# Agilent M9216A PXI High Voltage Data Acquisition

## Service Guide

Agilent Technologies

# Notices



## Manual Part Number

M9216-90010

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## Safety Notices

**CAUTION**

A **CAUTION** notice denotes a hazard. It calls attention to an operating procedure, practice, or the likes of 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.

**WARNING**

**A WARNING notice denotes a hazard. It calls attention to an operating procedure, practice, or the likes of 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.**

**WARNING**

**If this product is not used as specified, the protection provided by the equipment could be impaired. This product must be used in a normal condition (in which all means for protection are intact) only.**

The types of product users are:

- Responsible body is the individual or group responsible for the use and maintenance of equipment, for ensuring that the equipment is operated within its specifications and operating limits, and for ensuring that operators are adequately trained.
- Operators use the product for its intended function. They must be trained in electrical safety procedures and proper use of the instrument. They must be protected from electric shock and contact with hazardous live circuits.
- Maintenance personnel perform routine procedures on the product to keep it operating properly (for example, setting the line voltage or replacing consumable materials). Maintenance procedures are described in the user documentation. The procedures explicitly state if the operator may perform them. Otherwise, they should be performed only by service personnel.
- Service personnel are trained to work on live circuits, perform safe installations, and repair products. Only properly trained service personnel may perform installation and service procedures.

Exercise extreme caution when a shock hazard is present. Lethal voltage may be present on cable connector jacks or test fixtures. The American National Standards Institute (ANSI) states that a shock hazard exists when voltage levels greater than 30V RMS, 42.4V peak, or 60VDC are present.

A good safety practice is to expect that hazardous voltage is present in any unknown circuit before measuring.

Operators of this product must be protected from electric shock at all times. The responsible body must ensure that operators are prevented access and/or insulated from every connection point. In some cases, connections must be exposed to potential human contact. Product operators in these circumstances must be trained to protect themselves from the risk of electric shock.

Before operating an instrument, ensure that the line cord is connected to a properly-grounded power receptacle. Inspect the connecting cables, test leads, and jumpers for possible wear, cracks, or breaks before each use.

When installing equipment where access to the main power cord is restricted, such as rack mounting, a separate main input power disconnect device must be provided in closed proximity to the equipment and within easy reach of the operator.

For maximum safety, do not touch the product, test cables, or any other instruments while power is applied to the circuit under test. ALWAYS remove power from the entire test system and discharge any capacitors before: connecting or disconnecting cables or jumpers, installing or removing switching cards, or making internal changes, such as installing or removing jumpers.

Do not touch any object that could provide a current path to the common side of the circuit under test or power line (earth) ground. Always make measurements with dry hands while standing on a dry, insulated surface capable of withstanding the voltage being measured.

The instrument and accessories must be used in accordance with its specifications and operating instructions, or the safety of the equipment may be impaired.

**CAUTION**

- Do not exceed the maximum signal levels of the instruments and accessories, as defined in the specifications and operating information, and as shown on the instrument or test fixture panels, or switching card.
- Chassis connections must only be used as shield connections for measuring circuits, NOT as safety earth ground connections.
- If you are using a test fixture, keep the lid closed while power is applied to the device under test. Safe operation requires the use of a lid interlock.
- Instrumentation and accessories shall not be connected to humans.

To maintain protection from electric shock and fire, replacement components in mains circuits - including the power transformer, test leads, and input jacks - must be purchased from Agilent. Standard fuses with applicable national safety approvals may be used if the rating and type are the same. Other components that are not safety-related may be purchased from other suppliers as long as they are equivalent to the original component (note that selected parts should be purchased only through Agilent to maintain accuracy and functionality of the product). If you are unsure about the applicability of a replacement component, call an Agilent office for information.

**WARNING**

**No operator serviceable parts inside. Refer servicing to qualified personnel. To prevent electrical shock do not remove covers.**

## Front and Rear Panels Symbols

The CE mark is a registered trademark of the European Community.


The C-Tick mark is a registered trademark of the Australian Spectrum Management Agency.


This symbol indicates product compliance with the Canadian Interference-Causing Equipment Standard (ICES-001). It also identifies the product is an Industrial Scientific and Medical Group 1 Class A product (CISPR 11, Clause 4).


The CSA mark is a registered trademark of the CSA International.

This symbol indicates separate collection for electrical and electronic equipment, mandated under EU law as of August 13, 2005. All electric and electronic equipment are required to be separated from normal waste for disposal (Reference WEEE Directive, 2002/96/EC).


This symbol indicates the time period during which no hazardous or toxic substance elements are expected to leak or deteriorate during normal use. Forty years is the expected useful life of the product.

## Cleaning Precautions

**WARNING**

**To prevent electrical shock, disconnect the Agilent Technologies instrument from mains before cleaning. Use a dry cloth or one slightly dampened with water to clean the external case parts. Do not attempt to clean internally. To clean the connectors, use alcohol in a well-ventilated area. Allow all residual alcohol moisture to evaporate, and the fumes to dissipate prior to energizing the instrument.**

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# 1 Introduction



This chapter provides an overview description of the M9216A PXI high voltage data acquisition.

# General Information and Specification

The M9216A has eight internal semi-autonomous 16-bit 250 kSa digitizers (channels), and at the front end, a 32 input port multiplexer capable of withstanding voltages of up to 100 V.

It is specifically designed for automotive electronics voltage measurements. The M9216A slots into a standard PXI frame and physically occupy two slot spaces as shown in Figure 1-1. It works with a 5.0 V or 3.3 V signaling level and is compatible to PXI-2.

Several features differentiate the M9216A from standard general purpose digitizers.

- The M9216A does not have switchable voltage measurement ranges. Instead it has a concurrently active 5 V and 100 V (range) measurement sub-channels available on each of the eight channels. This capability allows the accurate measurements of both very low and high amplitudes simultaneously.
- Each of the eight channels is semi-autonomous and can be triggered independently from its own source data. This is unlike typical multichannel digitizers or scopes where all the channels are triggered with one of the channels.
- The M9216A is designed specifically for automotive electronics measurements and the full range of the 16-bit ADC is dedicated to positive voltage measurement which improves resolution and accuracy.
- The M9216A has an internal 32 input port relay multiplexer, capable of switching high voltages. This multiplexer can switch the input ports to the channel digitizer or to 16 auxiliary output connections. Each of the 32 ports can be configured with its own measurement and trigger parameters. When an input port is selected for measurement, the digitizer channels will be reconfigured automatically.

- The front panel port layout is shown in Figure 1-2. The next section will provide a broad overview of the internal architecture and the capabilities of the M9216A.

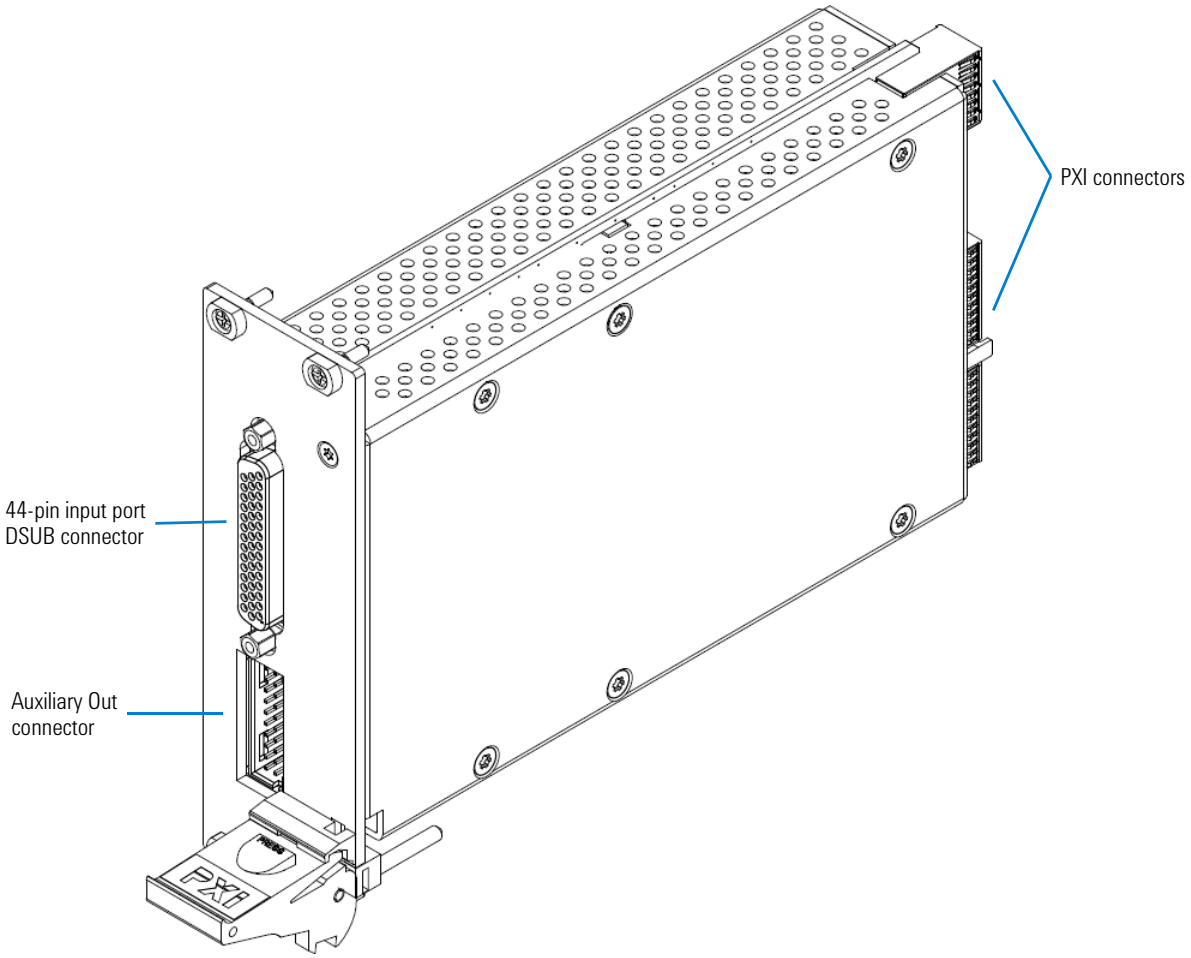


**Figure 1-1** M9216A 16-bit DAQ external construction

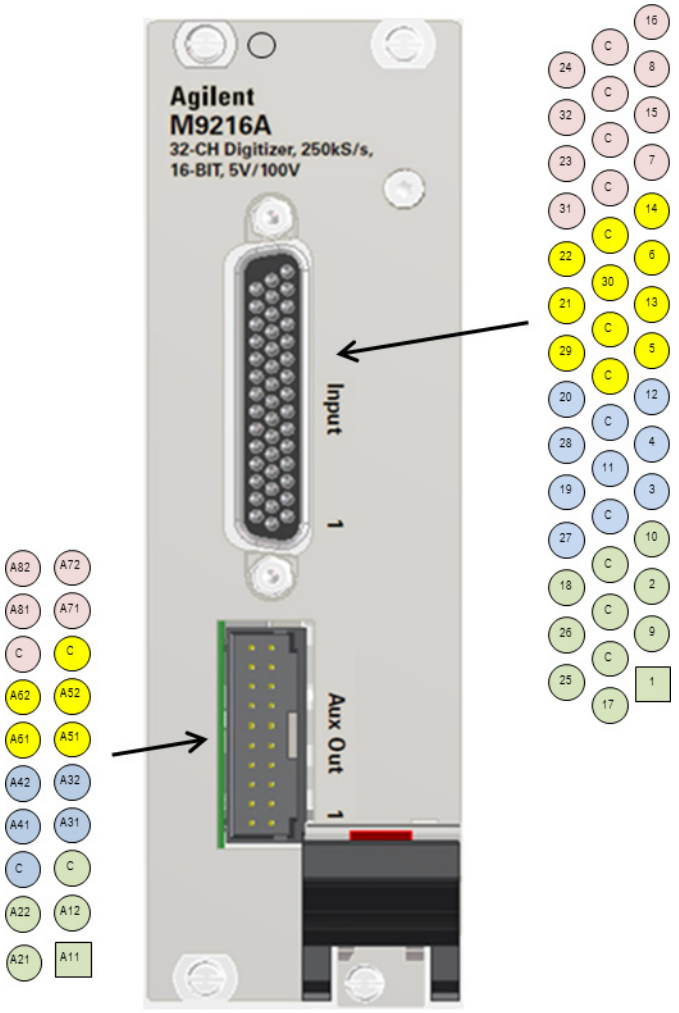


**Figure 1-2** Front panel input and auxiliary output port layout for the M9216A

# Hardware Description

## Block diagram overview

A block diagram of the M9216A DAQ is shown in Figure 1-3. At the front end of the DAQ is a 32 port high voltage multiplexer capable of withstanding 100 V @ 0.5 A, followed by a group of eight semi-autonomous digitizers. Each of these eight measurement channels has two sub-channels that are used for concurrent 5 V and 100 V range measurements. Both sub-channels are always active. You can select whether to retrieve data from one, both, or none of the sub-channels.

