

PASI

User Manual



Seismograph GEA24

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2.Important Notice

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This guide refers to “GEA24” SW version 2.0.2, Firmware version 2.5, HW library version 2.6.

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3. Warranty and safety instructions

Read these instructions carefully before using the product:

- Warranty will be void, if the product is used in any ways that is in contradiction with the instructions given in this manual.
- Warranty will be void if the seismograph has been tampered with.
- The device must be used only according to the instructions described in this manual. Faultless and safe operation of the device can be guaranteed only if the transport, storage, handling and operation of the device is appropriate.
- To prevent damage, use only original accessories or approved by PASI srl.
- The box is waterproof only if closed. When a suitable location has been selected for the seismograph, it must be ensured that no water can get into the device under any conditions. Direct sunlight is also to be avoided for long period. It is not recommended that the seismograph is installed on a strongly vibrating surface.

4. Introduction

The seismograph GEA24 is a device designed and assembled by P.A.S.I. srl, a leading company in Italy in the production of instruments for geology and geophysics.

This guide details the technical specifications and how to use the device. Please follow these guidelines.

Contents

Chapter 5, How to use - the system as regards the hardware.

Chapter 6, Full description of graphical interface and functionality- all the features in detail offered by the system.

Appendix A, technical characteristics of the system.

Appendix B, how to place the piezoelectric shock sensor.

Appendix C, Trigger connector.

Appendix D, Connection schemes.

5.How to use

Hardware elements

Gea24 consists of a control unit and one or two 12 channel seismic cables, equipped with 12 single takeouts and terminated with standard connectors Cannon NK2721C (cable adapters with a 24 takeout land streamer are available on request).

The instrument's standard equipment includes:

- Control unit Gea24
- USB cable for PC connection
- Trigger System (geophone or piezoelectric)
- USB Stick Gea24 containing manual and software
- Registration card

You can connect Gea24 to a laptop or tablet PC via USB cable; the Gea24 is also powered by the PC itself, so you do not need an external 12V battery.

The instrument is supplied with a USB key containing documents, manuals and the Gea24 management software to be installed on your PC (to run this, simply double-click on the file name).

Two-unit Gea24 can be "serialized" to get a complete system of 48 channels, simply by connecting them to two USB on the same PC.

Chapter 6 will explain in detail how to proceed with the configuration of one or both instruments.



FIGURE 1 GEA24 CONNECTED TO A PC

Hardware Connection

Gea24 can be placed either at the ends or in the center of the spreading; the patterns reported below simply represent the most common configuration.

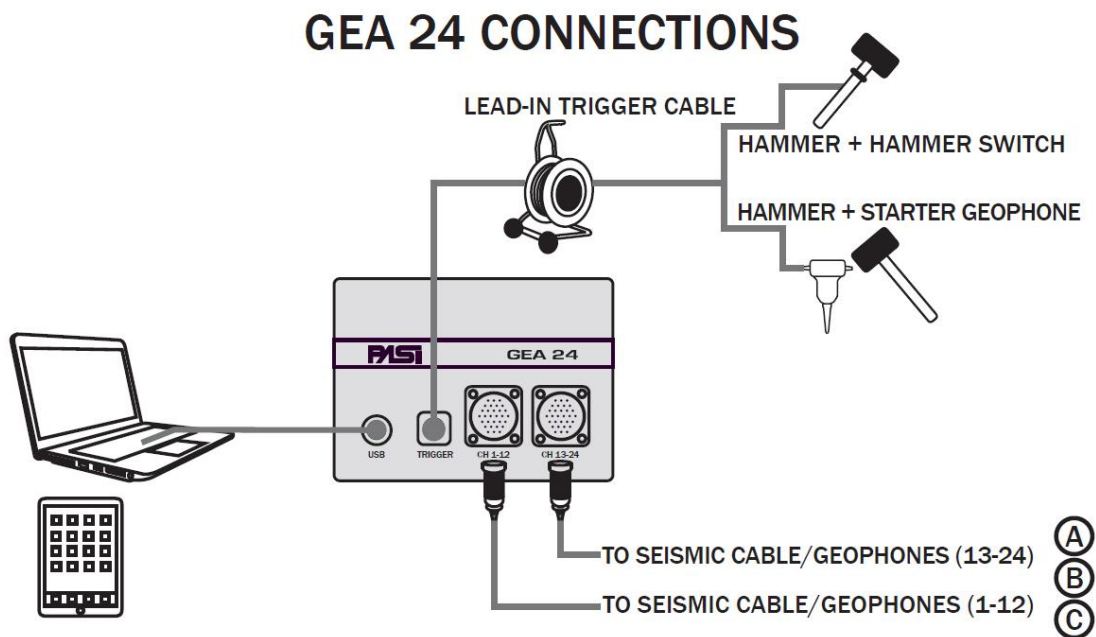


FIGURE 2 GEA24 CONNECTION SCHEME

In addition to the seismic cables, to become "active" GEA24 must be connected to a trigger or starter geophone using the supplied special connector.

Power supply

As indicated in Par.1.2, Gea24 is powered by the PC via the USB port; an external 12V battery is not necessary.

6.Full description of graphical interface and functionality

6.1 *Homepage*

The homepage is the starting page of the Gea24 program which allows you to control all operations:

- system parameter configuration (button 2, section 6.2)
- configuration of acquisition parameters and geophones (key 4, paragraph 6.3);
- implementation of a new acquisition (button 1, paragraph 6.4);
- file management shown in the system (key 3, paragraph 6.5);
- data transfer of files to an external USB drive (only for embedded PC) (paragraph 6.7);
- Updating the Gea24 software (only for embedded PC) (paragraph 6.8).

These features will be described in detail in the following sections, within this section you will find the following:

- Connecting the Gea24 instrument to the PC (section 6.1.1);
- selection of a template of acquisition configuration and geophones previously saved (drop down menu 5, paragraph 6.1.2).

Figure 3 shows the image of the homepage

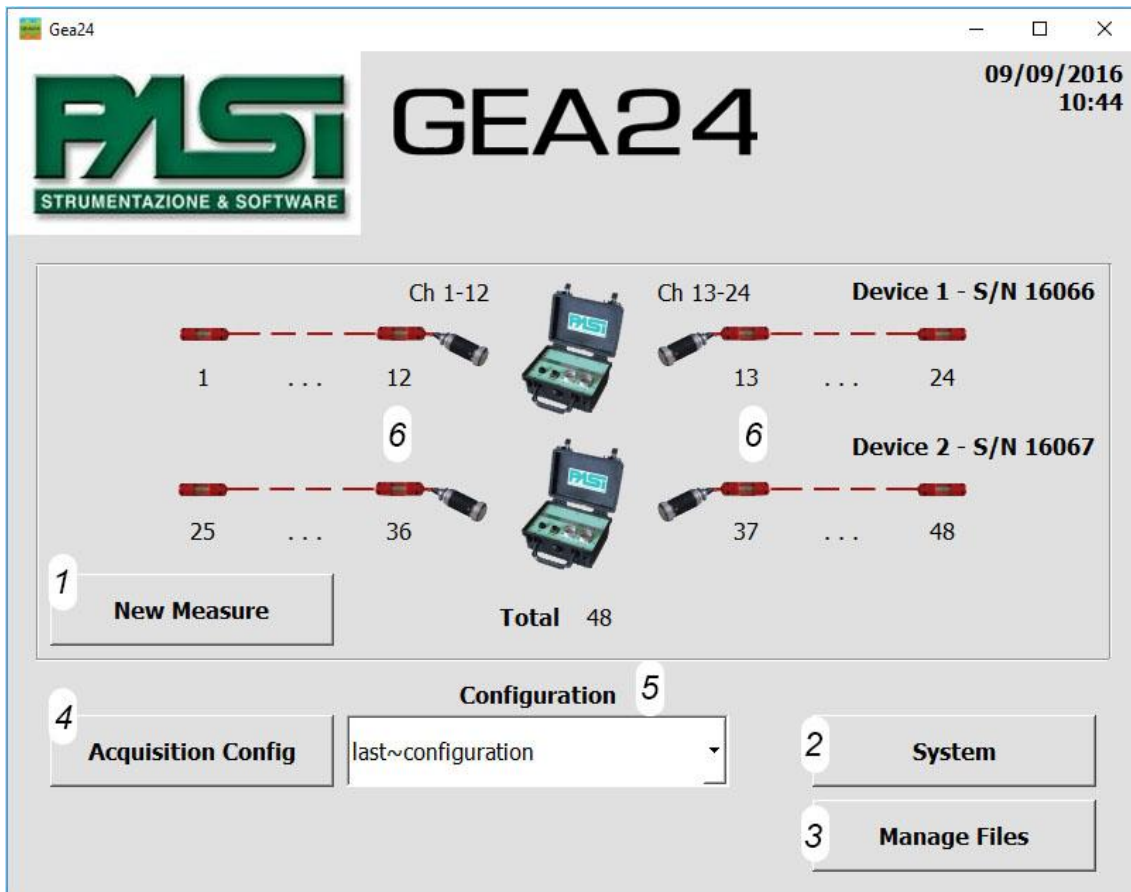


FIGURE 3 HOMEPAGE

6.1.1 Connecting the instrument Gea24 to the PC

If the Gea24 system is managed by an external PC and the application management has been installed, when you connect the instrument to the PC you can see the instrument display, the configuration lines and to enable the key for new acquisition.

The connection of the instrument to the PC must be made using the appropriate USB cable. The application will automatically detect the presence of the system and will show the picture of the instrument on the GUI together with the hardware serial number.

If you connect two Gea24 tools there will be two images shown on the GUI with two serial numbers. Tool number 1 will be the one with the lowest serial number, while tool number 2 will be the one with the highest serial number.

NOTE 1: In order to carry out active measures the trigger must always be connected to instrument 1.

NOTE 2: After updating the Gea24 software on the PC, its first connection to the USB might require a few seconds while the system is detected, as an update of the firmware on Gea24 tool might be necessary.

6.1.2 Setting the acquisition configuration template

With the dropdown menu (5) shown in Figure 3, the operator can select the template to use for acquisition configuration.

Gea24 requires that the acquisition template is always configured, in order to maintain the set of configured parameters necessary. For this reason on the Gea24 system there will always be a default template called "last-configuration" and the operator will not be able to delete it.

The operator can view the parameters of the selected template as described in paragraph 6.3. It will also be possible to change the values of the parameters and save them with a new name.

In the event that the operator has modified some of the template parameters without saving the file, this configuration will be lost when a new change is made to the parameters, or a new template is loaded. If an acquisition is made, the configuration will be stored and maintained in the template "last configuration", so it can be reused later.

6.2 System Configuration

To open the System Configuration window, press the System button (2) in Figure 3.

The system configuration allows you to:

- configure the GUI language;
- configure the linear unit and the geophones sensitivity value;
- configure the preferences for saving data on SEG2 files;
- configure the save folder of file SEG2 acquired (for external PC system only).

6.2.1 Configuration of linear measurement unit

Gea24 can work with the MKS system of units and the imperial system. The units of measurement are shown in Table 1

Units
m
yd
ft

TABLE 1 - LINEAR MEASUREMENT UNIT

The set unit of measure is used to enter and view the configuration values of the geophones and the display of the signal transmission speed to the ground (see section 6.3.3).

The decision does not affect the storage of data within the SEG2 file because linear measurements are always expressed in meters

6.2.2 Configuring geophones sensitivity unit of measure

This unit of measure is used in the process of configuring the geophones to provide the right identification information or used on a single geophone to correctly interpret the voltage values measured. The measurement unit is configurable at the system level, so the sensitivity values of all the geophones must be inserted with the same units of measure.

The units of measurement used are shown in table 2

Units of measurement, sensitivity of geophones
V/(m/s)
V/(cm/s)

TABLE 2 - GEOPHONES SENSITIVITY UNIT OF MEASURE

6.2.3 Configuring SEG2 preferences

The window allows you to enter your preferences for the string proposed by the Gea24 program as a default for the name SEG2 file storage of the acquired data. The following information will assist the operator with the name of the file.

- File prefix: a code of 10 alphanumeric characters, defined by the operator;

- Progressive number: a four-digit sequential number, automatically incremented by the system when saved, if you press “reset number” you go back to zero;
- Default file name: by clicking the drop down menu you have various options to name the file, a combination of the start date, start time acquisition (obtained from the control PC) and progressive number;
- File extension (.seg2, .dat or .sg2). WARNING: the saved files will in any case conform to the standards seg2 regardless of the extension adopted.

In any case, the operator will be able to make any modifications he considers appropriate to the file name when saving an individual acquisition, including the complete cancellation of pre-set string.

6.2.4 Configuration of the SEG2 file directory

The window allows you to select in which folder of the external PC the SEG2 files, acquired from the system, will be saved.

