

# Agilent U2781A USB Modular Instrument Chassis

## User's Guide

Agilent Technologies

# Notices

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11900 Penang, Malaysia

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## Safety Notices

**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. If the equipment is used in a manner not specified by the manufacturer, the protection provided by the equipment may be impaired.

**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 Information

The following general safety precautions must be observed during all phases 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 Symbols

The following symbols indicate that precautions must be taken to maintain safe operation of the instrument.

| | |
|---|---|
|  | 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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| **ICES/NMB-001** | This ISM device complies with the Canadian ICES-001. |

## General Safety Information

**WARNING**

- **Do not use the device if it is damaged. Before you use the device, inspect the case. Look for cracks or missing plastic. Do not operate the device around explosive gas, vapor or dust.**
- **Do not apply more than the rated voltage (as marked on the device) between terminals, or between terminal and external ground.**
- **Always use the device with the cables provided.**
- **Observe all markings on the device before connecting to the device.**
- **Turn off the device and application system power before connecting to the I/O terminals.**
- **When servicing the device, use only specified replacement parts.**
- **Do not operate the device with the removable cover removed or loosened.**
- **Do not connect any cables and terminal block prior to performing self-test process.**

**CAUTION**

- Do not load the output terminals above the specified current limits. Applying excessive voltage or overloading the device will cause irreversible damage to the circuitry.
- Applying excessive voltage or overloading the input terminal will damage the device permanently.
- If the device is used in a manner not specified by the manufacturer, the protection provided by the device may be impaired.
- Always use dry cloth to clean the device. Do not use ethyl alcohol or any other volatile liquid to clean the device.
- Do not permit any blockage of the ventilation holes of the device.

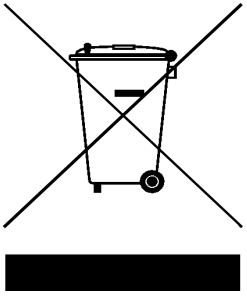
# Waste Electrical and Electronic Equipment (WEEE) Directive 2002/96/EC

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 household 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:

http://www.agilent.com/environment/product

for more information.

# In This Guide...

1 **Getting Started** provides an overview of the U2781A USB modular instrument chassis, the product outlook and dimension. This chapter also contains instructions on how to get started with the U2781A USB modular chassis.

2 **Features and Functions** provides information for better understanding of the features and functions of U2781A USB modular instrument chassis.

3 **Characteristics and Specifications** specifies the characteristics, environment conditions, and specifications of the U2781A USB modular instrument chassis.

| Agilent Technologies | **DECLARATION OF CONFORMITY**<br>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:** USB Modular Instrument Chassis (USB Card cage)
**Models Number:** U2781A
**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

**Supplementary Information:**
U2781A is USB Modular Instrument chassis with 6 USB modules slot.

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

19-Dec-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 U2781A Rev 1.0

**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<br>(ESD 4kV CD, 8kV AD) | B |
| | IEC 61000-4-3:1995 / EN 61000-4-3:1995<br>(3V/m, 80% AM) | A |
| | IEC 61000-4-4:1995 / EN 61000-4-4:1995<br>(EFT 0.5kV line-line, 1kV line-earth) | B |
| | IEC 61000-4-5:1995 / EN 61000-4-5:1995<br>(Surge 0.5kV line-line, 1kV line-earth) | B |
| | IEC 61000-4-6:1996 / EN 61000-4-6:1996<br>(3V, 0.15~80 MHz, 80% AM, power line) | A |
| | IEC 61000-4-11:1994 / EN 61000-4-11:1994<br>(Dips 1 cycle, 100%) | C |
| | Canada: ICES-001:1998<br>Australia/New Zealand: AS/NZS 2064.1 | |
| **Safety** | IEC 61010-1:2001 / EN 61010-1:2001<br>Canada: CSA C22.2 No. 61010-1:2004<br>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

**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

Introduction 2

Product Overview 3

- Product Outlook 3
- Dimensions 4

Standard Purchase Items Checklist 5

Installations and Configurations 6

- A. Instrument Setup 7
- B. Check Your System Requirements 9
- C. Check Your Pre-Installed IO Libraries Suite 10
- D. Install the Agilent IO Libraries Suite Version 14.2 or Higher 12
- E. Install the Modular Instrument Chassis Hardware Driver 13
- F. Install the Agilent Measurement Manager 15
- G. Connect Your Modular Instrument Chassis to the PC 18
- H. Hardware Verification 21
- I. Agilent Measurement Manager 23

General Maintenance 26

**2** Features and Functions

Introduction 28

USB Backplane 29

Trigger Bus (TRIG [0..7]) 31

External Trigger Out 32

External Trigger In (Star Trigger) 33

Simultaneous Synchronization (SSI) 34

- Single Master–multiple Slaves 36
- Multiple Master–multiple Slaves 39

System Reference Clock 41

Chassis Temperature Monitoring 42

Fan Speed Monitoring 43

Identifying Modules Location 44
Geographical Address 44
Modules Identification 44

**3** Characteristics and Specifications
Product Characteristics 48
Electrical Specifications 49
Mechanical Specifications 50

# List of Figures

Figure 2-1 USB backplane block diagram 30
Figure 2-2 Block diagram of Trigger Bus (TRIG [0..7]) and Trigger Out 31
Figure 2-3 Block diagram of the 10 Mhz Reference Clock and External Trigger In 33
Figure 2-4 Synchronization between modules in the chassis 35
Figure 2-5 Single Master–multiple Slave triggering with DAQ 36
Figure 2-6 Single Master–multiple Slave triggering 37
Figure 2-7 Multiple Master–multiple Slave triggering 39
Figure 2-8 Block diagram of temperature monitoring and fan control 42
Figure 2-9 Identifying modules location 45

# List of Tables

Table 2-1 Pin information of SSI connector 29
Table 2-2 Trigger out bits for U2300A, U2500A, and U2600A Series DAQ devices 32
Table 2-3 Example of configurations for single Master-multiple Slaves using DAQ and U2700A Series modular products. 38
Table 2-4 Example of configurations for multiple Master–multiple Slaves 40

# 1 Getting Started

Introduction 2
Product Overview 3
- Product Outlook 3
- Dimensions 4

Standard Purchase Items Checklist 5
Installations and Configurations 6
- A. Instrument Setup 7
- B. Check Your System Requirements 9
- C. Check Your Pre-Installed IO Libraries Suite 10
- D. Install the Agilent IO Libraries Suite Version 14.2 or Higher 12
- E. Install the Modular Instrument Chassis Hardware Driver 13
- F. Install the Agilent Measurement Manager 15
- G. Connect Your Modular Instrument Chassis to the PC 18
- H. Hardware Verification 21
- I. Agilent Measurement Manager 23

General Maintenance 26

This chapter provides an overview of the U2781A USB modular instrument chassis, the product outlook and dimension. This chapter also contains instructions on how to get started with the chassis from the installation of modules to the chassis to the installations of hardware and software to the start-up and configurations of Agilent Measurement Manager application software.

# Introduction

The U2781A USB modular instrument chassis is a 4U height chassis with six USB module slots. It is a portable chassis with high performance added value. It targets a wide range of applications in both industrial and scientific environments. It helps to lower cost of test and accelerate your test system integration and development.

The Agilent U2781A is equipped with USB plug-and-play connectivity. The USB interface that is compliant with the TMC-488.2 Standards work seamlessly with Agilent Measurement Manager software and can be controlled remotely via industry standard SCPI commands. In addition, the U2781A modular instrument chassis comes with Agilent IO Libraries Suite 14.2.

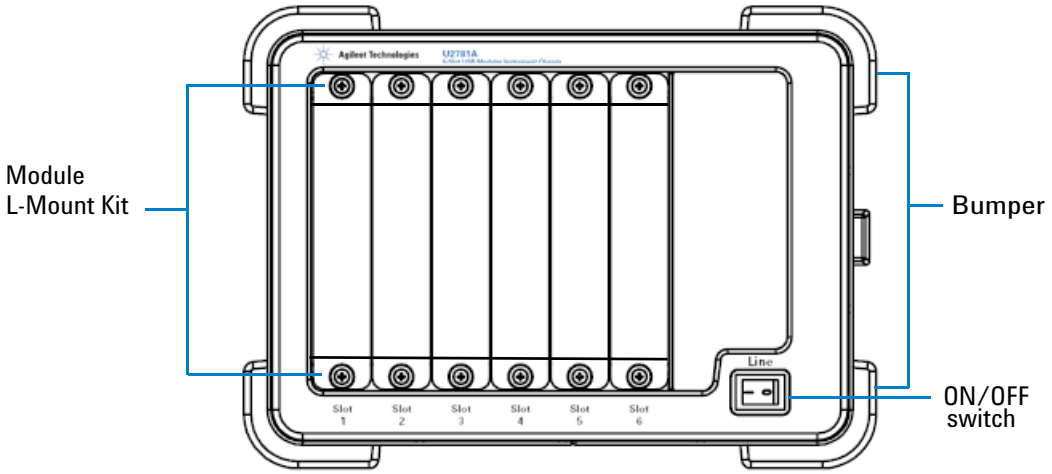
The U2781A modular instrument chassis comes with star trigger bus, which offers precise synchronization between USB modules and the external trigger signal. The star trigger bus is a dedicated trigger lines between the external trigger input and USB slots.

