Configuration and
Measurement Instructions

Keysight Technologies M9703A Hardware Extension of 89600 VSA Software

Notice: This document contains references to Agilent. Please note that Agilent's Test and Measurement business has become Keysight Technologies. For more information, go to www.keysight.com.

KEYSIGHT
TECHNOLOGIES

Notices

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.

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.

The following safety precautions should be observed before using this product and any associated instrumentation.

This product is intended for use by qualified personnel who recognize shock hazards and are familiar with the safety precautions required to avoid possible injury. Read and follow all installation, operation, and maintenance information carefully before using the product.

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 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.

WARNING

Operator is responsible to maintain safe operating conditions. To ensure safe operating conditions, modules should not be operated beyond the full temperature range specified in the Environmental and physical specification. Exceeding safe operating conditions can result in shorter lifespans, improper module performance and user safety issues. When the modules are in use and operation within the specified full temperature range is not maintained, module surface temperatures may exceed safe handling conditions which can cause discomfort or burns if touched. In the event of a module exceeding the full temperature range, always allow the module to cool before touching or removing modules from chassis.

Keysight products are designed for use with electrical signals that are rated Measurement Category I and Measurement Category II, as described in the International Electrotechnical Commission (IEC) Standard IEC 60664. Most measurement, control, and data I/O signals are Measurement Category I and must not be directly connected to mains voltage or to voltage sources with high transient over-voltages. Measurement Category II connections require protection for high transient over-voltages often associated with local AC mains connections. Assume all measurement, control, and data I/O connections are for connection to Category I sources unless otherwise marked or described in the user documentation.

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. If the circuit is capable of operating at or above 1000V, no conductive part of the circuit may be exposed.

Do not connect switching cards directly to unlimited power circuits. They are intended to be used with impedance-limited sources. NEVER connect switching cards directly to AC mains. When connecting sources to switching cards, install protective devices to limit fault current and voltage to the card.

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 close 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.

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.

When fuses are used in a product, replace with the same type and rating for continued protection against fire hazard.

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.

Before performing any maintenance, disconnect the line cord and all test cables.

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 Keysight. 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 Keysight to maintain accuracy and functionality of the product). If you are unsure about the applicability of a replacement component, call an Keysight office for information.

WARNING

No operator serviceable parts inside. Refer servicing to qualified personnel. To prevent electrical shock do not remove covers. For continued protection against fire hazard, replace fuse with same type and rating.
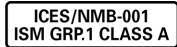
PRODUCT MARKINGS:

$C\mathcal{E}$

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

Australian Communication and Media Authority mark to indicate regulatory compliance as a registered supplier.

ICES/NMB-001
ISM GRP.1 CLASS A

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).

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South Korean Class A EMC Declaration. This equipment is Class A suitable for professional use and is for use in electromagnetic environments outside of the home. A급 기기 (업 무 용 방 송 통 신 기 자 재) 이 기 기 는 업 무 용 (A급) 전 자 파 적 합 기 기 로 서 판 매 자 또 는 사 용 자 는 이 점 을 주 의 하 시 기 바 라 며 , 가 정 외 의 지 역 에 서 사 용 하 는 것 을 목 적 으 로 합 니 다 .

This product complies with the WEEE Directive marketing requirement. The affixed product label (above) 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 product is classified as "Monitoring and Control instrumentation" product. Do not dispose in domestic household waste. To return unwanted products, contact your local Keysight office, or for more information see
http://about.keysight.com/en/companyinfo/environment/takeback.shtml.

This symbol indicates the instrument is sensitive to electrostatic discharge (ESD). ESD can damage the highly sensitive components in your instrument. ESD damage is most likely to occur as the module is being installed or when cables are connected or disconnected. Protect the circuits from ESD damage by wearing a grounding strap that provides a high resistance path to ground. Alternatively, ground yourself to discharge any built-up static charge by touching the outer shell of any grounded instrument chassis before touching the port connectors.

This symbol on an instrument means caution, risk of danger. You should refer to the operating instructions located in the user documentation in all cases where the symbol is marked on the instrument.

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 Keysight 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.

# Keysight M9703A Hardware Extension of 89600 VSA Software

The 89601B: 89600 VSA software supports the Keysight M9703A AXIe High–Speed Digitizer. This VSA measurement hardware configuration offers broadband vector signal analyzer measurements up to 625 MHz of analysis bandwidth (model dependent).

Model	Bandwidth
M9703A-SR1	390 MHz
M9703A-SR2	625 MHz

> **NOTE** That the M9703A is not supported by the earlier 89601A VSA software, neither by the 32-bit version of the current software i.e. You must use the 64-bit version of the 89600 VSA software with M9703A.

