



TELEDYNE TEST TOOLS
Everywhere you look™



Operator's Manual
Arbitrary Waveform Generator
High Definition AWG
T3AWG3352 and T3AWG3252

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Safety Instructions

This section contains instructions that must be observed to keep the instrument operating in a correct and safe condition. You are required to follow generally accepted safety procedures in addition to the precautions specified in this section. **The overall safety of any system incorporating this instrument is the responsibility of the assembler of the system.**

Safety Symbols

These symbols appear on the instrument's front and rear panels and in its documentation to alert you of important safety considerations.



CAUTION of damage to instrument, or **WARNING** of hazard to health. Attend to the accompanying information to protect against personal injury or damage. Do not proceed until conditions are fully understood and met.



WARNING. Risk of electro-shock.



Measurement ground connection.



Safety (protective) ground connection.



Power On (rear power switch); connected to AC mains.



Power Off (rear power switch); disconnected from AC mains.



Standby Power (front of instrument).

Precautions

User proper power cord. Use only the power cord shipped with this instrument and certified for the country of use.

Maintain ground. This product is grounded through the power cord grounding conductor. To avoid electric shock, connect only to a grounded mating outlet.

Observe all terminal ratings. Do not apply a voltage to any terminal that exceeds the maximum rating.

Use only within operational environment listed. Do not use in wet or explosive atmospheres.

Use indoors only.

Keep product surfaces clean and dry.

Do not block the cooling vents. Refer to operating environment details.

Do not remove the covers or inside parts. Refer all maintenance to qualified service personnel.

Do not operate with suspected failures. Do not use the product if any part is damaged. Obviously incorrect measurement behaviours (such as failure to calibrate) might indicate impairment due to hazardous live electrical quantities. Cease operation immediately and sequester the instrument from inadvertent use.

Operating Environment

CAUTION. To ensure proper cooling, keep sides of the instrument clear of obstructions.

Place the instrument on a cart or bench, observing clearance requirements:

- Top: 20 mm (0.8 in)
- Left and right side: 150 mm (5.9 in)
- Bottom: 20 mm (0.8 in)
- Rear: 75 mm (3 in)

CAUTION. Ensure that the equipment is positioned in a way that the disconnecting device can be readily accessible.

The instrument is intended for indoor use and should be operated in a clean, dry, nonconductive environment. Occasionally a temporary conductivity that is caused by condensation must be expected. This location is a typical office/home environment. Temporary condensation occurs only when the product is out of service.

Before using this product, ensure that its operating environment is maintained within these parameters:

Temperature	Operating +5 °C to +40 °C (+41 °F to 104 °F) Non-operating -20 °C to +60 °C (-4 °F to 140 °F)
Humidity	Operating 5% to 80% relative humidity with a maximum wet bulb temperature of 29 °C at or below +40 °C, non-condensing. Non-operating 5% to 95% relative humidity with a maximum wet bulb temperature of 40 °C at or below +60 °C, non- condensing.
Altitude	Operating 3,000 m (9,843 feet) Non-operating 12,000 m (39,370 feet)

Cleaning

WARNING. To avoid personal injury, power off the instrument and disconnect it from line voltage before performing any other following procedures.

Inspect the arbitrary waveform generator as often as operating conditions require. To clean the exterior surface, perform the following steps:

- Remove loose dust on the outside the instrument with a lint-free cloth. Use care to avoid scratching the front panel display.
- Use a soft cloth dampened with water to clean the instrument. Use a 75% isopropyl alcohol solution as a cleaner.

CAUTION. To avoid damage to the surface of the arbitrary waveform generator, do not use any abrasive or chemical cleaning agents.

Calibration

The recommended calibration interval is one year. Calibration should be performed by qualified personnel only.

Abnormal Conditions

Operate the instrument only as intended by the manufacturer.

If you suspect the instrument's protection has been impaired, disconnect the power cord and secure the instrument against any unintended operation.

The instrument's protection is likely to be impaired if, for example, the instrument shows visible damage or has been subjected to severe transport stresses.

Proper use of the instrument depends on careful reading of all instructions and labels.

WARNING. Any use of the instrument in a manner not specified by the manufacturer may impair the instrument's safety protection.

Power Supply Requirements

WARNING. To reduce the risk of fire and shock, ensure that the mains supply voltage fluctuations do not exceed 10% of the operating voltage range.

The AC inlet ground is connected directly to the frame of the instrument. For adequate protection against electric shock, connect to a mating outlet with a safety ground contact.

No manual voltage selection is required because the AC Adapter automatically adapts to line voltage.

Source Voltage and Frequency	100 to 240 VAC \pm 10% @ 45-66 Hz
Power Consumption	Maximum: 100W



WARNING - Electrical Shock Hazard

Only use the power cord provided with your instrument

Power the Instrument On and Off

Power On

- Insert the AC power cord into the power receptacle on the rear panel.
- Switch the mains power switch to the **On** position.
- Use the front-panel **Standby** button to power on the instrument.
- Wait until the system shows windows desktop.
- The software will start automatically.

Power Off

- Close the application in use. 
- Press the front-panel power button  to power off the instrument.

Standby Power

The Standby button does not disconnect the unit from the AC power supply. The only way to fully power down the instrument is to turn the rear Power switch to the **Off** position, then unplug the AC power cord from the outlet. We recommend unplugging the instrument if it will be unused for a long period of time.

Preface

This manual describes the installation and operation of the High Definition T3AWG3K-C Series Arbitrary Function Generators. Basic operations and concepts are presented in this manual. The easy touch screen display interface allows the user to create waveforms scenarios, with only a few screen touches.

Package Contents

The standard T3AWG3K-C Series package includes the following:

- T3AWG3252 or T3AWG3352 Arbitrary Waveform Generator equipment
- Power Cord
- Performance/Calibration Certificate
- Quick Start Guide
- CE certificate

Recommended Accessories

Item	Description
T3AWG3-8 DIG/T3AWG3-8DIG-UPGRADE	Kit for 8 Bit digital outputs
T3AWG3-8DIG-TTL	LVDS to LVTTTL digital adapter probe
T3AWG3-8DIG-SMA	LVDS to SMA digital adapter cable
T3AWG3-8DIG-MSCAB	Digital output LVDS cable
T3AWG3-RACKMOUNT	Rack Mount Kit

Mechanical Characteristics

Net Weight	6.5kg
Net Weight with Package	7 kg
Overall Dimensions	Height: 143 mm Width: 362 mm Depth: 258 mm

Key Features

The following list describes some of the key features of the High Definition T3AWG3K-C Series

- High resolution, high sampling rate: 16 Bits, 1.2GS/s
- Best output frequency vs amplitude trade-off: 350MHz, 48V voltage window
- 3 operating modes in the same instruments: Function Generator, Arbitrary Waveform Generator or Digital Pattern Generator
- Very long memory: up to 1 GSample per channel
- Mixed signal generation: 2 analog output + 8 digital outputs (with T3AWG3-8 DIG option)
- Touch screen user interface to create complex waveforms scenarios in just a few screen touches
- Large 7 inch, 1024x600 capacitive touch LCD
- Touchscreen or Keypad data entering
- Windows 10 operating system
- USB and LAN interfaces
- Compact size with the possibility of rack mounting

Instrument Set Up

Unpack the instrument and check that you received all items listed in the Package Contents paragraph.

NOTE. The instrument does not ship with a product software CD. To install the latest software release, follow the instructions in the paragraph “Obtaining the Latest Version Releases”.

Protect Your Instrument from Misuse

Check Input and Output Connectors

When connecting a cable, be sure to distinguish the input connector from the output connectors to avoid making the wrong connection.



CAUTION. Do not short output pins or apply external voltages to Output connectors. The instrument may be damaged.

CAUTION. Do not apply excessive inputs over ± 15 Vpk to Trigger Input connector. The instrument may be damaged.

Obtaining the Latest Version Releases

The latest release of the software may not be installed on your instrument. The latest version could be found on the Teledyne LeCroy website (teledynelecroy.com) in the support area.

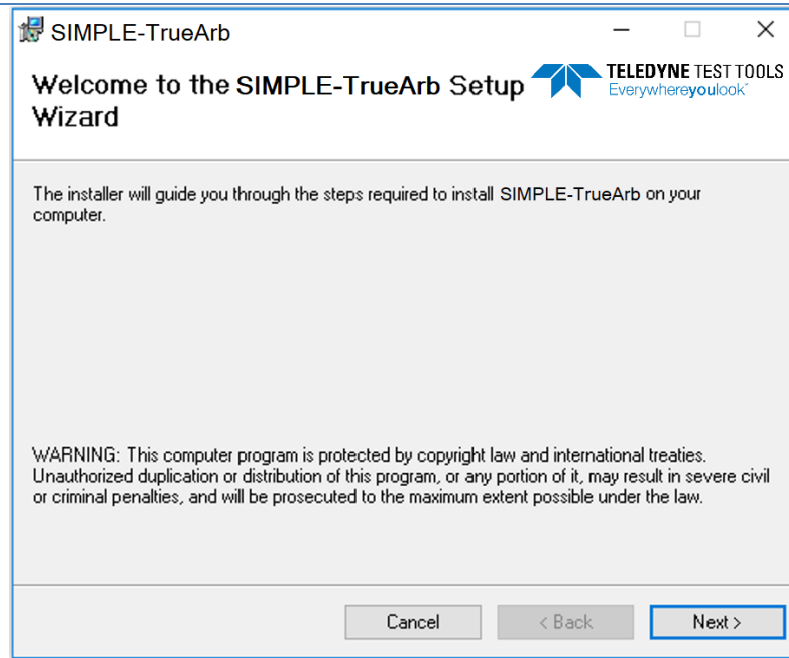
Install Simple TrueArb Application

If your instrument has already installed another version of the TrueArb application, you must first uninstall it.

1. Download the TrueArb setup package from Teledyne Lecroy website and decompress it to instrument's local disk.

DotNetFX461	25/07/2017 15:30	Cartella di file	
vcredist_x64_10	25/07/2017 15:30	Cartella di file	
vcredist_x64_14	25/07/2017 15:30	Cartella di file	
WindowsInstaller4_5	25/07/2017 15:30	Cartella di file	
AFGTouchUI_Setup	25/07/2017 15:28	Pacchetto di Wind...	26,640 KB
setup	25/07/2017 15:28	Applicazione	843 KB

2. Double click on the "setup.exe" to start the installation.
3. Follow the steps and click next to continue the procedure.



4. When the application has been installed, press the “Close” button to continue.

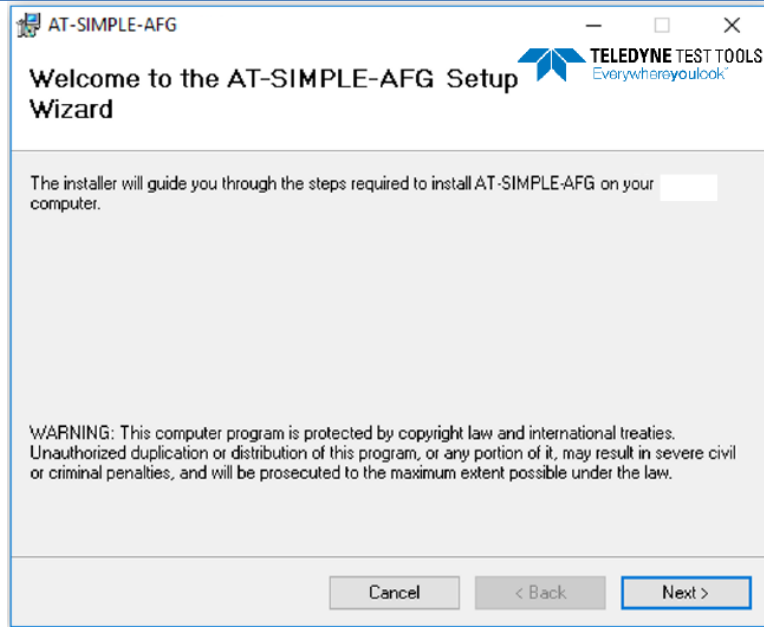
Install Simple AFG Application

If your instrument has already installed another version of the Simple AFG application, you must first uninstall it.

1. Download the AFGTouchUI setup package from Teledyne LeCroy website and decompress it to instrument's local disk.

DotNetFX461	25/07/2017 15:30	Cartella di file	
vcredist_x64_10	25/07/2017 15:30	Cartella di file	
vcredist_x64_14	25/07/2017 15:30	Cartella di file	
WindowsInstaller4_5	25/07/2017 15:30	Cartella di file	
AFGTouchUI_Setup	25/07/2017 15:28	Pacchetto di Wind...	26,640 KB
setup	25/07/2017 15:28	Applicazione	843 KB

2. Double click on the “setup.exe” to start the installation.
3. Follow the steps and click next to continue the procedure.



4. When the application has been installed, press the “Close” button to continue.

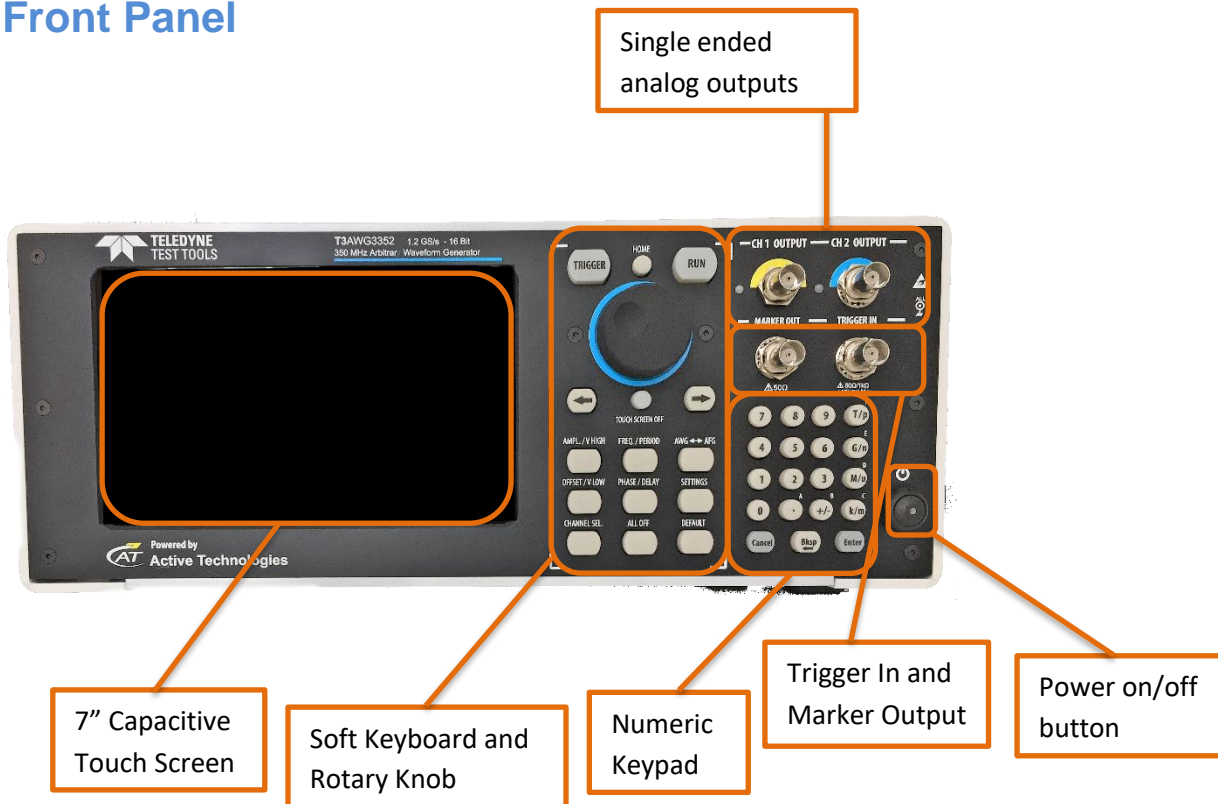
Instrument Overview

The HD T3AWG3K-C includes a 7" capacitive touch screen and AFG & AWG user interfaces based on a Microsoft Windows 10 platform.

You can control instrument operations using one or all of the following entering methods:

- Touch Screen and Front-panel soft key controls
- Keyboard and mouse

Front Panel



The Touch screen functionalities and features are described in the Application paragraphs.

Analog Outputs

The T3AWG3K-C Series instrument has two analog output channels, each one is single-ended and the connector type is a standard BNC.

Marker Output

The Marker Out is a digital output channel that generates a pulse related to the analog waveform. Its impedance is 50 Ohm and the output voltage amplitude ranges from 1 V to 2.5 V into 50 Ohm load.

The Marker Out generates a digital pulse synchronous with the waveform depending on the Run Mode. To set the Marker Out parameters refer to the Marker Settings.

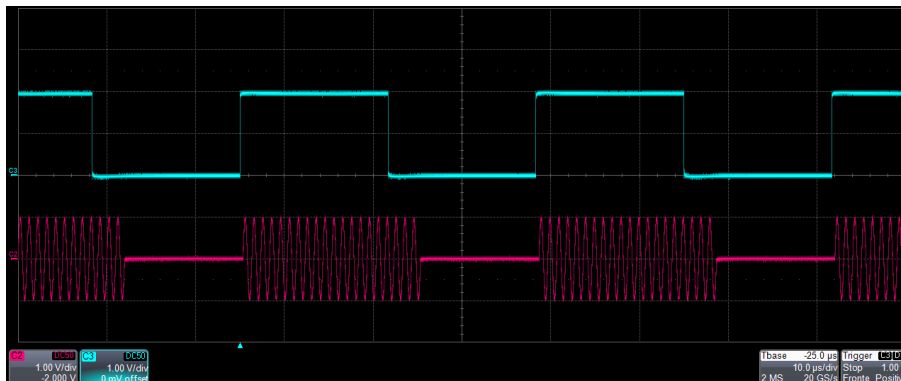
The connector type is a standard BNC.

Marker Out Specification	Value
Connector	1 BNC for each pair of channels on the Front Panel
Output impedance	50 Ω
Output level (into 50 Ω)	1 V to 2.5 V

Trigger In

The Trigger In (TRG. IN connector on the front panel) allows to control the generation by an external signal source. It has a selectable impedance of 1 kOhm or 50 Ohm. For information on how to set the trigger parameters or the Run Mode, refer to the Trigger section. In Continuous mode the Trigger In doesn't have any effect.

Trigger In Specification	Value
Connector	BNC on the Front Panel
Number of connectors	1
Input impedance	1 kΩ or 50 Ohm selectable
Slope/Polarity	Positive or negative selectable



Trigger In signal (blue, top) that starts a burst of sine waveform (red, bottom)

Soft Keyboard and Rotary Knob

Most of the buttons used with the HD T3AWG3K-C Series applications are virtual ones on the touchscreen, but a few physical buttons control basic functions, such as the setting of amplitude, offset, frequency, etc.

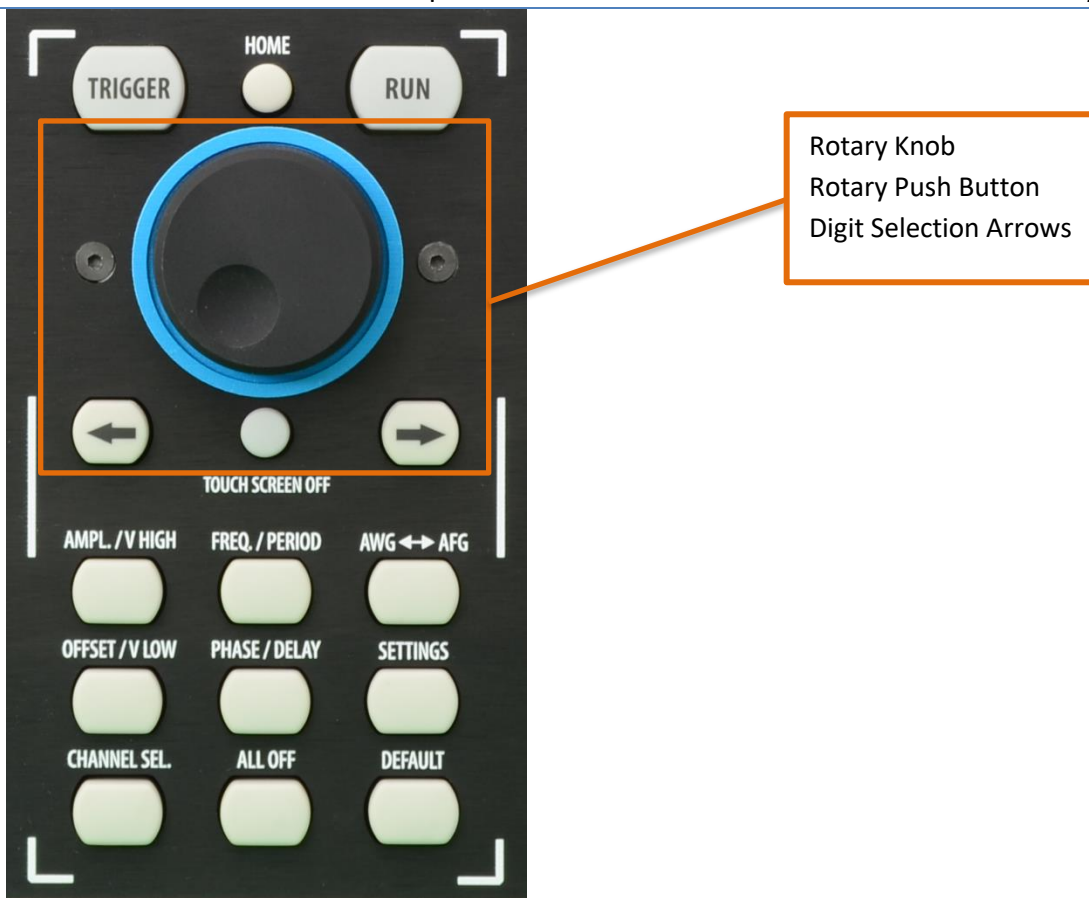
A physical numeric keypad is available on the front-panel and it can be used instead of the virtual numeric pad.

A useful central knob is available for fine-tuning and adjustments during the on the fly set up operation.

The rotary knob will change the value in continuous, analog fashion. The push button rotary knob lets you to change the value increment between Coarse and Fine adjustment.

The → key will move the selected digit to the right and the ← key will move the selected digit to the left.

You can keep pressed the rotating knob and rotate it on the right or on the left to change the Delta increment.



Button	Description
HOME	If you are in a sub-menu page, use this button to return to the main page.
TRIGGER	Use this button to send an internal trigger to the instrument.
RUN	Use this button to start and stop the signal generation. If the button is on and green the instrument is running while if it is off the instrument is stopped. Pushing the button will change the instrument state.
LEFT ARROW	Once the virtual numeric keypad will be opened, use this button to move to the left the digit selection cursor.
RIGHT ARROW	Once the virtual numeric keypad will be opened, use this button to move to the right the digit selection cursor.
TOUCH SCREEN OFF	Use this button to disable the touch screen.
AMPL./V HIGH	Use this button to set the high voltage level or the amplitude of the waveform.
FREQ/PERIOD	Use this button to set the period or the frequency of the waveform.
AWG <-> AFG	Use this button to switch between AFG mode and AWG operating mode.
OFFSET/V LOW	Use this button to set the low voltage level or the offset of the waveform.
PHASE/DELAY	N.A.
SETTINGS	Use this button to open the Settings page.
CHANNEL SEL.	Use this button to change the output selection in the user interface.
ALL OFF	Use this button to turn off all the outputs.
DEFAULT	Use this button to restore the default settings.

Numeric Keypad

The physical numeric keypad lets you to set the parameter value and their measure unit.

Once a parameter to be edited is selected by using the touch panel or the soft keyboard each number pressed in the keypad will be displayed in the display. The Bksp key is provided for deleting erroneous key presses. The [+/-] key will toggle the sign of the number being entered and may be pressed after terminating the entry. After the sign and the numeric portion of the desired value have been entered, the pressing of the multiplier button applies the parameter. The Enter button closes the virtual keyboard and will apply the entered value.



When you select a parameter on the user interface, if you press a Unit Measure Range button it will automatically update the available range allowed for that parameter.