The Agilent U2781A USB modular instrument chassis can be applied to nearly any industrial data acquisition, industrial automation and education environment. The primary advantage is its synchronization capability between modules.

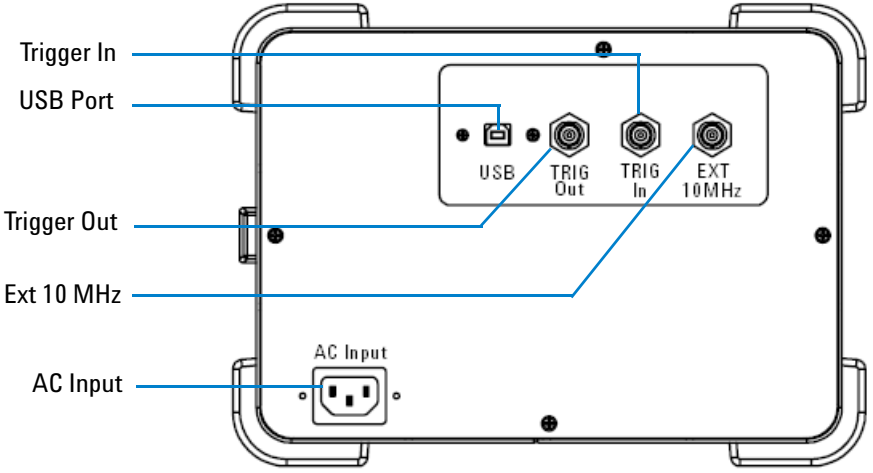
# Product Overview

## Product Outlook

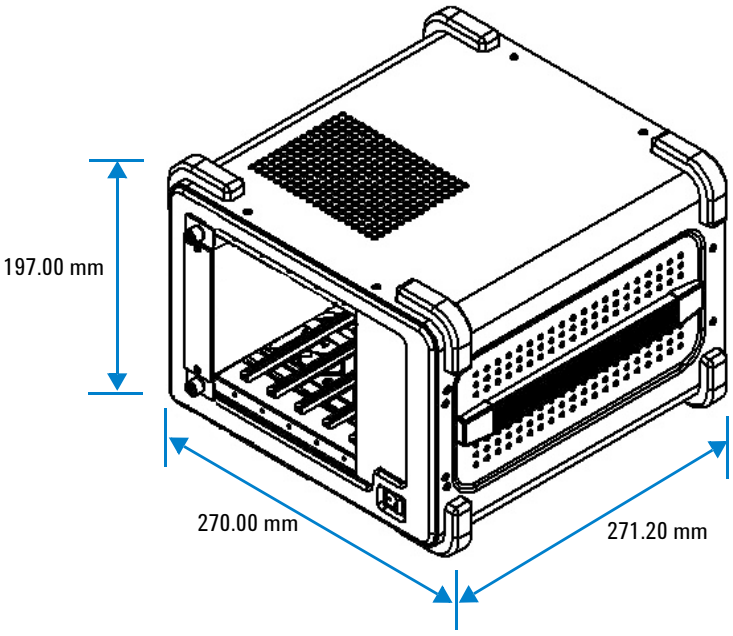
### Front View




### Rear View



## Dimensions



# Standard Purchase Items Checklist

Inspect and verify the following items for the standard purchase of U2781A USB modular instrument chassis. If there are missing items, contact the nearest Agilent Sales Office.

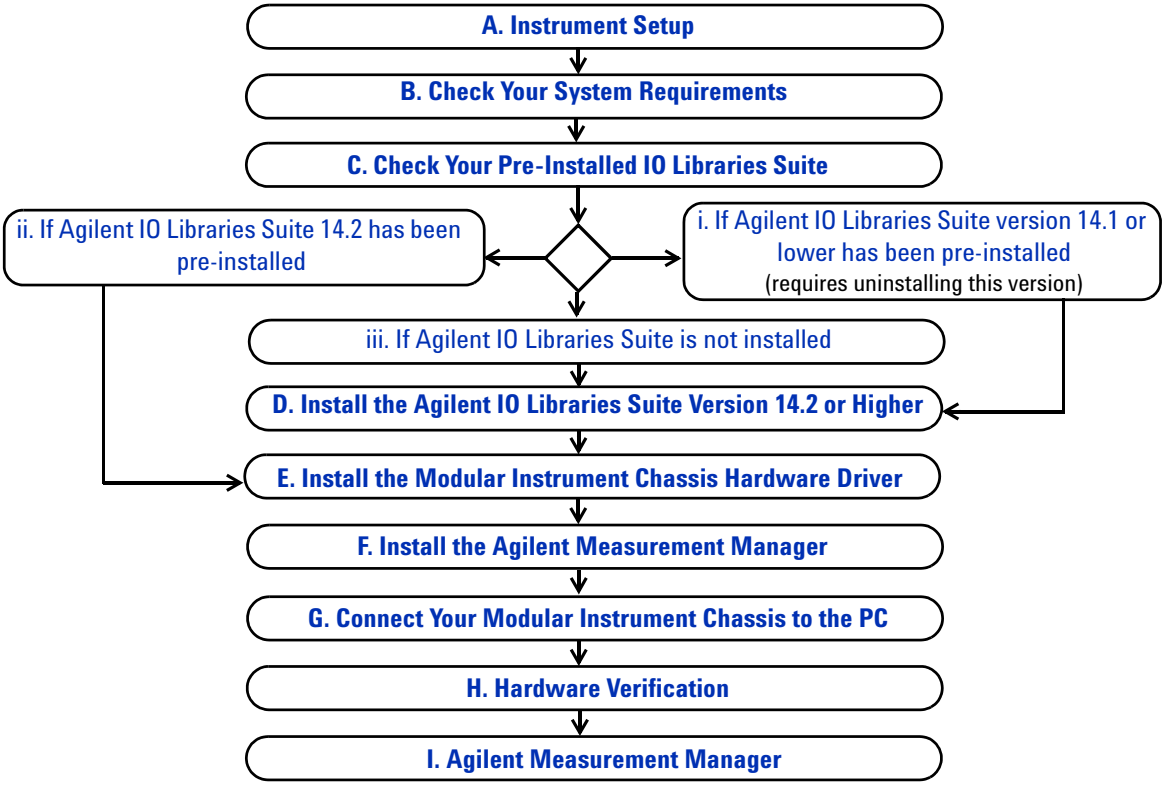
- ✔ Power cord
- ✔ USB Extension Cable
- ✔ Agilent U2781A USB Modular Instrument Chassis Quick Start Guide
- ✔ Agilent USB Modular Products Reference CD-ROM
- ✔ Agilent Automation-Ready CD (contains the Agilent IO Libraries Suite)
- ✔ Functional Test Certificate

# Installations and Configurations

If you are using the U2781A USB modular instrument chassis with the Agilent Measurement Manager, follow the step-by-step instructions as shown in the following flowchart.

**NOTE**

- If you do not wish to specifically use the U2781A USB modular instrument chassis with the Agilent Measurement Manager software, and use the USB module with Agilent VEE, LabVIEW, or Microsoft Visual Studio only, you can skip steps F and H in the following flowchart.
- You need to install IVI-COM driver before using the U2781A Series with Agilent VEE, LabVIEW or Microsoft Visual Studio.



# A. Instrument Setup

### L-Mount Kit Installation and Chassis Setup

In order to slot in the USB modular instrument into the U2781A USB modular instrument chassis, you are required to install the L-Mount kit to any of your USB modular instrument. The L-Mount kit is a standard shipped item of USB modular instrument.

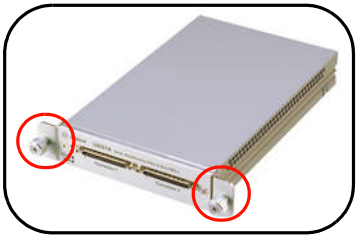
Follow the simple procedures below to install the L-Mount kit to a USB modular instrument.



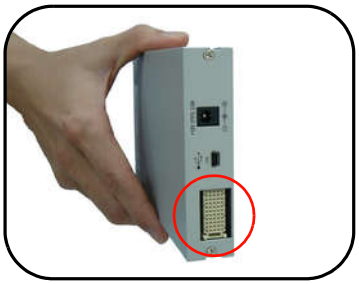
**1** Unpack the L-Mount kit from the packaging.