Selecting the checkbox "Automatic creation of a folder for each day," the system will create an additional folder within the folder you selected; the name given will have the date of the day of the acquisition where all the scanned files of that day will be saved.

The configuration function for the SEG2 file folder is only for Gea24 system with external PC.

6.3 *Configuring acquisition parameters*

To open the acquisition configuration window press "Acquisition Config" on the homepage (Button 4 on Figure 3).

This operation allows you to:

- view the configuration parameters stored in the selected template in the dropdown menu (5) when the "Config acquisition" key is pressed;
- modify the acquisition configuration parameters;
- save a new configuration of the acquisition parameters on a template so that you can retrieve it later.
- The configuration of the acquisition parameters is divided into three main windows in sequence, so as to manage through each window a group of homogeneous information:

- The first window allows you to configure the lines: enabling of geophones, configuration of the order on the line and their polarity (paragraph 6.3.1);
- the second window allows the configuration of its acquisition parameters, such as acquisition time or sampling frequency (paragraph 6.3.2);
- The third window enables the configuration of location and sensitivity of the enabled geophones (section 6.3.3).

NOTE: The acquisition Configuration feature is available even if the Gea24 instrument is not attached to a PC, as it works only on the PC configurations, without communicating with the Gea24 instrument. The ability to configure the acquisition without Gea24 being connected allows the operator to prepare the acquisition configuration templates well before the acquisition and use the control PC only.

The three acquisition configuration windows are equipped with three buttons: "Main", "Save" and "Ok", the following describes their functions.

- The "Main" button allows you to return to the homepage without saving the changes made to the parameters.
- The "Save" button allows you to save the information on a template, so that the configuration can be retrieved later using the pull-down menu on the homepage. The operator will be asked to enter the name of the template on which to store the configuration.
- The "OK" button allows you to return to the homepage and save the changes made to the default configuration template "last-configuration". This configuration can be called back to make variations or to carry out an acquisition, as for any other template saved by the operator.

6.3.1 Configuration window of the lines (Lines configurations)

This window shows the Gea24 with two 12-geophones lines connected (Figure 4). The operator can decide which geophone to use to acquire the signal.

Above you can see the line attached to the Gea24 left connector, the geophones are numbered from 1 to 12 as indicated on the front panel of the instrument. Below you can see the line attached to the Gea24 right connector, the geophones are numbered from 13 to 24 as indicated on the front panel of the instrument. The numbers shown next to each checkbox refer to the position on the geophone line and will from now on be called "physical geophone". On the left line the geophones are ranked in such a way that the geophone further away from the connector of the line is physical geophone 1, the

geophone closer to the connector is physical geophone 12. On the right line the geophone closer to the connector is referred to as physical geophone 13 and the further away from the connector is physical geophone 24. Physical geophones are numbered from 1 (the geophone further away from the instrument on the left), progressively increasing up to 24 (the geophone further away from the instrument on the right).

The enabling or disabling of each geophone can be performed by pressing on the appropriate checkbox.

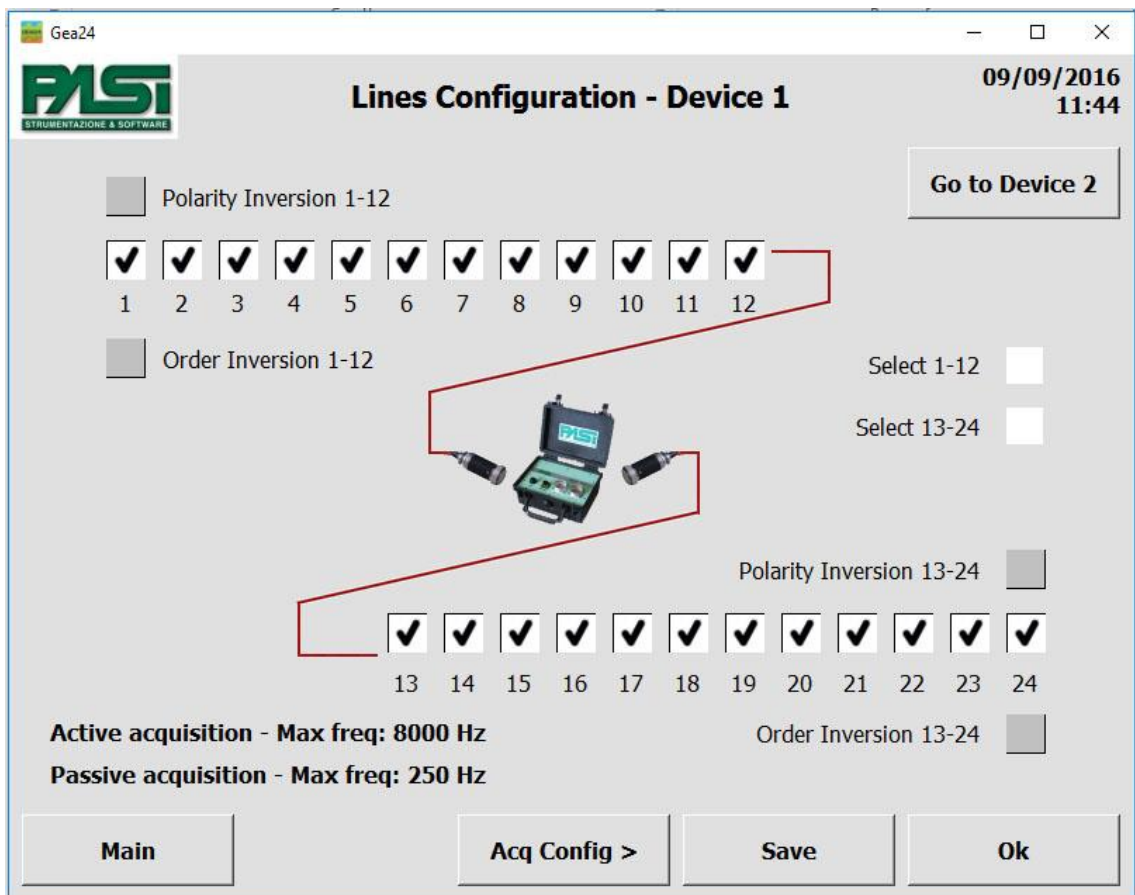


FIGURE 4 - CONFIGURATION WINDOW OF THE LINES

Via the checkbox "Order inversion 1-12" the operator can reverse the order of the geophones on the line on the left; by selecting the checkbox you can consider the physical geophone 1 the closest to the connector, and the physical geophone 12 the furthest away from the connector.

Similarly you can reverse the order of the geophones on the right line by selecting the checkbox "Order inversion 13-24".

By selecting the checkbox "Polarity inversion 1-12" you can invert the polarity of the signals acquired by Gea24 system on the line on the left before processing and saving them. Similarly by selecting the checkbox "Polarity inversion 12-24" you can invert the

polarity of the signals acquired by Gea24 system on the right line before processing and saving them.

Via the checkbox "Select 1-12" you can enable or disable all the geophones of the line to the left, likewise via the checkbox "Select 12-24" you can enable or disable all the geophones of the line to the right.

On the window there are also shown the maximum frequency configurable values for the active and passive acquisition, since these values depend on the number and position of the enabled geophones. Table 3 shows the dependence of the sampling frequency for the active acquisition and multiple passive acquisition, and table 4 shows the dependence of the sampling frequency for the non-multiple passive acquisition.

Geophone ID	Maximum sampling rate
7 to 12	32000 Hz / 31.25us
1 to 12	16000 Hz / 62.5us
13 to 24	8000 Hz / 125us

TABLE 3 - MAXIMUM SAMPLING FREQUENCY RATE FOR ACTIVE AND PASSIVE MULTIPLE ACQUISITIONS

Geophone ID	Maximum sampling rate
10 to 12	2000 Hz / 500us
7 to 12	1000 Hz / 1ms
1 to 12	500 Hz / 2ms
1 to 24	250 Hz / 4ms

TABLE 4 - MAXIMUM SAMPLING FREQUENCY FOR NON MULTIPLE PASSIVE ACQUISITIONS

The GUI software allows the management of two Gea24 systems simultaneously, to move to the management window of the rating of the second geophones Gea24 system you must press "Go To Device 2" button.

The configuration window of the lines of the second instrument is identical to the first one.



The maximum frequency values in the tables 3 and 4 are valid for a single commanded Gea24 instrument. In the case of acquisitions made with two Gea24 instruments connected simultaneously, the maximum configurable frequency sampling will be the lower between the two Gea24 instruments considered separately.

NOTE: In order to achieve high acquisition sampling it may be necessary to enable the acquisition only to the geophones ranging from numbers 7 to 12 (or between 1 and 6 if geophone order inversion is enabled); you can also use two instruments at the same time and enabling for each one only the geophones with numbers ranging from 7 to 12 (or between 1 and 6 if geophones order inversion is enabled).

By pressing the "Acq Config>" we proceed to the second window of the configuration of the parameter acquisition.

6.3.2 Data collection configuration window (Acquisition configuration)

The window allows you to configure the parameters required for the acquisition. The fields vary as a result of the choice made on the drop-down menu "Mode" configuration, which can be "Active" or "Passive". For the "passive" mode, there are two additional options that affect the parameters required by the GUI: with the checkbox "Multiple Acquisition" checked or empty.

Pressing the button "<Lines Config " you go back to the lines configuration first window, by pressing the "Geos Config>" button we proceed to the third configuration window of the parameters of the geophones.

Next we will describe the parameters of the three different cases of acquisition.

6.3.2.1 *Active acquisition configuration window*

The configuration window for the "Active" mode is shown in figure 5.

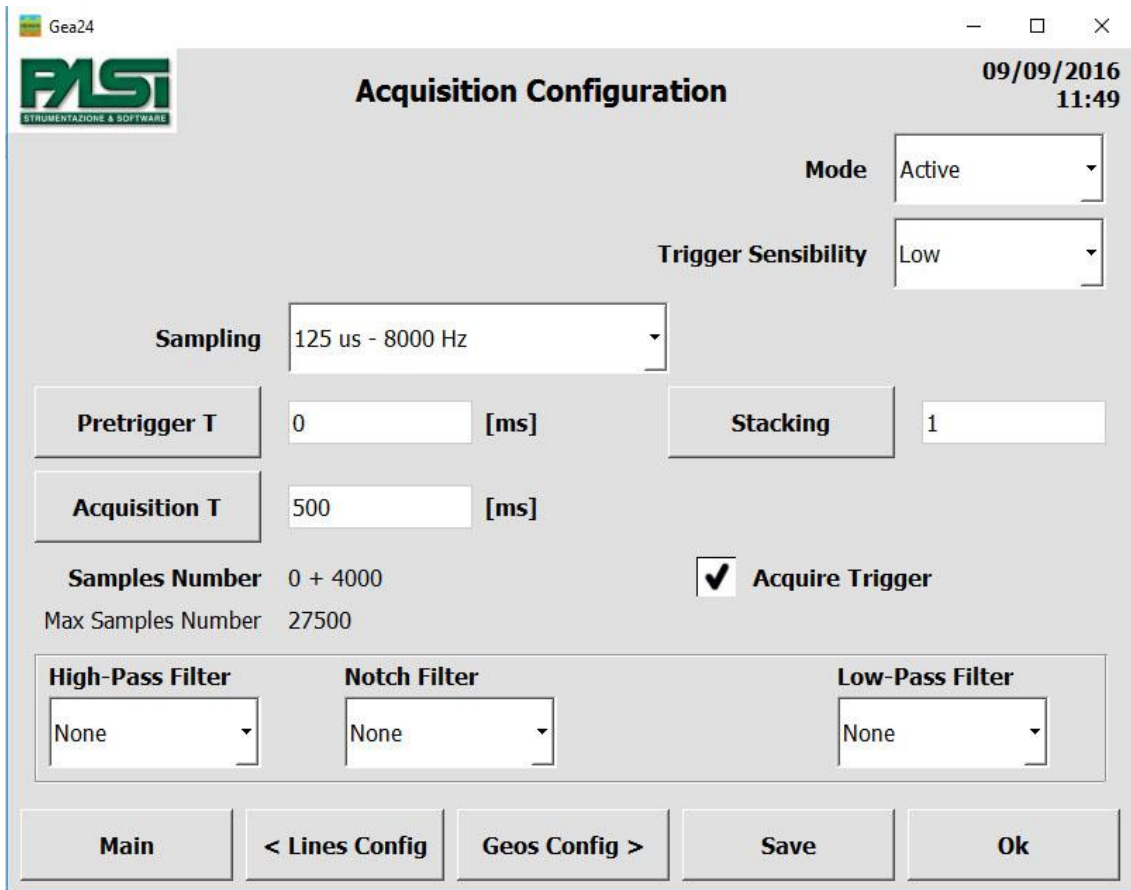


FIGURE 5 – “ACTIVE” ACQUISITION CONFIGURATION WINDOW

The following describe the parameters to include in the configuration window.