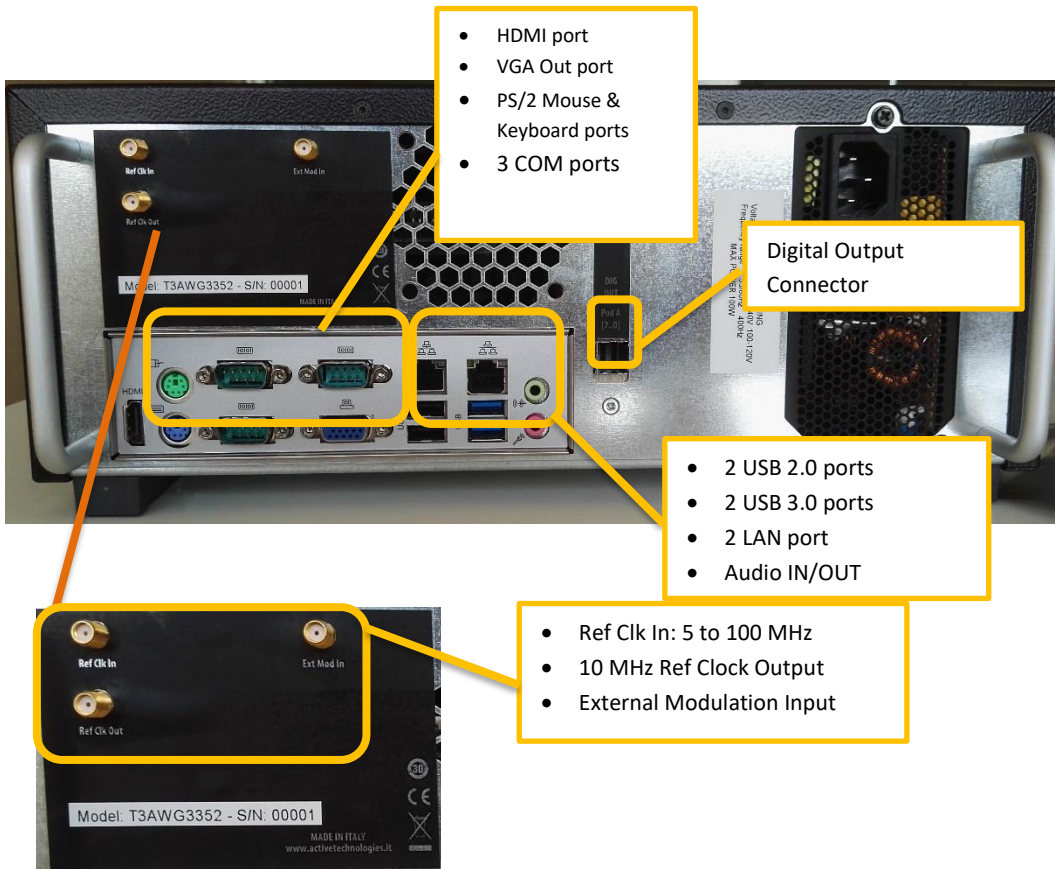
Unit Measure Range Button	Unit Measure Range
T/p	Tera / pico
G/n	Giga / nano
M/u	Mega / micro
k/m	Kilo / milli

For example, if you select the Frequency parameter and you press k/m the unit measure range will be kHz, if you press M/u it will be MHz, if you press G/n it will be GHz, if you press T/p nothing will happen because that range is not available for the selected parameter.

If both the two unit of measure of a Unit Measure Range button are available for the selected parameter (i.e. Mega and Micro), if you press the range button **M/u**, the range will switch accordingly between Mega and Micro.

Rear Panel

The callouts on this image gives the description of the corresponding connectors.



External Modulation Input Connector

Important Note: this connector is not used by the TrueArb application.

When using the Simple AFG application, the HD T3AWG3K-C has an input connector to receive an external analog signal that is used as modulating source. When the selected Run Mode is “Modulation” and the source is “External” the instrument will use this signal to modulate the carrier waveform.

For the specification please refer to the Auxiliary Channels section.

The connector type is a SMA.

Reference Clock Input Connector

The HD T3AWG3K-C can use an external clock source to generate the sampling clock frequency.

This feature allows to synchronize the generator with an external clock.

The connector type is a SMA.

Reference Clock Output Connector

This connector outputs the internal 10MHz reference clock used to synthesize the DAC sampling clock. If the clock source is internal it produces a signal at 10 MHz, if the source is external it is disabled.

The connector type is a SMA.

Digital Output Connector

Important Note: this connector is not used by the Simple AFG application.

When using the TrueArb application, the T3AWG3K-C series has optional 8-bit digital outputs, synchronized with the corresponding analog channels. The digital output pins are native LVDS standard and the maximum update rate is 1.2 Gbps. The output connector is a customized version of the Mini-SAS HD standard connector. An optional adapter cable to convert from Mini-SAS HD to SMA is available. The mixed signal generation is a great solution for digital designs and validation, system synchronization and DAC/ADC tests. The digital output connector and the digital cable should be connected as shown in the picture below.

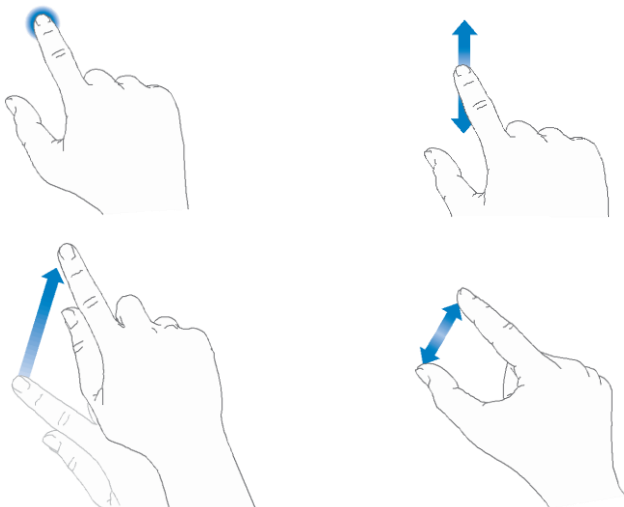


Touch UI

The User Interface is designed for touch to drive simplicity in operating with an Arbitrary Waveform Generator, by using today's modern technique, used on Tablet or smart phones, available in capacitive touch-screen displays.

All the important instrument controls and settings are always one touch away:


- swipe down gesture to change the output channel
- swipe left or right to navigate through the sequencer entries
- pinch in-out to zoom the waveform graph
- use the touch-friendly virtual numeric keyboard to modify the parameters and to enter new values on the fly



Quick Start Guide


If you are a beginner user, follow the steps below to generate your first waveform.

1. Connect the power cord and the push the front-panel on/off switch  to turn on the instrument.

2. Press the AWG/AFG button  to switch from the Simple AFG to the TrueArb application. Wait until the TrueArb application is executed and ready to accept new commands.

3. Connect the Output 1 of the instrument to the oscilloscope input with a cable, select 50 Ohm load on the oscilloscope input.

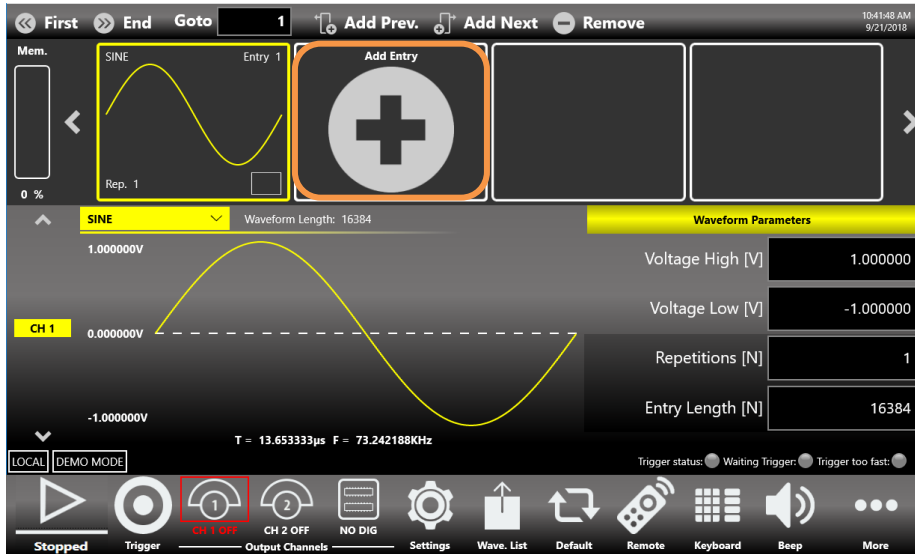


4. Touch the settings button  on the TrueArb UI to open the instrument settings window.
5. Select Dev. Settings → General page, select Continuous as Run Mode.

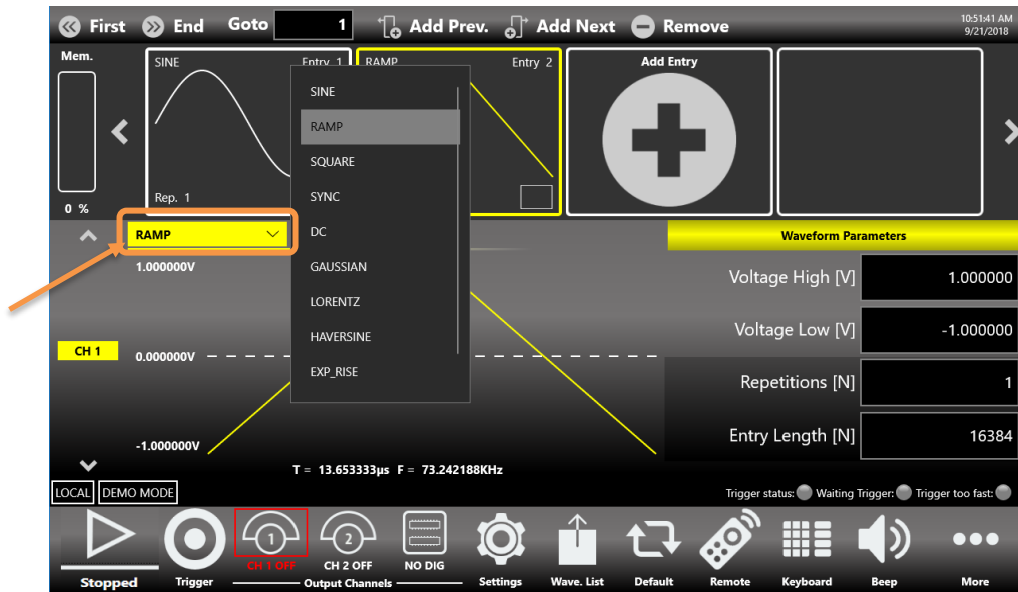


6. Touch again the setting button to close the instrument settings window.
7. By default the CH1, CH2 are disabled: it means that the outputs are mechanically disconnected from the load and the digital outputs are in OFF state.

- The waveform sequencer located at the top of the application starts by default with a single entry with a sine waveform. Touch the Add Entry button to insert a new entry into the Channel1.



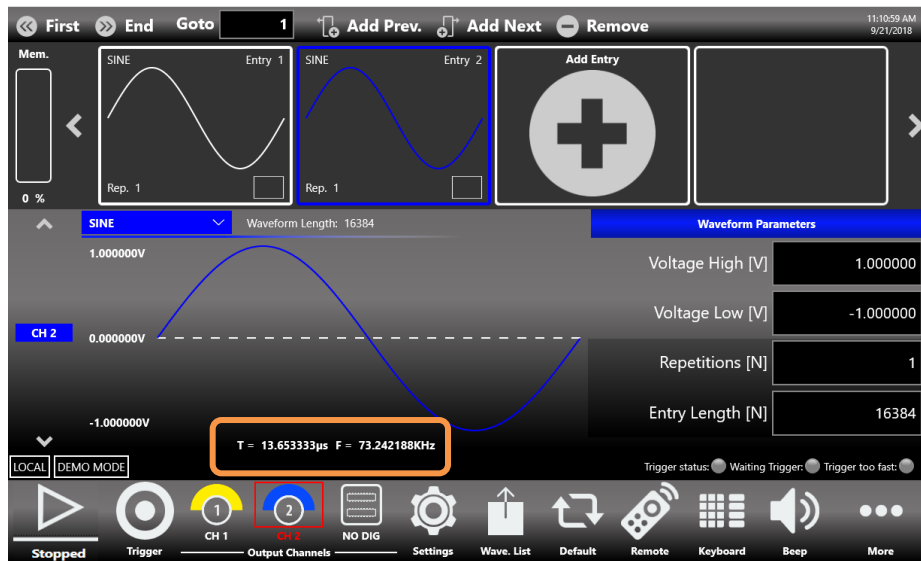
- Touch the dropdown waveform list and change it from Sine to Ramp.



- Swipe down to switch from Channel 1 to Channel 2. In the Channel 2 by default the two sequencer entries will be two Sine Waveforms.

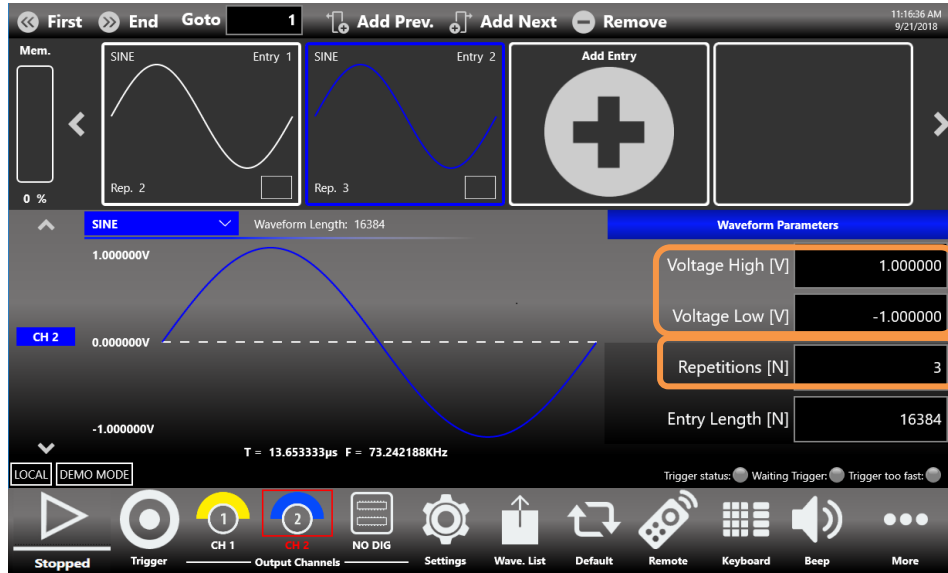



- Enable the output channels by pressing the CH1 and CH2 buttons located in the bottom of the application so that they are no longer greyed out.

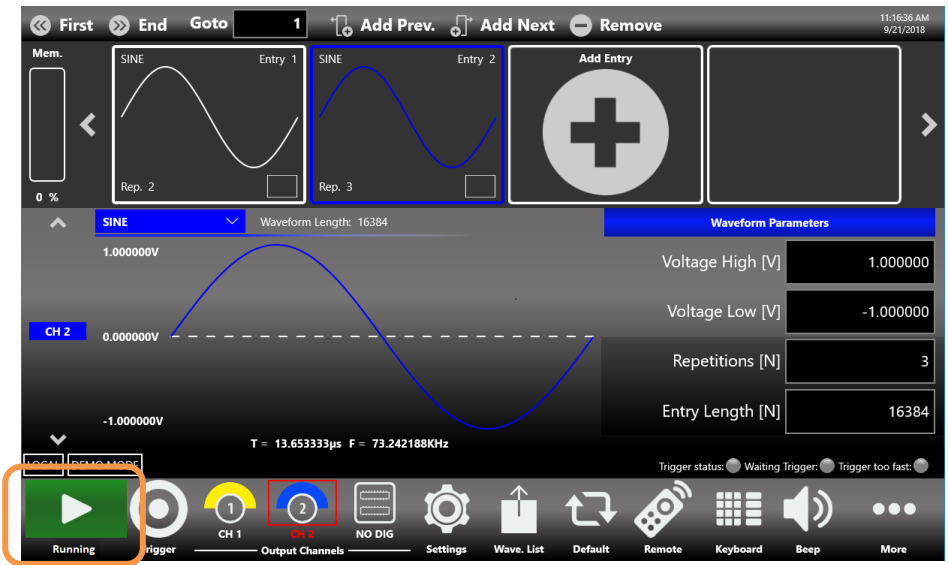


- Touch the Entry 1 and set the Repetition[N]=2 then touch the Entry 2 and set Repetition[N]=3.

13. You can change the Amplitude/Voltage High and Offset/Voltage Low for each entry.

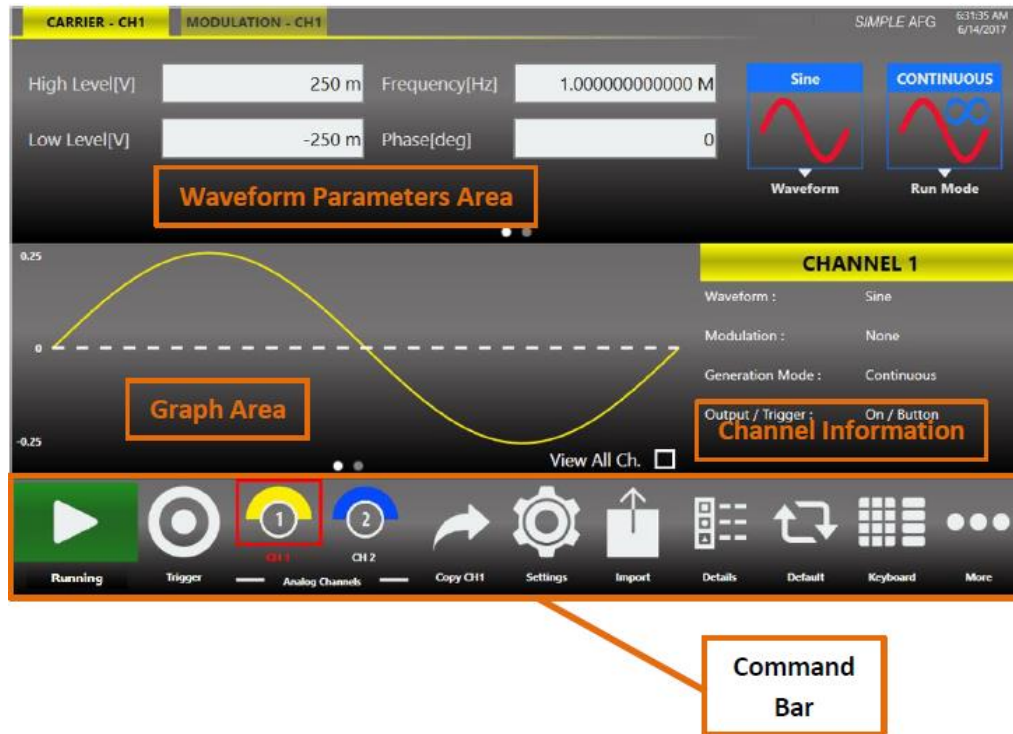


14. Press the RUN/STOP button  and check the generated waveforms on the oscilloscope: the Entry 1 should be repeated two times and the Entry 2 should be repeated three times.



AFG Application User Interface

When using the AFG application, the Simple AFG software environment provides an easy access to all instrument functionalities and parameters.



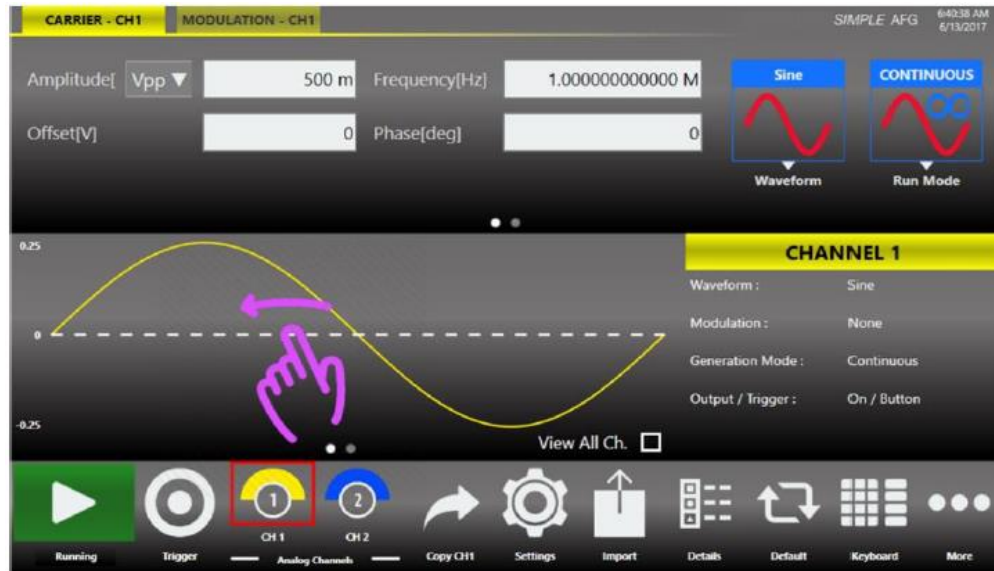
Simple AFG user interface consists of four main elements:

- **Waveform Parameters Area:** it contains all the waveform settings. It is composed by the **Carrier** tab and the **Secondary** tab.
The **Carrier** tab allows to choose the Run Mode and the Waveform type and to set its parameters.
The **Secondary** tab is used to define the **Modulation**, **Sweep** or **Burst** parameters depending on the selected Run Mode.
- **Graph Area:** shows a qualitative graphical representation of the generated waveform.
- **Channel Information:** summarizes the channel settings.
- **Command Bar:** in this bar there are elements to control the instrument operations, to modify the instrument settings and to manipulate waveforms.

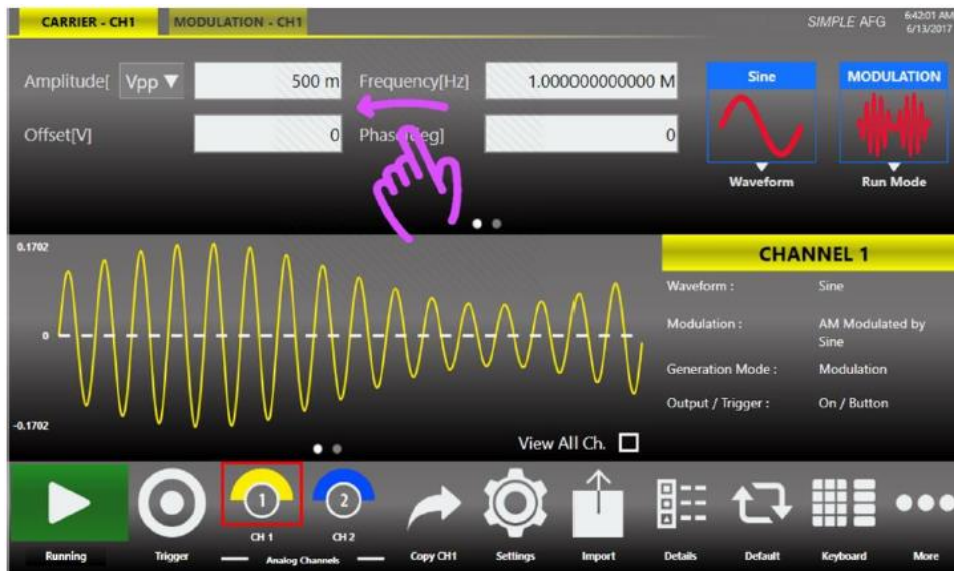
As mentioned, the display is 7" capacitive touch screen display and you can use the gestures like on a mobile phone:



If you use the Swipe left or right gesture on the Graph Area you can switch between the Output Channel 1 and Output Channel 2 page.



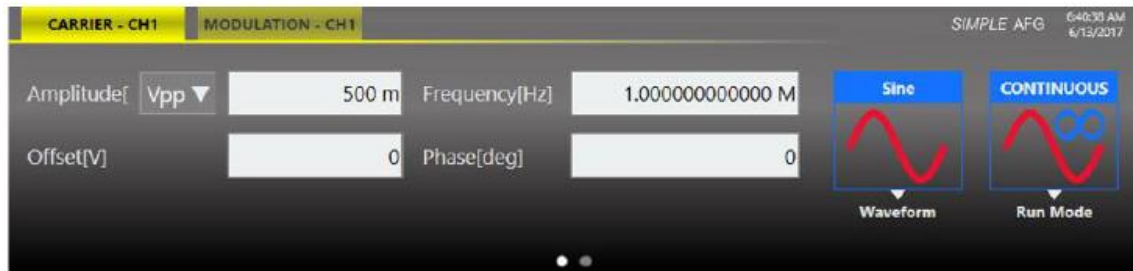
If you use the Swipe left or right gesture on the Waveform Parameter Area you can switch the page between Carrier tab and the Secondary tab. The Secondary tab can be Modulation, Sweep or Burst depending on the selected Run Mode.



Waveform Parameters Area

This section is composed by two tabs: the **Carrier** tab and the **Secondary** tab.