**2** Remove your USB module by pulling the bumper (front end of the casing) in an outward direction. For U2300A, U2500A, and U2600A Series DAQ, lift the plastic body casing and remove it from your USB module.



**3** Using the Philip screw driver, screw the L-Mount kit to your USB module.



**4** To slot in the USB module to your chassis, turn your USB module perpendicularly and ensure that the 55-pin backplane connector is at the bottom side of the USB module.



**5** Your USB module is now ready to be plug into an instrument chassis.



**6** Screw L-Mount Kit to U2781A chassis after USB modular is plugged in.

## B. Check Your System Requirements

Before installing the Agilent Measurement Manager software and the hardware driver, make sure your PC meets the following minimum system requirements for installation and data acquisition.

**Processor** 1.6 GHz Pentium® IV or higher

**Operating system** One of the following Microsoft® Windows® versions: 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 higher

**Available RAM** 512 MB or higher recommended

**Hard disk space** 1 GB

**Pre-requisite** Agilent IO Libraries Suite 14.2 or higher, Agilent T&M Toolkit 2.1 Runtime version, Agilent T&M Toolkit Redistributable Package 2.1 patch, Microsoft® .NET Framework version 1.1 and 2.0

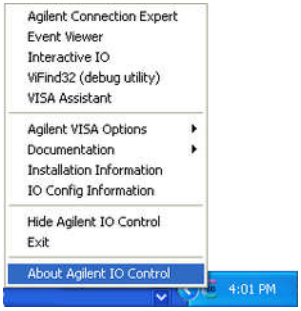
**NOTE**

- The Agilent T&M Toolkit 2.1 Runtime, and Microsoft® .NET Framework 1.1 and 2.0 are bundled with the Agilent Measurement Manager software installer.
- If you do not have Agilent T&M Toolkit 2.1 Runtime, or Microsoft® .NET Framework 1.1 and 2.0 installed in your PC, launching the Agilent Measurement Manager software installation, as instructed in **F. Install the Agilent Measurement Manager**, will prompt for installation of these tools.

## C. Check Your Pre-Installed IO Libraries Suite

To check the version of your pre-installed IO Libraries Suite follow the instructions below.

1 Right-click IO Control icon on your taskbar notification area and the context menu will appear as shown below. Select **About Agilent IO Control**.




2 Agilent IO Control window will appear and the version of installed IO Libraries Suite will be displayed as shown below.




**NOTE**

If the Agilent IO Control icon is not visible on the taskbar notification area it may indicates that,

- you do not have the Agilent IO Libraries installed, or
- you have hidden the Agilent IO Control icon from the taskbar notification area.

To activate the icon, go to **Start > All Programs > Agilent IO Libraries Suite > Utilities > IO Control**. You will now see the Agilent IO Control icon appear on your taskbar notification area.

### i. If Agilent IO Libraries Suite version 14.1 or lower has been pre-installed

If you have Agilent IO Libraries Suite version 14.1 or lower installed on your PC, you are required to uninstalling the IO Libraries Suite.

1. To uninstall, go to **Start > Control Panel > Add or Remove Programs**. The Add or Remove Programs window will appear select Agilent IO Libraries Suite 14.1 or lower version.
2. Click **Change/Remove** and select **Remove** when the instructions on the screen prompted to proceed uninstalling the IO Libraries Suite version 14.1 or lower from your PC.
3. Proceed to **D. Install the Agilent IO Libraries Suite Version 14.2 or Higher**.

### ii. If Agilent IO Libraries Suite 14.2 has been pre-installed

If you have the IO Libraries Suite 14.2 pre-installed on your PC, skip Step D and proceed to **E. Install the Modular Instrument Chassis Hardware Driver**.

### iii. If Agilent IO Libraries Suite is not installed

If you do not have IO Libraries Suite installed on your PC, go to **D. Install the Agilent IO Libraries Suite Version 14.2 or Higher**.

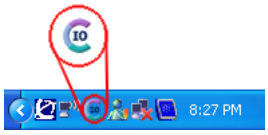
# D. Install the Agilent IO Libraries Suite Version 14.2 or Higher

The Agilent IO Libraries Suite 14.2 is available in the *Agilent Automation- Ready CD* that comes with the standard purchase of U2781A USB modular instrument chassis.

**NOTE**

- If you do not have the *Agilent Automation-Ready CD*, obtain the Agilent IO Libraries Suite 14.2 or higher at http://www.agilent.com/find/iolib.
- Ensure that you do not have any USB module connected to your PC during installation of the Agilent IO Libraries Suite.

1. Disconnect any USB module that is connected to your PC and close all other applications on your PC.
2. Insert the *Agilent Automation- Ready CD* into your CD-ROM drive, and follow the instructions on your screen.
3. If the installation does not start automatically, go to **Start > Run** (on the Windows start menu) and type `<drive>:\autorun\auto.exe` where `drive` is your CD-ROM drive.
4. If you obtain the Agilent IO Libraries Suite from the web, save the self-extracting zip file (*.exe) to any location on your hard disk.
5. Double-click the installation file to launch the installation.
6. Follow the instructions on your screen to proceed with the installation.
7. After the installation is completed, you will see the IO Control icon on the Windows taskbar notification area as shown below.




**NOTE**

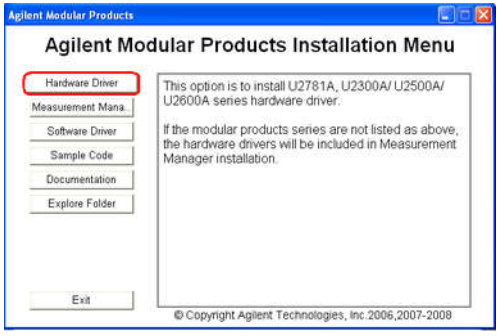
For detailed installation instructions, refer to the *Agilent IO Libraries Suite Getting Started Guide* at http://www.agilent.com/find/iolib.

# E. Install the Modular Instrument Chassis Hardware Driver

1 Verify that your PC meets the minimum system requirements as stated in **B. Check Your System Requirements**.

2 Insert the *Agilent USB Modular Instrument Product Reference CD- ROM* into the CD- ROM drive of your PC.

3 The installer will automatically launch the Agilent Modular Products Installation Menu. Select **Hardware Driver** to begin the hardware driver installation.




4 If the menu does not launch automatically, 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.

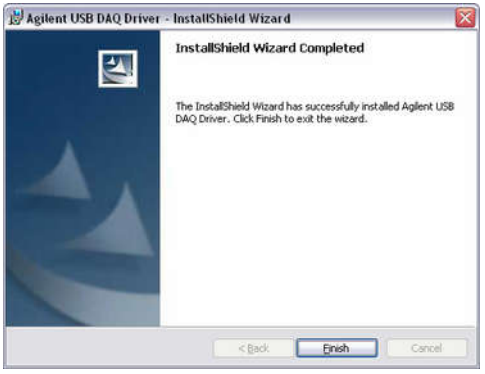
5 The Agilent USB DAQ Driver dialog box will appear as shown below. Click **Next** to proceed. This will install the chassis and DAQ drivers.



6 Click **Install** to begin installation.



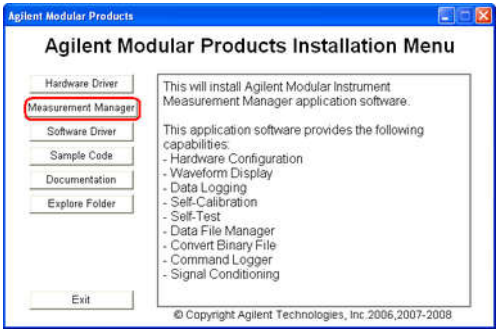

7 Click **Finish** when the installation has completed.



# F. Install the Agilent Measurement Manager

1 If you have done **E. Install the Modular Instrument Chassis Hardware Driver**, proceed to Step 2. Otherwise, close all other applications on your PC and insert the product reference CD-ROM into your CD-ROM drive.

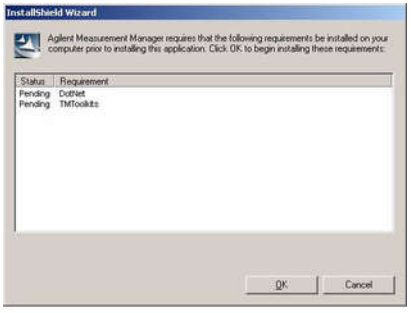
2 Select **Measurement Manager** on the Agilent Modular Products Installation Menu to begin the installation.




3 If the installation menu does not appear after a few seconds, go to **Start > Run** and type `<drive>:\Application\Modular Instruments Measurement Manager\setup.exe`, where `drive` is your CD-ROM drive.

