



# Model 676

## High Performance AWG

## Simple Rider SW User Manual

Rev 2.0, July 2020



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# General Safety Summary

Review the following safety precautions to avoid injury and prevent damage to this product or any products connected to it.

To avoid potential hazards, use this product only as specified.

*Only qualified personnel should perform service procedures.*

## To Avoid Fire or Personal Injury

### Use Proper Power Cord

Use only the power cord specified for this product and certified for the country of use.

### Ground the Product

This product is grounded through the grounding conductor of the power cord. To avoid electric shock, the grounding conductor must be connected to earth ground. Before making connections to the input or output terminals of the product, ensure that the product is properly grounded.

### Observe All Terminal Ratings

To avoid fire or shock hazard, observe all ratings and markings on the product. Consult the product manual for further ratings information before making connections to the product.

### Power Disconnect

The power cord provides Mains disconnect.

### Do Not Operate Without Covers

Do not operate this product with covers or panels removed.

### Do Not Operate With Suspected Failures

If you suspect that there is damage to this product, have it inspected by qualified service personnel.

### Avoid Exposed Circuitry

Do not touch exposed connections and components when power is present.

### Do Not Operate in Wet/Damp Conditions.

### Do Not Operate in an Explosive Atmosphere.

### Keep Product Surfaces Clean and Dry.

### Provide Proper Ventilation

Refer to the manual's installation instructions for details on installing the product so it has proper ventilation.

# Safety Requirements

This section contains information and warnings 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 safety precautions specified in this section.

## Safety Symbols

Where the following symbols appear on the instrument's front or rear panels, or in this manual, they alert you to important safety considerations.



instrument.

This symbol is used where caution is required. Refer to the accompanying information or documents in order to protect against personal injury or damage to the



This symbol warns of a potential risk of shock hazard.



This symbol is used to denote the measurement ground connection.



This symbol is used to denote a frame or chassis connection.



This symbol is used to denote a safety ground connection.



On (Supply). This is the DC power connect/disconnect switch at the back of the instrument.



Off (Supply). This is the DC power connect/disconnect switch at the back of the instrument.



This symbol is used to denote Power. It is located on the front panel and denotes Power On/Off status of the instrument.



This symbol is used to denote Direct Current.

---

**CAUTION**

The **CAUTION** sign indicates a potential hazard. It calls attention to a procedure, practice or condition which, if not followed, could possibly cause damage to equipment. If a **CAUTION** is indicated, do not proceed until its conditions are fully understood and met.

---

**WARNING**

The **WARNING** sign indicates a potential hazard. It calls attention to a procedure, practice or condition which, if not followed, could possibly cause bodily injury or death. If a **WARNING** is indicated, do not proceed until its conditions are fully understood and met.

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**CAT I**

Installation (Overvoltage) Category rating per EN 61010-1 safety standard and is applicable for the instrument front panel measuring terminals. CAT I rated terminals must only be connected to source circuits in which measures are taken to limit transient voltages to an appropriately low level.

## Operating Environment

The instrument is intended for indoor use and should be operated in a clean, dry environment. Before using this product, ensure that its operating environment is maintained within these parameters:

**Temperature:** 0 °C to 50 °C.

**Humidity:** Maximum relative humidity 80% (non-condensing) for temperatures up to 40 °C decreasing linearly to 50 % relative humidity at 50 °C.

**Altitude:** Up to 10,000 ft (3,048 m) at or below 30 °C.

## AC Power Source

For External AC Adapter: 100 to 240 VAC (+/-10%) at 45-66 Hz; Automatic AC voltage selection;

Installation Category: 300V CAT II

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

## Power Consumption

$\leq 120$  watts



**WARNING - Electrical Shock Hazard**

Only use the power cord provided with your instrument.

## Calibration

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

## Cleaning

Clean only the exterior of the instrument, using a damp, soft cloth. Do not use chemicals or abrasive elements. Under no circumstances allow moisture to penetrate the instrument.

## 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.

# Environmental Considerations

This section provides information about the environmental impact of the product.

## Product End-of-life Handling

Observe the following guidelines when recycling an instrument or component.

## Equipment Recycling

Production of this equipment required the extraction and use of natural resources. The equipment may contain substances that could be harmful to the environment or human health if improperly handled at the product's end of life. In order to avoid release of such substances into the environment and to reduce the use of natural resources, we encourage you to recycle this product in an appropriate system that will ensure that most of the materials are reused or recycled appropriately.



The symbol shown to the left indicates that this product complies with the European Union's requirements according to Directive 2002/96/EC on waste electrical and electronic equipment (WEEE).

# Operating Requirements

## Power Supply

Source Voltage and Frequency	100 to 240 VAC ±10% @ 47-63Hz					
	115VRMS@400Hz					
	Characteristic	condition	Min.	Nom.	Max.	Units
	Voltage	45-66Hertz	85	100-240	264	VRMS
	Amplitude	360-440 Hertz	100	115	132	VRMS
Power Consumption	Voltage Wave shape	All	Sine			
	Maximum: 120W					
Surge Current	30 A peak (25°C) for 5 line cycles, after product has been turned off for at least 30 s.					

## Mechanical Characteristics

Net Weight	9.7kg
Net Weight with Package	10.7 kg
Overall Dimensions	Height: 160 mm Width: 450 mm Depth: 340 mm
Dimensions with Package	Height: 210 mm Width: 500 mm Depth: 400 mm

## Environmental Characteristics

Temperature	Operating +5 °C to +50 °C (+41 °F to 122 °F) Non-operating -20 °C to +60 °C (-4 °F to 140 °F)
Humidity	Operating 8% to 90% relative humidity with a maximum wet bulb temperature of 29 °C at or below +50 °C, non-condensing Non-operating 5% to 98% 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)

## Preface

This manual describes the installation and operation of Model 676 High Performance AWG using the Simple Rider software. Basic operations and concepts are presented in this manual.

The easiest touch screen display interface (SimpleRider™) allows to generate a signal only in few screen touches.

The Model 676 High Performance AWG offers premium signal integrity thanks to the 14 bit DAC, the signal reaches 5 Volts pk-pk into 50 Ohm single ended or 10 Vpp into 100 Ohm differential, more it is possible to move the Common Mode Voltage between  $\pm 2.5$  V. The calculated analog bandwidth is 460 MHz, but thanks to the flat-band compensation the Model 676 High Performance AWG can generate a sine function up to 600 MHz.

Its software architecture provides the possibility to generate predefined pulses and modulation or to load a waveform from a file.

## Package Contents

The standard Model 676 High Performance AWG Series package includes the following:

- Model 676 Arbitrary Waveform Generator instrument
- Power Cord

- Performance/Calibration Certificate
- Model 676 Introduction and Compliance document

## Recommended Accessories

Item	Description
<b>RM KIT</b>	Rack Mount Kit
<b>SSD KIT SA</b>	SSD Solid State Drive for Secure Area
<b>WAR EXT</b>	Warranty Extension
<b>CAL. CERT</b>	Certification of Calibration

# Introduction

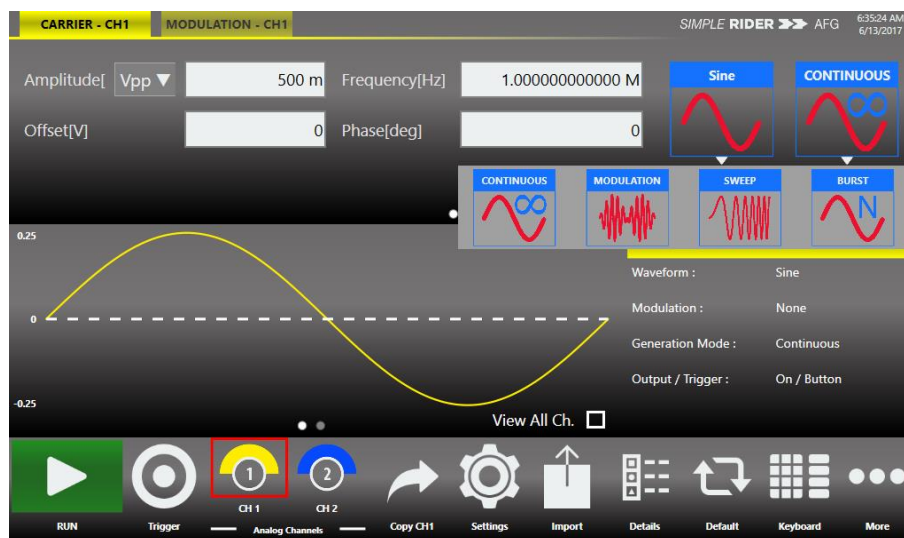
Arbitrary Function Generator has two independent channels. Each channel can generate a predefined function or a user defined waveform loaded from a file.

When you select a function, the display shows the characteristic parameter of the chosen function, for example if you choose the pulse waveform, you can set amplitude, offset, frequency, duty cycle and the duration of leading and trailing edge.

## Run Mode

The instrument can be used in different run mode, each one offers different skills:

- **Continuous:** the selected waveform is generated in continuous way until the stop button is not pressed.
- **Modulation:** allows to select among different type of modulation. The modulating source can be a predefined waveform, a user defined waveform loaded from a file or an external analog signal.
- **Sweep:** changes the frequency on time following a defined profile. You can choose the sweep profile between linear, logarithmic, upstairs and user defined.
- **Burst:** allows to generate a defined or infinite number of waveform cycle starting after the reception of a trigger signal. The gated mode generates only when the trigger is true.



## Touch Screen display and Soft Keyboard

The new Rider Series delivers 7" capacitive touch-screen display and the touch-screen friendly SimpleRider™ software allows users to generate pulses quickly by a few screen touches.



The UI ergonomic approach is well balanced to offer multiple ways to operate the instrument by offering a complementary soft keyboard and a useful central knob for fine-tuning and adjustments during the set-up operation.

## Simple Rider Touch User Interface

All instrument controls and parameters are accessed through an intuitive UI that recalls the simplicity of Tablets and modern smartphones: touch features and gestures are available to engineers and scientists to create signals or modulations in few touches.

The swipe gesture gives easy access to the output and signal parameters.



- A touch-friendly virtual numeric keypad has been designed to improve the user experience on entering the data.
- Time saving shortcuts and intuitive icons simplify your setup also during signal combination operations.
- Model 676 supports the most common interfaces for remote control (Ethernet) for easy customized instrument programming

## Power the Instrument On and Off

### **Power On**

- Insert the AC power cord into the power receptacle on the rear panel.
- Use the front-panel power button to power on the instrument.
- Wait until the system shows windows desktop.
- The Simple Rider software will start automatically

### **Power Off**

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

## 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.



The instrument has both input and output connectors on the front panel. When connecting a cable, be sure to distinguish the input connectors from the output connectors.



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

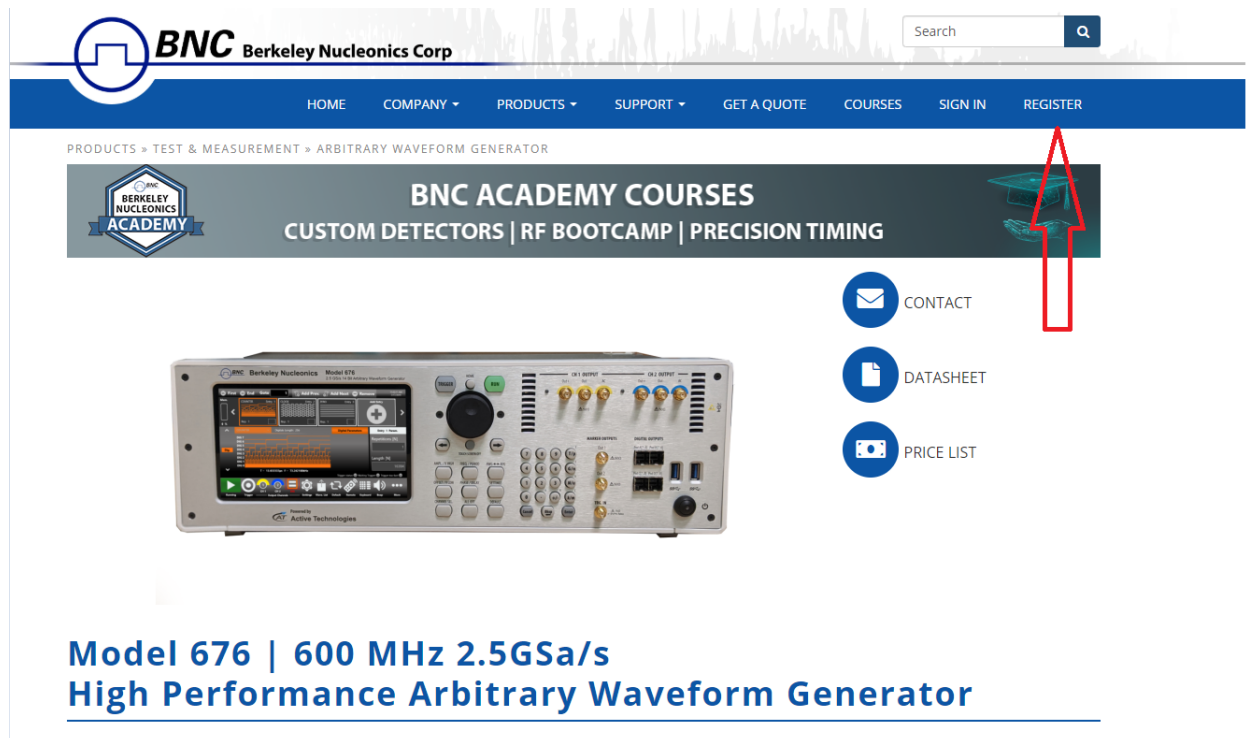


**CAUTION.** Do not apply excessive inputs over  $\pm 15 V_{pk}$  to Trigger Input connector. The instrument may be damaged.

