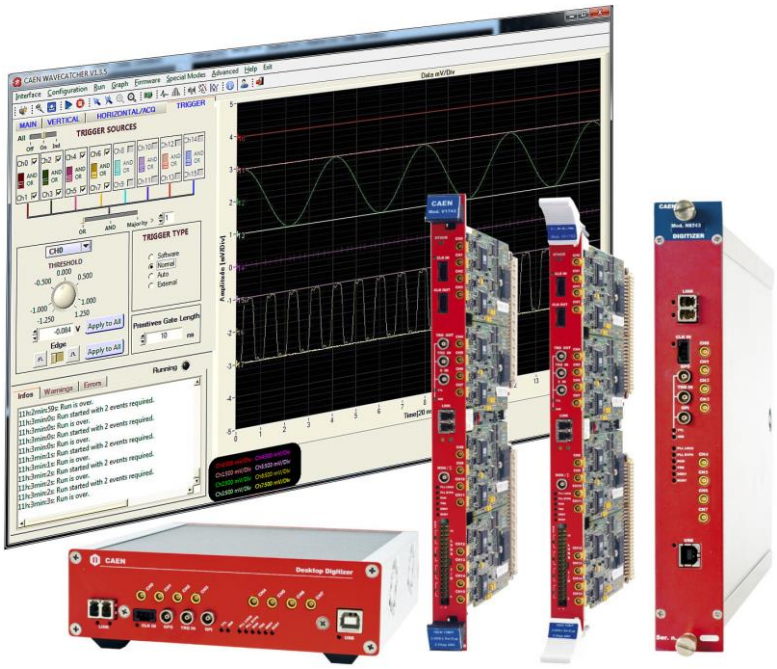
CAEN
Tools for Discovery

Electronic Instrumentation



User Manual UM2754

WaveCatcher

Oscilloscope Tool for 743 Digitizer Family

Rev. 2 – 03 February 2016

Purpose of this Manual

This User Manual contains the full description of the WaveCatcher software compliant to the CAEN Switched Capacitor Digitizers of the 743 family.

Software release of reference: WaveCatcher 1.7

Change Document Record

Date	Revision	Changes
10 April 2015	00	Initial release
29 July 2015	01	Updated § **2**
03 February 2016	02	Replaced **Fig. 4.1**. Updated § **Saving Data**. Added § **Primitives Gate Length**, § **Max Num Evts/ Read Block**

Symbols, Abbreviated Terms and Notation

DC	Direct Current
LED	Light Emitting Diode
OS	Operating System
PC	Personal Computer
USB	Universal Serial Bus

Reference Documents

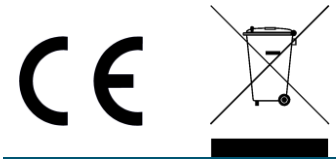
[RD1] GD2783 – First Installation Guide to Desktop Digitizers & MCA

[RD2] GD2512 – CAENUpgrader QuickStart Guide

[RD3] UM1935 – CAENDigitizer User & Reference Manual

All documents can be downloaded at: http://www.caen.it/csite/LibrarySearch.jsp

CAEN S.p.A.
Via Vetraia, 11 55049 Viareggio (LU) - ITALY
Tel. +39.0584.388.398 Fax +39.0584.388.959
info@caen.it
www.caen.it



Index

List of Figures

List of Tables

1 Introduction

The WaveCatcher is a software for Windows OS which has been designed as an user friendly interface putting the acquisition power of the fast CAEN 743 Digitizer family at the fingertips of users concerned with the simultaneous and synchronized acquisition of transient waveforms from multiple channels systems. The selected format recalls the familiar operation of a Digital Oscilloscope, although with some differences, namely in the front end section, which will be indicated in this manual.

The WaveCatcher software supports the CAEN 743 Digitizer family in different form factors, as indicated in **Tab. 1.1**.

For the details on the supported boards and the principle of operation, please refer the relevant digitizer User Manual free available for download on CAEN website.

Board Models	Description	Product Code
DT5743	DT5743 - 8 Ch. 12 bit 3.2GS/s Switched-Capacitor Digitizer: 3 events/ch (1kS/event), EP3C16, SE	WDT5743XAAAA
N6743	N6743 - 8 Ch. 12 bit 3.2GS/s Switched-Capacitor Digitizer: 3 events/ch (1kS/event), EP3C16, SE	WN6743XAAAAA
V1743	V1743 - 16 Ch. 12 bit 3.2GS/s Switched-Capacitor Digitizer: 3 events/ch (1kS/event), EP3C16, SE	WV1743XAAAAA
VX1743	VX1743 - 16 Ch. 12 bit 3.2GS/s Switched-Capacitor Digitizer: 3 events/ch (1kS/event), EP3C16, SE	WVX1743XAAAA

Tab. 1.1: List of supported boards

2 Installation

WaveCatcher software is provided with Windows support, 32 and 64-bit.

Before installing the WaveCatcher software:

- **Make sure** that your **hardware** (Digitizer and/or Bridge, or Controller) is **properly installed** (refer to the related User Manual for hardware installation instructions) and the relevant **communication cable** (optical fiber or USB cable) is **properly connected**.
- **Make sure** you **have installed** the **driver** for your OS and for the communication link to be used (see § **Drivers**).
- **Make sure** you have installed the required third-party software: NI LabWindows™/CVI Run-Time Engine 2009 or higher (*)

(*) Find the latest LabWindows™/CVI RNE version available on National Instruments web site at:

http://search.ni.com/nisearch/app/main/p/bot/no/ap/tech/lang/it/pg/1/sn/catnav:du/q/LabWindows/

In order to properly run the WaveCatcher software, the third-party NI LabWindows™/CVI Run-Time Engine (2009 or higher) must be installed in the host PC

Drivers

Basing on the CAEN hardware in the setup, the user must install the driver required by the communication link being used and compliant to the OS and the CPU architecture.

CAEN provides the drivers for all the different types of physical communication channels:

- **USB 2.0.** Supported directly by Desktop and NIM Digitizers, or through the V1718/VX1718 Bridges by VME64/VME64X Digitizers.
- **CONET Optical Link.** Managed by the A2818 PCI card or A3818 PCIe card. Supported directly by all form factors (Desktop, NIM, VME64 and VME64X Digitizers).
- **VME bus.** Restricted to VME64 and VME64X Digitizers and accessed by the V1718 and V2718 bridges.

Some explicative hardware connection options are described in **Tab. 2.1** with the relevant required drivers.

HW connection chain	Comm. Link	Drivers
PC –> **USB** –> DT57xx/N67xx	USB	Driver for DT/NIM digitizers
PC –> **USB** –> V1718 –> **VME** –> V17xx	USB	Driver for V1718 Bridge
PC –> **PCI** –> A2818 –> **CONET** –> DT57xx/N67xx/V17xx	OPT	Driver for A2818 Controller
PC –> **PCIe** –> A3818 –> **CONET** –> DT57xx/N67xx/V17xx	OPT	Driver for A3818 Controller
PC –> **PCI** –> A2818 –> **CONET** –>V2718 –> **VME** –> V17xx	OPT	Driver for A2818 Controller
PC –> **PCIe** –> A2818 –> **CONET** –>V2718 –> **VME** –> V17xx	OPT	Driver for A3818 Controller

Tab. 2.1: Series Digitizer Hardware Connections

The drivers are available for free download on CAEN website, www.caen.it (**login is required**):

- Driver for DT/NIM digitizers in the *Software/Firmware* tab at

  *Home / Products / Modular Pulse Processing Electronics / **<FORM FACTOR>** / Digitizers / **<DIGITIZER>***

- Driver for V1718 Bridge in the *Software/Firmware* tab at

  Home / Products / Modular Pulse Processing Electronics / VME / Controller (VME) / V1718

- Driver for A2818 or A3818 Controller in the *Software/Firmware* tab at

  *Home / Products / Modular Pulse Processing Electronics / PCI/PCIe / Optical Controllers / **<CONTROLLER>***

Documentation on driver installation can be found in the V1718, A2818, A3818 User Manual, downloadable from the *Documentation* tab. Document **[RD1]** can be referred to for the installation of the USB driver with Desktop and NIM digitizers.

Software

The last release of the WaveCatcher installation package is available for free download by logging in and accessing CAEN web site at:

Home / Products / Firmware/Software / Digitizer Software / Readout Software / WaveCatcher.

The installation procedure in this paragraph refers specifically to a Windows 7 64-bit system. In case of a different Windows OS, the displayed dialogue boxes, indications or operations may differ slightly from the following instructions.

- Download the WaveCatcher installation package on your host station.
- Unpack the compressed file and launch the Installer. The program Setup Wizard will start.
- Click **[Next]** to continue

Fig. 2.1: Setup Wizard step 1

- Select the relevant checkbox to accept the software license agreement, then click **[Next]** to continue

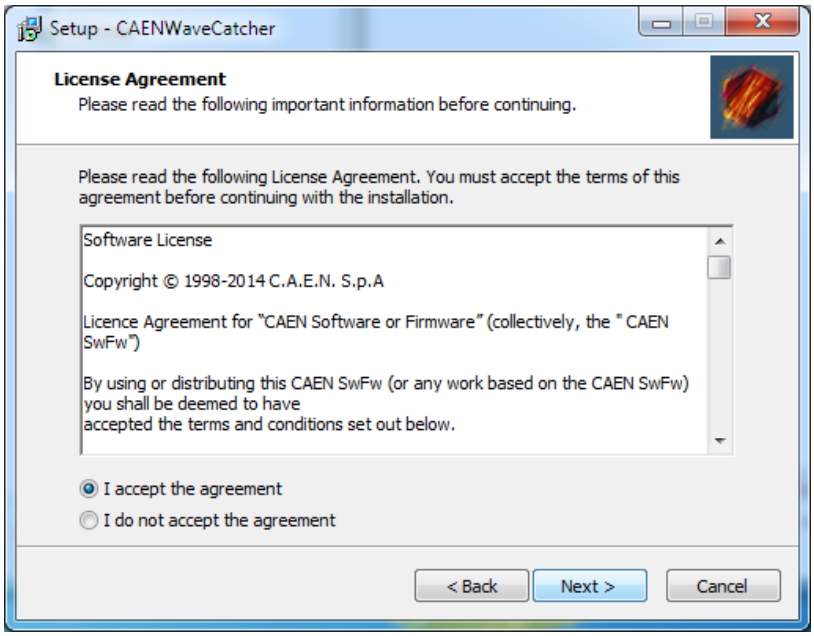


Fig. 2.2: Setup Wizard step 2

- Optionally, select the destination folder for the program installation by the **[Browse]** key, then click **[Next]** to continue.

  The default destination path of the program is:

  C:\Program Files (x86)\CAEN\Digitizers\Wavecatcher

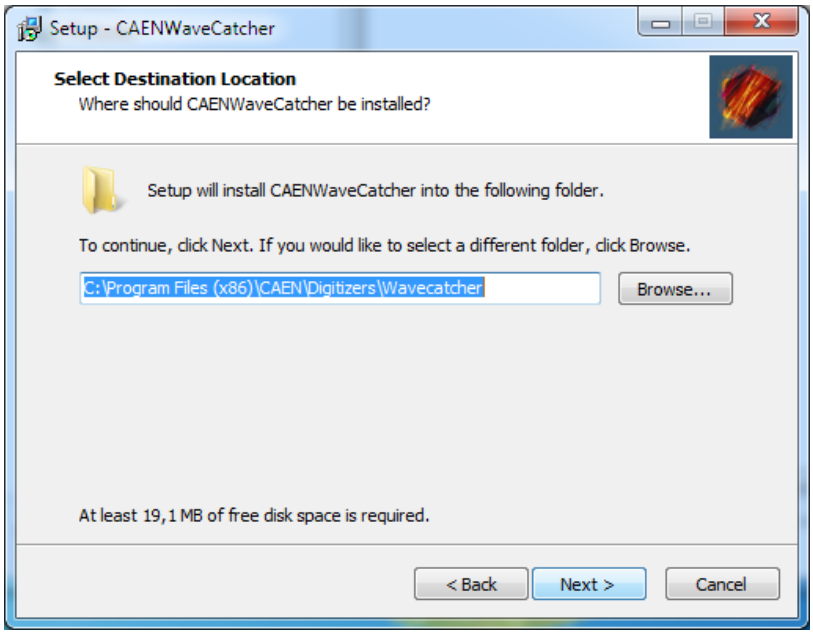


Fig. 2.3: Setup Wizard step 3

- Optionally, select the Start Menu folder for the program shortcuts by the **[Browse]** key, then click **[Next]** to continue.

  The default Start Menu folder for the program's shortcuts is:

  CAEN\Digitizers\Wavecatcher

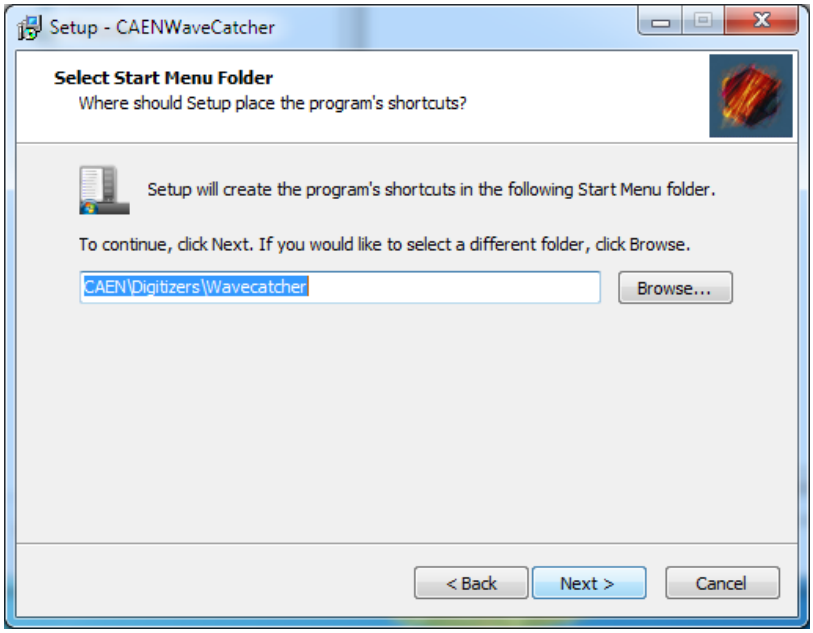


Fig. 2.4: Setup Wizard step 4

- Click [Install] to execute the program installation

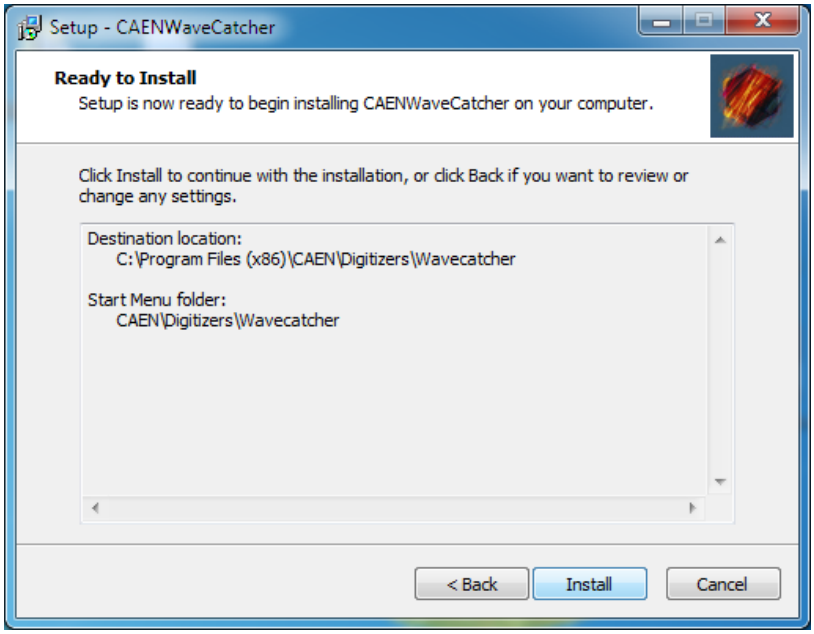


Fig. 2.5: Setup Wizard step 5

- The program installation is completed. Optionally, select the relevant checkbox to launch directly the program, then click **[Next]** to exit the Setup Wizard.

Fig. 2.6: Setup Wizard step 6

3 Initialization

Board Connection Panel

Upon launching the WaveCatcher program, the Board Connection Dialog Box appears (see **Fig. 3.1**).

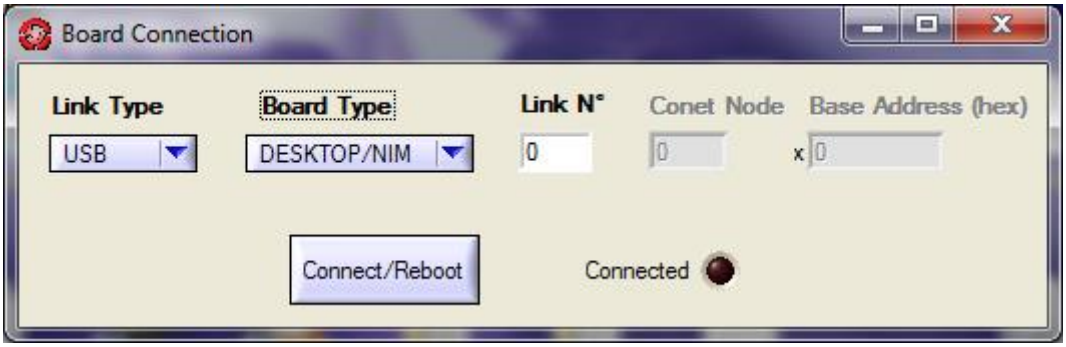


Fig. 3.1: Connection Dialog box

Link Type

Allows to select the communication link (**USB** or **OPTICAL**).

Board Type

Selects the form factor of the board to connect to **(DESKTOP**, **NIM** or **VME).**

Link N°

In case of USB, the link numbers are assigned by the PC when you connect the cable to the device; it is 0 for the first device, 1 for the second and so on. There is not a fixed correspondence between the USB port and the link number. For the Optical, the link number indicates which link of A2818 or A3818 is used; Link index start from 0 (1st Optical link port in the 1st slot used). It is not known a priori which is the first slot used (it depends on the motherboard of the PC used).

IMPORTANT NOTE: if A2818 and A3818 are installed together, the A2818 has lower index assigned.

Conet Node

CONET is CAEN proprietary optical link protocol. In case of Daisy-chain, the *Conet Node* identifies which device in the chain is being addressed. The node is 0 for the first device in the chain, 1 for the second and so on. In case of USB, *Conet Node* must be 0.

In order to connect, select the *Link Type* and the *Board Type* from the respective pull down menus; type the desired Link Number in the *Link N°* entry box; for the Optical Link only, type the CONET Node number in the *Conet Node* entry box; click on the *Connect/Reboot* key.

The green graphical LED aside the *Connect/Reboot* key blinks while a connection attempt is in progress, then remains ON indicating the connection succeeded. The WaveCatcher Main Screen appears, and the Board Connection Dialog Box can be iconized.

Base Address (hex)

It is required only if the VME board type is selected. This field must be filled with the digitizer's VME Base Address, a 8-digit number whose four MSB are given by the position of the relevant on-board rotary switches (refer to the digitizer User Manual for details); the four LSB must be set to "0000".

Connect/Reboot

Once all the required connection parameters are set, this button starts the connection to the board. The "Connected" LED gives the user the status of the connection:

GREY = Disconnected.

BLINKING GREEN = Connection in progress.

GREEN = Connected.

Connection process includes the board initialization and could require several seconds to be completed.

When connected, the same button can be used to reboot the hardware.

Connection Options

Tab. 3.1 shows the connection parameters in case of typical connection cases.