The multiplexer is used to switch any eight of the 32 input ports to the M9216A's eight digitizing channels. 16 of the input connector can also be switched to the auxiliary output connector. This allows the input ports to be connected to other measurement instruments or to a measurement bus.

As shown in Figure 1-3, the 32 input ports of the DAQ are arranged into four banks. The significance of each bank is that the eight input ports belonging to each bank shares one common return ground that is DC isolated from the other banks as well as chassis ground.

## Digitizer architecture

**MULTI CHANNEL** The M9216A have eight dedicated channels that may be independently configured. These digitizers are labeled as Channel 1 to Channel 8 in Figure 1-3.

Each channel itself consists of a 5 V and 100 V sub channel that are sampled at the same instant and are always active, that is no voltage range switching is required in the M9216A. Each of these sub- channels can record up to 30 kSa. You can choose to retrieve none, either, or both the channels 16 bit data from the hardware.

The 5 V sub-channel will clip any high voltage internally to approximately 5.3 V to prevent damage to the circuitry.

Each digitizer channel can be connected to four input ports via the input multiplexer and the programmable interface allows each input port to have a different trigger and measurement configuration. Thus, it is possible to alternately view the M9216A as having 32 logical channels with the constraint that only eight logical channels can be utilized simultaneously.

The internal multiplexer is able to switch 16 input ports (limited to certain rules, see "Using the auxiliary output port" on page 16) to the primary **Aux(n)1** and complementary **Aux(n)2** auxiliary ports. The arrangement allows external access to two ports for each channel.

There are four isolated common ground return in the M9216A. A group of 8 input ports and two digitizer channels shares one common return ground. They are group logically together in a bank. For example ports 1, 9, 17, 25, 2, 10, 18, 26, Channel 1, and Channel 2 are grouped together in Bank 1.

**SINGLE CHANNEL** The primary behavior of the M9216A as described above is called the Multiple Channel mode. In addition, the M9216A can be reinitialized in Single Channel mode. In this mode, the entire internal sample memory of the M9216A is allocated to one channel which allows a maximum record size of 240 kSa. The limitation is that only one of the 32 ports can be used for acquisition at a time and the auxiliary output ports cannot be selected.

Logically (and programmatically) the M9216A behaves as a single channel digitizer with a 32-1 input port multiplexer. The logical block diagram of the M9216A in Single Channel mode is shown in Figure 1-4.

The Single Channel Mode is useful when the 30 kSa per channel record size is not sufficient or when verifying and troubleshooting a problem. In most cases, the Multiple Channel Mode will be the preferred mode of operation as it allows parallel simultaneous acquisition.

**NOTE** The M9216A will hardware reset to its respective default state when switching between Single Channel and Multiple Channel measurement mode.

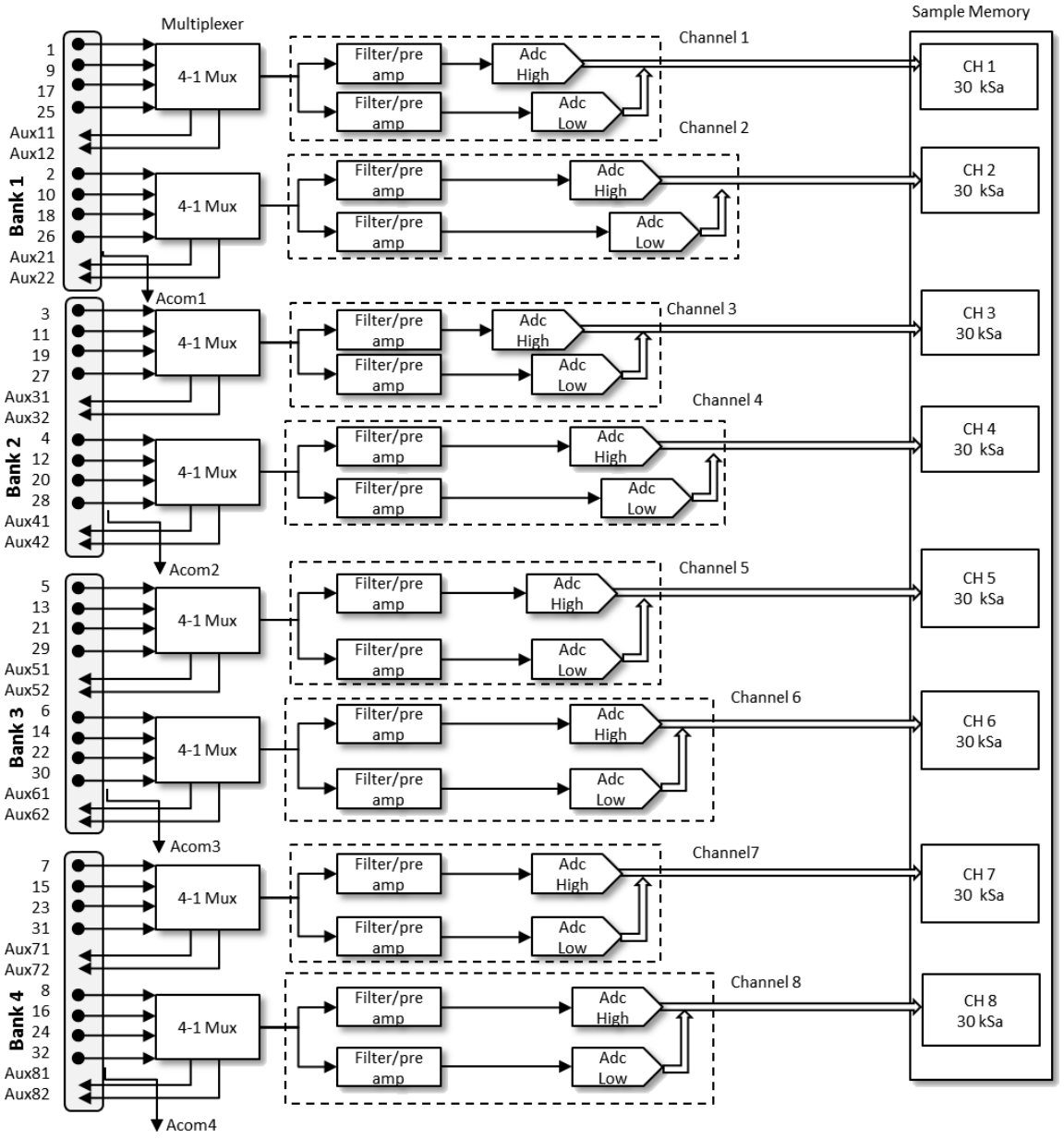


**Figure 1-3** M9216A in Multiple Channel measurement mode

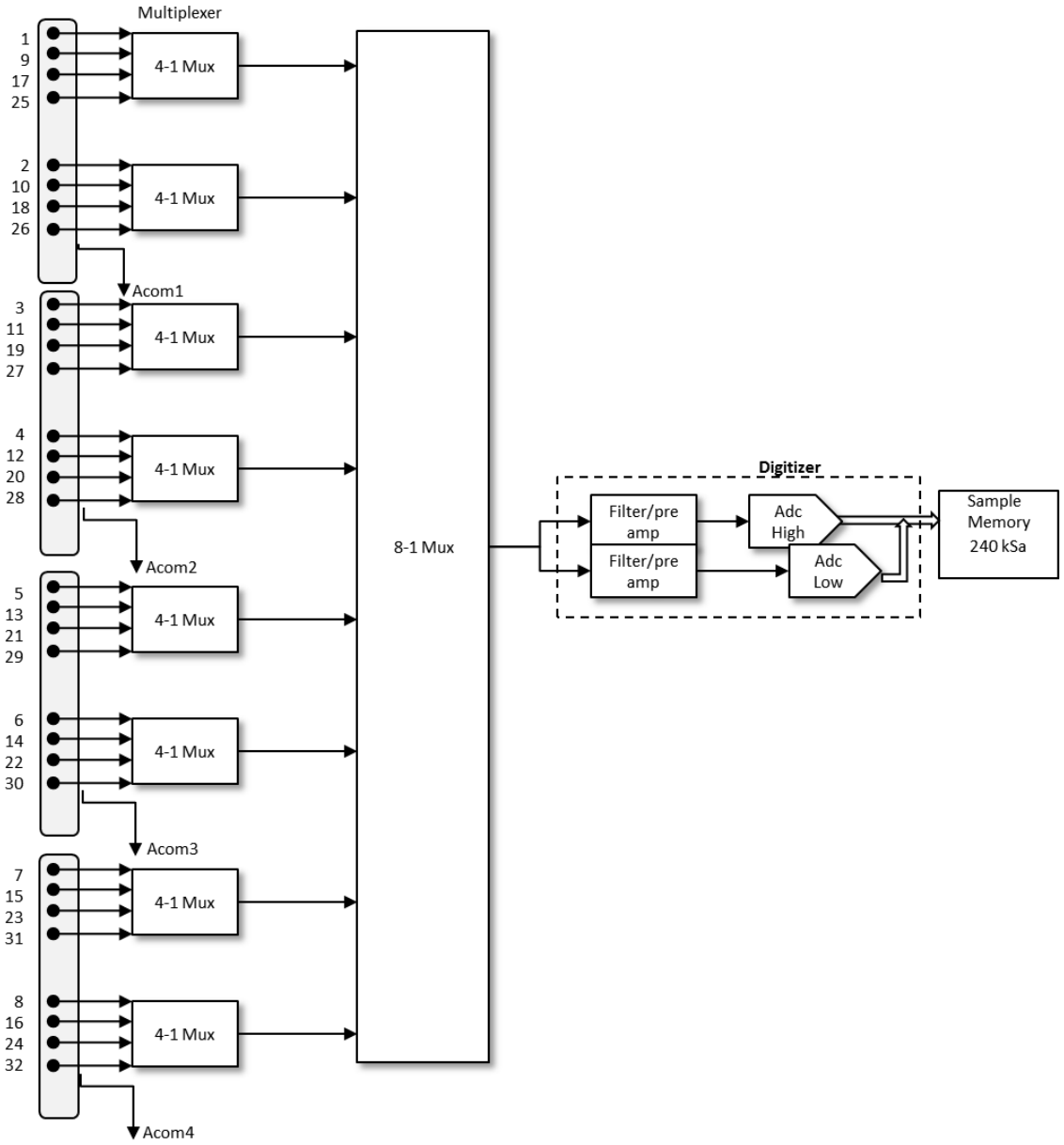


**Figure 1-4** M9216A in Single Channel measurement mode

# Using the M9216A

This section describes in general the steps and actions required to capture data with the M9216A. Figure 1-5 shows the flow chart of the required procedure to capture data from the DAQ after connection has been established with the M9216A.

Note that any function names used in this section and throughout this guide is generic.

Please refer to the *Agilent M9216A Soft Front Panel (SFP) Help* and *Agilent M9216A LabVIEW G Programming Information* for a full listing and detailed description of the IVI commands as well as the parameters definition.

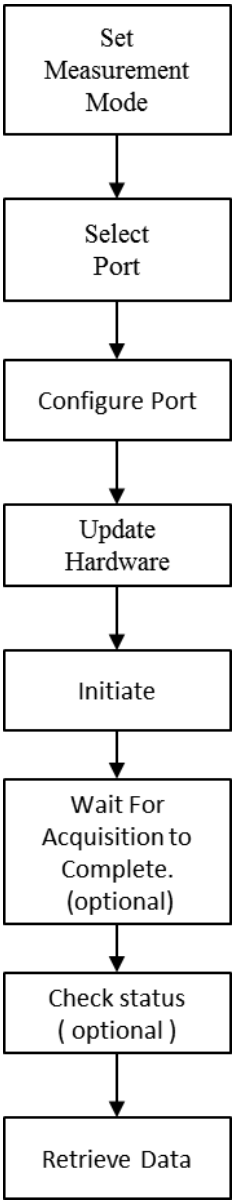


**Figure 1-5** Steps required to capture data with the M9216A

## Set the measurement mode

This operation sets the global modes of the M9216A. The settings will apply to all eight digitizer channels.

During this step, the M9216A measurement mode has to be set in either Single Channel or Multiple Channel. In Single Channel measurement mode, you can only utilize one of the eight digitizers sequentially (one at a time) while in Multiple Channel mode all eight channels are available. The advantage of the Single Channel mode is that the sample memory length is 240 kSa while it is only 30 kSa in Multiple Channel mode.

During this step, the trigger mode of the M9216A will also need to be set in either Immediate or in Channel trigger mode. In Immediate mode, the M9216A will start the acquisition immediately upon receipt of the Initiate command. In Channel mode, the M9216A will use the channel's source data and trigger configuration to start the acquisition.