Configuring the 89600 VSA software application to use the M9703A hardware

1. Start the 64-bit version of the 89600 VSA software application.
2. Configure the M9703A digitizer as the VSA measurement input by creating an *'Analyzer Configuration'* that uses the M9703A digitizer as the *Logical Instrument* (ADC) by performing the following steps:
   a. From the menu, go to **Utilities** > **Hardware** > **Configurations**, and click on **Add New Configuration** button (⊕). This will open the 'New Hardware Configuration' dialog.
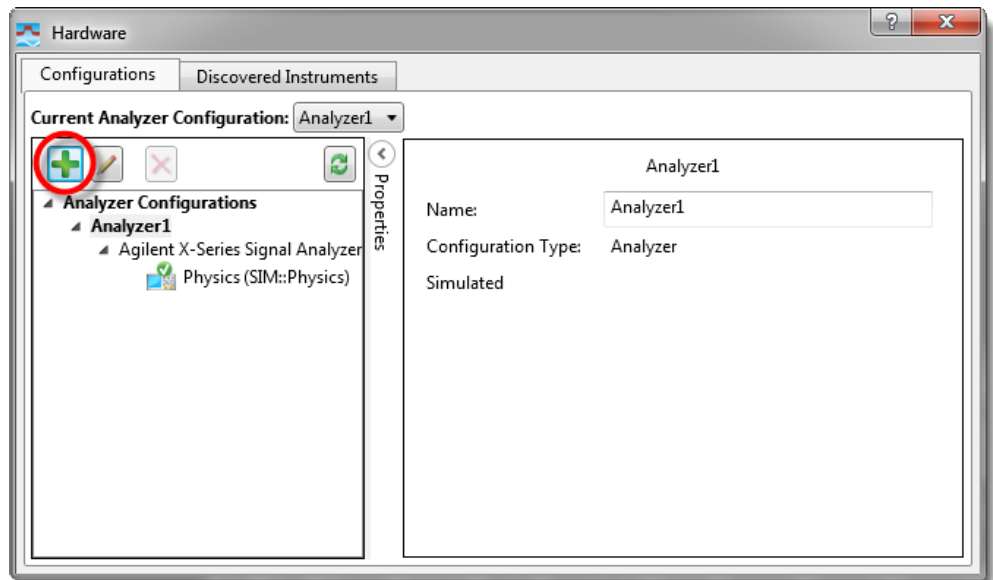
   b. De-select 'Simulate Hardware' if it is selected.
   c. Select the M9703A digitizer from the list of *'Possible Logical Instrument'* and drag it or click on the ⊳ button to add it to the *'Configuration'* box.
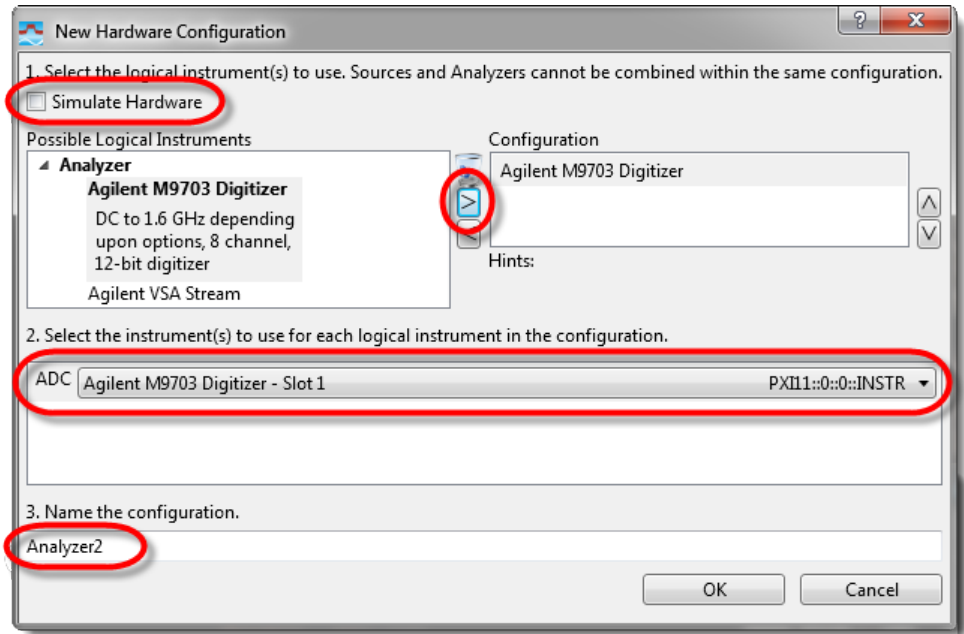
d. In the box below ensure that M9703A appears as the 'ADC' entry, and if you have more than one M9703A connected - select the required unit using the drop-down list.