- Sampling: through the drop-down menu the sampling frequency must be configured (or the corresponding sampling period) of the signal. The number of configurable values and the maximum frequency are dependent on the number and position of the geophones that have been enabled in the configuration phase of the lines, as described in paragraph 6.3.1.

Sampling period – Sampling frequency
15,625 μ s - 64000 Hz
31,25 μ s - 32000 Hz
62,5 μ s - 16000 Hz
125 μ s - 8000 Hz
250 μ s - 4000 Hz

500 us μ s - 2000 Hz
1 ms - 1000 Hz
2 ms - 500 Hz
4 ms - 250 Hz
8 ms - 125 Hz
16 ms - 62,5 Hz

TABLE 5 - AVAILABLE PERIODS AND SAMPLING RATES

- Pretrigger T: you must enter the time in milliseconds during which you want to acquire the signal prior to the trigger shot.
- Acquisition T: you must enter the time in milliseconds during which you want to acquire the signal subsequent to the release of the trigger.
- Trigger Sensibility: the type of trigger sensitivity must be configured so that it actually triggers the acquisition.

Trigger sensibility
Very high
High
Medium
Low
Very Low

TABLE 6 – TRIGGER SENSITIVITY

- Stacking: you must enter the number of stacks that you want to accomplish for the acquisition. During signal visualization after acquisition it will also be possible to decide to carry out more stacking in addition to that configured in this window.
- Acquire trigger: the trigger signal will be acquired displayed and saved by ticking the checkbox, otherwise it will not be acquired, displayed and saved.
- High Pass Filter, Notch Filter (Suppress harmonics, if checkbox selected), Low Pass Filter: You can configure the filters that will be applied to the acquired signal.

High pass filter
None
10 Hz
20 Hz
30Hz
40 Hz
50 Hz
70 Hz
100 Hz
150 Hz
200 Hz
300 Hz
400 Hz

TABLE 7 - HIGH PASS FILTER

Notch filter
None
50 Hz
60 Hz

TABLE 8 - NOTCH FILTER

Low-pass filer
None
125 Hz
250 Hz
500 Hz
1000 Hz

TABLE 9 - LOW-PASS FILER

6.3.2.2 Multiple passive acquisition configuration window

The configuration window for "Passive" mode and multiple configuration is given in Figure 6, see also paragraph 6.9.

The screenshot shows the 'Acquisition Configuration' window. At the top left is the 'Gea24' logo and 'STRUMENTAZIONE & SOFTWARE'. The title bar says 'Acquisition Configuration'. The date and time are '09/09/2016 12:07'. The 'Mode' dropdown is set to 'Passive'. Below it, 'Trigger Sensibility' is set to 'Manual'. The 'Sampling' dropdown is set to '125 us - 8000 Hz'. A checked checkbox labeled 'Multiple acquisition' is present. There are four input fields: 'Delay Time' (2 [s]), 'Interval' (0 [s]), 'Acquisition T' (500 [ms]), and 'Repetitions' (10). Below these, 'Samples Number' is '0 + 4000' and 'Max Samples Number' is '27500'. There are three filter dropdowns: 'High-Pass Filter' (None), 'Notch Filter' (None), and 'Low-Pass Filter' (None). At the bottom are five buttons: 'Main', '< Lines Config', 'Geos Config >', 'Save', and 'Ok'.

FIGURE 6 - MULTIPLE PASSIVE ACQUISITION CONFIGURATION WINDOW

In the following sections the parameters to insert in the configuration window are described.

- Sampling: See the active acquisition explanation, see also page 23.
- Delay Time: you must enter the delay in seconds from when it is manually triggered by the operator to when the geophones have to actually acquire the signal.
- Acquisition T: the time in milliseconds of duration of each acquisition made must be entered.
- Interval: you must enter the time in seconds between the start of an acquisition and the beginning of the next series. If this time is less than the sum of the acquisition time plus the data collection time, on the PC the next acquisition will start immediately following.
- Repetitions: number of successive acquisitions that have to be made automatically.

- High Pass Filter, Notch Filter (Harmonics Suppression if checkbox selected), Low Pass Filter: You can configure the filters that will be applied to the acquired signal.

6.3.2.3 Non multiple passive acquisition configuration window

The configuration window for the "Passive" mode and non-multiple configuration is shown in Figure 7.

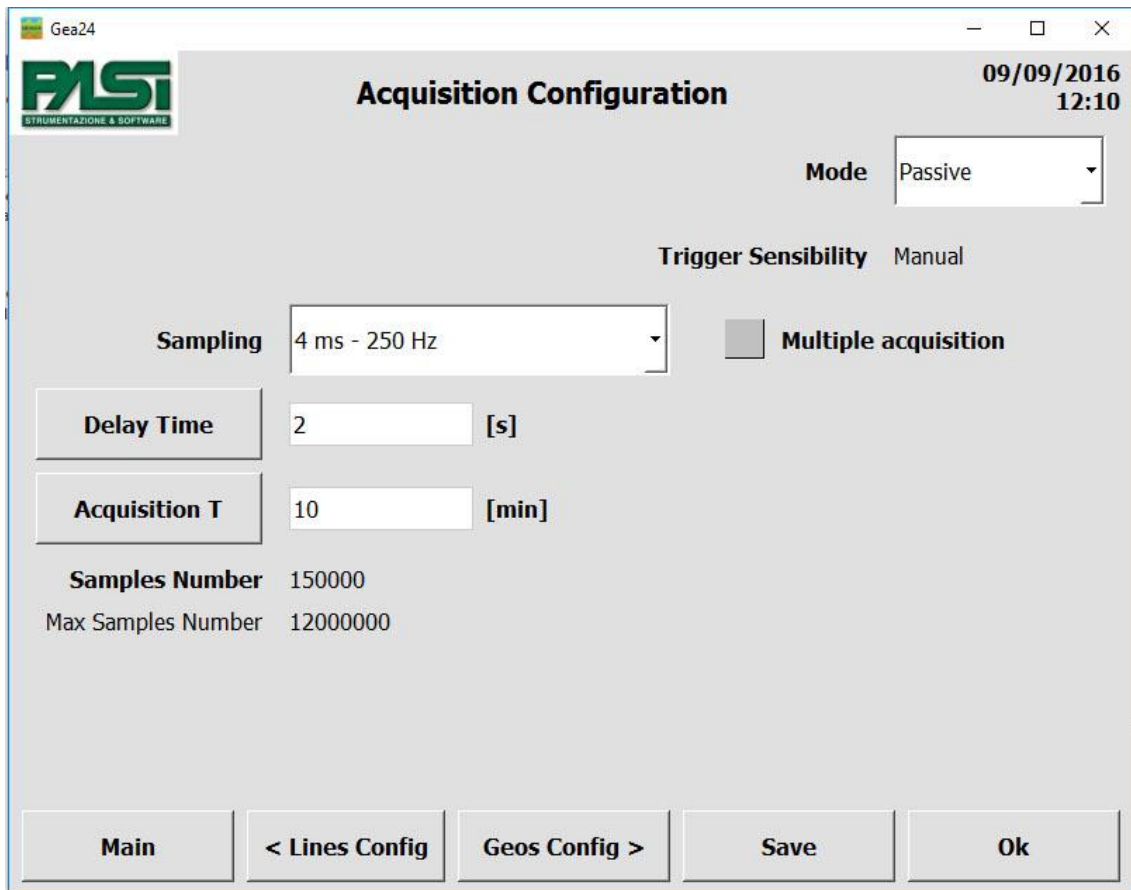


FIGURE 7 - NON MULTIPLE PASSIVE ACQUISITION CONFIGURATION WINDOW

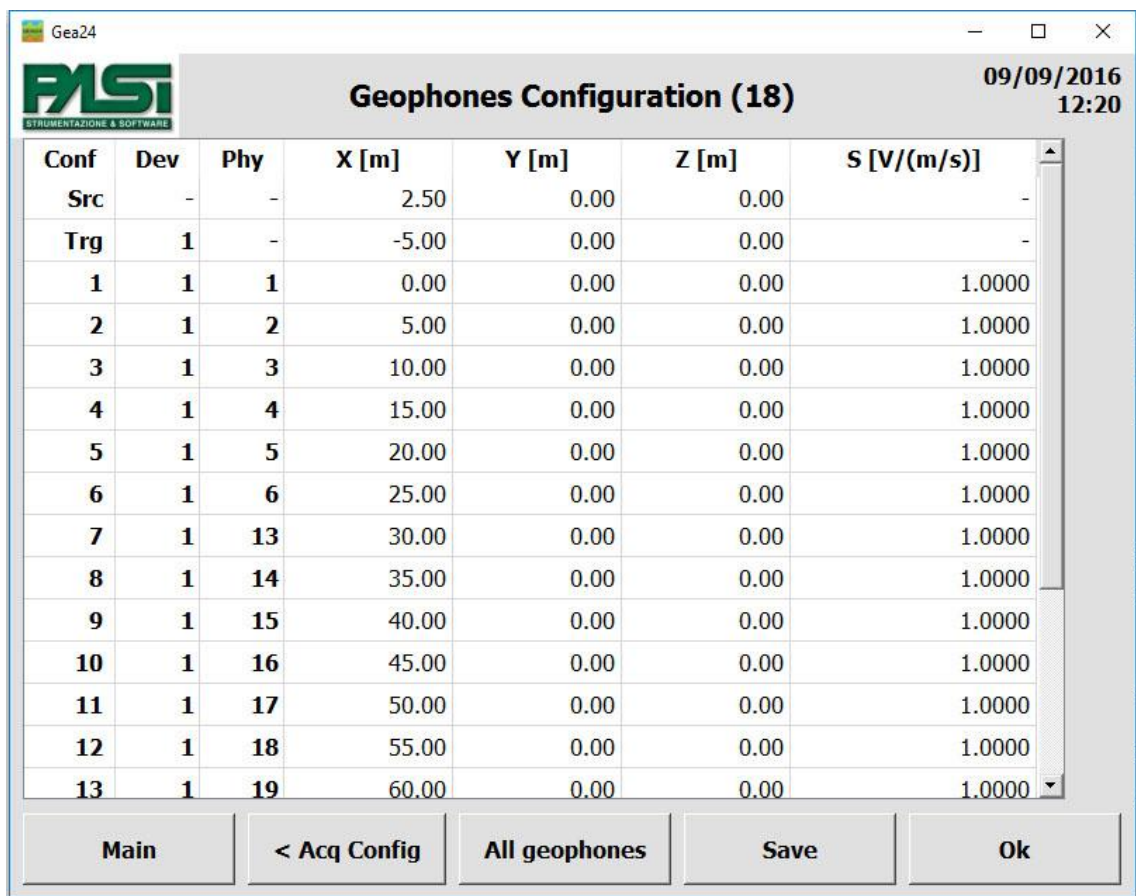
The following sections describe the parameters to be included in the configuration window.

- Sampling: See the active acquisition explanation, see also page 23.
- Delay Time: you must enter the delay in seconds from when the acquisition is triggered manually by the operator to when the signal acquisition by the geophones has to be actually carried out.
- Acquisition T: you must enter the duration of the acquisition in minutes.

6.3.3 Geophone configuration Window

The geophone Configuration window allows you to display all the configuration parameters of all the geophones in a table, to this you add the configuration concerning the source (position of the energization point) and the trigger (geophone starter, piezoelectric starter, etc.). The table shows the values that refer to the parameters stored in the selected template by entering the procedure storage, and any changes made by the operator.

Figure 8 shows an example of the window



Conf	Dev	Phy	X [m]	Y [m]	Z [m]	S [V/(m/s)]
Src	-	-	2.50	0.00	0.00	-
Trg	1	-	-5.00	0.00	0.00	-
1	1	1	0.00	0.00	0.00	1.0000
2	1	2	5.00	0.00	0.00	1.0000
3	1	3	10.00	0.00	0.00	1.0000
4	1	4	15.00	0.00	0.00	1.0000
5	1	5	20.00	0.00	0.00	1.0000
6	1	6	25.00	0.00	0.00	1.0000
7	1	13	30.00	0.00	0.00	1.0000
8	1	14	35.00	0.00	0.00	1.0000
9	1	15	40.00	0.00	0.00	1.0000
10	1	16	45.00	0.00	0.00	1.0000
11	1	17	50.00	0.00	0.00	1.0000
12	1	18	55.00	0.00	0.00	1.0000
13	1	19	60.00	0.00	0.00	1.0000

FIGURE 8 - CONFIGURATION VIEW WINDOW - ALL GEOPHONES

The example shown in figure 8 is a configuration of the lines realized by enabling the physical geophones from 1 to 6 on the left side of the first system, the physical geophones from 13 to 24 on the right side of the first system, disabling all of the geophones of the second system and not reversing the order on the lines.

