Startup
Guide

Keysight M9099
Waveform Creator 3.1

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KEYSIGHT
TECHNOLOGIES

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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:

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.

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).

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. A 급 기기 (업무용 방송통신기자재) 이 기기는 업무용 (A 급) 전자파적합기기로서 판매자 또는 사용자는 이 점을 주의하시기 바라며 , 가정외의 지역에서 사용하는 것을 목적으로 합니다 .

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.

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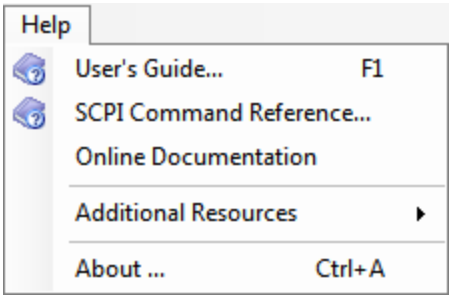
Preface

The scope of the Startup Guide is to introduce you to Waveform Creator software and describe the process of Installing and Licensing the product. It also encloses details on how to quickly get started with the software.

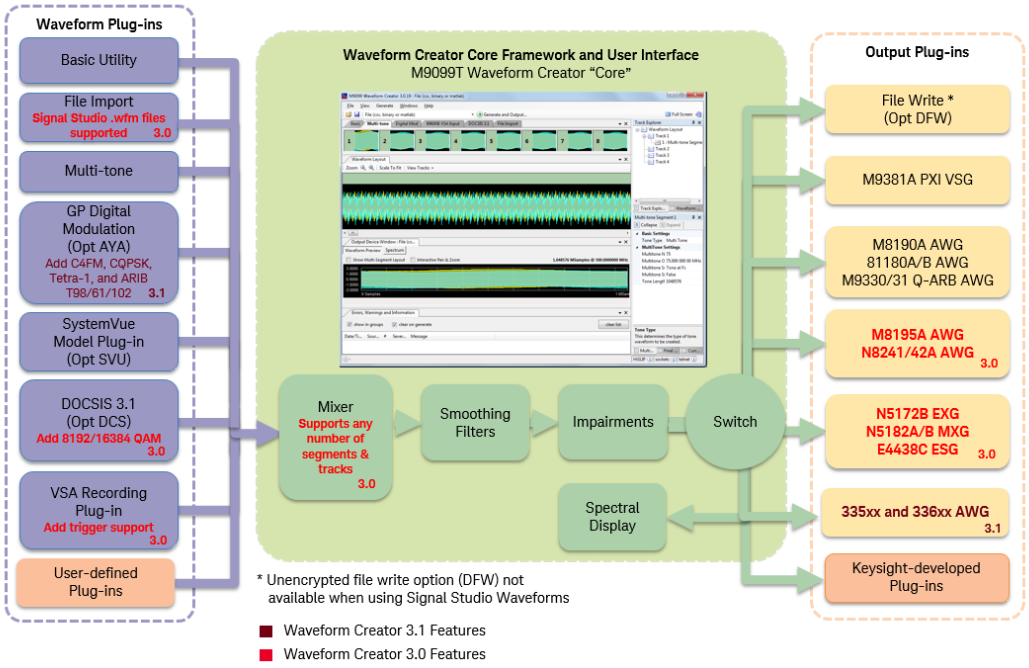
To access M9099 Waveform Creator help, launch the Product and click **Help** > **User's Guide**.



Introduction

M9099 Waveform Creator provides a modular and flexible waveform creation environment supporting analog and digital modulation formats for a series of Keysight instruments for R&D, design validation, and test engineers who need to create and manage custom waveforms for wireless and high speed wireline product design and testing.

Waveform Creator provides a simple, easy, and modular SW framework for creating, combining & managing custom, arbitrary waveforms, with support for corrected waveform download to Keysight AWGs and Signal Generators. It accelerates design validation and testing of chips, modules, and systems by streamlining development and management of custom stimulus waveforms.