Connection chain	Conn. Type	Conn. Parameters		
		Link Nr	Board Nr	VME Base Address
PC –> **USB** –> DT5743/N6743	USB	0	not required	not required
PC –> **USB** –> V1718 –> **VME** –> V1743	USB	0	not required	32100000[1]
PC –> **USB** –> DT5743/N6743[2]	USB	1	not required	not required
PC –> **PCI** –> A2818 –> **CONET** –> DT5743/N6743[3]	OPTLINK	0	0	not required
PC –> **PCI** –> A2818 –> **CONET** –> V1743[3]	OPTLINK	0	0	0
PC –> **PCI** –> A2818 –> **CONET** –> V2718 –> **VME** –> V1743[3]	OPTLINK	0	0	32100000[1]
PC –> **PCI** –> A2818 –> **CONET** –> V1743[3][4]	OPTLINK	0	1	0

[1] *This VME base address is only as an example. In order to know the correct VME base address to be used, please refer to the Digitizer's User Manual*
[2] *It is supposed that at least two USB ports are used by the PC to communicate with as many digitizers (see the examples at the end of **[RD3]**)*
[3] *The same applies if using the A3818 PCIe card*
[4] *The Digitizer is intended to be part of an optical Daisy chain (see the examples at the end of **[RD2]**)*
Tab. 3.1: Examples of Hardware Connections and the relevant communication parameters

Reboot

To Reboot the Digitizer, click on the *Connect/Reboot* key in the Board Connection Dialog Box (see **Fig. 3.1**)

4 Main Screen

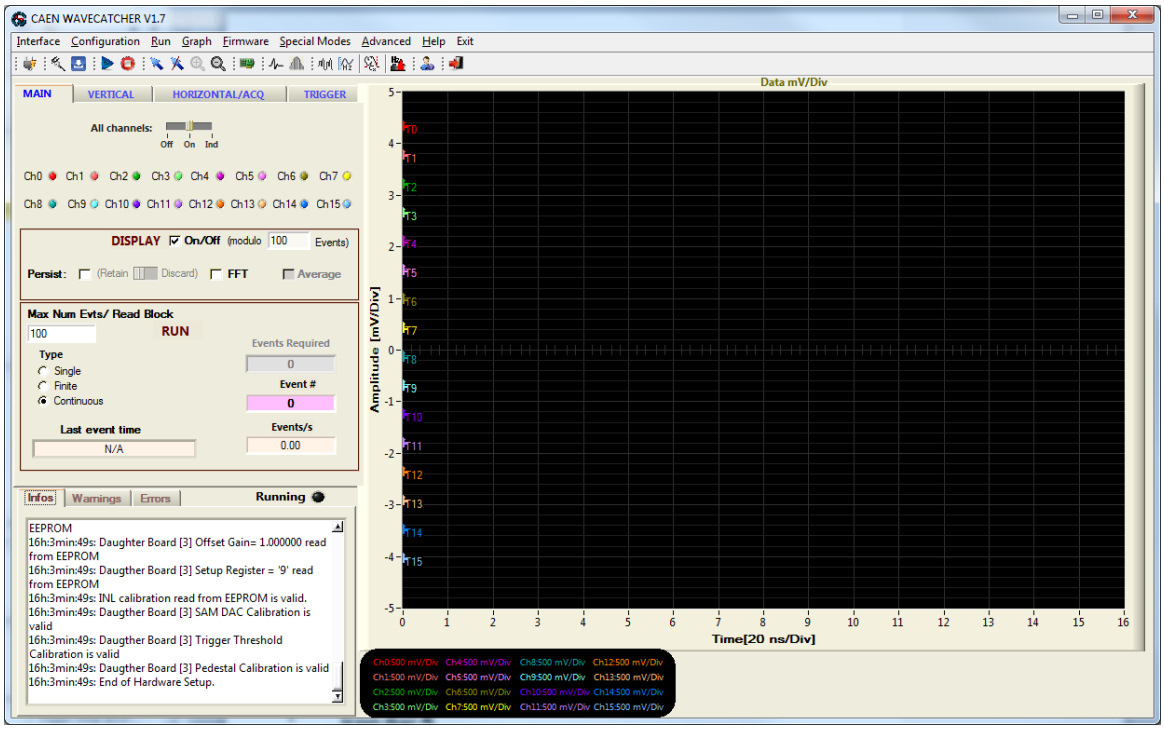


Fig. 4.1: Main Screen

The WaveCatcher Main screen is composed of the following items.

Header Bar

Contains the indication of the software Name, Logo and Version on the left, and the conventional Windows Iconize, Expand and Close Keys on the right.

Menu Bar

Composed of the following Menu items:

Interface/Configuration/Run/Graph/Firmware/Special Modes/Advanced/Help/Exit

Icon Bar

Contains the icons corresponding to the following Menu items:

Board Connect/Calibrate Pedestals/ Save Pedestals to Flash/Start/Stop/Enable Cursors/Delete Cursors/ Zoom In/Zoom Out/Firmware Version/Pulser Mode/Charge Mode/Noise Measurements/Time Measurements/Rate Measurements/Software Users Guide/Exit

Acquisition Section

Includes 4 toggleable tabs:

MAIN / VERTICAL / HORIZONTAL/ACQ / TRIGGER

System Messages Section

includes 3 toggleable tabs:

Infos/Warnings/Errors

Graphic Display Section

Here, the digitized waveforms can be displayed with different colour traces: up to 8 for Desktop and NIM modules, while up to 16 in case of VME modules.

Parameter Display

Here, parameter values related to the traces can be displayed in the respective colour codes.

5 Menu Bar

The WaveCatcher Menu Bar includes the following functions:

Interface/Configuration/Run/Graph/Firmware/Special Modes/Advanced/Help/Exit

Interface Menu

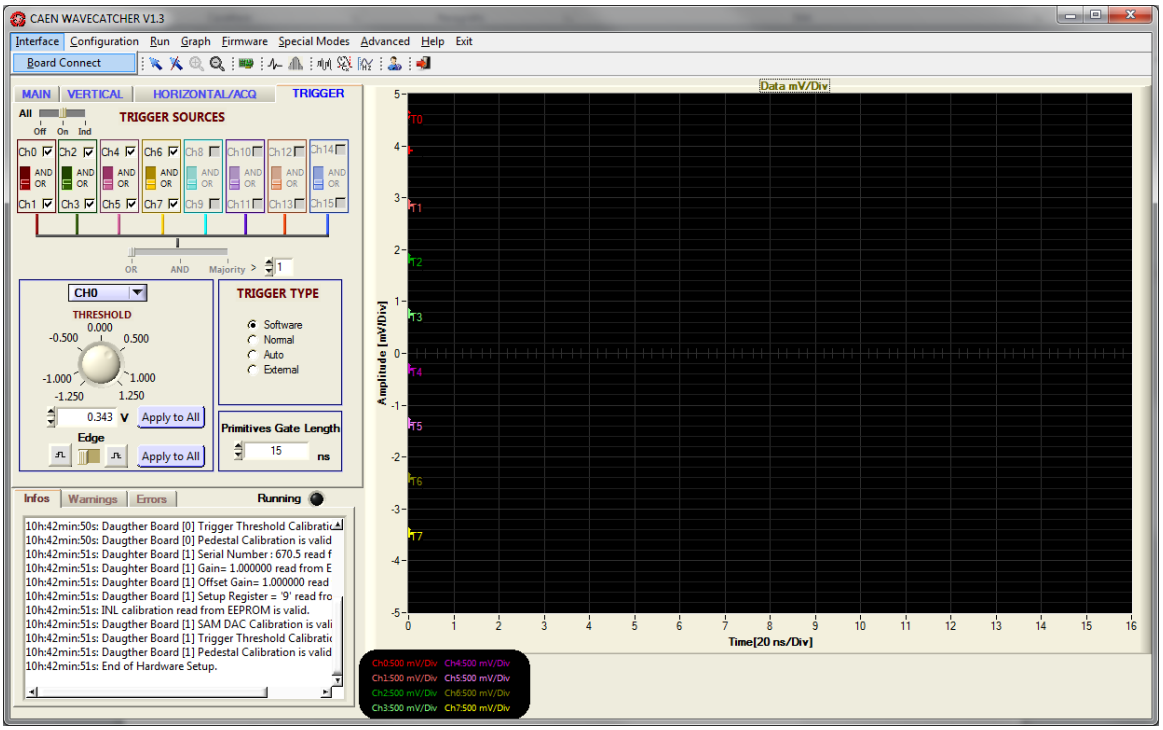


Fig. 5.1: Interface Menu

Board Connect

By left clicking on this pull down menu item, the Connection Dialog Box appears (see **Fig. 5.2**) allowing the user to set up or modify the connection of the 743 series digitizer to the Host PC either through the USB, either through the CONET Optical Link with PCI or PCIe interface. This is performed in the Link Type Pull Down Menu. The Board Type Menu allows the user to enter the type of Digitizer Architecture (VME or Desktop). Refer to § **Board Connection Panel** for a detailed parameters description.

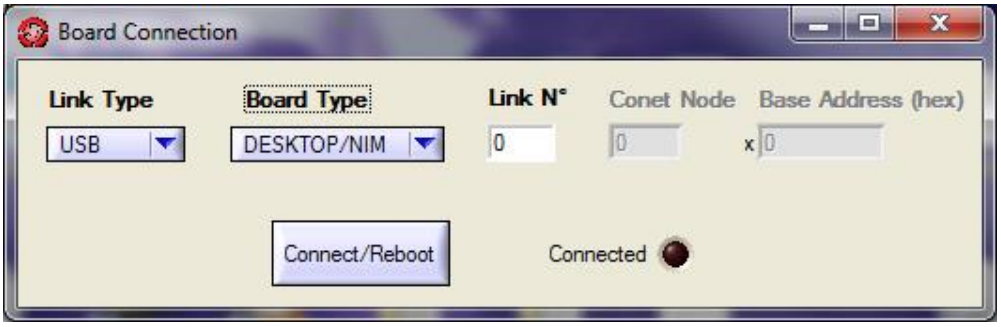


Fig. 5.2: Connection Dialog Box

Configuration Menu

Calibration options in the Menu are fully described in the board's User Manual.

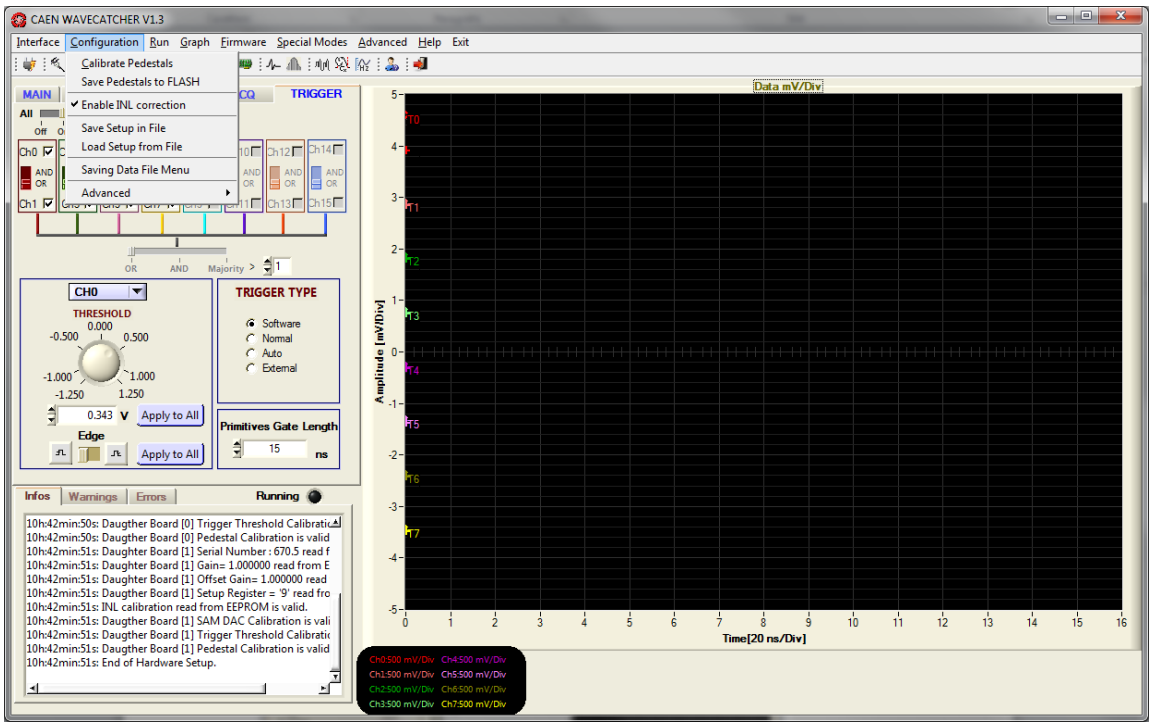


Fig. 5.3: Configuration Menu

Calibrate Pedestals

This item opens a Pedestal calibration Dialog Box (see **Fig. 5.4**) where the user can enter the number of events that will be required to perform the Pedestal calibration.

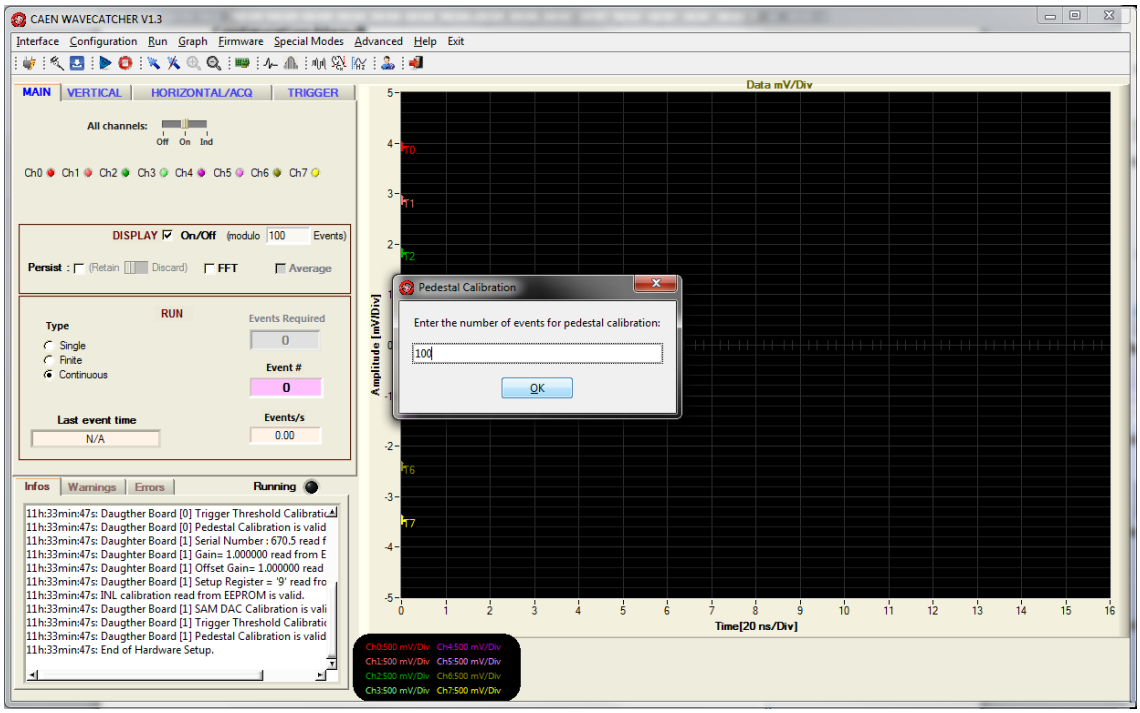


Fig. 5.4: Calibrate Pedestals Dialog Box

⚠ **WARNING:** No signal has to be sent to any of the device inputs during the Pedestal Calibration operation.

Save Pedestals to FLASH

This item allows the user to save to the digitizer EEPROM the pedestal values.

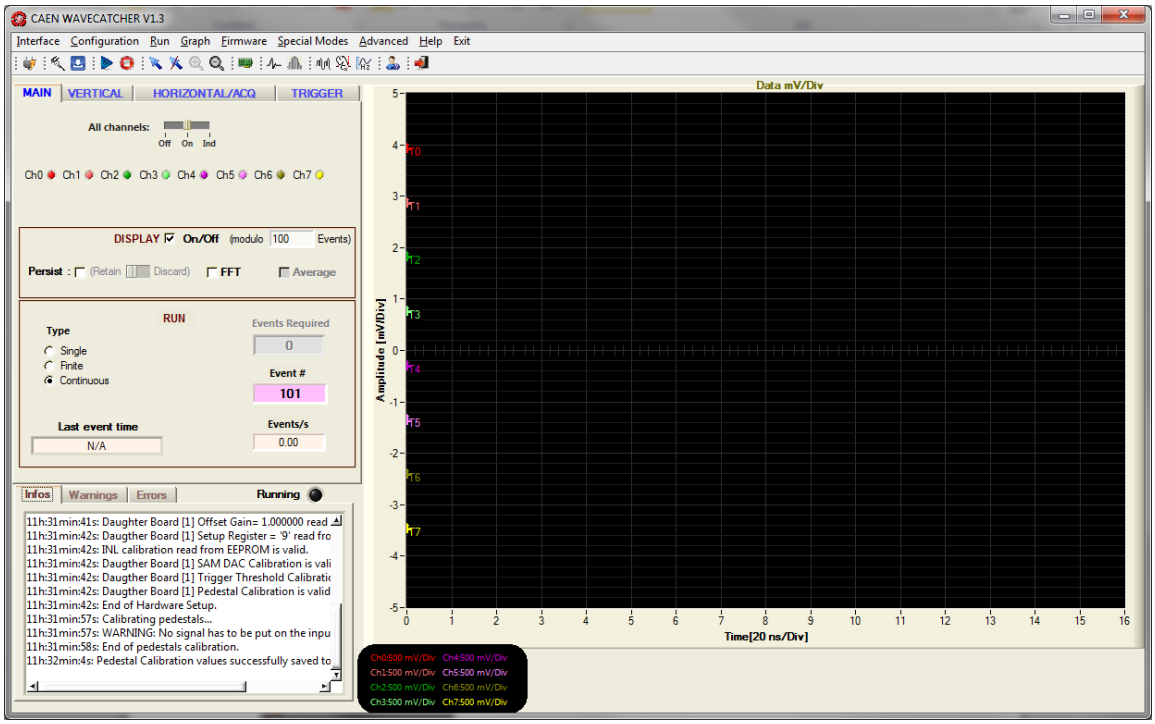


Fig. 5.5: Pedestals-to-FLASH memory screen

Enable INL Correction

By left clicking on this Pull Down Menu item, the user can enable the Integral Non Linearity correction for the acquired data.

Save Setup to File

By left clicking on this item in the Pull Down Menu, the user can access to a Setup Folder window where the current Acquisition Configuration can be stored in a *.dat* file with the name chosen by the user.

Load Setup from File

By left clicking on this item in the Pull Down Menu, the user can access to a Windows Directory window from where an Acquisition Configuration previously stored in a *.dat* file can be retrieved and used to reconfigure accordingly the digitizer.

Saving Data File Menu

By left clicking on this item in the Pull Down Menu, the File Menu Dialog Box opens where the user can configure the file type (ASCII or BINARY) and enable the data splitting to multiple files selecting the number of events per file. Go to p. **49** for output data format descriptions.

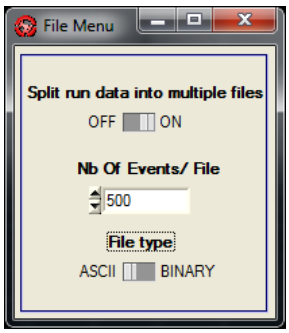


Fig. 5.6: File Menu Dialog Box

Advanced

This menu is not fully accessible to the user.