- In the **Carrier** tab it is possible to define the Run Mode, of the Carrier Waveform and its parameters as explained in the relative chapter.
- In the **Secondary** tab it is possible to define the parameters that describe the **Modulation, Sweep** and **Burst**. This tab changes title name and functionality depending on the selected Run Mode. For example, if the Run Mode is Sweep the Secondary tab will take the title name "Sweep" and the tab page will show the Sweep parameters. The same will happen for Modulation and Burst modes. In Continuous Run Mode the Secondary tab is not active.



You can touch the parameter area to open the Virtual numeric keypad, edit the parameter value and its measure unit.

Below there is a description of the keypad items:

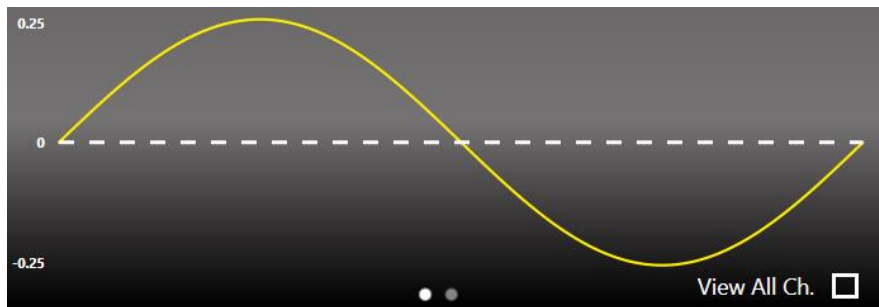


- 1. Parameter Name and Value:** This area of the virtual keyboard displays the parameter name, value and unit of measure.
- 2. Numeric Keypad:** this area contains the keys to edit the number that will be displayed in the area 1. The [+/-] key will toggle the sign of the number being entered and can be pressed at the end of the number editing. Touch the "MIN" and "MAX" buttons to set the minimum and maximum allowed value for the selected parameter. Use the "DEF" button to set the default value.
- 3. Arrows:** The left/right arrows allow to move the cursor or select the different digit position as the arrows on the front panel. The up/down arrows allow to modify the value.

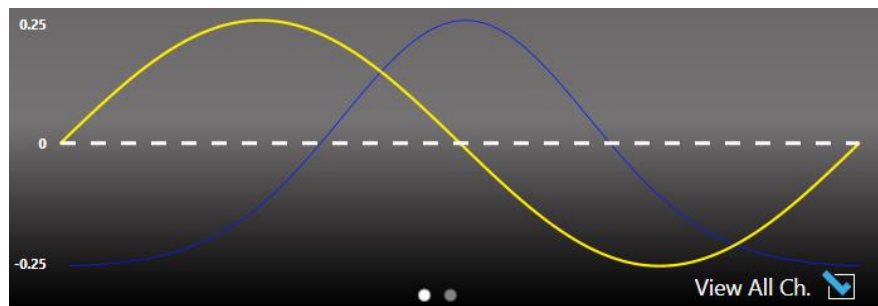
4. **Measurement Unit:** After typing the numeric value these buttons can apply a different multiplier of the measurement unit. When a measurement unit is pressed, the value is applied on the fly.
5. **Coarse / Fine:** the coarse/fine button let you to modify the granularity of the increment. You can increment or decrement the selected parameter using the UP/DOWN arrows button or rotating knob on the front panel. When Fine is selected, the increment is of 1 unit at the current cursor position. When Coarse is pressed, the Delta increment is displayed in the parameter area and the parameter value changes in steps of the selected increment. You can keep pressed the knob and rotate it on the right or on the left to change the Delta Coarse increment.
6. **Control Buttons:** The “Close” button closes the virtual keypad without applying any changes on the instrument while the “Enter” button confirms the changes and it applies them on the instrument. “Bksp” (backspace) button is provided for deleting erroneous key presses, “Delete” button deletes all digit of the textbox.
7. The **horizontal scrollbar** allows to change quickly the selected value. The position specifies the value between the allowed minimum and the maximum. The increment/decrement value entered by the rotary knob or by the scrollbar are applied to the instrument on the fly.

Graph Area

The graph area displays the Output channel waveform with a vertical legend that shows the minimum and maximum voltage levels and the offset.



Note: When **View All Ch.** is checked the graph shows all channels graphs overlapped. The vertical scale is that of the selected channel.



Channel Information

This area displays the channel name and a list of all the main current channel settings: the selected waveform type, the Modulation / Sweep / Burst mode, the Generation mode, the channel status and the Trigger Source.














Command Bar Area





The command bar contains several touch buttons to control the instrument. Below a detailed description of this bar is provided.



Command Bar Buttons	Description
	<p>Running/Stopped Button – Use this button to set the instrument in Running state (or Ready to receive a Trigger) or in the Stopped state. If the button is green the instrument is running while if it is grey the instrument is stopped. Pushing the button will change the instrument state.</p>
	<p>Trigger Button – Use this button to send an internal software trigger to the instrument. Independently from the setting this trigger is always received.</p>
	<p>Output Channels Buttons - Press CH1, CH2, to change the Output channel page. If you press again the selected Channel, you can turn OFF/ON. When a channel is OFF, it is mechanically disconnected from the output.</p>
	<p>Copy Ch1 (Ch2) Button –This button copies all the channel settings to the other channel. When you press the button a dialogue window appears to Confirm or Cancel the operation. You can copy the channel 1 into channel 2 or the channel 2 into channel 1 depending on the current selected channel.</p>
	<p>Settings Button – Use this button to open the output channel Settings and device Settings. (For more information, please refer to the relative section).</p>

 <p>Import</p>		<p>Import Button – Use this button to open the page where you can import a waveform from a file and use it as Carrier Waveform, Modulation Law or Sweep Profile. (For more information, please refer to the relative section).</p>
 <p>Details</p>		<p>Details Button – Use this button to open a page that summarizes all channel settings.</p>
 <p>Default</p>		<p>Default – Use this button to restore the default value of all parameters of the instrument.</p>
 <p>Keyboard</p>		<p>Numeric Keyboard Button – Use this button to enable or disable the virtual numeric keyboard.</p>
 <p>More</p>		<p>More Button – Use this button to have access to other instrument features. These buttons are explained in the following table.</p>

More Button Menu Items	Description
<p>Exit</p> 	<p>Exit Button – Press this button to close the application.</p>
<p>TrueArb</p> 	<p>Change Application – Use this button to switch from AFG to TrueARB application.</p>
<p>Minimize</p> 	<p>Minimize Button – press this button to minimize the application screen; in this way you can access to Windows OS.</p>
<p>Load Settings</p> 	<p>Load Setting Button – Use this button to load user instrument settings from a file (called Memory). (For more information, please refer to the relative section).</p>
<p>Save Settings</p> 	<p>Save Setting Button – Use this button to store the instrument settings to a file (called Memory). (For more information, please refer to the relative section).</p>
<p>Windows Keyboard</p> 	<p>Windows Keyboard Button – Use this button to Enable or Disable the alphanumeric keyboard.</p>

	Remote Control Button – Use this button to open the SCPI server page. In that page you can enable or disable the SCPI server and see the sequence of commands sent to the instrument and its response.
	Beep Button – Use this button to enable or disable the beep audio signal when the user touches a button.
	About Button – Use this button to check the credits, the software, the firmware release number and the instrument serial number.
	Help Button – Use this button to open the User Manual.

Input / Output Channel

The HD T3AWG3K-C has two independent analog channels. Each channel is a single-ended output and it is provided on a BNC connector located on the front instrument panel (CH1 OUTPUT and CH2 OUTPUT).

The Marker Out is a digital output signal provided on a BNC connector located on the front instrument panel (MARKER OUT). It is possible to choose in the software the channel it is related to (CH1/CH2).

The Trigger In is an input signal provided on a BNC connector located on the front instrument panel (TRIGGER IN).

The External Modulation Input is an input signal provided on a SMA connector located on the rear instrument panel (Ext. Mod. In).

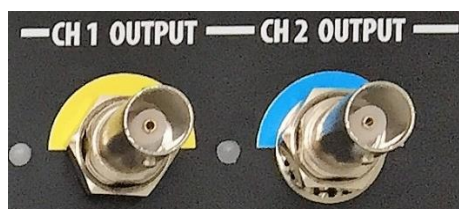
The Trigger In and the External Modulation Input signals are common input sources for both the instrument channels.

Analog Output Channel

The term Output Channel, as used in this user manual, refers to the analog signal provided on the BNC output connector located on the front instrument panel.

For some parameters the Simple AFG application supports different input formats. For example, it is possible to specify the frequency of a waveform or alternatively it is possible to specify the corresponding time period. It is possible to switch between two different parameter formats by just touching the parameter label.

Note that the input format is the same for all channels, so if the High/ Low Level format is selected for channel 1, the channel 2 will use that format as well.



Main Channel Vertical Parameters

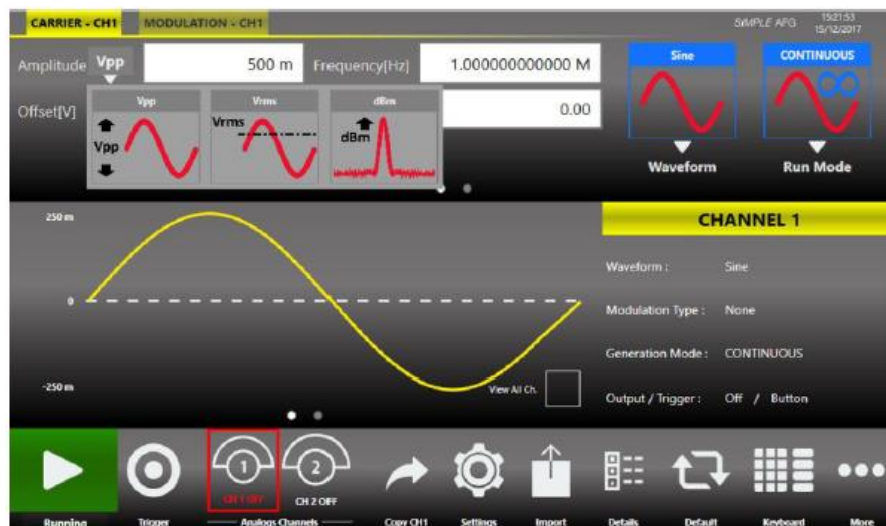
The Simple AFG application provides the control of the vertical (voltage) parameters of the Output channel in the format **Amplitude[Vpp] / Offset[V]** or in the format **Voltage High[V] / Voltage Low[V]**. By touching the labels, you can switch between the two formats.

The output signal levels displayed by the Simple AFG UI text are calculated for the specified source and load impedances that by default are 50 Ohm. To change the expected load and source impedance please refer to the Channel Settings.

Amplitude

It defines the difference between the maximum value and the minimum value of the waveform expressed in Volts except for functions non-symmetrical with respect to 0 V, such as Sinc and Gaussian, where the amplitude may have a different meaning depending on the waveform type.

The amplitude can be represented in three different formats that can be selected by opening the menu beside the amplitude label:

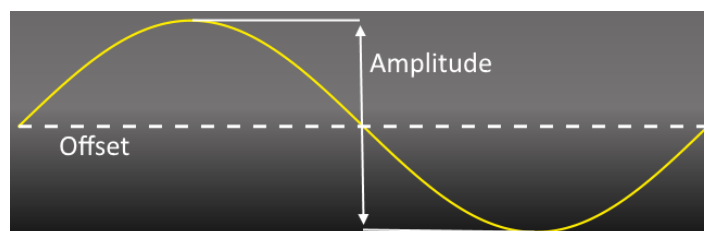


- **Vpp (Peak to Peak Voltage):** it is the difference between the highest and lowest level of the waveform.
- **Vrms (Root Mean Square Voltage):** it is the rms value of the waveform.
- **dBm:** it is the power transferred to the load expressed in dBmW (this representation is available only for sine wave). Its value takes in account the Load set in Channel Settings.

Note: The Vrms and the dBm set in the textbox are referred only to the waveforms amplitude. They don't take into consideration the Offset of the waveform.

Offset[V]

It defines the voltage of $(V_{max} + V_{min})/2$ expressed in Volts where V_{max} is the maximum level of the waveform and V_{min} is the minimum level of the waveform

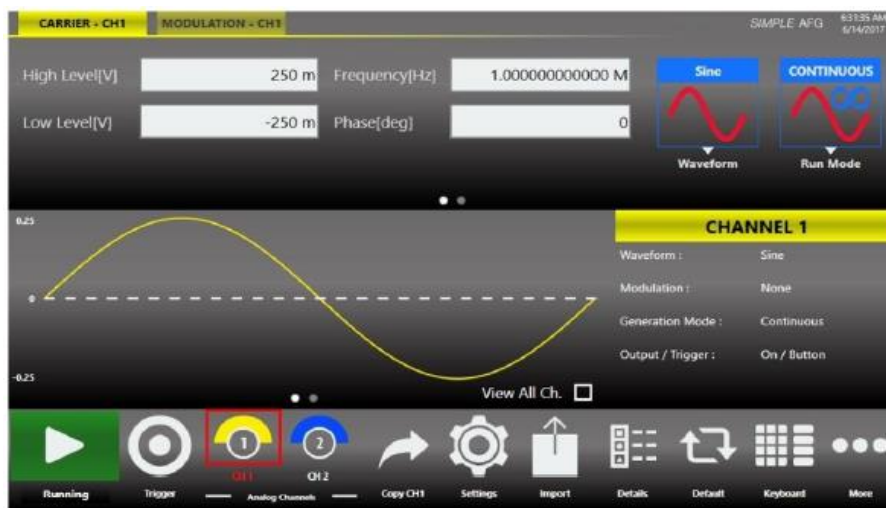
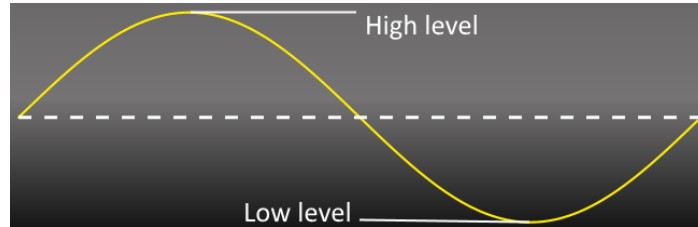


High Level [V]

It defines the maximum level of the waveform expressed in Volts

Low Level [V]

It defines the minimum level of the waveform expressed in Volts



These parameters are available for all function except the DC level that is identified only by the Offset parameter.

Main Channels Horizontal Parameter

The horizontal parameters control the frequency, the phase and the shape of the waveform. The set of available parameters depends on the selected waveform.

Frequency [Hz] / Period [s]

This parameter defines the frequency or the period of the generated waveform. This parameter is available for all the functions except DC Level and Noise.

In sweep run mode it is replaced by the Phase[deg] or Start Freq/Stop Freq[Hz] parameters.

Touching the parameter label the format switches between Frequency and Period.

Phase [deg] / Delay [s]

It controls the initial phase of the waveform. This control is available for all functions except DC Level and Noise.

For all waveforms it is displayed as "Phase" except for the Pulse function that it is displayed as Delay [s].

Symmetry [%]

This parameter is defined only for the Ramp function. It represents the percentage of the cycle in which the ramp function is rising.

Width [s] / Duty Cycle [%]

It defines the duration of the High-level part of the Pulse function. The width is defined as Full Width at Half Maximum (FWHM) that means the time from the medium of the leading edge to the medium of the trailing edge. The duty cycle is the percentage value of the width compared to the period.

Touching the label, you can change the format between the Width (absolute) and Duty Cycle.

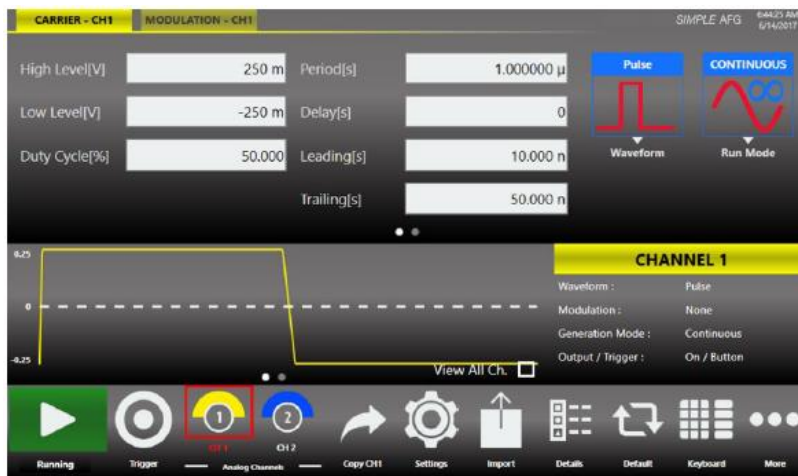
Leading – Trailing Edge [s]

In the Pulse function, it defines the transition time between Low level and High level for the Leading Edge and between High level and Low level for the Trailing Edge.

Note: the values refer to the rise and fall time between the 10% and the 90% of the pulse amplitude. The 0% to 100% transitions will be longer than the set values anyway the graph represents the entered value as the 0% to 100% transition time.

Note: Using the Pulse Waveform the following constraints must be met:

- $Leading\ Edge + Trailing\ Edge < Period$
- $Width < Period$



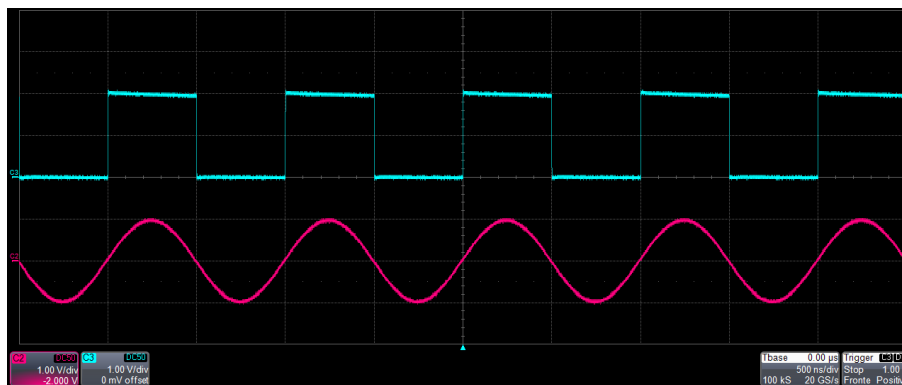
Auxiliary Channels



Marker Out

The Marker Out generates a digital pulse synchronous with the waveform or with the modulating function depending on the Run Mode. To set the Marker Out parameters refer to the Channel Settings.

Marker Out Specification	Value
Connector	1 BNC per pair of channels on the Front Panel
Output impedance	50 Ω
Output level (into 50 Ω)	1 V to 2.5 V

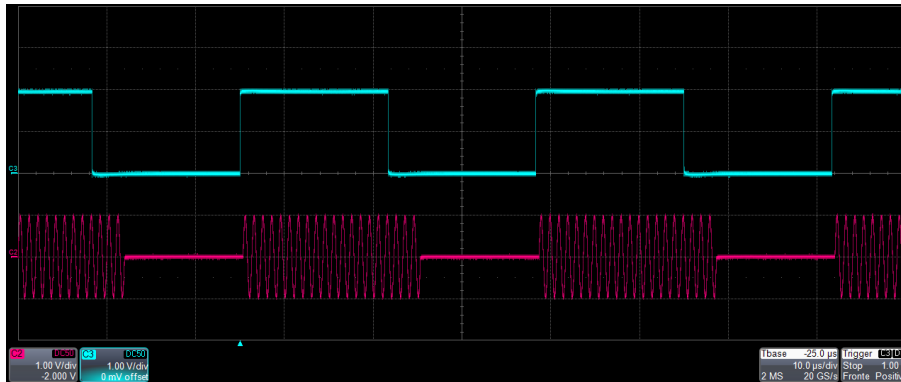


Marker out (blue, top) synchronous with the analog signal (red, bottom)

Trigger In

The TRIGGER IN (TRG. IN connector on the front panel) allows to control the signal generation when a channel is in Burst Run Mode or in Sweep Run Mode. Refer to the chapters about the Device Settings to know how to define the trigger parameters or the Run Mode. In Continuous and Modulation Run Modes the Trigger In doesn’t have any effects.

Trigger In Specification	Value
Connector	1 BNC on the Front Panel
Input impedance	1 k Ω or 50 Ohm selectable
Slope/Polarity	Positive or negative selectable



Trigger In signal (blue, top) that starts a burst of sine waveform (red, bottom)

Reference Clock Input

When the “Clock Source” is set on “External” in the “Device Settings” page, the internal clock synthesizer uses the signal from “Reference Clock Input” SMA connector to generate the DAC sampling clock signal.

Reference Clock Input	Value
Connector type	1 SMA on the Rear Panel
Input impedance	50 Ohm, AC coupled
Input Frequency range	5 MHz to 100 MHz

External Modulation Input

The HD T3AWG3K-C can accept the modulating signal from an external source, through the External Modulation Input SMA connectors located on the Rear Panel.

External Modulating Input	Description
Connector Type	1 SMA on Rear Panel for all channels
Input Impedance	10 kOhm
Input Voltage Range	± 0.5 V for all modulations

Reference Clock Output

This connector outputs the internal 10MHz reference clock used to synthesize the DAC sampling clock. If the clock source is internal it produces a signal at 10 MHz, if the source is external it is disabled.

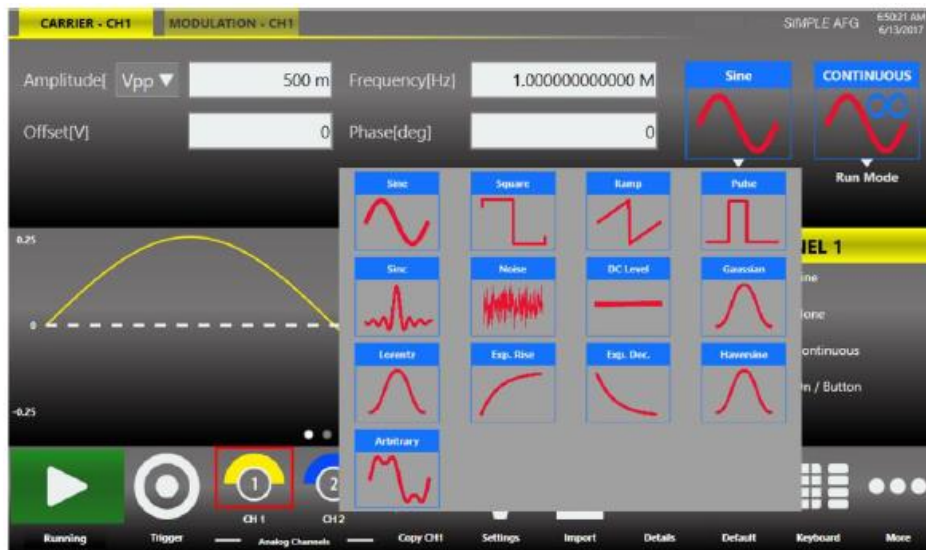
The connector type is a SMA.

Reference Clock Input	Value
Connector	SMA on the Rear Panel
Number of connectors	one for all analog output
Output impedance	50 Ohm, AC coupled

Predefined Waveforms

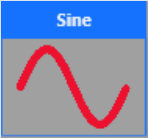
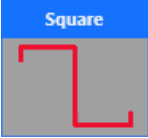

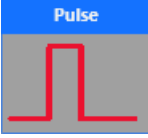

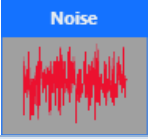

The Simple AFG application provides 12 predefined functions each of them described by its own set of parameters. It is also available the **Arbitrary** waveform that allow to load a waveform from a file or from remote.




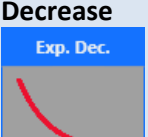


Touching the “Waveform” button on the “Carrier” a dropdown menu opens where it is possible to select a waveform to use as carrier.



List and Parameters of Predefined Waveforms

The following table shows the available waveforms, the parameters that you can change for each one and the possible combination of run mode and waveforms. The Continuous Run Mode has been omitted from the table because it is available for all waveforms.