## Configure the port and the channel

Configuration involves setting up the measurement and trigger parameters for each of the 32 input ports.

If the M9216A trigger mode has been set to Immediate, configuration will only require setting the acquisition's Record Size which is the length of the waveform.

If the M9216A trigger mode is set to Channel, the following parameters can be set:

- Slope (positive/negative/both)
- Trigger Level (V)
- Trigger Hysteresis (V)
- Pre-trigger Samples
- Record Size
- Trigger delay (µs)

- Trigger Hold Off Count
- Trigger Timeout (µs)

For the definition of the parameters in detail, please refer to the *M9216A Programing Interface Help* that is included in the installation disc.

## Select the port

As mentioned previously, there are 32 input ports and eight physical digitizers in the M9216A.

In the Multiple Channel mode, eight ports can be selected for simultaneous acquisition. However all these input ports must be from different channels.

In the Single Channel mode, you must select one of the available thirty two ports for acquisition.

In each case, the configuration setting for the selected port(s) (from the previous step) will be used during acquisition.

The programming interface also allows selection of the input port via an alternative logical port numbering system *InputConnectorSelection*, which may be easier to refer for some users. In this scheme, each channel is allocated four input connectors numbered logically from one to four. This selection method is also used in the Soft Front Panel included with the M9216A.

**NOTE** You may also first select a port and then configure a port. This is because the actual operations are only executed in the hardware after an **Update Hardware** command has been sent.

## Update the hardware

Prior to this step, all the changes to the configuration parameters and port selections are cached in the host driver. The Update Hardware operation is required to synchronize the driver and hardware.

All the necessary relays will be switched and the DAQ will be loaded with the configurations of the selected port.

**CAUTION** If this step is not called, the hardware will still be loaded with the previous configuration and the multiplexer relays will not be switched to the correct positions.

**CAUTION** If an input port selection has been changed, please allow at least 1 millisecond for the relays to settle before initiating acquisition.

## Initiate measurement

This step will start channel acquisition. In Single Channel mode, only one channel (connected to the selected input port) will be active. In Multiple Channel mode, all eight channels will start acquisition. Both the 5 V and 100 V sub-channels will be active, with the data sampled concurrently.

The *Initiate acquisition* function returns immediately without waiting for the acquisition to complete.

## Waiting for the acquisition to complete

The acquisition will stop when the waveform is successfully acquired or the input signal not achieving a valid trigger condition within the specified timeout period.

In the Multiple Channel mode, acquisition is considered completed only when ALL the eight channels have completed waveform recording or have timed out waiting for a valid trigger condition.

To check the status of the acquisition, you can poll the hardware using the *Get Status* function. However this is a rather inefficient method. Another method is to wait for the acquisition to complete before checking the status. This can be done by calling the *WaitForAcquisitionToComplete* function.

**WARNING** **Any attempt to start another measurement when the current measurement is still in progress may result in unpredictable behavior.**

## Fetching data

When the acquisition is completed, the data will be automatically transferred to the host controller memory and it will be available for retrieval from the user's memory buffer. The data retrieved will be intrinsically 16 bit unsigned data for each of the voltage range.

Upon reset by default, both the 5 V and 100 V waveform recordings will be transferred to the host. You can optionally select not to transfer any data at all or transfer only the 5 V or 100 V waveform record for a digitizer by using the *Range Select* parameter of the channel configuration.

The M9216A is factory calibrated during manufacturing. Each channel has its own calibration coefficients and they are stored in the module's EEPROM. The coefficients are used to estimate the waveform's voltage from the raw ADC data.

The raw ADC data can be retrieved using the *FetchWaveformInt32* method while the estimated voltage can be retrieved using *FetchWaveformReal64*.

## Using the auxiliary output port

As mentioned previously, the input ports can be switched to the auxiliary output ports. Figure 1-5 shows the structure of the input multiplexer for a pair of digitizer channels on the same bank.

The primary auxiliary port is designated Aux[*ChannelNumber*]1. For example the primary auxiliary port for Channel 2 is Aux21.

The complementary auxiliary output port is designated Aux[*ChannelNumber*]2. For example the complementary auxiliary port for *Channel 2* is Aux22.

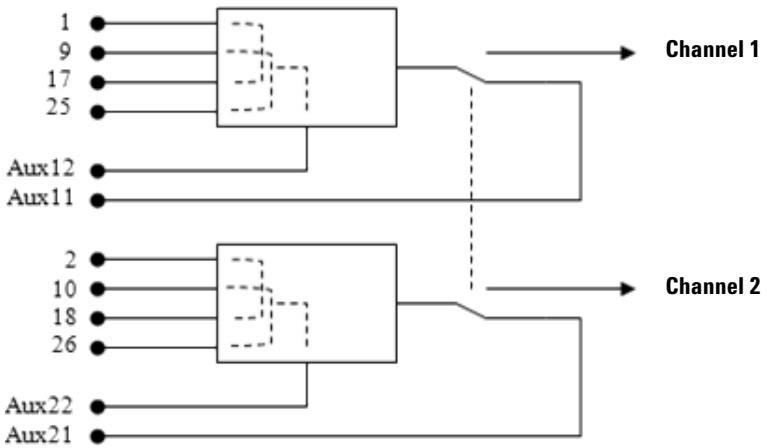


**Figure 1-6** Input Multiplexer for Bank 1

### Multiplexer Selection Rules

Within the same bank, two selected input ports can only be switched in **unison** to primary auxiliary output port or to the digitizer channel. For example, you cannot switch input port 1 to channel 1 while switching input port 2 to Aux21.

**WARNING** **The complementary auxiliary port cannot be independently controlled and is switched as shown in Table below.**

**NOTE** Disconnect the complementary auxiliary port from a measurement bus or instrument if there is no intention of using it.

**Table 1-1** Primary and complementary auxiliary output port pairings

**Channel 1**

| Aux11(Primary) | Aux12 (Complementary) *Always Connected* |
|---|---|
| Port 1 | Port 17 |
| Port 9 | Port 25 |
| Port 17 | Port 1 |
| Port 25 | Port 9 |

**Channel 2**

| Aux21(Primary) | Aux22 (Complementary) *Always Connected* |
|---|---|
| Port 2 | Port 18 |
| Port 10 | Port 26 |
| Port 18 | Port 2 |
| Port 26 | Port 10 |

**Table 1-1** Primary and complementary auxiliary output port pairings (continued)

**Channel 3**

| Aux31(Primary) | Aux32 (Complementary) *Always Connected* |
|---|---|
| Port 3 | Port 19 |
| Port 11 | Port 27 |
| Port 19 | Port 3 |
| Port 27 | Port 11 |

**Channel 4**

| Aux41(Primary) | Aux42 (Complementary) *Always Connected* |
|---|---|
| Port 4 | Port 20 |
| Port 12 | Port 28 |
| Port 20 | Port 4 |
| Port 28 | Port 12 |

**Channel 5**

| Aux51(Primary) | Aux52 (Complementary) *Always Connected* |
|---|---|
| Port 5 | Port 21 |
| Port 13 | Port 29 |
| Port 21 | Port 5 |
| Port 29 | Port 13 |

**Table 1-1** Primary and complementary auxiliary output port pairings (continued)

**Channel 6**

| Aux61(Primary) | Aux62 (Complementary) *Always Connected* |
|---|---|
| Port 6 | Port 18 |
| Port 14 | Port 30 |
| Port 22 | Port 22 |
| Port 30 | Port 14 |

**Channel 7**

| Aux71(Primary) | Aux72 (Complementary) *Always Connected* |
|---|---|
| Port 7 | Port 19 |
| Port 15 | Port 31 |
| Port 23 | Port 23 |
| Port 31 | Port 15 |

**Channel 8**

| Aux81(Primary) | Aux82 (Complementary) *Always Connected* |
|---|---|
| Port 8 | Port 20 |
| Port 16 | Port 32 |
| Port 24 | Port 24 |
| Port 31 | Port 16 |

# General Specifications

**Table 1-2** Digitizer input

| Description | Specification |
|---|---|
| Number of channels | 8 concurrent dual range channel |
| Resolution | 16 bit |
| Sampling rate | 250 kSa/s |
| Analog bandwidth (anti aliasing filter) | 85 kHz typical |
| Dual range specifications<br>• 5 V<br>• 100 V | <br>• 1 mV to 5 V<br>• 20 mV to 100 V |
| Input coupling | DC |
| Input impedance | 550 kΩ typical |
| Internal sample memory | • 30k sample per channel in Single Channel mode<br>• 240k sample per channel in Multiple Channel mode |
| Trigger | • Software and digital trigger<br>• Pre-trigger sample, post trigger delay, trigger count, and trigger timeout |

**Table 1-3** Digitizer input accuracy specifications (at 25 ± 3 °C)

| Description | Specification |
|---|---|
| 5 V range<br>• Zero offset<br>• Gain (% of reading)<br>• Noise 3 sigma | <br>• ± 200 µV<br>• ± 0.05%<br>• 200 µV |
| 100V Range<br>• Zero offset<br>• Gain (% of reading)<br>• Noise 3 sigma | <br>• ± 1 mV<br>• ±0.05%<br>• 2 mV |

**Table 1-4** Multiplexer

| Description | Specification |
|---|---|
| Input ports | 32 |
| Output ports | • 8 ports to ADC<br>• 8 ports to Primary Auxiliary Out<br>• 8 ports to Complementary Auxiliary Out |
| Maximum input voltage | 100 V |
| Maximum input current | 0.5 A |
| Maximum common return pin voltage with respect to chassis ground | 45 V |

**Table 1-5** Power consumption

| Description | Specification |
|---|---|
| Maximum current consumption from PXI | |
| • 5 V<br>• 3.3 V | • 0.8 A<br>• 0.5 A |
| Maximum input voltage | 100 V |
| Maximum input current | 0.5 A |
| Maximum common return pin voltage with respect to chassis ground | 45 V |
| Warm up time | 0.5 hour |

**Table 1-6** Physical attributes

| Description | Specification |
|---|---|
| Form | • 3U<br>• 2 slot |
| Weight | • 0.51 kg |
| Dimension | |
| • Depth<br>• Height<br>• Width | • 212.73 mm<br>• 129.11 mm<br>• 40.30 mm |

**Table 1-7** Environmental conditions

| Description | Specification |
|---|---|
| Operating temperature | 0 °C to 550 °C |
| Storage temperature | –200 °C to 700 °C |
| Relative humidity | 0% to 80% non-condensing |

**Table 1-8** Certifications and Compliance

| Description | Specification |
|---|---|
| CE Mark Compliance | Safety EN/IEC 61010-1 |
| EMC Immunity | EN/IEC 61326-1 Industrial Environment MIL-STD-461E/RS103 |
| EMC Emissions | EN/IEC 61326-1 Class A MIL-STD-461E/RE102 |

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# 2
# Module Installation



This chapter specifies the installation procedures of the M9216A PXI high voltage data acquisition.

# Unpack and Inspect the Module

**CAUTION** The M9216A is shipped in materials which prevent damage from static. The module should only be removed from the packaging in an anti-static area after ensuring that correct anti-static precautions are taken. Store all modules in anti-static envelopes when not in use.

## ESD precaution

Electrostatic discharge (ESD) can damage or destroy electronic components. All work on electronic assemblies should be performed at a static-safe work station. The following figure shows an example of a static-safe work station using two types of ESD protection.

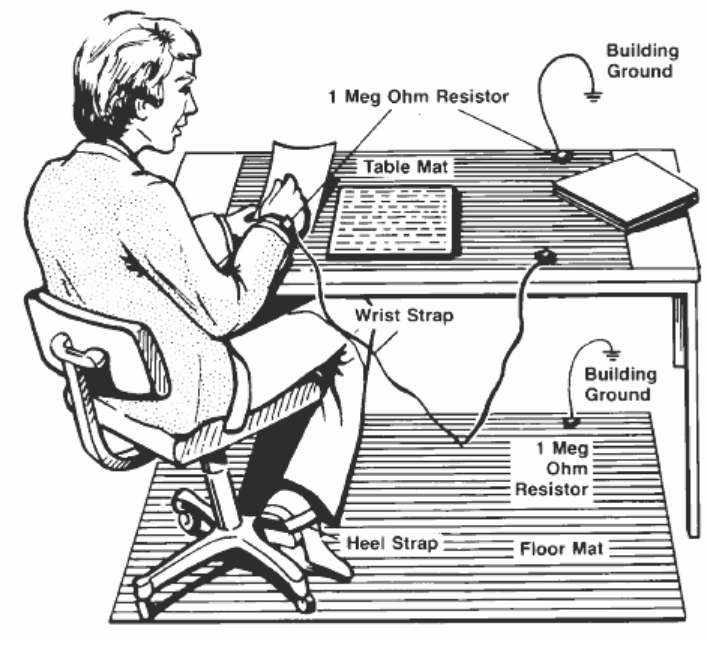



**Figure 2-1** Static-safe work station example

Purchase acceptable ESD accessories from your local supplier.