- **Restricted Access:** this item is dimmed for the user as it's only for CAEN test purposes.
- **Dump FLASH contents to Files:** the user can dump the FLASH content by safety to files in order to be able to recover from a possible corruption of the memory.

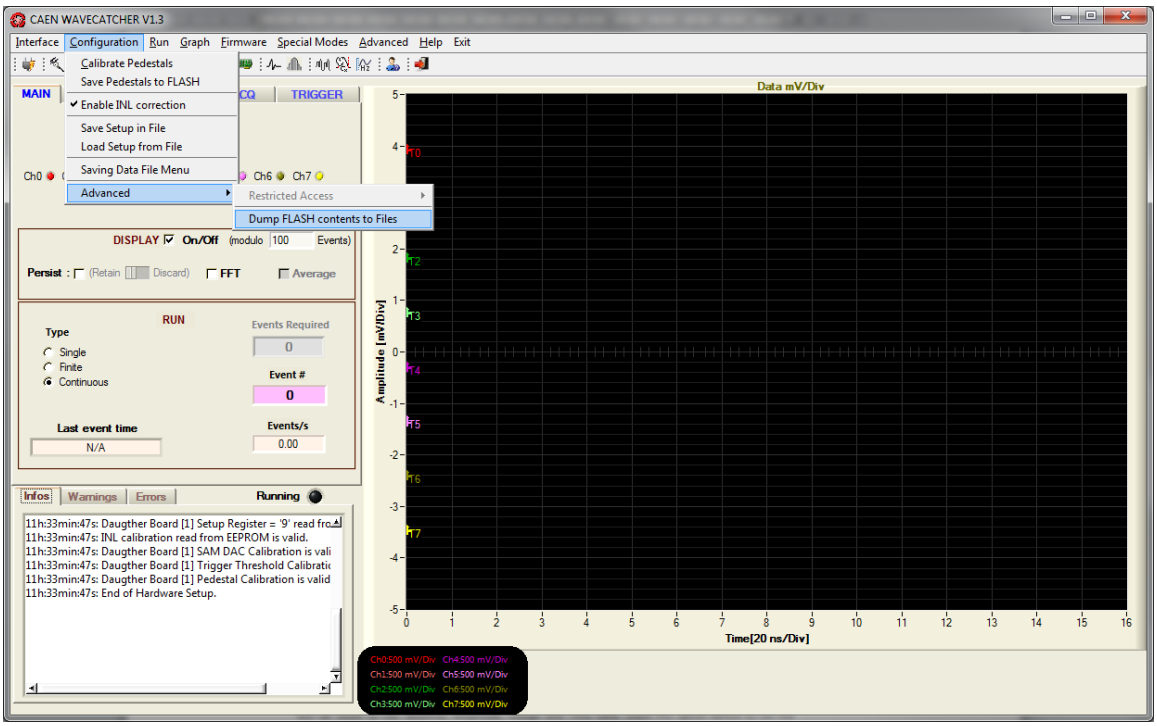


Fig. 5.7: Advanced Settings Pull Down Menu

Run Menu

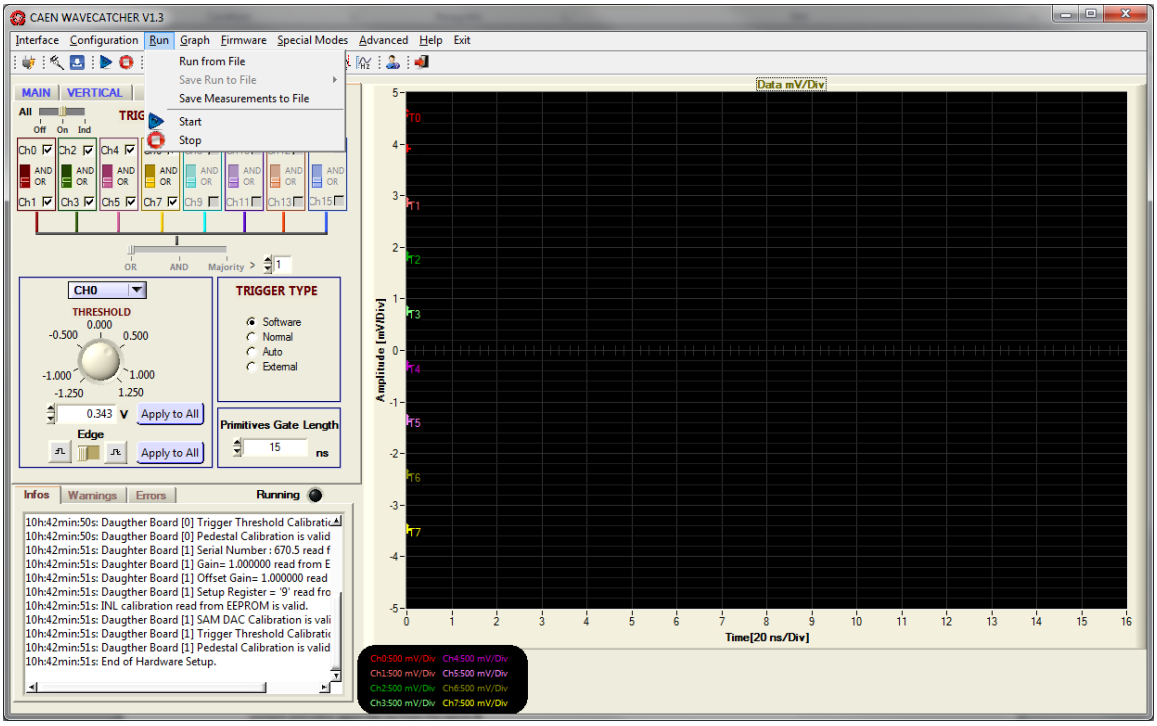


Fig. 5.8: Run Menu

Start/Stop Run

By left clicking on this Pull Down Menu item, the user can start and stop the acquisition on all channels.

Run from File

By checking this option, the user enables the option of running from a file saved with the same software version as the current. The selection of the directory and the name of the file will be proposed at the start of the run. As long as this options is checked and as long as the end of the file is not reached, the software will continue reading the successive events in the file after each stop and start. If the user wants to read the file from the beginning it is suggested to uncheck and check again the run from file option.

Save Run to File

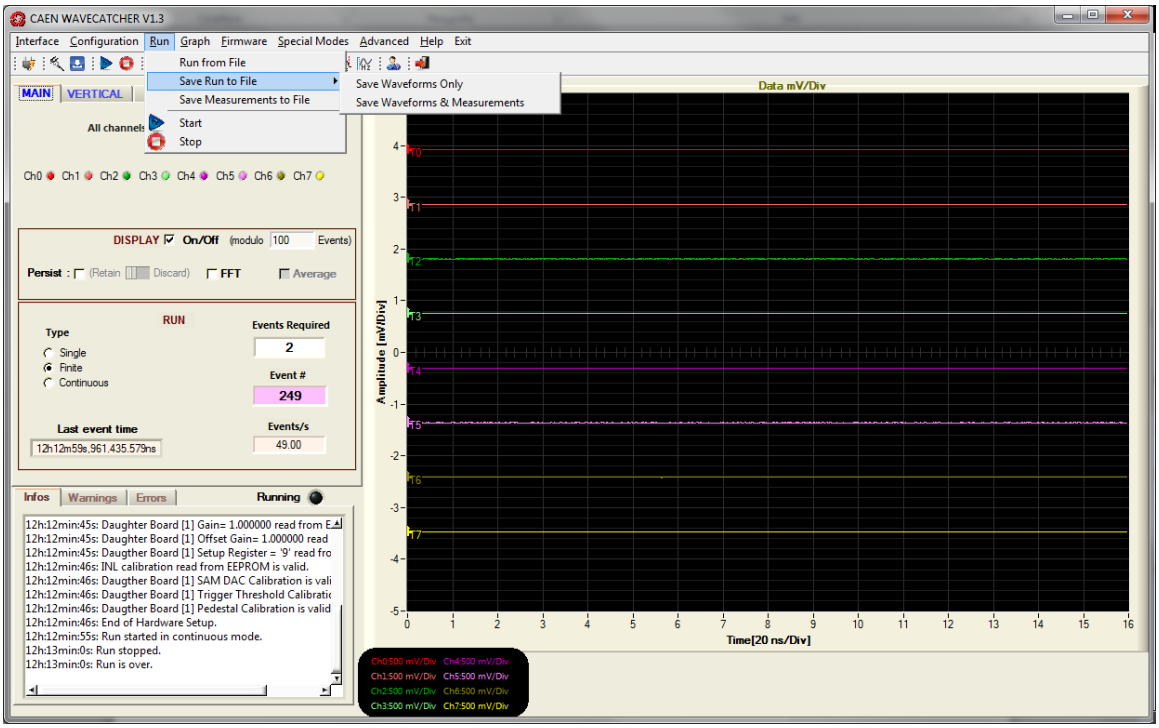


Fig. 5.9: Save Run to file Menu

See also § **11**.

- **Save Waveforms Only:** by checking this option, the user enables the option of saving waveforms to file. The selection of the directory and the file name will be proposed at the start of the run.
- **Save waveforms & Measurements:** by checking this option, the user enables adding measurements such as Baseline, Amplitude, Charge, Leading and Trailing Time to the file. This may slow down a little bit the acquisition.

  Baseline is the number of samples to compute the baseline is selectable in the *Advanced->Time Measurements* Panel.

  Amplitude is the peak of the waveform (can be positive or negative).

  Charge is computed as an integration of all the waveform with baseline extraction. (baseline as computed above).

  Leading and trailing times are computed according to the options set in the *Advanced-> Time Measurements* Panel.

Save Measurements to File

By left clicking on this Pull Down Menu item, the measurement information will be will be saved to file: Baseline, Amplitude, Charge and Time Data. Check this option before to run the acquisition. See also § **11**.

Graph Menu

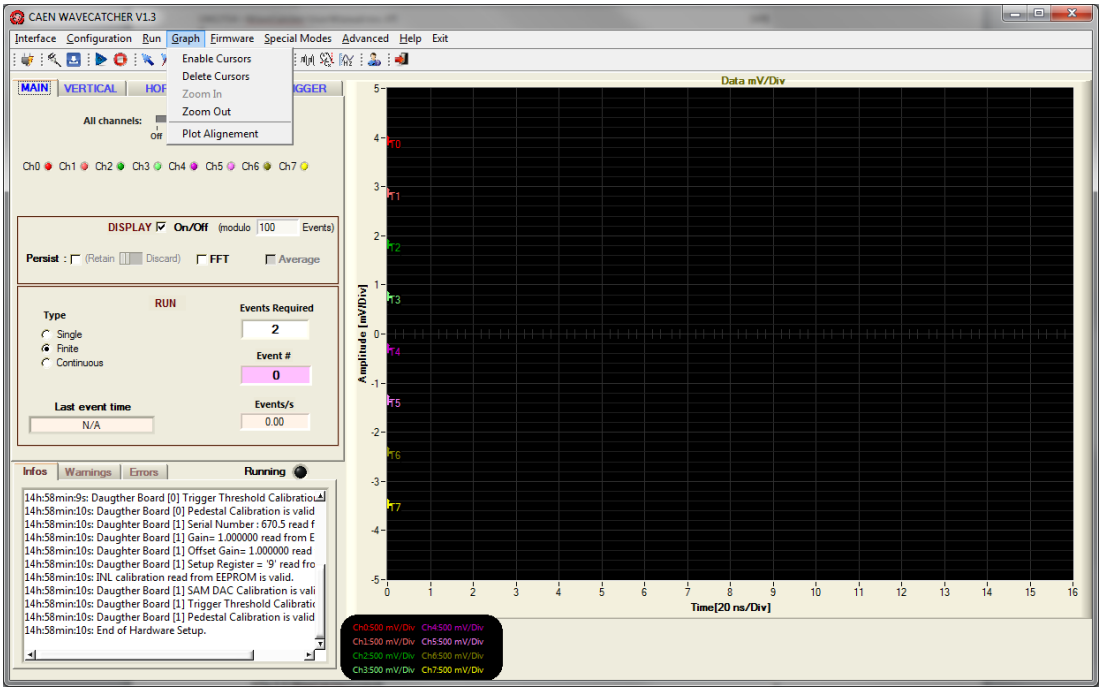


Fig. 5.10: Graph Settings Pull Down Menu

Enable/Delete Cursors

By left clicking on this Pull Down Menu item, the user can toggle on and off the cursors on the graph display. Each cursor is formed by two yellow mobile lines, one horizontal and one vertical forming a cross-hair with a small circle at the lines crossing. Each cursor can be activated buy left clicking with the pointer in the area within one division from the cross-hair center and can be dragged across the graph area. When active, the cursor is highlighted. To set the cursor position, left click again once the desired position is reached, then to release the cursor place the pointer to a distance greater than one division and left click again. The cursor will return to the normal intensity. The cursor values can be read in the window to the left bottom of the screen. Displayed values include X1 (first cursor) and X2 (second cursor) horizontal values in ns, x1-x2 time interval length between the cursors in ns and deltaY (difference of amplitude between the two cursors) in Divisions.

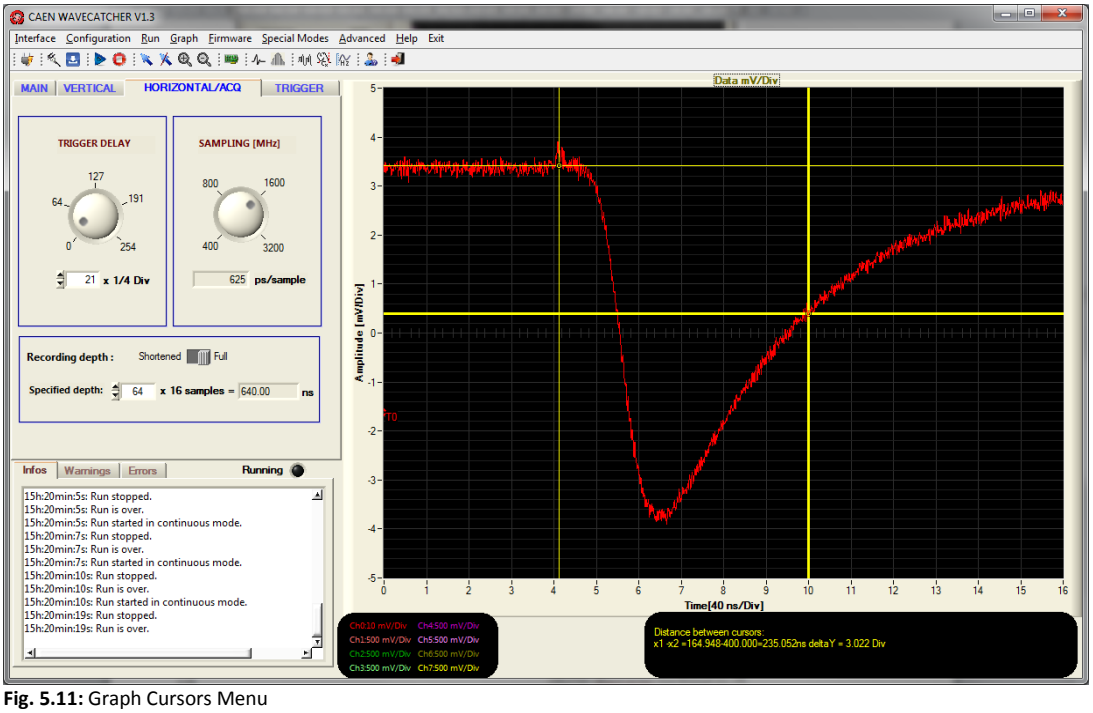


Fig. 5.11: Graph Cursors Menu

Zoom In/Out Options

By left clicking on the *Zoom In* item, the user can expand in the waveform area on the graph display selected by the cursors. By left clicking on the *Zoom Out* item, the user can reduce the former expansion till the original dimensions of the waveform display are reached.

Plot Alignment Settings

By left clicking on this item in the Pull Down Menu, the Plot Alignment Menu Dialog Box opens with the following settings:

- **Enable/Disable Plot Alignment**
- **Align On [Channel]**
- **Edge**
- **Threshold**

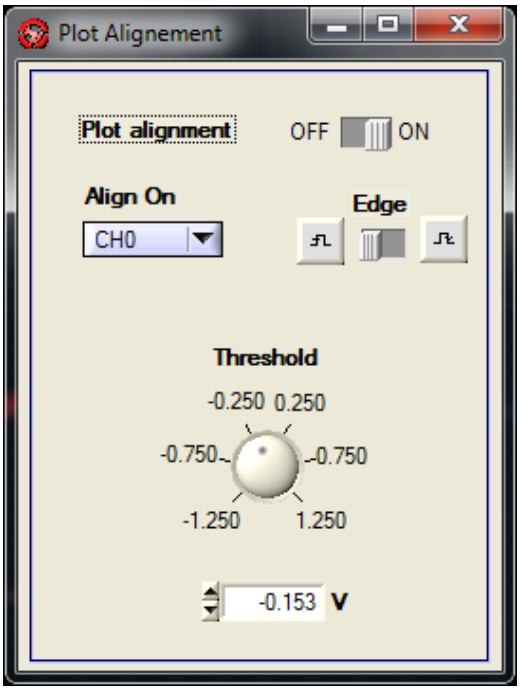


Fig. 5.12: Plot Alignment Dialog Box

Firmware Menu

Firmware

By left clicking on this Pull Down Menu item, the user can visualize a dialog box containing the Daughter boards and the Mother board firmware release versions.