4 Click **OK** to begin installation.

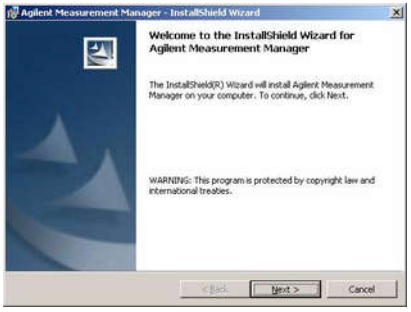
5 If you do not have the Agilent T&M Toolkit 2.1 Runtime version and/or Microsoft .NET Framework version 1.1 and 2.0 installed, the InstallShield Wizard software pre-requisite will appear as shown below.



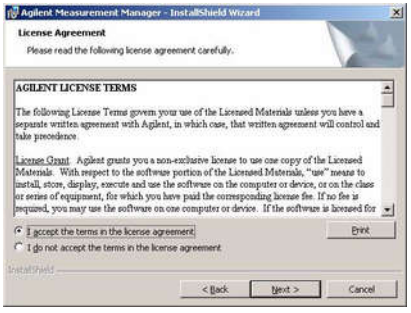

6 Click **OK** to begin installation of the listed missing software.

**7** Once the above installation is completed, installation of the Agilent Measurement Manager software will proceed as normal.

**8** The Agilent Measurement Manager InstallShield Wizard dialog box will appear as shown below. Click **Next** to begin.



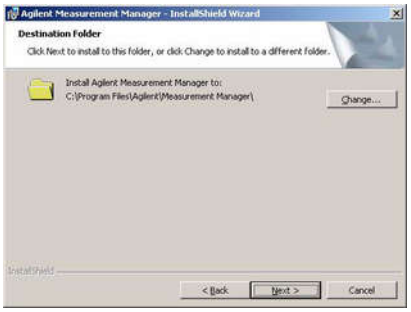

**9** Read the License Agreement and select **I accept the terms in the License Agreement** to proceed. You may click **Print** to print a hardcopy of the Agilent License Terms for reference. Click **Next** to proceed.



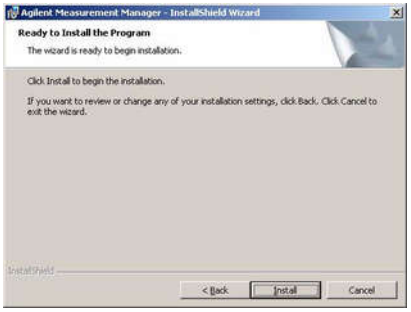

**10** Fill in the Customer Information form, as shown below, accordingly and click **Next**.



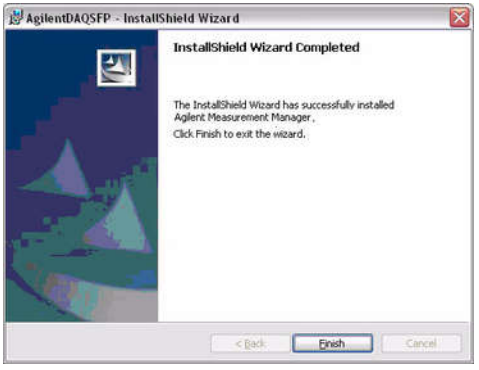
**11** Click **Next** to install to the folder specified or click **Change** to install to a different folder.




**12** Click **Install** to begin the installation of Agilent Measurement Manager.




**13** Click **Finish** when the installation has completed.




**14** A shortcut to this software will be created on your desktop.

**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.

## G. Connect Your Modular Instrument Chassis to the PC

1 After all installations have successfully completed, connect the power cord to the AC input of the chassis device you have set up in Step A. The AC input requirement is 110 V/240 VAC, 50/60 Hz.

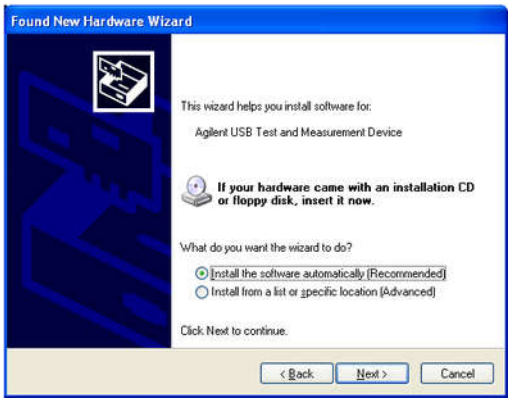
2 Connect the modular instrument chassis to any USB ports on your PC with the bundled USB cable.

3 Your PC will automatically detect the connected chassis and the Found New Hardware Wizard window will appear as shown below.

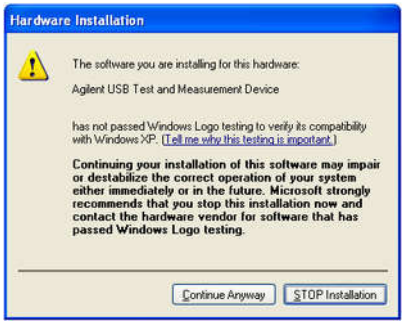



4 Select **Yes, this time only** and click **Next** to proceed.

5 Select **Install the software automatically (Recommended)** and click **Next**.




6 A warning message will appear in the Hardware Installation window, as shown below. Click **Continue Anyway** to proceed with the installation of the driver.




**NOTE**

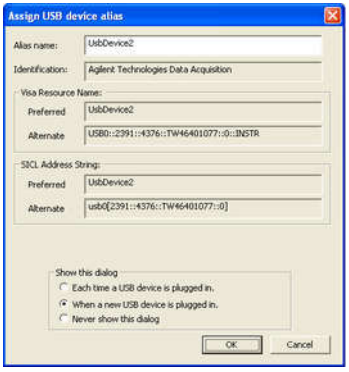
If you do not wish the receive similar warning message in future, follow the instructions below.

1 Go to **Start > Control Panel** and double-click System.
2 Select Hardware tab, on the Drivers panel click **Driver Signing** and the Driver Signing Options dialog box will appear.
3 Select **Ignore** to disable the warning message.

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




8 When the installation has completed, the Assign USB device alias window will appear as shown below. Each time a USB device is plugged in, this dialog will be shown. To configure or disable this dialog, select an options in the Show this dialog panel and click **OK**.




9 The modular instrument chassis is now ready for usage.

**NOTE**

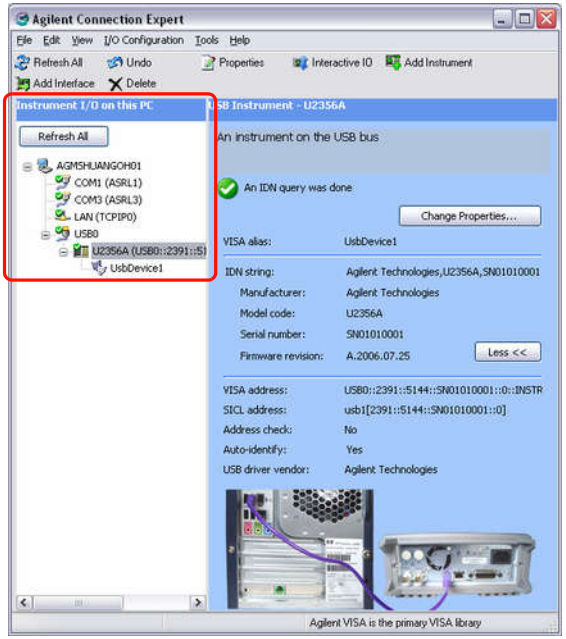
- Before proceeding, you may verify your connected modular instrument chassis using Agilent Connection Expert.
- For more information on hardware verification, refer to **Hardware Verification** in *Agilent U2781A USB Modular Instrument Chassis User's Guide*.

# H. Hardware Verification

Agilent Connection Expert is one of the utility of the Agilent IO Libraries. The Connection Expert configures connected instruments and enables communication. Connection Expert will be able to automatically detect the USB modules plugged into the PC.

1 Go to **Start > All Programs > Agilent IO Libraries Suite > Agilent Connection Expert** to launch the Agilent Connection Expert.

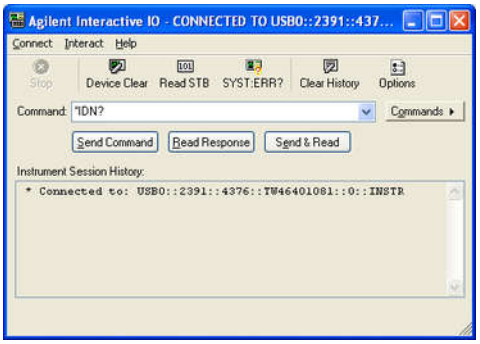
2 The connected USB modules will be visible in the **Instrument I/O on this PC** panel as indicated below. Click on the USB module connection interface and right-click.