- Conductive table-mat and wrist-strap combination.
- Conductive floor-mat and heel-strap combination.

Both types, when used together, provide a significant level of ESD protection. Of the two, only the table-mat and wrist-strap combination provides adequate ESD protection when used alone. To ensure your safety, the static-safe accessories must provide at least 1 Ω of isolation from ground.

**WARNING** **These techniques for a static-safe work station should not be used when working on circuitry with a voltage potential greater than 500 V.**

## Inspect the module for damage

After unpacking the M9216A, carefully inspect the unit for any shipping damage. Report any damage to the shipping agent immediately, as such damage is not covered by the warranty (warranty information can be found at the beginning of this manual).

**CAUTION** To avoid damage when handling a module, do not touch exposed connector pins.

**NOTE** Information on preventing damage to your Agilent equipment can be found at http://www.agilent.com/find/tips.

## Return the module for service

Should it become necessary to return the M9216A for repair or service, follow the steps below:

1. Review the warranty information shipped with your product.
2. Contact Agilent to obtain a Return Material Authorization (RMA) and return address. If you need assistance finding Agilent's contact information, go to http://www.agilent.com/find/assist (worldwide contact information for repair and service) or refer to the Support information on the product web page at http://www.agilent.com/find/M9216A.
3. Write the following information on a tag and attach it to the malfunctioning equipment.
   - Name and address of owner. A P.O. box is not acceptable as a return address.
   - Product model number (for example, M9216A).
   - Product serial number (for example, MYXXXXXXXX). The serial number label is located on the side panel of the module. The serial number can also be read from the Soft Front Panel interface, but only after the software is installed.
   - Description of failure or service required.
4. Carefully pack the module in its original ESD bag and packing carton. If the original carton is not available, use bubble wrap or packing peanuts and place the instrument in a sealed container and mark the container "**FRAGILE**".
5. On the shipping label, write "**ATTENTION REPAIR DEPARTMENT**" and the RMA number.

**NOTE** If any correspondence is required, refer to the product by its serial number and model number.

# Verify the Shipment Contents

The following items are included in the M9216A shipment:

- *M9216A Software and Product Information CD- ROM* (M9216- 10001) - contains software, drivers, and all product documentation in PDF format.
- Printed copy of this document, *M9216A Startup Guide*
- Calibration certificate

**NOTE**

Every PXI module is shipped with a Software and Product Information CD-ROM. The M9216A-CD1 option provides the *M9216A Software and Product Information CD-ROM* (M9216-10001).

All of the files contained on the CD are available for free download at the Agilent website at http://www.agilent.com/find/M9216A.

# Install the Software

## System requirements

**Table 1** Minimum system requirements

| | | | |
|---|---|---|---|
| Operating systems | Windows ® XP SP3 or later (32-bit) Home or Professional | Windows Vista® SP1 and SP2 or later (32-bit and 64-bit) Home Basic, Home Premium, Business, Ultimate, or Enterprise | Windows ® 7 (32-bit and 64-bit) Starter, Home Basic, Home Premium, Professional, Ultimate, or Enterprise |
| Processor speed | 600 MHz or higher required<br>800 MHz recommended | 1 GHz 32-bit (x86) or<br>1 GHz 64-bit (x64),<br>Itanium 64 is not supported | 1 GHz 32-bit (x86) or<br>1 GHz 64-bit (x64),<br>Itanium 64 is not supported |
| Available memory | 256 MB minimum (1 GB or more recommended) | 1 GB minimum | 1 GB minimum |
| Available disk space[1] | 1.5 GB available hard disk space, includes:<br>• 1 GB for Microsoft® .NET Framework 2.0 SP2[2]<br>• 65 MB for Agilent IO Libraries Suite | 1.5 GB available hard disk space, includes:<br>• 1 GB for Microsoft® .NET Framework 2.0 SP2[2]<br>• 65 MB for Agilent IO Libraries Suite | 1.5 GB available hard disk space, includes:<br>• 1 GB for Microsoft® .NET Framework 2.0 SP2[2]<br>• 65 MB for Agilent IO Libraries Suite |
| Video | Super VGA (800 × 600) 256 colors or more | Support for DirectX 9 graphics with 128 MB graphics memory recommended (Super VGA graphics is supported) | Support for DirectX 9 graphics with 128 MB graphics memory recommended (Super VGA graphics is supported) |
| Browser | Microsoft® Internet Explorer 6.0 or greater | Microsoft® Internet Explorer 7 or greater | Microsoft® Internet Explorer 7 or greater |
| Chassis | A cPCI, PXI-1, or PXIh chassis peripheral slot. The Agilent M9018A chassis is recommended. | | |
| Interface controller | A PXI or PXIe remote or embedded controller. | | |
| Remote controller | An Agilent M9045A ExpressCard interface (for portable laptops) or Agilent M9047A PCIe interface (for desktop PCs) or equivalent PXI or PXIe remote controllers running one of the above operating systems. | | |

**Table 1** Minimum system requirements

| | |
|---|---|
| Embedded controller | An Agilent M9021A System Interface Card, or equivalent embedded controller running one of the above operating systems.<br>**Note:** The embedded controller must be compatible with the Agilent M9018A chassis. |
| Softwares | • Agilent IO Libraries Suite 16.0 and above is required.<br>• Adobe® Reader® version 6.0 or higher is required to view the provided PDF files. |

[1] Because of the installation procedures, less memory may be required for the operation than is required for the installation.

[2] .NET Framework Runtime Components are installed by default with Windows Vista and Windows 7. Therefore, you may not need this amount of available disk space.

## Power up the controller

If you are using a remote controller, power up the host computer.

If you are using an embedded controller, complete the following steps:

1. Install the embedded controller module into a compatible chassis.

   Recommended: Agilent M9018A 18 slot PXIe Chassis
2. Connect your I/O peripherals (mouse, keyboard, and monitor).
3. Power up the chassis.

## Install the softwares

The M9216A softwares are located on the bundled CD (M9216-10001). The same softwares are also available for free download at the Agilent website: http://www.agilent.com/find/M9216A.

This installation includes the following:

- Agilent IO Library Suite (IOLS), which includes the Agilent Connection Expert.
- Soft Front Panel (SFP), device drivers (IVI-C and IVI-COM, and LabVIEW G), and related user documentation for the M9216A.

**NOTE** Each PXI module has its own device driver (IVI-C and IVI-COM, and LabVIEW G) and soft front panel (SFP) software.

1. From the CD browser, launch the installer.
2. Follow the installer prompts to install all software and documentation for the M9216A PXI High Voltage Data Acquisition.

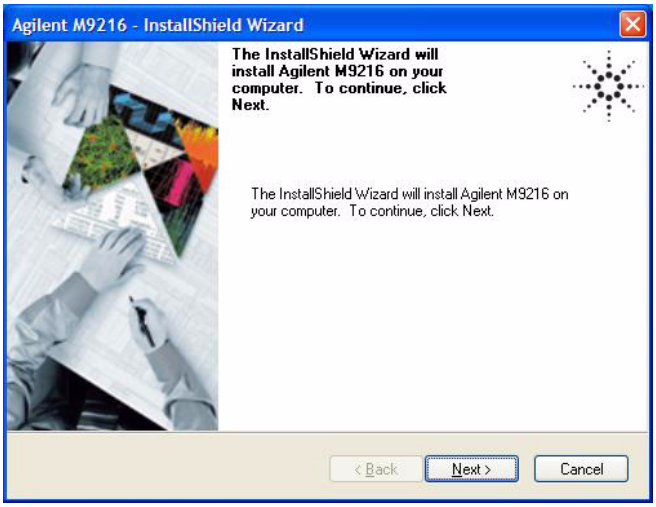



**Figure 2-2** InstallShield Wizard for Agilent M9216A

**3** After installation is complete, power down the chassis (and the host PC if using the remote controller).

# Install the Module

**CAUTION**

- The PXI hardware does not support "hot-swapping" capabilities (changing modules while power is applied to the chassis).
- Before installing the M9216A into the chassis, ensure that the chassis is powered off and unplugged to prevent damage to the module.

**NOTE** The M9216A module can be used in a chassis with a cPCI, PXI-1, or PXIh chassis peripheral slot.


The module can be installed in any standard PXI slot marked with a peripheral slot compatibility image (a circle containing the slot number).


The module can also be installed in any hybrid PXI slot marked with a peripheral slot compatibility image (the letter "H" and a solid circle containing the slot number).

1. Ensure that the chassis power switch is at the Off (Standby) position before you unplug the PXI chassis.
2. If the chassis has multiple fan speed settings, ensure that the fans are set to automatic. Do not set the fan speed to low or turn it off.
3. Position the chassis so that there is ample space between the chassis fan intake and exhaust vents. Blockage by walls or obstructions affects the air flow needed for cooling. (Refer to the chassis documentation for more information about cooling).
4. If you are using an embedded controller, proceed to step 5. If you using a remote controller, skip to step 6.

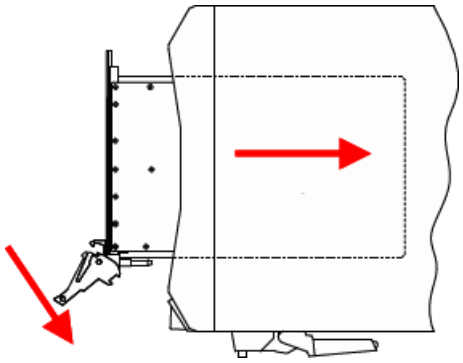


**Figure 2-3** Installing the module to the chassis

5 Hold the module by the injector/ejector handle, and slide it into an available PXI (or hybrid) slot, as shown in Figure 2-3.

- Install the module into the PXI slot of the chassis by placing the module card edges into the front module guides (top and bottom).
- Slide the module to the rear of the chassis and assure that the injector/ejector handle is pushed down in the unlatched (downward) position.
- Slide the module completely into the chassis.
- When you begin to feel resistance, push up on the injector/ejector handle to fully inject the module into the chassis.

6 If you are using a remote controller, install the System Interface Card in the chassis.

7 Latch the module by pulling up on the injector/ejector handle and secure the front panel to the chassis using the module front-panel mounting screws.

8 Tighten the screws on the module (or remote controller) front panel. Performance may suffer if the screws are not tightened properly.

9 Verify that the PXI chassis fans are operable and free of dust and other contaminants that may restrict airflow.

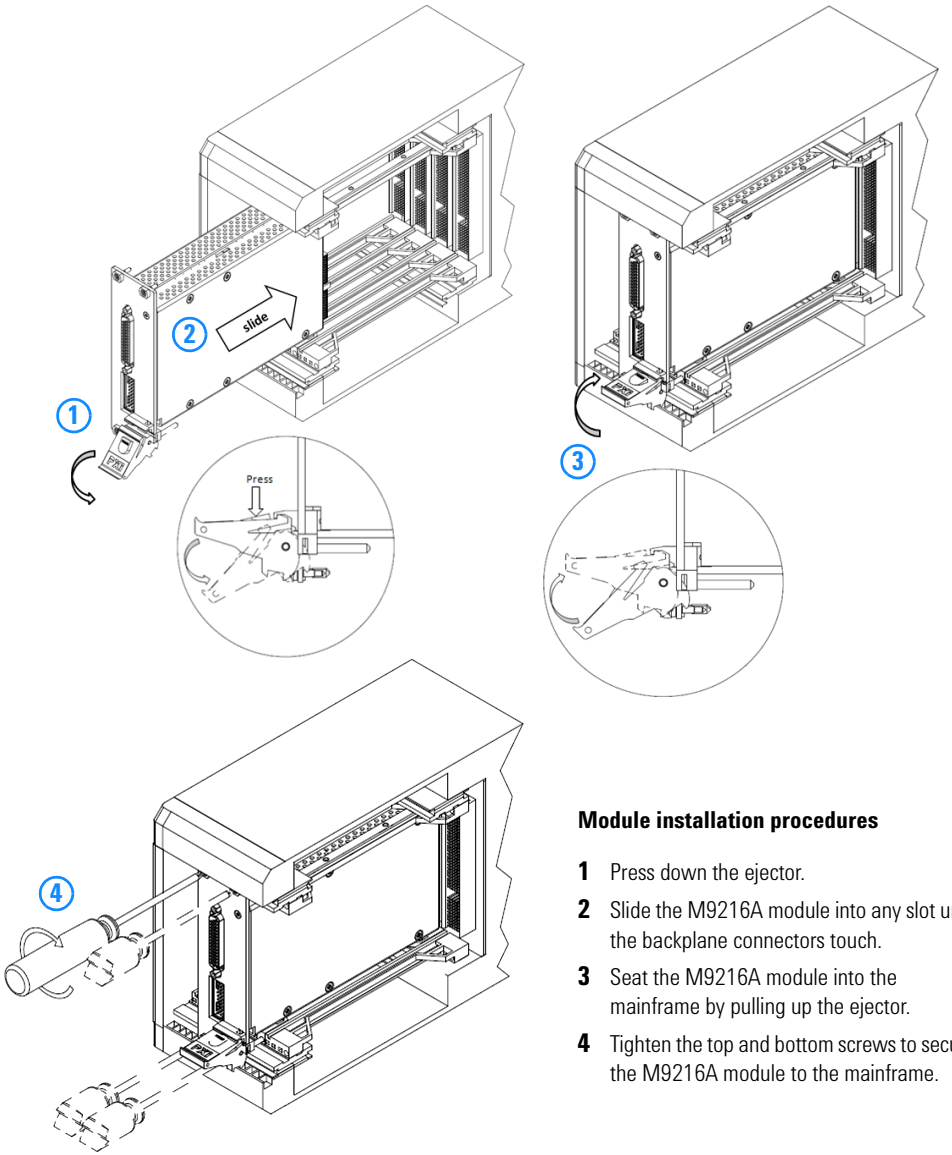
10 Install all chassis covers and filler panels after installing the module. Missing filler panels may disrupt necessary air circulation in the chassis.