## Obtaining the Latest Version Releases

The latest version of an optional application that you ordered with your instrument may not be installed on your instrument. The following download location is a fast and easy way to get the latest software version.

To download the latest version of software, register on the website; go to the home page of the Berkeley Nucleonics website ([www.berkeleynucleonics.com](http://www.berkeleynucleonics.com)), press the Register button in the upper right of your screen.



**Model 676 | 600 MHz 2.5GSa/s  
High Performance Arbitrary Waveform Generator**

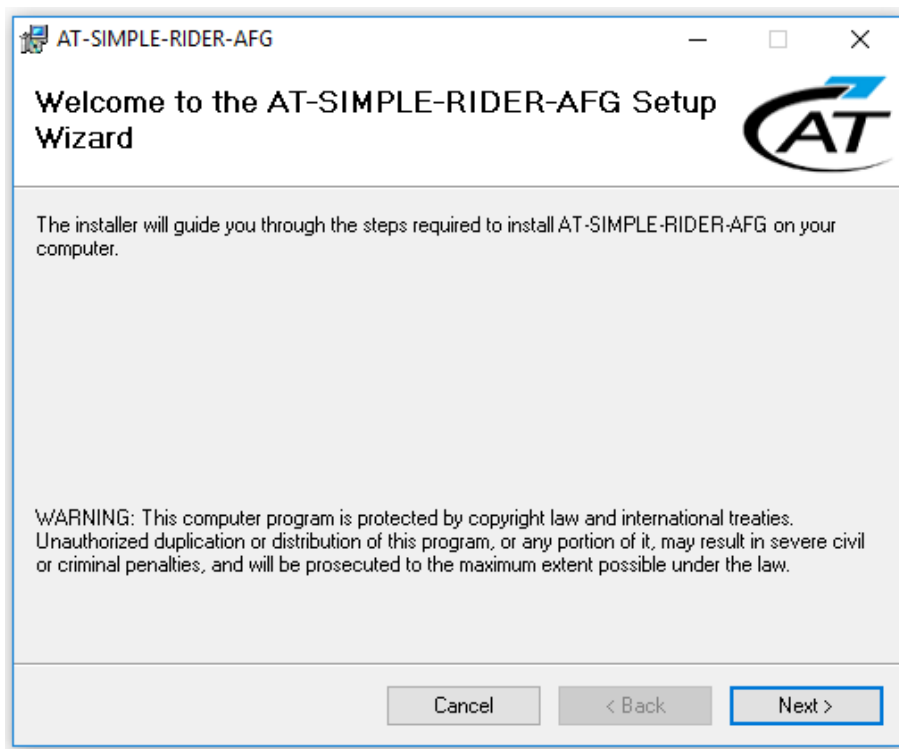
## Install Model 676 Simple Rider Application

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

1. Download the Model 676 Simple Rider setup package from Berkeley Nucleonics 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

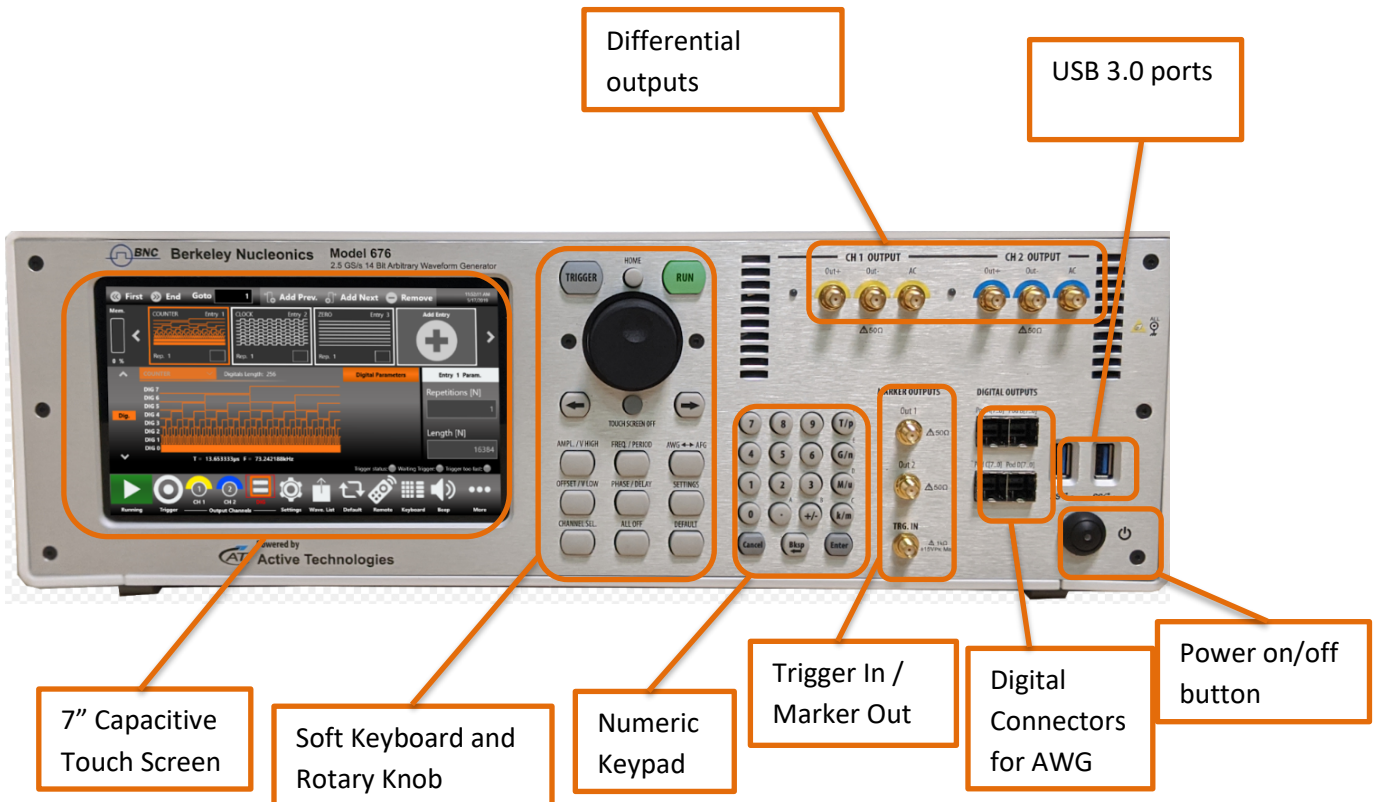
2. Double click on the "setup.exe" to start the installation.
3. Follow the steps and click next to continue the procedure.



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

# Instrument Overview

## Front Panel



The Touch screen functionalities and features are described in the Simple Rider Software section.

## Analog Channel Outputs

Each channel controls two SMA output connector, one for the positive signal and one for negative one.

OUTPUT 1 – Differential DC Coupled Analog output 1 (SMA connector).

OUTPUT 2 – Differential DC Coupled Analog output 2 (SMA connector).

Each connector is coupled at 50 Ohm then in single ended operation the source impedance is 50 Ohm, instead in differential operation the source impedance is 100 Ohm.

The connectors named AC is not used in Simple Rider (AFG) mode, but they are used only in Expert Rider (AWG) mode.

## Trigger Input / Marker Output

TRG.IN - SMA input connector for Trigger IN. The **Trigger In** input has a fixed impedance of 1 kOhm and a programmable threshold level in the range -10 V to 10 V.

MARKER 1 / 2 - SMA output connector are the **Marker Out** of the two channels. The **Marker Out** impedance is 50 Ohm and the output voltage amplitude ranges from 1 V to 2.5 V into 50 Ohm load.

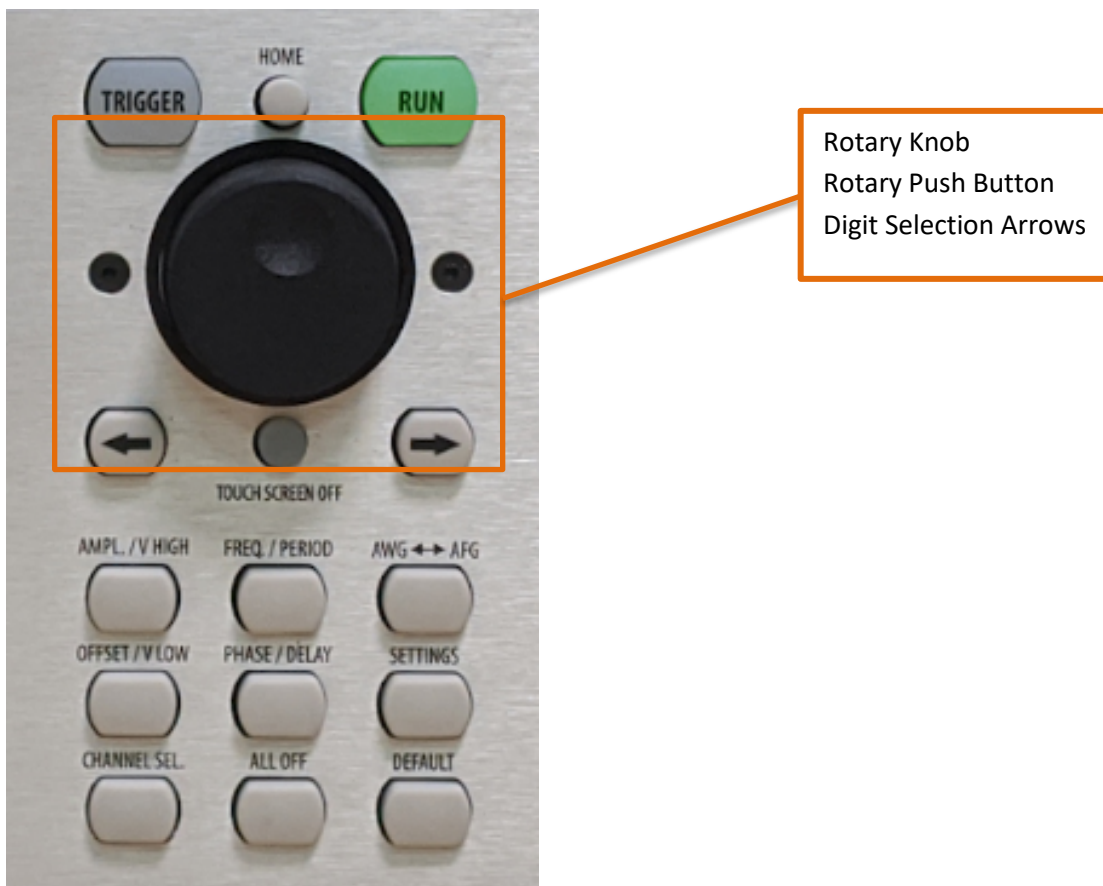
## Front Panel Buttons

Most of the buttons you use with Simple Rider application 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 right. You can keep pressed the rotating knob and rotate it on the right or on the left to change the Delta increment.



Button	Description
<b>HOME</b>	If you are in a software sub-menu page, use this button to return to the main page.
<b>TRIGGER</b>	Use this button to send an internal trigger to the instrument.
<b>RUN</b>	Use this button to start and stop the signal generation. When the button led is <b>green</b> , it means that the instrument is in stopped state. If you press the button the instrument will be armed (running state) and the led will turn to <b>red</b> : the instrument generates the signal or it is ready to receive the trigger signal.
<b>LEFT ARROW</b>	Once the virtual numeric keypad will be opened, use this button to move left the digit selection cursor.
<b>RIGHT ARROW</b>	Once the virtual numeric keypad will be opened, use this button to move right the digit selection cursor.
<b>TOUCH SCREEN OFF</b>	Use this button to disable the touch screen.
<b>AMPL./V HIGH</b>	Use this button to set the high voltage level or the amplitude of the waveform.
<b>FREQ/PERIOD</b>	Use this button to set the period or the frequency of the waveform.
<b>AWG &lt;-&gt; AFG</b>	Use this button to switch between Simple Rider (AFG) and Expert Rider (AWG) operation.
<b>OFFSET/V LOW</b>	Use this button to set the low voltage level or the offset of the waveform.
<b>PHASE/DELAY</b>	Use this button to set the delay or the phase of the waveform.
<b>SETTINGS</b>	Use this button to open the Settings page
<b>CHANNEL SEL.</b>	Use this button to change the output selection in the user interface
<b>ALL OFF</b>	Use this button to turn off all the outputs.
<b>DEFAULT</b>	Use this button to restore the default settings.

## Front Panel Numeric Keypad

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

Use the touch panel to select the parameter, each number pressed 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 entry. After the sign and numeric portion of the desired value have been punched in, the pressing of the multiplier button applies the parameter. The Enter button close the virtual keyboard and applying the written value.





When you select a parameter on the user interface, if you press a multiplier button it will automatically set the available range linked to the parameter.