3 A context menu will appear as shown below and select **Send Commands To This Instrument**.



4 The Agilent Interactive IO dialog box will appear as shown below. Click **Send & Read** to send the `*IDN?` default command. The instrument's response should appear in the **Instrument Session History** panel.




5 Successful communication between the Agilent Connection Expert and the connected hardware indicate successful hardware installation and connection establishment.

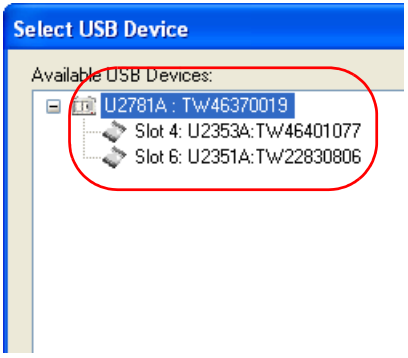
# I. Agilent Measurement Manager

1 Double-click the Agilent Measurement Manager software icon on your desktop or go to **Start > All Programs > Agilent > Modular Products > Measurement Manager** to launch the software.

2 The Agilent Measurement Manager welcome screen will appear as shown below.



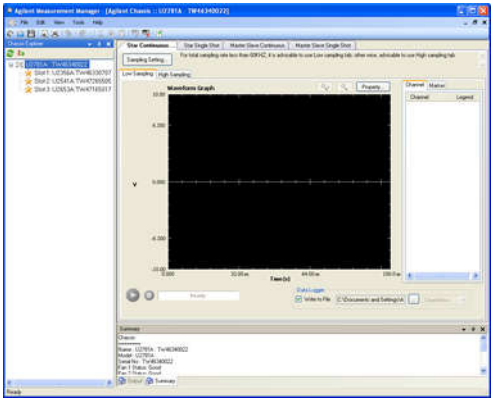

3 The Select USB Device dialog box will appear. It will show all USB modules that are connected to your PC as shown below.




4 If an empty chassis is connected to your PC, slot in at least one USB module into your chassis and click **Refresh**.

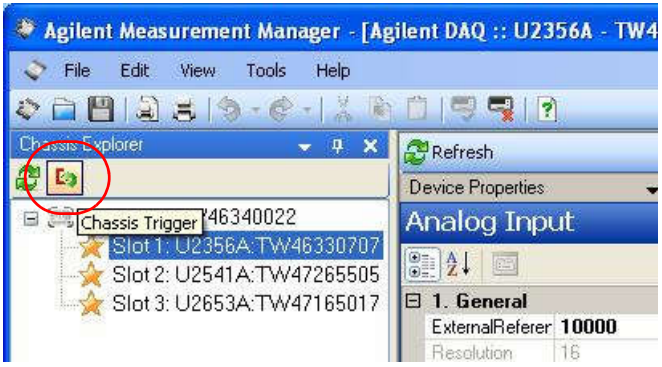
5 To start the application, click **OK** to establish the connection.

6 The Agilent Measurement Manager window will appear as shown in the following figure. On the chassis Explorer panel, you will see a list of devices that are connected to your PC.



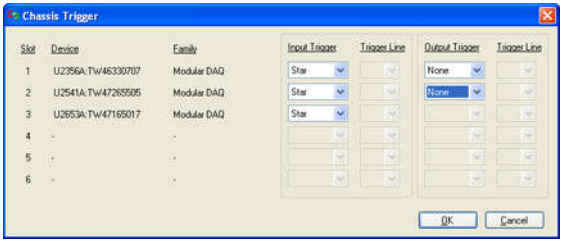
### Trigger mode configuration

The chassis default trigger setting is set to Star Trigger for all U2300A, U2500A, U2600A, and U2700A Series devices upon connection. To configure the trigger mode, click on the Chassis Trigger in the Chassis Explorer and a pop-up menu will appear as shown below. Select the desired trigger mode—Star Trigger[1], Master or Slave[2], and None when no trigger is required.




[1] U2781A offers star trigger bus that aims to provide high performance synchronization features that can be configured via Agilent Measurement Manager.

[2] Master/Slave trigger mode allows one of the modules to be set as the trigger source (Master), while other modules are configured to listen to the trigger bus for the trigger signal (Slave).




**NOTE** For more information on how to use Agilent Measurement Manager, refer to *Agilent Measurement Manager Help File*.

# 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. Power off the chassis device and remove the power cord and I/O cable from the chassis.
2. Shake out any dirt that may have accumulated inside the chassis device.
3. Wipe the chassis with a dry cloth.

# 2
# Features and Functions

Introduction 28
USB Backplane 29
Trigger Bus (TRIG [0..7]) 31
External Trigger Out 32
External Trigger In (Star Trigger) 33
Simultaneous Synchronization (SSI) 34
    Single Master–multiple Slaves 36
    Multiple Master–multiple Slaves 39
Simultaneous Synchronization (SSI) 34
Chassis Temperature Monitoring 42
Fan Speed Monitoring 43
Identifying Modules Location 44
    Geographical Address 44
    Modules Identification 44

This chapter provides information for better understanding of the features and functions of U2781A USB modular instrument chassis.

# Introduction

The Agilent U2781A USB modular instrument chassis provides six USB modular slots and is equipped with 200 W universal AC power supply and built-in over current protection circuit. A 10 MHz system reference clock is supplied to each modules slots. There are two temperature sensors and a monitoring fan control circuit to monitor the internal temperature and speed of the fan. The fan is mainly used for heat dissipation.

The chassis also provides external 10 MHz reference clock, external trigger in and trigger out functions via BNC connectors at the rear panel.

The key function for the chassis is to provide users with flexibility when using the U2781A modular instrument chassis. The modular chassis allocates housing for six USB modules with built-in power supply. The USB backplane provides a means to synchronize the modules.

The key features of the U2781A USB modular instrument chassis are as follows:

- Simultaneous Synchronization (SSI)
- Star trigger
- Internal and external 10 MHz reference clock
- Trigger in and trigger out signals
- Standard SCPI commands
- IVI-COM driver compatibility
- USBTMC 488.2 compliant
- Hi-Speed USB 2.0 interface

The key functions of the Agilent U2781A USB modular instrument chassis will be elaborated in the following sections.

# USB Backplane

### 55-Pin Backplane Connector Pins Configuration

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 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 |

**Table 2-1** 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 |

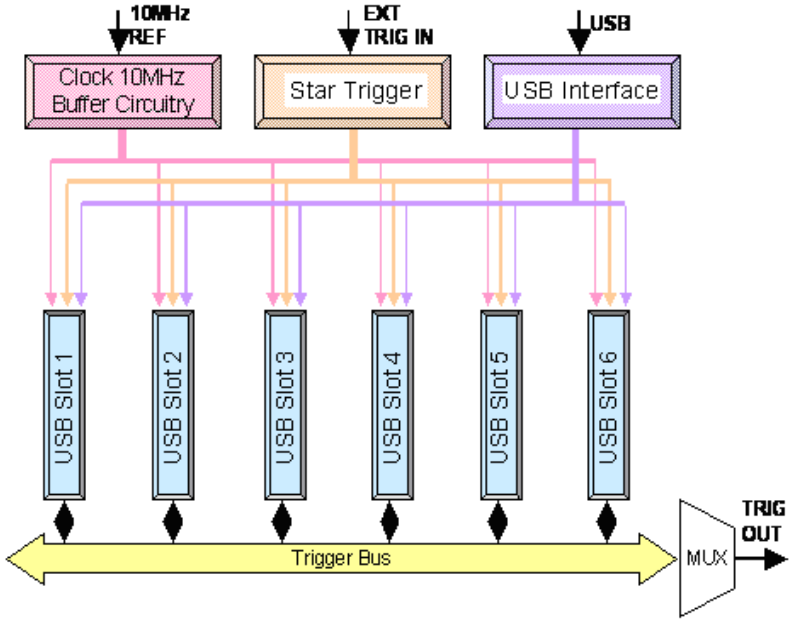



**Figure 2-1** USB backplane block diagram

# Trigger Bus (TRIG [0..7])

Trigger Bus (TRIG [0..7]) is an 8-bit digital bus connected from slot 1 to slot 6 to synchronize different USB modules. This trigger bus enables the USB modules of passing trigger signals to one another.

To have one of the modules to control the operation of the other modules, set the particular module as MASTER and the rest as SLAVE (refer to **Simultaneous Synchronization (SSI)** for more details). The control signal is sent from the MASTER module to the SLAVE modules through this trigger bus. See following figure for the bus architecture.