With this configuration there are 18 geophones in the table, since only the enabled geophones for collecting measurements are reported.

The table has the following columns.

- Conf: contains the indication of the first line relative to the source (energization point), the second line refers to the acquisition of the trigger, and all the following lines refer to the authorized geophones and are numbered in sequence from 1, these numbers are those to which reference will be made later in the process of noise monitoring, data acquisition display and saving on seg2 file.
- Dev: identifies the instrument to which the geophone is connected using index 1 to identify the instrument with the lowest serial number, and index 2 to identify the instrument with the highest serial number. The trigger should always be connected to instrument 1.
- Phy: identifies the physical geophone relative to the configured geophone, the position number from 1 to 24 is reported on the line as shown in the figure of the line configuration window.
- X, Y, Z and S: parameters of the position on the axes x, y and z, and sensitivity configured for each geophone.

For the Gea24 system with external PC, you can change the parameters directly on the table, select the value with the mouse or with the tab button and enter the new value via the keyboard.

For the Gea24 system with embedded PC you cannot change the parameter values configured directly on the table. To change the configuration values you must use an additional viewing window and change the parameters of a single geophone. To access the edit window you have to press any cell within the display table. The edit window of a single geophone is described in Section 6.3.4.

The window has the button "<AcqConfig", when pressed, it takes you to the acquisition configuration window.

For the Gea24 system with external PC you will have the "All geophones" button that allows you to open the parameter configuration window of all geophones simultaneously. This window is described in Section 6.3.5.

6.3.4 Viewing and changing the configuration of a single geophone (only for GEA24 embedded PC)

This window is only present on the Gea24 system with embedded PC, and is used when entering the parameters of the geophones.

Figure 9 is an example of the window.

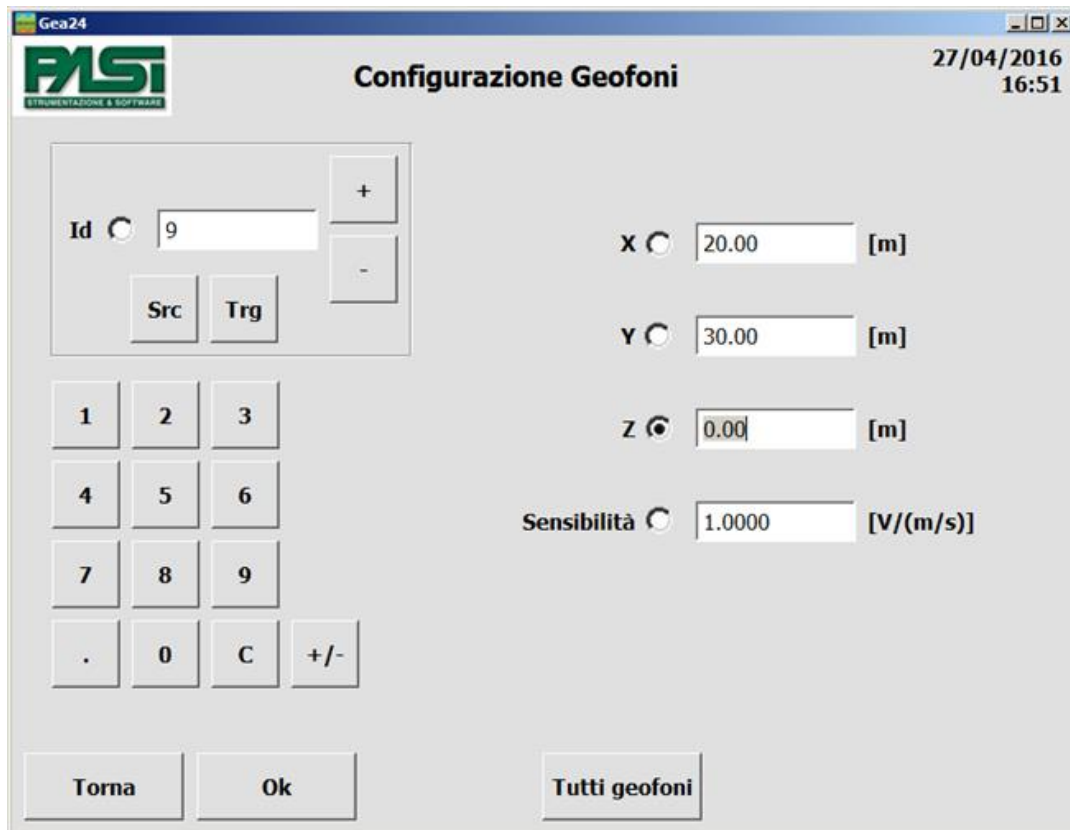


FIGURE 9 - WINDOW FOR DISPLAYING AND MODIFYING THE CONFIGURATION OF A SINGLE GEOPHONE WITH EMBEDDED PC ONLY

The window contains the complete configuration of a single geophone and it allows you to navigate through the list of geophones, the source and the trigger geophone. It is composed of the following elements (see Figure 9):

- geophone identifier field (Id);
- source display button (SRC);
- trigger display button (TRG);
- next geophone display button (+);
- previous geophone display button (-);
- keyboard for entering the numerical values of the parameters or the identifier of the geophone;
- field display of the parameters / parameter display fields (X, Y, Z, sensitivity);
- radio buttons to select a parameter or the identifier and it allows you to input via the keyboard;
- button to open the configuration window at the same time on all the geophones of the parameters (see section 6.3.5).

6.3.4.1 *Selecting a geophone, the source or the trigger*

The item you select (geophone, source or trigger) for which you want to display data can be done in two ways:

- press one of the specific selection keys of a geophone (source, trigger, previous geophone, next geophone);
- select the radio button on the identifier field of the geophone (id) and enter the number using the keypad.

Specific keys allow you to select the source or the trigger or use the special keys "-" and "+". To go to the previous or next in the list. This mode can be used even though a different field has been selected using the radio buttons.

Using the numeric keypad you have to press the radio button of the relevant identifier field, so that it is selected and you can enter the digits, afterwards you can enter the value regarding the geophone you want using the numeric keypad. This procedure does not allow you to select the source nor the trigger.

The display fields will report the parameter values configured for the selected item.

6.3.4.2 *Changing the value of a parameter*

Changing the value of a parameter can be done as follows:

- select the relevant geophone as described above;
- press the radio button for the parameter to be modified, the numeric value will be highlighted;
- enter the new numerical value for the selected parameter, the previous numeric value will be replaced by the number you entered. The new value is automatically saved.

6.3.5 Changing parameters on all geophones

The window allows you to modify the parameters on all the geophones at the same time. The change made in this way does not affect the source nor the trigger parameters and these should be set separately.

Figure 10 shows an image of the window where a change to the parameter in position X is being made

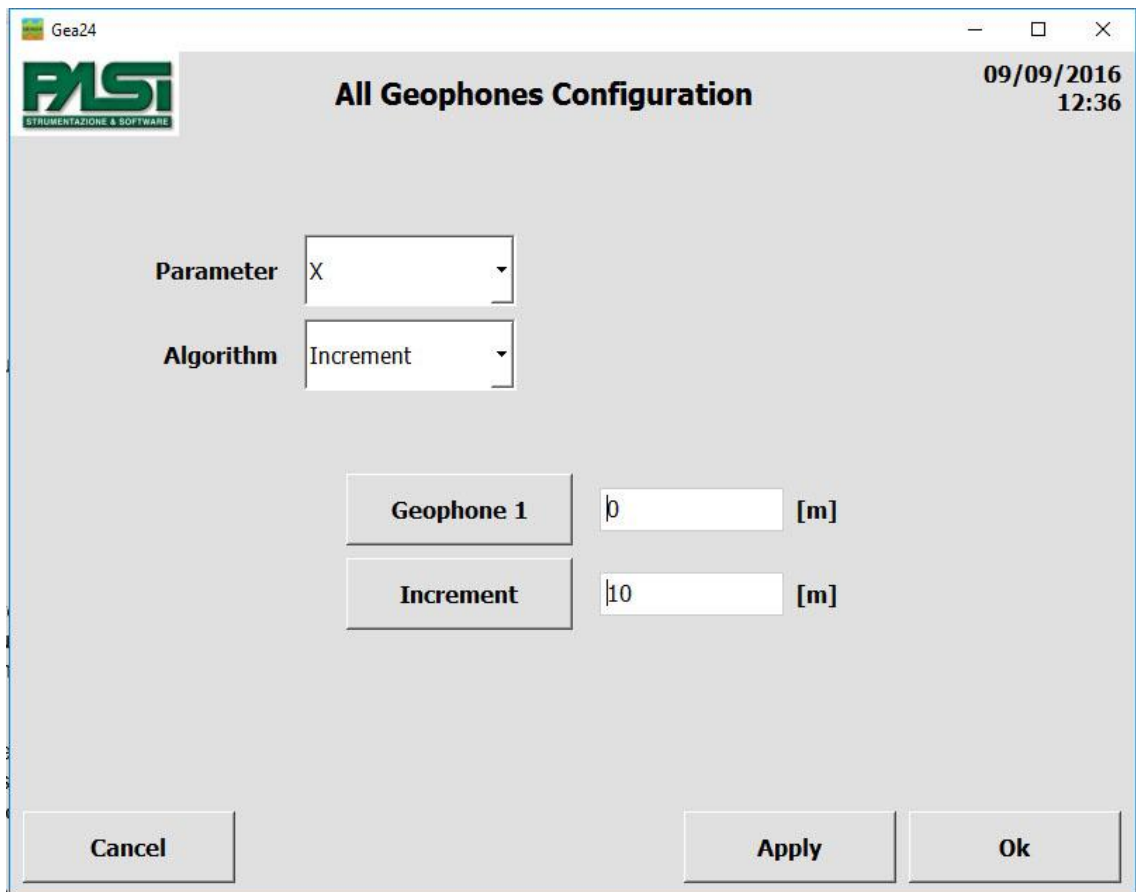


FIGURE 10 - CHANGING PARAMETERS ON ALL GEOPHONES

The list below explains the controls of the parameter setting window on all geophones.

- Parameter: allows you to choose from the drop down menu the parameter you prefer to work on (X, Y, Z, or sensitivity).
- Algorithm: allows you to choose the value calculation algorithm for individual geophones: for the parameters X, Y and Z you can choose constant, increase or decrease algorithms; for sensitivity only the constant algorithm is available.
- Constant value: allows you to enter the constant value to be applied to the parameter.
- Geophone 1: allows you to set the value of the first geophone for Increase and Decrease algorithms.
- Increase: allows you to set the value by which the previous parameter of the geophone will be increased to obtain the next value.
- Decrease: allows you to set the value by which the previous parameter of the geophone will be decreased to obtain the next value.
- Apply: the button must be pressed to apply the chosen algorithm with the set parameters so that you can calculate the values and assign them to the enabled geophones.

6.3.6 Saving a Configuration

Saving a Configuration allows you to store all the information contained in a configuration, hence the set of parameters entered in the three windows: lines configuration the Acquisition configuration and Configuration of geophones. Each saved configuration can be identified and retrieved via the name the operator gave it.

To save a configuration use the save button in any of the three windows of the configuration parameter input. A window will open with an alphanumeric keyboard that will allow you to enter the configuration name so that you will be able to recall it in the future.

After saving the configuration, in the drop-down menu on the homepage you will see the name of the configuration saved and active at that time. The configuration is saved statically on the hard disk of the control PC.

If the changes have not been saved, meaning the operator has made some changes to the configuration parameter and has quit the three windows of the configuration, pressing the "OK" button without pressing the "SAVE" button first, in the "Configuration" drop-down menu you will see "last configuration". In this case, the configuration parameters are stored on a temporary file system, they may be used to carry out an acquisition, displayed or further modified by pressing the "Acq config" button, however, they will be overwritten as soon as the operator exits the configuration windows by pressing the "OK" button again.

6.4 *Acquisition Procedure*

6.4.1 Geophone noise monitoring

After selecting the configuration to use, by clicking on the (1) button "New Acquisition" in the homepage (figure 3) you enter the acquisition mode of the seismic traces. The geophone noise monitoring window allows the operator to view in real time the noise detected by the geophones themselves. This will allow the operator to check the correct operation of the hardware and the correct positioning of the geophones in the field. Figure 11 shows the noise monitoring window.

