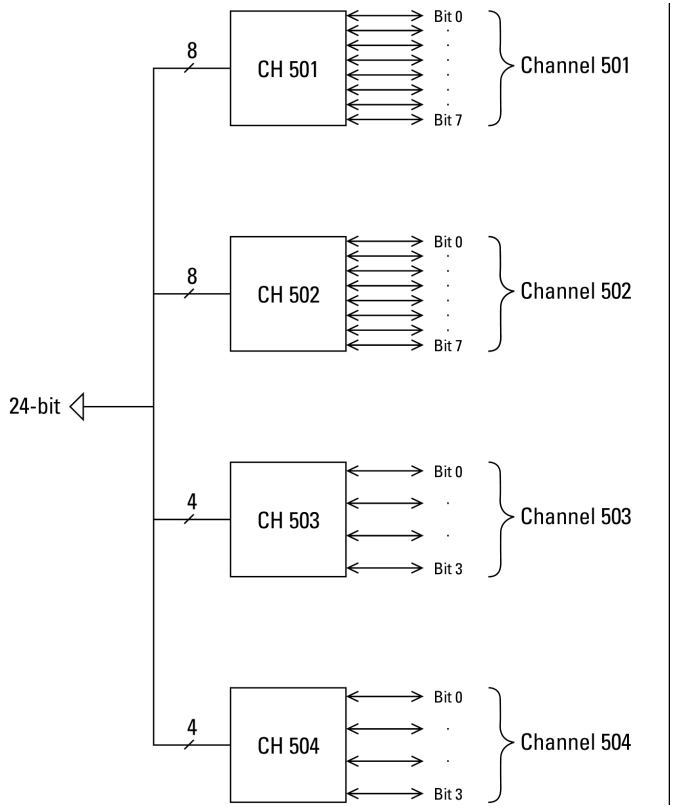


Figure4-4 General purpose digital I/O of Agilent U2300A series DAQ

The SCPI programming examples below will help you to configure the DIO and read a digital channel.

Configure the digital channel as OUTPUT and check the digital data

Example 1:

```
-> CONF:DIG:DIR OUTP,(@501)
-> SOUR:DIG:DATA 123,(@501)
-> SOUR:DIG:DATA? (@501)
<- 123
```

Example 2:

```
-> CONF:DIG:DIR OUTP,(@502)
-> SOUR:DIG:DATA:BIT 1,4,(@502)   //to set the 4th digital output line at channel 2 to 1

-> SOUR:DIG:DATA:BIT? 4,(@502)
<- 1
```

Configure the digital channel to INPUT and read back the value

Example 1:

```
-> CONF:DIG:DIR INP,(@501)
-> MEAS:DIG? (@501)               //to read back the digital value at channel 1

<- 23
```

Example 2:

```
-> CONF:DIG:DIR INP,(@501)
-> MEAS:DIG:BIT? 3,(@501)
<- 0
```

NOTE Input commands are not allow when channel is in Output mode, while output commands are not allow when channel is in Input mode.

Example 3:

```
-> CONF:DIG:DIR OUTP,(@501,503)
-> CONF:DIG:DIR INP,(@502,504)
-> CONF:DIG:DIR? (@501:504)
<- OUTP,INP,OUTP,INP

-> MEAS:DIG? (@501)
<- ! VI_ERROR_TMO: A timeout occurred

-> SOUR:DIG:DATA? (@502)

<- ! VI_ERROR_TMO: A timeout occurred
```

General Purpose Digital Counter (GPC)

The U2300A series DAQ has two independent 31–bit up/down counters to measure the input channels, which is TTL compatible. It has a programmable counter clock up to 12 MHz or clock generation. Refer to Figure 4- 5.

The counter is designed with the following features:

- Count up/down capability
- Internal/external programmable counter clock source up to 12 MHz
- Programmable gate selection which can be triggered internally or externally
- Pre- loaded software initial count for Totalizer
- Read- back capability of current count, without affecting the counting process

This digital counter operates in two modes; totalizer and measurement modes.

