DOLANG

Geophysical

W2Z

SEISMOGRAPH

User Manual

Indice generale

1 Software Installation

Refer to the folder / directory of the installation file , whose name is:

Installation Disk **W2Z**

In it there is a file with the name :

Installing USB Drivers **FTDI.pdf**

Open it and follow the prompts to install the USB drivers needed to operate the equipment.

After installation of the driver, run the installation file:

SETUP W2Z.exe

Will be created in C drive (default): JEA WIRELESS folder , with inside the application file , with .exe extension.

2 First Use

Please read carefully this section.
This wireless seismic system is composed of:

- one unit connected to the PC by USB wire and its tripod (MOM unit)
- several geophonic units disposed on the ground following a geometry (GU unit)
- one trigger unit, equipped with a triggering wire system (TRG unit)

MOM Unit on tripod

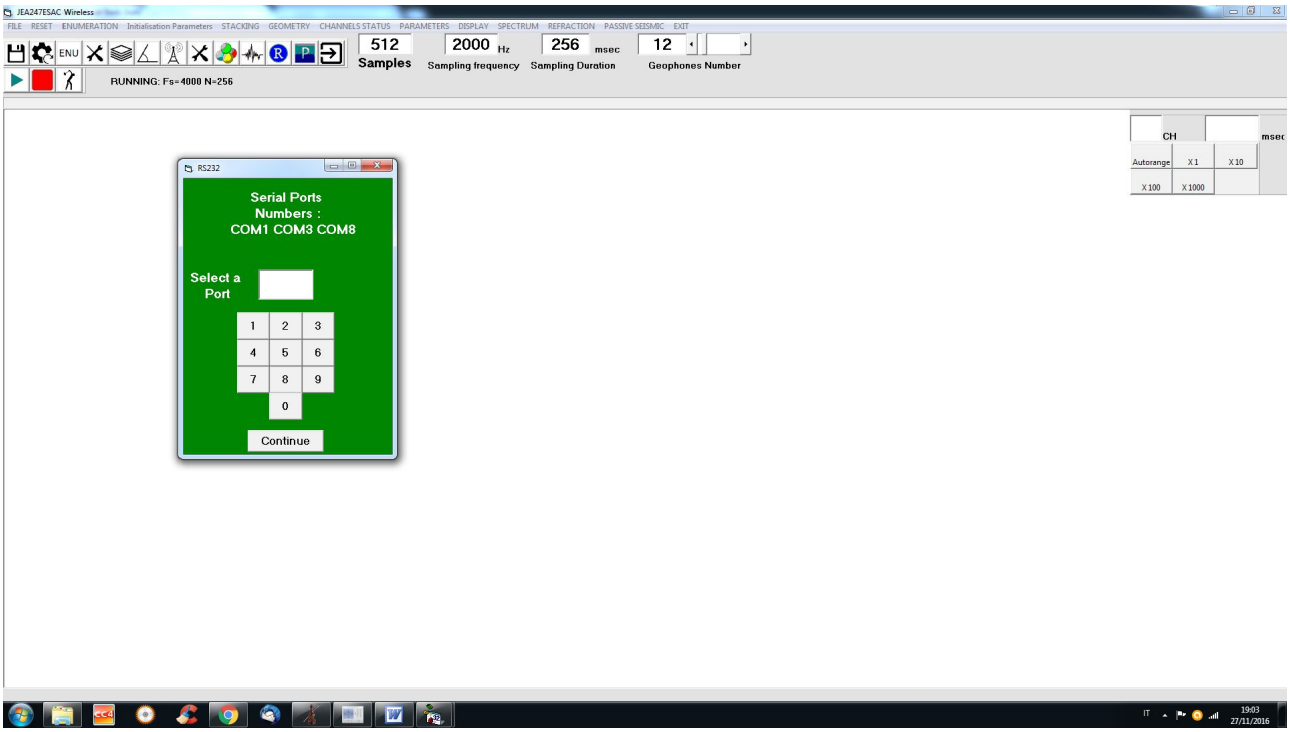
Trigger Unit

After you have installed the USB driver and application (see file "Install USB Driver FTDI.pdf"), connect the MOM unit to your PC, using the USB wire.