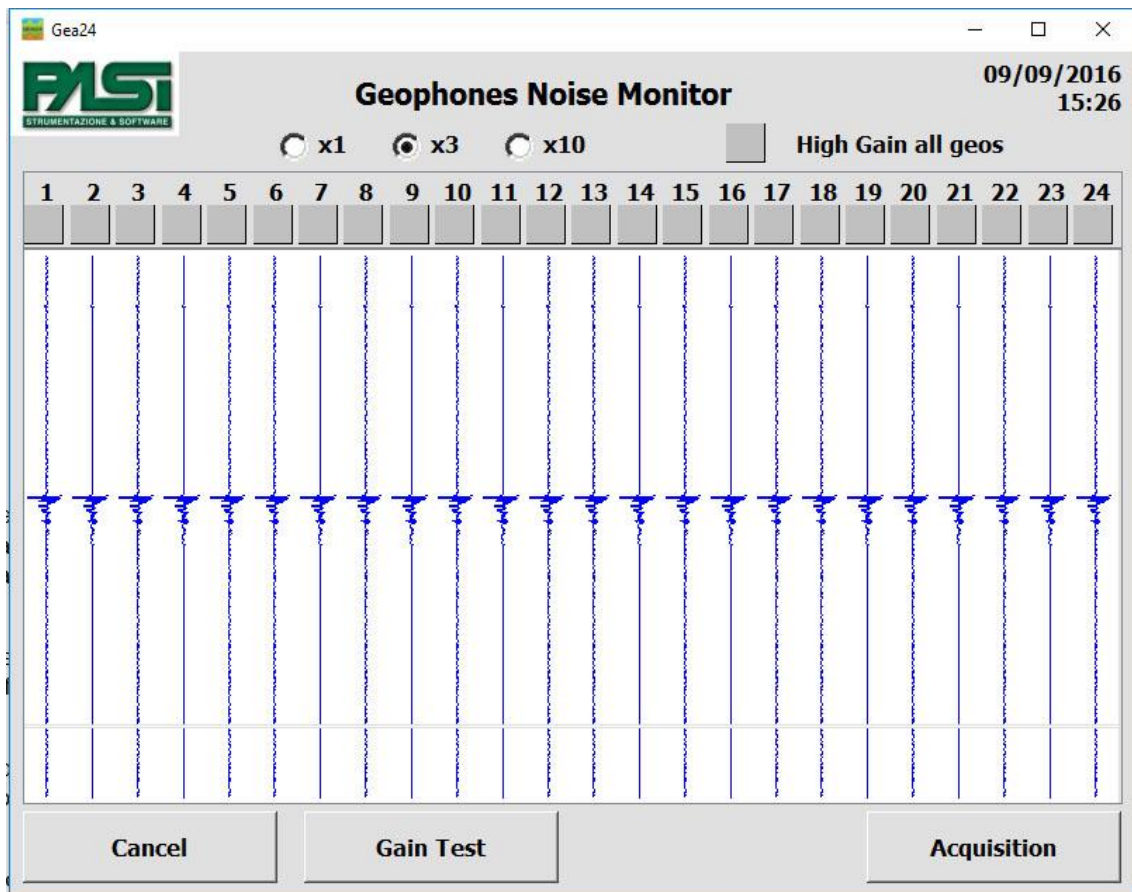


FIGURE 11 - NOISE MONITORING WINDOW

The graphs show the signal detected by each enabled geophone with the time on the vertical axis and the amplitude on the horizontal axis. The window does not intend to provide quantitative information of the noise measured by the geophones, but only qualitative information of the environmental situation in which the physical geophones are operating. If more than 24 geophones are connected you have to use the scrollbar to display the noise of all the geophones.

There are three radio buttons labelled x1, x3 and x10 that allow you to view the acquired noise at that multiplied value, so low intensity signals can be displayed if thought necessary. This multiplying factor has no influence on the signal acquired during the acquisition.

The square checkbox below the identifier of each geophone is for selecting the high gain for that geophone. This high gain will be visible in the noise monitoring window because it corresponds to an amplification of the signal shown by a 5 (x5) factor and will be applied to the acquired signal by the geophone in the next phase of real acquisition. The checkbox labelled "High Gain all geos" allows you to select the high gain for all geophones simultaneously, or deselect it for all geophones.

The button "Gain test" only appears if you are about to make an active acquisition, and allows you to create fictitious acquisitions with a trigger included as in a real acquisition. The Gea24 system will acquire signals from the geophones, will compare them with a threshold and return to the noise monitoring window by configuring each individual geophone with high gain if the acquired signal is below the threshold used, or with a low gain if the signal acquired is located above the threshold. The operator will be able to see the settings chosen by the system during the gain test and modify them.

The window also contains the following control buttons:

- Cancel - Exits the display window of the "Geophones Noise Monitoring" and goes back to the homepage;
- Acquisition - Exits the noise monitoring function and moves to the acquisition start screen waiting for the trigger (see section 6.4.2.1 and figure 12) or, if you are creating a multiple passive acquisition, on the SEG2 parameter management screen (6.5.1);
- Gain test - only appears if you are about to make an active acquisition and it allows you to automatically set the gain by executing a test acquisition.

6.4.2 Trigger Window

The window can be represented in two different ways: active and it must have the automatic trigger, or passive and so you will have a manual trigger.

6.4.2.1 Active acquisition: automatic trigger

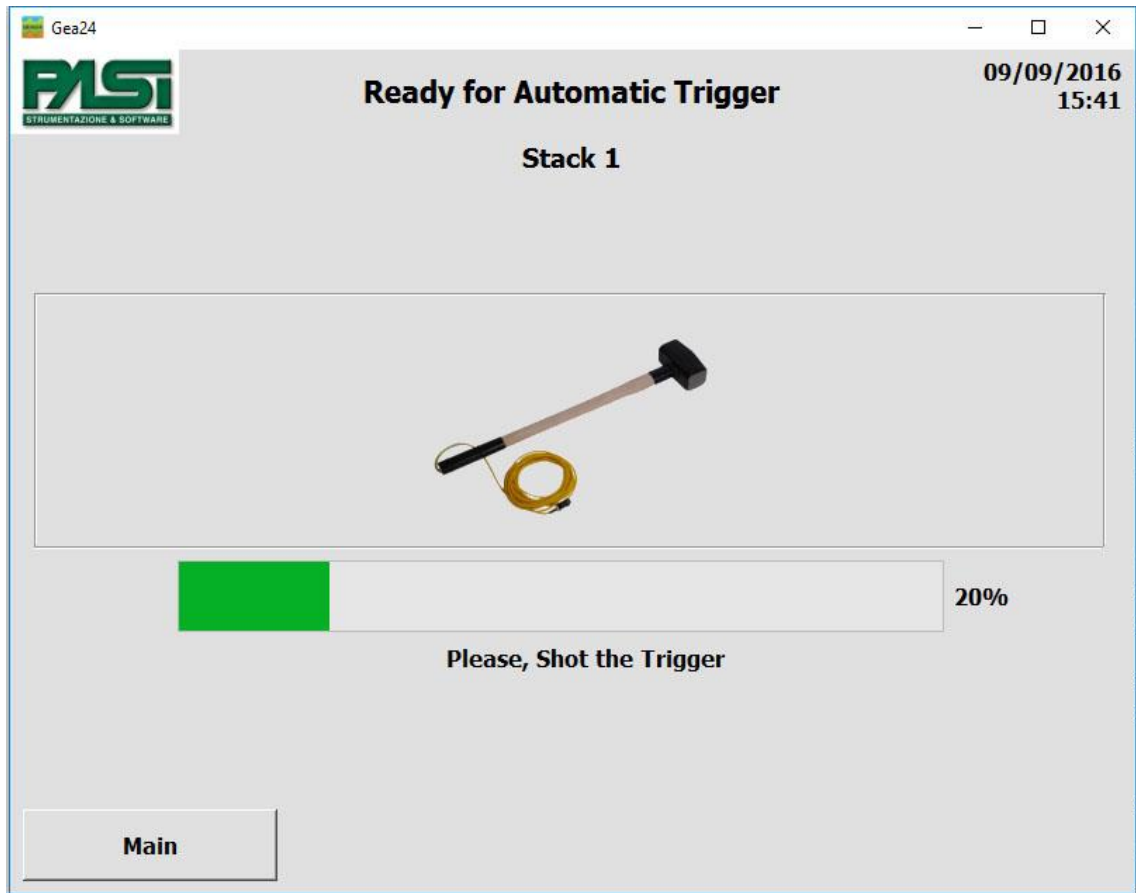


FIGURE 12 - AUTOMATIC TRIGGER WINDOW

The window shows a progress bar that shows the pretrigger time as a percentage. At the end of the pretrigger time the bar will stop and go green, indicating that now you can proceed to trigger the event, the system will remain in this status until the event is triggered. The example in figure 14 shows the acquisition with a pretrigger time of 500 milliseconds, acquisition time after triggering of 2000 milliseconds, and a system that has acquired the pretrigger data and is ready to be triggered.

If the event is triggered before the pretrigger time has been completed, the acquisition will be correct, but samples not acquired prior to the trigger event will have a value equal to zero.

The window also contains the following command button:

- Main - Exits the window of early acquisition and goes back to the homepage, in this case, the acquisition is not made and you will have to repeat the procedure from the beginning (New acquisition -> Noise Monitor -> Acquisition).

6.4.2.2 *Passive acquisition: manual trigger*

In the case of passive acquisition some data acquisition windows concerning the SEG2 files used to save the scanned data are shown, as these acquisitions can be long lasting and in this way you can still save the acquired data up to the moment of an interruption of the acquisition (controlled by the operator, or due to low battery, or other problems). These SEG2 data acquisition windows are shown in paragraphs 6.5.1.

The wait window of the manual trigger window will show the "Start acquisition" button, and the system will wait for you to press this button to start the acquisition.

Once the operator has pressed the start acquisition button, if a waiting time after manual trigger equal to 0 was set under "Acquisition Configuration", the acquisition by the geophones will begin immediately; otherwise, the screen will display a progress bar, after which acquisition by the geophones will automatically start.

In the case of a non-multiple acquisition, the Gea24 system will carry out acquisition in a continuous way for the planned duration of the acquisition configuration, whereas in the case of a multiple acquisition the Gea24 system will carry out the sequence acquisitions and pauses between acquisitions as determined by the acquisition configuration.

The window also contains the following command button:

- Main - Exits the acquisition window and goes back to the homepage, in this case, the acquisition is not carried out and you will need to repeat the procedure from the beginning (New acquisition -> Noise Monitor -> Acquisition).

6.4.3 The "Acquisition in progress" window

The "Acquisition in progress" window will show a progress bar indicating the percentage of acquisition.

The window also contains the following command button:

- Main - Exits the current Acquisition window and goes back to the homepage, the acquisition is stopped and the data collected will be lost.

6.4.4 Stacking

During an active acquisition, if a stacking value different from 1 has been set during the "acquisition configuration" phase, the system will automatically proceed with the acquisition of the repeated signal. This means that at the end of an acquisition, the system

will check if the configuration requires the execution of a further stacking acquisition: if the answer is yes you will return to the "Automatic Trigger" window, and will have to repeat the sequence provided by the configuration (you will wait for the pre-trigger time plus the time of the automatic trigger event set by the operator). This loop will continue until all the stacking acquisitions expected by the "acquisition configuration" have been carried out.

To end the acquisition operation, the operator can press the main button, and in this case the data acquired up to that time will be deleted and the system will return to the Gea24 homepage.

6.4.5 Display of acquired data

After the acquisition is completed, the Gea24 will proceed to collect the acquired signals and will apply any configured filters. For an active acquisition the acquired signals are displayed whereas for a passive acquisition the acquired signals are saved directly to the SEG2 files without being displayed.

The "Acquisition Results" window shows a table where vertical graphs of all geophones enabled for acquisition are shown - see Figure 13.