e. You may either use the default name or specify another name for this analyzer configuration.

f. Click OK to close the *'New Hardware Configuration'* dialog.

g. But before closing the 'Hardware Configurations' dialog, use the **Current Analyzer Configuration** drop-down to select the newly created *M9703A Digitizer* as the current item.
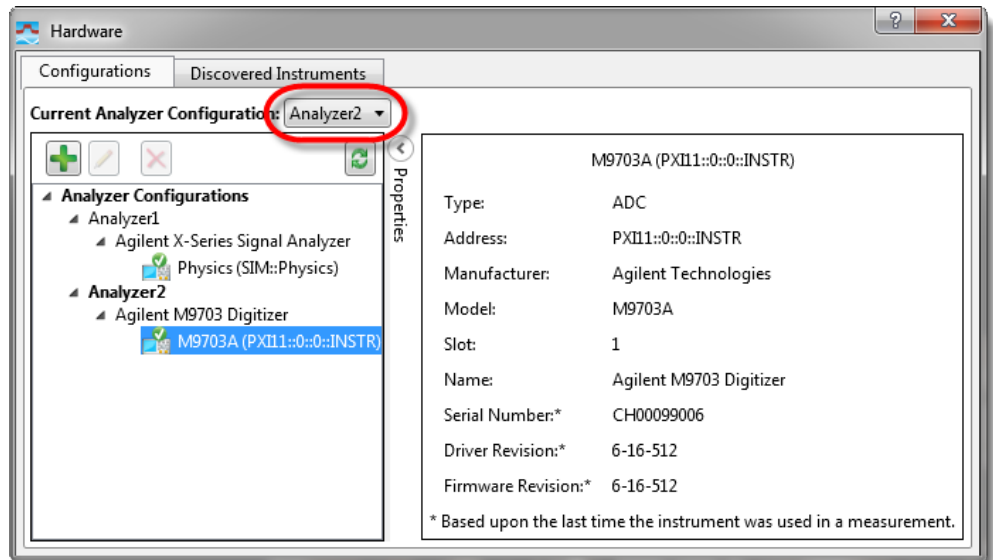
3. Review and configure the Measurement Setup Parameters.

Multi–Channel Measurements

When using the M9703A digitizer in VSA configuration, the digitizer forms the measurement front-end data acquisition hardware for the 89600 VSA software. The M9703A digitizer supports single channel I+jQ, multi-channel Dual I + jQ, and cross channel measurement configurations. The analysis bandwidth and maximum sample rate depend on whether the digitizer model is M9703A-SR1 or M9703A-SR2.

Interleaved Mode

The option of using two channels of the M9703A in Interleaved mode is provided if your product has been ordered with the -INT option. This in effect provides double the sampling rate with the trade-off of halving the available center frequency range. As shown in the table:

Mode	Model Option	Center Frequency Range	Sampling Rate
Normal (Non-Inter-leaved)	-SR1	0 - 1 GHz	1 GS/s
	-SR2	0 - 1.6 GHz	1.6 GS/s
Interleaved	-SR1	0 - 1 GHz	2 GS/s
	-SR2		3.2 GS/s

NOTE For best measurement fidelity you should ensure that the center frequency + analog bandwidth/2 does not cross the Nyquist frewquency.

Interleaved mode may be enabled by opening the **Input** > **Extensions..** window from the menu bar. Then select the **Enable Interleaving** option, changes are applied immediately.
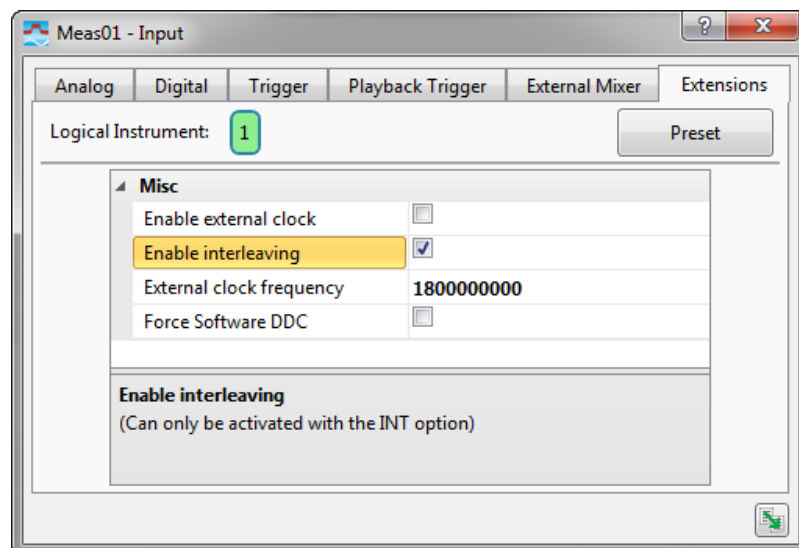
External Clock