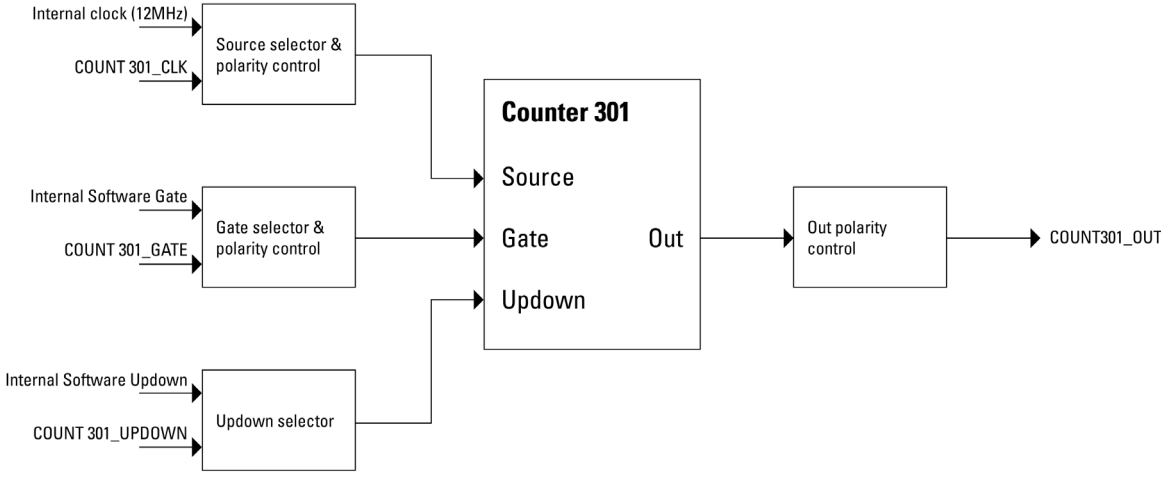


Figure4-5 General purpose digital counter

Totalizer mode

In totalizer mode, the counter will start counting the number of pulses generated on COUNT_CLK. This is done after the GATE is enabled. The totalize count is measured with the following command:

```
MEASure:COUNter:TOTalize? (@301)
```

The example below illustrates the count up mode when the counter is configured as Totalize with initial count set to 0.

COUNT_GATE will enable the counting after Totalize function has been enabled and the COUNT_OUT pin will output a series of pulses as shown below.

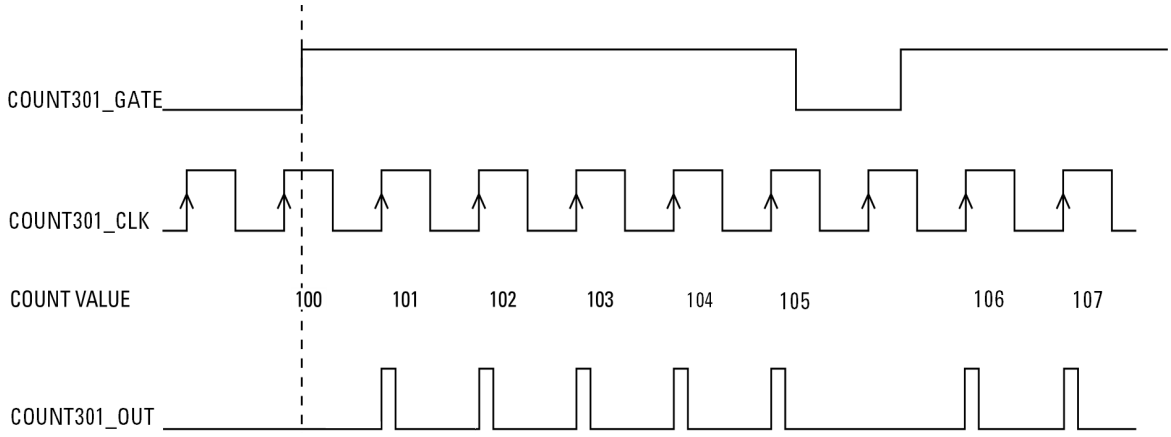


Figure4-6 Totalizer mode

NOTE The output pulse width is at 20.8 ns.