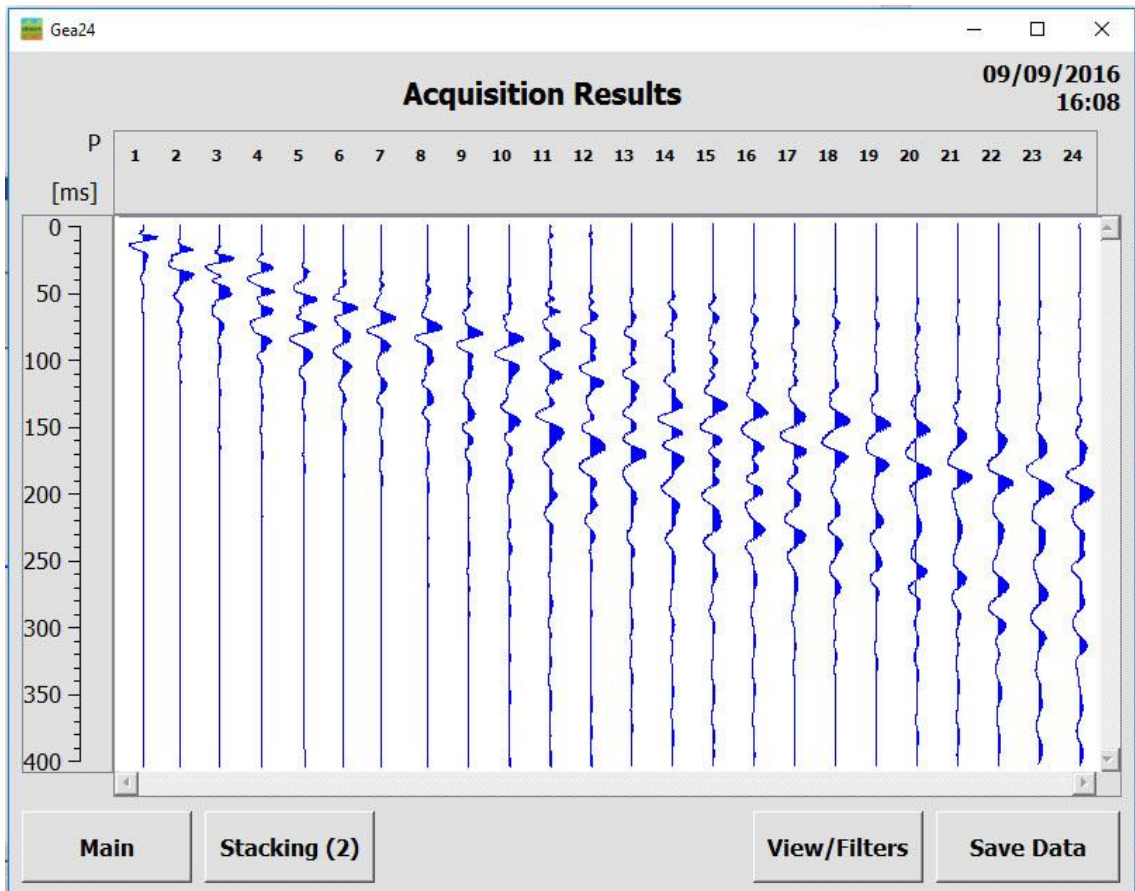


FIGURE 13 - ACQUIRED SIGNAL WINDOW

Across the top are the ID numbers of the physical geophones (Trg identifies the signal acquired from the Trigger). The letter "P" indicates that the signal is shown with the polarity as it has been acquired. If the signal is inverted from the "View / Filter" window the indication becomes "- P" to indicate that the signals have been inverted.

Down the left side the time axis (in milliseconds) the same for all the geophones, is shown.

To display the signal for its entire duration and for all the geophones it may be necessary to use the scroll up and down the table.

The "Result Acquisition" window will allow the operator to perform the following:

- Signal Picking (Marker) - By clicking on the screen, within the graphics display table, an acquired signal of an event of interest (for example, the first arrivals of the signals in the seismic refraction), a red line will appear with the indication of the time that corresponds to the selected point. The markers must be placed during the first display and before saving the data. In this case, the markers will be stored and viewable even when the acquisitions are recalled in "File Management", it is not possible to add or modify markers on an already acquired file.
- View / Filters - The operator can change the representation of the graphics or apply filters to the acquired signal. The application of filters is only possible if no filter had been expected to be used during the "acquisition configuration".
- Stacking - The operator can make further stacking acquisitions after having viewed the result of the acquisition.
- Total> - this button is available after stacking by the operator during the display phase. After carrying out stacking controlled by the display phase, only the last stacking signal is displayed: by pressing the "Total" button you can visualize the signal that includes the previous stacking and the last one you acquired.
- <Last - this button is shown after stacking by the operator during the display phase. It allows you (while you are viewing the total signal of all stackings carried out) to go back and view the signal, relative to the last stacking performed.
- Undo Stack -you will find this button after stacking by the operator during the display phase. It allows you to discard the acquisition from the last stacking.
- Save Data - Saving data acquired on SEG2 file.

The window also contains the following command button:

- Main - Exits the "Acquisition Display" window and goes back to the homepage, the acquired data will be deleted if the operator confirms that he/she wants to leave the display page without saving the data.

6.4.5.1 View parameters configuration

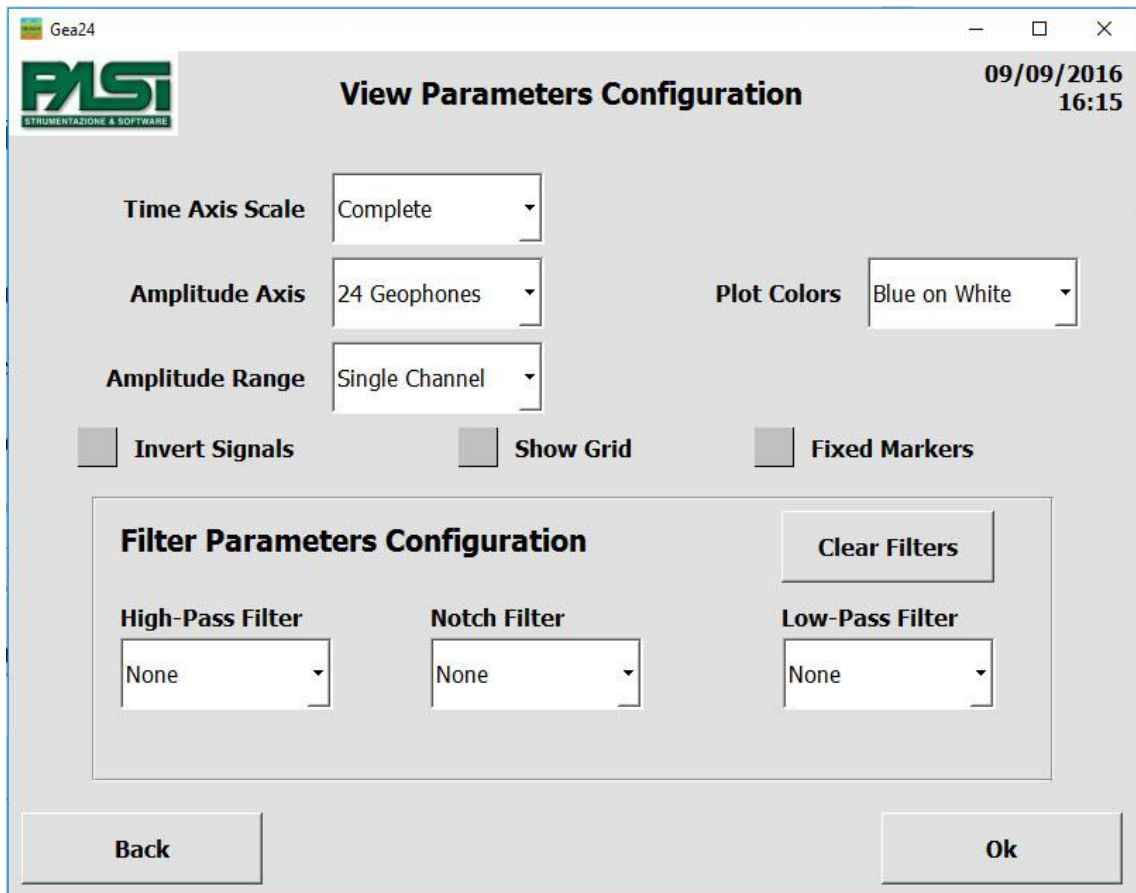


FIGURE 14 - PARAMETER AND FILTER DISPLAY CONFIGURATION

The parameters which the operator can set are listed below.

- Time Axis Scale: Time interval displayed on a single screen, this parameter allows you to increase or decrease the time scale of signals. The possible values depend on the characteristics of the acquired signal. The default "Full" allows you to view the entire signal on a single screen.
- Amplitudes axis: Number of geophones shown on a single screen, this parameter consequently allows you to vary the available space for the amplitude of each signal. The possible values are:
 - 24 geophones displayed;
 - 12 geophones displayed;
 - 6 geophones displayed;
 - 3 geophones displayed.
- Amplitude range: full scale used on the amplitude of the individual signals, allows you to select the full scale that you want to apply to all signals displayed. The operator can choose from the following:

- Global - The signals obtained are presented with the same full scale value, this is relative to the maximum amplitude value measured on all acquired signals. This view will allow you to have a visual reference of the attenuation of the signals received on the different geophones. Through a special checkbox, the operator can choose whether to include the signal of the trigger from the calculation of the maximum amplitude: if you want to exclude the trigger signal, the latter will have its own full scale that will be different from the scale value used for all the other signals of the geophones, where the full scale of the geophones will be calculated as the maximum of the signals acquired by the geophones.
- Single channel - The acquired signals are each represented by a different full scale value, calculated as a value of maximum amplitude measured on the single acquired signal. This allows you to view each signal to the maximum possible size.
- Single channel x 5 - The view is identical to that of the "Single channel", but the full scale signal is equal to one fifth of the maximum amplitude value measured on the single acquired signal. This view will allow you to visualize in better detail the small values of amplitude of each signal, but not the portions of signals whose width is greater than 1/5 of the maximum measured amplitude.
- Show Grid: Grid Presence, allows you to activate or disable the presence of the reference grid on the time axis.
- Plot Colors: Selecting background colors and curves of the graphs, you can set the graphs to have a white background and blue curves, or black background and white curves.
- Invert signals: the checkbox is shown only when you enter the window from the signal acquired display from the last stacking operation. It allows you to reverse the signals acquired with the last stacking before adding them to the total signals that include all stacking operations. This value goes back to "not inverted" with each stacking strike carried out, so it is necessary to confirm for each strike the reverse if you want to add more inverted strikes.
- Fixed markers: if selected, this allows you to insert a marker relative to a fixed time position on the charts of all the geophones, if not selected it allows you to insert a marker in the time position on the graph of each geophone only before acquisition storage.

6.4.6 Applying filters

Using the "View / Filters", if any, it is possible to apply digital filters to the scanned and displayed signal. You will find the "View / Filters" buttons during the display phase only if in the "acquisition configuration" the filters were not set, otherwise you will find the "View" button and the operator will not be able to apply additional filters.

The filters applied during the "acquired data display" phase do not overwrite the acquired signal (as is the case of the filter set in the phase of "acquisition setup"), so it is possible to carry out various tests by applying different types of filters and returning to the original signal acquired.

Applying a filter to the displayed signal inhibits the ability to make further stacking acquisitions on the filtered signal, since it is expected that the application of the filter is used only in the last display phase before saving the data.

The filters available are the same as in the "acquisition configuration" window, to which reference is made for the description (see section 6.3.2.2 figure 6), and are listed below.

- High-pass filter;
- Notch Filter (Suppress harmonics);
- Low Pass Filter.

6.4.7 Stacking Configuration

The stacking function can also be activated after displaying the received signal. In this way the operator can select the geophones on which he/she wants to carry out stacking, and keep the acquired signal unchanged on the geophones that he/she considers to be satisfactory.

By pressing the stacking key, the horizontal heading of the table of the acquired signals from the geophones will change, and under the ID number of each geophone, a checkbox is displayed and the number of acquisitions made for each individual geophone. To avoid stacking on a geophone that is considered satisfactory, the corresponding checkbox will have to be selected, otherwise stacking will be carried out on the geophones that have not been selected.

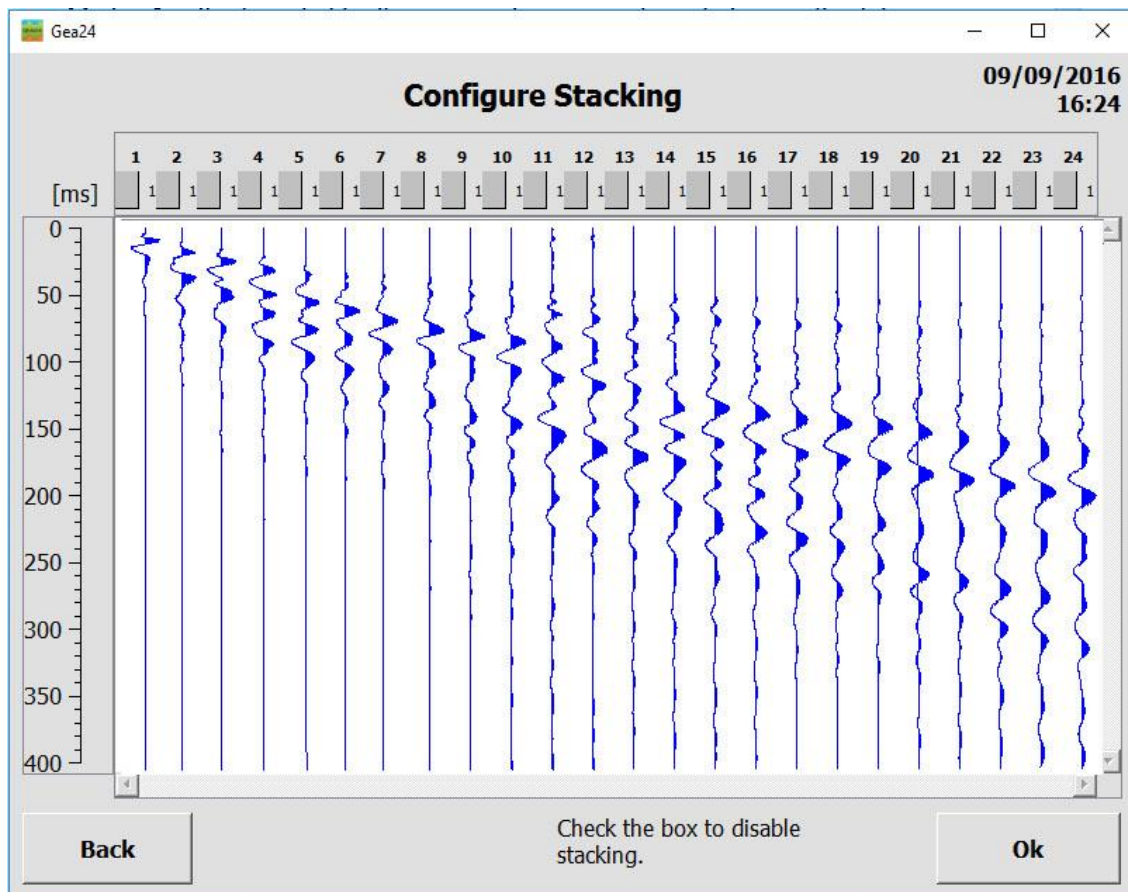


FIGURE 15 - STACKING WINDOW CONFIGURATION

To carry out stacking on unselected geophones the OK button must be pressed. You will return to the "Automatic trigger" window and a new acquisition procedure will be carried out (see paragraph 6.4.2.1).