The option of using an external sampling clock is provided. This clock must be con-tinuously present if the mode is selected otherwise an error will occur. The range of clock input frequency is model dependent, as shown in the table below:

Model option	Frequency Range
-SR1 models	1.8 to 2 GHz
-SR2 models	1.8 to 3.2 GHz

To use this option, first connect an external clock signal in the accepted range to the CLK IN connector on the M9703A front panel. The signal must be in the range +5 to +15 dBm.

Then open the **Input** > **Extensions...** window from the menu bar. Select the **Enable external clock option**, and double click the **External clock frequency** value to bring up the editing window. You may then set the value of the external clock frequency being applied. As shown below:
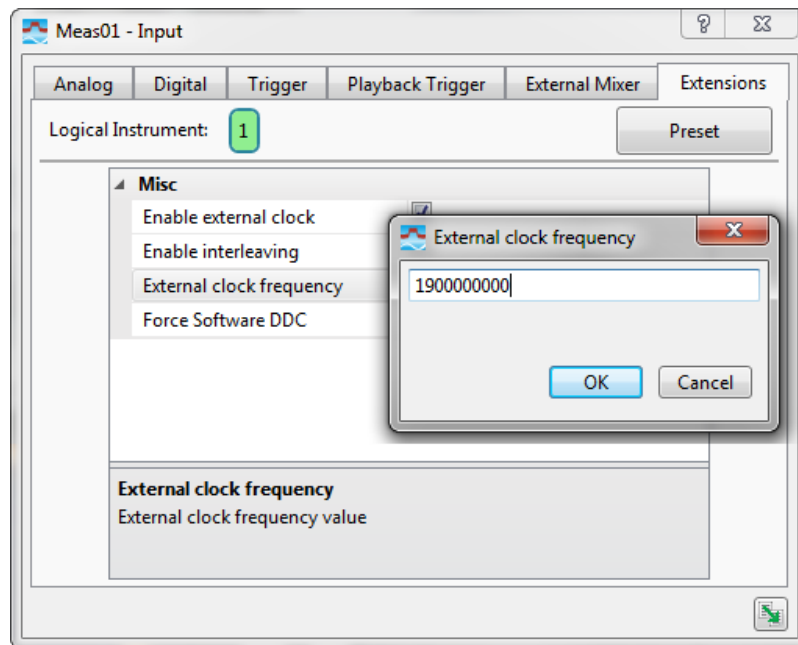
Force Software DDC

This function overrides the hardware processing which is normally performed by the M9703A, and forces the VSA software to perform the DDC operation. It is provided simply as a demonstration of the difference in performance between hardware DDC and software.

It can be enable as shown in the screen capture below by ticking the **Force Software DDC** option.
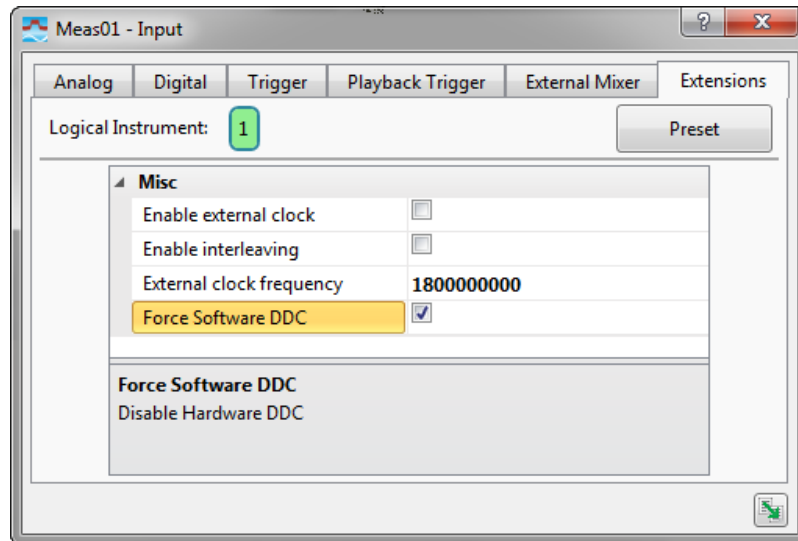
Measurement Setup Parameters

This section provides measurement and parameter setup information which are specific to the 89600 VSA software when used along with the M9703A AXIe High-Speed Digitizer. This information will help you to properly setup the VSA in this hardware configuration to make measurements using the M9703A digitizer.