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

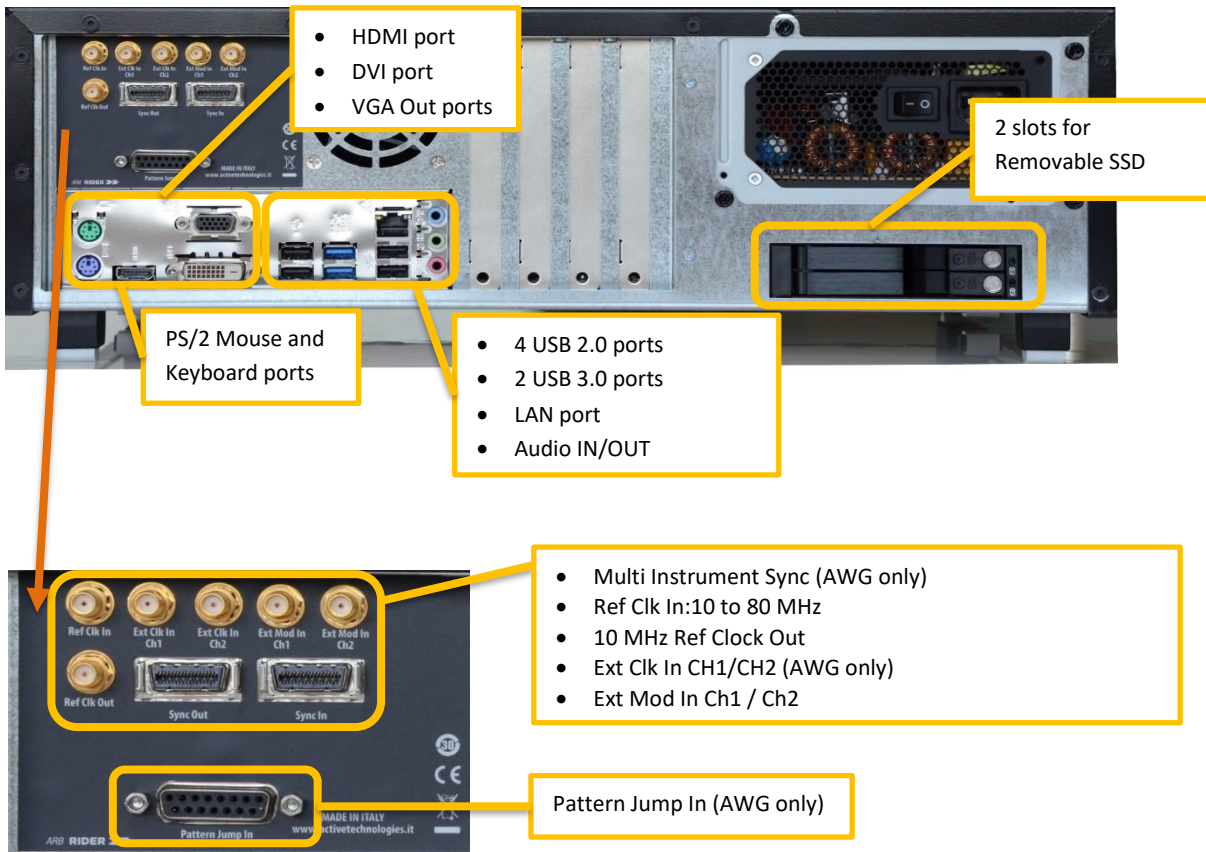
As example when you select a Frequency parameter and you press k/m the unit measure range that will be inserted is kHz, if you press M/u it will be inserted MHz, if you press G/n it will be inserted GHz, if you press T/p nothing will happen because that range is not available for the selected parameter.

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



## Rear Panel

The callouts on this image correspond with the following descriptions.



## External Modulation Connectors

The Model 676 High Performance AWG has 2 input connectors (one for each channel) to receive an external signal and use it as modulating source. When the selected Run Mode is “Modulation” and the source is “External” the instrument sample that signal at 50 MS/s and use it to modulate the carrier waveform.

For the specification please refer to the Auxiliary Channels section.

## Reference Clock Connectors

The Model 676 High Performance AWG can use an external clock source to generate the sampling clock at 2.5 GS/s. This feature allows to synchronize the generator with an external clock.

For the specification please refer to the Auxiliary Channels section.

### Reference Clock Out Connector

This connector generates the low frequency clock used as reference for the sampling clock. If the clock source is internal it produces a signal at 10 MHz, but if the source is external it generates the reference frequency.

For the specification please refer to the Auxiliary Channels section.

# Simple Rider Software

The Model 676 High Performance AWG includes a 7" capacitive touch screen and Simple Rider touch user interface based on a Microsoft Windows platform.

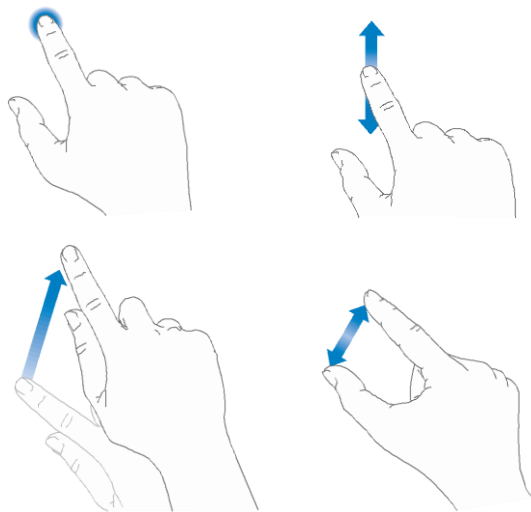
You can control instrument operations using the following:

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

## Simple Rider Touch UI

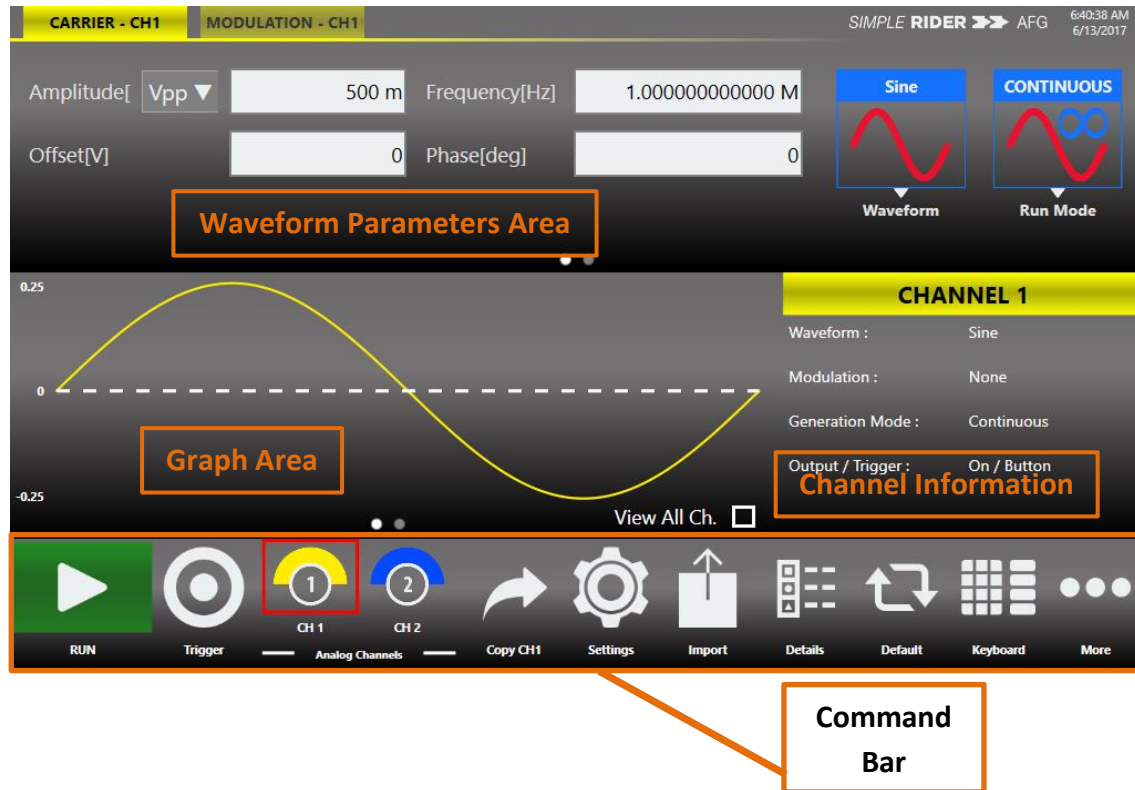
Simple Rider UI is designed for touch to drive simplicity in operating with a pulse generator, by optimizing the today's modern technique, used on Tablet or smart phones, of capacitive touch-screen display.

All the important instrument controls and settings are always one touch away: swipe gesture to change the channel, Carrier / Modulation tab selection and have access to the modulation parameters, use the touch-friendly virtual numeric keyboard to change parameter values on the fly.



## User Interface Description

The Simple Rider software environment provides an easy access to all product functions and parameters.



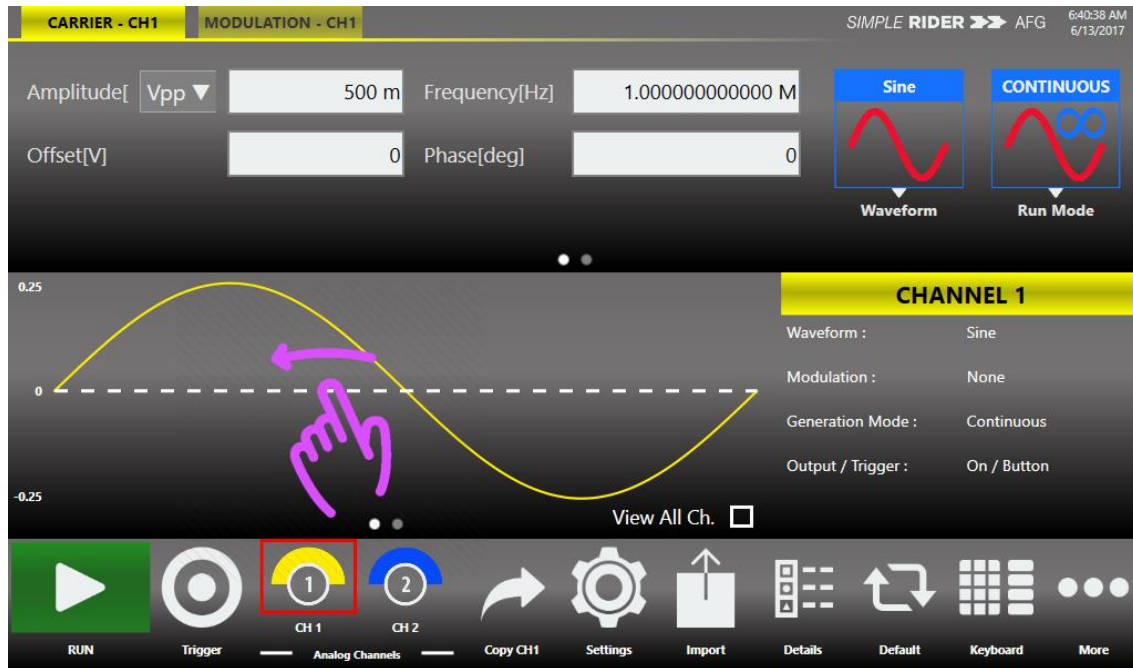
It consists of four main elements:

- **Waveform Parameters Area:** It contains all the waveform setting. It is composed by the **Carrier** tab and the **Secondary** tab.  
The **Carrier** tab allows to choose the Run Mode and the Waveform and to set its parameters.  
The **Secondary** tab is used to set the parameter of **Modulation**, **Sweep** or **Burst** depending on the selected Run Mode.
- **Graph Area:** It show a qualitative graph of the signal.
- **Channel Information:** It summarize the channel settings.
- **Command Bar:** In that bar are available other setting explained below.

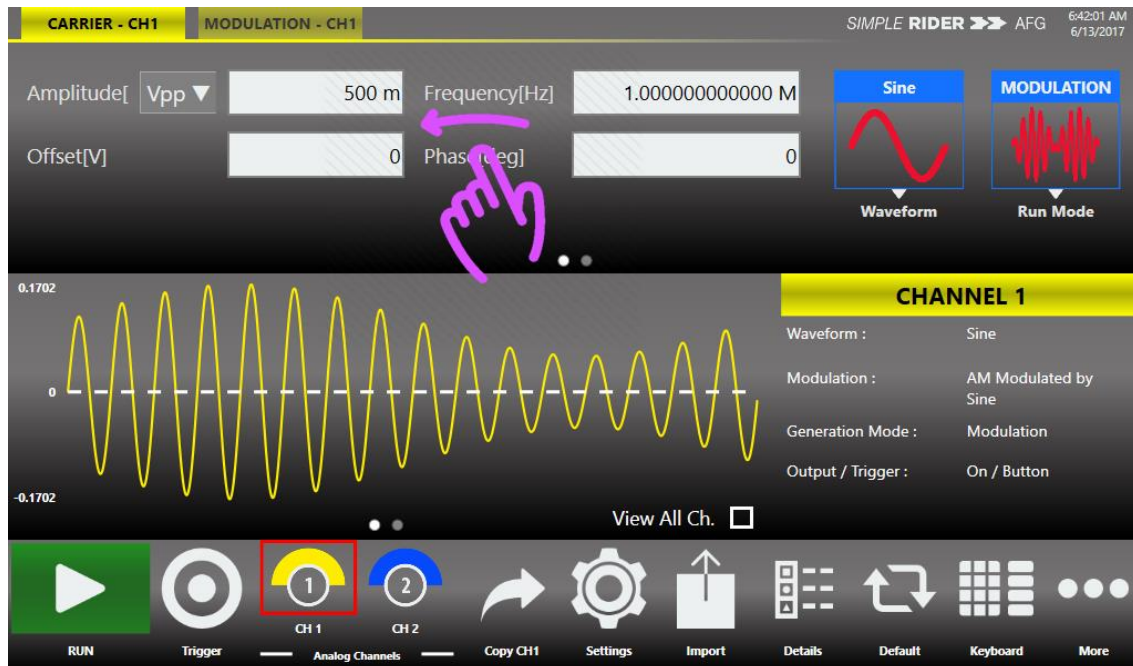
As mentioned, the display is 7" capacitive touch screen display and you can have access to parameters and generate pulses quickly by a few screen touches.



If you use the Swipe left or right gesture on the Graph Area you change the Output channel page.