2.1 Verify Comunication Port Number

Launch the application ESAC Wireless.

Once launched, you will notice something like this:



Setting Comunication Port

In the green box appears the RS232 ports available on PC.
(which in this example are the number 1, 3 and 8).

Port numbers range from 1 to 16.

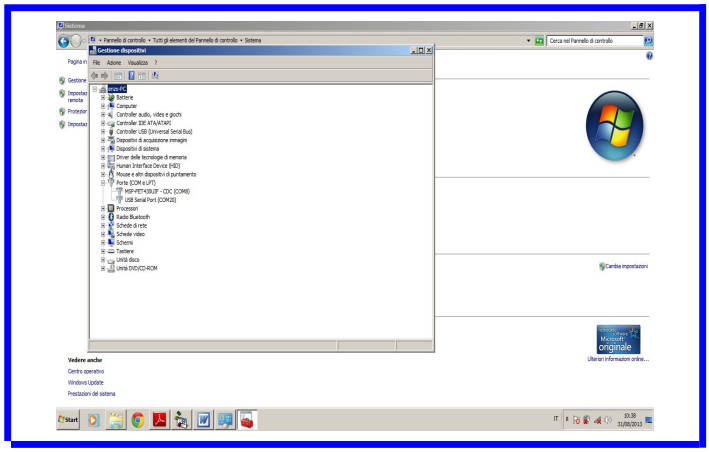
To remove ambiguity about which port is dedicated to the equipment, just disconnect the USB port and run the software again. The correct number will be that disappeared.

The other parameters are the default ones.

Note:
It is still possible that at the first plugging of the device (MOM), the operating system decides to assign a different number (over 16) to the port.

In this case, the port would not appear in the green box, and you have to change its number.

Go to the Control Panel ☾ System ☾ Device Manager Ports (COM & LPT)



In this example, port 20 can not be seen, to change the number to go to USB Serial Port (COM20), right click, Properties, Port Settings, Advanced, Number of the COM port, then set a number less than or equal to 16.

<u>Important:</u>

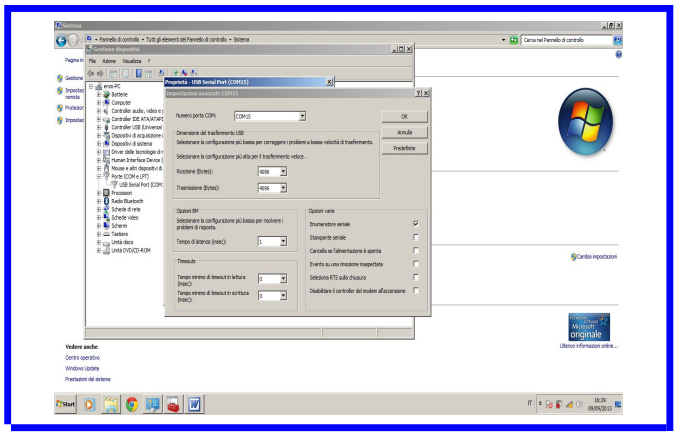
It is necessary to vary the value of "latency time" , which is measured in msec.
It is related to data transmitted from device to PC.

The equipment connected to the USB socket will wait for a time equal to the "time-lag" between one packet of data and the next.

It is necessary to lower this value to 1 msec.

Connect the USB cable to MOM (it may be off).

Open the System control panel ☾ System ☾ Hardware ☾ Ports (Com & LPT) and select the port number corresponding to the one used, right-click, go to Properties, Port Setting, Advanced.



The latency time is now set to 1 msec.

In the case of transmission from a PC to the device, the protocol is already structured to transmit packets employing a time of 1 msec or greater.

3 Layout of W2Z on field operations

Once you have MOM unit connected to USB of Computer and all geophonic Units and Trigger Unit switched ON (verify the blinking led is ON), dispose MOM facing all other units.

Inside each box there is a directional antenna that must aim to the proper direction to transmit and receive a radio signal. In case of misalignment radio signal will be poor or neglectable and working range insufficient.

Each Unit as a front and a back side; antenna will receive and transmit from front side.

Radio transmission will be performed only between MOM unit and geophone Units and Trigger.

No transmission is done between singular units and/or Trigger.