Waveform	Frequency Range	Parameters	AM, FM, PM, PSK, FSK	PWM	Sweep	Burst
Sine 	T3AWG3352: 1 uHz÷70 MHz ≤ 12 Vpp 70 MHz÷120 MHz ≤ 9 Vpp 120 MHz÷180 MHz ≤ 6 Vpp 120 MHz÷350 MHz ≤ 3 Vpp T3AWG3252: 1 uHz÷70 MHz ≤ 12 Vpp 70 MHz÷120 MHz ≤ 9 Vpp 120 MHz÷180 MHz ≤ 6 Vpp 120 MHz÷250 MHz ≤ 3 Vpp	Amplitude, Offset, Frequency, Phase	√		√	√
Square 	T3AWG3352: 1 uHz÷40 Mhz ≤ 12Vpp 40 Mhz÷80 Mhz ≤ 10Vpp 80 Mhz÷150 Mhz ≤ 7Vpp T3AWG3252: 1 uHz÷40 Mhz ≤ 12Vpp 40 Mhz÷80 Mhz ≤ 10Vpp 80 Mhz÷120 Mhz ≤ 7Vpp	Amplitude, Offset, Frequency, Phase	√		√	√
Ramp 	T3AWG3352: 1 uHz÷15 Mhz T3AWG3252: 1 uHz÷10 Mhz	Amplitude, Offset, Frequency, Phase, Symmetry	√		√	√
Pulse 	T3AWG3352: 1 uHz÷5 Mhz ≤ 12Vpp 5 Mhz÷60 Mhz ≤ 10Vpp 60 Mhz÷150 Mhz ≤ 7 Vpp T3AWG3252: 1 uHz÷5 Mhz ≤ 12Vpp 5 Mhz÷60 Mhz ≤ 10Vpp 60 Mhz÷120 Mhz ≤ 7 Vpp	Amplitude, Offset, Frequency, Phase, Duty Cycle, Leading Edge, Trailing Edge		√		√
Sinc 	T3AWG3352: 1 uHz÷15 Mhz T3AWG3252: 1 uHz÷10 Mhz	Amplitude, Offset, Frequency, Phase	√		√	√
Noise 		Amplitude, Offset				√
DC Level 		Offset				

Waveform	Frequency Range	Parameters	AM, FM, PM, PSK, FSK	PWM	Sweep	Burst
Gaussian 	T3AWG3352: 1 uHz÷30 Mhz T3AWG3252: 1 uHz÷20 Mhz	Amplitude, Offset, Frequency, Phase	✓		✓	✓
Lorentz 	T3AWG3352: 1 uHz÷30 Mhz T3AWG3252: 1 uHz÷20 Mhz	Amplitude, Offset, Frequency, Phase	✓		✓	✓
Exponential Rise 	T3AWG3352: 1 uHz÷15 Mhz T3AWG3252: 1 uHz÷10 Mhz	Amplitude, Offset, Frequency, Phase	✓		✓	✓
Exponential Decrease 	T3AWG3352: 1 uHz÷15 Mhz T3AWG3252: 1 uHz÷10 Mhz	Amplitude, Offset, Frequency, Phase	✓		✓	✓
Haversine 	T3AWG3352: 1 uHz÷30 Mhz T3AWG-3252: 1 uHz÷20 Mhz	Amplitude, Offset, Frequency, Phase	✓		✓	✓
Arbitrary 	T3AWG3352: 1 uHz÷200 MHz T3AWG3252: 1 uHz÷140 MHz	Amplitude, Offset, Frequency, Phase	✓		✓	✓

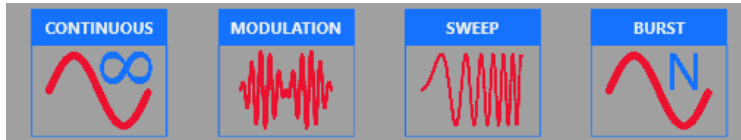


You can assign the “**Arbitrary**” waveform using the “**Import**” button of the command bar. For more information refer to the “Import from File” section. By default, the “Arbitrary” waveform is a cosine function.

Note: When Arbitrary waveform is selected the amplitude and offset of the original waveform are lost because the waveform is normalized. The amplitude and offset of the normalized waveform can be modified as for any predefined waveforms.

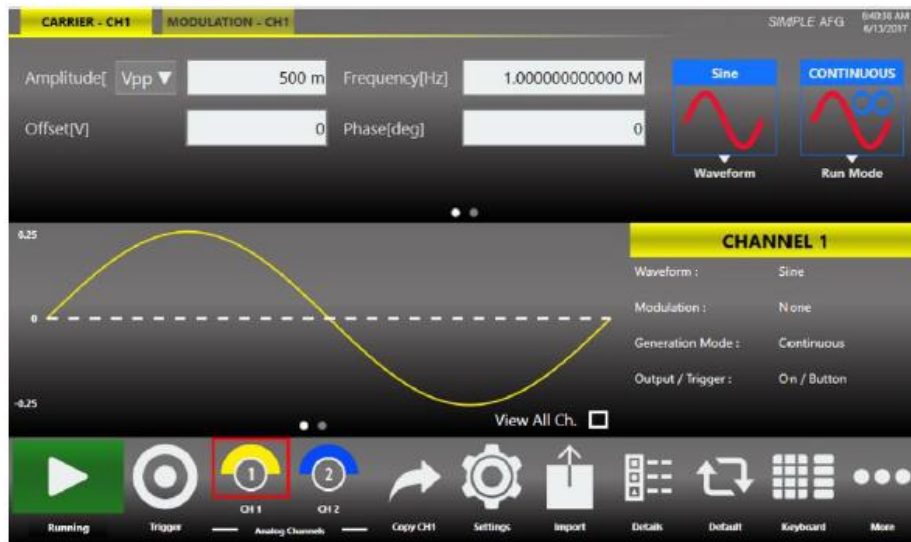
Run Mode

On the Carrier tab pressing the “Run Mode” button a menu opens showing all possible choices for the Run Mode. If “Modulation”, “Sweep” or “Burst” is selected the software moves directly on the secondary tab that takes the name of the selected Run Mode.



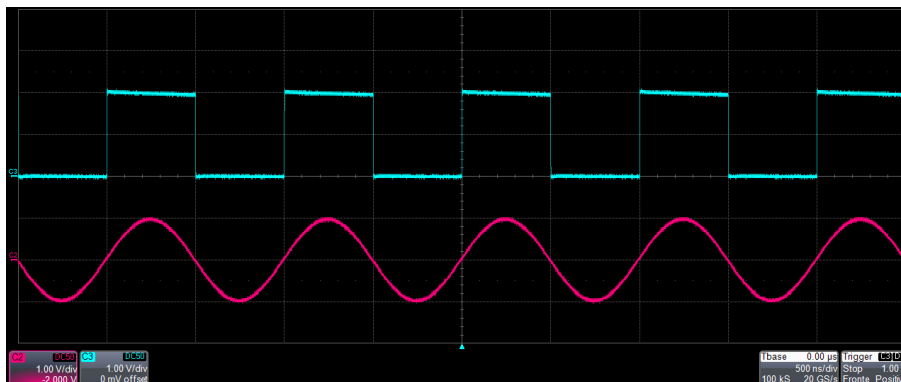
Continuous

In the Continuous mode when the Run/Stop button is pressed the waveform is reproduced continuously until the Run/Stop button is pressed again or Waveform / Run Mode is changed.



Marker Out Behavior in Continuous Run Mode

In Continuous mode, the **Marker Out** generates a pulse with a duty cycle of 50% at the beginning of each period. The Marker have the same frequency of the carrier waveform until it is below 75 MHz. Over 75MHz the Marker Out frequency is divided by 2 from 75MHz up to 150MHz, by 4 from 150MHz up to 300MHz and by 8 from 300MHz up to 350MHz.

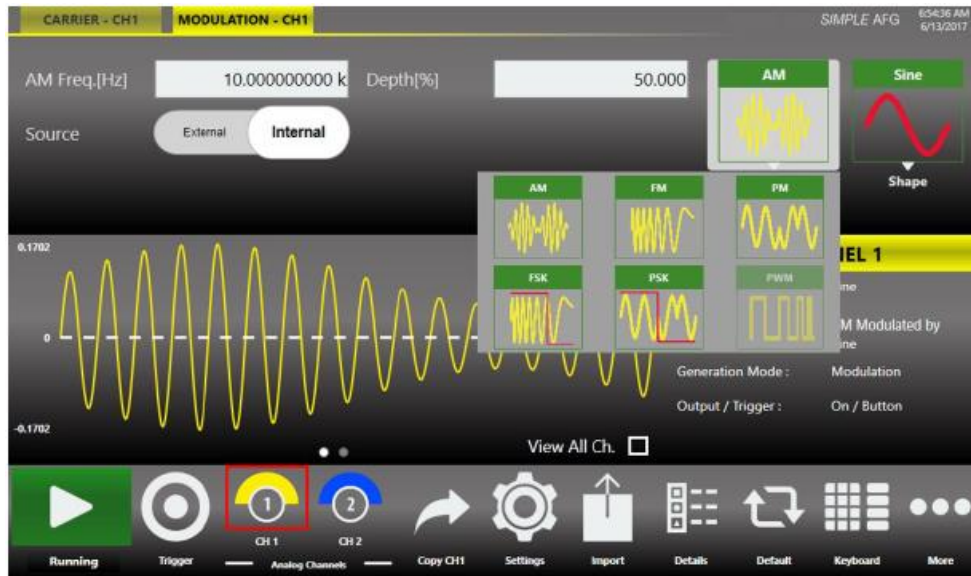


Marker out (blue, top) synchronous with the analog signal (red, bottom)

Modulation

In this Run Mode, it is possible to modulate a carrier waveform with a modulation law that can be another waveform or an external signal. All waveforms except Noise and DC level support the Modulation Run Mode.

Touching the “Type” button the modulation type menu opens as shown in the picture below.



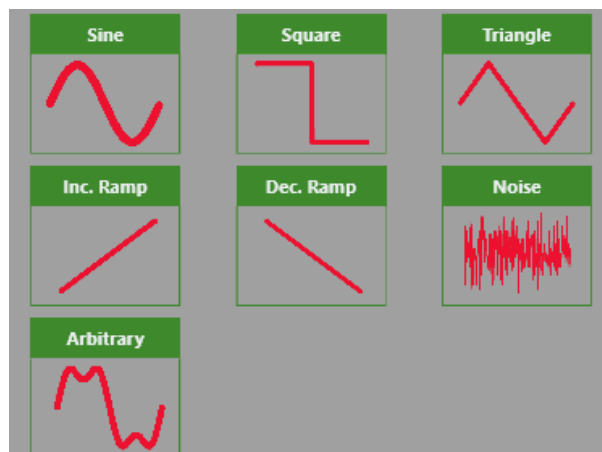
The modulation types are:

- **Amplitude Modulation (AM)**
- **Frequency Modulation (FM)**
- **Phase Modulation (PM)**
- **Frequency Shift Keying (FSK)**
- **Phase Shift Keying (PSK)**
- **Pulse Width Modulation (PWM)**

The PWM modulation is the only modulation supported by the Pulse waveform.

The types of modulation are explained in detail in the following sections of this chapter.

Touching the “Shape” button the modulation type menu opens. The possibility to choose the shape is only available for AM, FM, PM and PWM modulations.



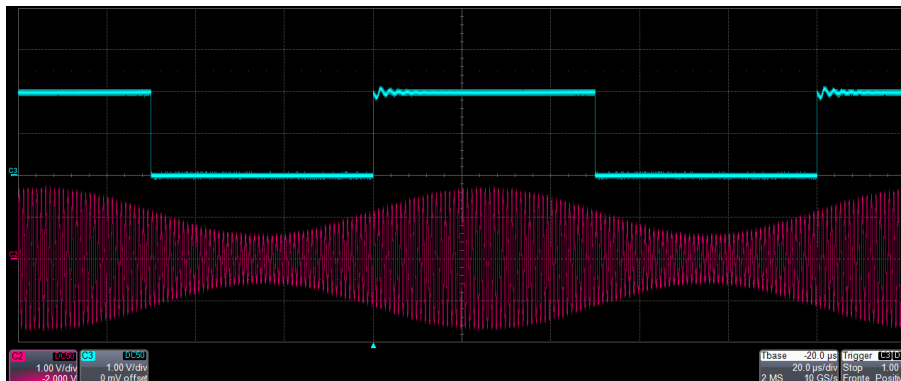
The modulation **Shapes** (when available) can be:

- **Sine**
- **Square**
- **Triangle**
- **Increase Ramp**
- **Decrease Ramp**
- **Noise**
- **Arbitrary**: it allows to load a Modulating Waveform from file. For the file specification please refer to the “Import from File” section. By default, the “Arbitrary” waveform is a cosine function.

Marker Out Behaviour in Modulation Run Mode

If the modulating source is **Internal**, the **Marker Out** generates a square wave synchronous with the modulating waveform. The leading edge of this pulse is positioned at the beginning of the modulating waveform.

If the modulating source is **External**, the **Marker Out** is disabled.



Marker out (blue, top) synchronous with the modulating waveform of the AM (red, bottom)

Modulation General Parameter

- **Frequency [Hz]**: it defines the modulating frequency. It can vary between 500 uHz and 50 MHz.
- **Source**: the source can be **Internal** or **External**. If **Internal** is selected it is possible to select a Shape. If **External** is selected the instrument accepts a modulating signal from the **Ext. Mod.** SMA connector.

Modulation Types and associated parameters

- **Amplitude Modulation (AM)**: the amplitude of the carrier waveform is modulated following the modulating shape. It is available for all functions except for the Pulse.
The parameter **Depth [%]** controls the modulation depth between 0% and 120%.
- **Frequency Modulation (FM)**: the frequency of the carrier waveform is modulated following the modulating shape, it is available for all functions except for the Pulse.
The parameter **Deviation [Hz]** defines the deviation of frequency with respect to the carrier frequency. The Deviation is between 0 Hz and the maximum frequency that satisfies the following 2 relationships:
 - $Carrier\ Frequency - Deviation > 0\ Hz$
 - $Carrier\ Frequency + Deviation \leq Maximum\ Frequency$

Where the Maximum Frequency depends on the selected carrier. To know the maximum allowed frequency for each function, please refer to the Predefined Waveforms chapter.

For example, for a sine function at 200 MHz the Deviation must be below 200 MHz.

- **Phase Modulation (PM):** the phase of the carrier waveform is modulated following the modulating shape. It is available for all functions except for the Pulse.

The parameter **Deviation [deg]** set the maximum phase deviation of the carrier waveform. It can vary in the range 0 to 360 degrees.

- **Frequency Shift Keying (FSK):** this modulation is a 2 level FSK. The carrier frequency switches between the initial carrier frequency and the initial carrier frequency + **Hop Frequency [Hz]**. It is available for all functions except for the Pulse.

Note that the Hop Frequency can be negative and it must satisfy the following conditions:

- $Carrier\ Frequency - Hop\ Frequency > 0\ Hz$
- $Carrier\ Frequency + Hop\ Frequency \leq Maximum\ Frequency$

Where the Maximum Frequency depends on the selected carrier. To know the maximum allowed frequency for each function, please refer to the Predefined Waveforms chapter.

- **Phase Shift Keying (PSK):** this type of modulation is a 2 level PSK. The carrier phase is shifted by the value of **Hop Phase [deg]**. It is available for all functions except for the Pulse. The hop phase is between 0 and 360 deg.
- **Pulse Width Modulation (PWM):** this modulation is available only for the Pulse waveform. It modulates the width of the Pulse of the quantity defined in the **Deviation [%]** parameter that defines the maximum increase and decrease of the Duty Cycle percentage. The deviation must meet the following conditions:

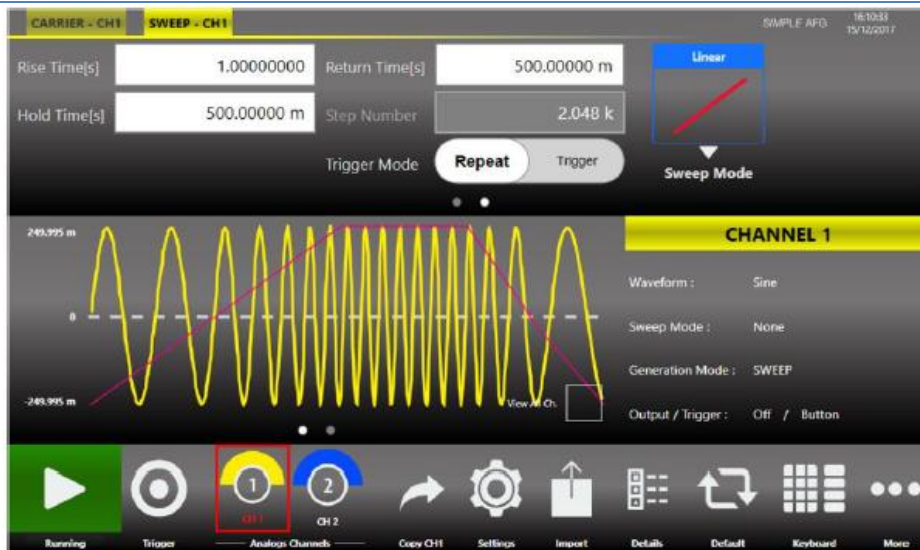
- $deviation\ [\%] \leq duty\ cycle\ [\%] - \frac{Leading\ Edge[s]}{0.8} * \frac{100[\%]}{Period\ [s]} - \epsilon$
- $deviation\ [\%] \leq 100[\%] - duty\ cycle\ [\%] - \frac{Trailing\ Edge[s]}{0.8} * \frac{100[\%]}{Period\ [s]} - \epsilon$

Where ϵ is a small margin to avoid that the duty cycle reaches the 0 % or the 100 % and the factor “0.8” take in account that the edges are defined as 10-90%.

Sweep

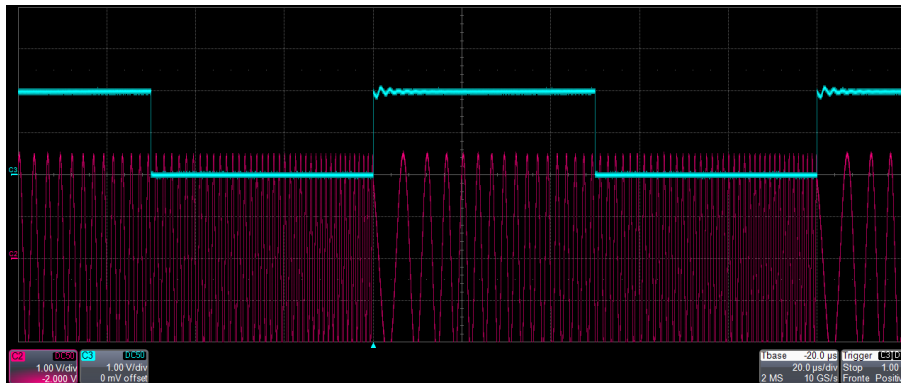
The Sweep mode varies the waveform frequency following a law that can be **Linear**, **Logarithm**, **Upstair** or **User Defined**. The **User Defined** selection gives the possibility to load the sweep profile from a file.

The Sweep is available for all function except for Pulse, Noise and DC level.



Marker Out behaviour in Sweep Run Mode

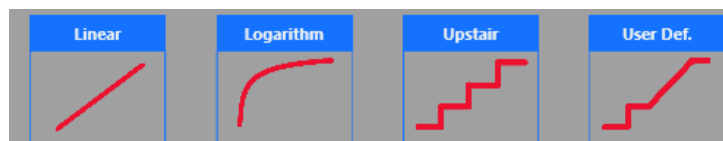
In this Run Mode the **Marker Out** generates a square wave with the rising edge placed at the beginning of each sweep.



Marker out (blue, top) synchronous with the sweep (red, bottom)

Sweep Mode

Touching the Sweep Mode button a menu opens that gives the possibility to choose a sweep profile among the following:



- **Linear:** the frequency increases and decreases linearly.
 - **Logarithm:** the frequency increases and decreases following a logarithmic function.
 - **Upstair:** the frequency varies step by step. The number of steps is selectable through the **Step Number** parameter.
 - **User Defined:** allows to load a sweep profile from a file. For the file specification please refer to the "Import from File" section. By default, the "Arbitrary" waveform is a cosine function.
- Note:** the time to execute the sweep is the sum of Sweep Time, Hold and Return. When the User Defined mode is selected these 3 parameters are not meaningful.

Parameters

- **Rise Time [s]:** it controls the time to increase the frequency from the Start Frequency up to the Stop Frequency.
- **Hold [s]:** it is the time that the frequency keeps the Stop Frequency.
- **Return [s]:** it controls the time to decrease the frequency from the Stop Frequency back to the Start Frequency.

Note: the time parameters must meet the following conditions:

$$\text{Rise Time} + \text{Hold} + \text{Return} \leq 2000 \text{ s}$$

- **Step Number:** it selects the number of frequency steps of the Upstair Sweep mode.
- **Start Frequency [Hz]:** it selects the initial sweep frequency.
- **Stop Frequency [Hz]:** it selects the final sweep frequency.

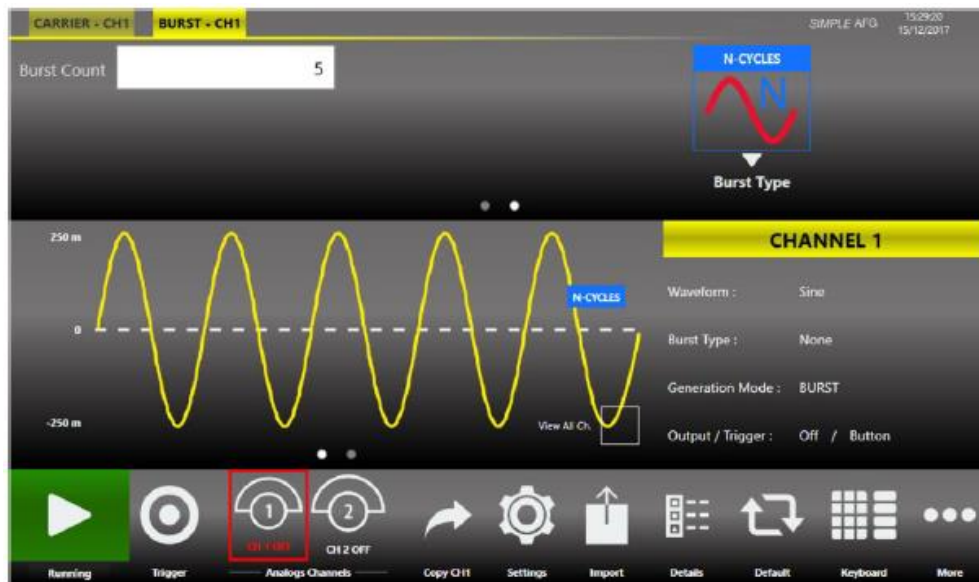
Note: The **Start Frequency [Hz]** and the **Stop Frequency [Hz]** are defined in the Carrier tab.

Sweep Trigger Mode

- **Repeat:** the instrument starts when the Run/Stop button is pressed and repeats the sweep continuously.
- **Trigger:** When the Run/Stop button is pressed the instrument waits for a Trigger signal. When the trigger is detected it generates the sweep profile then stops waiting for a new Trigger. During the wait for a Trigger the instruments generates the waveform with its frequency equal to the start frequency.

Burst

In Burst mode a waveform is repeated a predefined number of times or until the Trigger signal is at High Level depending on the selected Burst Type. This Run Mode is available for all waveforms except the DC level.

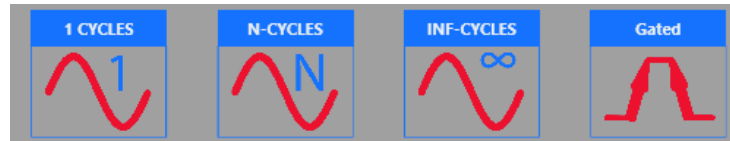


Marker Out behaviour in Burst Run Mode

In this Run Mode, the **Marker Out** generates a pulse with a duration equal to the duration of the burst sequence or to the gate time duration (time when the Trigger signal is at High level).

Burst Mode

The burst mode allows to define the behaviour of the instrument after the Trigger reception. Touching the “Mode” button the following menu opens and it is possible to select the burst type.



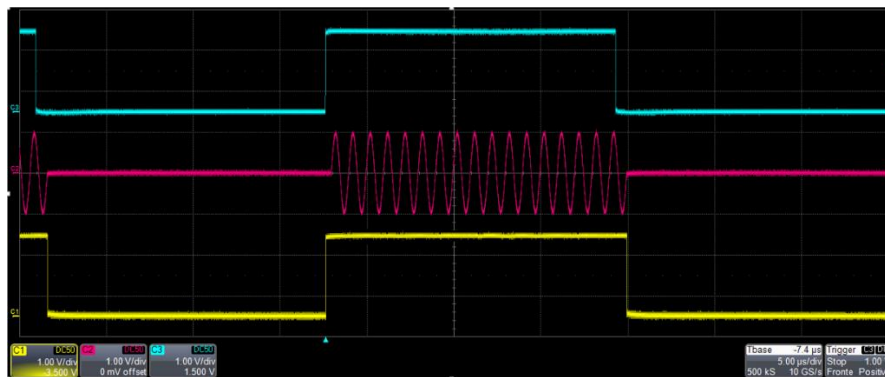
- **1 Cycles:** the instrument waits for a Trigger. When the trigger is detected it generates one time the carrier waveform then it stops and waits for the next Trigger.
- **N-Cycles:** the instrument waits for a Trigger. When the trigger is detected it generates N times the carrier waveform then it stops and waits for the next Trigger. The number of N cycles to generate is defined by the **Number of Cycles** parameter.
- **Inf-Cycles:** this mode is similar to the previous one, but after the Trigger the generation starts until the Run/Stop Button is pressed.
- **Gated:** the waveform is generated only when the Trigger is “true”. When the trigger returns to “false” the instrument terminates the current burst sequence then it returns waiting for the next trigger.