Measurement Setup Parameters:

Alignment / Calibration	Preset
Channels	Range
Connection	Recording
Coupling	Setup Save/Recall
Center Frequency Limits	Span
Frequency Counter	Trigger Holdoff
Hardware	Triggering
Overlap	

Alignment/Calibration: If required, an internal calibration may be performed. Note that this operation may require several minutes to complete. Accessed from the menu **Utilities > Calibration**.

Channels: From the menu **Input > Channels**, available options:
- 1 channel through 8 channels,
- I+jQ (IN1+jIN2)
- Dual I+jQ (IN1+jIN2, IN3+jIN4)
- Triple I+jQ (IN1+jIN2, IN3+jIN4, IN5+jIN6)
- Quad I+jQ (IN1+jIN2, IN3+jIN4, IN5+jIN6, IN7+jIN8)

The custom channel configuration may be used to specify a non-standard mapping between the digitizer input and the VSA logical channel. The default mapping of logical channel to digitizer input is:

Logical Channel	Digitizer Input
1	IN1
2	IN3
3	IN5
4	IN7
5	IN2
6	IN4
7	IN6
8	IN8

From the menu **Input > Analog** the following parameters can be set:

Range: The M9703A digitizer has two range settings: 2 V (10 dBm) and 1 V (4 dBm).
Coupling: DC
Input Impedance: 50 Ohms.
Connection: Single Ended.

The frequency measurement parameters may be configured from the **MeasSetup > Frequency** menu.

Frequency:

Digitizer Model	Band	Center	Span	Start	Stop
M9703A-SR1	0 to 390.625 MHz	195.3125 MHz	390.625 MHz	0	390.625 MHz
M9703A-SR2	0 to 625 MHz	312.5 MHz	625 MHz	0	625 MHz

Span: The maximum span is dependent upon the maximum sample rate of the particular M9703A digitizer model.

Model	Max span
M9703A-SR1	390.625MHz
M9703A-SR2	625 MHz

ResBW: 3 MHz

Main Time Length: 1.273125 µs

Center Frequency Limits: The limits depend on which model you are using:

Model	Limits
M9703A-SR1	0 to 1.0 GHz
M9703A-SR2	0 to 1.6 GHz

Frequency Counter: Not available.

Trigger settings may be accessed via the **Input > Trigger** menu:

The following trigger parameters are available:
- **Style:** Free Run*, External, and Magnitude**
- **Slope:** available for External and Magnitude**
- **Level:** available for External and Magnitude**
- **Delay:** available for External and Magnitude**

Trigger levels:

Trigger Type	Level	Default
External	-5 V to +5 V	2V
Magnitude**	0 to 1.414 V	10 mV

Trigger delays:

Trigger Type	Max Pre-Trigger Delay	Max Post-Trigger Delay
External	VSA increases the record size to make the pre-trigger delay fit (limited by the amount acquisition memory available).	1 second
Magnitude**	−137 samples * sampling Interval	1 second

*On "Segmented Capture" feature the free run triggered is not supported. (Segmented Capture feature may be accessed via the **MeasSetup > Time** menu)
**M9703A-DDC option is required for Magnitude triggering.

Trigger Holdoff: The trigger holdoff is not supported by the M9703A digitizer.

Soft Front Panel Control: The 'Disconnect' feature can be used to pause the VSA and release its control of the M9703A digitizer. Then the digitizer can be used independently from the VSA, for example, using the MD1 SFP application. Independent control must be released before resuming VSA measurements. When returning to the VSA and starting or resuming a measurement, the VSA will restore the digitizer state that was set before disconnected.

Hardware: Set up an Analyzer Configuration with the M9703A digitizer as the Logical Instrument, as described in Measurement Configuration Setup.

Overlap: The M9703A digitizer does not support overlap processing. However, overlap processing is available during recording playback.

Preset: The default parameter settings that are different from the 'Preset Setup' settings are listed below. (Any parameters not listed here are set to the same value as Preset Setup.)

Recording: the VSA application enables time data recording from the M9703A digitizer to the PC's disk drive. The length of time waveform recording is limited by the memory available on the M9703A digitizer.

Setup Save/Recall: The M9703A digitizer state is not saved when the VSA application is closed. When a setup is recalled into the VSA, the M9703A digitizer state is set appropriately based on the recalled VSA setup.