The following SCPI programming example shows how to set the counter mode:

```
//Supply the signal to COUNT301_CLK
//Counter mode setting
-> COUN:FUNC TOT,(@301)          //Set As Totalize Function
-> COUN:GATE:SOUR INT,(@301)     //Set the GATE source as internal
-> COUN:CLK:POL AHI,(@301)       //Set the clock polarity as active high
-> COUN:CLK:SOUR EXT,(@301)      //Set the clock source as external
-> COUN:TOT:IVAL 100,(@301)      //Initial Count Value
-> COUN:TOT:UDOW:DIR UP,(@301) //Set as Count Upmode
-> COUN:TOT:UDOW:SOUR INT,(@301) //Set the Up/Down source as internal
-> SOUR:COUN:OUTP:POL AHI,(@301)

-> COUN:TOT:INIT (@301)          //Initiate totalize
-> MEAS:COUN:TOT? (@301)         //Initial Value = 100
<- 100
-> MEAS:COUN:DATA? (@301)        //Return Totalize value
<- 100
-> COUN:GATE:CONT ENAB,(@301)    //Start Counting (For INT gate only)
-> COUN:GATE:CONT DIS,(@301)     //Stop Counting (For INT gate only)
-> MEAS:COUN:TOT? (@301)
<- 105
-> MEAS:COUN:DATA? (@301)
<- 105
-> COUN:ABOR (@301)              //Abort all counter operation
-> COUN:TOT:CLE (@301)           //Clear Count Value
-> MEAS:COUN:TOT? (@301)
<- 0
-> MEAS:COUN:DATA? (@301)

<- 0
```

Measurement mode

In the measurement mode, frequency, period and pulse width are measured. The measurement is gated by either an internal or external gate source.

The gate source is set using the command below:

```
SENSe:COUNter:SOURce
```

Since all three measurements are derived from the same basic measurement, the measured frequency, period and pulse width can be easily retrieved from commands below:

```
MEAS:COUN:FREQ (@<ch_list>
MEAS:COUN:FREQ (@<ch_list>
MEAS:COUN:FREQ (@<ch_list>
```

The return value for frequency, period and pulse width measurements is a floating value.

NOTE

- The input frequency measurable range is from 0.1 Hz to 6 MHz.
- The pulse width measurement is in the range of 0.167 s to 178.956 s.

The following SCPI programming examples are for frequency, period and pulse width measurements.

Example 1:

```
//Supply the signal to COUNT301_GATE
//Counter mode setting
//Take 5.5 kHz with 70% duty cycle square wave as
measurement
-> COUN:GATE:SOUR EXT,(@301)
-> COUN:GATE:POL AHI,(@301)
-> COUN:CLK:POL AHI,(@301)
-> COUN:CLK:SOUR INT,(@301)
-> COUN:CLK:INT?
<- 12000 KHz
-> SOUR:COUN:OUTP:POL AHI,(@301)

-> COUN:FUNC FREQ,(@301)
-> MEAS:COUN:DATA? (@301)//Return value depend on
                           function set
<- 5.499542              //Frequency in kHz
-> COUN:FUNC PER,(@301)
-> MEAS:COUN:DATA? (@301)
<- 0.1818333             //Period in ms
-> COUN:FUNC PWID,(@301)
-> MEAS:COUN:DATA? (@301)
<- 0.12725               //Pulse width in ms

-> MEAS:COUN:FREQ? (@301)
<- 5.499542

-> COUN:FUNC? (@301) //Function automatic set to FREQ
<- FREQ
-> MEAS:COUN:PER? (@301)
<- 0.1818333
-> COUN:FUNC? (@301) //Function automatic set to PER
<- PER
-> MEAS:COUN:PWID? (@301)
<- 0.12725
-> COUN:FUNC? (@301) //Function automatic set to PWID

<- PWID
```

Example 2:

```
//Assume 10 MHz external Clock for FREQ,PER,PWID
  measurement
-> COUN:CLK:SOUR EXT,(@301)
-> COUN:CLK:EXT 10000,(@301) //Must set the external
                               Clock value (KHz)
-> COUN:CLK:EXT? (@301)
<- 10000
```

NOTE Direction of the counter and the initial value of the counter are not important for this mode.