Waveform Creator provides various benefits out of the box:

- Optional generation of DOCSIS 3.1 downstream and upstream signals.
- Optional waveform creation plug-in for basic digital modulation.
- Optional waveform creation plug-in for SystemVue simulation models.
- Other Standard waveform plug-ins for general-purpose waveform creation.
- Importing of waveform data from CSV, LabVIEW CSV, HDF, BIN, M8190A DUC IQBINFile, or Signal Studio's WFM file type.
- Flexible waveform creation and generation capability for the following Keysight products:

    - M9381A PXI VSG,
    - N5182A/B MXG, N5172B EXG, and E4438C ESG,
    - M933xA AWG, N824xA AWG, and
    - M8195A AWG, M8190A AWG and 81180A/B AWG
    - 335xx and 336xx AWG
- Output plug-in for writing unencrypted waveform files (CSV, MAT,BIN,M8190A DUC IQBIN, M9381A native files, and WFM).
- User extendable functionality such as creating your own waveform input plug-ins.
- SCPI remote control for test automation.

Related Documentation

To access documentation related to M9099 Waveform Creator, click the links below to open the related document.

Document	Description	Help Link/Location	Format
Startup Guide	This guide includes quick install and license setup instructions with instructions to quickly get started with Waveform Creator	64-bit - *C:\Program Files (x86)\Keysight\M9099\Documentation\M9099_StartupGuide.pdf* Web Link - *http://literature.cdn.keysight.com/litweb/pdf/M9099-90002.pdf*	PDF
M9099 Waveform Creator Help	This help includes Waveform Creator Core GUI and supported Plug-ins' documentation	32-bit - *C:\Program Files (x86)\Keysight\M9099\Documentation\wc.chm*	(Microsoft Help Format) CHM
SCPI Reference Manual	This manual includes descriptions and details of SCPI commands supported in Waveform Creator	32-bit - *C:\Program Files (x86)\Keysight\M9099\Documentation\SCPI Command Reference.html*	HTML
Keysight License Manager Help	This help file provides information on Keysight Licensing	32-bit - *C:\Program Files\Agilent\Agilent License Manager\AgilentLicenseManager.chm* 64-bit -*C:\Program Files(x86)\Agilent\Agilent License Manager\AgilentLicenseManager.chm* Alternatively, you can find help under:Start > All Programs > Keysight License Manager > Keysight License Manager Help	(Microsoft Help Format) CHM
Keysight I/O Libraries Help	This help file provides information on Keysight I/O libraries	32-bit - *C:\Program Files\Agilent\I/O Libraries Suite\VisaCom.chm* 64-bit - *C:\Program Files(x86)\Agilent\I/O Libraries Suite\VisaCom.chm*	(Microsoft Help Format) CHM
SystemVue Help	This is online version of SystemVue software help	http://www.keysight.com/find/eesof-systemvue-documentation	Web

For more details, visit:

- Product Documentation on the web: http://www.keysight.com/find/modular-m9099-docs .
- KC for Waveform Creator: http://www.keysight.com/find/modular-wfc-knowledge .
- KC for Modular Solutions: http://www.keysight.com/find/modular-knowledgecenter .

System Requirements

Following are Keysight recommended configurations:

CPU	2 GHz or faster 32-bit (x86) or 64-bit (x64) processor
RAM	2 GB recommended (32-bit) / 4 GB recommended (64-bit)
Video RAM	512 MB recommended
Hard Disk	1 GB available
Additional Drives	DVD to load software; license transfer requires network access, USB Flash drive, USB hard drive, or USB DVD drive
Operating System	Microsoft Windows® 7 Professional, Enterprise, or Ultimate (64-bit/32-bit)