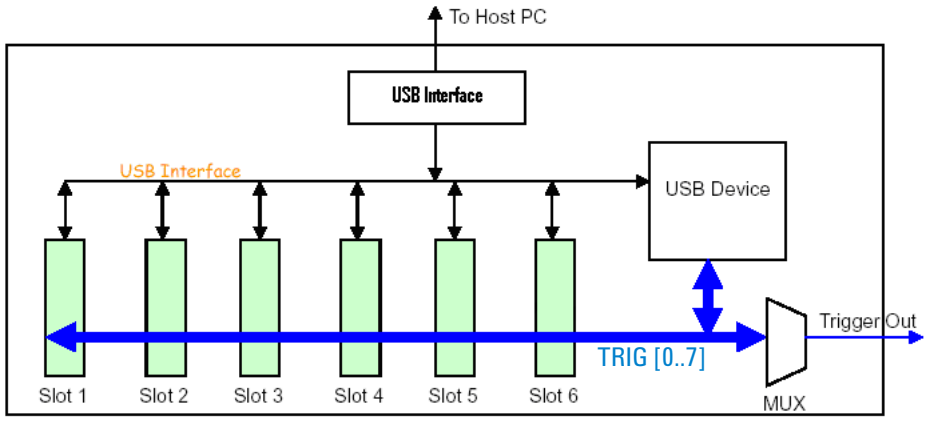



**Figure 2-2** Block diagram of Trigger Bus (TRIG [0..7]) and Trigger Out

In addition, the trigger bus can also be used to carry out the pre-configuration of the chassis and modules before any triggering activities. Refer to **Identifying Modules Location** for more information.

# External Trigger Out

Trigger Out selects one of the eight lines from trigger bus (TRIG [0..7]) as an external trigger source. The selection of the trigger out line is done by the USB device in the chassis as illustrated in Figure 2-2 by means of a multiplexer. Table 2-2 defines the available trigger out signals provided by U2300A, U2500A, and U2600A Series DAQ, whereas for U2700A Series modular products, user is allowed to choose any trigger line from the trigger bus (TRIG [0..7]) as an external trigger source.

The SCPI command below is used to select one of the lines or bits of the trigger bus (TRIG [0..7]) as an external trigger source:

```
TRIGger:OUT {0|1|2|3|4|5|6|7}
```

**Table 2-2** Trigger out bits for U2300A, U2500A, and U2600A Series DAQ devices

| Trigger Out | Function |
|---|---|
| Bit-0 | Time base |
| Bit-1 | Reserved |
| Bit-2 | Reserved |
| Bit-3 | A/D trigger |
| Bit-4 | Reserved |
| Bit-5 | Reserved |
| Bit-6 | Reserved |
| Bit-7 | D/A trigger |

# External Trigger In (Star Trigger)

The star trigger bus offers a very high performance or precise synchronization between modules. The star trigger bus is a dedicated trigger line between the External Trigger Input and USB slots. This trigger signal is sent from external to each slot through a 1-to-6 CLK buffer. The slot-to-slot skews are minimized to ensure that trigger signal reaches all six slots simultaneously. Refer to the following figure for the star trigger bus architecture illustration.

To set star trigger as the module trigger source, the following SCPI command is sent to the modules:

```
OUTP:TRIG:SOUR STRG
```

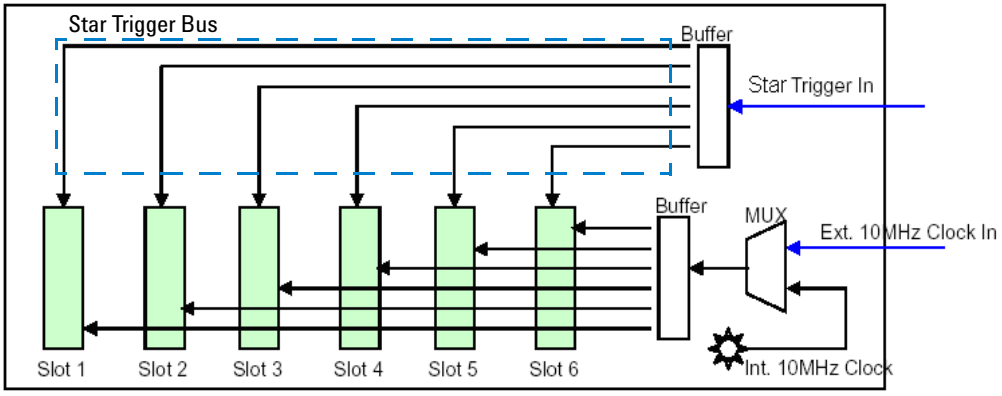



**Figure 2-3** Block diagram of the 10 Mhz Reference Clock and External Trigger In

# Simultaneous Synchronization (SSI)

Simultaneous Synchronization (SSI) provides synchronization between the modular products within the chassis. Figure 2-4 illustrates an example of SSI. The SSI feature should be configured using the bundled Agilent Measurement Manager (AMM).

SSI allows users to set the modules as MASTER or SLAVE. The MASTER module sends the SSI signal to the slave modules via the backplane trigger bus (TRIG [0..7]). SLAVE modules will then receive the signal and begin synchronization with MASTER module.

There are two SSI configuration modes available — single Master–multiple Slaves and multiple Masters–multiple Slaves.

**NOTE**

- Only ONE master can be assigned for U2300A, U2500A, and U2600A Series.
- For more information, refer to the *AMM Help File,* Chassis Trigger page.

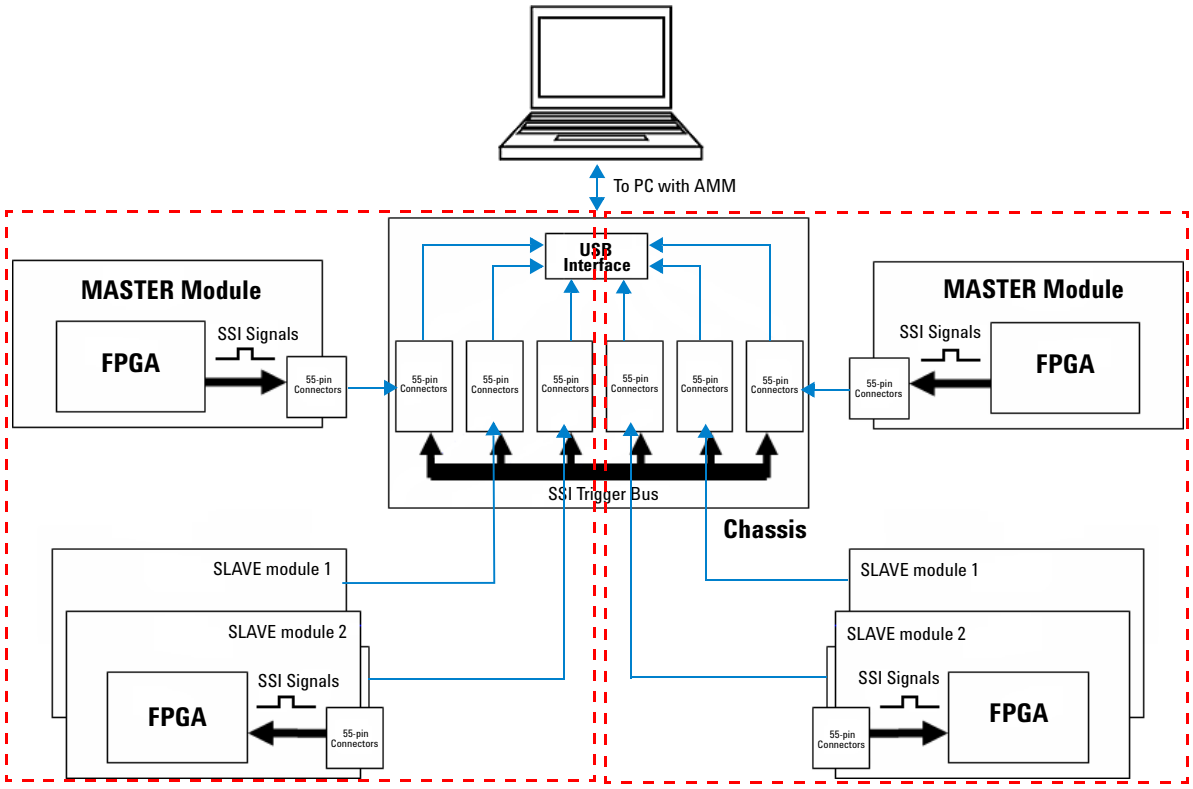



**Figure 2-4** Synchronization between modules in the chassis

## Single Master–multiple Slaves

In this configuration, only one Master module is allowed to send the SSI trigger event to the receiving Slave modules.

### Configuration with Agilent U2300A, U2500A, and U2600A Series DAQ only

When there is one or more U2300A, U2500A, or U2600A Series DAQ in the SSI configuration, SSI allows users to set only one of the modules as MASTER and others as SLAVE through AMM. Alternatively, users can also set this configuration using the SCPI commands.