11 If you are using a remote controller, connect the System Interface Card in the chassis to host computer.

12 Plug in and power up the PXI chassis.

13 If you are using a remote controller, reboot the host PC.

**WARNING** **Tighten the screws on the module front panel. Protection provided by the equipment could be impaired if the screws are not tightened properly.**




**Module installation procedures**

1. Press down the ejector.
2. Slide the M9216A module into any slot until the backplane connectors touch.
3. Seat the M9216A module into the mainframe by pulling up the ejector.
4. Tighten the top and bottom screws to secure the M9216A module to the mainframe.

**Figure 2-4** Module installation procedures

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# 3 Performance Verifications and Adjustments



This chapter contains information required to test, calibrate, and verify the performance of the Agilent M9216A 16-bit DAQ.

# Introduction

This product is a Safety Class I instrument that is provided with a protective earth terminal when installed in the PXI mainframe. Please review Chapter 1, “Introduction,” starting on page 1 before proceeding with the performance verification or calibration steps.

The mainframe and all related documentation should also be reviewed for familiarization with safety markings and instructions before operation or service.

**WARNING** **The information in this manual is for service-trained personnel who are familiar with electronic circuitry and are aware of the hazards involved. To avoid personal injury or damage to the instrument, do not perform procedures in this manual or do any servicing unless you are qualified to do so.**

**WARNING** **Voltages greater than 30 Vrms, 42 Vpk, or 60 Vdc are considered hazardous.**

**WARNING** **Interruption of the protective (grounding) conductor (inside or outside the mainframe) or disconnecting the protective earth terminal will cause a potential shock hazard that could result in personal injury. (Grounding one conductor of a two-conductor outlet is not sufficient protection.)**

**CAUTION** Static electricity is a major cause of component failure. To prevent damage to the electrical components in the digitizer, observe anti-static techniques whenever working on the digitizer.

# Recommended equipment

Table 3-1 lists the recommended test equipment to perform the verification and calibration tests described in this chapter.

**Table 3-1** Recommended test equipment for verification and calibration

| Instrument | Requirements | Example |
|---|---|---|
| Controller | PC or industrial PC capable of supporting PCIe bus extender | Hewlett Packard Z600 Workstation |
| PXI bus extender | PCIe bus extender with minimal x1 capability | Agilent M9021A PXIe System Interface and M9047A PCIe Desktop Adaptor x8 System |
| Mainframe | PXI mainframe compatible with digitizer and PXIe bus extender | Agilent M9018A PXIe Controller |
| DC standard | Voltage range of 1 mV to 100 V | Krohn-Hite Model 522 GPIB DC Source/Calibrator |
| Digital multimeter | 4-wire ohmmeter measurement | Agilent 34420A Digital Multimeter |
| Pin matrix | General purpose pin matrix capable of switching up to 100 V | Agilent Dual/Quad L4433A Reed Matrix with Termination Block |

# Verification Test

This chapter describes the procedures to verify that the M9216A DAQ is

- functional (functional verification), and that it
- meets the primary testable specifications (performance verification test)

## Test conditions

For valid tests, all test equipment and the digitizer must have a 1.5 hours warm-up, and the line voltage must be at 115/230 Vac ± 10%. The ambient temperature of the test area should be stable between 22 °C and 28 °C during the test.

The performance verification tests and calibration should be performed at least once a year. For heavy use or severe operating environments, you are recommended to perform the tests more often.

The verification tests assumes that the person performing the tests understands how to operate the mainframe, DAQ, and specified test equipment. It is assumed that a qualified, service-trained person will select and connect the cables, adapters, and probes required for the test.

The test procedures do not specify equipment settings for test equipment, except in general terms. The Agilent M9216A Soft Front Panel software will be used to control the M9216A DAQ module.

For a full description and details on how to use the M9216A Soft Front Panel (SFP), please refer to the *Agilent M9216A Soft Front Panel Help*.

The end of this chapter provides a performance test form template for the MP9216 DAQ verification tests. The test form template provides blank spaces for you to enter the results of each Performance Verification test and to compare

the results with the upper and lower limits of the test. You can use this record as a template for recording the measured data.

## Connectivity verification

Before you proceed with the connectivity verification procedure shown below, follow the instructions in Chapter 2, “Module Installation,” starting on page 25 to install the M9216A module into the PXI chassis.

The intention of this step is to verify that the host PC is able to communicate with the M9216A module and to prepare for the verification tests to follow.

Run the Agilent Connection Expert (ACE) by clicking its desktop shortcut icon, or by clicking **Start > All Programs > Agilent IO Library Suite > Agilent Connection Expert**.

The ACE will display all modules that are connected and installed. Review the configuration data and launch the M9216A SFP. The M9216A SFP will provide control over the module for installation verification procedures. Ensure that the **Simulation Mode** checkbox is cleared.

If the M9216A does not show up on the instrument list:

- Verify that the M9216A DAQ is correctly installed in the mainframe.
- If you are using an external host PC and PCI bus extender system, verify that the mainframe power is turned on. Ensure that the mainframe is powered on before the PC controller. See the mainframe user's manual for additional information.
- Check that the bus extender card residing in the host computer is plugged in properly.

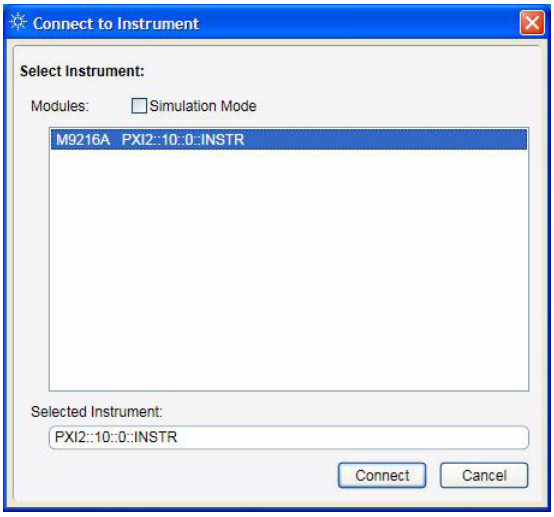


**Figure 3-1** Connect to Instrument dialog box

When successful, the M9216A SFP dialog box will appear. Click on the **Help > About** menu and view the information of the M9216A (Figure 3-2).

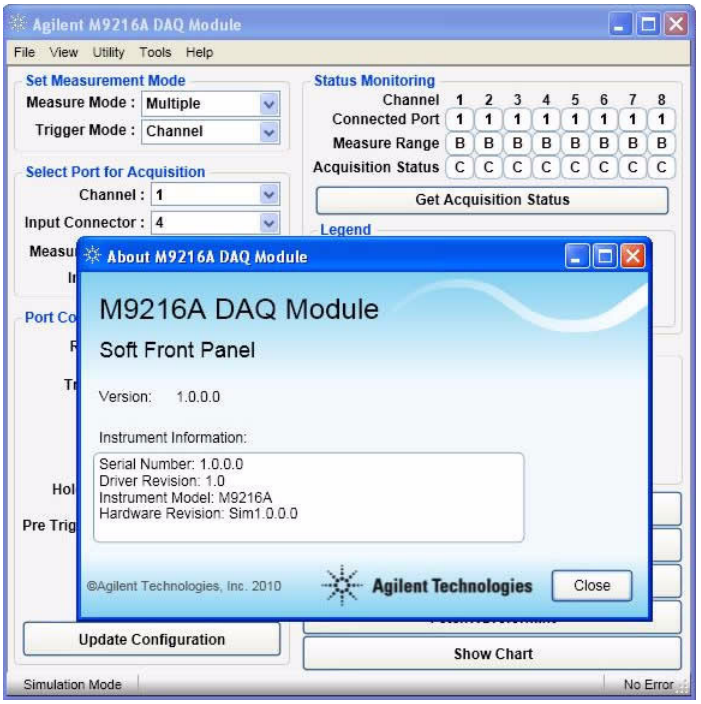


**Figure 3-2** M9216A instrument information from Help menu

## DAQ manual verification

DAQ verification tests are used to verify that the 32-channels of the M9216A meets the DC accuracy specifications and electrical performance listed in the "General Specifications" section.

The procedure shown in this section are performed manually and the Agilent M9216A SFP is used to control the M9216A DAQ module.

However, since there are many measurements required, Agilent recommends the uses of a pin matrix module to switch the DC calibrator source to the appropriate channel

(See “Recommended equipment” on page 41). To speed up and automate testing, the M9216A IVI-COM interface can also be programmed to control the module.

**WARNING** **Some pin matrix modules have selectable protection resistors to prevent damage to the relays due to high current. During measurement, please ensure that resistor is bypassed (i.e., we need to ensure that the impedance of the path from the calibrator to the DAQ is as small as possible — ideally zero ohms).**

**WARNING** **During measurement, ensure that the auxiliary output of the digitizer is disconnected from the low impedance load, as an inadvertent switch to auxiliary output may damage both the relays in the switch matrix DC during testing.**

**WARNING** **The DC calibrator can produce dangerous voltages which are present on the terminals. Do not touch the front (or rear) panel terminals unless you are sure that there are no dangerous voltages present. When connecting or removing the connector to the digitizer, ensure that the calibrator output is disconnected or set to zero volts.**

### Test procedure to verify a single channel

The procedure described below will verify the accuracy of one of the M9216A's channel. A series of DC voltages are applied at the channel under test, the voltage is then measured (averaged) with the M9216A, and the results are then compared with the specifications.

Note that the verification has to be performed for both the 5 V and 100 V range.

**STEP 1 — Set M9216A measurement mode** By default, the M9216A will start up in the *Multiple Channel* measurement mode. Change the measurement mode to *Single Channel*. A

dialog box will appear asking for confirmation. Click **OK**. Take note that this action will cause a **hardware reset** to the *Single Channel*'s default state.

**STEP 2 — Select and configure the input port** Change the M9216A configuration from the default configuration.

- Set Trigger Mode to *Immediate*.
- Set *Input Connector Selection* to 1. This will result in Input Port 1 to be selected. Note that the SFP uses the logical connector selection for selecting ports. In this scheme, each channel is allocated four input connectors numbered logically from one to four. However the equivalent physical input port number is also shown in the SFP.
- Change Input Port 1's *Record Size* to 20000. Click **Update Configuration** to lock in the change.

**NOTE** In *Immediate* trigger mode, only the *Record Size* acquisition parameter is relevant.

Remember to click **Update Hardware** so that the hardware is actually configured. The setup is shown in Figure 3-3 below.

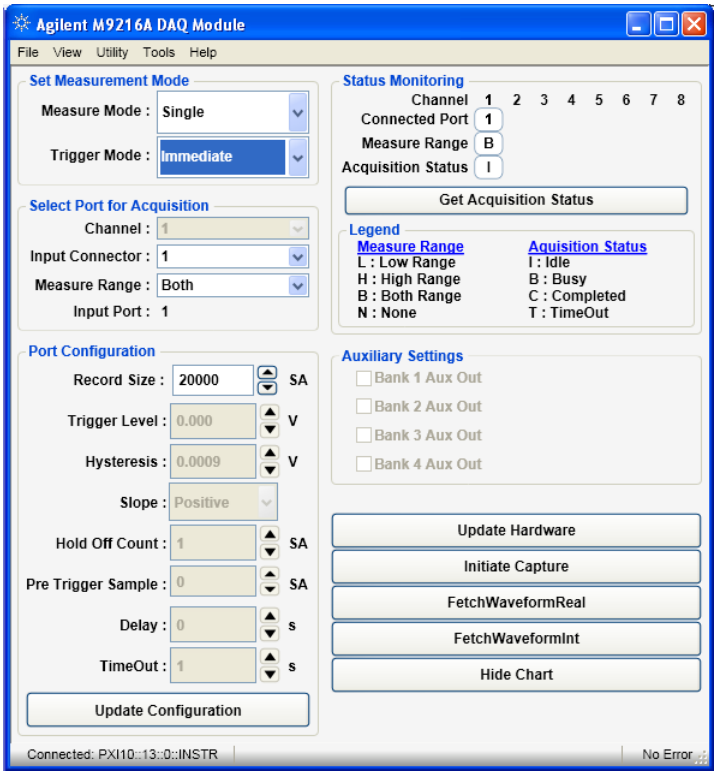


**Figure 3-3** Setting for M9216A

**STEP 3 — Calibrator** Turn off the DC calibrator output or set the DC calibrator voltage to zero. Connect the calibrator output to the channel under test as shown in Figure 3-4. Remember to connect the correct return for the port under test as the M9216A has four isolated common return. Use a connector saver or terminal block to prevent damaging the M9216A connector.