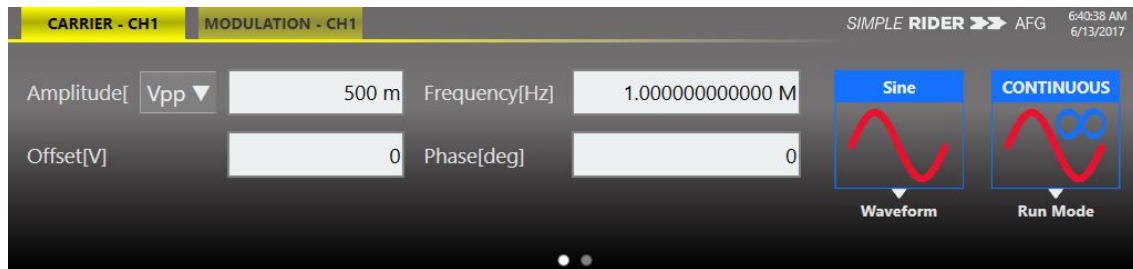
If you use the Swipe left or right gesture on the Waveform Parameter Area you switch the page between Carrier tab and the Secondary tab. The Secondary tab can be Modulation, Sweep or Burst depending on the selecting Run Mode.



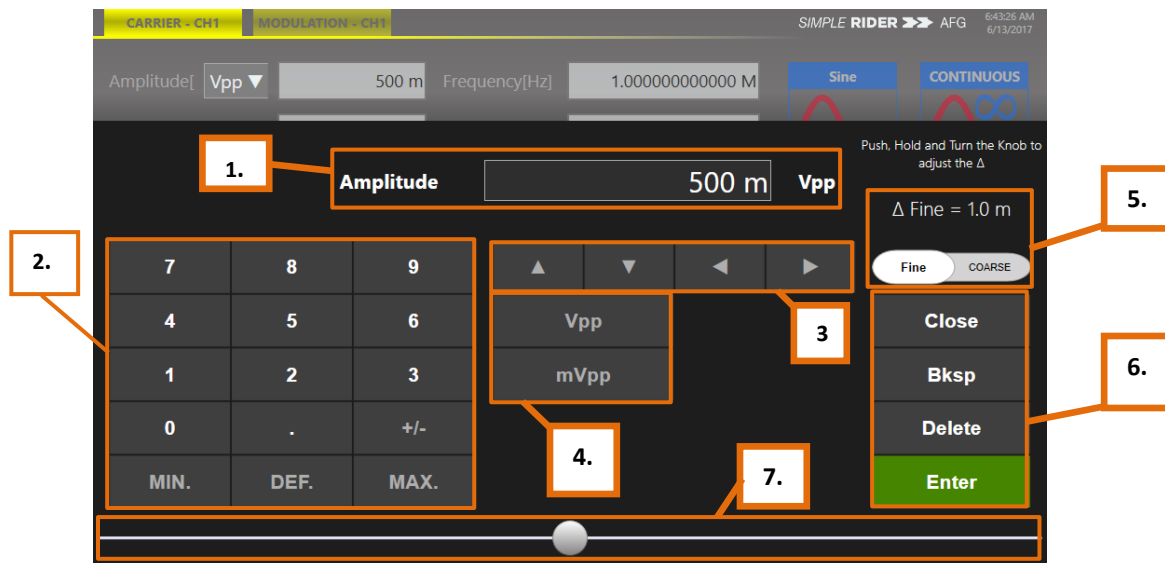
## Waveform Parameters Area

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

- The **Carrier** tab give you access to the selection of the Run Mode, of the Carrier Waveform and its parameters explained in the relative chapter.
- The **Secondary** tab allow you to select the parameter relatives at **Modulation**, **Sweep** and **Burst**. This tab changes name and function depending on the selected Run Mode, for example when you select Sweep as Run Mode in the tab title appears “Sweep” and the tab shows the Sweep parameter; the same thing happens for Modulation and Burst, in Continuous Run Mode it is not active.

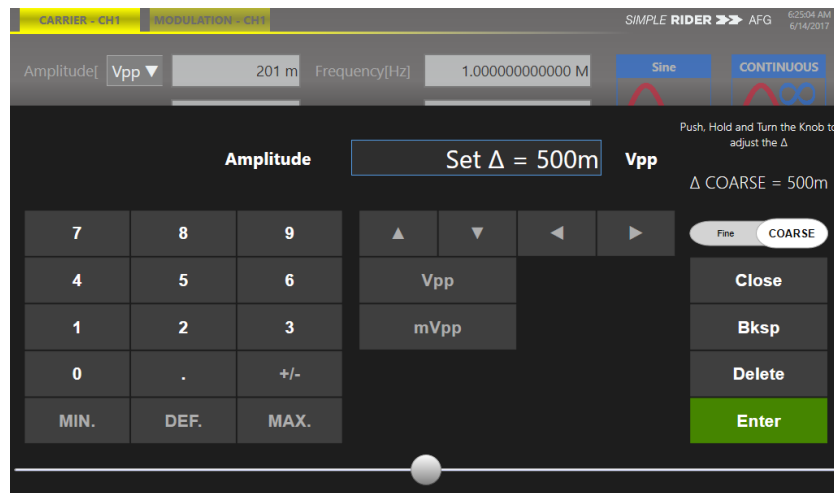


You can touch the parameter area to open the Virtual numeric keypad, edit the parameter value and its measure unit.



1. **Parameter Name and Value:** This area of the virtual keyboard displays the parameter name, value and unit of measure.
2. **Numeric Keypad:** Each number pressed will be displayed in the area 1, the [+/-] key will toggle the sign of the number being entered and can be pressed after terminating the entry. 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 numbers these buttons apply 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 set to the minimum resolution; more if you touch a digit it selects and the variations are applied to that digit.  
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.

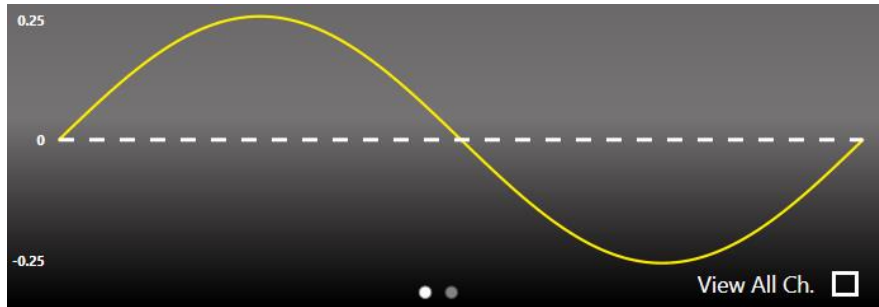


6. **Control Buttons:** The “Close” button closes the virtual keypad without applying any changes on the instrument while the “Enter” button confirms the changes and it applies them on the instrument.  
“Bksp” (backspace) button is provided for deleting erroneous key presses, “Delete” button deletes 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.

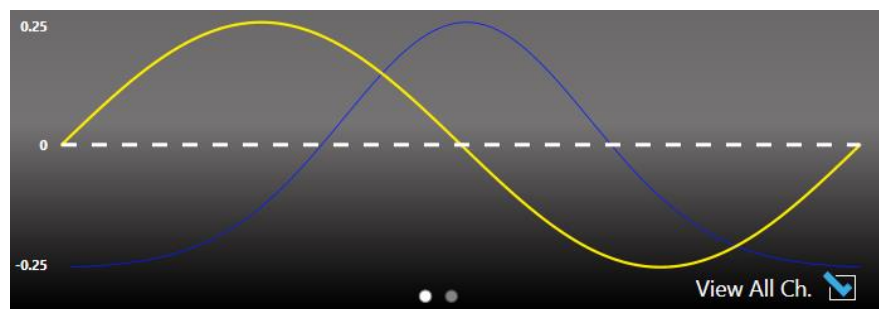
## Graph Area

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





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



### Channel Information

This area displays the channel name and a list with all the main current channel settings that are the selecting waveform, the Modulation / Sweep / Burst mode, the Generation mode, the channel status and the Trigger Source.



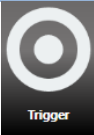



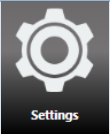

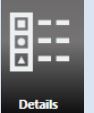
CHANNEL 1	
Waveform :	Sine
Modulation :	None
Generation Mode :	Continuous
Output / Trigger :	On / Button

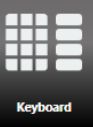

### Command Bar Area









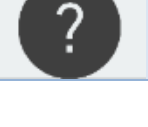
The command bar contains several touch buttons to control the instrument, the following table describes them in detail.





Command Bar Buttons	Description
 STOP  RUN	<b>START/STOP Button</b> – Use this button to set the instrument in Running state (or Ready to receive a Trigger) or in Stop state. If you press start when all channels are off, you will receive a message asking you to activate the channels.
 Trigger	<b>Trigger Button</b> – Use this button to send an internal software trigger to the instrument. Independently from the setting this trigger is always received.
 Analogs Channels	<b>Output Channels Buttons</b> - 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 disconnected through a relay.
 Copy CH1	<b>Copy Ch1 (Ch2) Button</b> – Use this button to copy all 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 or the channel 2 depending on the selecting one.
 Settings	<b>Settings Button</b> – Use this button to open the output channel Settings and device Settings. (For more information, please refer to the relative section).
 Import	<b>Import Button</b> – Use this button to open the page where you can load a waveform from a file and set it as Carrier Waveform, Modulation Law or Sweep Profile. (For more information, please refer to the relative section).
 Details	<b>Details Button</b> – Use this button to open a page that summarize all channel settings.

	<b>Numeric Keyboard Button</b> – Use this button to enable or disable the virtual numeric keyboard.
	<b>More Button</b> – Use this button to have access to other instrument features. These buttons are explained in the following table.

More Button Menu Items	Description
	<b>Exit Button</b> – Press this button to close the application.
	<b>Minimize Button</b> – press this button to minimize the application screen; in this way you can access to Windows OS.
	<b>Load Setting Button</b> – Use this button to load user instrument settings from a file called Memory. (For more information, please refer to the relative section).
	<b>Save Setting Button</b> – Use this button to store the instrument settings to a file called Memory. (For more information, please refer to the relative section).
	<b>Windows Keyboard Button</b> – Use this button to Enable or Disable the alphanumeric keyboard.
	<b>Remote Control Button</b> – Use this button to open the SCPI server page. In that page you can enable or disable the SCPI server and see the command sent to the instrument and the response.
	<b>Beep Button</b> – Use this button to enable or disable the beep audio signal when the user touches a button.
	<b>About Button</b> – Use this button to check the credits, the software, the firmware release number and the instrument serial number.
	<b>Help Button</b> – Use this button to open the User Manual.

## Input / Output Channel

The Model 676 High Performance AWG has 2 independent analog channels, each channel is differential then it drives 2 SMA connector on the front panel.

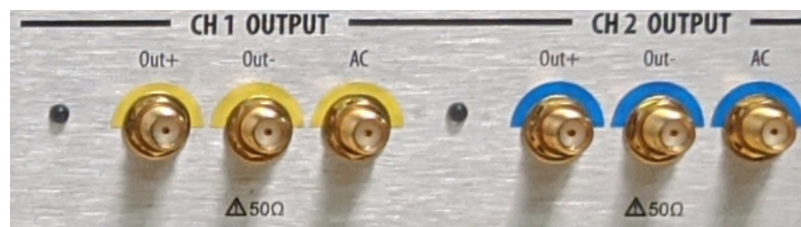
For each channel, it is available a Marker Out and an External Modulation Input SMA connector. The Trigger In, the External Clock Reference and the Reference Clock Out connectors are shared between channels.

## Analog Output Channel

The term Output Channel as used in this user manual, refers to the analog signal at the SMA output connectors (labels OUT1+/-, OUT2+/-) on the front panel.

For some parameters the Simple Rider application supports different input formats, for example the frequency of a waveform can be set directly or entering the corresponding a period value. If different input formats are available touching the parameter label the input format switches.

Note that the input format is the same for the two channels, then if you select the format High/ Low Level on the channel 1, also the channel 2 use that format.



## Main Channels Vertical Parameters

The Simple Rider 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 format.

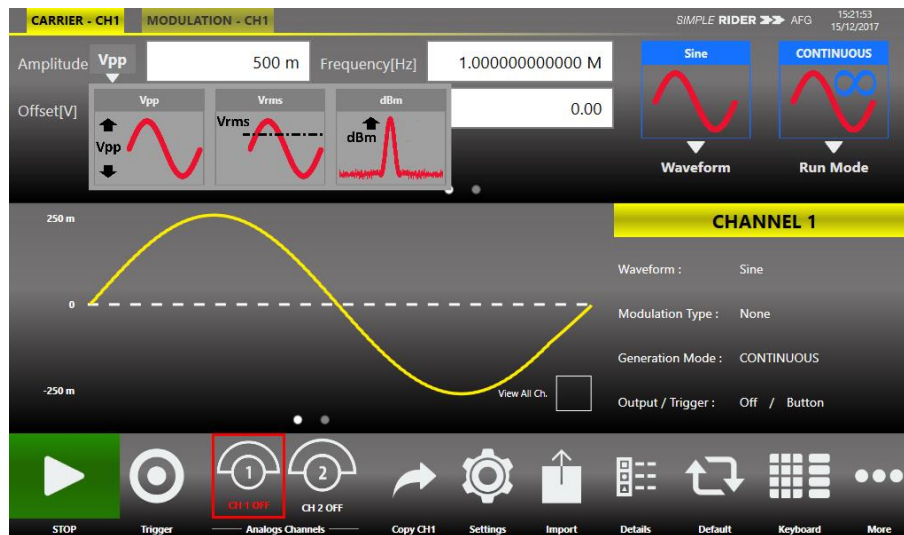
The output signal levels indicated by the SimpleRider UI textbox will be delivered into the selected impedance that by default is 50 Ohm. To change the load impedance please refer to the Channel Settings.