Note: If you select the Noise as carrier for the Burst mode, the frequency/period associated to the Noise is the last used one. It doesn't affect the generated noise but affects the duration of the burst.

Note: when the instrument is waiting for the first Trigger the Output voltage level keeps the Offset voltage but during the wait state after the first execution the Output voltage level keep the last sample of the carrier waveform.

In the following picture, you can see the gated mode operation. From top to bottom there are:

- C3 (blue trace) is the Trigger signal source from the external Trigger In connector.
- C2 (red trace) is the generated signal.
- C1 (yellow trace) is the marker out.



Burst Gated with Trigger from external


Main Command Button Description

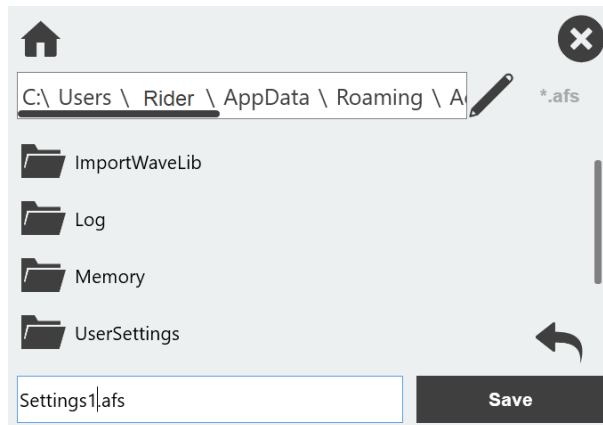
Save Settings





The button “Save Settings” in the “More” menu allows to save the current instrument settings called “*memory*”. In the relative dialogue box, you can save a new *memory* entry or overwrite an existing one. If you try to overwrite an existing *memory* entry, a dialogue box appears to ask confirmation.

The file extension for the *memory* file is “.afs”.

In the bottom textbox you can type a new name then pressing the “Save” button  the *memory* will be saved.



In this page it is possible to choose to destination folder to save the current settings. The “pencil”  activates the

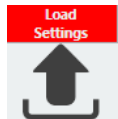
textbox to specify a path. The “house button”  on the top left sets the path to home path and the “left arrow”



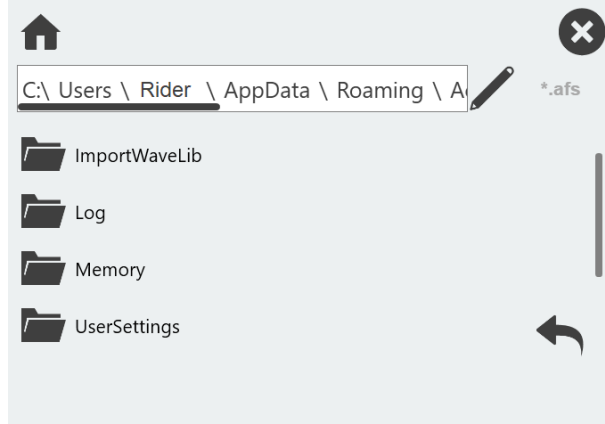
restores the path to the previous one.

Note: Some file names are reserved for the “Memory State” accessible by Remote Commands. The reserved names are: Memory0.afs, Memory1.afs, ..., Memory4.afs,... It is possible to use those names but they will be deleted or overwritten by remote commands without confirmation. Take also care that the “Memory0.afs” saves the last settings before the instrument is powered off. Therefore, this file is overwritten every time that the instrument is powered off.

Load Settings



Touching the “Load Settings” button in the “More” menu, a page will open showing the list of all the saved *memories*. Selecting a *memory* entry, the current instrument settings will be immediately updated with those of the *memory* entry.



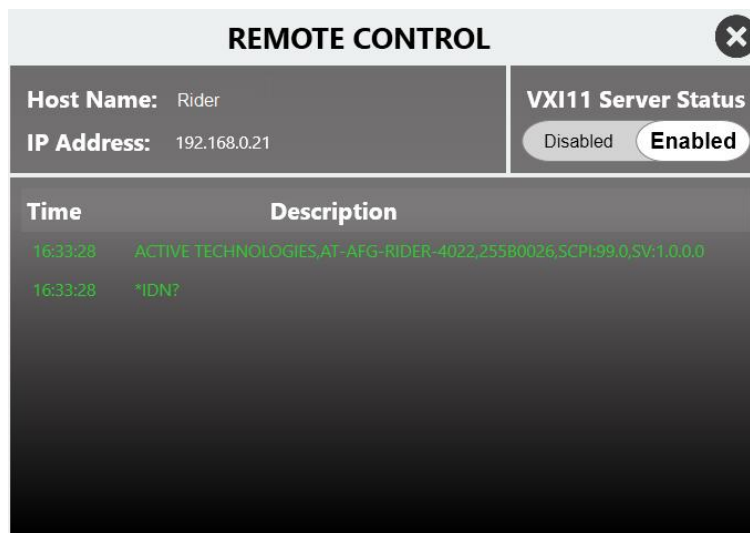
The buttons have the same functions they have in the “Save Settings” page.

Note: at the power on of the instrument the file “Memory0.afs”, containing the last setting before the power off, is used to update the current instrument settings.

Remote Control

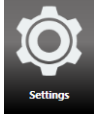


The “Remote” button located in the Command Bar opens the page of the SCPI server. In that page there is the list of all the commands received by the SCPI server and its replies. If the text of the command is displayed in **green** it means that the command is correct and it has been accepted by the server. If the text of the command is displayed in **red** it means that the command is wrong and it hasn’t been accepted by the server.



In the top of the page the Host Name and the IP Address of the instrument are shown. The slider on the right side of the page allows to enable or disable the SCPI server. By default it is enabled.

Channels and Device Setting

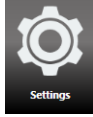


Press this button to open the settings page composed by three tabs, one for each Channel and one for the Device. You can swipe left or right to switch among the tabs.

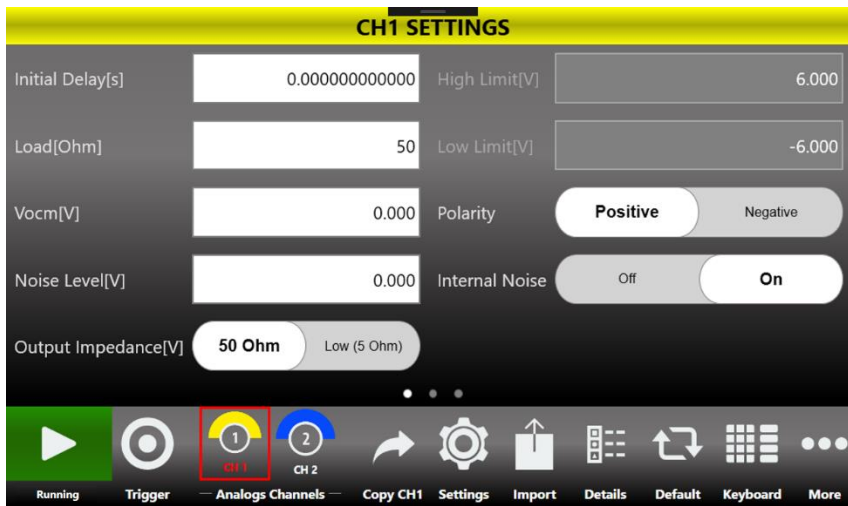


Touching a channel button or pressing the “CHANNEL SEL.” button on keypad the settings page will switch between the channels tabs.

Channels Settings



Touching the Settings button or the “SETTINGS” button on keyboard, the setting page opens.

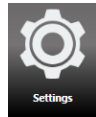


Channel Setting	Description
Initial Delay	Set the Initial Delay of the selected channel. The delay range is 0s to 14 s.
Load [Ohm]	The instrument applies the appropriate scaling to the output waveform to get the right amplitude on the defined Load expressed in Ohm. The impedance range is 1 Ohm to 1 MOhm.
Vocm[V]	Controls the common mode voltage of the channel. The range is between -6 V to 6 V on 50 Ohm load and it depends on the selected load impedance (i.e. -12V to 12V on open load).
Noise Level [V]	Use this setting to add noise to the output signal. The voltage shown in the textbox defines the peak voltage of the noise level. The range is 0V to 6 Vpk (i.e. 0 to 12Vpp). The Noise is hardware generated using a pseudo random algorithm. Note: When you set the Noise amplitude please pay attention that Signal + Noise does not exceed the amplitude of 12 Vpp.
Internal Noise	Use this control to enable or disable the noise added to the output signal.
High Limit	You can set the maximum voltage that the channel can generate. This limit is verified during the generation. The High Limit range is 0V to 6V. The constraint High Limit > Low Limit must be met. This feature can be used to make sure to not damage the load.

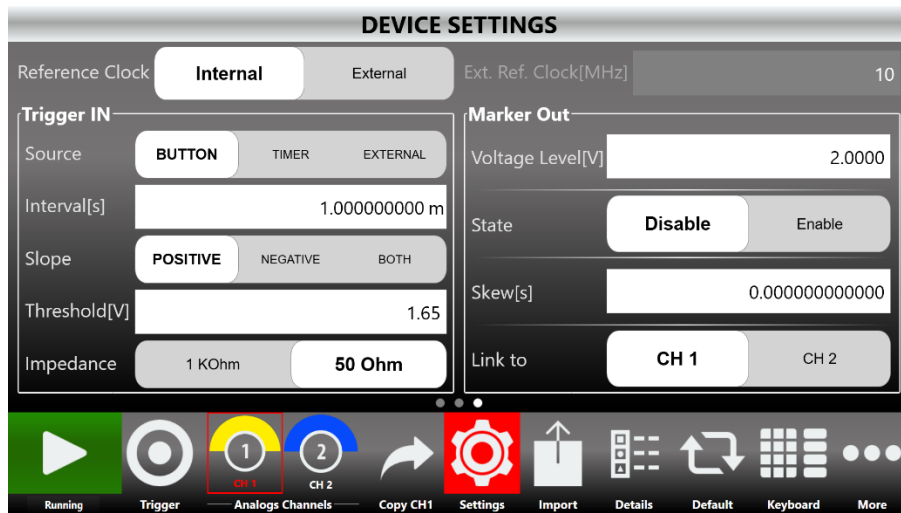
Low Limit	You can set the minimum voltage that the channel can generate. This limit is verified during the generation. The High Limit range is -6V to 0V. The constraint High Limit > Low Limit must be met. This feature can be used to make sure to not damage the load.
Polarity	This control allows you to invert the polarity of the output signal.

Device Settings

The “Device Settings” page contains the general setting of the instrument, such as the clock source and the Marker Out setting.



Touching the “Settings” button in the menu bar or the “SETTINGS” button on the keyboard the channel settings page open. Sliding the page from right to left or touching the last point on the bottom of the page the Device Setting page is displayed.



Device Setting	Description
Reference Clock	It can be Internal or External . If it is Internal the DAC sampling clock is generated internally. If it is External the DAC sampling clock is synthesized starting from the external clock source provided to to the External Reference SMA connector located in the rear panel. The external reference clock frequency must me specified in the Ext. Ref. Clock[MHz] parameter.
Ext. Ref. Clock[MHz]	This textbox defines the External Reference Clock frequency in MHz. This parameter has effect only if the Reference Clock is set on External.
Trigger IN	Use this group of parameters to define the Trigger In behaviour (see the table below).
Marker Out	Use this group of parameters to define the Marker Out behaviour (see the table below).

Trigger In Settings

The Trigger In settings parameters are in the Device Setting page. These parameters are shared by both the instrument channels.

Trigger In Setting	Description
Source	<p>Button: the Trigger event is provided to the instrument by the Trigger button on the keyboard or Trigger button on the menu bar or from a Remote Command.</p> <p>Timer: The Trigger is internally generated by a Timer. The Timer count is set by Interval [s] textbox.</p> <p>External: the Trigger event is generated by the signal applied externally on the BNC connector (TRG. IN) when it crosses the selected Threshold with the selected Slope. You can select Threshold value and Slope using the relative textbox and slider.</p> <p>Note: The Trigger buttons and the Trigger from remote command are always active, independently from the selecting Trigger Source.</p>
Interval [s]	Set the timer count. It has effect only when the selecting Source is Timer. The Interval range is from 13.4 us to over 100 s.
Slope	The Slope can be positive or negative. When positive is selected the trigger detected when the signal on the "TRG. IN" SMA connector crosses the threshold from low to high. The negative option is the opposite. It has effect only when the selecting Source is External.
Threshold [V]	It is the threshold that the external signal applied to the "TRG.IN" connector must cross to issue a Trigger event to the instrument. It has effect only when the selected Source is External.
Impedance	It selects if the "TRG. IN" connector impedance: 1 KOhm or terminated into 50 Ohm.

Marker Out Settings

The Marker Out settings parameters are in the Device Setting page. The Marker Out BNC connector is shared by both the instrument channels.

The screenshot shows the 'Marker Out' settings panel. It includes a 'Voltage Level[V]' input field with the value 0.000. Below it is a 'State' toggle switch currently set to 'Disable'. The 'Skew[s]' input field also shows 0.000. At the bottom, the 'Link to' toggle switch is set to 'CH 1'.

Marker Out Setting	Description
Voltage Level [V]	it sets the Marker high level Voltage. The Low level is fixed to 0V. The Voltage Level range is 1 V to 2.5 V on 50 Ohm load (twice on open load).
State	It enables or disables the Marker Out. When the Marker Out is disabled it is forced to 0 V.
Skew [s]	It sets the delay between the marker and the analog channels. The skew range depends on the Run Mode: in Gated (Burst) it is 0s to 3us; for all others modes it is 0s to 14s.
Link To	The Marker Out frequency is related to the analog channel frequency. Since there is a unique Marker Out signal while there are two analog channels it is possible, by means of this parameter, to define the analog channel that is related to the Marker Out signal.

Import from File

The Import page allows to load a waveform from a file and assign it to the Carrier waveform or to the Modulation profile

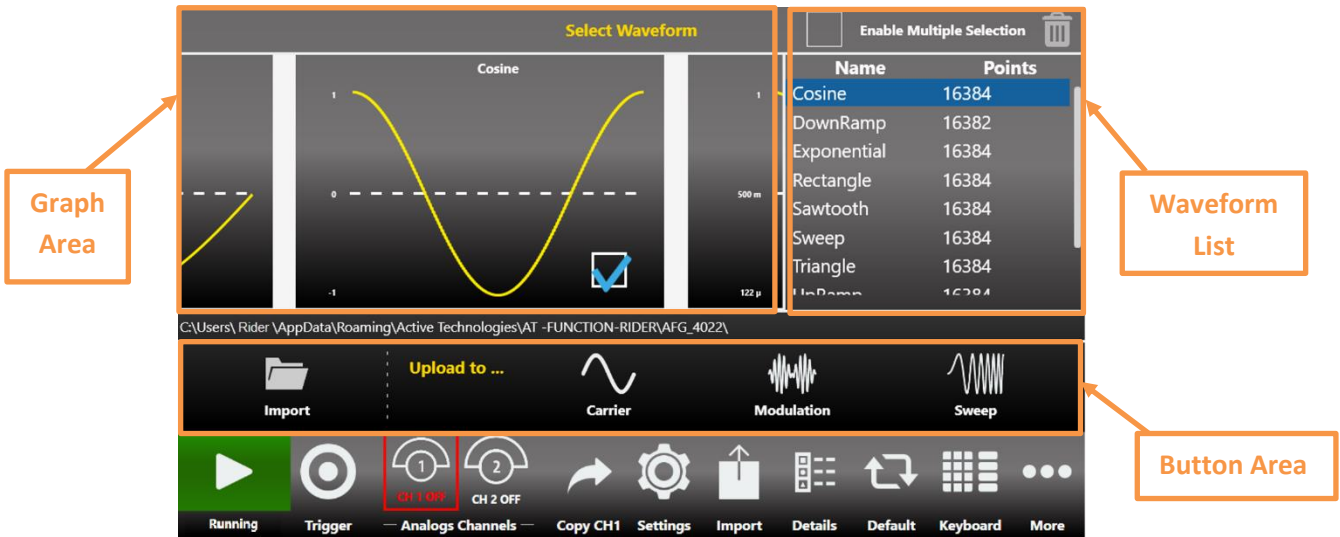


or to the Sweep profile. This page opens by touching the **Import** button.

Once the waveform has been imported it will be available by choosing "Arbitrary" as waveform type for the Carrier/Modulating/Sweep of the channel. For example, if the "Cosine.txt" is imported and assigned as "Carrier Wave" for the channel 1 then the imported waveform can be selected by choosing "Arbitrary" as carrier waveform type of the channel 1.



To switch between channels, you can touch a channel button  or press “CHANNEL SEL.” button on the keyboard.




Import File Specifications	Description
Accepted Formats	.txt (Tab Separated text), .csv (Comma Separated Value), .trc (Teledyne LeCroy oscilloscopes)
Length Range	Between 2 and 16384 samples. The instrument memory is limited at 16 k sample (16384) for each arbitrary waveform. If a longer waveform is imported it will be resampled to match the maximum length.
Offset and Amplitude Range	When a waveform is imported from a file its original amplitude and offset are lost because the waveform is normalized during the importing process. The amplitude and offset of the normalized waveform can be redefined as for any predefined waveforms.

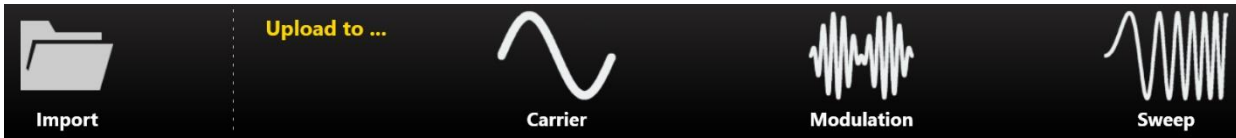
The Import page is divided into three areas: the **Graph Area**, the **Waveform List** and the **Button Area**. Below a detailed description of these areas is provided.

Graph Area: shows preview of the waveform. A waveform is selected by touching the checkbox in the graph. The selected waveform then can be assigned to the Carrier or Modulation Wave or Sweep Profile of the channel by touching one of the 3 buttons (**Carrier** button, **Modulation** button, **Sweep** button) in the Button Area located on the right side of the “Upload to...” label.

Waveform List: This section contains a list of all the predefined and imported waveforms.

- The **Trash Bin**  deletes the selected waveforms. It is not possible to delete a predefined waveform.
- The **Multiple Select Enable** **Enable Multiple Selection** checkbox enables the selection of multiple waveforms to be deleted. If multiple waveforms are selected for import only the first one is imported.

Button Area: It is composed by 4 buttons:



- **Import:** opens the file system browser to search and load a waveform. The loaded waveform is added to the Waveform List.
- **Carrier:** assigns the selected waveform to the “Arbitrary” Carrier of the current channel.
- **Modulation:** assigns the selected waveform to the “Arbitrary” Modulation of the current channel.
- **Sweep:** assigns the selected waveform to the “Arbitrary” Sweep profile of the current channel.

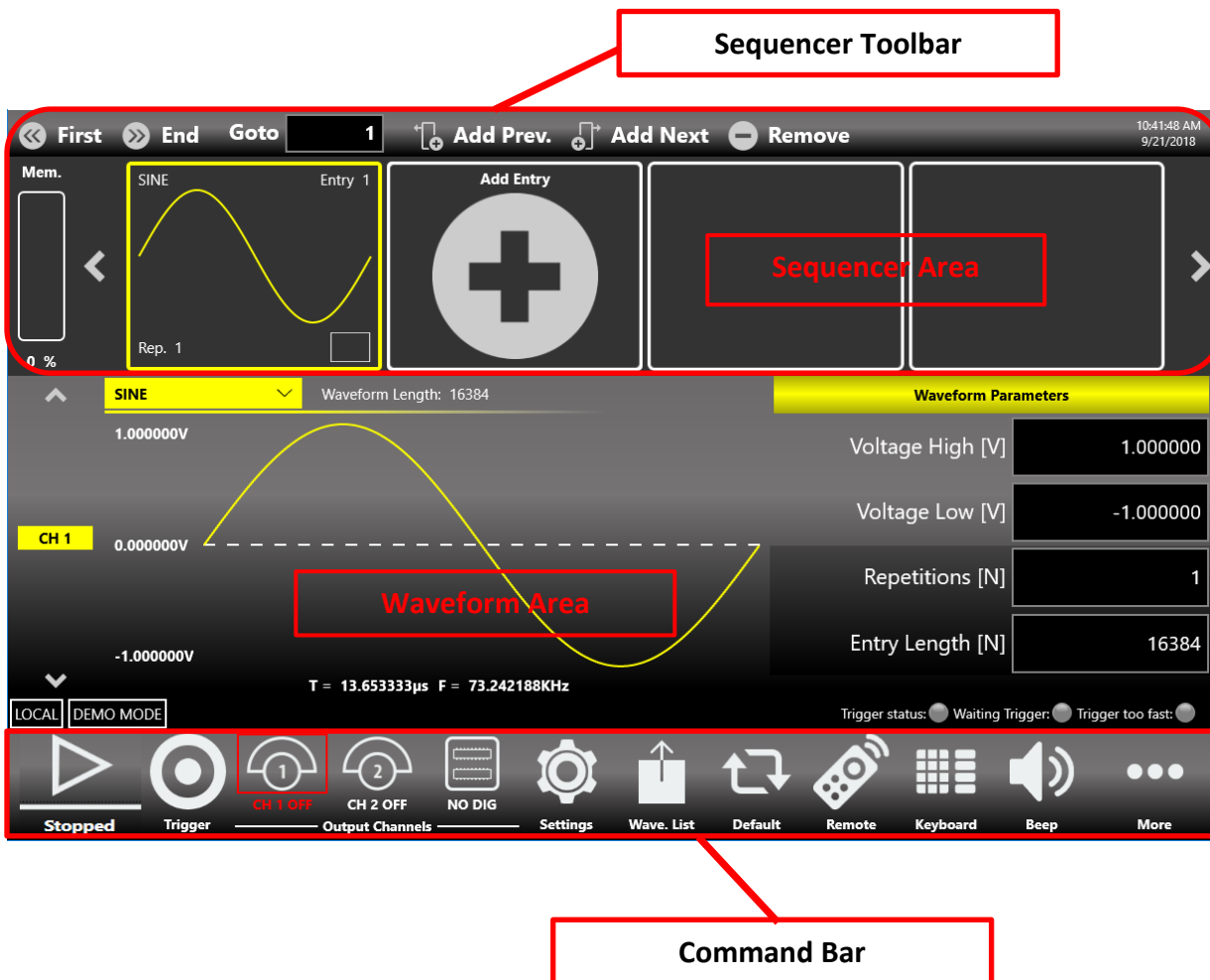
Example: how to modulate a carrier with an imported waveform in Burst Run Mode. Use the following steps:

1. Press the Import button, select the import waveform from predefined list or from preferred folder and upload it to Modulation
2. Set Run Mode to “Modulation”
3. In the Modulation tab press the Shape button and select “Arbitrary”
4. Set the Modulation parameters as preferred
5. Press Run/Stop button to start the generation.

AWG Application User Interface

Both High Definition T3AWG3352 and T3AWG3252 offer premium signal integrity thanks to the 16 bit resolution DAC. The output signal can reach up to 12 Volts pk-pk into 50 Ohm single ended. In addition, it is possible to move the offset voltage in a range of ± 6 V thus providing an output voltage window of ± 24 Volts into 50 Ohm load or 48 Volts into open load. The High Definition T3AWG3352 can generate sine wave signals up to 350 MHz, while the High Definition T3AWG3252 up to 250 MHz. The software architecture provides the possibility to easily generate predefined waveforms and modulated signals or to load an arbitrary waveform from a user defined file.

In summary the TrueArb technology provides AWG capabilities to the instrument where every data point is used to generate the output signal which has been stored in memory; the software architecture makes arbitrary waves easier to manipulate and more flexible once they've been created and it adds sequencing features to the instrument.



TrueArb user interface consists of four main elements:

- **Sequencer Area:** the sequencer contains a list of entries that the user can add/remove to create its own waveform scenario. Each entry can be repeated or changed in length. The sequencer is common to all channels.
- **Sequencer Toolbar:** this bar contains elements that are used to navigate, add and remove the sequencer items that will be described below.