Summary of Software/Hardware Compatibility with Waveform Creator

Microsoft .NET Framework	Ensure that you have Microsoft .NET Framework version 4 or higher installed on your system. The Microsoft .NET Framework 4 can be found at http://www.microsoft.com/en-in/download/details.aspx?id=17851 .
Keysight IO Libraries Suite	Ensure that you have IO Libraries Suite 16.3 or higher installed on your system. The Keysight IO Libraries Suite can be found on the CD that is part of shipment content or at http://www.keysight.com/find/iosuite .
VSA for pre-corrections filter calibration	If you wish to use the optional pre-corrections filter calibration capability, you also need Keysight 89601B VSA version 15 or higher installed on your system. Support till version 18.5 is provided.
M9381A VSG/CW Source Instrument Drivers	Install M9381A VSG Drivers from http://www.keysight.com/find/M9381A Please install M9381A driver version 1.3.300.0 or higher.
M8190A AWG Driver	If you wish to use the M8190A streaming capability, you also need Keysight M8190A Driver. Install the M8190A driver from http://www.keysight.com/main/software.jspx?ckey=sw385 Please install version 3.0 or higher.
NI-IVI Compliance Package	The M933xA series AWG require that the NI IVI Compliance Package 4.1 or greater be installed. To get the latest release of the NI IVI Compliance Package, go to http://www.ni.com/drivers/

M933xA AWG Source Instrument Drivers	Install M933xA Drivers from http://www.keysight.com/main/software.jspx?ckey=2033326 Please install M933xA driver version 2.01 or higher.
N824xA AWG Source Instrument Drivers	If you want to use N824xA output plug-in, please install N824xA AWG Source Instrument Drivers 16.3 or higher from http://www.keysight.com/main/software.jspx?ckey=1670471 .
SystemVue Software	To use SystemVue Model Plug-in, please install SystemVue software 2013.08 or 2013.08 SP1 release.

Installing Waveform Creator

Follow the given steps to get the executable and install Keysight M9099 Waveform Creator software (core and plug-ins) on your system.

Pre-requisites

A host PC with Keysight IO Libraries Suite software correctly installed.
For more details, refer to Summary of Software/Hardware Compatibility with Waveform Creator section under *System Requirements* .

Obtain Waveform Creator Executable

Obtain the Waveform Creator executable from the following sources:

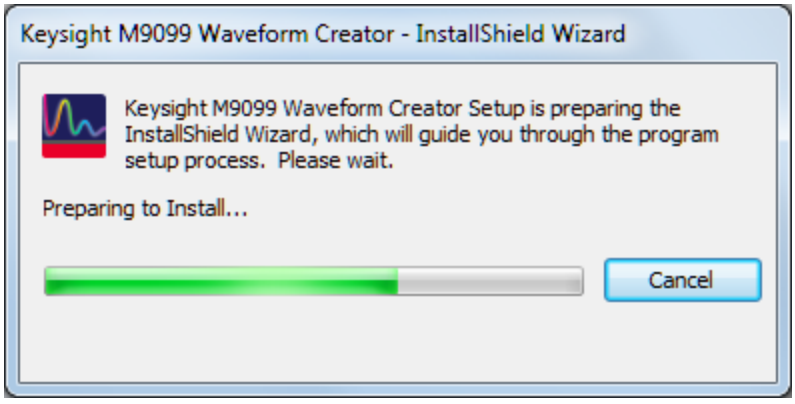
- www.keysight.com/find/M9099-SW
- CD-ROM (Product ordered with -MED option)