**Note:** for non-symmetrical with respect to 0 V functions such as Sinc and Gaussian, the amplitude is half the entered value because the system considers the amplitude of the window between -Vpk and +Vpk. For example, if you select a Sinc waveform and set the amplitude at 1 Vpp and the Offset at 0 V, you will obtain a Sinc between 0 and 500 mV, the same thing goes for Vhigh and Vlow, in this case they are respectively -500 mV and 500 mV.

### Amplitude

It is the difference between the maximum value and the minimum value of the function.

The amplitude can be represented in three different formats, you can choose the format opening the menu near the amplitude label:

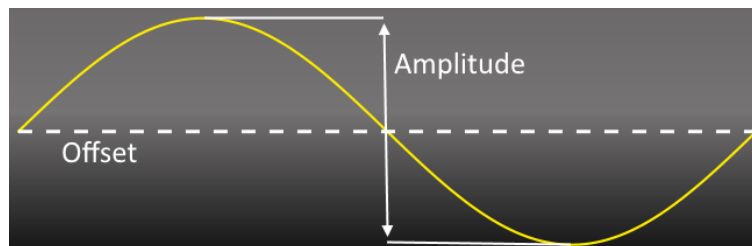


- **Vpp (Peak to Peak Voltage):** it is the difference between the highest and lowest level of the signal.
- **Vrms (Root Mean Square Voltage):** it is the effective value of the waveform.
- **dBm:** it is the power transferred to the load expressed in dBmW (this representation is available only for 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 to the amplitude, they don't take care of the Offset, then if the Offset is different from 0 V the Vrms or dBm value is not the value of the output signal.

### Offset[V]

It is the voltage of the “zero” of the waveform.

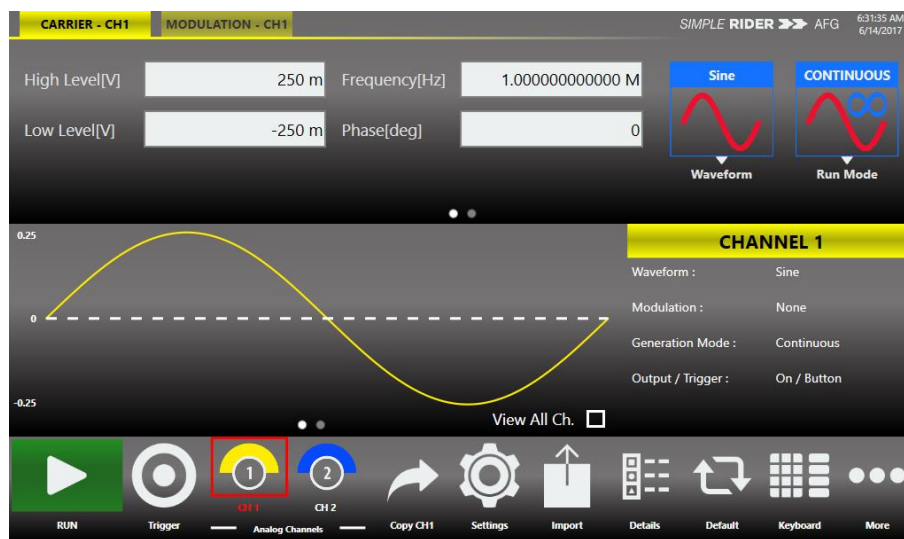
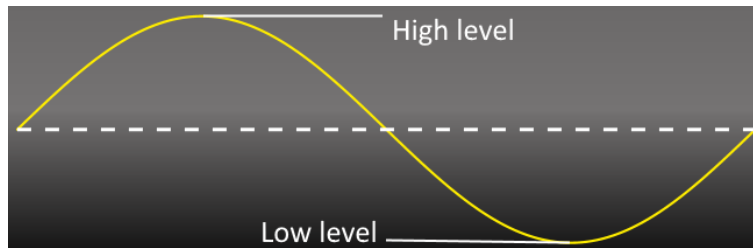


### Voltage High[V]

It controls the output high voltage level.

**Voltage Low[V]**

It controls the output low voltage level.



These parameters are available for all function excepts the DC level that is identified only by an offset.

**Main Channels Horizontal parameter**

The horizontal parameters control the frequency, the phase and the shape of the waveform; what parameters you have to set depends on the selected waveform.

**Frequency [Hz] / Period [s]**

They control the frequency or the period of the generated waveform. This control is available for all the functions excepts DC Level and Noise.

Touching the label, it will change the format between Frequency and Period.

**Phase [deg] / Delay [s]**

It controls the initial phase of the function. That control is available for all function 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 [%]**

These controls define the duration of the High-level part of the Pulse function. The width is defined as Full Width at Half Maximum (FWHM), it 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]**

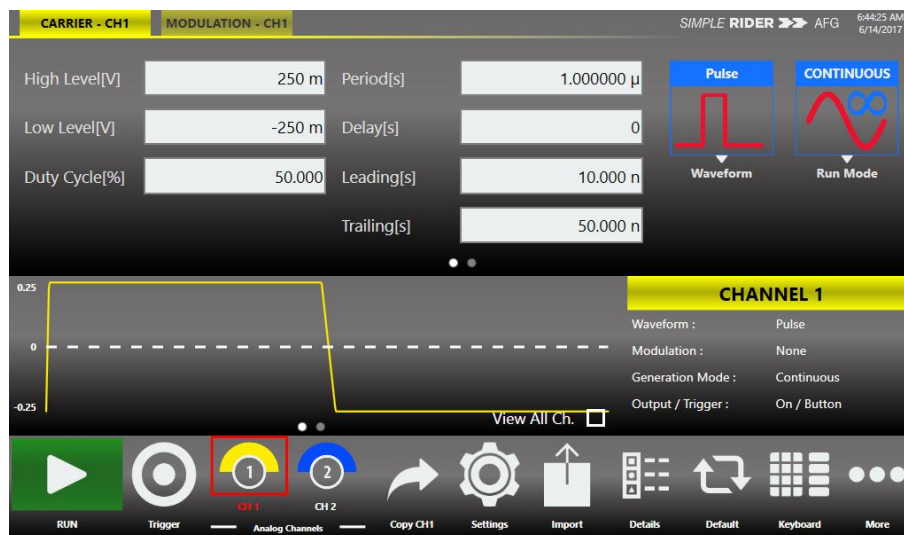
In the Pulse function, they define the transition time between Low and High level for the Leading Edge and between High and Low level for the Trailing Edge.

**Note:** the values refer to the rise and fall time between the 10% and the 90% of the pulse amplitude, then the edges will be longer than the set values, but the graph shows the entered value as total rise or fall time.

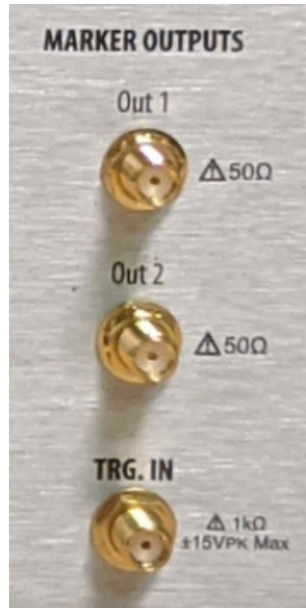
**Note:** Using the Pulse Waveform the constraints:

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

Must be met.



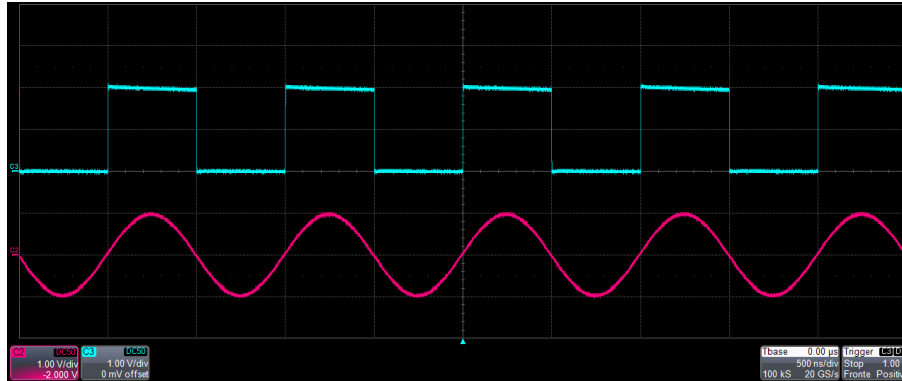
## Auxiliary Channels



### 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 SMA on the Front Panel
Output impedance	50 $\Omega$
Output level (into 50 $\Omega$ )	1 V to 2.5 V
Resolution	10 mV
Accuracy (typical)	$\pm(2\% \text{ setting} + 10 \text{ mV})$
Variable delay control	0 to 60606 ps
Resolution	78 ps
Accuracy (typical)	$\pm(10\% \text{ of setting} + 140 \text{ ps})$
Rise/fall time (10% to 90%, 2.5 V, typical)	800 ps
Jitter RMS	155 ps

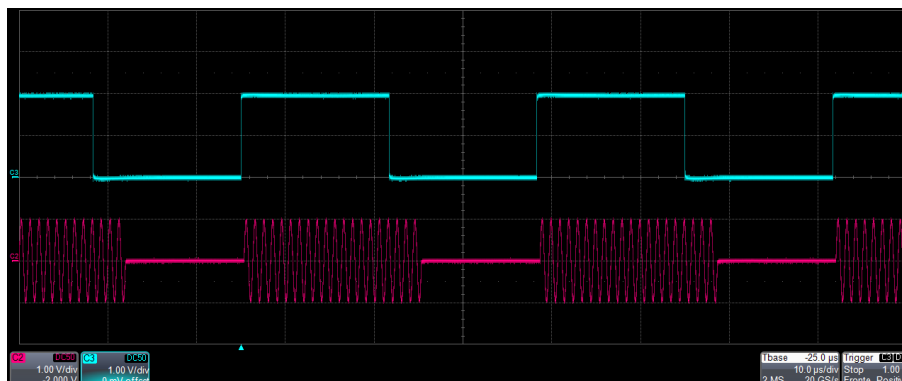


Marker out (blue, top) synchronous with the analog signal (red, bottom)

## Trigger In

The Trigger In (TRG. IN connector on the front panel) can be used to control the signal generation when a channel is in Burst Run Mode or in Sweep Run Mode. To know how to set the trigger parameter or the Run Mode refer to the inherent manual chapters. In Continuous and Modulation Run Modes the Trigger In doesn't have any effects.

Trigger In Specification	Value
<b>Connector</b>	SMA on the Front Panel
<b>Number of connectors</b>	one for all analog channels
<b>Input impedance</b>	1.1 k $\Omega$
<b>Slope/Polarity</b>	Positive or negative selectable
<b>Input damage level</b>	< -15 V or > +15 V
<b>Threshold control level</b>	-10 V to 10 V
<b>Resolution</b>	50 mV
<b>Threshold control accuracy (typical)</b>	$\pm(10\% \text{ of }  \text{setting}  + 0.2 \text{ V})$
<b>Input voltage swing</b>	0.5 V <sub>p-p</sub> minimum
<b>Minimum pulse width</b>	12 ns
<b>Initial trigger / gate delay to Analog Output</b>	384.6 ns $\pm$ 50 ps



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” from the “Device Settings” page, an internal clock generator takes the signal on “Reference Clock Input” SMA connector as reference to generate the DAC clock signal at 2.5 GHz.

Reference Clock Input	Value
<b>Connector type</b>	1 SMA on the Rear Panel
<b>Number of connectors</b>	one for all analog output
<b>Input impedance</b>	50 Ohm, AC coupled
<b>Input voltage range</b>	-5 dBm to 4 dBm sine or square wave
<b>Damage level</b>	+8 dBm or $\pm 15$ V <sub>DC</sub> Max
<b>Input Frequency range</b>	10 MHz to 80 MHz

## External Modulation Input

The Model 676 High Performance AWG can accept the modulating signal from an external source, through the External Modulation Input connectors on the Rear Panel. In the following table you can see the main characteristics.

External Modulating Input	Description
<b>Connector Type</b>	2 SMA on Rear Panel (one for each channel)
<b>Input Impedance</b>	10 kOhm
<b>Input Voltage Range</b>	$\pm 1$ V for all modulation except FSK and PSK 3.3 V for FSK and PSK
<b>Bandwidth</b>	10 MHz with 50 MS/s sampling rate

## Reference Clock Output

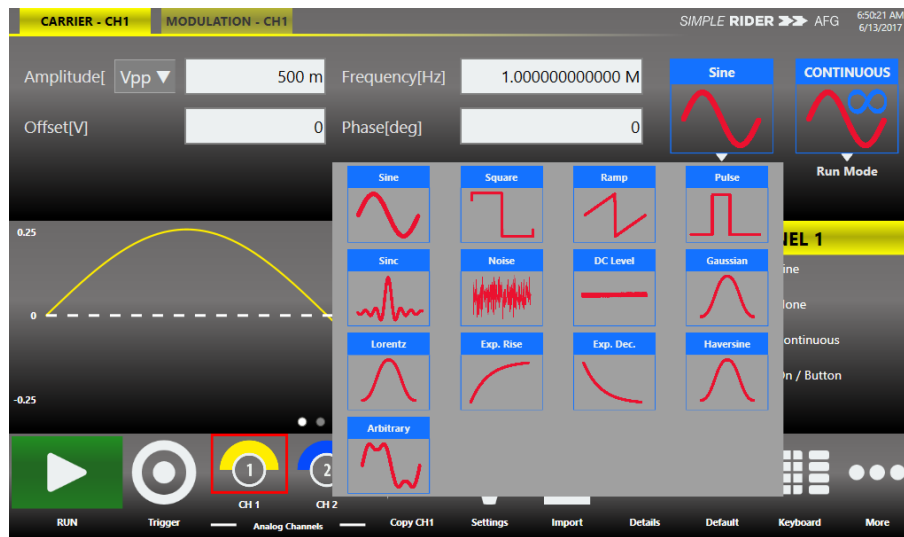
This connector output the clock signal at 10 MHz or the Reference Clock Input if the Clock source is External.