- **Waveform Area:** It contains the **Waveform Graph** and the **Waveform Parameters** related to the selected entry.
- **Command Bar:** in this bar there are elements to control the instrument operations, to modify the instrument settings and to manipulate waveforms.

As mentioned, the display is 7" capacitive touch screen display and you can use the gestures like in a mobile phone:



If you use the Swipe up or down gesture on the **Waveform Area** you can switch between the Output Channel 1 and Output Channel 2 page.



If you use the Swipe left or right gesture on the **Sequencer Area** you can navigate through the sequencer entries.

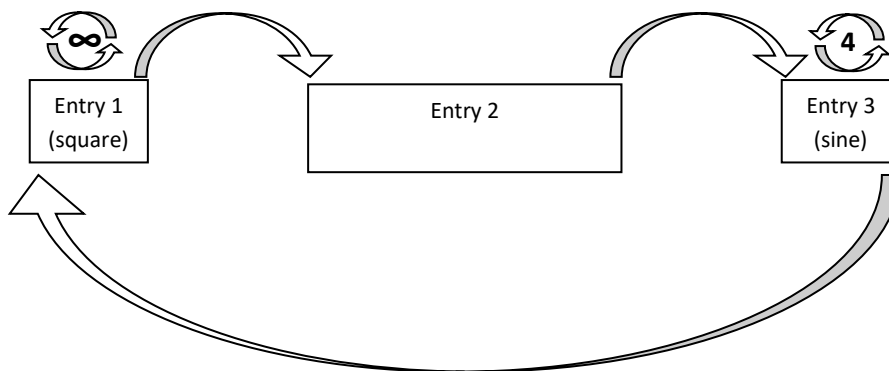
Sequencer Area

It is sometimes necessary to create long waveform files to fully implement a DUT test. In case where portions of a waveforms must be repeated, the waveform sequencer functionalities can save you a lot of memory-intensive waveform programming.

The Sequencer allows you to define the set of waveforms that will be generated, their sequence, the number of repetitions for each waveform and the generation conditions.

The sequencer is mainly used for the following two purposes:

- Output waveform longer than hardware memory
- Change the output waveform quickly on a specific trigger conditions



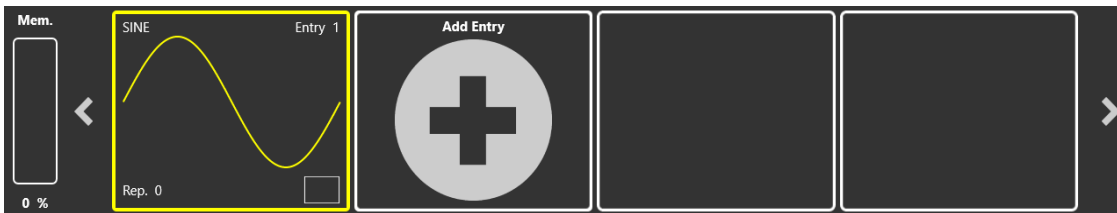
A sequence is made of multiple entries; each entry contains analog and digital waveforms properly formatted.

IMPORTANT NOTE

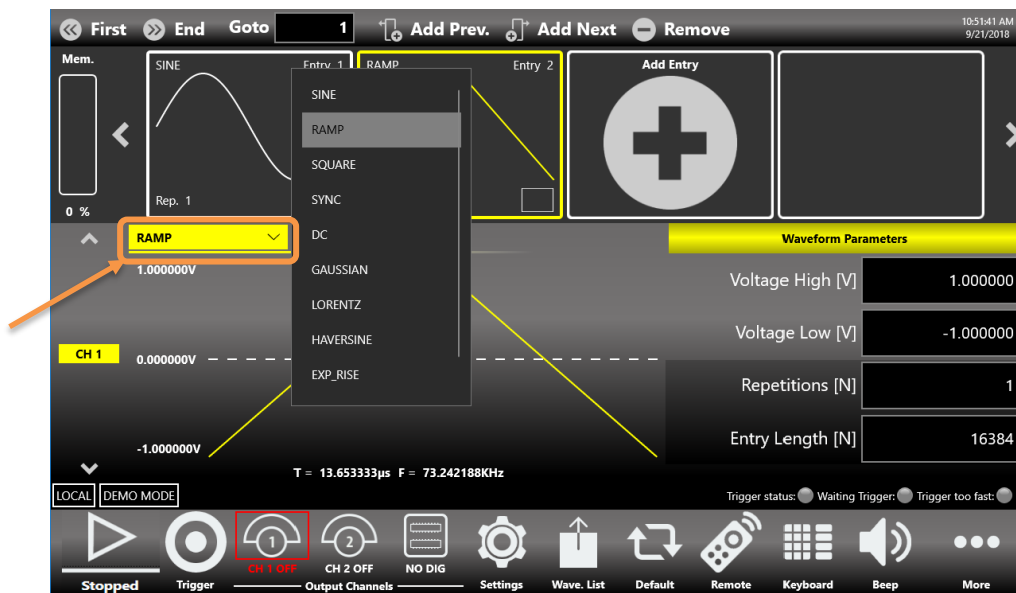
The T3AWG3K-C Series has a unique sequencer for all channels. Therefore, the length and repetitions of each sequencer entry are common to all output channels. In the same way all analog and digital outputs share the same sampling clock. In this way they are synchronized with each other.

The sequencer starts by default with a single entry with a Sine Waveform. You can touch on the “Add Entry Button” to insert a new entry into the sequencer.

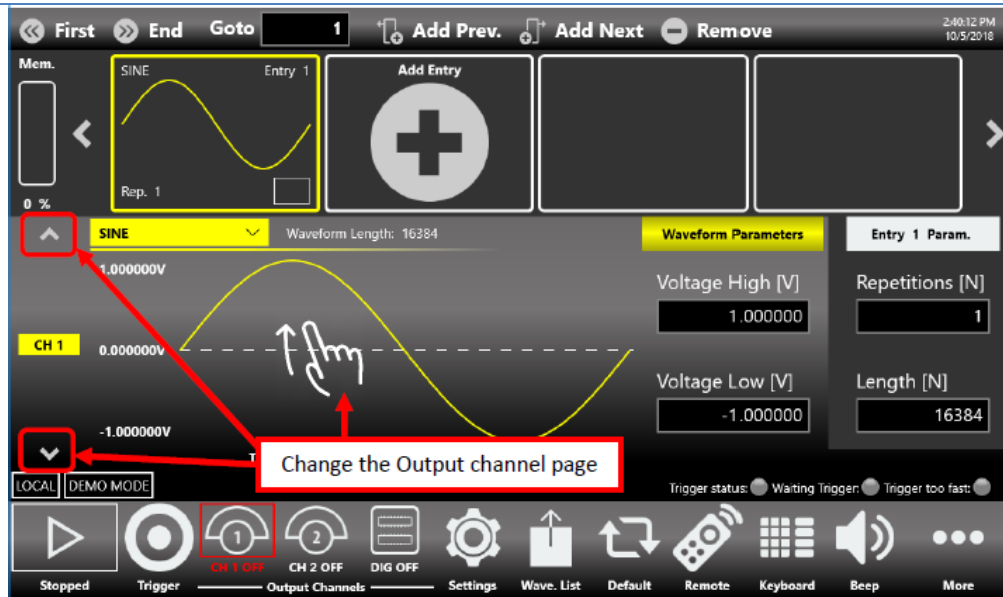
The TrueArb inserts by default a Sine waveform into the new Entry.



To modify the waveform of an entry of the sequencer, you can touch the waveform dropdown list that will open showing a list of all the waveforms available in the “Waveform List” (predefined or imported).



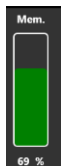
Important Note: if you need to modify the waveform of the other channel that by default are automatically set to sine waveform when you add a new entry in the sequencer, you should use the swipe up/down gesture on the Graph Area or press the up/down arrow on the left side of the graph to change the Output Channel page. Then you can change the waveform by pressing the dropdown waveform list.



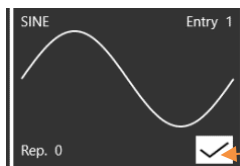
IMPORTANT NOTES

- The maximum number of allowed sequencer entries is limited to 100 even if the hardware can support up to 16384 entries. The maximum number of 16384 entries is supported by remote instrument programming.

Sequencer Area Items



- **Memory Usage.** Shows the percentage of memory used to store the waveforms placed in the sequencer



Selection Button

Sequencer Entry. Each sequencer item contains several information:

- The index of the Entry (Entry N). Each entry is enumerated starting from 1 up to 16384.
- The name of the Waveform assigned to the selected output channel in that entry. Each output channel can have a different waveform assigned to the same sequencer entry.
- The number of Repetitions. Each entry can be repeated from 0 up to 4294967295 times.

If you touch the selection button in the entry, a second bar will open that will let you to:

- Select All the entries
- Deselect All the entries,
- Remove the Selected entry

- Close the bar.



Sequencer Toolbar

This sequencer toolbar contains several buttons to navigate and control the sequencer that are described here below in detail:

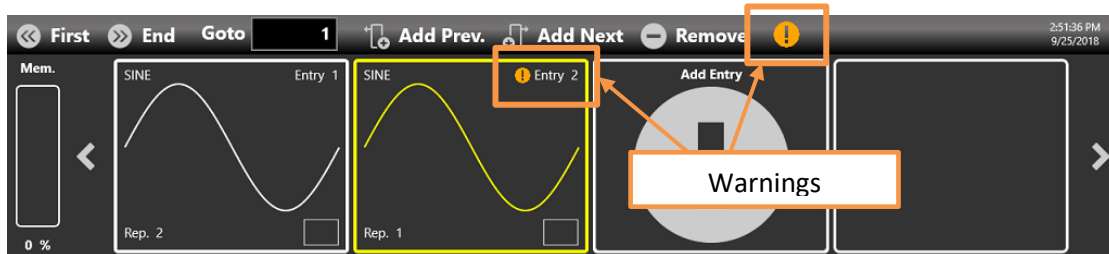


Sequencer Toolbar	Description
First	First Entry Button – Press this button to go to the first entry.
End	Last Entry Button – press this button to go to the last entry.
Goto <input type="text" value="1"/>	Goto Entry Button – Use this button to go to the Entry N.
Add Prev.	Add Prev. Button – Use this button to add a sequencer entry before the selected entry.
Add Next	Add Next. Button – Use this button to add a sequencer entry after the selected entry.
Remove	Remove Button – Use this button to remove the selected entry.

Sequencer Warnings

Warnings are shown in the sequencer toolbar in case one or more channel waveforms have been assigned to an entry with a different length. The upper warning gives is general warning that notifies this condition. Additional warnings are displayed inside the entries where the warning condition is detected.

In presence of warnings the application will modify the mismatching waveforms during the execution to match the entry length using the strategy specified in the *Sample increasing/decreasing strategy* parameter (Device Settings -> General page).



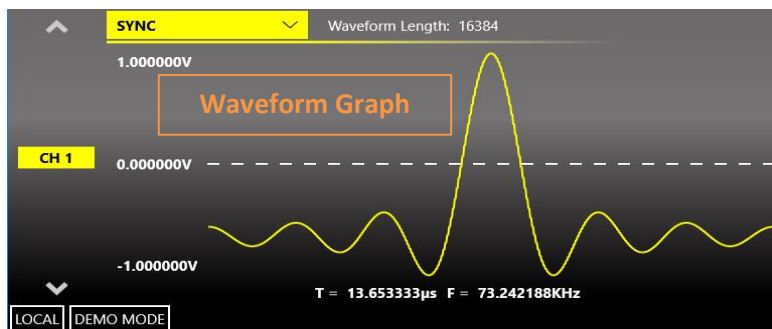
Waveform Area

This area is divided in two main sections, the **Waveform Graph** area that contains a graphical representation of the channel waveform and the **Waveform Parameters** area.

The Waveform Graph gives a description of the waveform assigned to the current channel and sequencer entry. The waveform is described as:

- The waveform shape
- The waveform duration and frequency
- The waveform amplitude

The waveform length in term of number of samples as it was originally defined in the Waveform List (described below)



The Waveform Parameters area is divided in two parts. The upper part contains the vertical parameters of the selected waveform in terms of Amplitude[Vpp] and Offset[V] or Voltage High[V] / Voltage Low [V]. These two parameters can be specified independently for each sequencer entry and for each output channel.

In the lower part there are the Repetitions[N] and the Entry Length[N] for the selected sequencer entry. These two parameters are specific for the selected **sequencer entry**. Repetitions[N] is the number of repetitions of the selected sequencer entry.

These parameters are common to all the channels in the same sequencer entry.

Note: Repetitions[N]=1 means that the waveform is executed only once.

The screenshot shows the 'Waveform Parameters' menu with the following settings:

- Voltage High [V]: 1.000
- Voltage Low [V]: -1.000
- Repetitions [N]: 1
- Entry Length [N]: 2048

Annotations on the right side of the menu:

- A bracket groups 'Voltage High [V]' and 'Voltage Low [V]' with a box labeled 'Waveform Vertical Parameters'.
- A bracket groups 'Repetitions [N]' and 'Entry Length [N]' with a box labeled 'Entry Parameters'.

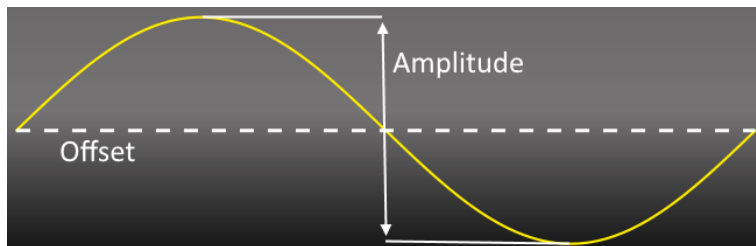
At the bottom of the menu, there are status indicators: 'Trigger status: ●', 'Trigger too fast: ●', and 'Run status: ●'.

Amplitude[Vpp] parameter

It defines the difference between the maximum value and the minimum value of the waveform expressed in Volts.

Offset[V]

It defines the voltage of $(V_{max}+V_{min})/2$ expressed in Volts where V_{max} is the maximum level of the waveform and V_{min} is the minimum level of the waveform.

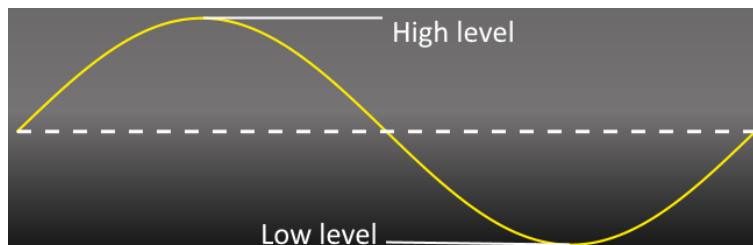


Voltage High[V]

It defines the maximum level of the waveform expressed in Volts

Voltage Low[V]

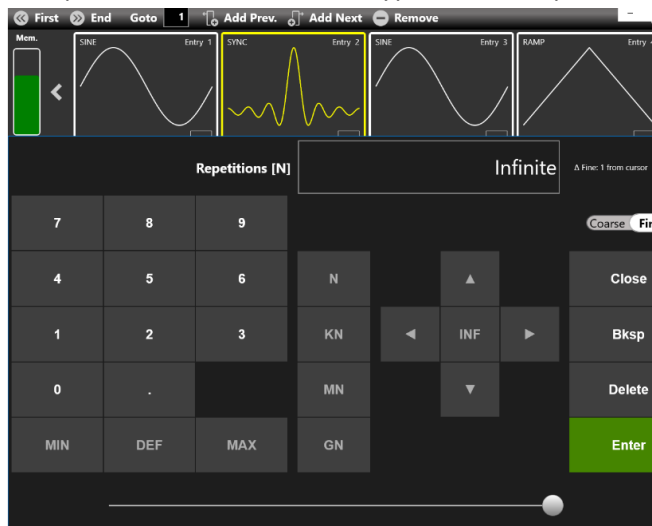
It defines the minimum level of the waveform expressed in Volts



IMPORTANT NOTES

- The maximum value of repetitions is infinite: Repetitions[N]=Infinite
- Entry Length[N]=2048 is the length of the selected sequencer entry
- The entry length granularity is 16 and the minimum length is 16.
- The Waveform length is the original length of the waveform in terms of number of samples
- The entry length can be different from the waveform length because the entry length is the same for all the instrument channels while the waveform length can be different. In case the entry length and the waveform length are different the original waveform will be manipulated (resampled/cut/extended) to match the entry length
- The maximum value of repetitions is infinite. To set the repetitions to infinite open the On-Screen Keyboard and press the “INF” button.

You can touch the parameter area to open the Virtual numeric keypad, edit the parameter value and its measure unit.



Below there is a description of the keypad items:

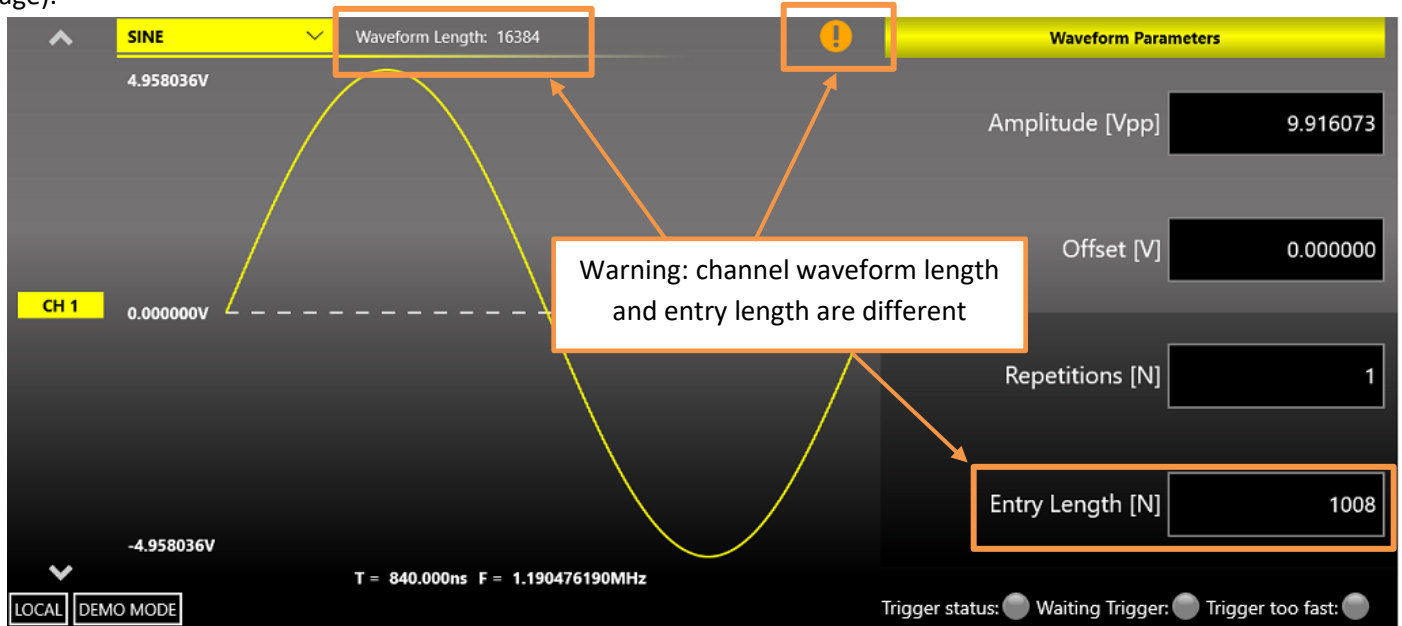


1. **Parameter Name and Value:** This area of the virtual keyboard displays the parameter name, value and unit of measure.
2. **Numeric Keypad:** this area contains the keys to edit the number that will be displayed in the area 1. The [+/-] key will toggle the sign of the number being entered and can be pressed at the end of the number editing. Touch the “MIN” and “MAX” buttons to set the minimum and maximum allowed value for the selected parameter. Use the “DEF” button to set the default value.
3. **Arrows:** The left/right arrows allow to move the cursor or select the different digit position as the arrows on the front panel. The up/down arrows allow to modify the value.
4. **Measurement Unit:** After typing the numeric value these buttons can apply a different multiplier of the measurement unit. When a measurement unit is pressed, the value is applied on the fly.
5. **Coarse / Fine:** the coarse/fine button let you to modify the granularity of the increment. You can increment or decrement the selected parameter using the UP/DOWN arrows button or rotating knob on the front panel.
When Fine is selected, the increment is of 1 unit at the current cursor position.
When Coarse is pressed, the Delta increment is displayed in the parameter area and the parameter value changes in steps of the selected increment.
You can keep pressed the knob and rotate it on the right or on the left to change the Delta Coarse increment.
6. **Control Buttons:** The “Close” button closes the virtual keypad without applying any changes on the instrument while the “Enter” button confirms the changes and it applies them on the instrument. “Bksp” (backspace) button is provided for deleting erroneous key presses, “Delete” button deletes all digit of the textbox.
7. The **horizontal scrollbar** allows to change quickly the selected value. The position specifies the value between the allowed minimum and the maximum.
The increment/decrement value entered by the rotary knob or by the scrollbar are applied to the instrument on the fly.

Waveform Warnings

A warning is shown in the waveform graph in case the channel waveforms length is different from the entry length. The upper warning gives is general warning that notifies this condition. Additional warnings are displayed inside the entries where the warning condition is detected.

In presence of warnings the application will modify the mismatching waveforms during the execution to match the entry length using the strategy specified in the *Sample increasing/decreasing strategy* parameter (Device Settings -> General page).

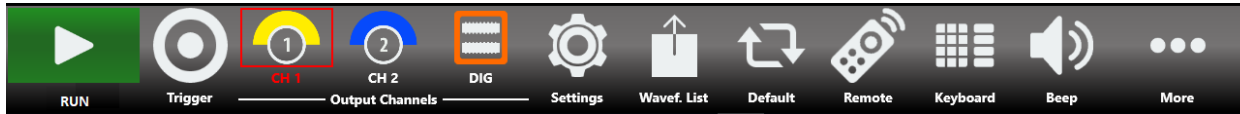


Status Toolbar



Trigger Information indicator: Trigger status: Waiting Trigger: Trigger too fast: provides information on the trigger signal condition.











- The **Trigger status** LED notifies you that the instrument has received a trigger signal
- The **Waiting Trigger** LED notifies you when the instrument is waiting for a trigger signal.
- The **Trigger too fast** LED notifies you that the trigger event has been latched, but the trigger frequency is too high and the instrument cannot be rearmed before the completion of the previous trigger event. In this situation some trigger events may be lost.