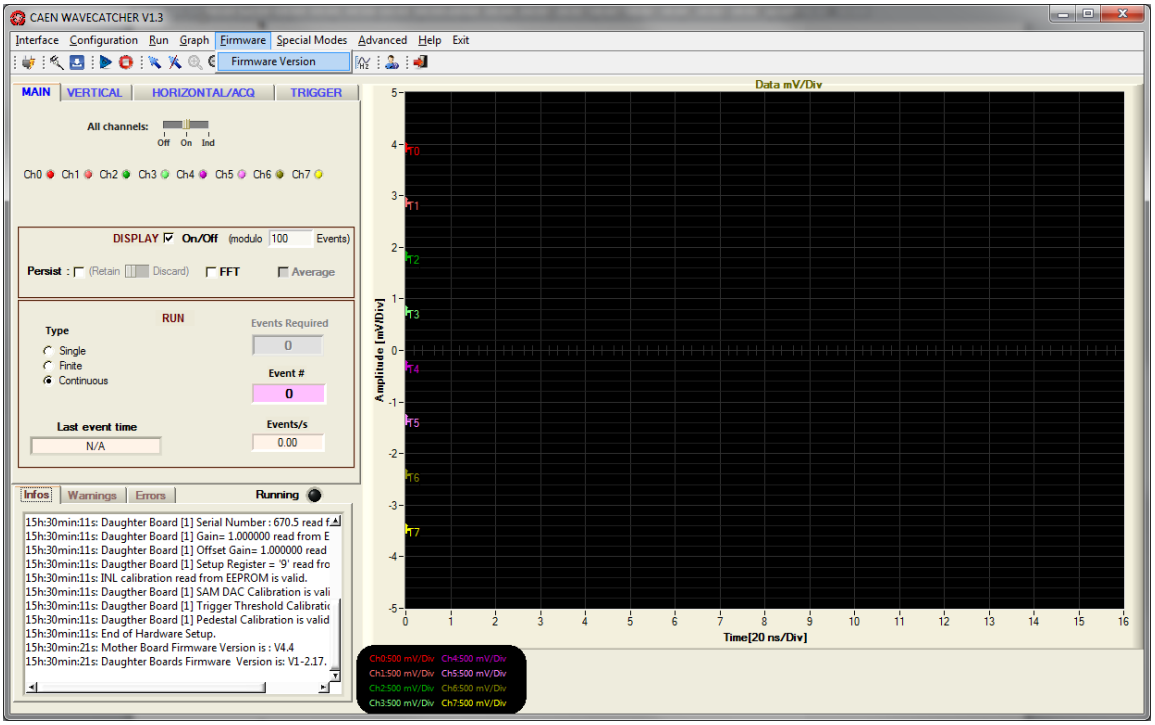


Fig. 5.13: Firmware Menu

Special Modes Menu

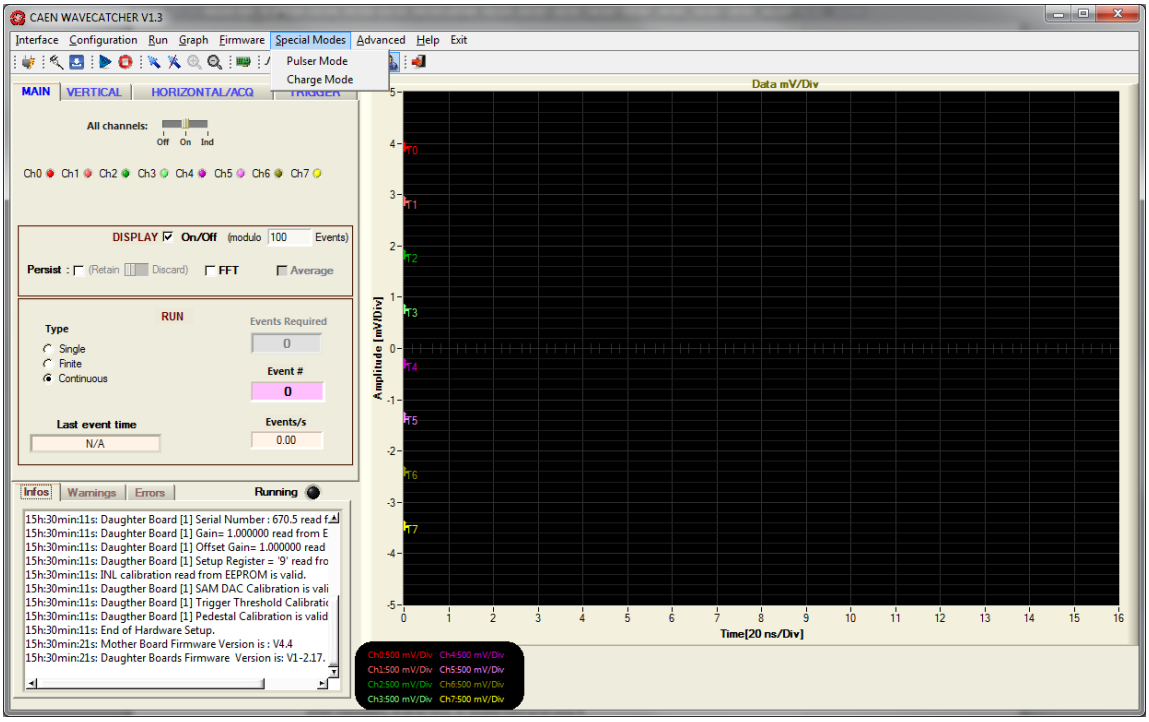


Fig. 5.14: Special Modes Menu

Pulser Mode

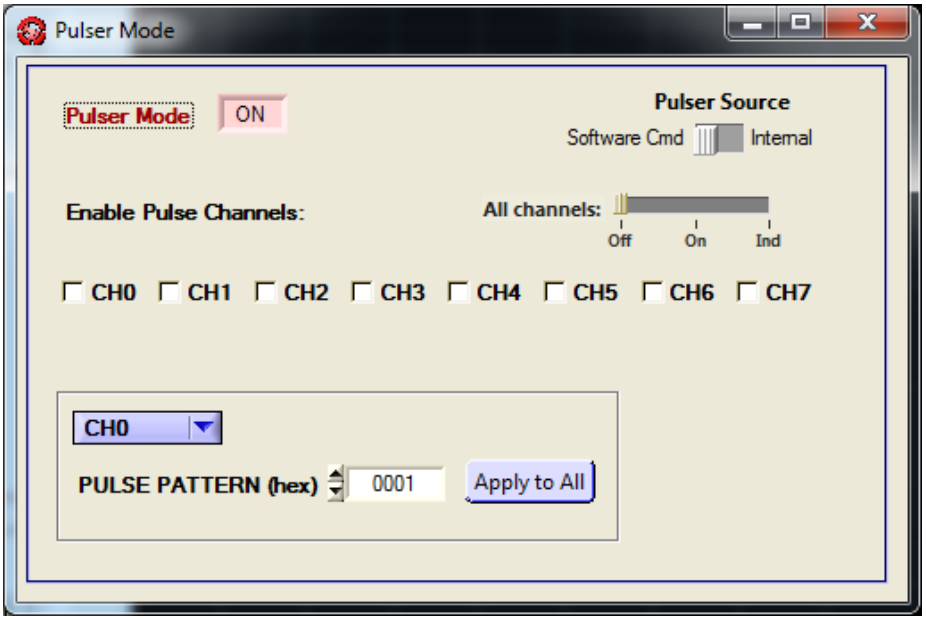


Fig. 5.15: Pulser Mode Panel

By left clicking on this Pull Down Menu item, the user can visualize a dialog box containing the following Pulser settings:

- **Enable/Disable Pulser Mode key**
- **Enable/Disable Pulse Channels menu:** the user can enable the channels to be provided with the pulse either individually, or all at once, or disable them all at once.
- **Pulse Pattern:** the user can apply a configurable pulse pattern (hexadecimal value to be typed in) to selectable channels or all channels.
- **Pulser Source:** selectable pulse source to be a Software Command or the Internal Clock

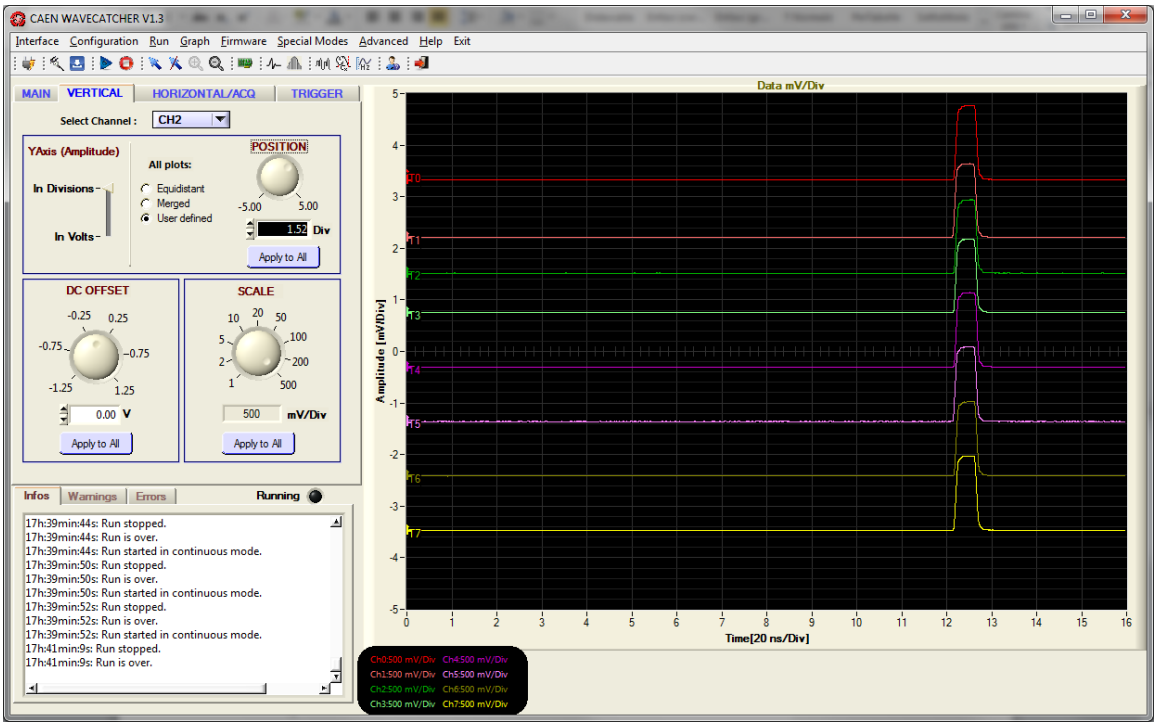


Fig. 5.16: Pulser Mode Plot

Charge Mode

By left clicking on this Pull Down Menu item, the user can visualize a dialog box containing the following Charge Mode settings

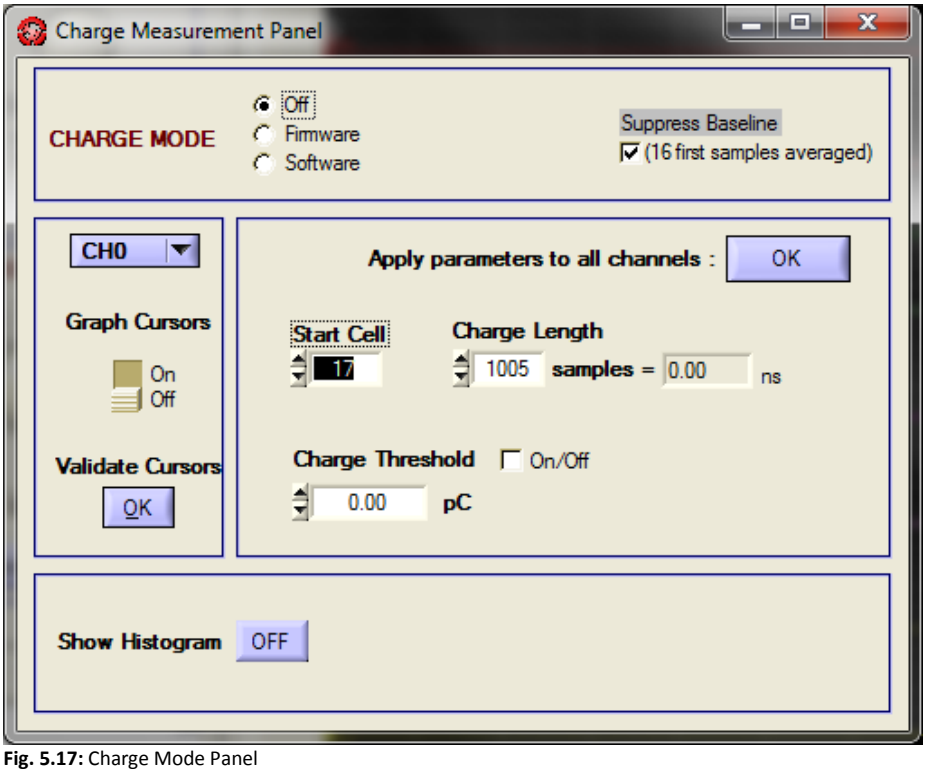


Fig. 5.17: Charge Mode Panel

- **Enable/Disable Charge Mode:** the user can select between charge integration made at firmware or software level. before enabling the charge mode, the appearing cursors must be used (in standard mode) to select the region of integration (see **Fig. 5.18**).

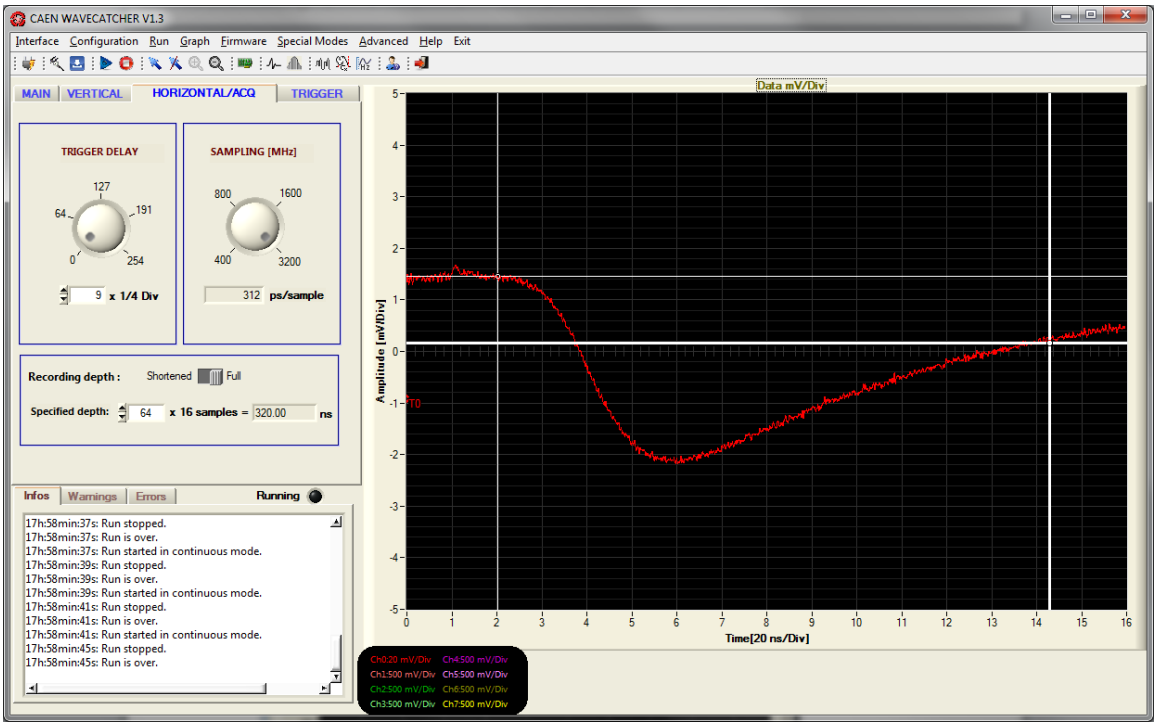


Fig. 5.18: Charge Integration region selection

- **Enable/Disable channels:** allows to enable the channels for which the charge parameters have to be applied.
- **Suppress Baseline option selection**
- **Enable/Disable/Validate the Graph Cursors:** this options apply to selectable channels. Selecting a pulse region by placing the cursors and then using the Validate Cursors key allows to set the pulse integration window; this can also be done by typing the Start Cell and Charge Length values in the relevant text boxes.
- **Set Charge Parameters:** *Start Cell*/*Charge Length* (in nanoseconds)/*Charge Threshold* (in picocoulombs). *Start Cell* and *Charge Length* define the pulse integration window. Setting the charge threshold, the firmware is configured so that the board will provide only charge values under the fixed threshold.
- **Enable/Disable Show Histogram:** allows to enable the histogram plot. Setting the *Show Histogram* key ON, opens the *Charge Histogram* Dialog Box (see **Fig. 5.19**). The *Charge Histogram* Dialog Box allows the user to manage the charge histogram plot. It is possible to select the channel to plot, possibly configuring the charge region of interest to be plotted. An auto Y-axis scaling or a user configurable fixed range may be selected. The user can also configure the number of bins for the histogram plot and save the histograms to file or reset the histograms plot

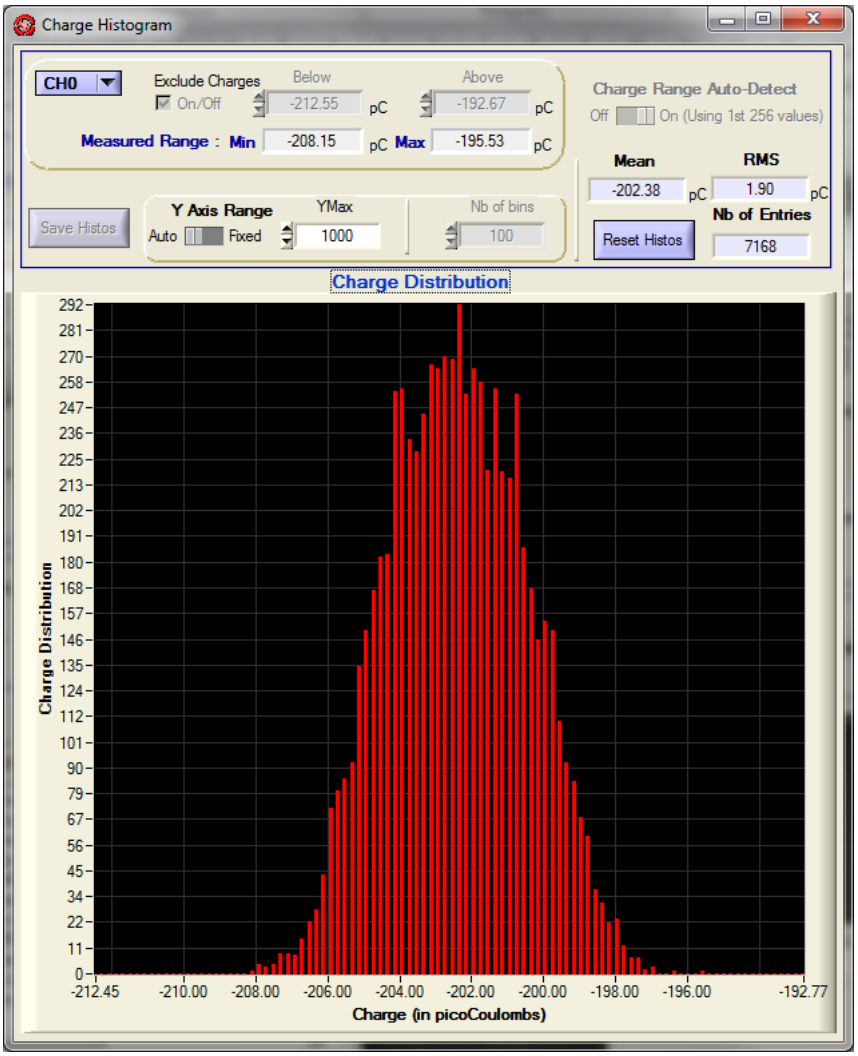


Fig. 5.19: Histogram Plot Dialog Box

Advanced Menu

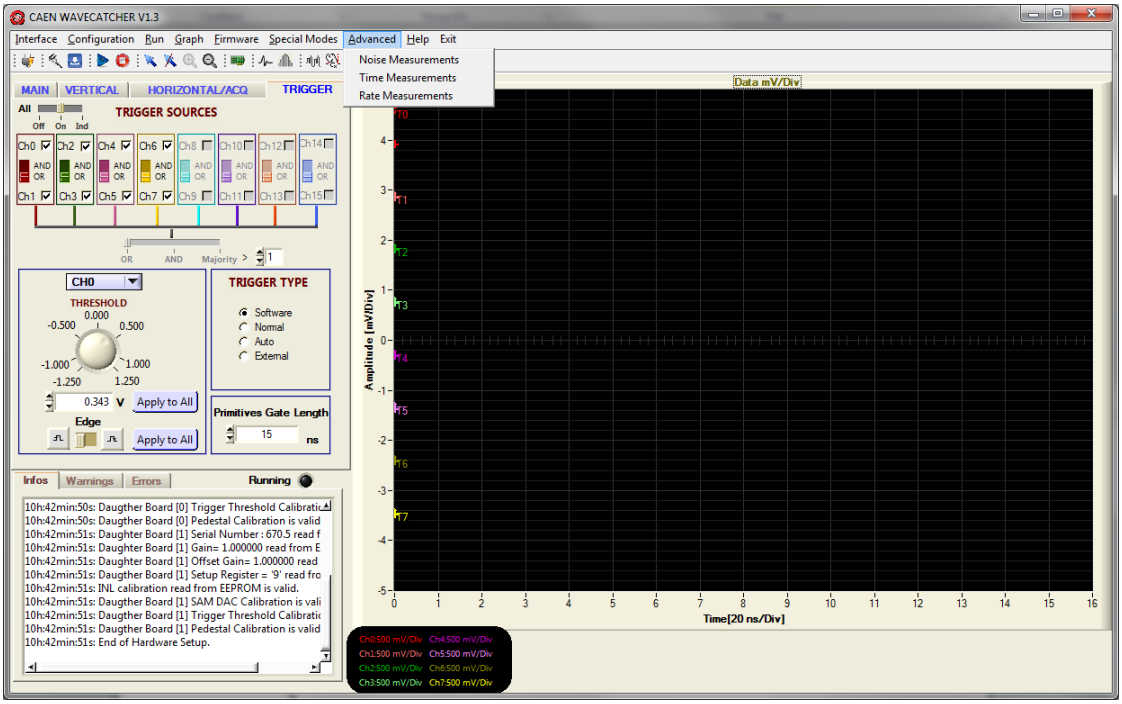


Fig. 5.20: Advanced Menu

Noise Measurements

This section allows the user to perform noise measurements. By clicking the relevant option in the Menu, the *Noise Measurements* screen appears.