Trigger Sources

The Agilent U2300A series USB DAQ provides flexible trigger options for various applications. There are four types of trigger sources:

- none (immediate trigger)
- digital trigger
- analog trigger
- star trigger

Users can configure the trigger source for A/D and D/A operations remotely.

NOTE

- The D/A and A/D conversions share the same analog trigger.
- Star trigger is used when the DAQ is connected into the modular instrument chassis.

All four types of trigger sources are summarized in the table below:

Trigger Source	Type	Condition	Pin Selection
None (immediate trigger)	Pre/Middle/ Post/Delay	N/A	N/A
Digital trigger		Positive/Negative	EXTD_AI_TRIG EXTD_AO_TRIG
Analog trigger		Above High/Below Low/Window	EXTA_TRIG SONE

Trigger Types

There are four types of trigger, which are pre- trigger, post- trigger, middle- trigger and delay- trigger.

Pre-trigger

This trigger type is used when you wish to collect data before a trigger event. The A/D conversion starts when you execute the specified function calls and stops when the trigger event occurs. For example, you specify four sample points and the analog trigger occurs after four sample point are converted. Refer to Figure 4- 7.

NOTE Due to memory limitation on hardware, the maximum sample points is only up to 8 MSa.

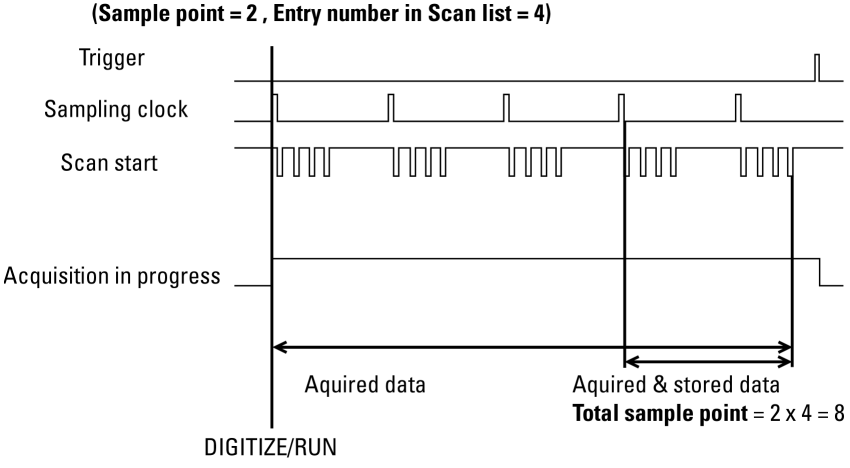


Figure4-7 Pre-trigger

Middle-trigger

This trigger type is used when you want to collect data before and after a trigger event. The sampled data are equal before and after trigger. For example, if the user specify four sample points, the conversion only begins after the trigger event occurs. Two sample points before and after the trigger are taken. Refer to Figure 4- 8.