Reference Clock Input	Value
<b>Connector</b>	SMA on the Rear Panel
<b>Number of connectors</b>	one for all analog output
<b>Output impedance</b>	50 Ohm, AC coupled
<b>Frequency</b>	10 MHz or External Reference Clock input
<b>Accuracy</b>	$\pm 1.0 \times 10^{-6}$
<b>Aging</b>	$\pm 1.0 \times 10^{-6}$ /year
<b>Jitter (rms, typical)</b>	11.5 ps


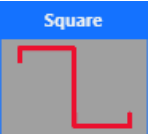
## Predefined Waveforms


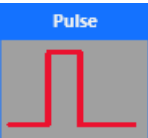

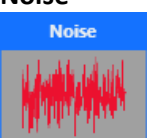
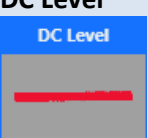

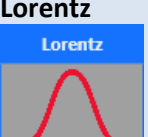

The Simple Rider application provides 12 preload functions, in each one you can change the characterizing parameter. It is also available the **Arbitrary** waveform that allow to load a waveform from a file or from remote.




Touching the “Waveform” button on the “Carrier” tab you open the menu and you can select a waveform to use as carrier.



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
<b>Sine</b> 	1 uHz – 350 MHz @ 5 Vpp 350 MHz – 550 MHz @3 Vpp 550 MHz – 600 MHz @2 Vpp	Amplitude, Offset, Frequency, Phase	✓		✓	✓
<b>Square</b> 	1 uHz – 330 Mhz	Amplitude, Offset, Frequency, Phase	✓		✓	✓

Waveform	Frequency Range	Parameters	AM, FM, PM, PSK, FSK	PWM	Sweep	Burst
<b>Ramp</b> 	1 uHz – 30 Mhz	Amplitude, Offset, Frequency, Phase, Symmetry	✓		✓	✓
<b>Pulse</b> 	1 uHz – 330 Mhz	Amplitude, Offset, Frequency, Phase, Duty Cycle, Leading Edge, Trailing Edge		✓		✓
<b>Sinc</b> 	1 uHz – 60 Mhz	Amplitude, Offset, Frequency, Phase	✓		✓	✓
<b>Noise</b> 		Amplitude, Offset				✓
<b>DC Level</b> 		Offset				
<b>Gaussian</b> 	1 uHz – 60 Mhz	Amplitude, Offset, Frequency, Phase	✓		✓	✓
<b>Lorentz</b> 	1 uHz – 60 Mhz	Amplitude, Offset, Frequency, Phase	✓		✓	✓
<b>Exponential Rise</b> 	1 uHz – 30 Mhz	Amplitude, Offset, Frequency, Phase	✓		✓	✓

Waveform	Frequency Range	Parameters	AM, FM, PM, PSK, FSK	PWM	Sweep	Burst
<b>Exponential Decrease</b> 	1 uHz – 30 Mhz	Amplitude, Offset, Frequency, Phase	✓		✓	✓
<b>Haversine</b> 	1 uHz – 60 Mhz	Amplitude, Offset, Frequency, Phase	✓		✓	✓
<b>Arbitrary</b> 	1 uHz – 400 MHz	Amplitude, Offset, Frequency, Phase	✓		✓	✓

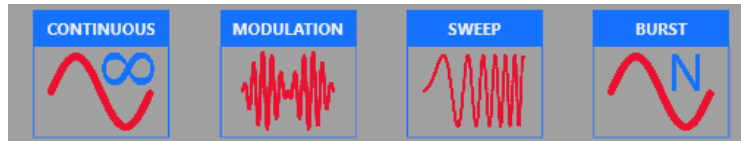


You can assign the “**Arbitrary**” waveform using the “**Import**” button of the command bar, for more information refer to the “Import from File” section. By default, the “Arbitrary” is a cosine function.

**Note:** When you select Arbitrary as waveform the Amplitude and Offset written in the waveform file don’t matter, but Offset and Amplitude of the generated signal are selectable like for predefined waveforms.

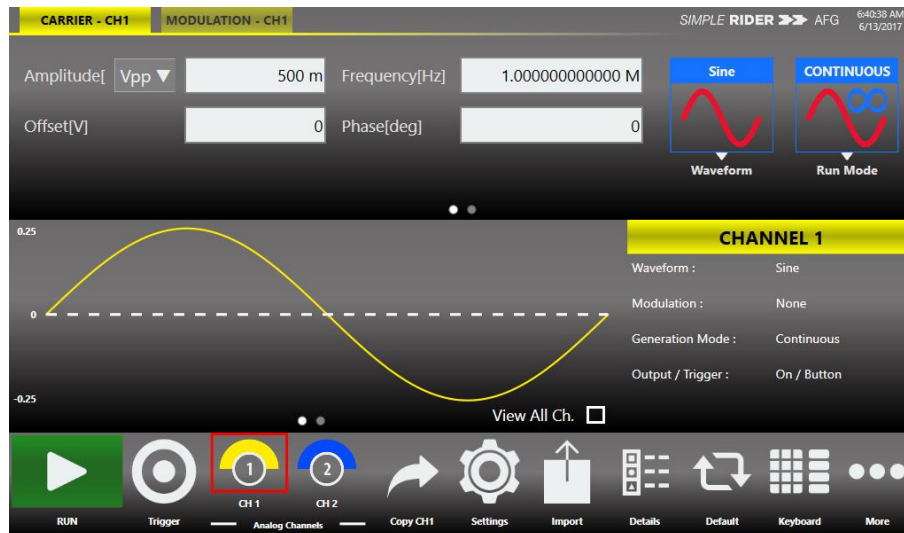
## Run Mode

On the Carrier tab pressing the “Run Mode” button you can open the following menu and select a Run Mode. When you select “Modulation”, “Sweep” or “Burst” the software shift directly on the secondary tab that take the name of the selected Run Mode.



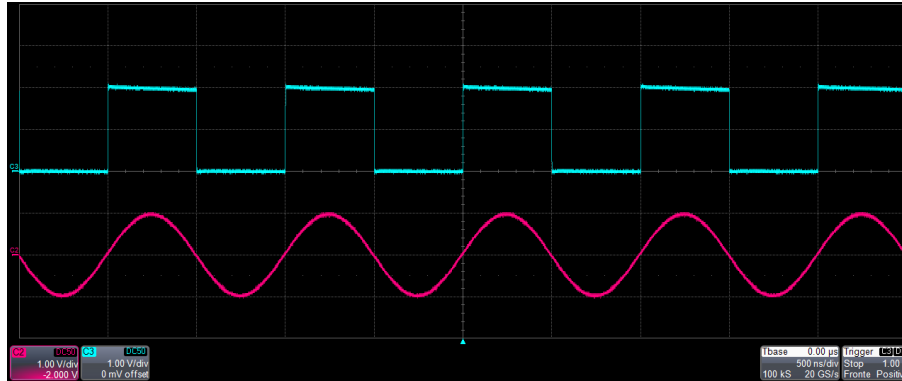
## Continuous

In the Continuous mode when you touch the Run button the function is reproduced continuously until you press the stop button or change Waveform / Run Mode.



## Marker Out behaviour in Continuous Run Mode

In Continuous mode, the **Marker Out** generate a pulse with a duty cycle of 50% at the beginning of each cycle. The Marker pulses follow the carrier frequency until it is under 100 MHz, because its minimum period is 10 ns. If the carrier frequency increases the Marker Out generate a pulse every 2 waveform cycles until it reaches period of 10 ns and then it generates a pulse every 4 period, and so on.

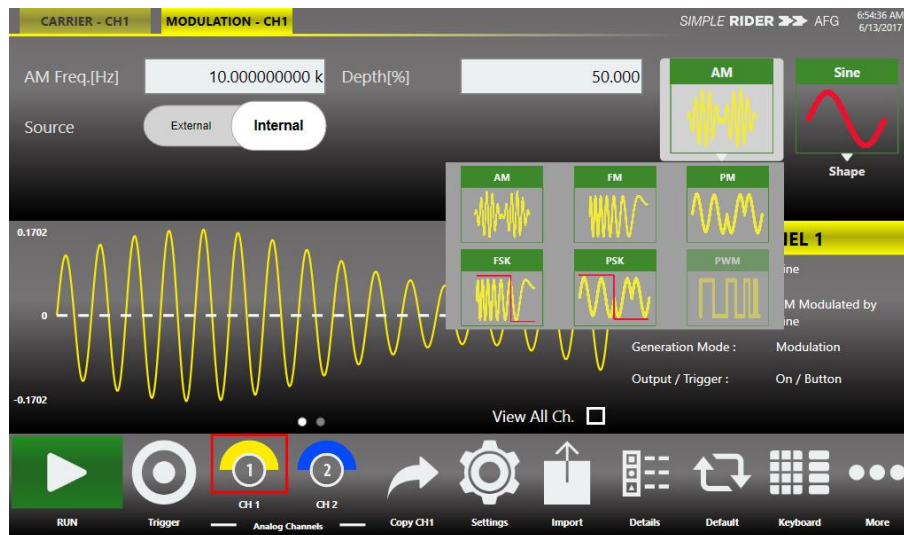


Marker out (blue, top) synchronous with the analog signal (red, bottom)

## Modulation

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

Touching the “Type” button you open the modulation type menu as you can see in the following figure.



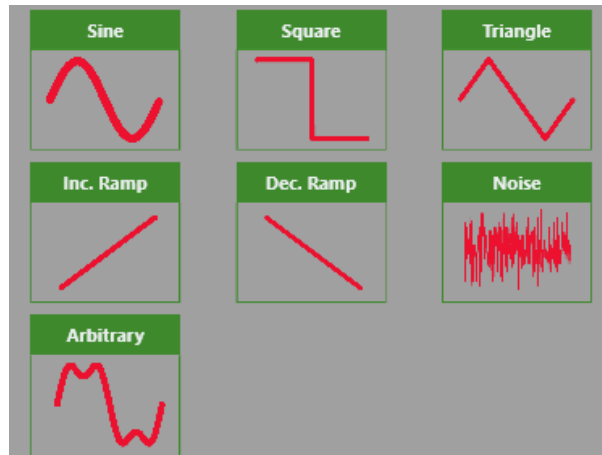
The modulation Types are:

- **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 available for the Pulse waveform.

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

Touching the “Shape” button you open the modulation type menu. The choice of the shape is available only for AM, FM, PM and PWM modulations.



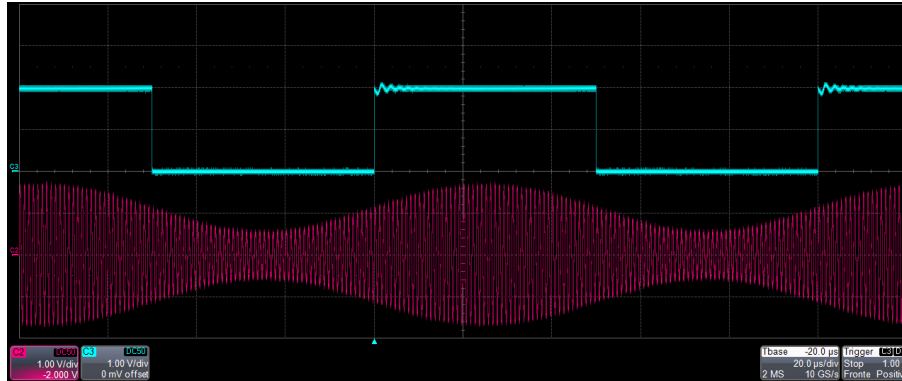
The modulation **Shape** (when available) are:

- **Sine**
- **Square**
- **Triangle**
- **Increase Ramp**
- **Decrease Ramp**
- **Noise**
- **Arbitrary**: it allows to load a Modulating Wave 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, the leading edge of this pulse is on 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 controls the modulating frequency. It varies between 500 uHz and 50 MHz.
- **Source:** the source can be **Internal** or **External**. If you select **Internal** it is possible to select a Shape, but if you select **External** the instrument accepts a modulating signal from the **Ext. Mod.** SMA connector.