Command Bar



Command Bar Buttons	Description
	<p>RUN/STOP Button – Use this button to set the instrument in Running state (or Ready to receive a Trigger) or in the Stopped state. If the button is green the instrument is running while if it is grey the instrument is stopped. Pushing the button will change the instrument state.</p>
	<p>Trigger Button – Use this button to send an internal software trigger to the instrument. Independently from the setting this trigger is always received.</p>
	<p>Output Channels Buttons - Press CH1, CH2, DIG to change the Output Channel page. If you press again the Channel button, you will turn it OFF/ON.</p> <p>When a channel is OFF, it is mechanically disconnected from the output.</p> <p>The DIG button means “Digital” and it will connect/disconnect the Digital Signals. When digital signals are disabled they will keep logic “zero” value at the output.</p>
	<p>Settings Button – Use this button to open the output channel Settings, device Settings, Marker Settings and Sequencer Settings. (For more information, please refer to the relative section).</p>
	<p>Wavf. List – Use this button to open a page where you can Import/Export a waveform from file. (For more information, please refer to the relative section).</p>
	<p>Default – Use this button to restore the default value of all parameters of the instrument.</p>
	<p>Numeric Keyboard Button – Use this button to enable or disable the virtual numeric keyboard.</p>
	<p>Remote – Use this button to open the SCPI server page. In that page you can enable or disable the SCPI server and see the sequence of commands sent to the instrument and its response.</p>

 <p>Beep</p>	<p>Beep – Use this button to enable or disable the beep audio signal when the user touches a button.</p>
 <p>More</p>	<p>More Button – Use this button to have access to other instrument features. These buttons are explained in the following table.</p>

More Button Menu Items	Description
 <p>Exit</p>	<p>Exit Button – Press this button to close the application.</p>
 <p>Full Screen</p>	<p>Full/Float Button – press this button to maximize or reduce the application screen; in this way you can access to Windows OS.</p>
 <p>Load From</p>	<p>Load From Button – Use this button to load a configuration file. (For more information, please refer to the relative section).</p>
 <p>Save As</p>	<p>Save As – Use this button to Save the Current configuration into an existing one or create a new one. (For more information, please refer to the relative section).</p>
 <p>Export</p>	<p>Export – Use this button to export the current configuration. (For more information, please refer to the relative section).</p>
 <p>Remote Control</p>	<p>Remote Control Button – Use this button to open the SCPI server page. In that page you can enable or disable the SCPI server and see the sequence of commands sent to the instrument and its response.</p>
 <p>Change Format</p>	<p>Change Format – Use this button to change the waveform vertical parameters from Voltage High(V) and Voltage Low(V) to Amplitude(Vpp)/Offset(V)</p>
 <p>AFG</p>	<p>Change Application – Use this button to switch from AWG to AFG application.</p>
 <p>About</p>	<p>About Button – Use this button to check the credits, the software and firmware release number and the instrument serial number.</p>
 <p>Help</p>	<p>Help Button – Use this button to open the User Manual.</p>

<p>Calibration</p> 		<p>Calibration button – Use this button to enter the Calibration and Diagnostic page. (For more information, please refer to the relative section).</p>
<p>License</p> 		<p>License button – Use this button to enter the License setup page. (For more information, please refer to the relative section).</p>

Settings

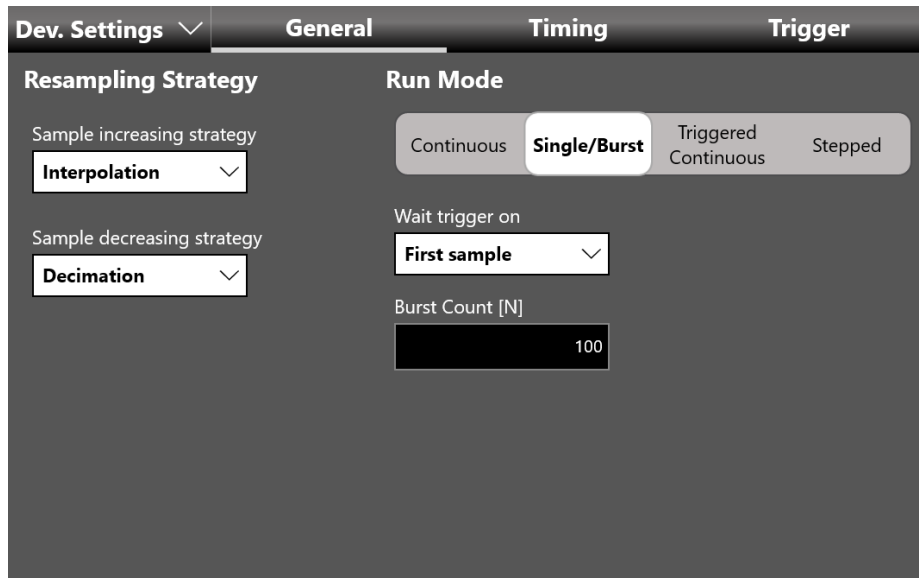


Touch the “Settings” button to open the page relative to the Device Settings, Channel Settings, Marker Setting and Sequencer Setting.

Device Settings

The device settings are common for all the instrument and they are grouped in General settings, Timing settings and Trigger settings.

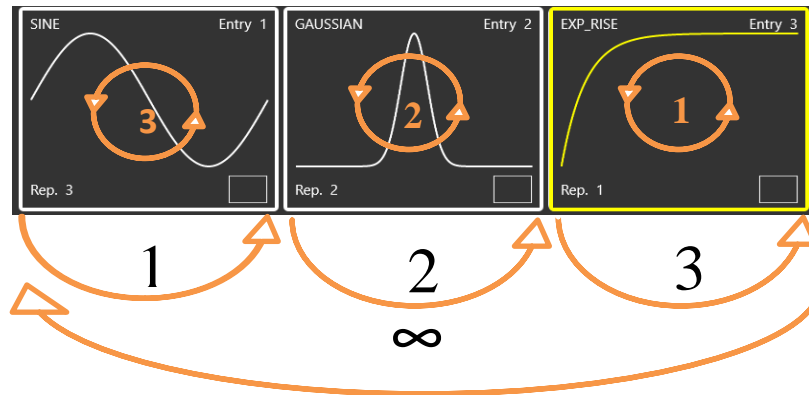
General



Run Mode

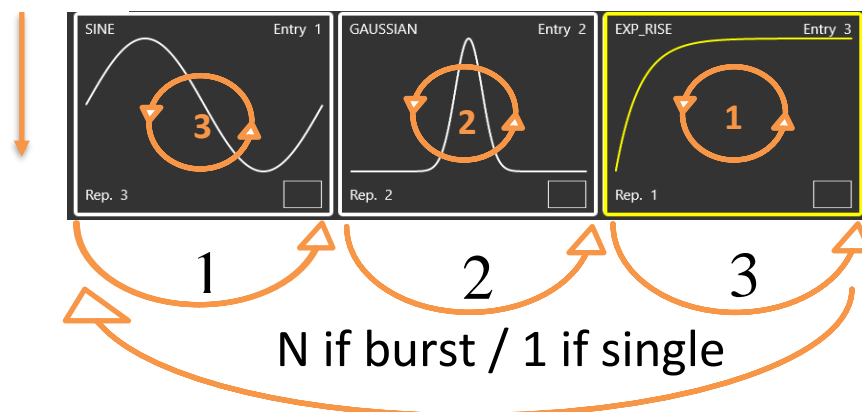
The Run Mode defines the sequencer execution flow:

- **Continuous:** when the RUN/STOP button is pressed each waveform will loop as written in the entry repetition parameter and the entire sequence is repeated circularly until the user presses the RUN/STOP button as shown in the picture below



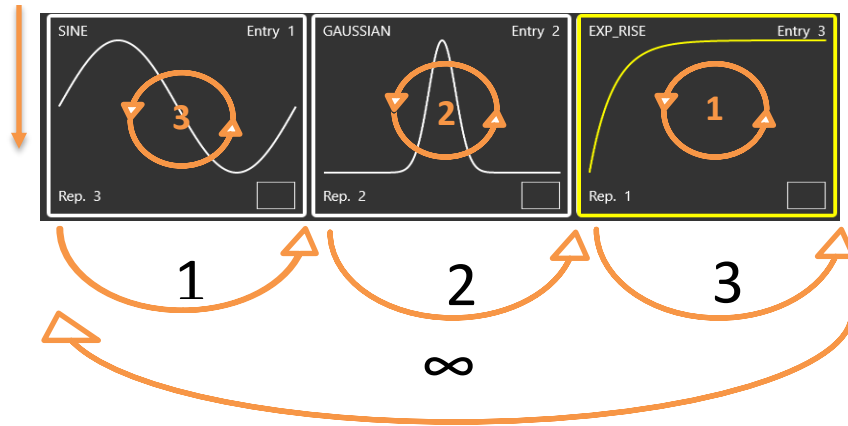
- **Single/Burst:** when the RUN/STOP button is pressed the instrument waits for a trigger event. When the trigger event occurs, each waveform will loop as written in the entry repetition parameter and the entire sequence will be repeated circularly many times as written in the Burst Count[N] parameter. If you set Burst Count[N]=1 the instrument is in Single mode and the sequence will be repeated only once.

Start Trigger



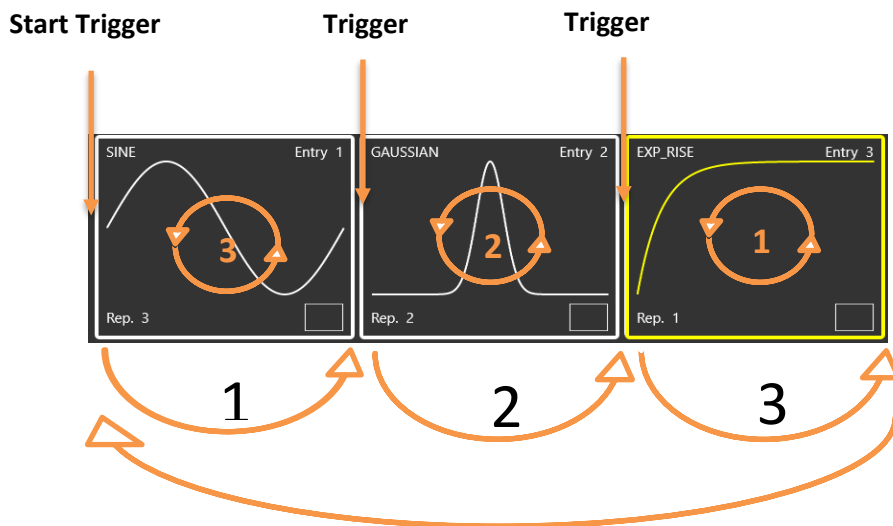
- **Triggered Continuous:** when pressing the RUN/STOP button the instrument waits for a trigger event. When the trigger event occurs, each waveform will loop as written in the entry repetition parameter and the entire sequence will be repeated circularly until the user presses the RUN/STOP button.

Start Trigger



- **Stepped:** after pressing the RUN/STOP button each entry waits for a trigger event before its execution. The waveform of the entry will loop as written in the entry repetition parameter. After the generation of an entry has completed, the last sample of the current entry or the first sample of the next entry is held until the next trigger is received. At the end of the entire sequence the execution will restart from the first entry.

Note: if you set Infinite repetitions on one entry, the Trigger event lets you jump to the next one.



Wait Trigger On

Defines the behaviour of the output during the wait trigger condition in the Triggered Run Modes. If “First sample” is selected the first waveform sample of the next entry is held until the next trigger is received. If “Last sample” is selected the last waveform sample of the current entry is held until the next trigger is received.

Resampling Strategy

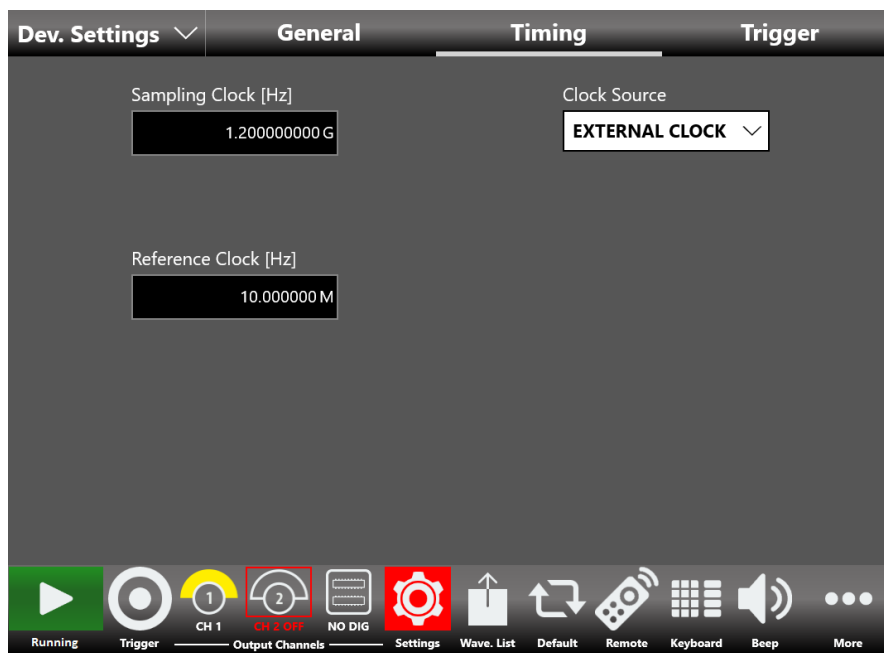
It defines the strategy to adapt the original waveform length to the sequencer entry length. The “Sample increasing strategy” parameter defines the strategy used to adapt the waveform length to the sequencer entry length in the case where the original waveform length is shorter than the sequencer entry length. The techniques adopted can be:

- *Interpolation*: it performs a linear interpolation between the waveform samples
- *Return Zero*: it fills with '0's the tail of the waveform
- *Hold Last*: it holds the last value of the waveform
- *Samples Multiplication*: it repeats the waveform samples

The “Sample decreasing strategy” parameter defines the strategy used to adapt the waveform length to the sequencer entry length in the case where the original waveform length is longer than the sequencer entry length. The techniques adopted can be:

- *Decimation*: it reduces the number of samples maintaining the waveform shape
- *Cut tail*: it cuts the tail of the waveform reducing its size
- *Cut head*: it cuts the head of the waveform reducing its size.

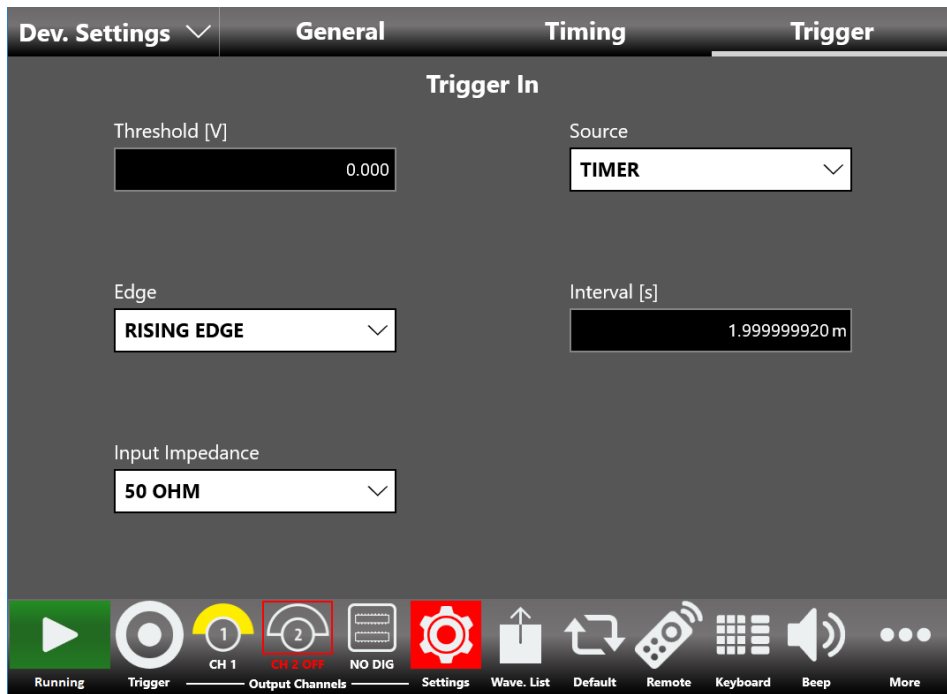
Timing



- *Sampling Clock[Hz]*: specifies the Arbitrary Waveform Generator Sample Rate.
- *Sampling Clock Source*: specifies the clock source as Internal or External.
If **Internal Clock** is selected, the sampling clock is synthesized using a reference clock generated internally.
If **External** is selected, the sampling clock is synthesized using the clock provided externally to the Ref.Clock In SMA connector.
When the External is selected, the Reference Clock[Hz] control will appear and the user needs to specify the Reference Clock frequency[Hz].

Trigger

The Trigger settings are common for all the channels



Trigger In Setting	Description
Source	<p>Trigger Button: the Trigger event is provided to the instrument by the Trigger button on the keyboard or Trigger button on the menu bar or from a Remote Command.</p> <p>Timer: The Trigger event is internally generated by a Timer. The Timer count interval is set by Interval [s] textbox.</p> <p>Trigger In Connector: the Trigger event is generated by the signal applied externally on the BNC connector (TRIGGER IN) when it crosses the selected Threshold with the selected Slope. You can select Threshold value and Slope using the relative textbox and slider.</p> <p>Note: The Trigger buttons and the Trigger from remote command are always active, independently from the selecting Trigger Source.</p>
Interval [s]	Sets the timer count interval. It has effect only when the trigger Source is Timer. The edited value is automatically rounded to the closest value that the hardware can implement.
Edge	<p>The Slope can be positive or negative. When Rising Edge is selected the trigger is detected when the signal on the “TRIGGER IN” BNC connector crosses the threshold from low to high. The Falling Edge option is the opposite.</p> <p>“Both Edges” means that Trigger is sensitive to both edges of the signals. It has effect only when the selected Source is External.</p>
Threshold [V]	It is the threshold that the external signal applied to the “TRIGGER IN” connector must cross to issue a Trigger event to the instrument. It has effect only when the selected Source is External.
Impedance	It selects if the “TRIGGER IN” connector impedance: 1 KOhm or terminated into 50 Ohm.

Channel Settings

The channels settings page allows to manage the parameters of the analog and digital channels.

The screenshot displays the 'Ch. Settings' menu with three tabs: 'CH 1', 'CH 2', and 'DIG'. The 'CH 1' tab is selected and highlighted with a yellow underline. The settings for CH 1 are as follows:

- Amplitude Scale [%]:** A numeric input field showing '100.000'.
- Output Impedance:** A dropdown menu showing '50 Ohm' with a downward arrow.
- Skew [s]:** A numeric input field showing '0p'.
- Polarity:** Two radio buttons, 'Negative' and 'Positive', with 'Positive' selected.
- Base Line Offset [V]:** A numeric input field showing '0.000'.

CH 1 and CH 2 analog channel page


- **Amplitude Scale[%]:** this parameter that can be modified at run-time to adjust the waveform amplitude while the instrument is running and it is applied to all the waveforms contained in the sequencer. It is expressed in % and it has a range of 0% to 100%. 100% means that the waveform keeps its original amplitude.
- **Skew[s]:** this parameter defines a fine time delay among the analog output channels to de-skew the outputs. The resolution is about 3 ps and depends on the sampling frequency as well as the maximum time skew allowed. The edited value is automatically rounded to the closest value that the hardware can implement.
- **Output Impedance:** defines the output impedance of the analog outputs. It can be set 50 Ohm or Low Impedance (5 Ohm).
- **Polarity:** when “Negative” is selected the analog output signal will be inverted.
- **Base Line Offset[V]:** defines the DC offset value added to the output signal respect to the ground level.

Digital Channels



- *Digital Channels*: it is possible to enable up to 8 digital lines.

If the Digital Channels number is 0, the DIG button  will be disabled. If two or more digital lines are

selected the DIG button  can be touched to enable/disable the digital lines. Once the digital channels are enabled (≥ 2 digital channels selected) it is possible to access to the Digital Channels Page (see the picture below) to define the digital waveform sequence as for the analog channel page.

IMPORTANT NOTE: enabling the digital lines will cause a decrease of resolution in the analog output channels as shown in the following table.

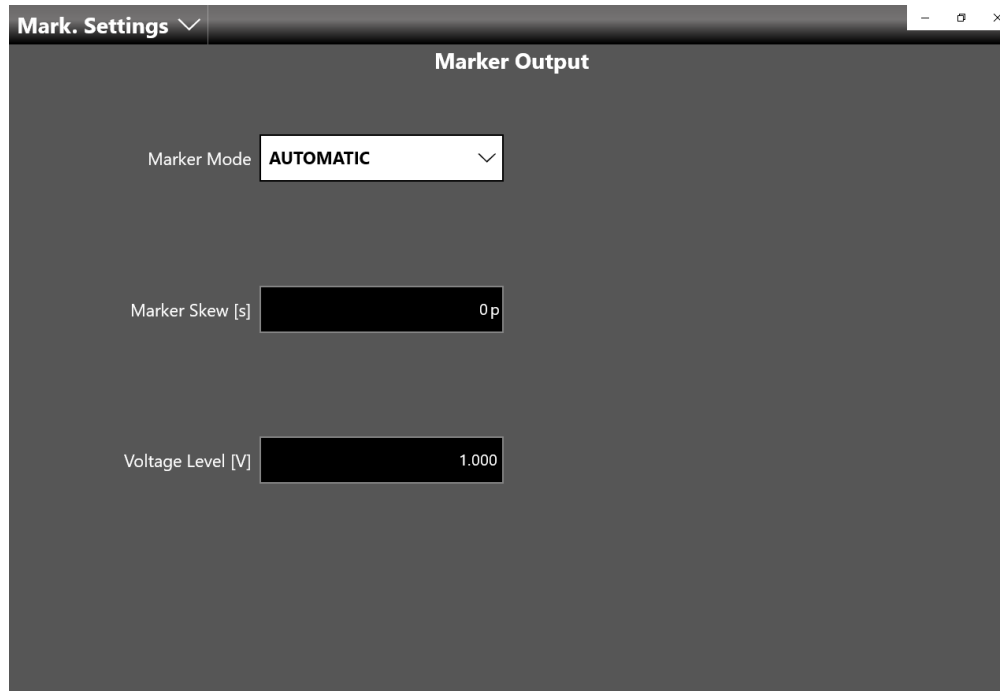
Number of digital lines	CH1 Resolution	CH2 Resolution
0	16 bits	16 bits
2	14 bits	16 bits
4	12 bits	16 bits
6	12 bits	14 bits
8	12 bits	12 bits



- *Voltage Level[V]*: this parameter defines the output voltage level (in Volt) of the LVDS to LVTTTL Digital Probe. Please note that it will take effect only when the Digital Option is installed in the instrument and with the LVDS to LVTTTL probe connected.
- *Skew[s]*: it sets the delay between the analog channels and the digital channels to de-skew the analog and digital outputs. The skew between analog/digital channels depends on the sampling frequency: the minimum skew is 1 clock cycle @ the sampling frequency. The edited value is automatically rounded to the closest value that the hardware can implement.

Marker Settings

On the marker output page, you can set the behaviour and parameters of the Marker signal that is provided at the front panel MARKER OUT BNC connector.



Marker Mode:

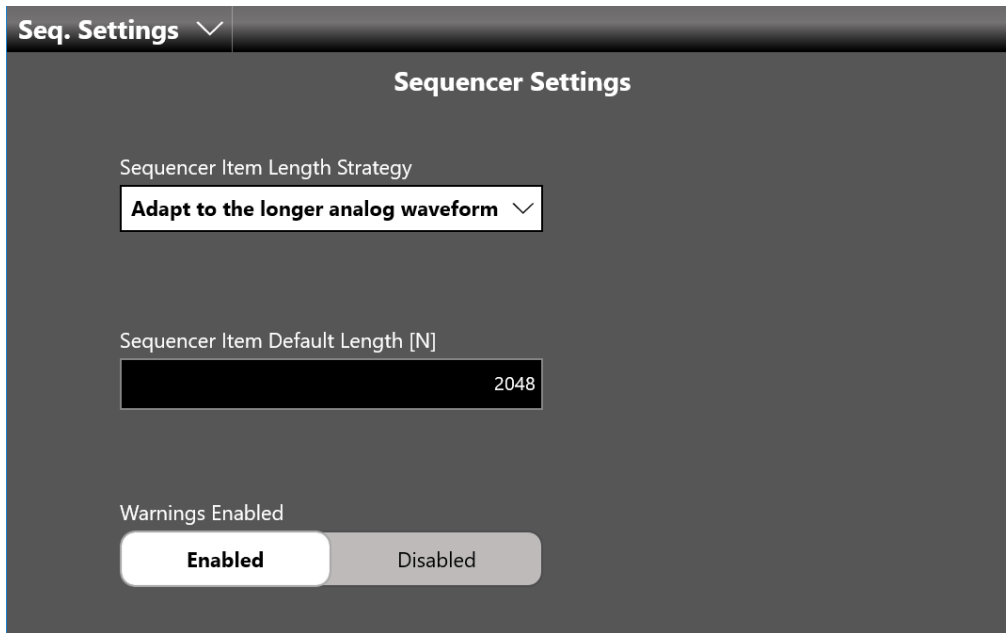
- **Automatic:** the marker has a behavior that depends on the Run Mode. In detail:
 - **Continuous:** the instrument generates a Marker pulse of the duration from 6 ns to 12 ns (depending on the sampling frequency) for each sequencer entry.
 - **Single/Burst:** each time the start event has been received, the instrument generates a Marker pulse of the duration from 6 ns to 12 ns (depending at the sampling frequency).
 - **Triggered Continuous:** each time the start event has been received, the instrument generates a Marker pulse of the duration from 6 ns to 12 ns (depending at the sampling frequency).
 - **Stepped:** each time an event has been received, the instrument generates a Marker pulse of the duration from 6 ns to 12 ns (depending at the sampling frequency).
- **Fixed To Low Voltage/ Fixed To High Voltage:** the marker level is fixed to low level or high level.
- **Replicate Digital 0:** it means that The Marker Out will behave like the Digital line 0 output. This choice is available only when the digital option is installed and the *Digital Channels* parameter (Channel Settings -> DIG page) is > 0.

Marker Skew[s]: defines the skew between the marker and the analog channels. The resolution is 78 ps. The edited value is automatically rounded to the closest value that the hardware can implement.

Voltage Level[V]: it sets the Marker high level Voltage. The Low level is fixed to 0V.

Sequencer Settings

The sequencer setting page contains some parameter to define the strategy to manage the length of the sequencer entries in relationship with the length of the channel waveforms defined for each entry.