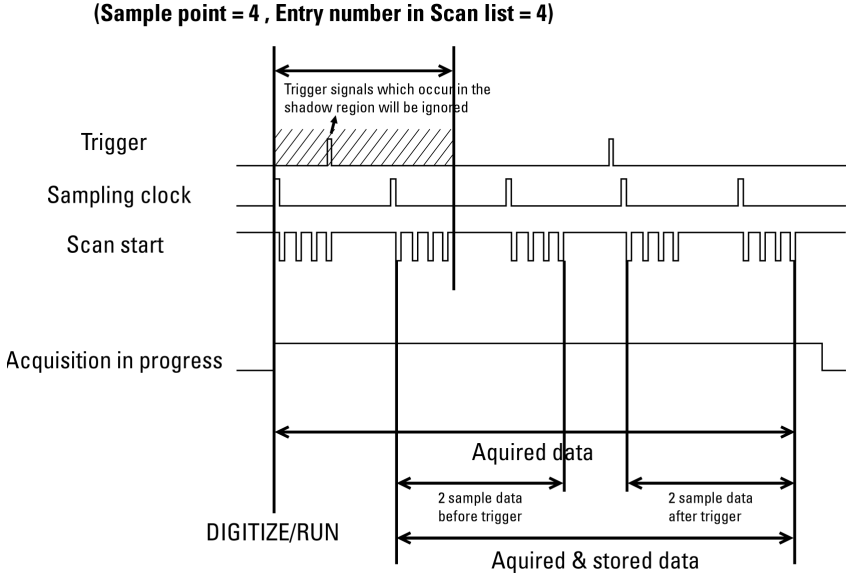


Figure4-8 Middle-trigger

Post-trigger

The post- trigger is the default setting and used in applications when you want to collect data after a trigger event. As illustrated in Figure 4- 9, the sample point are set to two. Total of two sample points are taken after the trigger starts.

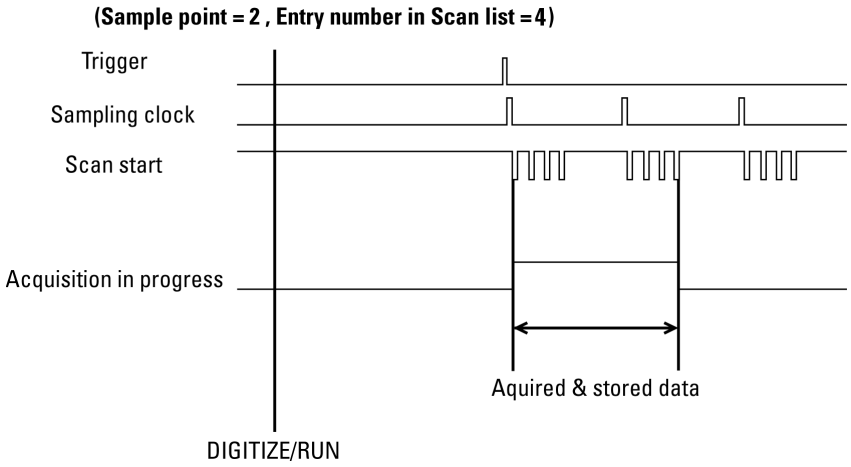


Figure4-9 Post-trigger

Delay-trigger

This trigger acquisition is used in applications if you want to delay the data collecting process after a specified trigger event. The delay time is controlled by the value, which is pre- loaded in the Delay_counter (32- bit). The clock source is the Timebase clock. When the count reaches zero, the counter stops and the board start to acquire data. When the internal 48 MHz is set as Timebase clock, the delay time is in the range of 20.8 ns to 89.47 s. If the Timebase clock is from external clock (48 MHz to 1 MHz), the delay time can be varied by user's setting.

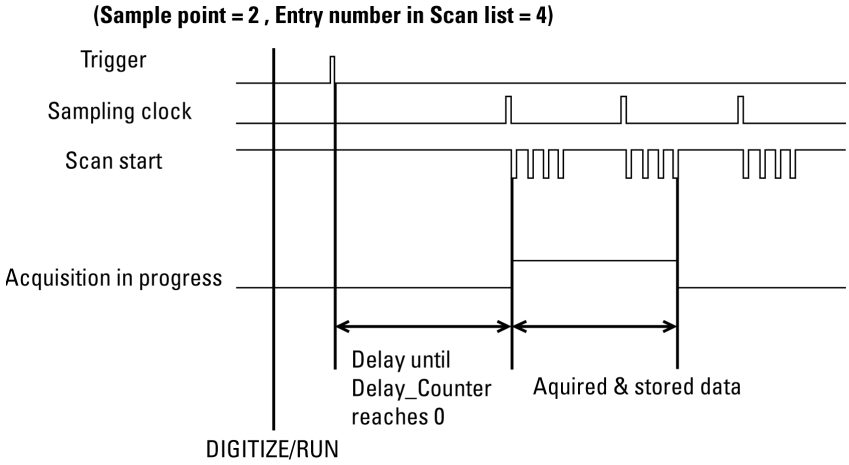


Figure4-10 Delay-trigger

Digital Trigger

There are positive and negative conditions in digital trigger. It is used when a rising or falling edge is detected on the digital signal. Positive condition is used when it triggers from low to high, while high to low when the negative condition is used.