**NOTE** Refer to *U2300A, U2500A, and U2600A Series DAQ Programmer's Reference.*

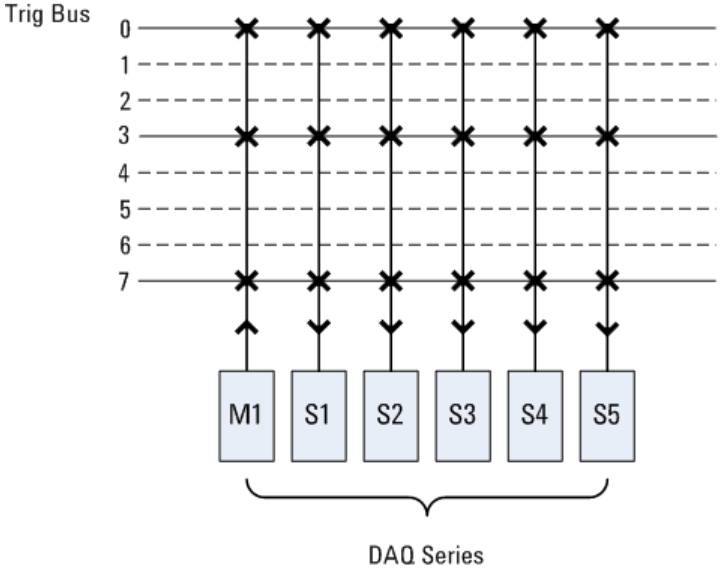



**Figure 2-5** Single Master–multiple Slave triggering with DAQ

### Configuration with combination of Agilent U2300A, U2500A, U2600A Series DAQ and U2700A Series modular products

With one DAQ configured as Master, all of the other U2700A Series modular devices can only be configured as Slave to receive the event of the signal as shown in Table 2-2.

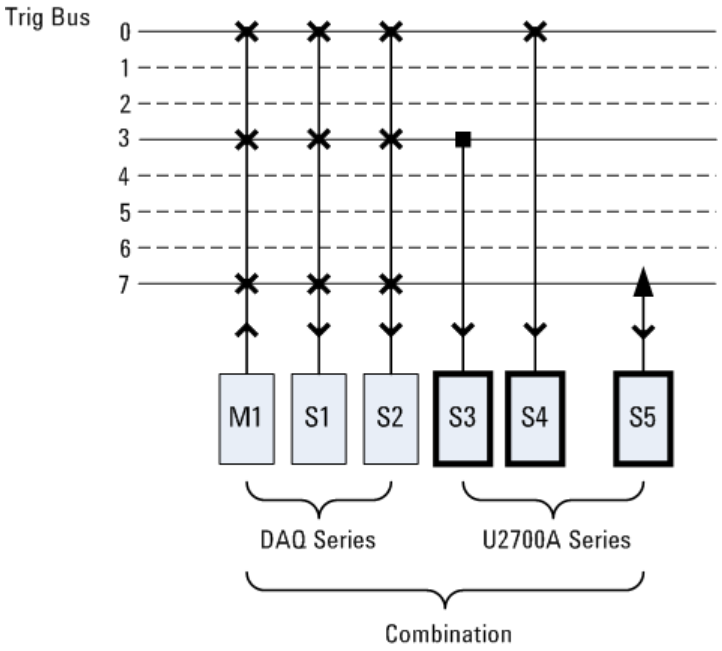



**Figure 2-6** Single Master–multiple Slave triggering

Table 2-3 shows some examples of supported and not supported configurations.

**Table 2-3** Example of configurations for single Master-multiple Slaves using DAQ and U2700A Series modular products.

| | Slot 1 | Slot 2 | Slot 3 | Slot 4 & Slot 5 | Slot 6 |
|---|---|---|---|---|---|
| | **DAQ** | **U2701A/U2702A** | **U2761A** | **U2722A** | **DAQ** |
| **Supported configurations** | | | | | |
| Configuration 1 | M = T0 – T7 | S = T0 | S = T3 | S = T7 | S = T0 – T7 |
| Configuration 2 | None | M = T1 | S = T1 | S = T1 | None |
| Configuration 3 | M = T0 – T7 | None | None | None | S = T0 – T7 |
| **Not supported configurations** | | | | | |
| Configuration 1[1] | M = T0 – T7 | M = T1 | S = T1 | S = T2 | None |
| Configuration 2[2] | S = T0 – T7 | M = T1 | S = T1 | S = T2 | None |
| Configuration 3[2] | S = T0 – T7 | M = T1 | S = T1 | S = T1 | None |
| Configuration 4[2] | S = T0 – T7 | M = T0 – T7 | S = T0 | S = T0 | None |

**M** — Master, **S** — Slave, **T0~T7** — Trigger bus (TRIG [0..7]), * — Star Trigger

[1] Multiple Master is not allowed with DAQ set as Master.

[2] U2700A Series modular devices should not be configured as Master.

## Multiple Master–multiple Slaves

In this configuration, groups of single Master- multiple Slaves are allowed in order to perform multiple synchronizations simultaneously. This configuration is only supported by U2700A Series modular products.

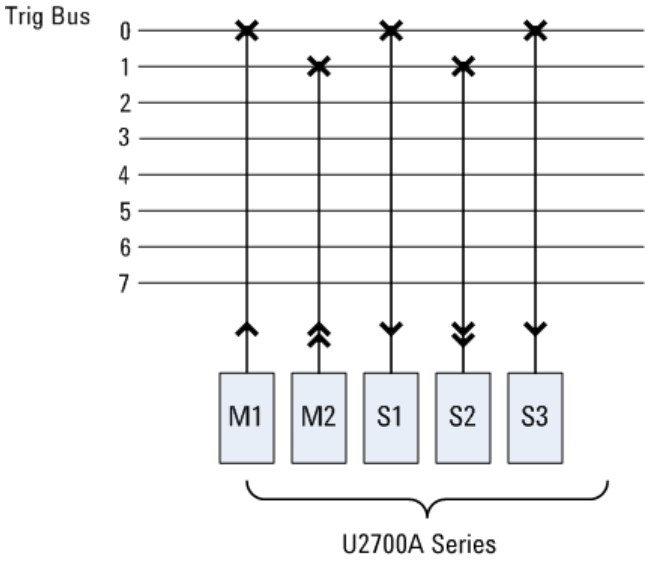



**Figure 2-7** Multiple Master–multiple Slave triggering

Table 2-4 shows some examples of supported and not supported configurations. Example of configurations for multiple Master–multiple Slaves.

**Table 2-4** Example of configurations for multiple Master–multiple Slaves

| | Slot 1<br>U2701A | Slot 2<br>U2702A | Slot 3<br>U2761A | Slot 4<br>U2751A | Slot 5 & Slot 6<br>U2722A |
|---|---|---|---|---|---|
| **Supported configurations** | | | | | |
| Configuration 1 | M = T0 | S = T0 | S = T0 | None | S = T0 |
| Configuration 2 | S = T1 | M = T1 | None | None | S = T1 |
| Configuration 3 | M = T0 | M = T1 | S = T0 | None | S = T1 |
| Configuration 4 | *(Out)<br>M = T1 | S = T1 | * (In) | None | S = T1 |
| Configuration 5 | *(Out) | * (In) | * (In) | None | * (In) |
| **Not supported configurations** | | | | | |
| Configuration 1[1] | M = T0 | M = T0 | S = T0 | None | S = T0 |
| Configuration 2[2] | M = T3 | S = T3<br>S = T4 | M = T4 | None | S = T4 |
| Configuration 3[3] | M = T0<br>S = T1 | S = T0 | S = T0 | None | S = T1 |
| Configuration 4[4] | *(Out)<br>M = T1 | * (In)<br>S = T1 | None | None | None |

**M** — Master, **S** — Slave, **T0~T7** — Trigger bus (TRIG [0..7]), * — Star Trigger

[1] Same trigger line is not allowed for multiple Master configuration.

[2] Slave device not allowed to occupy two trigger lines.

[3] Not allowed to have both Master and Slave configuration for a device.

[4] Not allowed to have Star Trigger and Slave mode for a device.

# System Reference Clock

The 10 MHz reference clock can come from two sources; internal backplane oscillator and external clock source.

The internal oscillator on the USB backplane supplies an independent 10 MHz system reference clock to each of the USB slot. This 10 MHz reference clock is driven through an independent buffer. Refer to Figure 2-3 for the block diagram. Every clock trace is in equal distance to ensure that the distance of the slot to the slot skew is minimized. Users can use this common reference clock signal to synchronize multiple modules in a measurement or control system.