Turn on the DC calibrator output to the specified testing voltage. Select the optimal output range of the DC calibrator.

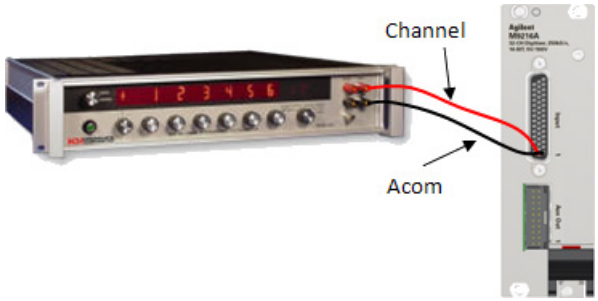


**Figure 3-4** Connecting the DC calibrator to the M9216A input port

**STEP 4 — Capture Waveform** Click **Initiate Capture**. When the operation is completed, the Status window will show the outcome of the capture operation. The recorded waveform can now be retrieved using the **FetchWaveFormReal** button.

**NOTE**

If user is using an external pin matrix to switch the calibrator, output to the M9216A input port, ensure that the pin matrix relay has time to settle before initiating waveform capture. Consult the specifications of the pin matrix module for more detail.

Press **Show Chart** to display the waveform. Two waveforms will be displayed for both the low and high range. On the upper left of each display, the average value of the waveform is shown.

Record the relevant mean voltage in the *Performance Test Record* form included at the end of this chapter.

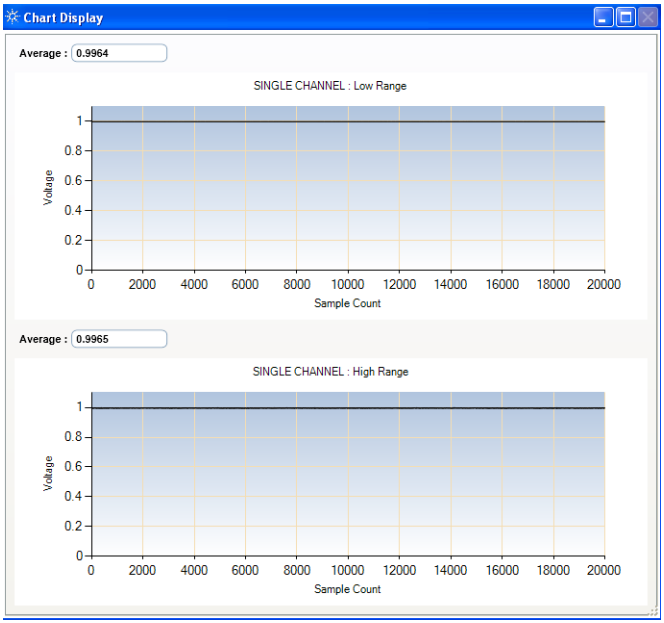


**Figure 3-5** Captured waveform for DC verification

**NOTE**

**STEP 2** and **STEP 4** have to be repeated for every test voltage, range, and channel. Table 3-2 lists the required test voltage for all 32 channels.

**Table 3-2** Required verification voltage for each channel

| 5 V range | 10 V range |
|---|---|
| 100 mV | 5 V |
| 500 mV | 10 V |
| 1.0 V | 25 V |
| 2.5 V | 50 V |
| 4.5 V | 75 V |
| 5.0 V | 100 V |

### M9216A multiplexer auxiliary output port verification

The procedure in this section verifies the functionality of the input multiplexer.

**NOTE** The M9216A should be in configured in *Multiple Channel* measurement mode before proceeding. This mode allows the user to access the auxiliary ports.

The step in this section describes how to manually verify that an input port can be connected to the primary and complementary auxiliary port. The steps can be easily automated, however the user must be careful to remove or calibrate out the resistance of intervening cables, fixtures or devices between the M9216A ports and the multimeter.

The example below shows how to verify that *Port 1* can be connected to the primary auxiliary port *Aux11*. During this test, we will also need to verify that *Port 9* must be connected to complementary auxiliary port *Aux12*. The SFP will be used only to control the multiplexer's state, no waveform capture will be required.

Please refer to "Multiplexer Selection Rules" on page 16 for a description of the multiplexer behavior.

**STEP 1 — Connect the port to the primary auxiliary** Select the multiplexer as shown in Figure 3-5. The M9216A should already be in *Multiple Channel* Measure Mode when started up. If not, please select *Multiple Channel* Mode first before proceeding. Note that changing the measurement mode will cause a hardware reset.

In the “Select Port for Acquisition” section, select channel 1 and Input Connector 1. In the “Auxiliary Settings” select Bank 1 and check *Set Aux Out*.

Press the **Update Hardware** button so that the settings are communicated to the M9216A. You should be able to hear the switching of the relays unless the relays were already in the correct position.

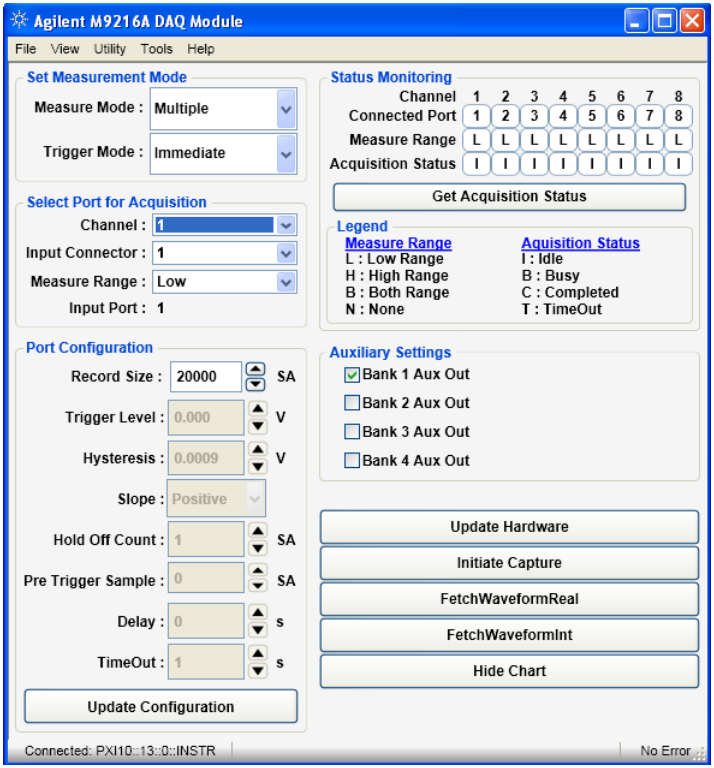


**Figure 3-6** Switch Bank 1 Ports to Auxiliary Output

**STEP 2 — Measure the primary auxiliary port** Use a multimeter to measure the resistance between input port 1 and primary auxiliary port Aux11 as shown in Figure 3-8. The resistance should be less than 1 ohm (without any external cabling). The four wire resistance measurement method is used to remove the multimeter probe cable resistance.

The complementary auxiliary port Aux12 should also be automatically connected to port17. Measure the resistance between pin 17 and Aux12 (Figure 3-9) and record the resistance in the *Performance Test Record*.

**Figure 3-7** Connect the multimeter to the M9216A front panel

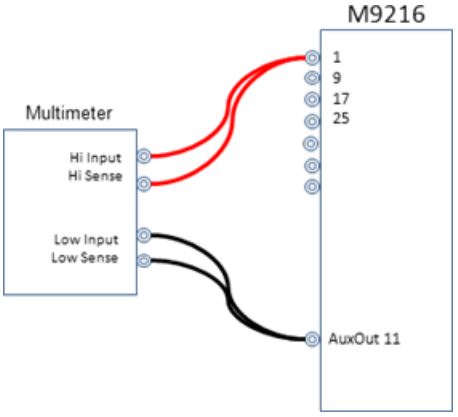


**Figure 3-8** Measuring the primary auxiliary output

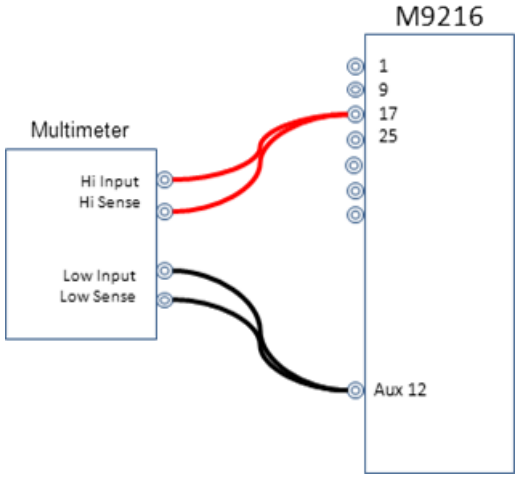


**Figure 3-9** Measuring the complementary auxiliary output

**NOTE**

To verify the entire multiplexer, every single port needs to be tested in a similar manner. A *Multiplexer Performance Test Record* is provided at the end of this chapter.

# Calibration Procedures

The coefficients required to estimate the waveform voltage requires the M9216A to be calibrated at the factory. The coefficients are then stored in the onboard EEPROM.

To prevent users from calibrating the instrument and possibly compromising the accuracy specifications of the M9216A, the API functions required to calibrate the instrument are not accessible via the IVI interface or SFP. The calibration APIs are however available for internal Agilent use upon request.

In this section, the procedure to calibrate the M9216A is described in general terms.

For valid calibration, the M9216A DAQ must have a one hour warm-up, the line voltage must be 115/230 Vac ± 10%. The ambient temperature of the test area should be between 22 °C and 28 °C and stable to within ±1 °C. Calibration should be performed at least once a year and for heavy use or severe operating environments perform the tests more often.

The calibration procedure requires a series of known, low noise and accurate voltages to be generated from a DC calibrator (see recommended test equipment list). Table 3-3 lists the predefined voltages used for calibrating both the 5 V and 100 V range. The calibration program performs a linear regression between the series of known voltages and measured ADC data.

**Table 3-3** DC voltages used for calibrating M9216A

| Calibration points | 5 V range (V) | 100 V range (V) |
|---|---|---|
| 1 | 0.005 | 0.10 |
| 2 | 0.10 | 1.00 |
| 3 | 0.25 | 2.50 |
| 4 | 0.50 | 5.00 |

**Table 3-3** DC voltages used for calibrating M9216A

| Calibration points | 5 V range (V) | 100 V range (V) |
|---|---|---|
| 5 | 0.75 | 7.50 |
| 6 | 1.00 | 10.0 |
| 7 | 1.25 | 12.5 |
| 8 | 1.50 | 15.0 |
| 9 | 1.75 | 17.5 |
| 10 | 2.00 | 20.0 |
| 11 | 2.25 | 22.5 |
| 12 | 2.50 | 25.0 |
| 13 | 2.75 | 27.5 |
| 14 | 3.00 | 30.0 |

Note that the path resistance from the pins of the input port to the input of the ADC channel is very low. Hence it is not necessary to calibrate all input ports of a channel. However it is required to calibrate the 5 V and 100 V range separately.

For example it is sufficient to use Input Port 1 to calibrate Channel 1, Input Port 2 to calibrate Channel 2 and etc.

To speed up the test, Agilent recommends the uses of a pin matrix module to switch the DC calibrator source to the appropriate input port (See recommended equipment at the beginning of this chapter). Ensure that the resistance from the DC calibrator output to the input port of the M9216A is small, not more than 1 ohm.

Figure 3-10 shows the flowchart required to calibrate one M9216A channel.

1. Set the M9216A to *Single Channel* measurement mode and *Immediate* trigger mode.
2. The input port selected for calibrating a channel needs to be configured to *Record Size* of 20000 points.

3 Connect the DC calibrator output to the input as shown in figure 3-4. When manually connecting the cables, remember to switch the DC calibrator output off or set the voltage to zero. Select the input port to the channel under calibration. Remember to always *Update Hardware* to ensure that the hardware is synchronized with the driver and that the relays are switched into position.