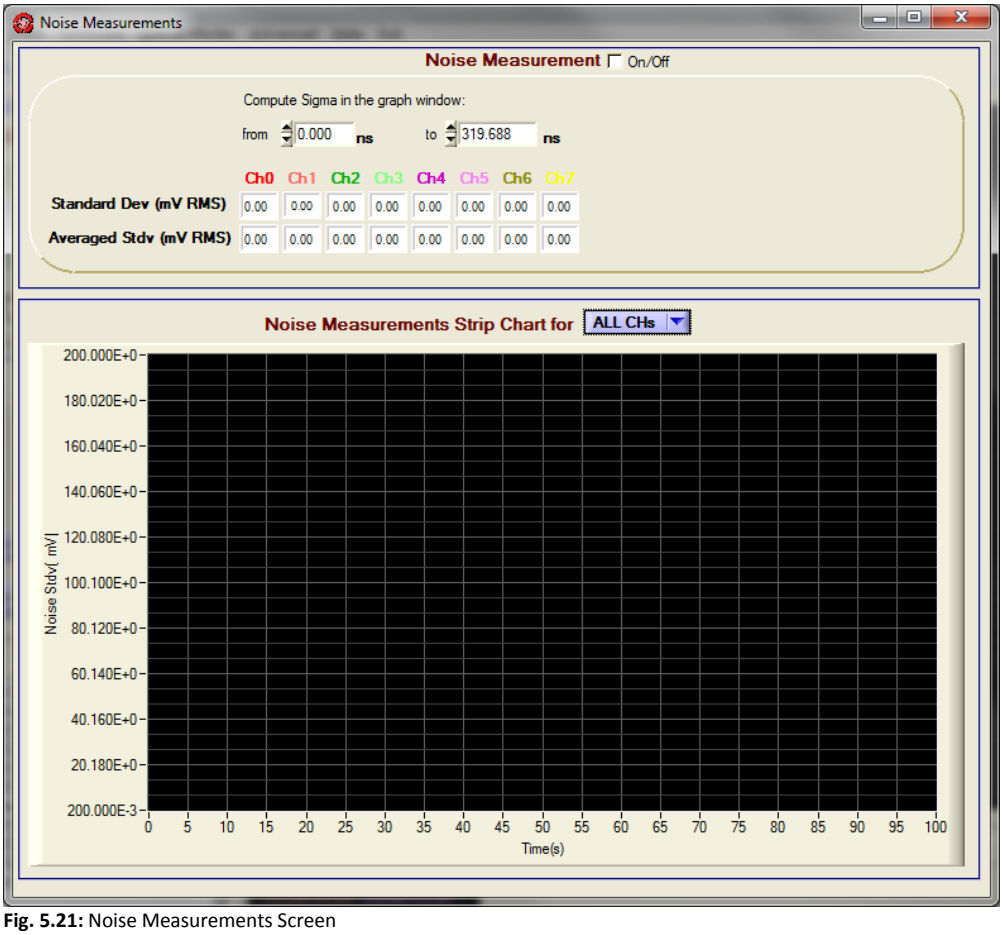


Fig. 5.21: Noise Measurements Screen

The noise measurements features are:

- -**Enable/Disable Noise Measurement:** it allows to activate or deactivate the noise measurement options.
- **Graphical Sigma computation:** it allows to compute the Sigma value in the graph time window specified by the user.
- **Standard Deviation:** it is the instant value of the RMS of the samples in the selected window.
- **Averaged Standard Deviation:** it is the averaged value of the RMS (from the beginning of the run).
- **Noise Measurement Strip Chart:** it is the strip chart of the instants values of the RMS of the samples versus Time in seconds.

Time Measurements

This section allows to define the options for all the timing measurements, such as the measured Leading/trailing Times put in the data files, time distance histograms and also some parameters for the computation of the Amplitude or the Baseline. These options can be applied for waveforms with single pulses. With the multiple pulses or overlapping pulses the results can be irrelevant.

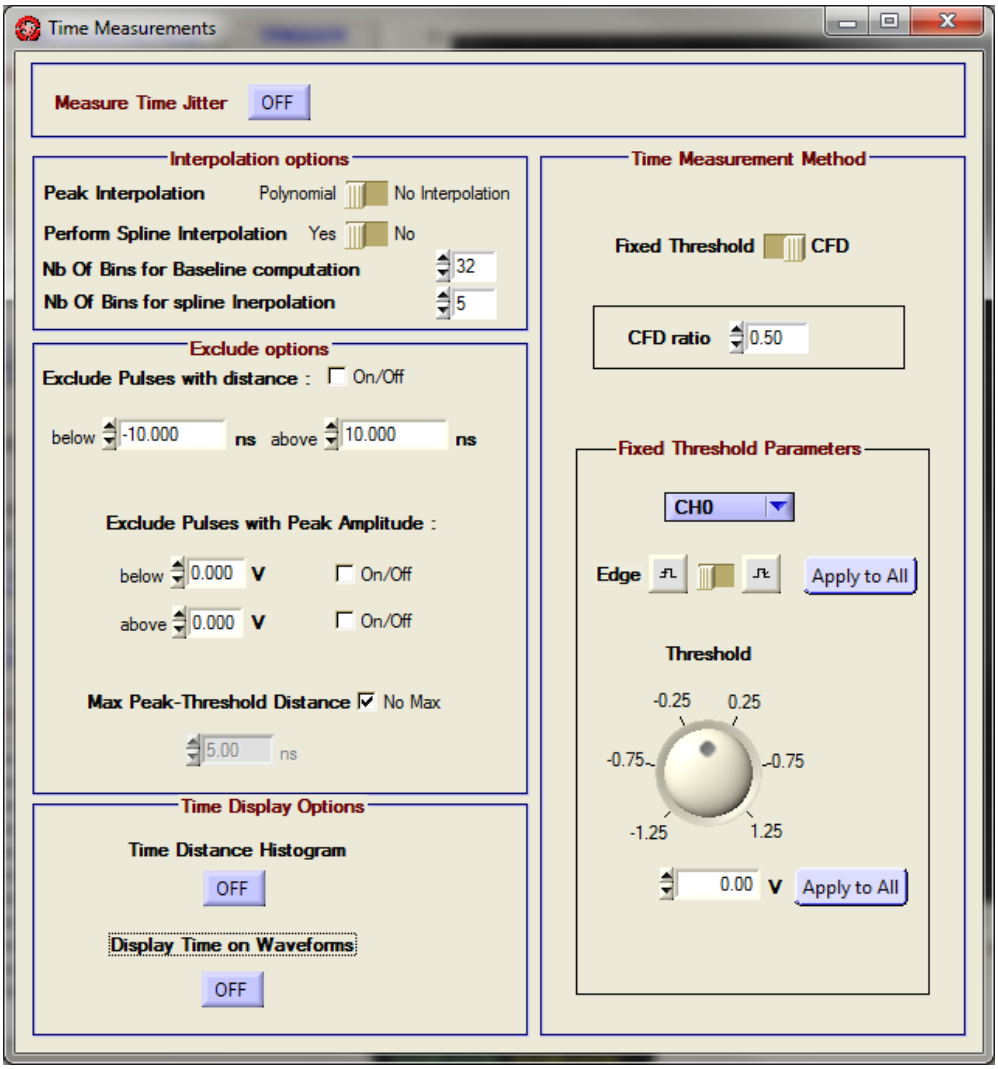


Fig. 5.22: Time Measurements Screen

The time measurements features are:

- **Enable/Disable Time Jitter Measure:** it enables the time measurements in the software -> Time Distance Histogram are then available.
- **Interpolation Options:**

  -*Peak Interpolation*: if no interpolation is selected, the peak is equal to the maximum value of the samples (positive or negative). If the interpolation is selected, a polynomial interpolation using the 3 points around the maximum value are used to define the peak value.

  -*Spline interpolation*: cubic spline can be used to interpolate between samples.

  -*Nb of bins for baseline computation*: is the number of samples at the beginning of the waveform that will be averaged and considered as a baseline. This number of bins is also used for the baseline and charge measurement s that are added to data files.

  -*Nb of bins for spline interpolation*: is the number of bins between samples that is added by the cubic spline interpolation.

- **Time Measurement Method**

  In order to compute the leading and trailing times of a pulse, two different methods are offered to the user:

  -*CFD(Constant Fraction Discriminator)*: for pulses with varying amplitude, this is the method that offers less jitter. The user defines the ratio (between 0 and 1) according to the signal shape. To minimize the jitter, this ratio should at the maximum of the slope of the signal.

  -*Fixed Threshold method*: for signals with a fixed amplitude or signals with a “plateau” and a non-clear peak, this method can be more efficient. The user defines a fixed threshold selectable for each channel, and defines also the edge (rising or falling) for the leading time computation, the other edge will be used to compute the trailing time.

- **Time Display Options:**

  -*Time Distance Histogram*: the software permits to display the histogram of the time distance between each pair of channels that were enabled during the run. The mean value and the RMS of the distribution are displayed during the acquisition in real time, each N events (N is the % event selected by the user in the main tab). At the end of the run, a Gaussian fit is applied to the distribution, and the fitted mean and fitted sigma are displayed. Save Histo in file option is available.

  -*Display time on Waveforms*: it permits to display on the waveform the position of the computed leading time. This option can be enabled even if the Time Measurements Enable is set to OFF.

- **Exclude Options:** these exclude options are applicable to the time distance histogram. It is possible to exclude Time distance above and below selectable values. It is also possible to exclude pulses with amplitude above and below selectable values. It is also possible to exclude pulses with a distance between the peak and the leading time above a certain value (this can be useful to exclude for example waveforms with multiple pulses or overlapping pulses)

Rate Measurements

This WaveCatcher section allows to measure the real raw trigger rates on each channel (independently of the acquisition rate) as all the channels on the board are equipped of discriminators.

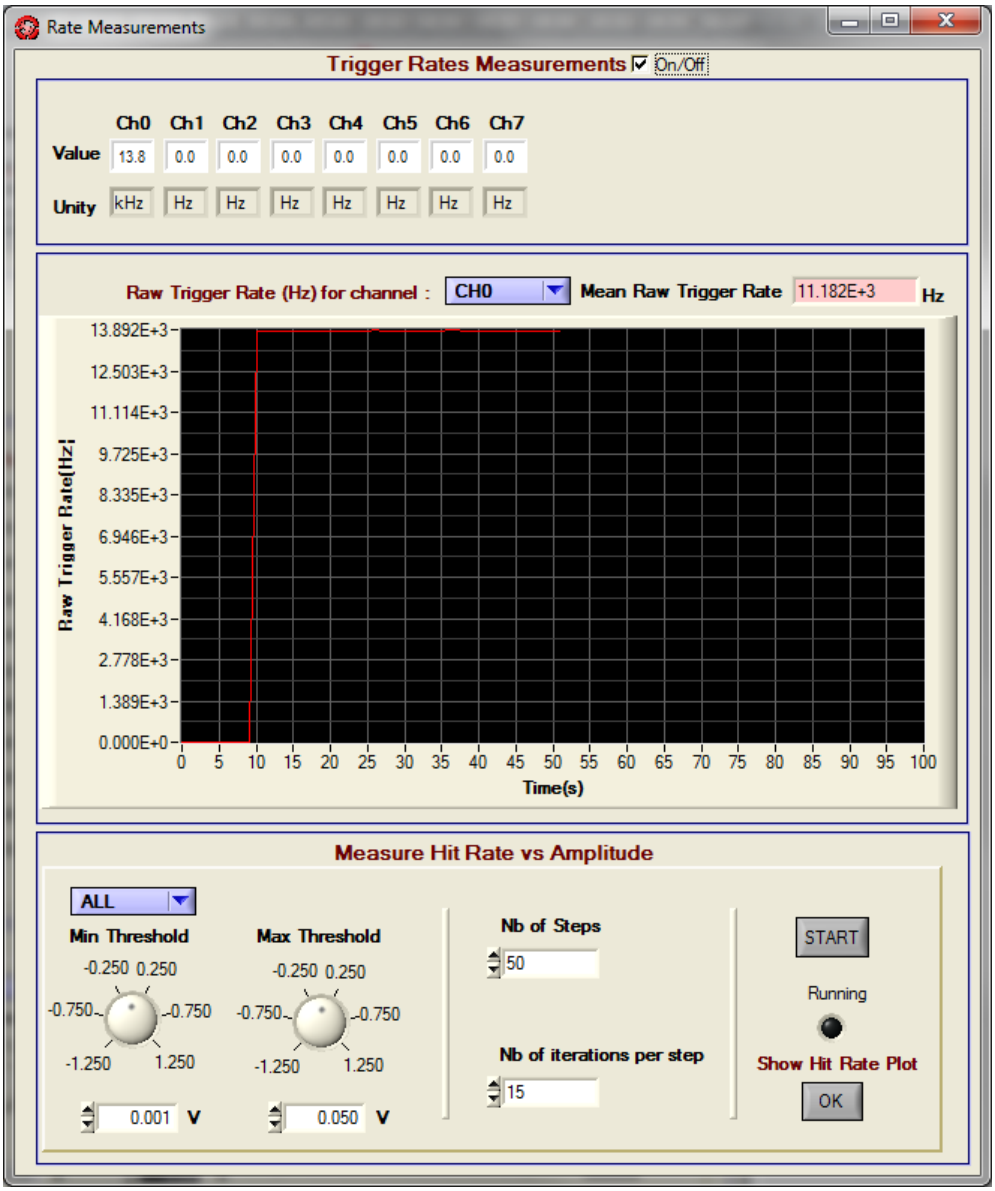


Fig. 55.3: Rate Measurements Screen

The rate measurements features are:

- **Enable/Disable Trigger Rates Measurements**: enabled/disabled the measurements.
- **Value:** for each channel the measured value is displayed with its corresponding unit which can be (Hz, KHz and MHz)
- **Unity:** this is the unit for the rate *Value* above described.
- **Channel Raw Trigger Rate strip chart:** it is the raw trigger rate vs time in seconds.
- **Mean Raw Trigger Rate**
- **Hit Rate vs Amplitude Measure:** *t.b.d.*
- **Show Hit Rate Plot:** *t.b.d.*

6 Icon Bar

Fig. 6.1: Icon Bar

The *Icon Bar* shown in **Fig. 6.1** includes the icons to fast perform the main functions in the WaveCatcher *Menu Bar* (see § **5**), corresponding to the items in the list below:

Description	Name	Icon
Opens the Board Connection Dialog Box	Board Connect	
Opens the Pedestals Calibration Dialog Bog	Calibrate Pedestals	
Save the Pedestals Calibration values to FLASH	Save Pedestals to FLASH	
Start the acquisition	Start Acquisition	
Stop the acquistion	Stop Acquistion	
Enable the graphical cursors	Enable Cursors	
Disable the graphical cursors	Disable Cursors	
Enable the Zoom In option	Zoom In	
Enable the Zoom Out option	Zoom Out	
Read the board's firmware revisions	Firmware Versions	
Opens the Pulser Mode Dialog Box	Pulser Mode	
Opens the Charge Mode Dialog Box	Charge Mode	
Opens the Noise Measurement Dialog Box	Noise Measurement	
Opens the Time Measurements Dialog Box	Time Measurements	
Opens the Rate Measurements Dialog Box	Rate Measurements	
Opens the Software's Users Guide (*t.b.d.*)	Software User's Guide	
Performs the program exit	Exit	

Tab. 6.1: Icon Bar list

7 Main Tab Description

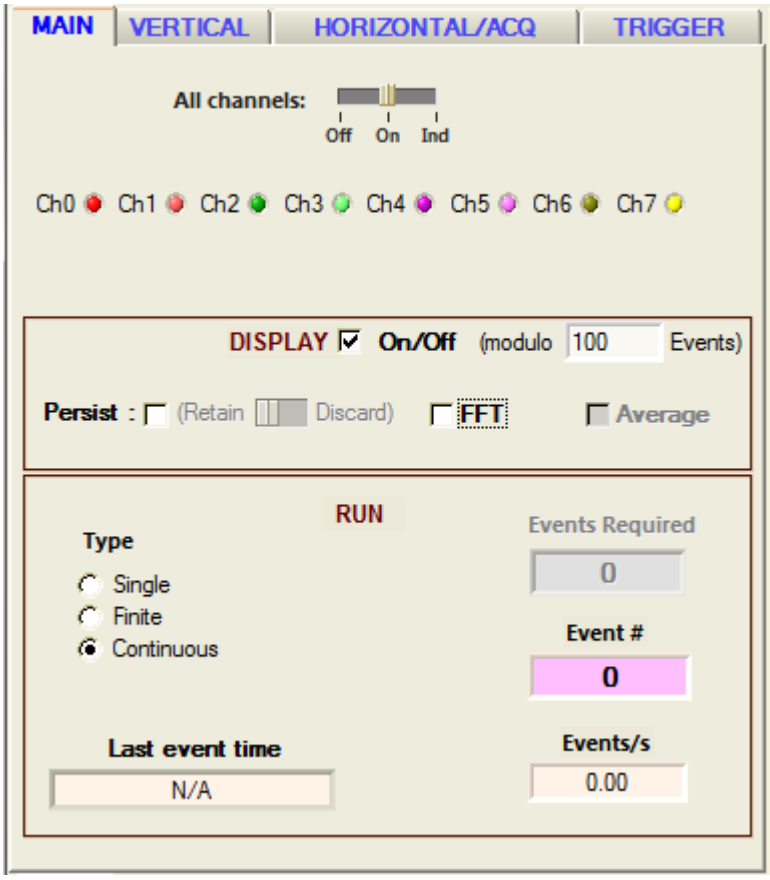


Fig. 7.1: Main Tab

The Main Tab presents the three sections following described.

Channels Display Section

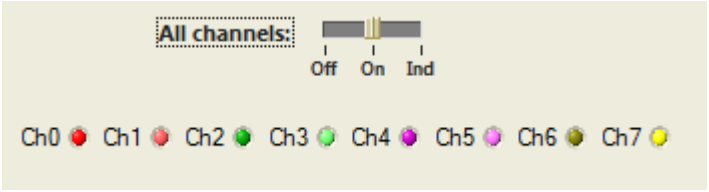


Fig. 7.2: Channels Display Section

Channels On/Off/Ind

It is a slide command which allows the user to select all channels to be Displayed (*On*) or Hidden (*Off*) or Displayed Independently (*Ind*). When the *Ind* position is selected, the user can display or hide the individual channel by left clicking on the desired channel LED.

Channel LEDs

Underneath the *All Channels* line, a row of LEDs lighten in different colours will indicate all channels being displayed. The LED colour will match the waveform trace colour.

Function Display Section

In this section of the Main Tab, the user can select the type of special function to be applied to the acquired data for display.