The window also contains the following command button:

- Back - Exits the "stacking configuration" window and returns to the "Data acquired" window.

6.5 Data Backup

Pressing the "Save Data" button on the "Data acquired" window it is possible to save a file in SEG2 format of the data that is displayed at that moment. If digital filters have been applied during the "data acquired" phase, the filtered data will be saved to file; if the operator decides to configure the acquired signal without the application of the filters he will have to press the "view/filter" button, uncheck the filters and press the OK button, so that he will be able to view the unfiltered data, after which the acquired unfiltered data can be saved.

Data saving on a file requires two steps:

- display and input of parameters to be stored in SEG2 file (see section 6.5.1);
- Entering the name of SEG2 file (see section 6.5.2) .

6.5.1 Viewing and entering SEG2 parameters

After pressing the "Save" button the "Set up Display" window of the SEG2 parameters will open.

The screenshot shows the 'SEG2 Parameters Configuration' window. At the top left is the 'Gea24' logo and the 'PASI' logo. The title bar says 'SEG2 Parameters Configuration' and the top right shows the date and time '09/09/2016 16:24'. Below the title bar, there is a dropdown menu showing 'CLIENT' and an 'Insert' button. To the right, it says 'DATUM is expressed in meters.' Below this is a table with two columns: 'Name' and 'Value'. The table contains the following data:

Name	Value
ACQUISITION_DATE	12/set/2016
ACQUISITION_TIME	09:41:42
CLIENT	Geao inc.
INSTRUMENT	PASI_Gea24
TRACE_SORT	AS_ACQUIRED
UNITS	METERS

Below the table is a 'Delete' button. At the bottom, there is a checkbox labeled 'Total signal polarity inversion' which is currently unchecked. There are 'Back' and 'Ok' buttons at the bottom left and right respectively.

FIGURE 16 - INPUT WINDOW OF SEG2 PARAMETERS

The "Configuration SEG2 Parameters" window opens also when carrying out a passive acquisition immediately after the geophone noise monitoring window.

The window includes:

- A drop-down menu containing a list of SEG2 standard parameters that can be entered by the operator;

- "Insert" - value input button for SEG2 parameter selected using the previous menu;
- Table where each line contains the name of a SEG2 parameter, its value, a delete checkbox (only on the parameters that can be eliminated by the operator);
- Delete - Button to delete SEG2 parameters that are selected in the table.
- Checkbox "total signal polarity inversion" - Allows you to save the signal with reversed polarity as SEG2 files.

The table contains some of SEG2 parameters that will be stored on the file that will be created for the acquisition. In the window some SEG2 parameters are present for the acquisition automatically filled by Gea24 (in normal characters, cannot be deleted or changed by the operator) plus some optional SEG2 parameters (in bold characters, can be deleted or set at will, the operator provides the value).

The configuration values of the geophones and of the acquisition used during data acquisition are not shown in the table, but they will automatically be saved as SEG2 files.

The SEG2 optional parameters that appear in the table and their values are by default those used during the last saved acquisition of SEG2 file, to facilitate the input of parameters in the event of repeated acquisitions.

Entering a new SEG2 parameter not present in the table adds that parameter to the table. Entering a SEG2 parameter in the table will enable you to change the value of this parameter. Pressing the "Insert" button the input window of the parameter value will open and display either the digital keyboard or alphanumeric keyboard depending on the type of parameter entered.

The window also contains the following control buttons:

- OK - Continues the procedure for saving and naming the SEG2 file.
- Back - Exits the " SEG2 Parameter Configuration" window and returns to the "Data Acquired" window.

6.5.2 Entering the name of the SEG2 file

This window contains the alphanumeric keypad. A default name is given according to the rules set by the operator (see section 6.2.3), which the operator may make changes to or replace completely.

If selected, the checkbox "Stacking: save each "shot" allows you to store the signals of each stacking operation carried out. These stacking signals are stored in a "raw" format without any filter applied by the Gea24 system.

Pressing the "OK" button will allow the Gea24 system to save the data to the control PC's hard disk.

6.6 *Data and Configuration File Management/managing configuration and data files*

The button "Manage file" on the homepage (see Figure 3 in Section 6.1) allows you to enter the "File Manager" window where the following functions are active:

- Display a SEG2 file present on the Gea24 control PC's fixed memory or in the embedded PC of the Gea24 system;
- Delete configuration template from the fixed memory of the Gea24 system;
- Delete an SEG2 file present on the Gea24 system embedded PC fixed memory (only for Gea24 systems with embedded PC).

The window also contains the following command button:

- OK - Exits the "File Manager" window and returns to the homepage.

6.6.1 Viewing an SEG2 file

An SEG2 file can be displayed by pressing the "View Data File" button. This opens a management file system window of the external PC or of the embedded PC. Use the directory tree to select the file of interest and press the "OK" button, this opens a window similar to the "Captured Data" window and containing the data in the SEG2 file you chose.

The data display window allows the operator to do the following:

- View - changes the way the signals are displayed (see paragraph 6.4.5.1 in figure 14);
- SEG2 info - opens a window with a table containing all the SEG2 Parameter pairs parameter value and name defined within the SEG2 files, both concerning the File Descriptor Block and the Block Channel Descriptor.

The window also contains the following command button:

- Main - Exits the window "View Files" and goes back to the homepage.

6.6.2 Eliminating the configuration template

The “Configuration” button opens a window with a table which contains all the configuration files defined by the operator.

Use the checkbox to select the ones you want to delete, press the delete button to delete all files from the Gea24 system.

The window also contains the following command button:

- OK - Exits the "Delete File "or "Delete template" window and returns to the “manage file” window.

6.7 *Exporting data files (only for embedded PC)*

You can export the data files of SEG2 stored on Gea24 PC memory to a USB memory stick. When the system is on the homepage, insert a USB memory stick or into the USB port located on the front of Gea24, the system will automatically detect the key and will open the "Input / Output Management" window after a few seconds.

This window also lets you update the management software, as described in paragraph 5.10.

The names of the files in the Gea24 control PC are shown in the display table indicating the date and time saved, organized from the most recent to the oldest. You can change the way they are organized by pressing the button at the top, and they can be organized by date or by name.

You must select one or more files and press the "Copy" button to copy the selected files to the USB memory stick. By pressing the "Copy and Delete" button the files will be automatically deleted from the memory of the Gea24 control PC after they have been copied to the USB memory stick.

6.8 *Software upgrade (only for embedded PC)*

To upgrade the Gea24 system software you must do the following.

- Obtain the self-installing Gea24 ".exe" file that you want to install.
- Copy the installation files to the root directory of a USB memory stick.

- Go to the homepage of the Gea24 program and insert the USB memory stick into a USB port on the control PC (if Gea24 system with external PC) or into the USB port on the front of Gea24 (if Gea24 system with embedded PC).
- The Gea24 software will automatically detect the key and the presence of the installation file, open "input / output management" window where the system software can be upgraded.
- Press the Upgrade key for the latest Gea24 version.
- After the upgrade the Gea24 program will terminate automatically (if Gea24 system with external PC) or the Gea24 system will turn off automatically (if Gea24 system with embedded PC) in order to complete the upgrade. After restart, the Gea24 system will be using the new version of the software.

The software upgrade can also be accomplished using the PC simply by launching the automatic installation file provided by Pasi: the new software version will be installed along with all the necessary drivers.

6.9 *Multiple passive acquisitions*

The multiple acquisition mode lets you configure the Gea24 system to automatically perform a series of acquisitions at specified intervals. In addition to configuring the parameters relative to single passive acquisition, which must be done with a manual trigger (acquisition time, sampling frequency, wait time after the trigger event), the information must be configured:

- number of repetitions: number of acquisitions that have to be carried out during the multiple acquisition;
- Repetition period in seconds: the time that has to elapse between the beginning of one acquisition and the beginning of the next one. If the repetition period is higher than the acquisition time plus the time it takes the geophone to collect the data, then Gea24 will be put on hold until the repetition time has passed, and then it will begin the next acquisition. If the repetition time is lower than the acquisition time plus the time it takes the geophone to collect the data, the Gea24 system will immediately carry out the next acquisition. If the operator sets the repetition period to 0, Gea24 will start the next acquisition when it has finished gathering the previous acquisition data and it will allow you to save the acquired data in one single file.

In a multiple acquisition mode Gea24 operates as follows to carry out acquisitions:

- the operator requests acquisition by pressing the New acquisition button;
- the Gea24 program goes to the geophone noise monitoring window (see section 6.4.1); after viewing it, press the Acquisition button;

- the Gea24 program displays the SEG2 parameter set up window to save to the acquired files (see section 6.5.1);
- the Gea24 program displays the SEG2 files name that will be saved using the name set up during system configuration (see section 6.2.3) by adding a serial number to avoid overwriting files related to previous acquisitions. If in the process of acquisition configuration the value of the repeat period was set to 0, you will be asked if you want to save:
 - the SEG2 file for each acquisition,
 - the file that collects in one single SEG2 file all the samples collected for each individual acquisition, completing fixed samples for periods between one acquisition and the next in which the acquisition data were collected;
 - both types of file.
- Gea24 program displays the manual acquisition window; press the Start button;
- the Gea24 program carries out real multiple acquisitions: the first acquisition is carried out; the acquired data of the first acquisitions are collected and saved to a SEG2 file; if the time you set as repetition time has already elapsed, the second acquisition begins; the second acquisition is carried out; the acquired data by the geophones is collected in the second acquisition and saved to a SEG2 file;
- The Gea24 program continues until it has acquired all the configured repetitions or multiple acquisition is interrupted by the operator using the specific button.
- At the end of the multiple acquisition the Gea24 program returns to the homepage.

6.10 Recovery after unexpected situations

Gea24 has acquired data recovery functions when unexpected problems occur during use. Unexpected means any situation that does not allow you to save the acquired data as SEG2 files, such as accidental disconnection of the USB cable between the system and the PC, or because of a flat battery. Unexpected does not include, for example, when the operator presses the wrong button on the GUI system that deletes the acquired data.

The system handles recovery from unexpected situations for the most critical cases from the point of view of the duration of the operations: active acquisition with stacking configured, continuous passive acquisition and multiple passive acquisition. This functionality is automatically triggered by Gea24 at the restart after the abnormal shutdown occurred: If the system detects the presence of acquisition data in the PC or in the Gea24 embedded PC system that has not yet been saved as SEG2 files, it will be recovered.

The following will describe how to recover data after an unexpected situation.

6.10.1 Active acquisition with stacking

The data you collected is saved as temporary files at the end of each stacking acquisition. This means that in the event of a shutdown of the Gea24 system, the data can be recovered with a possible loss of only the data acquired in the last stacking shot/strike if the shutdown occurred while Gea24 was acquiring the data or it was saving it to a temporary file.

When you first turn the Gea24 system on after an unexpected shutdown, the operator will be asked how he wants to proceed. The choices are as follows:

- save temporary data on Gea24 system as SEG2 files (section 6.10.1.1);
- recover temporary data on Gea24 system to a SEG2 file and proceed with the interrupted acquisitions (the same number of Gea24 systems used for the previous acquisition must be connected to the PC) section 6.10.1.2;
- delete the data acquired without saving it to an SEG2 file (section 6.10.1.3).