Installing Waveform Creator

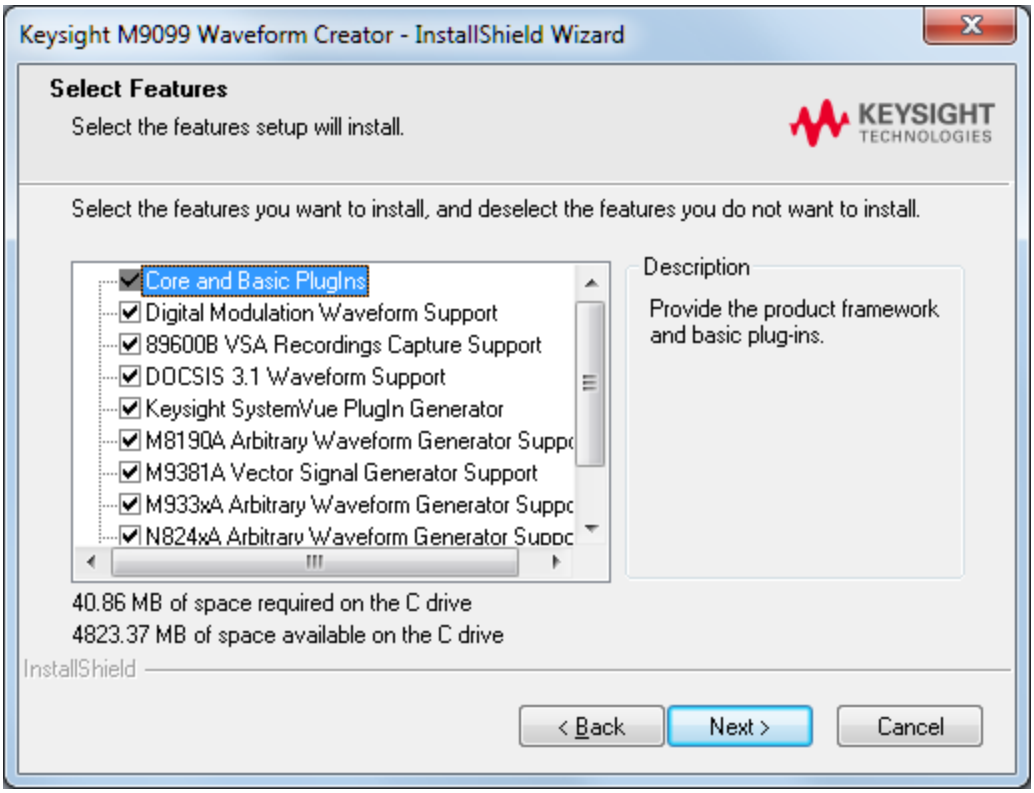
NOTE The installer for Waveform Creator supports smooth upgrade from previous version. You don't need to uninstall previous version of Waveform Creator (core and plug-ins) from your computer. This is automatically done of by the Waveform Creator installer.

Perform the following steps to install Waveform Creator:

1. Double-click the executable (*Keysight_M9099_3-1_Setup.exe*) to run the Waveform Creator setup. The following screen appears:



2. Follow the guided tour.



3. Select the features (plug-ins) you want to install and click **Next** to install in the default folder.
4. Follow the guided tour to complete the installation.

NOTE If you do not have the Keysight M938x Instrument Driver Version 1.1.199.3 or later or M933x Arbitrary Waveform Generator Instrument Drivers installed on your system, download the same from http://www.keysight.com/find/adnivicomdrivers .

Install the M8190A driver from http://www.keysight.com/main/software.jspx?ckey=sw385 . Similarly, locate the installers for the other drivers on Keysight website.

Silent Installation of Waveform Creator

To install Waveform Creator silently, perform the following steps:

1. Copy the following file to a non read-only directory.

* Keysight_M9099_3-1_Setup.exe

2. Run the command prompt as an administrator.
3. Navigate to the directory in which the M9099 Setup file is located.
4. Run the following command:

```
Keysight_M9099_3-1_Setup.exe /s /v /qn
```

Setting Up Licenses

This section describes Keysight software licensing and the licenses required to run the Keysight Waveform Creator software.

Keysight Software Licensing

The Waveform Creator software supports Node-Locked licensing type.

NOTE For more details on different license types and setup, launch **Keysight License Manager**from **Start** >**All Programs** > **Keysight License Manager** or by clicking from the system tray.

When you purchase Waveform Creator, you are provided with a License Redemption Entitlement Certificate that documents the options to which you are entitled. You can redeem the certificate at http://www.keysight.com/find/softwaremanager using the purchase order number, entitlement certificate number, and other details to run the software.