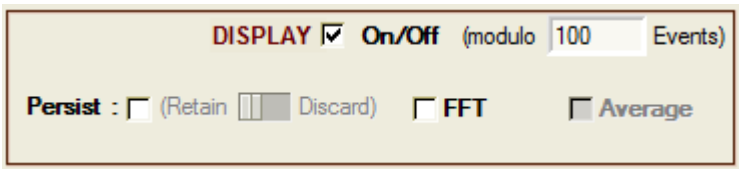


Fig. 7.3: Function Display Section

DISPLAY On/Off

If the checkbox is marked, the function display will be updated continuously. If the checkbox is unmarked, the function display will be updated every N% events, where N is the percentage of events set by the user by writing a value in the (% N events) checkbox.

Persist

After the first waveform is displayed, the successive waveforms are overwritten to it on the screen: no waveform is erased, and the successive traces overlap, as in the Persistence Mode of the conventional oscilloscopes.

RETAIN

In RETAIN Mode, Graph Data is continuously saved to memory. This mode is not advisable in Continuous acquisition Mode.

FFT

The Fast Fourier Transform of the acquired waveform is displayed. The X-axis indicates the frequencies composing the signal, in MHz, and the Y–axis indicates the amplitude values of the corresponding frequencies, in dB.

Average

The waveform resulting from the accumulated average of the incoming waveforms is displayed.

RUN Options Section

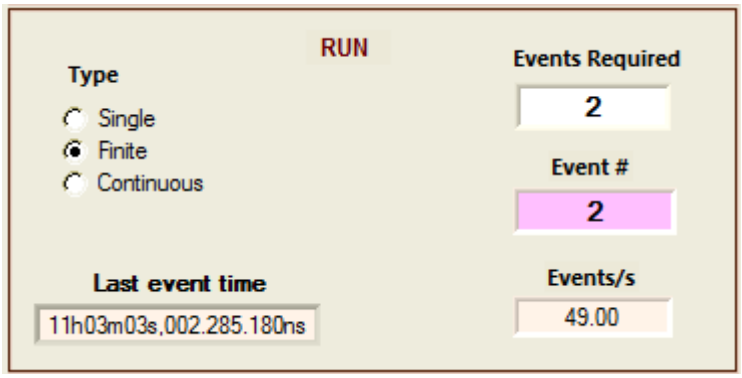


Fig. 7.4: RUN Options Section

Run Type

The Run options are:

- **Single:** the Single Run Mode allows the user to arm the digitizer. Upon receiving a valid trigger, the digitizer will perform a single acquisition on all channels and stop.
- **Finite:** the Finite Run Mode allows the user to arm the digitizer and preset a number of valid event triggers to be accepted before stopping the acquisition. The user can enter this number in the *Events Required* value box. Upon receiving a valid trigger, the digitizer will acquire data on all channels. The current number of valid events recorded is shown in the *Event #* value box. The acquisition will then be continued until the preset number of trigger events has been reached.
- **Continuous: i**n the Continuous Run Mode, the Digitizer acquires data continuously until a Stop Acquisition command is received. The current number of valid events recorded is shown in the *Event #* value box.
- **Last Event Time:** this value box shows the last recorded event timestamp value
- **Events/s :** this value box shows the rate of valid events/second.

Max Num Evts/ Read Block

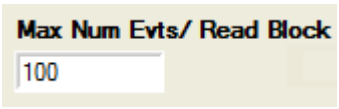


Fig. 7.5: Max Num Evts/Read Block Section

It defines the maximum number of events that can be read from the board at once, before to be processed by the software. Default value is 100,and it can range from 1 up to 1024. Higher values will permit to go faster, BUT, depending also on what the software does with the data (measuring time, charge histogramming etc.), a big value may makes the board to work in **burst-like mode**. So, the user have to tune this parameter and find the value fitting his needs.

Note: The software updates automatically the "modulo events" with respect to the *Max Num Evts/ Read Block* in order to permit to run faster when the display in OFF.

8 Vertical Tab Description

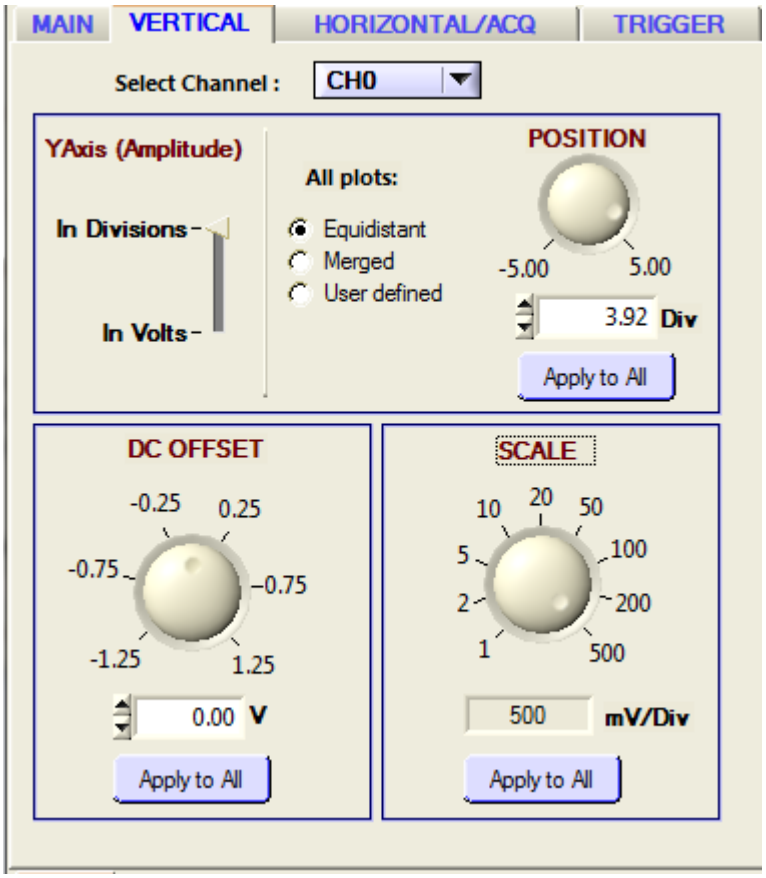


Fig. 8.1: Vertical Tab

Y-Axis Display & Position Sections

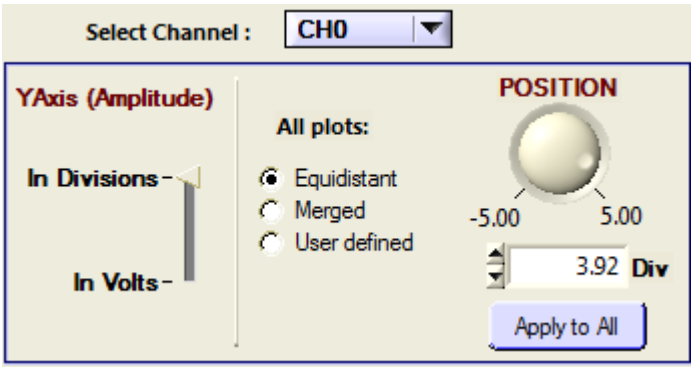


Fig. 8.2: Y-Axis and Position Sections

Y-Axis (Amplitude)

In this section, the user can select the units for the Y Axis values, either in Volts (then all the plots are merged and the only way to scale the graph is to use the zoom in/out) or in Divisions (then the user can choose different scales on each channel) by toggling the leftmost control slider.

The traces spacing can be selected (for all displayed traces) through the *All plots* options.

All Plots

- **Equidistant:** each trace is positioned at the same distance from the previous and from the following trace.
- **Merged**: all traces have the same graphic offset.
- **User defined**: the user can position each trace independently on the graph area, by selecting different graphic offsets. In this case, the channel to be positioned can be selected in the *Select Channel* Pull Down menu, and then position the selected channel trace by using the *Position* Knob or the *Up* and *Down* arrows under it.

Position

This is a purely graphical offset and allows the user to move the trace vertically. The range of graphical offset is between -5 and +5 divisions by the relevant knob. A finer control of the trace position is available thru the use of the *Up* and *Down* arrows, with a trace position resolution of 0.01 division. The *Apply to All* key allows the user to apply the same graphical offset to all the displayed channels.

DC Offset Section

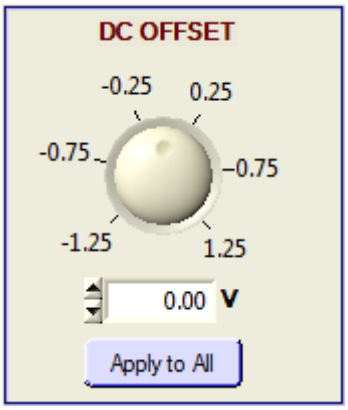


Fig. 8.3: DC Offset Section

DC Offset

This is the actual offset applied to the selected channel input of the digitizer (i.e. it affects the hardware). The range is from -1.25 to +1.25 V.

Each channel can have a different offset, applied by selecting the desired channel number in the *Select Channel* Pull Down Menu, and then setting the desired value with the *DC Offset* knob or thru the use of the use of the *Up* and *Down* arrows, with a voltage resolution of 0.01 V. The *Apply to All* key allows the user to apply the same DC offset to all the displayed channels.

Note: changing the DC Offset value, the software automatically changes the trigger threshold ranges accordingly in the Trigger Tab (see § **10**). A pop-up message is displayed advising the user.

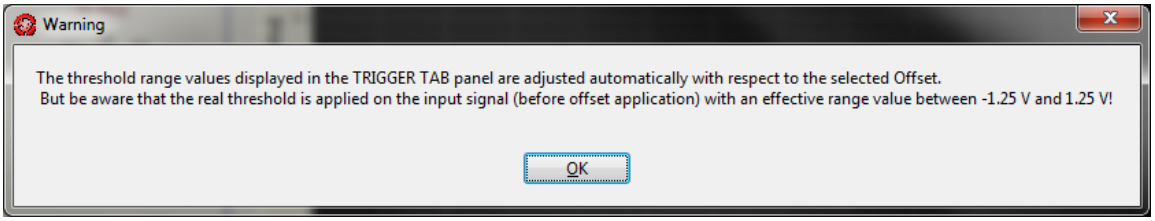


Fig. 8.4: System warning on DC Offset selection

Scale Section

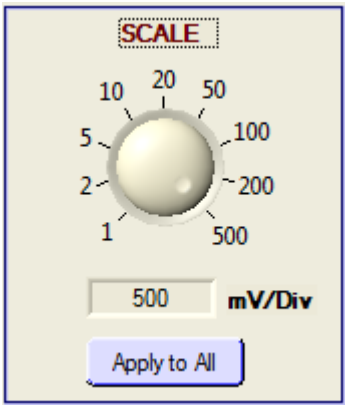


Fig. 8.5: Scale Section

Scale

This is a purely graphical zoom and allows the user to change the display vertical scale. The range is between 1 mV/Div and 500 mV/Div by the relevant knob. The *Apply to All* key allows the user to apply the same scale to all the displayed channels.

9 Horizontal/Acquisition Tab Description

The settings of the Horizontal/Acquisition Section are common to all channels of the digitizer.

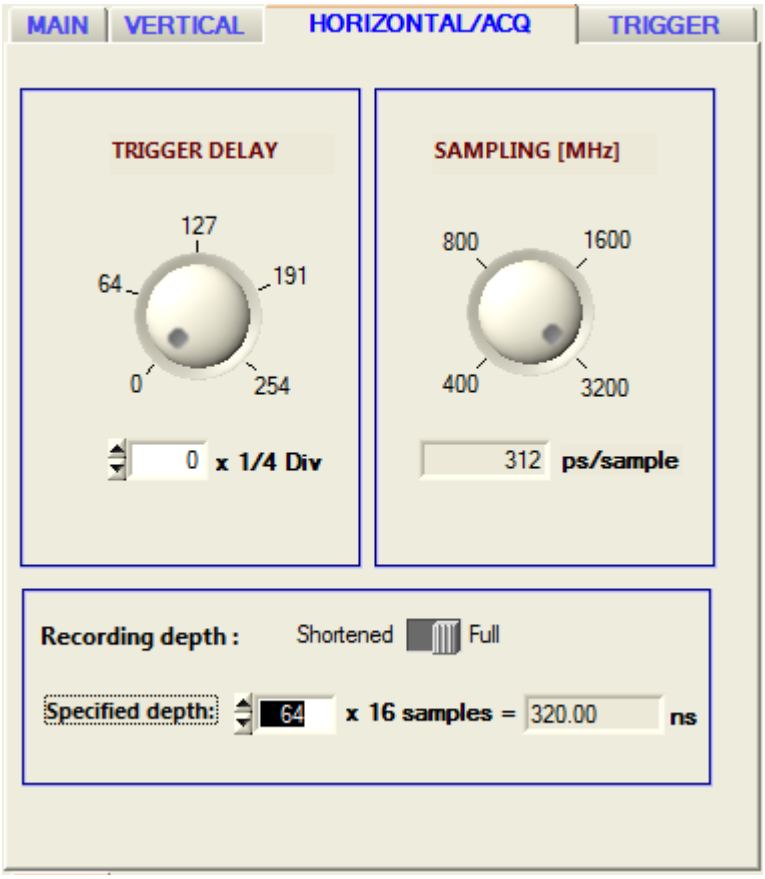


Fig. 9.1: Horizontal/Acquisition Tab

Trigger Delay (Post-Trigger) Section

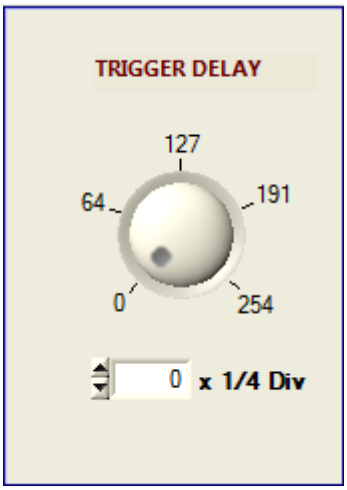


Fig. 9.2: Trigger Delay Section

Trigger Delay

The unit is ¼ of the X-Axis division unit, or 16 time the sampling frequency of the SAMLONG chip. For example, at 3.2 GS/s, a post-trigger = 1 is equivalent to 5ns of delay.

This delay allows the user to define the time during which, after the trigger condition occurs, the signal is still recorded before the memory content is frozen and then displayed.

With Trigger Delay = 0, the position of a pulse corresponding to the trigger decision is between division 12 and 13. The trigger delay value ranges from to 0 to 254 x ¼ divisions and can be set by *the Trigger Delay* knob or by using the *Up* and *Down* arrows under it.

Sampling Frequency Section

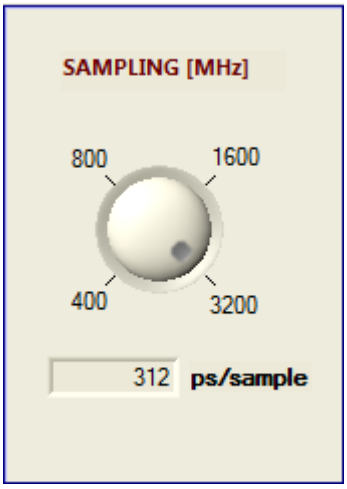


Fig. 9.3: Sampling Frequency Section

Sampling [MHz]

It allows the Sampling frequency of the 743 Series digitizers to be selected within 4 fixed values: 400 MS/s, 800 MS/s, 1600 MS/sec and 3200 MS/s, corresponding respectively to 2.5 ns/sample, 1.25 ns/sample, 625 ps/sample and 312 ps/sample. The sampling frequency can be selected thru the *Sampling* Knob.

Recording Depth Section

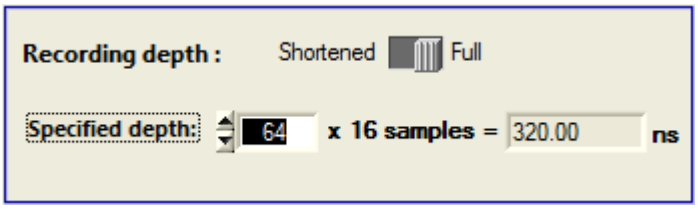


Fig. 9.4: Recording Depth Section

The minimum record length of the channels memory is 4 x 16 samples. The minimum record time is then equivalent to 20 ns record length when the sampling rate is 3.2 GS/sec. The maximum Recording Depth of the channels memory is 64 x 16 samples, equivalent to 2.5 µs of record length when the sampling rate is 400 MS/sec.

Recording Depth

The user can define a shortened record length from 4 to 63 adjacent segments of 16 samples each, by specifying the number of 16 samples segments to be recorded, thru the *Specified depth* Up and Down Arrows. If a record length of less than 64 segments is selected, the *Recording Depth* slider is automatically shifted to the *Shortened* position. The user can restore the full memory depth selection (64 segments full memory) by restoring the slider to the *Full* position.

Specified Depth

When *Recording depth* is set to *Shortened*, this is the number of 16-sample segments to be recorded. The value, ranging from 4 up to 63 segments, can be directly typed in the *Specified depth* Text Box, or by using the *Up* and *Down* arrows aside.

10 Trigger Tab Description

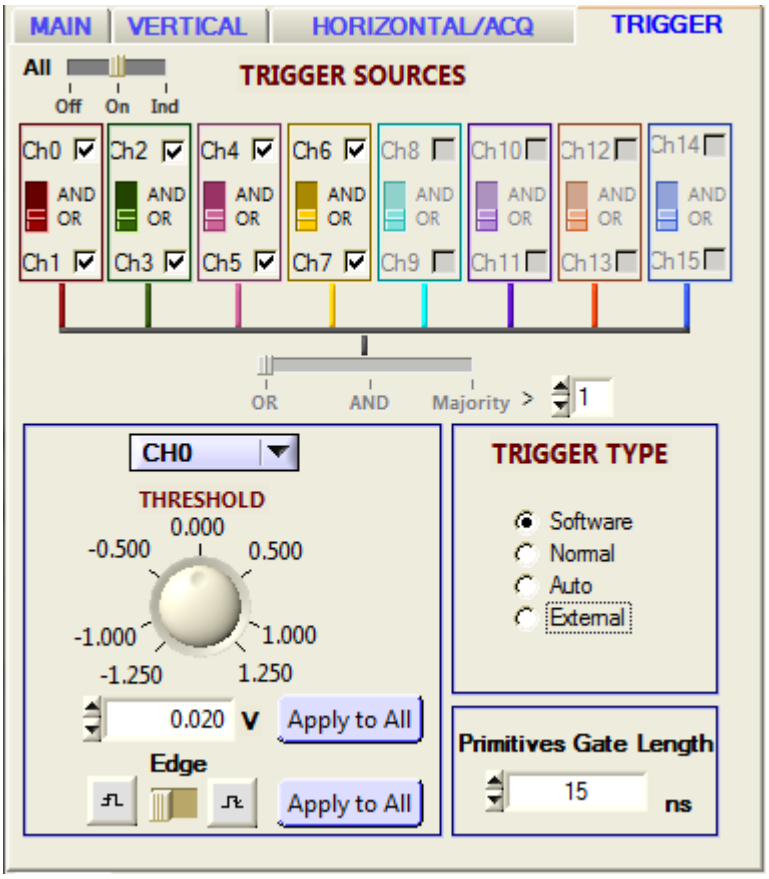


Fig. 10.1: Trigger Tab

Trigger Sources Section (Normal Type only)

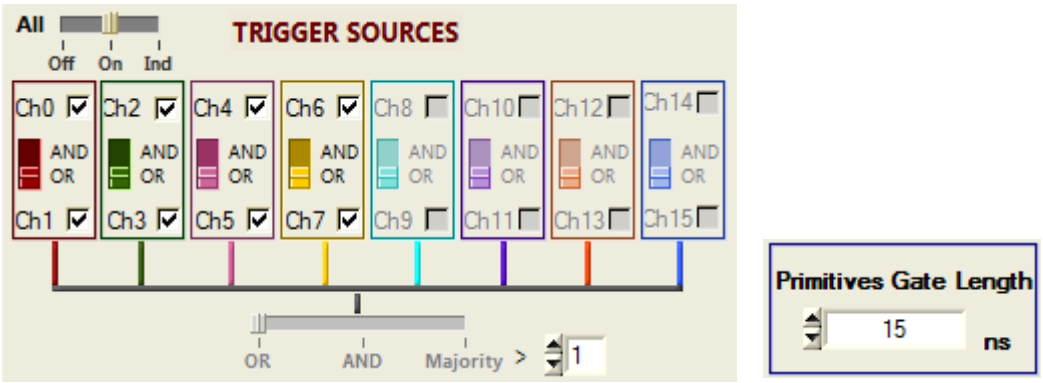


Fig. 10.2: Trigger Sources Section (sx) and Primitive Gate Length setting (dx)

All On/Off/Ind

The *Trigger Sources* slider in the upper section of the Trigger Tab allows the user to define the triggering conditions of the digitizer channels. In the *Off* position, all channels trigger conditions are disabled, and all the active channel checkboxes are automatically cleared. In the *On* position, all channels trigger conditions are enabled, and all the active channel checkboxes are automatically marked. To select the *Ind* (i.e. Individual channel triggering) position, the user must uncheck one or more of the channel checkboxes.