4 Set the calibrator voltage to the required test voltage and enable the calibrator output. Before initiating the waveform recording, ensure that the DC calibrator output have settled. The linear regression algorithm is sensitive to outliers and a single bad calibration point may cause the M9216A to fail accuracy specifications.

5 Initiate the waveform recording and when acquisition is completed, retrieve the raw channel ADC data. Calculate the mean value of the 20000 ADC samples $L_{mean}$. Store $L_{mean}$ and the calibration voltage $V_{cal}$ for use later in the linear regression algorithm.

   The steps described in Step Four and Five will need to be repeated until all the calibration points shown in Figure 3-10 are completed.

6 The linear regression algorithm will use the data set ($V_{cal}$, $L_{mean}$) to perform a linear regression and calculate the two calibration coefficients, the Gain and Offset of the channel. Note that each channel will have four coefficients; one set each for the low and high range.

**NOTE** Repeat the above steps to calibrate all eight channels.

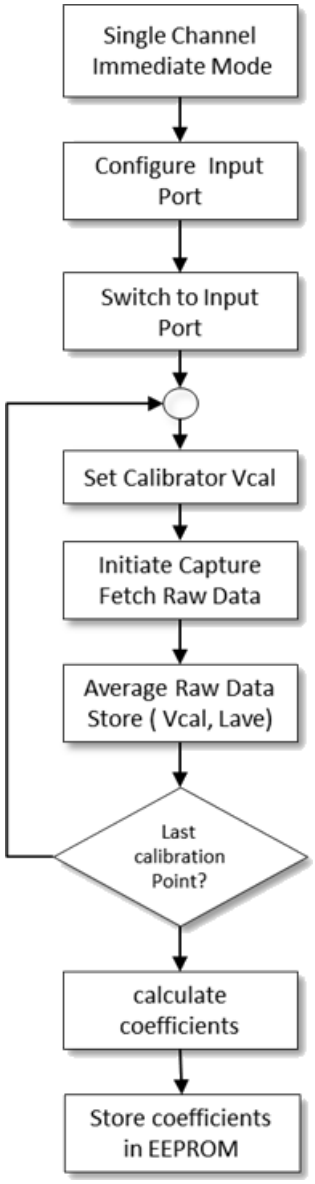


**Figure 3-10** Calibration flowchart

# Performance Test Record

Table 3-4 is a form you can use to record performance verification test results for your digitizer.

**Table 3-4** Performance Test Record for the Agilent M9216A Digitizer (part 1 of 4)

**Test facility:**

| | |
|---|---|
| Name | Report no. |
| Address | Date |
| City/State | Customer |
| Phone | Tested by |
| Model | Ambient temperature °C |
| Serial No. | Relative humidity % |
| Options | Line frequency (nominal) Hz |
| Firmware rev. | |

**Special notes:**

**Table 3-5** Performance Test Record for the Agilent M9216A Digitizer (part 2 of 4)

| Model | Report no. | Date |
|---|---|---|
| | | |

| Test equipment used: | Model no. | Trace no. | Cal due date |
|---|---|---|---|
| 1. | | | |
| 2. | | | |
| 3. | | | |
| 4. | | | |
| 5. | | | |
| 6. | | | |
| 7. | | | |
| 8. | | | |
| 9. | | | |
| 10. | | | |
| 11. | | | |
| 12. | | | |
| 13. | | | |
| 14. | | | |
| 15. | | | |

**Table 3-6** Performance Test Record for the Agilent M9216A Digitizer (part 3 of 4)

| Test no. | Digitizer range | Low limit | Measured reading | High limit |
|---|---|---|---|---|
| DC verification test channel _____ | | | | |
| 0.1 | 5 V | 0.09975 | | 0.10025 |
| 0.5 | 5 V | 0.49955 | | 0.50045 |
| 1 | 5 V | 0.9993 | | 1.0007 |
| 2.5 | 5 V | 2.49855 | | 2.50145 |
| 4.5 | 5 V | 4.49755 | | 4.50245 |
| 5 | 5 V | 4.9973 | | 5.0027 |
| 5 | 100 V | 4.9965 | | 5.0013 |
| 10 | 100 V | 9.994 | | 10.0015 |
| 25 | 100 V | 24.9865 | | 25.0023 |
| 50 | 100 V | 49.974 | | 50.0035 |
| 75 | 100 V | 74.9615 | | 75.0048 |
| 100 | 100 V | 99.949 | | 100.006 |
| DC verification test channel _____ | | | | |
| 0.1 | 5 V | 0.09975 | | 0.10025 |
| 0.5 | 5 V | 0.49955 | | 0.50045 |
| 1 | 5 V | 0.9993 | | 1.0007 |
| 2.5 | 5 V | 2.49855 | | 2.50145 |
| 4.5 | 5 V | 4.49755 | | 4.50245 |
| 5 | 5 V | 4.9973 | | 5.0027 |
| 5 | 100 V | 4.9965 | | 5.0013 |
| 10 | 100 V | 9.994 | | 10.0015 |
| 25 | 100 V | 24.9865 | | 25.0023 |
| 50 | 100 V | 49.974 | | 50.0035 |
| 75 | 100 V | 74.9615 | | 75.0048 |
| 100 | 100 V | 99.949 | | 100.006 |

**Table 3-6** Performance Test Record for the Agilent M9216A Digitizer (part 3 of 4)

| Test no. | Digitizer range | Low limit | Measured reading | High limit |
|---|---|---|---|---|
| DC verification test channel _____ | | | | |
| 0.1 | 5 V | 0.09975 | | 0.10025 |
| 0.5 | 5 V | 0.49955 | | 0.50045 |
| 1 | 5 V | 0.9993 | | 1.0007 |
| 2.5 | 5 V | 2.49855 | | 2.50145 |
| 4.5 | 5 V | 4.49755 | | 4.50245 |
| 5 | 5 V | 4.9973 | | 5.0027 |
| 5 | 100 V | 4.9965 | | 5.0013 |
| 10 | 100 V | 9.994 | | 10.0015 |
| 25 | 100 V | 24.9865 | | 25.0023 |
| 50 | 100 V | 49.974 | | 50.0035 |
| 75 | 100 V | 74.9615 | | 75.0048 |
| 100 | 100 V | 99.949 | | 100.006 |

**Table 3-7** Performance Test Record for the Agilent M9216A Digitizer (part 4 of 4)

| **Multiplexer Verification Test Agilent M9216A Bank no. 1** | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| **Input port** | | **Auxiliary port** | **Resistance Ω** | **Input port** | | **Auxiliary port** | **Resistance Ω** | |
| 1 | - | Aux11 | | 17 | - | Aux12 | | |
| 9 | - | Aux11 | | 25 | - | Aux12 | | |
| 17 | - | Aux11 | | 1 | - | Aux12 | | |
| 25 | - | Aux11 | | 9 | - | Aux12 | | |
| 2 | - | Aux21 | | 18 | - | Aux12 | | |
| 10 | - | Aux21 | | 26 | - | Aux12 | | |
| 18 | - | Aux21 | | 2 | - | Aux12 | | |
| 26 | - | Aux21 | | 10 | - | Aux12 | | |
| **Multiplexer Verification Test Agilent M9216A Bank no. 2** | | | | | | | | |
| **Input port** | | **Auxiliary port** | **Resistance Ω** | **Input port** | | **Auxiliary port** | **Resistance Ω** | |
| 3 | - | Aux31 | | 19 | - | Aux32 | | |
| 11 | - | Aux31 | | 27 | - | Aux32 | | |
| 19 | - | Aux31 | | 3 | - | Aux32 | | |
| 27 | - | Aux31 | | 11 | - | Aux32 | | |
| 4 | - | Aux41 | | 20 | - | Aux42 | | |
| 12 | - | Aux41 | | 28 | - | Aux42 | | |
| 20 | - | Aux41 | | 4 | - | Aux42 | | |
| 28 | - | Aux41 | | 12 | - | Aux42 | | |

**Table 3-7** Performance Test Record for the Agilent M9216A Digitizer (part 4 of 4)

| **Multiplexer Verification Test Agilent M9216A Bank no. 3** | | | | | | | |
|---|---|---|---|---|---|---|---|
| **Input port** | | **Auxiliary port** | **Resistance Ω** | **Input port** | | **Auxiliary port** | **Resistance Ω** |
| 5 | - | Aux51 | | 21 | - | Aux52 | |
| 13 | - | Aux51 | | 29 | - | Aux52 | |
| 21 | - | Aux51 | | 5 | - | Aux52 | |
| 29 | - | Aux51 | | 13 | - | Aux52 | |
| 6 | - | Aux61 | | 22 | - | Aux62 | |
| 14 | - | Aux61 | | 30 | - | Aux62 | |
| 22 | - | Aux61 | | 6 | - | Aux62 | |
| 30 | - | Aux61 | | 14 | - | Aux62 | |
| **Multiplexer Verification Test Agilent M9216A Bank no. 4** | | | | | | | |
| **Input port** | | **Auxiliary port** | **Resistance Ω** | **Input port** | | **Auxiliary port** | **Resistance Ω** |
| 7 | | Aux71 | | 23 | - | Aux72 | |
| 15 | | Aux71 | | 31 | - | Aux72 | |
| 23 | | Aux71 | | 7 | - | Aux72 | |
| 31 | | Aux71 | | 15 | - | Aux72 | |
| 8 | | Aux81 | | 24 | - | Aux82 | |
| 16 | | Aux81 | | 32 | - | Aux82 | |
| 24 | | Aux81 | | 8 | - | Aux82 | |
| 32 | | Aux81 | | 16 | - | Aux82 | |

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# 4
# Replaceable Parts



This chapter contains information on ordering replacement parts for your module.

# To Order Replaceable Parts

**NOTE** Parts are listed below according to the reference designators as shown in Figure 4-1. The parts list includes a brief description of each part with applicable Agilent part number.

You can order replaceable parts from Agilent using the Agilent part numbers shown in Table 4-1. To order the replaceable parts from Agilent, do the following:

1. Contact your nearest Agilent Sales Office or Service Center.
2. Identify the parts by the Agilent part number shown in the replaceable parts list (Table 4-1).
3. Provide the instrument model number and serial number.