The Keysight Software Licensing system issues a license file for each purchased option, by e-mail, to an address you specify. Each license file is a plain text file attachment with a file name in the form *XXXXXX_YYYYYY.lic*.

When you receive the e-mail, you should save the attached .lic file(s) to the Agilent license directory, which is, by default, located at *C:\Program Files\Agilent\licensing*.

NOTE You can check the status of your software licenses by running the optional Keysight License Manager or by selecting**Help** > **About...**from the Waveform Creator menu and then selecting the Licenses tab in the About dialog.

If a license is not available or not valid, the corresponding features will not be enabled by the Keysight Waveform Creator.

Waveform Creator Licenses

Keysight Waveform Creator Software Options

Product-Option	Feature*	Version*	Description
M9099T			Waveform Creator (Transportable Perpetual License)
M9099T-LIC	M9099_CS_CoreSoftware	3.000	Core product w/ Basic & Multi-tone plug-in licenses (Required)
M9099T-AYA	M9099_Wp_DigMod	3.000	Digital Modulation Library plug-in license
M9099T-DCS	M9099_Wp_Docsis	3.000	Docsis 3.1 Plug-in license
M9099T-DFW	M9099_Dp_DataFileWrite	3.000	Unencrypted Data File Write plug-in License
M9099T-SVM	M9099_Wp_SystemVue	3.000	SystemVue Model plug-in license (requires SystemVue software)

Waveform Creator Trial licenses

Product- Option	Feature	Version	Description
M9099T-LIC-TRL	M9099_CS_CoreSoftware	3.000	Waveform Creator core software (Trial)
M9099T-AYA-TRL	M9099_Wp_DigMod	3.000	Digital Modulation Plug-in (Trial)
M9099T-DCS-TRL	M9099_Wp_Docsis	3.000	Waveform Creator Docsis 3.1 Plug-in (Trial)
M9099T-SVM-TRL	M9099_Wp_SystemVue	3.000	SystemVue Model Plug-in (Trial)

Waveform Creator Support licenses

Product- Option	Feature	Version	Description
M9099T-LIC-12M		3.000	Waveform Creator, Core Software, Premium Support Plan (1-year)
M9099T-AYA-12M		3.000	Waveform Creator Digital Modulation, Premium Support Plan (1-year)
M9099T-DCS-12M		3.000	Waveform Creator Docsis 3.1 Plug-in, Premium Support Plan (1-year)
M9099T-DFW-12M		3.000	Waveform Creator Data File Write, Premium Support Plan (1-year)
M9099T-SVM-12M		3.000	Waveform Creator SystemVue Model, Premium Support Plan (1-year)

Quick Start

This section introduces a typical Waveform Creator workflow. You will create a test modulation in M9099 Waveform Creator, download it to the M9381A Vector Signal Generator (VSG), and verify the resulting RF signal using the N9020A MXA Signal Analyzer.

This should be sufficient to get you familiar with the basic workflow.

- Configure the System (page 21)
- Create a Simple Waveform (page 21)
- Download the Waveform (page 22)

Configure the System

Refer to System Requirements (page 13)

Create a Simple Waveform

Waveforms are created by dragging and dropping waveform segments from the active Segment Library window into the Waveform Layout window. Once the desired sequence of waveform segments is achieved, the composite waveform, including any added noise or other impairments, can be reviewed in the Output Device window.