## Modulation Types and relatives Parameter

- **Amplitude Modulation (AM):** this type of modulation changes the amplitude of the carrier waveform 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):** this type of modulation changes the frequency of the carrier waveform following the modulating shape, it is available for all functions except for the Pulse. The parameter **Deviation [Hz]** determinates the maximum increase and decrease of frequency with respect to the carrier frequency. The Deviation is between 0 Hz and the maximum frequency that satisfy 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 under the 200 MHz to satisfy the first constraint.
- **Phase Modulation (PM):** this type of modulation modifies the phase of the carrier waveform 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 from 0 to 360 deg.
- **Frequency Shift Keying (FSK):** this type of modulation is a 2 level FSK, it varies the carrier frequency 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, choosing it you should satisfy the following relationships:

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

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, it varies the phase of 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 type of modulation is available only for the Pulse waveform. It varies the width of the Pulse of a quantity sets in the **Deviation [%]** textbox. The parameter **Deviation [%]** indicate the maximum increase and decrease of the Duty Cycle percentage. The deviation has to meet the following relationships:

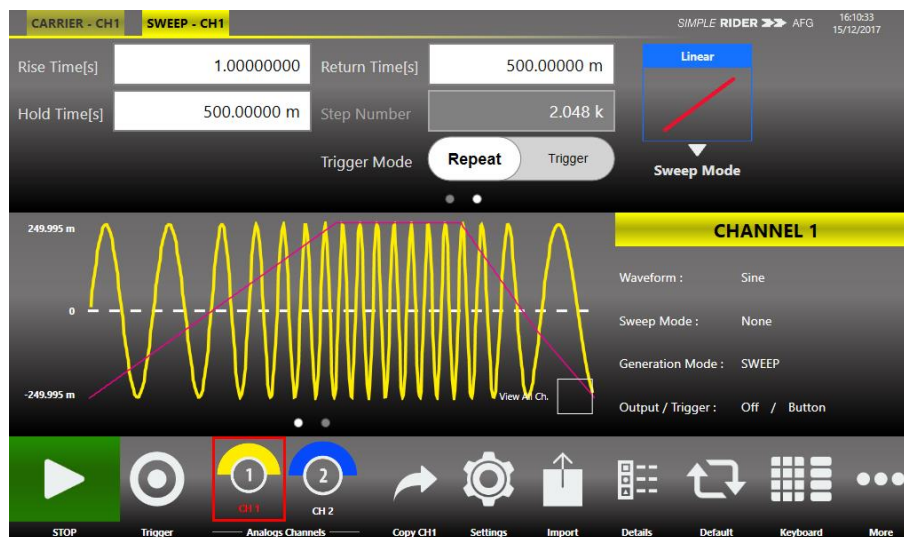
- $\text{deviation} [\%] \leq \text{duty cycle} [\%] - \frac{\text{Leading Edge}[\text{s}]}{0.8} * \frac{100[\%]}{\text{Period} [\text{s}]} - \varepsilon$
- $\text{deviation} [\%] \leq 100[\%] - \text{duty cycle} [\%] - \frac{\text{Trailing Edge}[\text{s}]}{0.8} * \frac{100[\%]}{\text{Period} [\text{s}]}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

Where  $\varepsilon$  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

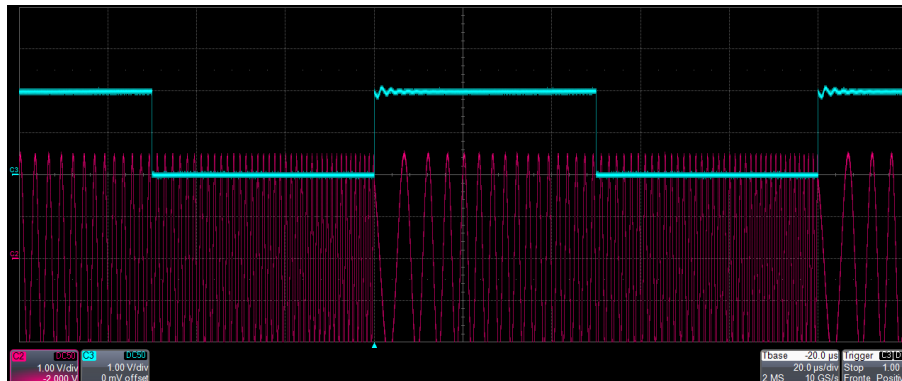
The Sweep mode varies the frequency following a law that can be **Linear**, **Logarithm** or **Upstair**, more there is the **User Defined** type that allows to load the sweep profile from a file.

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



## Marker Out behaviour in Sweep Run Mode

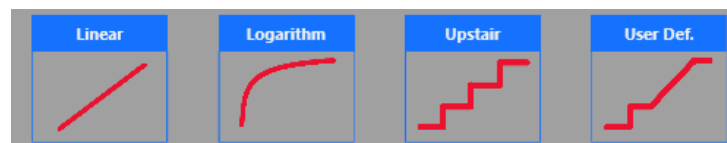
In this Run Mode the **Marker Out** generates square wave with the rising edge at the beginning of each sweep.



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

## Sweep Type

Touching the Type menu, you open the sweep type menu and you can select a profile among the following ones.



- **Linear:** the frequency increase and decrease linearly.
- **Logarithm:** the frequency increase and decrease 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 file, for the file specification please refer to the “Import from File” section. By default, the “Arbitrary” waveform is a cosine function.  
**Note:** When the User Defined mode is selected the time to execute the profile is defined by the sum of Sweep Time, Hold and Return, then these 3 parameters lose their original meaning.

## Parameters

- **Sweep Time [s]:** it controls the time to increase the frequency from the Start Frequency to the Stop Frequency.
- **Hold [s]:** it is the time that the signal stays at Stop Frequency.
- **Return [s]:** it controls the time to decrease the frequency and return from Stop Frequency to Start Frequency.

**Note:** Setting the time parameter is necessary to meet the following relationship:

$$\text{Sweep Time} + \text{Hold} + \text{Return} \leq 2000$$

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

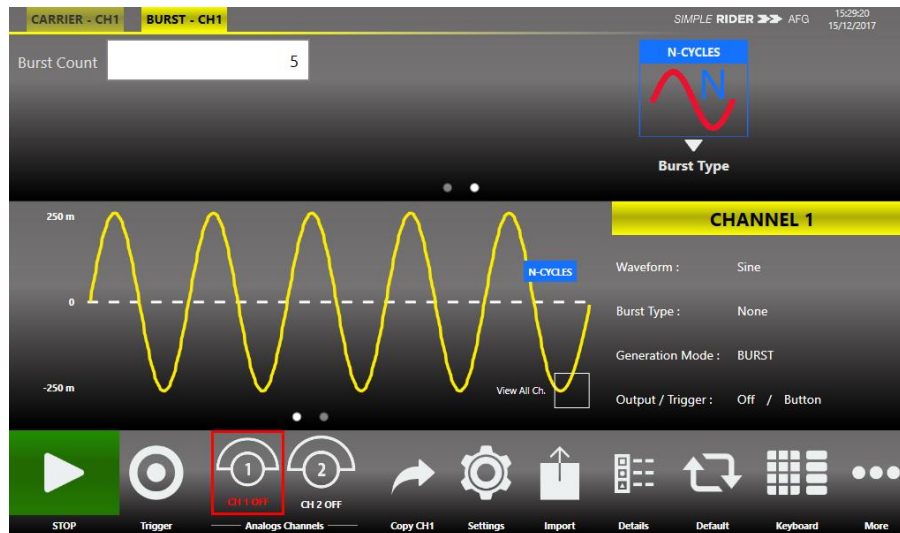
**Note:** The **Start Frequency [Hz]** and the **Stop Frequency [Hz]** appear in the Carrier tab.

## Sweep Trigger Mode

- **Repeat:** the instrument starts and repeats the sweep continuously.
- **Trigger:** When you press Run, the instrument waits for a Trigger signal, then generates the sweep profile once and returns in wait state for a new Trigger. When it is waiting for a Trigger, it generates the signal at the start frequency.

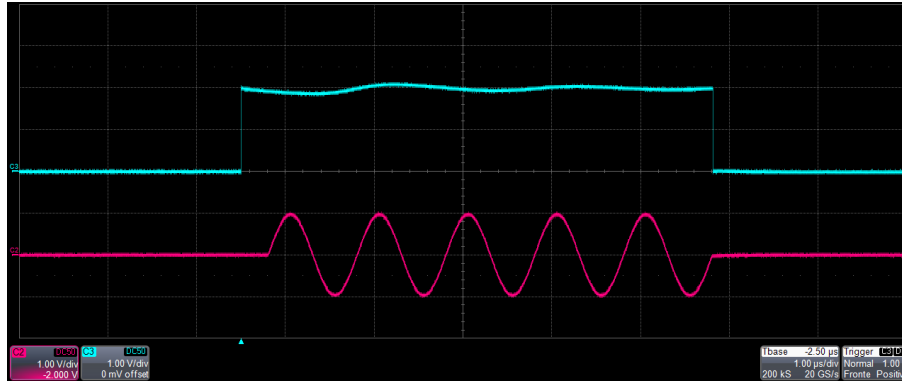
## Burst

The Burst mode allows to repeat a waveform a defined number of times or until the Trigger signal is at High Level depending on the selecting Mode. This Run Mode is available for all waveform except the DC level.



## Marker Out behaviour in Burst Run Mode

In this Run Mode, the **Marker Out** generate a pulse with a duration equal to the burst or gate duration. In the following picture, you can see that the Marker Out (C3, blue trace) follow the duration of the burst.



Marker out width (blue, top) follow the duration of the burst (red, bottom)

## Burst Mode

The burst mode allows to select the behaviour of the instrument after the Trigger reception. Touching the “Mode” button you open the following menu and you can select the type of burst.



- **1 Cycles:** the instrument wait for a Trigger, then generate one time the carrier waveform and return in wait state for the next Trigger.
- **N-Cycles:** this mode is similar to the last one, but after a Trigger the instrument generates the waveform N times. The number of cycle to generate is defined through the textbox **Number of Cycles**.
- **Inf-Cycles:** this mode is similar to the previous ones, but after the Trigger the generation starts until the Stop Button is pressed.
- **Gated:** in this mode, the signal is generated only when the Trigger is true. When the trigger returns false, the instrument terminates the current wave cycle then it stops the generation.

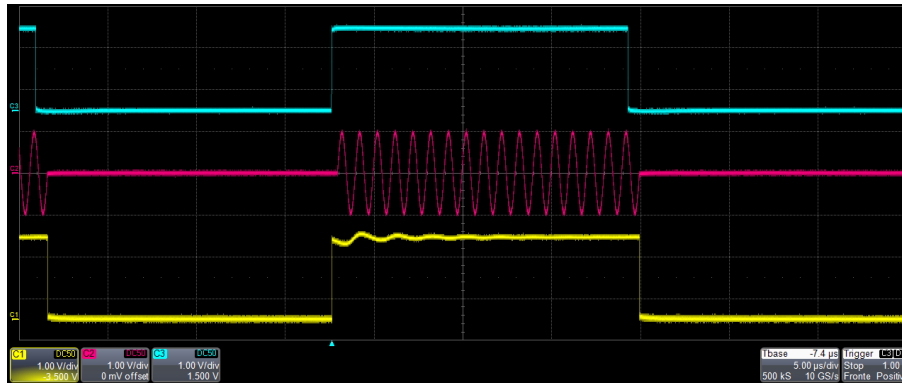
**Note:** If you select the Noise as carrier for the Burst mode, the frequency/period associated to the Noise is the last used one. It doesn't affect the generated noise, but affect the duration of the burst.

**Note:** when the instrument is waiting for the first Trigger the Output voltage level is the Offset voltage but during the wait state after the first execution the Output voltage level is 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) that is the Trigger source from external.

- C2 (red trace) that is the generated signal.
- C1 (yellow trace) that is the marker out.



*Burst Gated with Trigger from external*

# Main Command Button Description

## Save Settings

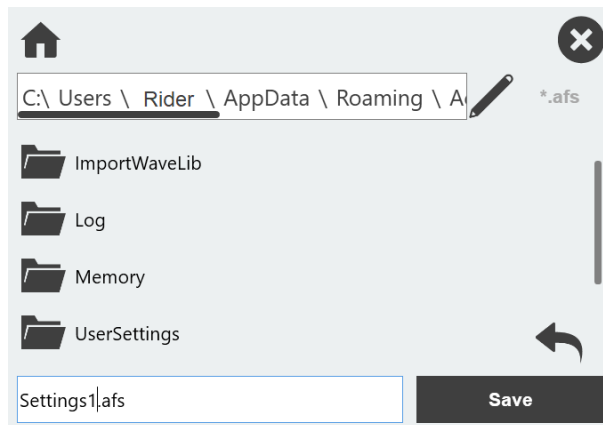



The button “Save Settings” in the “More” menu allows to save the current instrument settings. In the relative dialogue box, you can add a new memory entry or overwrite an existing one. If you try to overwrite an existing memory entry, a dialogue box appears to ask confirmation.

The file extension for the setup file is “.afs”, then if missed the operation is not valid.

**Save**

In the bottom textbox you can write a new name then pressing the “Save” button the setting will be saved.



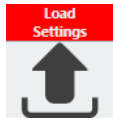
In that page you can choose where save the current settings, the “pencil”  activates the textbox

where you can write a path. The “house button”  on the top left modifies the path to home path

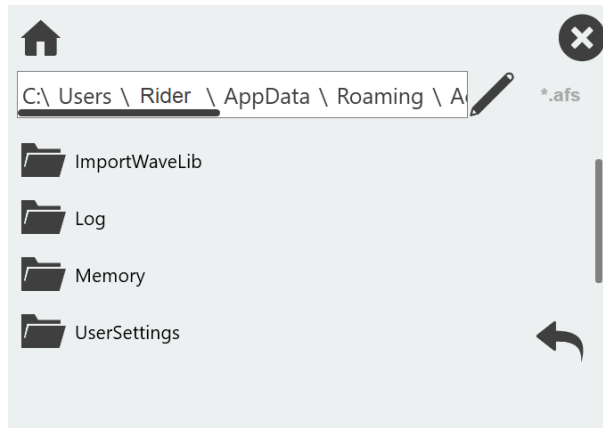
and the “left arrow”  allows to return to the last path.

**Note:** Some file names are reserved for the “Memory State” accessible by Remote Commands, they are Memory0.afs, Memory1.afs, ..., Memory4.afs, you can use that name but it will be deleted or overwritten by remote commands without confirmation, more note that the “Memory0.afs” save the last setting before power off the instrument then it is overwritten every time that you power off the instrument.

## Load Settings



Touching the “Load Settings” button in the “More” menu, a page will be opened that shows the list of all the saved settings. If you select a memory entry, you will load directly the settings into the instrument.