Trigger Sources

The *Trigger Sources* checkbox matrix allows the user to define the triggering pattern conditions. The user can select an *AND* or an *OR* condition for the (0,1),(2,3),(4,5),(6,7) and successive pairs of channels, if supported, by toggling the correspondent *AND/OR* switch in the selected channel pair box. A further *OR*, *AND* or *Majority* condition can be selected for the valid outputs of all the active pairs described above, by positioning accordingly the slider underneath the checkboxes area. The majority condition can be defined by selecting with the *Up* and *Down* arrows in the *Majority* value box the minimum number of valid pair outputs that will generate a valid trigger.

Primitives Gate Length

It defines the length of the primitives (pulses) built when the channel signal crosses the discriminator. These pulses of programmable length participate in the daughter-board trigger logic (AND, OR between groups of 2 channels set in the *Trigger Sources* section) and the result is sent to the motherboard to be processed in OR, AND or Majority. When implementing coincidences between channels, *Primitives Gate Length* defines the coincidence time window. The parameter ranges between 15 ns + 255*5 ns (1275 ns).

Trigger Type Section

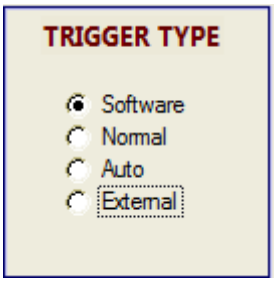


Fig. 10.3: Trigger Type Section

Trigger Type

- **Software:** a trigger command is generated by the software. This command enables the signal to be acquired, asynchronously from any valid trigger event received in the meantime, overrunning the trigger conditions set for the active channels.
- **Normal:** the signals will be recorded in the enabled channels upon the channel self trigger capability (the setting of the DC Offset and Threshold parameters are here involved) and the trigger logic programmed through the *Trigger Source* matrix.
- **Auto:** in the Auto Trigger Mode, the digitizer will accept all valid trigger events. If no valid trigger event is received during a preset time a trigger event will be generated by a timer, to allow the user to see the enabled channels traces.
- **External:** in the External Trigger mode, the digitizer will record the signals only if a valid logic level trigger is received at the digitizer TRG-IN input (refer to the digitizer User Manual).

Trigger Threshold (Normal Type only)

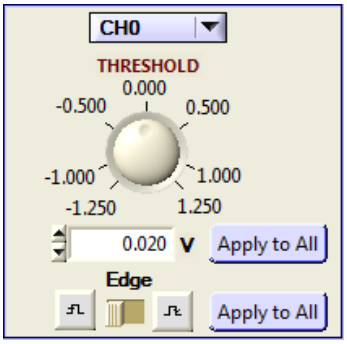


Fig. 10.4: Trigger Threshold Section

Threshold

This is the threshold level to be set, when working in *Normal Type* trigger mode, to acquire signals from the enabled channels. The specific channel to apply the threshold value is selected in the upper slide menu box. The threshold is expressed in Volts and ranges from -1.25 V to +1.25 V by the *Threshold* knob. A threshold fine tuning with 0.001 V resolution can be done through the *Up* and *Down* arrows, while using the *Apply to All* key permits to apply the same threshold to all the displayed channels.

The threshold value is referred to the DC Offset parameter value, so each time the latter is changed by the user, the threshold must be tuned accordingly to let the channel self trigger. Each time the DC offset parameter is changed, the software automatically changes the threshold ranges in the tab (see § **DC Offset**).

Note: be aware that the real threshold is applied on the input signal (before offset application) with an effective range value between -1.25V and +1.25V.

Edge

This setting permits to program the trigger for the specified channel to be issued upon the threshold level crossing by the rising (left) or the falling (right) edge of the input signal. The *Apply to All* key allows the user to apply the same edge setting to all the displayed channels.

11 Saving and Recalling Settings and Data

WaveCatcher manages a set of saving and recalling options for configuration parameters and data, which have been introduced in § **5**.

Saving Settings

Save Setup to File

By this option, which is must be checked from the *Configuration* Pull Down Menu in the program *Menu Bar*, the user can save the acquisition parameters to a *.dat* file on the host PC.

Once the Run has been started, the program will ask to select a file to save the Setup Data.

The file name is *Setup_*.dat*, where the file suffix can be typed by the user

Data are saved in *C:\Users\<USER>\AppData\Local\CAENWaveCatcher\Setup*

Note: the setup file contains binary information in the WaveCatcher structure code, except for the software version reported in ASCII format, and can only be managed by the WaveCatcher itself.

Recalling Settings

Load Setup from File

By this option, also accessible from the *Configuration* Pull Down Menu in the program *Menu Bar*, the user can load a configuration of acquisition parameters previously saved through the *Save Setup to File* option above described.

Note: the setup file must have been saved with the same version of the current software that is recalling the setup.

The user will be asked by the program to point to a valid setup file on the host PC.

Saving Data

File Menu

Feature accessible from the *Run* Pull Down Menu in the program *Menu Bar*: *Configuration -> Saving Data Menu File*

The user can select the output file type, ASCII or BINARY, split or not the data into multiple files with a programmable number of events per file (see p. **19**). These settings apply to the *Save Waveform only* and *Save Waveforms and Measurements* option in the *Save Run to File* Menu.

Save Run to File

Feature accessible from the *Run* Pull Down Menu in the program *Menu Bar*: *Run -> Save Run to File*

The user can save the acquired data (that can be the waveforms only or the waveforms and measurements) to a *.dat* file on the host PC. Output data format can be ASCII or binary according to the *File Menu* setting.

Once the Run has been started, the program will ask to select a file to save the Run Data.

The file name is *Run_*_Data_mm_dd_yyyy_Ascii*, where "*" can be customized by the user; *mm_dd_yyyy* is the data format automatically written by the software.

ASCII Format

Data are saved in *C:\Users\Pierluigi\AppData\Local\CAENWaveCatcher\Run_Data\Run_*_Data_mm_dd_yyyy_Ascii*

- **Save Waveforms Only:** for a single channel enabled, 2-event finite run, 64 samples of recording depth, the output file format is following reported in case of saving waveforms only:

=== DATA FILE SAVED WITH SOFTWARE VERSION: V1.3 ===

=== CAEN DIGITIZER BOARD TYPE x743 WITH 8 CHANNELS AND GAIN: 1.0 ===

=== Other Parameters ===

=== DATA SAMPLES [64] in Volts == NB OF CHANNELS ACQUIRED: 1 == Sampling Period: 312.5 ps == INL Correction: 1 ===

=== EVENT 1 ===

=== UnixTime = 1417101451.265 date = 2014.11.27 time = 16h.17m.31s.265ms == TDC From FPGA = 289728 == TDC Corrected = 16h17m31s,001.448.640ns ===

=== CH: 0 EVENTID: 1 FCR: 464 Baseline: 0.000000 V Amplitude: 0.000000 V Charge: 0.000 pC LeadingEdgeTime: 0.000 ns TrailingEdgeTime: 0.000 ns TrigCount: 17 TimeCount 1228 ===

-0.001155 -0.001220 -0.001113 -0.000319 -0.001539 -0.001081 -0.000262 0.000267 -0.000217 -0.000791 0.000214 -0.000053 -0.001136 -0.000763 0.001073 0.001263 0.001166 0.000933 0.000017 -0.001477 -0.000685 0.000338 -0.000918 -0.000035 -0.000304 0.000001 -0.000250 -0.000443 0.000089 -0.000102 0.000290 -0.000452 -0.001008 0.000300 0.000370 -0.000738 -0.001076 0.000909 0.000177 0.001638 0.000231 -0.000843 0.000458 -0.000538 0.000038 -0.000459 -0.000081 -0.001679 -0.000198 0.000598 -0.001066 -0.000421 -0.001007 -0.000966 0.000058 0.000542 0.001535 0.001112 0.002049 0.000776 -0.000892 -0.001122 -0.000282 -0.000320

=== EVENT 2 ===

=== UnixTime = 1417101451.275 date = 2014.11.27 time = 16h.17m.31s.275ms == TDC From FPGA = 304194 == TDC Corrected = 16h17m31s,001.520.970ns ===

=== CH: 0 EVENTID: 2 FCR: 192 Baseline: 0.000000 V Amplitude: 0.000000 V Charge: 0.000 pC LeadingEdgeTime: 0.000 ns TrailingEdgeTime: 0.000 ns TrigCount: 0 TimeCount 6 ===

-0.000588 0.000227 -0.000385 0.000692 0.000999 0.000467 0.000643 0.001506 0.001092 0.000594 0.000079 0.000038 -0.000764 0.000144 0.000498 -0.000267 0.000463 0.000267 0.000191 -0.000453 -0.000690 -0.000261 0.001196 0.000538 0.001142 0.000544 0.000575 0.002028 0.001351 0.000852 0.000145 0.000495 0.000115 -0.000118 0.000573 -0.000220 -0.000246 -0.001101 -0.000311 -0.001018 -0.000546 -0.002283 -0.000797 0.000047 0.000028 -0.000646 -0.001311 -0.001326 -0.000948 -0.000496 -0.000538 -0.000047 0.000081 -0.000250 0.001007 0.000333 -0.000763 0.000452 -0.000564 -0.000724 -0.000496 -0.000454 0.000414 0.001013

Note: Consider that using *Save Run to File* feature when the *Run* is configured as *Continuous,* may result in a huge amount of data saved to disk. This is notified to the user by a confirmation pop-up message.

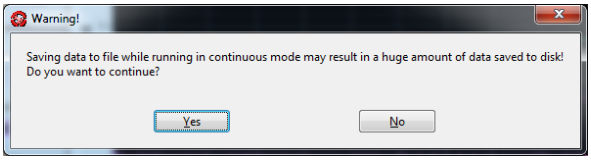


Fig. 11.1: Save Run to File confirmation window

- **Save Waveforms and Measurements:** this option saves the waveforms as well as the measurement parameters, which are Time Measurements Parameters (in the Time Measurement Section; see description at p. **31**) and/or the Charge Measurements Parameters (in the Charge Mode Section; see description at p. **27**).

  The Charge Mode or the Time Measurements must be enabled in the relevant configuration panel. This is reminded to the user by an *Information* window as soon as the *Waveforms and Measurements* option is checked

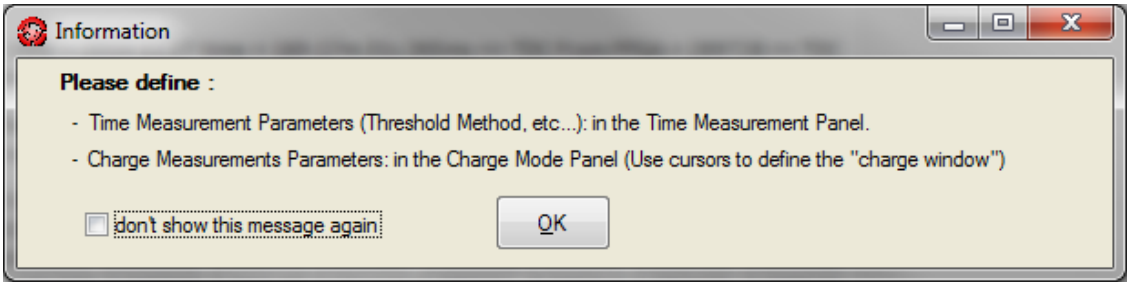


Fig. 11.2: Information window

For a single channel enabled, 2-event finite run, 64 samples of recording depth, the output file format is following reported in case of saving waveforms and measurements with Charge Mode and Time Measurement enabled:

=== DATA FILE SAVED WITH SOFTWARE VERSION: V1.3 ===

=== CAEN DIGITIZER BOARD TYPE x743 WITH 8 CHANNELS AND GAIN: 1.0 ===

=== Other Parameters ===

=== DATA SAMPLES [64] in Volts == NB OF CHANNELS ACQUIRED: 1 == Sampling Period: 312.5 ps == INL Correction: 1 ===

=== EVENT 1 ===

=== UnixTime = 1417102709.407 date = 2014.11.27 time = 16h.38m.29s.407ms == TDC From FPGA = 304194 == TDC Corrected = 16h17m31s,001.520.970ns ===

=== CH: 0 EVENTID: 2 FCR: 192 Baseline: 0.000000 V Amplitude: 0.000000 V Charge: 0.000 pC LeadingEdgeTime: -1.000 ns TrailingEdgeTime: -1.000 ns TrigCount: 0 TimeCount 6 ===

-0.000588 0.000227 -0.000385 0.000692 0.000999 0.000467 0.000643 0.001506 0.001092 0.000594 0.000079 0.000038 -0.000764 0.000144 0.000498 -0.000267 0.000463 0.000267 0.000191 -0.000453 -0.000690 -0.000261 0.001196 0.000538 0.001142 0.000544 0.000575 0.002028 0.001351 0.000852 0.000145 0.000495 0.000115 -0.000118 0.000573 -0.000220 -0.000246 -0.001101 -0.000311 -0.001018 -0.000546 -0.002283 -0.000797 0.000047 0.000028 -0.000646 -0.001311 -0.001326 -0.000948 -0.000496 -0.000538 -0.000047 0.000081 -0.000250 0.001007 0.000333 -0.000763 0.000452 -0.000564 -0.000724 -0.000496 -0.000454 0.000414 0.001013

=== EVENT 2 ===

=== UnixTime = 1417102709.507 date = 2014.11.27 time = 16h.38m.29s.507ms == TDC From FPGA = 304194 == TDC Corrected = 16h17m31s,001.520.970ns ===

=== CH: 0 EVENTID: 2 FCR: 192 Baseline: 0.000000 V Amplitude: 0.000000 V Charge: 0.000 pC LeadingEdgeTime: -1.000 ns TrailingEdgeTime: -1.000 ns TrigCount: 0 TimeCount 6 ===

-0.000588 0.000227 -0.000385 0.000692 0.000999 0.000467 0.000643 0.001506 0.001092 0.000594 0.000079 0.000038 -0.000764 0.000144 0.000498 -0.000267 0.000463 0.000267 0.000191 -0.000453 -0.000690 -0.000261 0.001196 0.000538 0.001142 0.000544 0.000575 0.002028 0.001351 0.000852 0.000145 0.000495 0.000115 -0.000118 0.000573 -0.000220 -0.000246 -0.001101 -0.000311 -0.001018 -0.000546 -0.002283 -0.000797 0.000047 0.000028 -

0.000646 -0.001311 -0.001326 -0.000948 -0.000496 -0.000538 -0.000047 0.000081 -0.000250 0.001007 0.000333 -0.000763 0.000452 -0.000564 -0.000724 -0.000496 -0.000454 0.000414 0.001013

Binary Format

The header format is in ASCII as follows:

"=== DATA FILE SAVED WITH SOFTWARE VERSION: %s ===\n"

"=== CAEN DIGITIZER BOARD TYPE x743 WITH %d CHANNELS AND GAIN: %f ===\n",

"=== Other Parameters ===

"=== DATA SAMPLES [%d] in Volts == NB OF CHANNELS ACQUIRED: %d == Sampling Period: %f ps == INL Correction: %1d ===\n"

Then, each event is given as binary code. In order to decode the data, use the C function:

```
if(fread (&EventNumber, sizeof(int), 1, FileForLoadingDataPntr)==0)  return 0; // Reached End Of File;
fread (&EpochTime, sizeof(double), 1, FileForLoadingDataPntr);
fread (&Year, sizeof(unsigned int), 1, FileForLoadingDataPntr);
fread (&Month, sizeof(unsigned int), 1, FileForLoadingDataPntr);
fread (&Day, sizeof(unsigned int), 1, FileForLoadingDataPntr);
fread (&Hour, sizeof(unsigned int), 1, FileForLoadingDataPntr);
fread (&Minute, sizeof(unsigned int), 1, FileForLoadingDataPntr);
fread (&Second, sizeof(unsigned int), 1, FileForLoadingDataPntr);
fread (&Millisecond, sizeof(unsigned int), 1, FileForLoadingDataPntr);
fread(TDC, sizeof(unsigned __int64), 1,FileForLoadingDataPntr);
fread(EventTimeChain, sizeof(char), 23,FileForLoadingDataPntr);
 for(chIndex = 0; chIndex < NbOfChannelsInFile; chIndex ++) //use Nb of Channels read in the Header
{               fread(&rdChannel, sizeof(int), 1,FileForLoadingDataPntr);
                    chGroup = (int)rdChannel/2;
                    channel = rdChannel%2;

                    fread(&eventId, sizeof(int), 1,FileForLoadingDataPntr);
                    EventID[chGroup]= eventId;
                    fread(&fcr, sizeof(int), 1,FileForLoadingDataPntr);
                    FirstCellToPlot[chGroup];
                    fread(&baseline,  sizeof(float), 1,FileForLoadingDataPntr);
                    Baseline[rdChannel]=  baseline;
                    fread(&charge, sizeof(float), 1,FileForLoadingDataPntr);
                    Charge[rdChannel]=  baseline;
                    fread(&riseTimeInstant, sizeof(float), 1,FileForLoadingDataPntr);
                    RiseTimeInstant[rdChanel]=riseTimeInstant;
                    fread(&fallTimeInstant, sizeof(float), 1,FileForLoadingDataPntr);
                    FallTimeInstant[rdChanel]=riseTimeInstant;
                    fread(&amplitude, sizeof(float), 1,FileForLoadingDataPntr);
                    Amplitide[rdChannel]= amplitude;
                    fread (&trigcount, sizeof(int), 1, FileForLoadingDataPntr);
                    fread (&timecount, sizeof(int), 1, FileForLoadingDataPntr);
                    TrigCount[rdChannel]= (unsigned short)trigcount;
                    TimeCount[rdChannel]= (unsigned short)timecount;

                    fread (DataTempBuffer, sizeof(signed short), NbOfSamplesInFile,FileForLoadingDataPntr);
                     //use Nb of Samples read in the Header
                    for(n= 0; n<NbOfSamplesInFile; n++)
                    {
                     dataSamples[rdChannel][n]= (float)DataTempBuffer[n]/10.0; // in ADC Counts
                    }
 }
```

Save Histograms

The user can save histograms build in the Charge Histogram Dialog Box when the Charge Mode is enabled (see description at p. **27**).

The file name is *Run_*_ChargeHistos_mm_dd_yyyy*, where "*" can be customized by the user; *mm_dd_yyyy* is the data format automatically written by the software.