Sequencer item Length Strategy:

- *Adapt to the longer analog waveform*: if this option is selected the length of an entry of the sequencer by default will be equal to the length of the longer channel waveform, among all analog channels, assigned to the entry.
- *Adapt to the shorter analog waveform*: if this option is selected the length of an entry of the sequencer by default will be equal to the length of the shorter channel waveform, among all analog channels, assigned to the entry.
- *Apply the default value*: if this option is selected the length of an entry of the sequencer by default will be equal to the value specified in the *Sequencer Item Default Length [N]* parameter


The length of each entry can be manually and individually overwritten by changing the Entry Length [N] parameter in the Waveform Parameters section of the Waveform Area. If a change in any channel waveform of the entry occurs, the length of the entry will be recalculated using the strategy specified in the *Sequencer item Length Strategy* parameter.

Sequencer Item Default Length [N]: this parameter specifies the length of the sequencer entries in the case when the *Sequencer item Length Strategy* parameter is set to *Apply the default value*.

Warnings Enabled: this parameter enables or disables the warnings shown in the Sequencer Toolbar and in the Waveform Area that notify that one or more channel waveforms have been assigned to an entry with a different length. This situation will cause the application to modify the mismatching waveforms during the execution to match the entry length using the strategy specified in the *Sample increasing/decreasing strategy* parameter (Device Settings -> General page).

Waveform List



Press the  button to open the Waveform List page that collects all the waveforms available in the current configuration.

Name	Length	Type
SINE	16384	Analog
RAMP	16384	Analog
SQUARE	16384	Analog
SYNC	16384	Analog
DC	16384	Analog
GAUSSIAN	16384	Analog
LORENTZ	16384	Analog
HAVERSINE	16384	Analog
EXP_RISE	16384	Analog
EXP_DECAY	16384	Analog
ZERO	16384	Digital
ONE	16384	Digital
Sine2	2048	Analog

Predefined Type: Analog Length: 16384 Description: 16384 points

Running Trigger CH 1 CH 2 **Wavef. List** Settings Default Remote Keyboard Beep More

The T3AWG3K-C series contains a set of Predefined Waveforms that are common to all configurations.

Please note: You cannot export or delete a Predefined waveform

How to import an Analog/Digital waveform from a file

Import button  allow you to import data from a file to create a new waveform

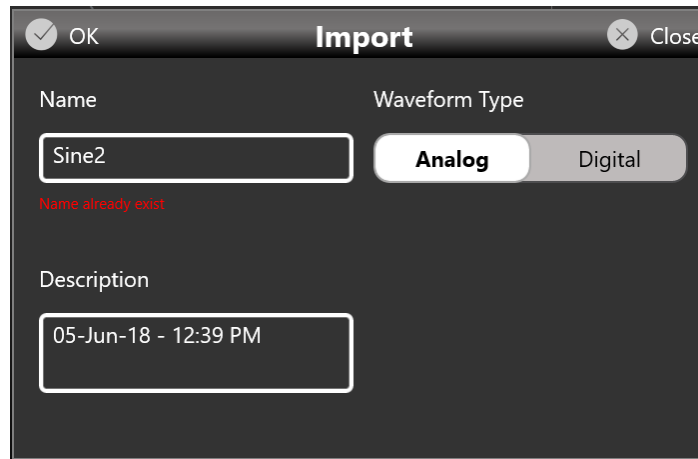
The supported file formats are:

- TXT – New line (\n) separated text file (one column only)
- .ZIP – Compressed file in binary proprietary format


1. Press the import button and the Windows File Browser will open, select the txt or zip file you would like to import. The Import page will open.
2. In the Import dialog, the Name and Description fields will be automatically filled with default values.
3. Select the Waveform Type you would like to import (“Analog” or “Digital”).
If “Analog” is selected the waveform data will be interpreted as a single column of values (the header is not allowed). The imported waveform is normalized so that the user can easily adjust its amplitude/offset using the Waveform parameters in the Graph area of the sequencer.

If “Digital” is selected each data point is represented by a 32 bit unsigned integer where the value of each bit is transferred to the corresponding digital line (Bit 0 -> Digital Line, Bit 1 -> Digital Line 1, ...).

4. Press OK to confirm or Close to cancel the operation.



How to export an Analog/Digital waveform to a file

- Select an analog or digital waveform on the waveform list
- Press the  **Export** button
- The exported waveform will be stored in a proprietary binary .zip file format that can be shared with other instruments running the same application.

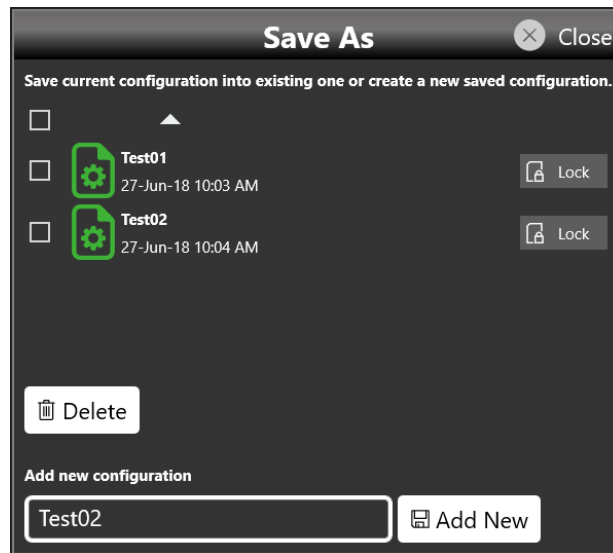
Configurations

A configuration contains the data in proprietary format relative to the channel waveforms inserted into the sequencer and all the instrument and sequencer parameters.

Save As...



A configuration can be saved by means of the “Save As” button that will open the following dialog box. The configuration will be saved in the configuration list that can be accessed by the “Load From” dialog box



On the page you can add a new configuration entry or overwrite an existing one. To create a new configuration entry, it is necessary to write a name in the text box in the bottom of the page and click on “Add New”.

Export Configuration



If you touch the Export Configuration button a proprietary binary .zip file relative to the current configuration will be exported. The exported file can be used to share configurations between different users or instruments.

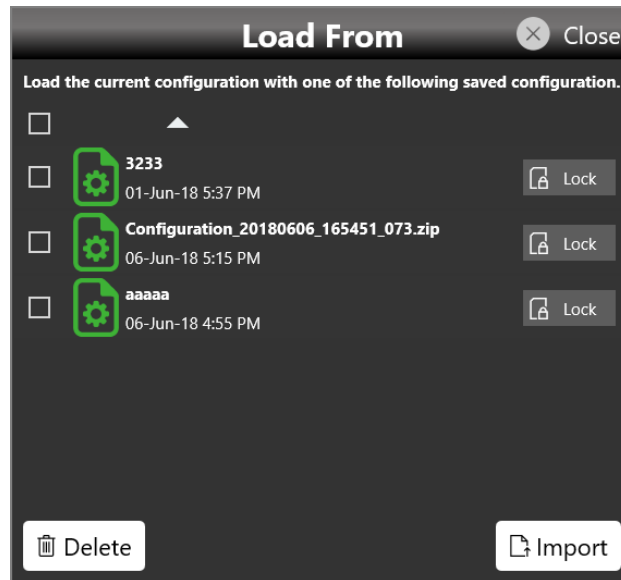
Load From...



Touching the “Load From” button in the “More” menu, a page will be opened that shows the list of all the saved and imported configurations.

If you select an existing Configuration, you will load all the settings into the instrument.

In the “Load From” page it is also possible to manage the configuration list: you can delete, import or lock a configuration. When a configuration is locked it can't be deleted or overwritten.

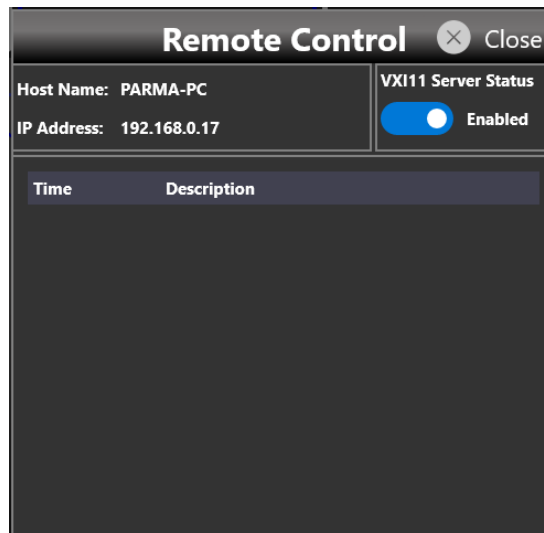


If you touch the Import Configuration button you can import the configuration file that comes from a different machine or from a different user. The imported configuration will be inserted in the “Load From” list.

Remote Control





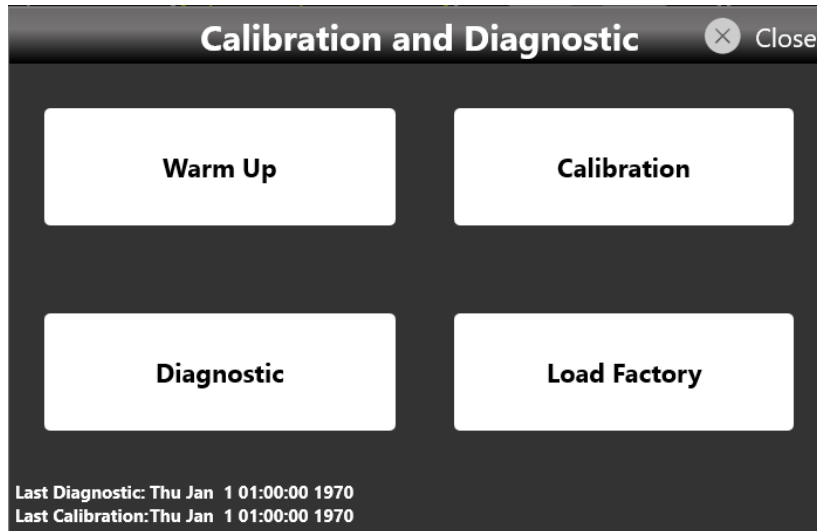
The “Remote” button located in the Command Bar opens the page of the SCPI server. In that page there is the list of all the commands received by the SCPI server and its replies. If the text of the command is displayed in **green** it means that the command is correct and it has been accepted by the server. If the text of the command is displayed in **red** it means that the command is wrong and it hasn't been accepted by the server.



In the top of the page the Host Name and the IP Address of the instrument are shown. The slider on the right side of the page allows to enable or disable the SCPI server. By default it is enabled.

Calibration and Diagnostic


To access the Calibration and Diagnostic page, select the More.. menu  then the calibration button .

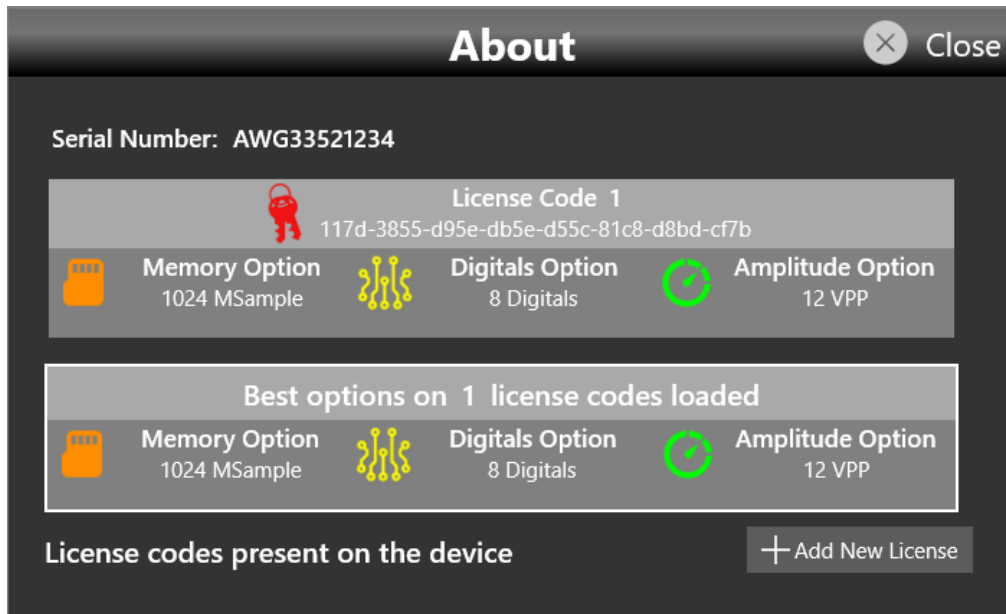


Below is a description of the actions executed by pressing the buttons located in the page:

- *Warm up* button: touching this button will start the warm up instrument procedure that will take 30 minutes. The elapsed time is shown. The procedure can be stopped by touching the Stop button located at the bottom right of the Warm Up page.
- *Calibration* button: touching this button will start the self-calibration of the instrument. The logs of the procedure are displayed in a text box that can be saved at the end of the procedure for further analysis.
- *Diagnostic* button: touching this button will start the self-diagnostic of the instrument. The logs of the procedure are displayed in a text box that can be saved at the end of the procedure for further analysis.
- *Load Factory* button: touching this button will load the factory calibration parameters.

License

To access the License page to manage the license options, select the More.. menu  then the license button



Touching the Add New License button it is possible enter a new licence key to enable any of the following licences:

- T3AWG3-M: memory extension to 256 MSamples per channel
- T3AWG3-X: memory extension to 512 MSamples per channel
- T3AWG3-XL: memory extension to 1024 MSamples per channel
- T3AWG3-HV: hi voltage output (12 Vpp on 50 Ohm)
- T3AWG3-8 DIG: 8 channel digital license
- T3AWG3-M-UPGRADE: memory extension to 256 MSamples per channel
- T3AWG3-X-UPGRADE: memory extension to 512 MSamples per channel
- T3AWG3-XL-UPGRADE: memory extension to 1024 MSamples per channel
- T3AWG3-HV-UPGRADE: hi voltage output (12 Vpp on 50 Ohm)
- T3AWG3-8DIG-UPGRADE: 8 channel digital license

To get the licence key please contact your distributor sales representative.

Appendix A – Digital Option and Accessories

When you buy the digital option, you will receive a software licence key and 1 mini-SAS HD cable 1m long.

Be careful that even if this cable has the same mechanical dimension of SFF-8644 standard the electrical connection is customized, so **it's not possible to use standard mini-SAS HD cables** otherwise the unit will be **damaged**.

There are also two additional accessories available to be used with the digital outputs. These accessories must be bought separately because they are not included in the digital option. The two accessories are:

- The T3AWG3-8DIG-SMA cable is a mini-SAS to SMA cable adapter. It allows to convert the 8 digital LVDS output of the mini-SAS connector into 16 SMA connectors (2 SMA per LVDS pair).
- The T3AWG3-8DIG-TTL is a probe that can be connected to the mini-SAS HD cable provided with the dig license. It allows to convert LVDS output of the mini-SAS HD connector into LVTTTL standard signals.

The end of the mini-SAS HD cable provided with the digital options mechanically mates with standard mini-SAS HD connectors while the **electrical connection is different from the standard**.

So if you need to connect the mini-SAS HD cable provided with the digital option you custom pcb to you can use standard mini-SAS HD connectors (e.g. Amphenol 10112626-101LF, Amphenol 10112632-101LF, Amphenol 10120666-101LF, TE Connectivity 2198484-1, TE Connectivity 2227580-1) but you should take care of using the electrical connection shown below.

The connection of the T3AWG3-8DIG-SMA cable adapter (mini-SAS HD to 16 SMA adapter cable) are also described in the table below.

Mini-SAS HD connector pinout



Mini-SAS HD connector	Assigned signal	T3AWG3-8DIG-SMA Mini SAS HD to 16 SMA cable (8 LVDS output)
A1	+12Vcc	NA
A2	+12Vcc	NA
A3	GND	SMA Ground
A4	DO7_P	RX1+
A5	DO7_N	RX1-
A6	GND	NA
A7	DO0_P	RX3+
A8	DO0_N	RX3-
A9	GND	SMA Ground
B1	CS1 (RESERVED). Do not connect.	NA
B2	+12Vcc	NA
B3	GND	SMA Ground
B4	DO6_P	RX0+
B5	DO6_N	RX0-
B6	GND	SMA Ground
B7	DO1_P	RX2+

B8	DO1_N	RX2-
B9	GND	SMA Ground
C1	+5Vcc	NA
C2	+5Vcc	NA
C3	GND	SMA Ground
C4	D5_P	TX1+
C5	D5_N	TX1-
C6	GND	SMA Ground
C7	D2_P	TX3+
C8	D2_N	TX3-
C9	GND	SMA Ground
D1	SCL (RESERVED). Do not connect.	NA
D2	SDA (RESERVED). Do not connect.	NA
D3	GND	SMA Ground
D4	D4_P	TX0+
D5	D4_N	TX0-
D6	GND	SMA Ground
D7	D3_P	TX2+
D8	D3_N	TX2-
D9	GND	SMA Ground

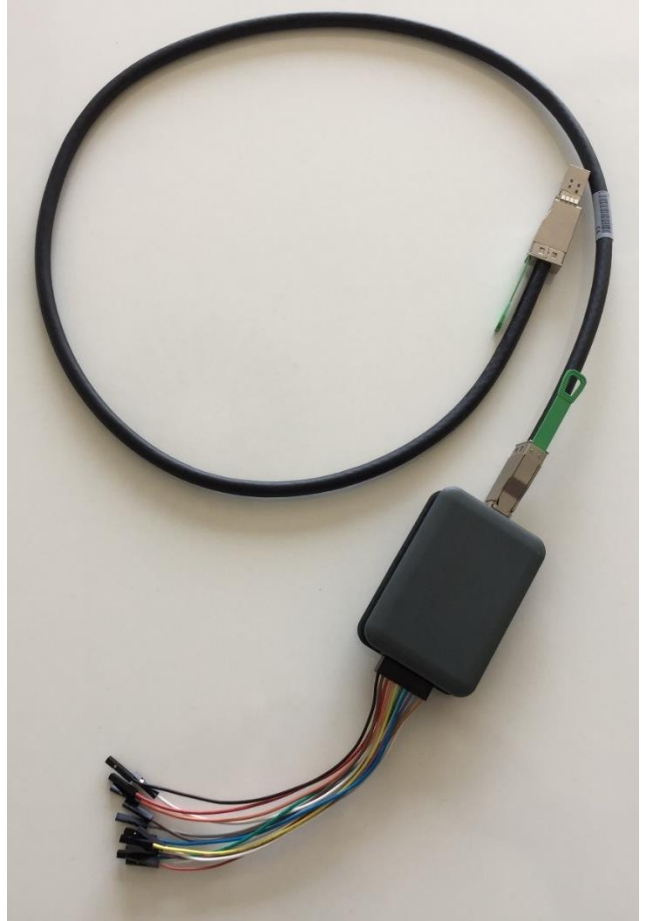
1.1 T3AWG3-8DIG-SMA



The T3AWG3-8DIG-SMA cable adapter converts from the Mini SAS HD connector located on the rear of the instrument to 16 SMA connectors. This cable ensures the best signal integrity and flexibility required for transmitting the high speed digital signals provided by the T3AWG3-CK generator series.

Output connector	SMA
Output type	LVDS
Number of SMA	16 (8 bits)
Cable type	Proprietary standard
Cable Length	1 meter

1.2 T3AWG3-8DIG-TTL

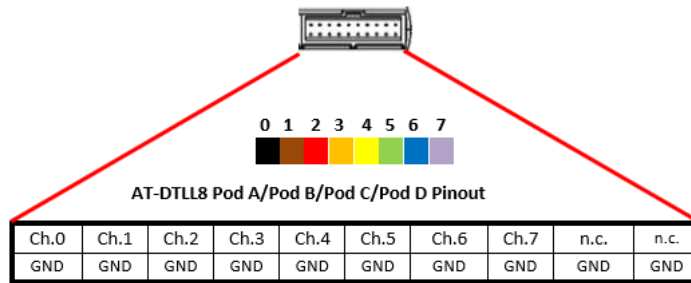


The T3AWG3-8DIG-TTL is an 8 bit LVDS to LVTTTL converter that converts LVDS differential signals provided by the mini-SAS HD digital connector to standard LVTTTL single ended signals. The probe provides the possibility to programme by software the voltage high level of the TTL signals from 0.8V to 3.8V.

The T3AWG3-8DIG-TTL probe max bit rate is 125 Mbps @ 0.8V and 400 Mbps @ 3.6V.

Important Note: the T3AWG3-8 DIG/T3AWG3-8DIG-UPGRADE does not include the T3AWG3-8DIG-TTL; that must be bought separately.

Below the description of the TTL signal connector is provided.



Output Connector	20 position 2.54 mm 2 Row IDC Header
Output Electrical Standard	LVTTTL
Output Impedance	50 Ω nominal
Output Voltage	0.8V to 3.8V programmable (same for all channels)
Maximum Update Rate	125 Mbps @ 0.8V and 400 Mbps @ 3.6V
Dimensions	W 52 mm – H 22 mm – D 76 mm
Input Connector	Proprietary standard
Cable Length	1 meter
Cable Type	Proprietary

Certifications

Teledyne LeCroy certifies compliance to the following standards as of the time of publication. Please see the EC Declaration of Conformity document shipped with your product for current certifications.

EMC Compliance

EC DECLARATION OF CONFORMITY - EMC

The instrument meets intent of EC Directive 2014/30/EU for Electromagnetic Compatibility. Compliance was demonstrated to the following specifications listed in the Official Journal of the European Communities:

EN 61326-1:2013, EN 61326-2-1:2013 EMC requirements for electrical equipment for measurement, control, and laboratory use.¹

Electromagnetic Emissions:

EN 55011:2010, Radiated and Conducted Emissions Group 1, Class A²³

EN 61000-3-2/A2:2009 Harmonic Current Emissions, Class A

EN 61000-3-3:2008 Voltage Fluctuations and Flickers, Pst = 1

Electromagnetic Immunity:

EN 61000-4-2:2009 Electrostatic Discharge, 4 kV contact, 8 kV air, 4 kV vertical/horizontal coupling planes⁴

EN 61000-4-3/A2:2010 RF Radiated Electromagnetic Field, 3 V/m, 80-1000 MHz; 3 V/m, 1400 MHz - 2 GHz; 1 V/m, 2 GHz - 2.7 GHz

EN 61000-4-4/A1:2010 Electrical Fast Transient/Burst, 1 kV on power supply lines, 0.5 kV on I/O signal data and control lines⁴

EN 61000-4-5:2006 Power Line Surge, 1 kV AC Mains, L-N, L-PE, N-PE⁴

EN 61000-4-6:2009 RF Conducted Electromagnetic Field, 3 Vrms, 0.15 MHz - 80 MHz

EN 61000-4-11:2004 Mains Dips and Interruptions, 0%/1 cycle, 70%/25 cycles, 0%/250 cycles⁴⁵

¹ To ensure compliance with all applicable EMC standards, use high-quality shielded interface cables.

² Emissions which exceed the levels required by this standard may occur when the instrument is connected to a test object.

³ This product is intended for use in nonresidential areas only. Use in residential areas may cause electromagnetic interference.

⁴ Meets Performance Criteria "B" limits of the respective standard: during the disturbance, product undergoes a temporary degradation or loss of function or performance which is self-recoverable.

⁵ Performance Criteria "C" applied for 70%/25

Safety Compliance

EC DECLARATION OF CONFORMITY – LOW VOLTAGE

The instrument meets intent of EC Directive 2014/35/EU for Product Safety. Compliance was demonstrated to the following specifications as listed in the Official Journal of the European Communities:

EN 61010-1:2010 Safety requirements for electrical equipment for measurement, control, and laboratory use – Part 1: General requirements

EN 61010-2:030:2010 Safety requirements for electrical equipment for measurement, control, and laboratory use – Part 2-030: Particular requirements for testing and measuring circuits

The design of the instrument has been verified to conform to the following limits put forth by these standards:

- Mains Supply Connector: Overvoltage Category II, instrument intended to be supplied from the building wiring at utilization points (socket outlets and similar).
- Measuring Circuit Terminals: No rated measurement category. Terminals not intended to be connected directly to the mains supply.
- Unit: Pollution Degree 2, operating environment where normally only dry, non-conductive pollution occurs. Temporary conductivity caused by condensation should be expected.

Environmental Compliance

END-OF-LIFE HANDLING



The instrument is marked with this symbol to indicate that it complies with the applicable European Union requirements to Directives 2012/19/EU and 2013/56/EU on Waste Electrical and Electronic Equipment (WEEE) and Batteries.

The instrument is subject to disposal and recycling regulations that vary by country and region. Many countries prohibit the disposal of waste electronic equipment in standard waste receptacles. For more information about proper disposal and recycling of your Teledyne LeCroy product, please visit teledynelecroy.com/recycle.

RESTRICTION OF HAZARDOUS SUBSTANCES (RoHS)

This instrument and its accessories conform to the 2011/65/EU RoHS2 Directive.