The choice must be made immediately by the operator: you cannot use the Gea24 system for other acquisitions before dealing with the temporary data. The following shows the three possible options that the operator has.

6.10.1.1 Save temporary data found on Gea24 system to an SEG2 file

Data is read and recovered from the temporary files on the Gea24 system and the acquisition result is displayed on the normal acquired data window, the operator can apply filters, change the view, discard the data without saving it or save the data to an SEG2 file with the normal procedures described in section 6.5. The operator will not be able to make further stacking acquisitions in this mode.

6.10.1.2 Recover the data and continue the interrupted acquisition

If you intend to continue with the interrupted acquisition, this option may be used. The key for this option will be activated only if the PC detects that it is connected to the same number of Gea24 instruments as in the first part of the acquisition process before the unexpected event. The window will indicate how many Gea24 instruments are expected and how many are detected, the operator may have to connect the correct number of instruments to the PC. If a tool is connected but not detected correctly you will have to remove and reinsert its USB connector.

The Gea24 system puts the trigger on standby in order to complete the sequence of stacking shots/strikes as configured. Once completed, these shots/strikes will be displayed

as usual in the window as described in section 6.5 as for a normal stacking acquisition, and the operator can perform additional stacking shots/strikes, delete the acquired data, or save the result to an SEG2 file.

If all the stacking shots/strikes have been carried out as per the acquisition configuration, the Gea24 system will open the result display window, and the operator will be able to perform additional stacking shots/strikes, delete the acquired data, or save the results as an SEG2 file, as in a normal acquisition that had not been interrupted.

6.10.1.3 Deleting the acquired data without saving it to an SEG2 file

The temporary data is deleted and Gea24 goes to the homepage to operate normally.

6.10.2 Continuous Passive Acquisition

The collected data is saved to a temporary file once a minute approximately for acquisitions with a sampling rate of 250Hz, or every 2 minutes if the sampling is done at 125Hz. This means that in case of failure and subsequent shutdown of the Gea24 system, all data can be recovered except for the acquired data of the last one or two minutes depending on sampling rate.

When you first turn on Gea24 system after an unexpected shutdown it will automatically save the contents of the temporary files on the system's memory, this will happen on a SEG2 file with the name chosen by the operator at the start of the acquisition. At the end of the recovery operation the operator will be informed that the data has been successfully saved.

6.10.3 Multiple passive acquisition

The collected data is stored as an SEG2 file at the end of each acquisition of the configured series. The SEG2 files of the individual acquisitions made up to that point will then be present in the Gea24 file system even if an unexpected shutdown occurs during acquisition. This means that in the event of a shutdown of the Gea24 system, the data can be recovered with a possible loss of only the last data acquired, if the shutdown occurred while Gea24 was acquiring the data or it was saving it to a temporary file.

The first time the Gea24 system is restarted after an unexpected shutdown, and where the operator had requested the storage of the entire sequence of acquisitions to a global file,

the global acquisition file will automatically be saved. The operator will then be informed that the data has been successfully saved.

If the operator had not required storage of the global multiple acquisition files the Gea24 system will not have to perform any data recovery operation.

Appendix A

Technical Specifications



24-CHANNELS SEISMOGRAPH - 24 BITS PASI MOD. GEA 24

www.pasigeophysics.com



TECHNICAL SPECIFICATIONS GEA 24	
Number of channels	24 chs + trigger (AUX ch) - 2 units can be serialized for a total of 48 chs
Data Conversion	24 real bits Sigma-Delta ADC (compatible with analog geophones of any resonance frequency)
Sampling intervals	Active Acquisitions: - up to 125 microsec (8000sps) on 24 chs, - up to 31.25 microsec (32000sps) on 6 chs Passive Acquisitions: - up to 4000 microsec (250sps) on 24 ch - up to 500 microsec (2000sps) on 3 chs
Acquisition length	27500 samples @ 24 chs (+aux) 174500 samples @ 3 chs (+aux) Unlimited samples for continuous acquisitions
Preamp. gain	0/52 dB, software selectable
Stacking	Unlimited number of stackings
Input impedance	2M Ω // 22nF
S/N ratio	117db @ 1ksps
Distortion	0.007% @ 16kHz
Bandwidth -3dB	6.8kHz@32ksps - 0.21 kHz@1ksps
Bandwidth +/- 0.1dB	3.5 kHz@32ksps - 0.11 kHz@1ksps
Filters	Low Pass: 125-200-500-1000Hz High Pass: 10-20-30-40-50-70-100-150-200-300-400Hz
Notch Filter	50-60Hz + harmonics
Trigger	Normally closed contact, normally open contact (e.g. with explosive), analog signal (starter geophone, hammer switch), TTL triggering. Trigger sensibility adjustable via software
Trace Display	Wiggle-trace / variable area
Noise-monitor	All channels + trigger; real time bar display
AUX channel	1x (for trigger or any other input signal)
External interface	1x USB 2.0 to external PC (not included)
Data format	SEG2, SAF (other formats available on request)
Power supply	5VDC from USB, 0.25A
Operating/Storage Temp.	-30°C to +80°C
Humidity	80% relative humidity, non condensing
Dimension	24cm x 19.5cm x 11cm
Weight	2 Kg

Available accessories:

- Seismic Cables
- Horizontal and Vertical Geophones
- 3D Land geophones
- Striking plate for "P and/or "S" waves
- Seismic Energizer "ISOTTA"
- 3D Borehole geophones
- Crosshole energizer
- Hammer Switch / Starter Geophone
- GPS option (georeferencing & timing)
- Radiotrigger

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Specifications subject to change without notice

Appendix B

How to place the piezoelectric shock sensor



**COME FISSARE L'HAMMER SWITCH (STARTER PIEZOELETTRICO) SULLA VOSTRA MAZZA
HOW TO FIX THE HAMMER SWITCH ON YOUR SLEDGE HAMMER**



FISSARE LO STARTER AL MANICO DELLA MAZZA TENENDO LE 4 VITI DI CHIUSURA RIVOLTE VERSO IL MANICO. DURANTE LA BATTUTA MANTENERE LA MAZZA IN POSIZIONE COME DA IMMAGINE PER EVITARE EVENTUALI DANNEGGIAMENTI DELLO STARTER

BY USING ADHESIVE TAPE, FIX THE HAMMER SWITCH ON THE SLEDGE HAMMER HANDLE WITH THE 4 SCREWS TOWARDS THE HANDLE ITSELF. WHEN YOU HIT THE GROUND, KEEP THE HANDLE IN THE POSITION INDICATED IN THE PICTURE TO AVOID ANY POSSIBLE ACCIDENTAL DAMAGE OF THE HAMMER SWITCH



RICOPRIRE LO STARTER CON NASTRO ADESIVO E FISSARE IL CAVO LUNGO IL MANICO IN MODO CHE NON VENGA "PIZZICATO" DURANTE LE BATTUTE

WITH ADHESIVE TAPE, COVER THE HAMMER SWITCH AND ALSO FIX ITS CABLE ALONG THE HANDLE TO AVOID ACCIDENTAL BREAKING

Appendix C

Trigger connector

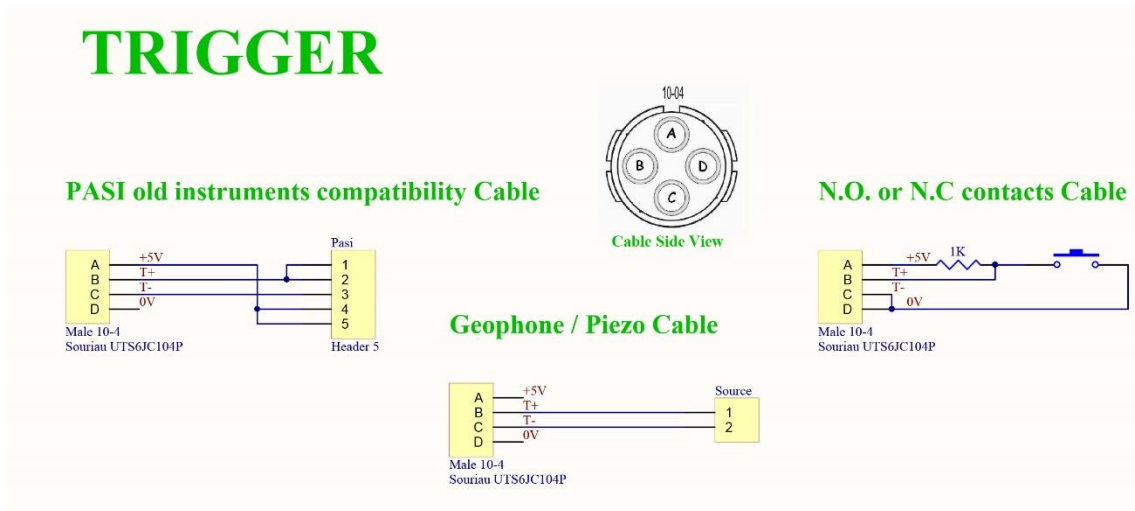
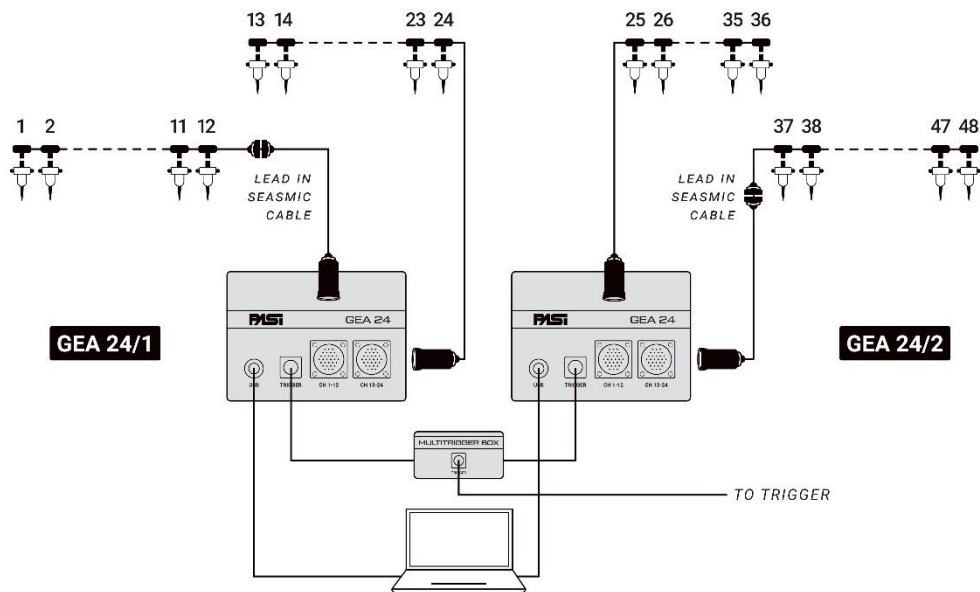


FIGURE 17 - TRIGGER CONNECTOR

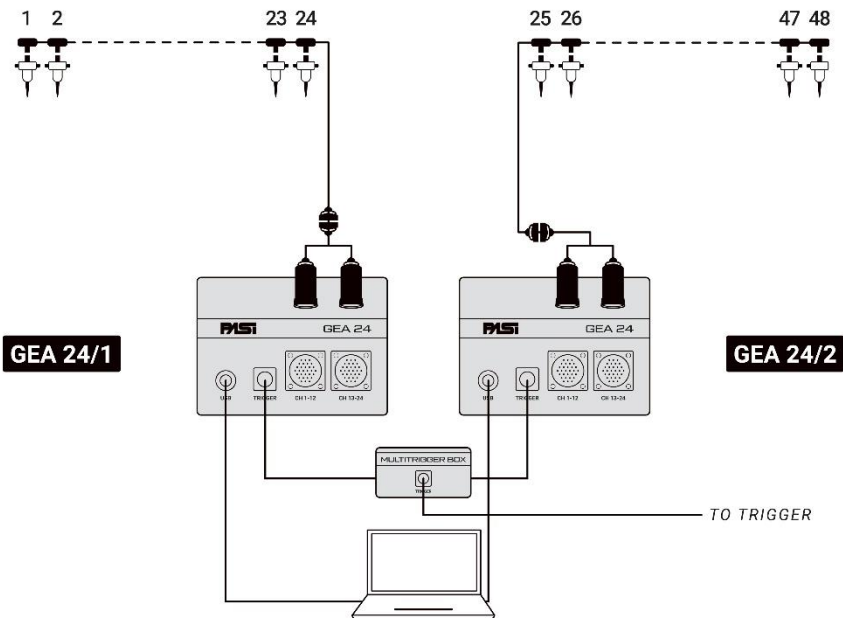
Appendix D

Connection schemes

48 Channel seismograph – 12 Channels cables



48 Channel seismograph – 24 Channels cables



Line Connections