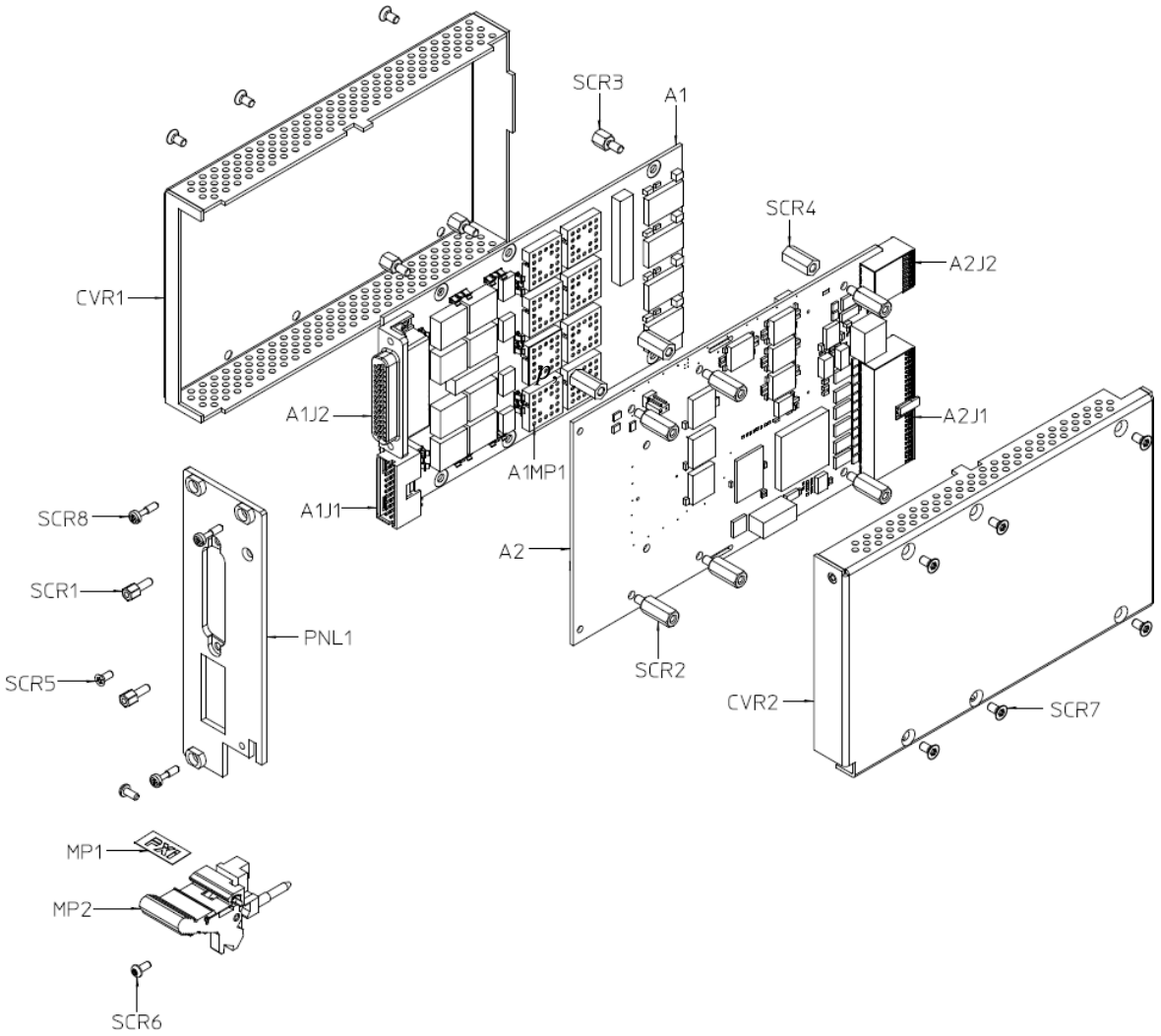



**Figure 4-1** M9216A module replaceable parts

**Table 4-1** M9216A module replaceable parts list

| Reference designator | Agilent part no. | Qty | Description |
|---|---|---|---|
| A1 | M9216-66601 | 1 | PCA- SINGLE ENDED DIGITIZER 32 CHANNELS ANALOG |
| A2 | M9216-66602 | 1 | PCA- SINGLE ENDED DIGITIZER 32 CHANNELS DIGITAL |
| A1J1 | 1252-0635 | 1 | CONNECTOR-HEADER THROUGH-HOLE 20-PIN .100-IN 2-ROW |
| A1J2 | 1252-5308 | 1 | CONNECTOR-D-SUBM-INIATURE RECEPTACLE THROUGH-HOLE 44-POS |
| A1MP1 | 8160-1670 | 16 | SHIELD COVER 16.96X16.96X2MM |
| A2J1 | 1253-8069 | 1 | CONNECTOR-RECEPTACLE RIGHT ANGLE THROUGH HOLE 110-PIN 2MM 5-ROW |
| A2J2 | 1253-7567 | 1 | CONNECTOR-SOCKET RIGHT-ANGLE THROUGH-HOLE 40-PIN 2MM 5-ROW |
| PNL1 | M9216-63202 | 1 | FRONT PANEL-2 SLOTS FOR SED MODULE |
| CVR1 | M9216-63201 | 1 | BOTTOM COVER-2 SLOTS FOR SED MODULE |
| CVR2 | M9216-63200 | 1 | TOP COVER-2 SLOTS FOR SED MODULE |
| MP1 | 5183-1633 | 1 | AGILENT LABEL FOR PXI LATCH |
| MP2 | 1440-0655 | 1 | HANDLE-ASSEMBLY EJECTOR-DT LOWER ALUMINUM POWER COATED BLACK FINE TEXTURE |
| SCR1 | 0380-2079 | 2 | STANDOFF-HEX .312-IN-LG .187-IN-A/F SST |
| SCR2 | 0380-2070 | 6 | STANDOFF-HEX MALE-FEMALE M3X0.5 6MM-A/F 14MM-LG SST PASSIVATED |
| SCR3 | 0380-4812 | 6 | STANDOFF-HEX MALE-FEMALE M3X0.5 5.5MM-A/F 6MM-LG SST-303 NATURAL-FINISH |
| SCR4 | M9186-21200 | 6 | STANDOFF, M3X13MM, FEMALE |
| SCR5 | 0515-1375 | 1 | SCREW-MACHINE 90-DEG-FLT-HD TORX-T8 M2.5X0.45 6MM-LG SST-300 PASSIVATED |
| SCR6 | 0515-1940 | 2 | SCREW-MACHINE W/PATCH-LOCK PAN-HD TORX-T8 M2.5X0.45 6MM-LG SST-300 PASSIVATED |

**Table 4-1** M9216A module replaceable parts list (continued)

| Reference designator | Agilent part no. | Qty | Description |
|---|---|---|---|
| SCR7 | 0515-1227 | 12 | SCREW-MACHINE 90-DEG-FLT-HD TORX-T10 M3X0.5 6MM-LG SST-300 PASSIVATED |
| SCR8 | 0515-1968 | 3 | SCREW, CONE POINT,6MM THREAD LENGTH |

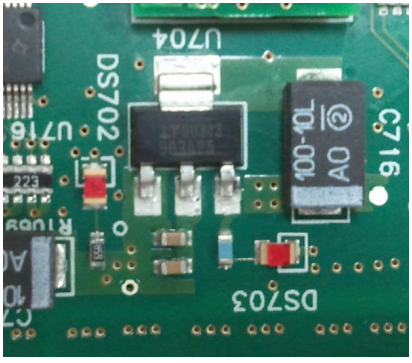
| Agilent M9216A Reference Designators | | | |
|---|---|---|---|
| A | — Assembly | PNL | — Panel |
| J | — Electrical connector | CVR | — Cover |
| JP | — Jumper | MP | — Miscellaneous mechanical parts |
| X | — Component, integrate circuit | SCR | — Screw or fastener |

# Troubleshooting Guide

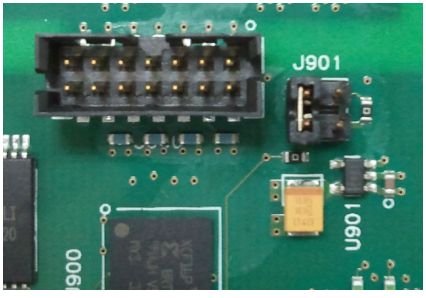
### No communication with the module

If the host computer is still unable to communicate with the module after it is confirmed that the module has been installed properly on a working system, it is likely that there is a problem on the digital controller board, M9216-66602.

Are both the LED indicators DS702 and DS703 on the digital controller board lighted? If any of the LED lights are not turned on, this could indicate a power supply problem on the digital board. Replace the digital board, perform calibration and verification test.




If the LEDs are both lighted up as per normal, inspect that the jumper on J901 is not missing and set correctly. If the jumper is missing or not set correctly, please put the jumper in the correct position as shown below and attempt to reestablish communication.



### Large measurement errors

If some or all of the digitizer channels are not able to perform proper measurements, it is most likely that the analog measurement board has a problem.

In case the voltage measurements are having large errors, the possibility exist that there is a gross calibration error or that the EEPROM on the digital controller board may be corrupted.

As a rule of thumb, for the 5 V measurement range, the level $L_{adc}$ should be approximately

$$L_{adc} = 11605.38 * V_{in}$$

For the 100 V measurement range

$$L_{adc} = 584.34 * V_{in}$$

To rule out that possibility, read the raw ADC data for the erroneous channel. If the raw ADC levels are close to the expected value, within ±10 levels, try performing the calibration test again for that channel.

In the event an input port is having gross errors, while other ports belonging to the same digitizer channel are accurate, this may indicate that the relays of the input multiplexer are not functioning or may have been damaged.

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# 5 Service



This chapter contains information on servicing the module, and it includes troubleshooting guidelines and repair/maintenance guidelines.

**WARNING** **Do not perform any of the service procedures unless you are a qualified service personnel.**

# Troubleshooting Techniques

There are two main steps to troubleshoot a faulty M9216A module:

1 Identify the problem, and

2 Test the module assembly to isolate the cause.

## Identifying the problem

Module problems can be divided into three general categories:

- Operator errors
- Catastrophic failures
- Performance out of specification

### Operator Errors

Apparent failures may result from operator errors.

### Catastrophic Failure

If a catastrophic failure occurs, use the M9216A Soft Front Panel (SFP) to communicate with the module in order to troubleshoot and isolate the module problem.

### Performance out of specification

If the module performance is out of specification limits, use the adjustment/calibration procedures in Chapter 3 to correct the problem.

# Repair/Maintenance Guidelines

This section provides guidelines to repair and maintain the M9216A module, including:

- ESD precautions
- Soldering printed circuit boards
- Post-repair safety checks

## ESD precautions

Electrostatic discharge (ESD) may damage MOS, CMOS, and other static sensitive devices in the M9216A module. This damage can range from slight parameter degradations to catastrophic failures.

When handling module assemblies, follow these guidelines to avoid damaging module components:

- Always use a static-free work station with a pad of conductive rubber or similar material when handling module components.
- After you remove the module from the mainframe, place the module on a conductive surface to guard against ESD damage.
- After you remove a MOS or CMOS device from an assembly, place the device onto a pad of conductive foam or other suitable holding material.
- If a device requires soldering, be sure that the assembly is placed on a pad of conductive material. Also, be sure you, the pad, and the soldering iron tip are grounded to the assembly. Apply as little heat as possible when soldering.
- When you replace a MOS or CMOS device, ground the foam before removing the device from the foam.

When soldering to any circuit board, keep in mind the following guidelines:

- Avoid unnecessary component unsoldering and soldering. Excessive replacement can result in damage to the circuit board and/or adjacent components.
- Do not use a high power soldering iron on etched circuit boards as excessive heat may lift a conductor or damage the board.
- Use a suction device or wooden toothpick to remove solder from component mounting holes. When using a suction device, be sure the equipment is properly grounded to prevent electrostatic discharge from damaging CMOS devices.

## Post-repair safety checks

After making repairs to the M9216A module, inspect the module for any signs of abnormal internally generated heat, such as discolored printed circuit boards or components, damaged insulation, or evidence of arcing. Determine and correct the cause of the condition. Then run the Verification Tests to verify that the module is functional.

# Agilent Technologies Calibration Services

When your module is due for calibration, contact your local Agilent Service Center for a low-cost recalibration. The M9216A is supported on automated calibration systems, which allows Agilent to provide this service at a competitive price.

## Calibration interval

A one-year interval is adequate for most applications. Accuracy specifications are under warranty only if adjustments are made at regular calibration intervals. Accuracy specifications will not be offered warranty beyond the one-year calibration interval. Agilent does not recommend extending calibration intervals beyond two years for any application. Agilent recommends that a complete readjustment should always be performed at the calibration interval. This will ensure that the M9216A will remain within specifications for the next calibration interval. The re-adjustment provides the best long-term stability and accuracy.

# Types of Service Available

If your instrument fails during the warranty period, Agilent will repair or replace it under the terms of your warranty. After your warranty expires, Agilent offers repair services at competitive prices.

# Extended Service Contracts

Most Agilent products are provided with optional service contracts that extend the coverage period after the standard warranty expires. If you have this service contract and your instrument happens to fail during the coverage period, Agilent will repair or replace it according to the contract.

# Obtaining Repair Service (Worldwide)

To obtain service for your instrument (in-warranty, under service contract, or post-warranty), contact your nearest Agilent Service Center. They will arrange to have your unit repaired or replaced, and are able to provide warranty or repair cost information where applicable. To obtain warranty, service, or technical support information you can contact Agilent at one of the following telephone numbers.

- In the United States: 800 829 4444
- In Europe: 31 20 547 2111
- In Japan: (81) 426 56 7832

You can also use our web link for the information on contacting Agilent worldwide:

www.agilent.com/find/assist

Or contact your Agilent representative.

Before shipping your instrument, ensure that you acquire shipping instructions, including the components to be shipped, from the Agilent Service Center. Agilent recommends that you retain the original shipping carton for use in such shipments.

# Re-packaging for Shipment

If the unit is to be shipped to Agilent for service or repair, make sure that you do the following.

- Attach a tag to the unit identifying the owner and indicating the required service or repair. Include the model number and full serial number.
- Place the unit in its original container with appropriate packaging material for shipping.
- Secure the container with strong tape or metal bands.
- If the original shipping container is not available, place your unit in a container with at least four inches of compressible packaging material around all sides for the instrument. Use static-free packaging materials to avoid additional damage to your unit.

**NOTE** Agilent suggests that you always insure your shipments.

# Cleaning

Clean the outer area of the module with a soft, lint-free, and slightly dampened cloth. Do not use detergent.

Disassembly is not required for cleaning.

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**www.agilent.com**

**Contact us**
To obtain service, warranty, or technical assistance, contact us at the following phone or fax numbers:

United States:
(tel) 800 829 4444 (fax) 800 829 4433
Canada:
(tel) 877 894 4414 (fax) 800 746 4866
China:
(tel) 800 810 0189 (fax) 800 820 2816
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
Latin America:
(tel) (305) 269 7500
Taiwan:
(tel) 0800 047 866 (fax) 0800 286 331
Other Asia Pacific Countries:
(tel) (65) 6375 8100 (fax) (65) 6755 0042

Or visit Agilent World Wide Web at:
www.agilent.com/find/assist

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