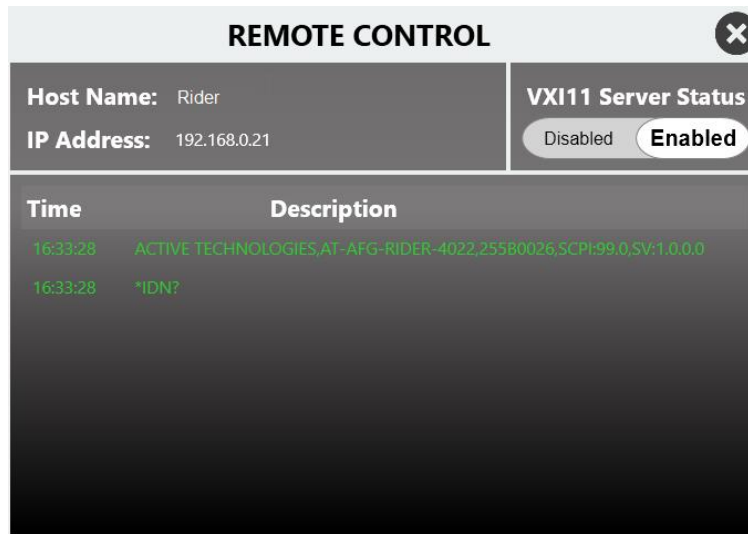
The buttons have the same function that have in the “Save Settings” page.

**Note:** at the power on, the file “Memory0.afs” contains the last setting before the power off.

## Remote Control

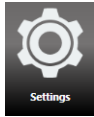


The “Remote Control” button from “More” menu opens the page of the SCPI server. In that page there is the list of all the command that the SCPI server receives and its replies. In particular a green written line denotes that the command is right and the server accepted it, otherwise a red written line indicates an error.



In the top of the page you can read the Host Name and the IP Address of the instrument. The slider allows to enable or disable the SCPI server, by default it is enabled.

## Channels and Device Setting

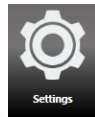


Press this button to open a page composed by three tabs, one for each Channel and one for the Device. You can swipe to switch among the tabs.



Touching a channel button on screen or pressing the “CHANNEL SEL.” button on keyboard, you can switch between channels.

## Channels Settings




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

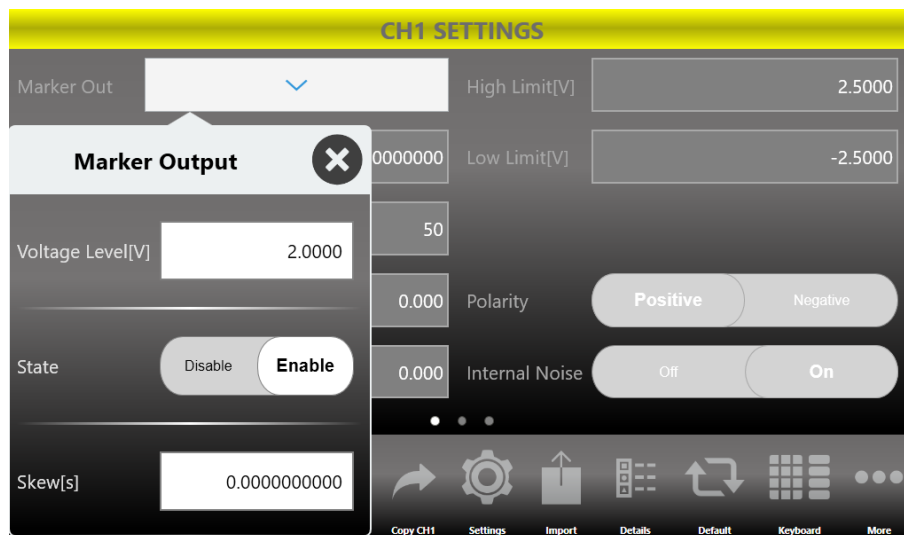


Channel Setting	Description
<b>Marker Out</b>	Set the Marker Out parameters (see the table below).
<b>Initial Delay</b>	Set the Initial Delay of the selected channel from Start or from Trigger signal. The delay is selectable between 0 and 100 s.
<b>Load [Ohm]</b>	<p>Selecting the load impedance, the instrument compensates the voltage to obtain the set voltage on the load.</p> <p>The impedance is selectable between 1 Ohm and 1 MOhm.</p> <p><b>Note:</b> the compensation is realized by adapting the voltage via software, the real output impedance of the instrument is fixed at 50 Ohm.</p>
<b>Vocm[V]</b>	Controls the common mode voltage of the channel. The range is between -2.5 V and 2.5 V into 50 Ohm but it depends on the selecting load impedance.
<b>Noise Level [V]</b>	<p>Use this setting to add noise to the signal. The voltage shown in the textbox represent the peak voltage of the noise level, it is selectable between 0 V and 5 Vpp (the value in the textbox is between 0 and 2.5 Vpk). The Noise is hardware generated using a pseudo random algorithm.</p> <p><b>Note:</b> When you set the Noise amplitude please pay attention that Signal + Noise does not exceed the amplitude of 5 Vpp.</p>
<b>Internal Noise</b>	Use this control to enable or disable the internal noise.
<b>High Limit</b>	<p>You can set the maximum voltage that the channel generates. This limit is verified during the generation, but it doesn't take care about the Common Voltage Level. The High Limit range is between 500 uV and 2.5 V. The constraint High Limit &gt; Low Limit must be met.</p> <p>This feature can be used to make sure to not damage the load.</p> <p><b>Note:</b> the High Limit doesn't force to set voltages under the limit, but during the generation the part of the waveform that exceeds the limit will be cut at the High Limit.</p> <p><b>Note:</b> the High Limit doesn't has effect when the carrier is the Sine waveform.</p>

<b>Low Limit</b>	<p>You can set the minimum voltage that the channel generates. This limit is verified during the generation, but it doesn't take care about the Common Voltage Level. The Low Limit range is between 0 V and -2.5 V.</p> <p>You must satisfy the constraint Low Limit &lt; High Limit.</p> <p>This feature can be used to make sure to not damage the load.</p> <p><b>Note:</b> the Low Limit doesn't force to set voltages under the limit, but during the generation the part of the waveform that exceeds the limit will be cut at the Low Limit.</p> <p><b>Note:</b> the Low Limit doesn't has effect when the carrier is the Sine waveform.</p>
<b>Polarity</b>	This control allows you to invert the polarity of the output signal.

## Marker Out Settings

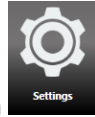
From the channel setting page, pressing the Marker Out button  you can open the Marker Out setting page.



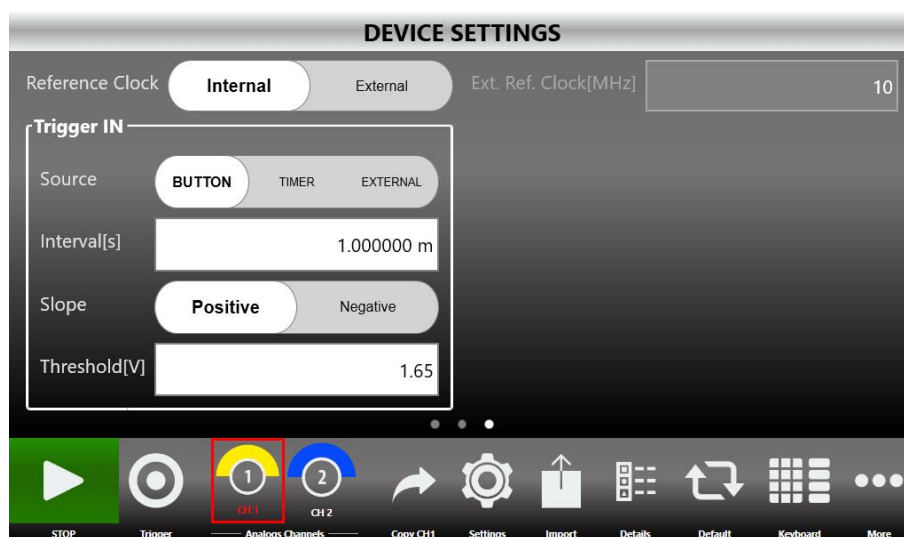
Marker Out Setting	Description
<b>Voltage Level [V]</b>	<p>It sets the Marker Out high level. The Marker Out generate a pulse between 0 V and Voltage Level synchronous with the generated signal, to know the behaviour in the different Run Mode please refer to the "Run Mode" section.</p> <p>The Voltage Level can be set between 1 V and 2.5 V at step of 10 mV.</p>
<b>State</b>	It enables or disables the Marker Out. When the Marker Out is disabled it is forced to 0 V.
<b>Skew [s]</b>	<p>It sets the delay from the start of the waveform.</p> <p>The skew range is from 0 s to 60.6 ns.</p>

## Device Settings

In the “Device Settings” page you can change the general setting of the instrument, such as the clock source and the channels behaviour varying the Run Mode.



Touching the “Settings” button in the menu bar or the “SETTINGS” button on the keyboard you open the channel settings, then slicing the page from right to left or touching the last ball on the bottom of the page, you reach the Device Setting page.



Device Setting	Description
<b>Reference Clock</b>	It can be <b>Internal</b> or <b>External</b> . If it is Internal the sampling clock is internally generated. On the contrary if External is selected the sampling clock come from an external source connected to the External Reference SMA connector on the rear panel. You can set the reference clock frequency using the External Reference Clock. The selecting frequency is internally multiplied to reach a sampling rate of 2.5 GS/s
<b>External Reference Clock</b>	This textbox allows you to set the External Reference Clock frequency. This parameter has effect only if the Reference Clock is set on External. The range of this parameter is between 10 MHz and 80 MHz.
<b>Trigger In</b>	Use this group of controls to set the Trigger In parameters (see the table below).

## Trigger In Settings

In the Device Setting page, you can find the Trigger In settings. The parameters are common for both the two channels.

Trigger In Setting	Description
<b>Source</b>	<p><b>Button:</b> the Trigger can be only come from Trigger button on the keyboard, Trigger button on the menu bar or from Remote Command.</p> <p><b>Timer:</b> The Trigger is internally generated by a Timer. The Timer count is set by Interval [s] textbox.</p> <p><b>External:</b> the Trigger is generated when the signal on the SMA connector (TRG. IN) overcome the selected Threshold with the selected Slope. You can select Threshold value and Slope using the relative textbox and slider.</p> <p><b>Note:</b> The Trigger buttons and the Trigger from remote are always active, independently from the selecting Trigger Source.</p>
<b>Interval [s]</b>	Set the timer count. It has effect only when the selecting Source is Timer. The Interval range is from 1 us to over 1999 s.
<b>Slope</b>	The Slope can be positive or negative. When positive is selected the trigger is sent only when the signal on the “TRG. IN” SMA connector overcome the threshold from low to high. The negative option is the opposite. It has effect only when the selecting Source is External.
<b>Threshold [V]</b>	It is the threshold to overcome to send a Trigger to the instrument. It has effect only when the selecting Source is External.

## Import from File


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

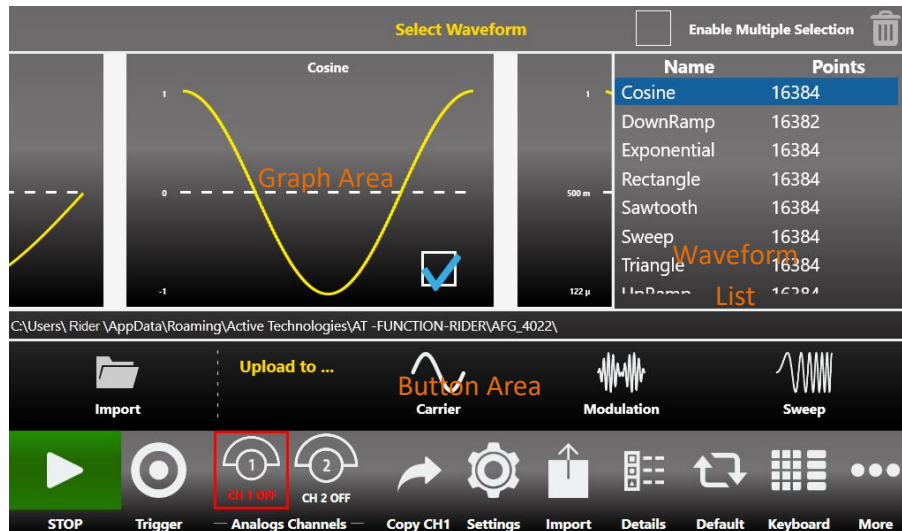


Sweep profile. You can open this page touching the **Import** button.

After the waveform assignment, you can find it in the Arbitrary shape of Carrier, Modulating or Sweep of the channels. For example, if you assign the “Cosine.txt” as “Carrier Wave” for the channel 1, you find that waveform in the “Arbitrary” shape of the “Carrier” tab 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
<b>Accepted Formats</b>	.txt, .csv
<b>Length Range</b>	Between 2 and 16384 samples. The instrument memory is limited at 16 k sample (16384) for each arbitrary waveform, but it is possible to import longer waveforms that will be resampled to the maximum length.
<b>Offset and Amplitude Range</b>	The vertical Offset and Amplitude of the imported waveform don't matter because when the waveform is selected it is normalized at the Offset and Amplitude selected in the textbox.

**Graph Area:** It offers a preview of the waveform. When you touch the checkbox in the graph, you select the waveform, touching one of the button in the Button Area you can assign it as Carrier, Modulation Wave or Sweep Profile.

**Waveform List:** This section contains a list with the predefined and imported waveforms.

- The **Trash Bin**  allows to delete the selected waveforms. You can delete the predefined ones.
- The **Multiple Select Enable**  checkbox allows to select more than one waveform to delete. If you try to import more than one waveform, it imports only the first selected one.

**Button Area:** It is composed by 4 buttons:

- **Browse:** allows to search a waveform in the file system and load it. After loading, the waveform is included in the Predefined Folder.
- **Carrier Waveform:** Assign the selected waveform as Carrier for the current channel.

- **Modulating Wave:** Assign the selected waveform as Modulating for the current channel.
  - **Sweep profile:** Assign the selected waveform as Sweep profile for the current channel.
- Note:** After the loading, the waveform is present in the relative Arbitrary / User Defined section.