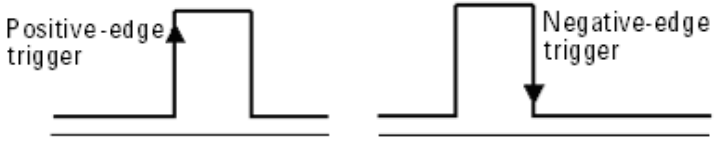


Figure4-11 Positive and negative edge of digital trigger.

Analog Trigger

There are three analog trigger conditions in U2300A series DAQ and the trigger conditions are as follows:

- Above high
- Below low
- Window

It uses two threshold voltages, which are Low_Threshold and High_Threshold. Users can easily configure the analog trigger conditions using the Agilent Measurement Manager software.

Above high

Figure 4- 12 illustrates the above high analog trigger condition. The trigger signal is generated when the analog input signal is higher than the High_Threshold voltage. In this trigger condition, the Low_Threshold voltage is not used.

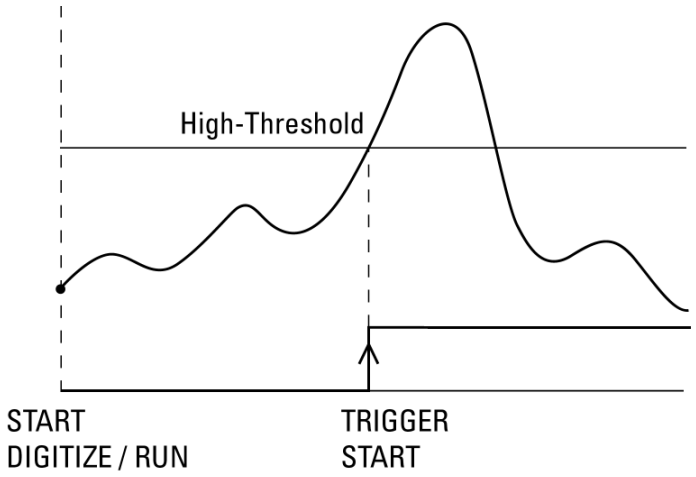


Figure4-12 Above high trigger condition

Below low

In below low trigger condition, the trigger signal is generated when the analog input signal is lower than the Low_Threshold voltage. In this trigger condition, the High_Threshold voltage is not used. Figure 4- 13 illustrates the above high analog trigger condition.

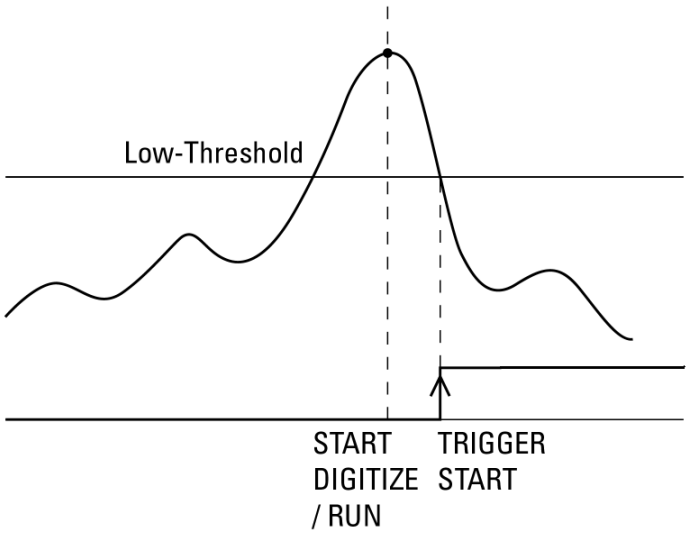


Figure4-13 Below low trigger condition

Window

The window trigger condition is shown in Figure 4- 14. The trigger signal is generated when the input analog signal falls within the voltage range of the High_Threshold and Low_Threshold.