The default SCPI command of `ACQuire:RSIGnal AUTO` will scan through and detect if there is any valid clock source from the external BNC connector. If none is found, then the internal 10 MHz clock source will be used.

The SCPI command below will direct the reference clock source to the internal 10 MHz:

```
ACQuire:RSIGnal INT
```

# Chassis Temperature Monitoring

The chassis contains a temperature control circuitry. It has two thermistor sensors to sense the inner temperature of the chassis. The temperature control circuitry communicates with backplane USB device through an $I^2C$ interface as illustrated in following figure.

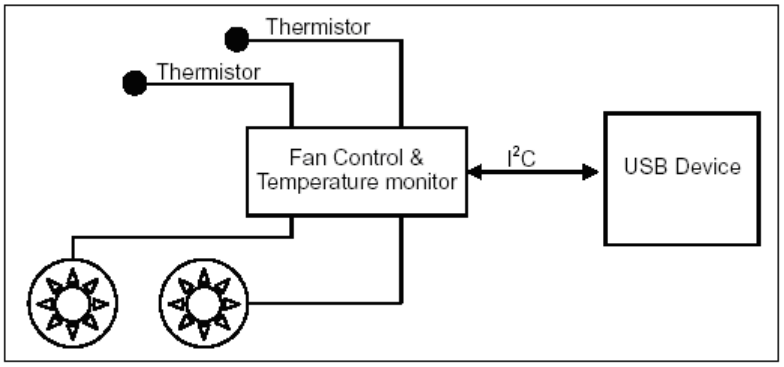



**Figure 2-8** Block diagram of temperature monitoring and fan control

The SCPI command below queries the temperature reading from the sensors in degree Celsius (°C):

```
SYSTem:TEMPerature? {1|2}
```

# Fan Speed Monitoring

The U2781A USB modular instrument chassis is also integrated with a fan speed control circuit. It is used to monitor the fan status and speed. The control circuit communicates with backplane USB device via $I^2C$ interface. Refer to Figure 2-8.

To query the fan status, send the SCPI command below:

```
SYSTem:FSTATus? {1|2}
```

To query the fan speed in revolutions per minute (rpm), send the SCPI command below:

```
SYSTem:FSPeed? {1|2}
```

# Identifying Modules Location

## Geographical Address

Each slot in the chassis is designed with a 3-bit address pin, which is designated as a location identity for USB modules. The address for all six slots are as below:

| Slot | Address |
|---|---|
| 1 | 001 |
| 2 | 010 |
| 3 | 011 |
| 4 | 100 |
| 5 | 101 |
| 6 | 110 |

The USB modules are able to read this 3-bit data and know which slot the module is plugged in. To read the geographical address of each module, the SCPI command below is used:

```
SYSTem:CDEScription?
```

## Modules Identification

You may have more than one module or chassis connected to the same host PC. The following figure illustrates an example of the connection.

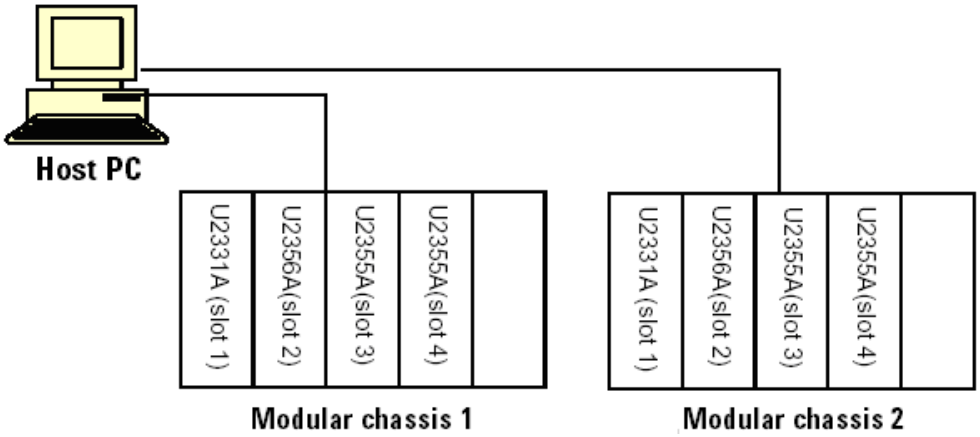



**Figure 2-9** Identifying modules location

To identify the location of the modules, a pre-configuration setting is needed before the synchronization or triggering event begins. Follow the steps below:

1 Send the following command to the modular chassis to trigger it. This command will be used to transmit the number to all USB modules via Trigger Bus (TRIG [0..7]). You can choose from 1 to 255 for your chassis number.

```
SYSTem:IDentity {1|2|3…|255}
```

2 Send the following command to every module in the chassis to query each of the slot and chassis numbers.

```
SYST:CDES?
```

3 You may need to perform some sorting routine to determine which slot it is at and what is the assigned number of its host chassis. If a chassis has six modules in it, then there will be a total of seven SCPI commands to send to chassis and modules.

4 During this identification operation, the trigger bus is used. Hence, any triggering activities on the backplane would be blocked.

5 Prior to any triggering activities, you must stop the configuration activity by sending the following command:

```
SYSTem:IDentity {0|OFF}
```

**NOTE**

- Do not execute the above mentioned steps when the USB modules are in the process of acquiring data.
- You do not need to perform the above pre-configuration if you are using the Agilent Measurement Manager software. You are only required to press the “Refresh” button.

# 3
# Characteristics and Specifications

Product Characteristics 48
Electrical Specifications 49
Mechanical Specifications 50

This chapter specifies the characteristics, environment conditions, and specifications of the U2781A USB modular instrument chassis.

# Product Characteristics

**REMOTE INTERFACE**

- Hi-Speed USB 2.0
- USBTMC Class Device

**POWER CONSUMPTION**

- 400 VA maximum
- Installation Category II

**OPERATING ENVIRONMENT**

- Operating temperature from 0 °C to +55 °C
- Relative humidity at 15% to 85% RH (non-condensing)
- Altitude up to 2000 meters
- Pollution Degree 2
- For indoor use only

**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, Class A, Group 1
- CANADA: ICES-001: 1998
- Australia/New Zealand: AS/NZS 2064.1

**ACOUSTIC EMISSION**

- Sound pressure level: 45.5 dB(A)
- Sound power level: 56.6 dB(A)

**SHOCK & VIBRATION**

Tested to IEC/EN 60068-2

**DIMENSION (WxDxH)**

270.00 mm x 271.20 mm x 197.00 mm

**WEIGHT**

3.7 kg (without any modules slotted in)

**WARRANTY**

Three years

# Electrical Specifications

| Power Supply AC Input | |
|---|---|
| Input voltage range | 100 to 240 VAC |
| Input frequency range | 50 to 60 Hz |
| Power consumption | 400 VA maximum |
| Efficiency | 75% |
| **Power Supply DC Output** | |
| Output rated voltage | 12 VDC |
| Max output rated current | 16.7 A |
| Max output rated power | 200 W |
| Over voltage protection | 13.2 to 16.2 V |

| Internal 10 MHz Reference Clock | |
|---|---|
| Accuracy | 25 ppm for operating range |
| Slot to slot skew | 350 ps |
| **External 10 MHz Reference Clock** | |
| Auto detection level | Yes |
| Input frequency range | 10 MHz |
| Input magnitude | 100 mVpp to 5 Vpp (sine/square wave) |
| Input impedance | 50 Ω ± 5 Ω |
| Damage level | 10 Vrms |
| **External Trigger In** | |
| Compatibility | TTL |
| $V_{IH}$ (Positive threshold voltage) | 2.0 V |
| $V_{IL}$ (Negative threshold voltage) | 0.8 V |
| Hold time | 8 ns pulse width |
| Input voltage range | 0 to 5.0 V |
| Slot to slot skew | 350 ps |
| **External Trigger Out** | |
| $V_{OH}$ | 2.9 V |
| $V_{OL}$ | 0.1 V |
| Output voltage range | 0 to 3.3 V |

# Mechanical Specifications

| **Physical Layout** | |
|---|---|
| Number of USB module slots | 6 |
| Dimension of each module slot | 25.40 mm (W) x 174.54 mm (D) x 105.00 mm (H) |
| Dimension of chassis | 270.00 mm (W) x 271.20 mm (D) x 197.00 mm (H) |
| Weight | 3.7 kg |
| Power LED | ON/OFF type |
| **USB Backplane** | |
| Connector | 55 pins Ernet male type C |
| Input signals | External 10 MHz clock in (BNC connector)<br>External trigger in (BNC connector) |
| Output signal | Trigger out (BNC connector) |
| **Cooling Fan** | |
| Number of fans | 2 |
| Fan speed | 3300 rpm ±10% |
| Noise | 37 dB(A) |
| Power (each fan) | 2.52 W |

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