Data are saved in *C:\Users\Pierluigi\AppData\Local\CAENWaveCatcher\Histos*

For a single channel enabled, 2-event finite run, 64 samples of recording depth, the histogram output file format is following reported:

=== CHARGE HISTOs ===

== CHANNEL : 0 ==

== Nb Of Entries in Histogram : 0 ==

== X AXIS : Charge in pico-Coulombs [100 values] ==

-0.219 -0.214 -0.210 -0.206 -0.201 -0.197 -0.192 -0.188 -0.184 -0.179 -0.175 -0.170 -0.166 -0.162 -0.157 -0.153
-0.148 -0.144 -0.140 -0.135 -0.131 -0.126 -0.122 -0.118 -0.113 -0.109 -0.104 -0.100 -0.096 -0.091 -0.087 -0.082
-0.078 -0.074 -0.069 -0.065 -0.060 -0.056 -0.052 -0.047 -0.043 -0.038 -0.034 -0.030 -0.025 -0.021 -0.016 -0.012
-0.008 -0.003 0.001 0.006 0.010 0.014 0.019 0.023 0.028 0.032 0.036 0.041 0.045 0.050 0.054 0.058
0.063 0.067 0.072 0.076 0.080 0.085 0.089 0.094 0.098 0.102 0.107 0.111 0.116 0.120 0.124 0.129
0.133 0.138 0.142 0.146 0.151 0.155 0.160 0.164 0.168 0.173 0.177 0.182 0.186 0.190 0.195 0.199
0.204 0.208 0.212 0.217

== Y AXIS : Charge Distribution [100 values] ==

0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0

== Mean Charge = -0.004 [pico-Coulombs] ==

== Charge Sigma = 0.046 [pico-Coulombs rms] ==

Recalling Data

Run from File

A data file, previously saved by one of the *Save Run to File* options, can be loaded into WaveCatcher through the *Run from File* feature accessible from the *Run* Pull Down Menu in the program *Menu Bar*.

The user will be asked by the program to point to a valid data file on the host PC.

12 Getting Started with the x743 Digitizers

The purpose of this section is to enable the user to perform some data acquisition tests to become familiar with the equipment.

The WaveCatcher Software supports the CAEN 743 Digitizers Family in different architecture formats. Currently CAEN DT5743 Desktop Digitizer, CAEN V1743 VME Modular Digitizer, CAEN VX1743 VME64X Modular Digitizer and N6743 NIM Modular Digitizer are supported.

Please refer to the installation (§ **2**) and to the initialization (§ **3**) for the initial setup of the system.

Signal Acquisition

The user should first proceed to the Pedestal Calibration.

Warning: In order to perform the correct Pedestal Calibration, all digitizer inputs must be disconnected from any signal source.

The user should select from the WaveCatcher *Menu Bar* the *Configuration* item, and select *Calibrate Pedestals* in the corresponding Pull Down Menu. The number of events required to calibrate the pedestals must be entered in the *Pedestal Calibration* Dialog Box that opens up. A completion bar pop-up window shows then the percentage of events acquired and processed for the pedestal calibration operation. When the operation is completed, the program interface appear as in **Fig. 12.1**. The end of the calibration is logged in the *Infos* section.

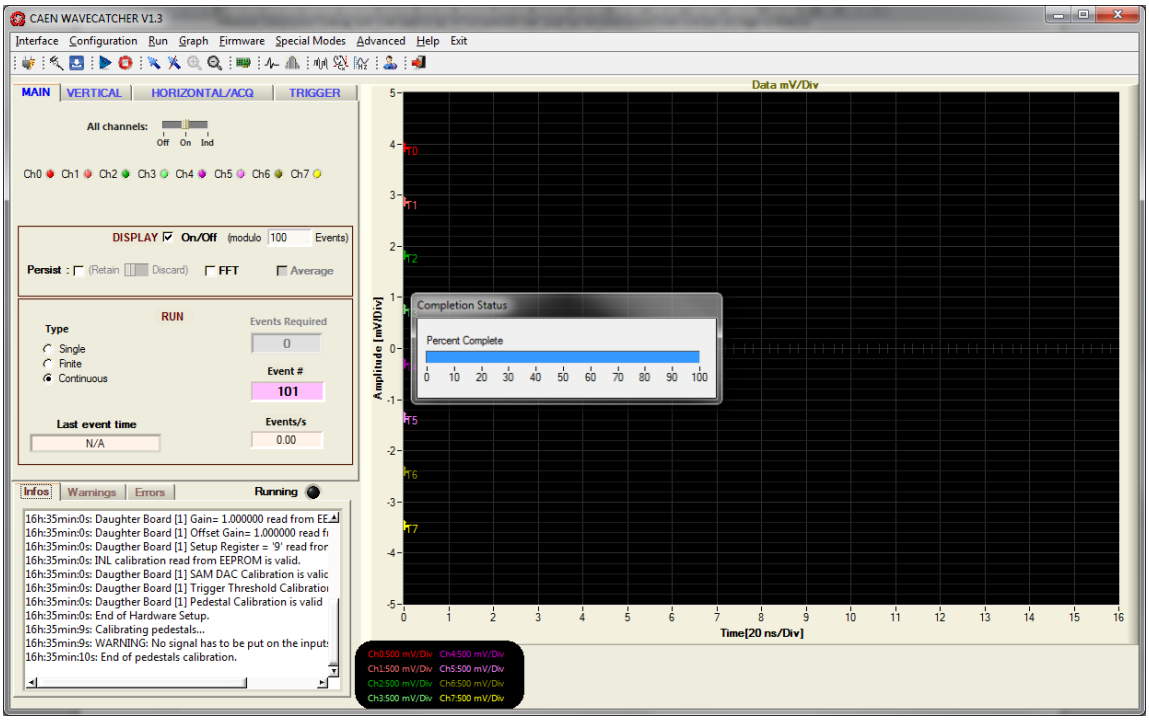


Fig. 12.1: Pedestal Calibration done

Note: A high number of events used for the pedestal calibration will ensure a better evaluation of the actual pedestal value, but will require longer time for the pedestal calibration processing.

The user should then Save the Pedestals to the Flash memory of the digitizer by using the correspondent command in the Configuration Pull Down Menu.

The user can now connect all the signals to the Digitizer inputs, select in the *Main Tab* the channels to be acquired and displayed and refer to § **5** of this manual for the selection of the channels (*Ch0* up to *Ch16*), displayed functions (*Persist* or *FFT*) and type of Run (*Single*, *Finite* or *Continuous*).

The user can select the *Horizontal/Acq* Tab and refer to § **9** of this manual for the selection of the desired *Sampling Speed* (400, 800, 1600or 3200 MS/s), *Trigger Delay* (i.e. Post-Trigger value) and *Record Depth*.

The user can select the *Vertical* Tab and refer to § **8** of this manual for the selection of the *DC Offset* (from -1.25 to +1.25 V) and for the setting of the position and graphic amplitude of the traces on the graph area.

Finally, the user can select the *Trigger* Tab and refer to the § **10** of this manual to set the Trigger conditions: *Trigger Source* Channels, *Logic* (AND,OR and Majority) Patterns, *Trigger Type* (*Software*, *Normal*, *Single* and *External*) and individual Trigger *Thresholds* and *Slope* (when applicable).

Now the Digitizer is ready to acquire the waveforms. The user can start the acquisition by clicking on the *Start* command in the *Run* Pull Down Menu or on the *Start* Icon on the *Icon Bar* (see § **6**). The green *Running* LED in the *Main Tab* will light up, and the signal(s) will be displayed on the graph screen as in the example shown in **Fig. 12.2**.

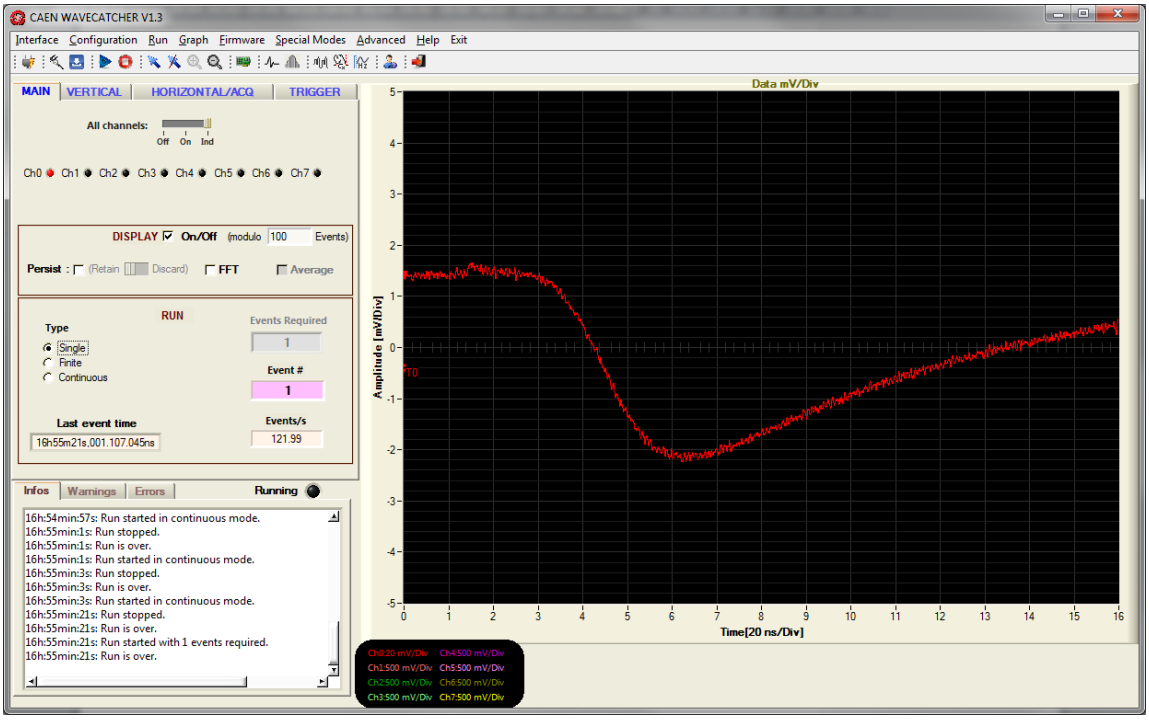


Fig. 12.2: WaveCatcher Acquiring Signal Screen

The user can stop the acquisition at any time by clicking on the *Stop* command in the *Run* Pull Down Menu or on the *Stop* Icon on the Icon Bar (see § **6**). The green *Running* LED in the *Main Tab* will turn off.

13 Software Exit

Before quitting the WaveCatcher program, it is necessary to verify that the current acquisition has been completed, otherwise the current data being acquired would be lost.

To exit the program, the user can:

- **click on the *Exit* Item** on the WaveCatcher *Menu Bar*

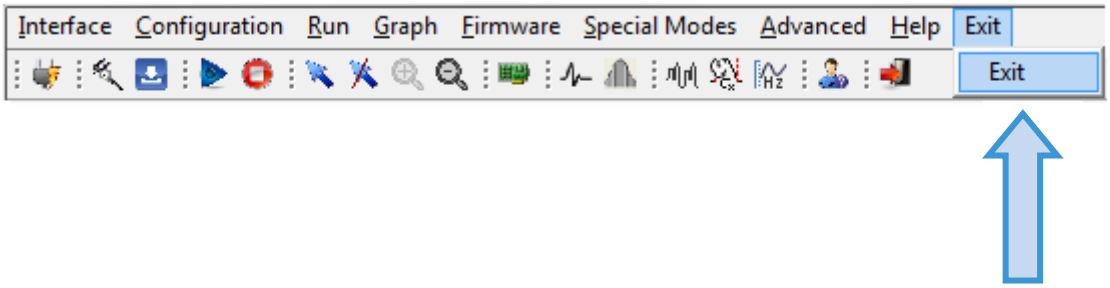


Fig. 13.1: Exit option 1

- **click on the *Exit* Icon** on the WaveCatcher *Icon Bar*

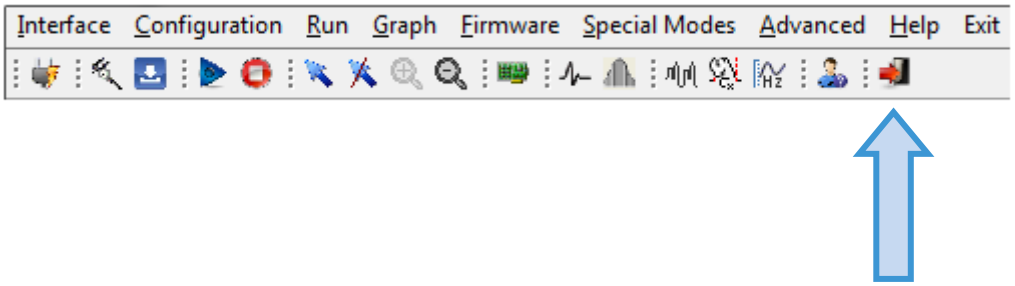


Fig. 13.2: Exit option 2

- **click on "*X*" red key** on the upper right corner of the program window.

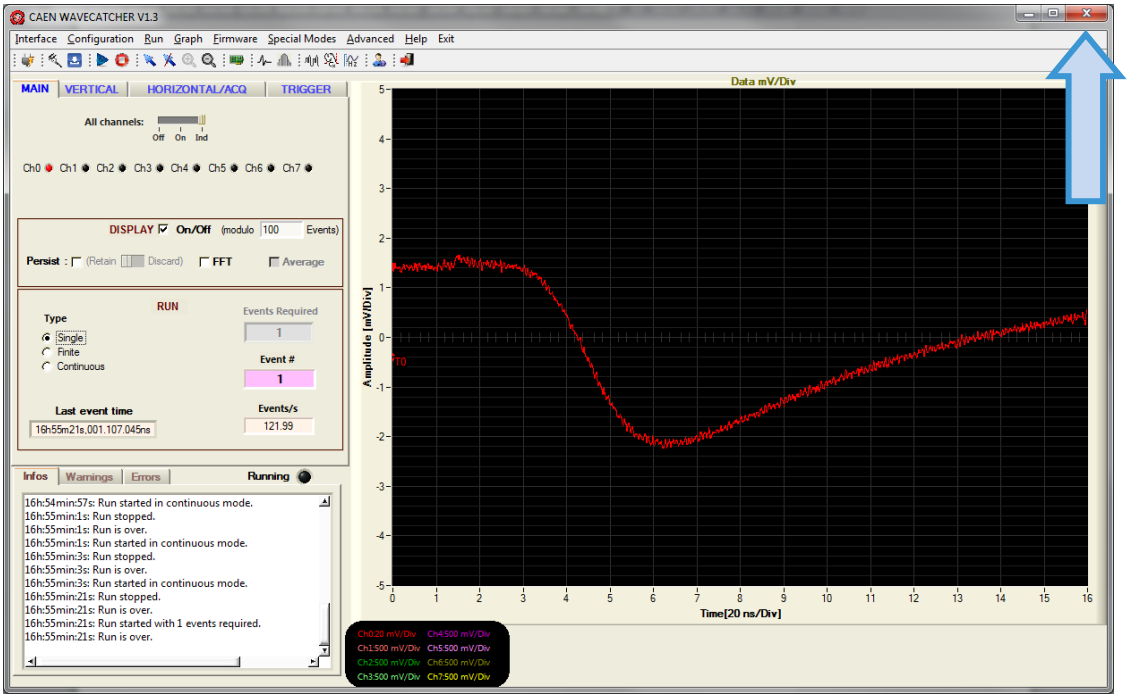


Fig. 13.3: Exit option 3

14 Message Windows

Info/Warnings/Errors

A 3-tab section in the bottom-left side of the WaveCatcher Main Screen (see **Fig. 4.1**), gives the user a feeling on his operating, displaying a chronological list of the performed actions and the relevant board status, as well as warnings and errors.

Info Tab

Contains all the messages: Info / Warnings and Errors.

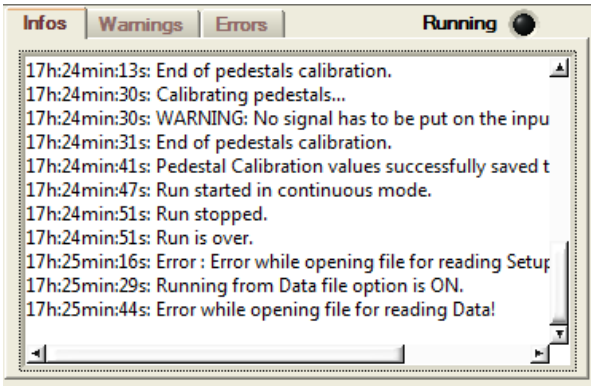


Fig. 14.1: Info Tab

Warnings Tab

Permits to display only warning messages.

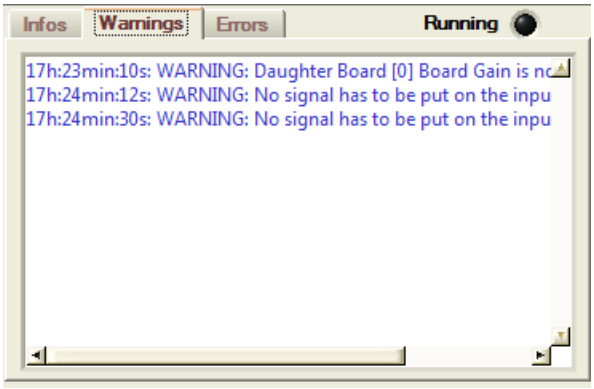


Fig. 14.2: Warnings Tab

Errors Tab

Permits to display only error messages.

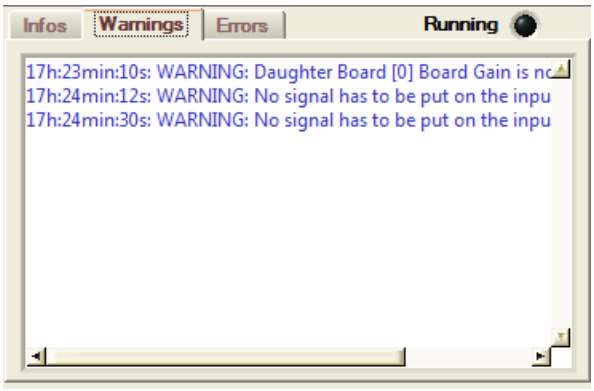


Fig. 14.3: Errors Tab

A log file after each session is available with all the information displayed in the *Info Tab* under *%USERPROFILE/AppData/local/CAENWaveCatcher/logfile.txt*. While saving data to file, a copy of *logfile* is saved within the file name folder.

15 Technical support

CAEN Support services are available for the user by accessing the *Support & Services* area on CAEN website at www.caen.it.

CAEN makes available the technical support of its specialists at the e-mail addresses below.

support.nuclear@caen.it
(for questions about the hardware)

support.computing@caen.it
(for questions about software and libraries)

CAEN SpA is acknowledged as the only company in the world providing a complete range of High/Low Voltage Power Supply systems and Front-End/Data Acquisition modules which meet IEEE Standards for Nuclear and Particle Physics. Extensive Research and Development capabilities have allowed CAEN SpA to play an important, long term role in this field. Our activities have always been at the forefront of technology, thanks to years of intensive collaborations with the most important Research Centres of the world. Our products appeal to a wide range of customers including engineers, scientists and technical professionals who all trust them to help achieve their goals faster and more effectively.

CAEN S.p.A.
Via Vetraia, 11
55049 Viareggio
Italy
Tel. +39.0584.388.398
Fax +39.0584.388.959
info@caen.it
www.caen.it

CAEN GmbH
Klingenstraße 108
D-42651 Solingen
Germany
Phone +49 (0)212 254 4077
Fax +49 (0)212 25 44079
Mobile +49 (0)151 16 548 484
info@caen-de.com
www.caen-de.com

CAEN Technologies, Inc.
1140 Bay Street - Suite 2 C
Staten Island, NY 10305
USA
Tel. +1.718.981.0401
Fax +1.718.556.9185
info@caentechnologies.com
www.caentechnologies.com

CAEN
Tools for Discovery
Electronic Instrumentation

UM2754 - WaveCatcher User Manual rev. 2 - 03 February 2016
00100-12-DGT08-MUTX