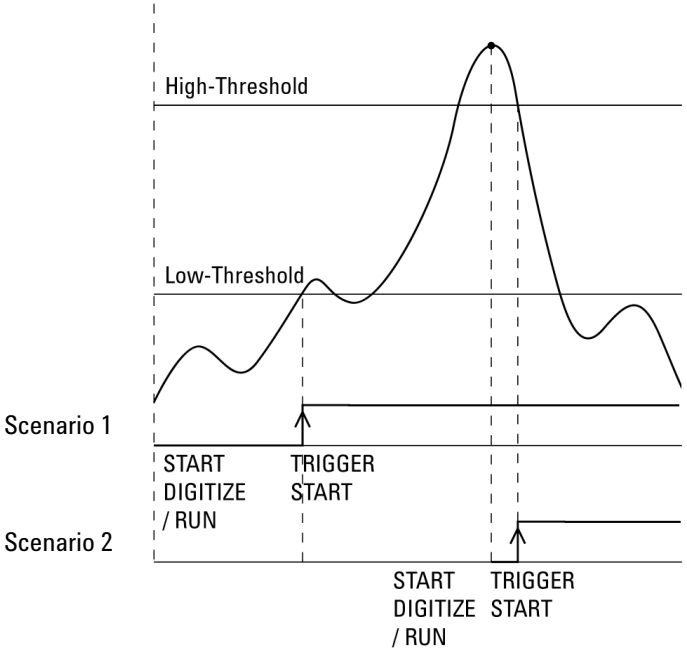


Figure4-14 Window trigger condition

SCPI Programming Examples

Analog Input

Example 1:

```
//Digital trigger with delay trigger type
//Supply Digital trigger signal to EXTD_AI_TRIG
-> ACQ:POIN 1000              //For “DIG” mode
-> ACQ:SRAT 1000
-> TRIG:SOUR EXTD             //Digital Trigger
-> TRIG:DTRG:POL POS
-> TRIG:TYPE DEL
-> TRIG:DCNT 225000000        //Count value ~= 5 s
-> WAV:STAT?
<- EMPT
-> WAV:COMP?
<- YES

-> DIG                        //Start Single Shot Acquisition
-> WAV:STAT?
<- FRAG
-> WAV:COMP?
<- NO
//Wait for trigger
//Delay 5 seconds after the trigger event
-> WAV:STAT?
<- DATA
-> WAV:COMP?
<- YES
```

Example 2:

```
//Digital trigger with Middle trigger type
-> WAV:POIN 1000              //For “RUN” mode
-> ACQ:SRAT 1000
-> TRIG:SOUR EXTD             //Digital Trigger
-> TRIG:DTRG:POL POS
-> TRIG:TYPE MID
-> RUN
```

Example 3:

```
//Analog trigger with Pre trigger type
-> ACQ:POIN 1000          //For "DIG" mode
-> ACQ:SRAT 1000
-> ROUT:SCAN (@101)
-> ROUT:CHAN:POL BIP,(@101)
-> TRIG:SOUR EXTA         //Analog trigger
-> TRIG:ATRG:COND AHIG    //Above high Threshold
                           trigger condition
-> TRIG:ATRG:HTHR 3       //3 V high Threshold
-> TRIG:ATRG:LTHR -3      //–3 V low Threshold
-> TRIG:TYPE PRE          //Pre trigger
-> DIG
//Trigger will happen when signal go above 3 V
```

Example 4:

```
//Analog Trigger with first scan channel as trigger channel
(SONE mode)
-> ACQ:POIN 1000          //For "DIG" mode
-> ACQ:SRAT 1000
-> ROUT:SCAN (@133,101)   //Use channel @133 as
                           trigger channel
-> ROUT:CHAN:POL UNIP,(@133,101)
-> TRIG:SOUR EXTA
-> TRIG:ATRG:SOUR SONE
-> TRIG:ATRG:COND BLOW    //Below Low Threshold
                           trigger condition
-> TRIG:ATRG:HTHR 6       //6 V High Threshold
-> TRIG:ATRG:LTHR         //2 V Low Threshold
-> TRIG:TYPE POST         //Post Trigger
-> DIG
//Trigger will take place when signal fall below 2 V at channel
@133
```

NOTE Middle trigger and Pre trigger are not allow in RUN mode, NONE trigger and SONE trigger.