Follow these steps to create a simple waveform:

1. Run the M9099 Waveform Creator software.
2. Select the Multi-tone Segment Library tab.
3. Drag and drop Segment 1 from the Segment Library window into the Waveform Layout window by selecting the colored box numbered 1.
   The Multi-tone Segment 1 panel appears on the left.
4. Change the segment 1 settings to the following (leave all others at their default values):
   a. Tone Type: Single Tone
   b. Tone Frequency: 60.00 MHz
   c. Tone Modulation Symbol Rate: 10.00 MHz
   d. Tone Modulation Type: 16 QAM
   e. Tone Filter Type: Root Raised-Cosine
   f. Tone Filter BT/Shape: 0.300
   g. Tone Minimum Length: 65536

NOTE Waveforms can also be imported in the form of CSV, LabVIEW CSV, HDF, BIN, and M8190A DUC IQBIN file format using File Import plug-in. To import:

1. In the File Import Segment, under **Segment Settings**, set the **File Type** to "XXX File", where XXX=CSV, LabVIEW CSV, HDF, BIN, or M8190A DUC IQBIN.
2. Specify the **Waveform File Name** under **Segment Settings** to import the desired file.

Download the Waveform

Generated waveforms using Waveform Creator can be downloaded either to an output device like M9381A, M8190A, M933xA, 81180-series instrument, or File (csv, matlab or binary format).

This section provides instructions for downloading waveforms on M9381A VSG. Similar steps can be taken to download waveforms on other supported output devices.

M9381A VSG

To download waveform on an M9381A VSG:

1. Connect the M9099 Waveform Creator to the M9381A Vector Signal Generator (page 22)
2. Run M9099 software
3. Generate Output (page 23)

Connect the M9099 Waveform Creator to the M9381A Vector Signal Generator

The Keysight M9381A VSG hardware comprises four interconnected PXIe modules, typically hosted in an Keysight M9018A PXIe chassis. These modules must be controlled over the PXIe bus by the M9381A instrument driver in order to deliver the product functionality. The driver may be hosted by an embedded controller PC in the same PXIe chassis, or by an external laptop or desktop PC whose PCIe backplane has been extended (by adapters and cable) onto the backplane of the PXIe chassis. The possible configurations are fully described in the *Keysight M9381A Configuration Guide (5991-0897EN)*.

Once the M9381A hardware is configured and the M938x VSG/CW Source Instrument Driver is installed, other applications (such as M9099) may communicate with the M9381A by means of IVI-COM driver calls to the VISA PXI address assigned to the M9381A in the Keysight IO Libraries Suite.

Generate Output

To generate output:

1. Select Generate > Output Device > Keysight M9381A VSG to select the output device.
2. Select the Current Output Device Settings window and change the device settings to the following (leave all other parameters at their default values):
   a. Instrument Address: <VISA string from Agilent IO Libraries>
   b. Frequency: 1.5 GHz
   c. Amplitude: 0 dBm
   d. RF On: True
3. Click the Generate and Output button in the tool bar to send the created waveform to M9381A VSG.

NOTE If you have no M9381A hardware installed (and therefore have no address to enter), you can still explore the software functionality by changing the M9381A output device setting Output To to Output to Simulated HW. In this mode, Settings changes and waveform downloads will appear to work, but the changes and data are simply discarded by the M9381A driver. For more details on M9381A Output plug-in settings, refer to the User's Guide.

Data File Write

Waveform Creator allows you to save the output waveform to a file in either of the following formats:

- CSV (comma separated)
- N5110A waveform (*.bin)
- MATLAB® Level 5 MAT-File
- M8190A DUC IQBIN File

To download waveform to a file:

1. Select Generate > Output Device > *File (csv, binary or matlab).
2. Set the parameter values.
3. Click the Generate and Output button in the tool bar to save the output to a file on the host computer.

For file data, the maximum sample rate is not limited by hardware, so for internal coding purposes a nominal limit of 5 GHz is set. Within this limit, the auto sample rate algorithm chooses the most appropriate sample rate for the generated waveform. If a higher sample rate is needed, then this nominal limit can be over-ruled by using the manual sample rate setting.

The output files are unencrypted and can be formatted in various ways to facilitate their import into other Keysight and non-Keysight tools.

NOTE Output to all supported Keysight VSG is standard as part of Waveform Creator functionality but file output is separately licensed as Waveform Creator option DFW.

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