Analog Output

Example 1:

```
//Digital trigger with delay trigger type
//Supply Digital trigger signal to EXTD_AO_TRIG
-> OUTP:TRIG:SOUR EXTD
-> OUTP:TRIG:DTRG:POL NEG
-> OUTP:TRIG:TYPE DEL
-> OUTP:TRIG:DCNT 225000000      //Count value ~= 5 s
-> ROUT:ENAB ON,(@201)
-> OUTP ON
//Wait for trigger
//Output turn on after 5 s of delay (after trigger happen)
```

Example 2:

```
//Analog trigger with POST trigger type
-> OUTP:TRIG:SOUR EXTA
-> OUTP:TRIG:ATRG:COND WIND     // Window trigger
                                 condition (–3 V to 3 V)
-> OUTP:TRIG:ATRG:HTHR 3        //3 V high Threshold
-> OUTP:TRIG:ATRG:LTHR -3       //–3 V low Threshold
-> OUTP:TRIG:TYPE POST
-> ROUT:ENAB ON,(@201)

-> OUTP ON
```

Example 3:

```
//Analog Trigger with first scan channel as trigger channel
(SONE mode)
-> OUTP:TRIG:SOUR EXTA
-> ROUT:SCAN (@133)              //Use Channel @133 as
                                 trigger channel
-> OUTP:TRIG:ATRG:SOUR SONE
-> OUTP:TRIG:ATRG:COND AHIG      //Above High threshold
                                 Trigger condition
-> OUTP:TRIG:ATRG:HTHR 4         //4 V High Threshold
-> OUTP:TRIG:ATRG:LTHR 1         //1 V Low Threshold
-> OUTP:TRIG:TYPE POST
-> ROUT:ENAB ON,(@201)
-> RUN                           //Important!
-> OUTP ON
```

NOTE For SONE mode, execute the `RUN/DIG` command first before turning on the output. Channel @133 will only respond to trigger signal during acquisition.

5 Calibration

This chapter introduces the calibration process to minimize A/D measurement errors and D/A output errors.

Introduction

The Agilent U2300A series USB DAQ are factory calibrated before shipment. The on- board reference voltage were calibrated and measured to ensure the accuracy.

It provides the self calibration flexibility to ensure the accuracy of the measurement under different environment use.

Self-calibration

The self- calibration can be operated using the SCPI command as follows:

CALibration:BEGin

In calibration mode, the command will initiate a voltage adjustment in sequence for the specified DAC channel. This sequence sets a zero and gain adjustment constant for each DAC output.

The function of DAQ will not carry on until the self- calibration is completed. You can query the status of calibration through SCPI command ***OPC?**.

NOTE It is recommended to warm up for 20 minutes before performing the self-calibration.

WARNING **Please remove all cables that are connected to the DAQ modules before performing the self-calibration, because the D/A output could change during the calibration process.**

General Maintenance

NOTE Repair or service which are not covered in this manual should only be performed by qualified personnel.

To remove the dirt or moisture in the chassis panel, the cleaning steps are as follows:

1. Turn off the unit and remove the DC adapter cord and I/O cable.
2. Shake out any dirt that may have accumulated inside the chassis unit.
3. Wipe the case with a damp cloth and mild detergent- do not use abrasives or solvents. Wipe the contact in each terminal with a clean swab dipped in alcohol.

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Europe:
(tel) 31 20 547 2111
Japan:
(tel) (81) 426 56 7832 (fax) (81) 426 56 7840
Korea:
(tel) (080) 769 0800 (fax) (080) 769 0900
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