Correct alignment is required between MOM from one side and all other units on the other; MOM must face units and viceversa. Set Mom unit on tripod to aim to the medium position of distributed units on the ground. It is better to direct MOM to the most distant units.

Before proceeding in the seismic survey, effect the chekup illustrated in next paragraph, consisting in verifying the status of each unit.

4 Channel Status

Before proceeding in operation with W2Z, you have to verify the correct functionality of all units, to see how is their ability in radio transmission in the environment you are and their battery state.

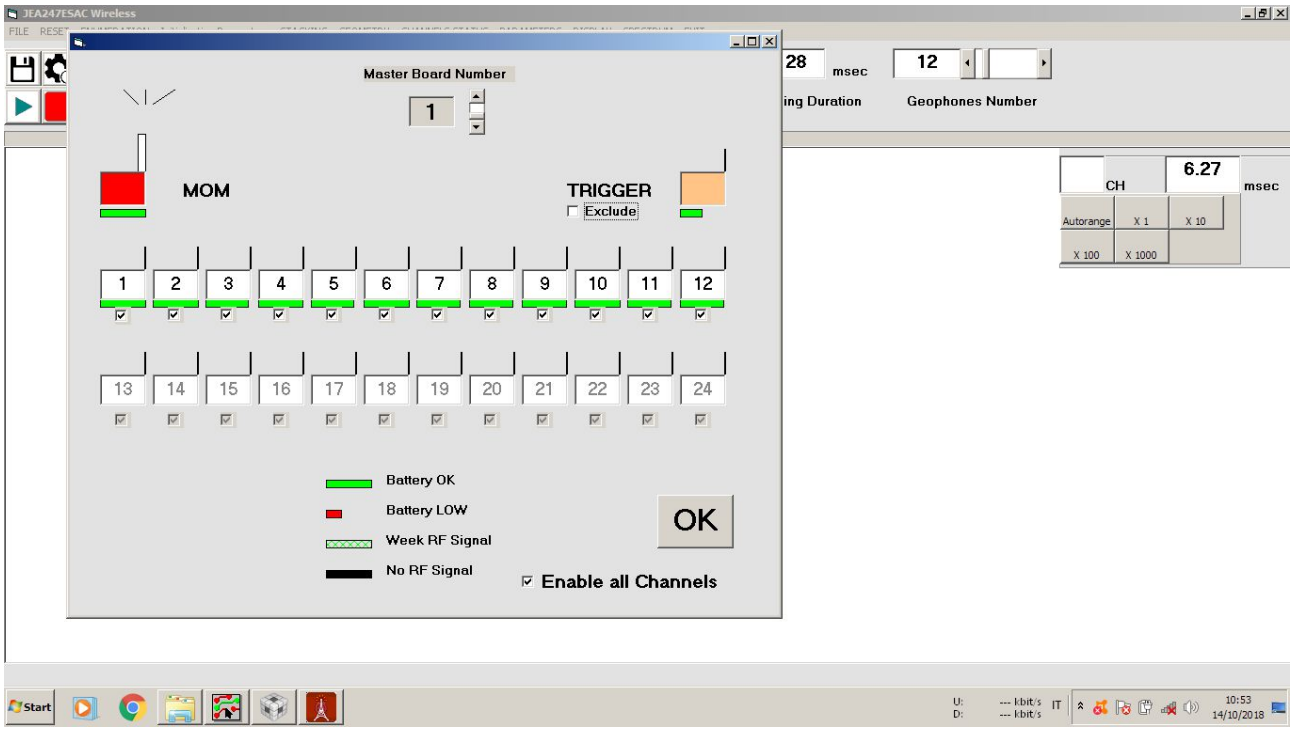
Set all Units on the field as required and following rules dictated on **Layout of W2Z in field operations**; switch them on and verify that the led is flashing.

Pressing CHANNEL STATUS you can verify the battery charge, looking at the length of the green line on bottom of each box representing a Unit of your system.
If the line is red, a charge will be needed, even if some time of allowance is guaranteed.

That same line tells even the status of the radio signal; if it appears cross-hatched, it means that signal is poor. Verify orientation of antenna of that unit, or if the range is too high. Anyway W2Z can still work but malfunctions may verify.

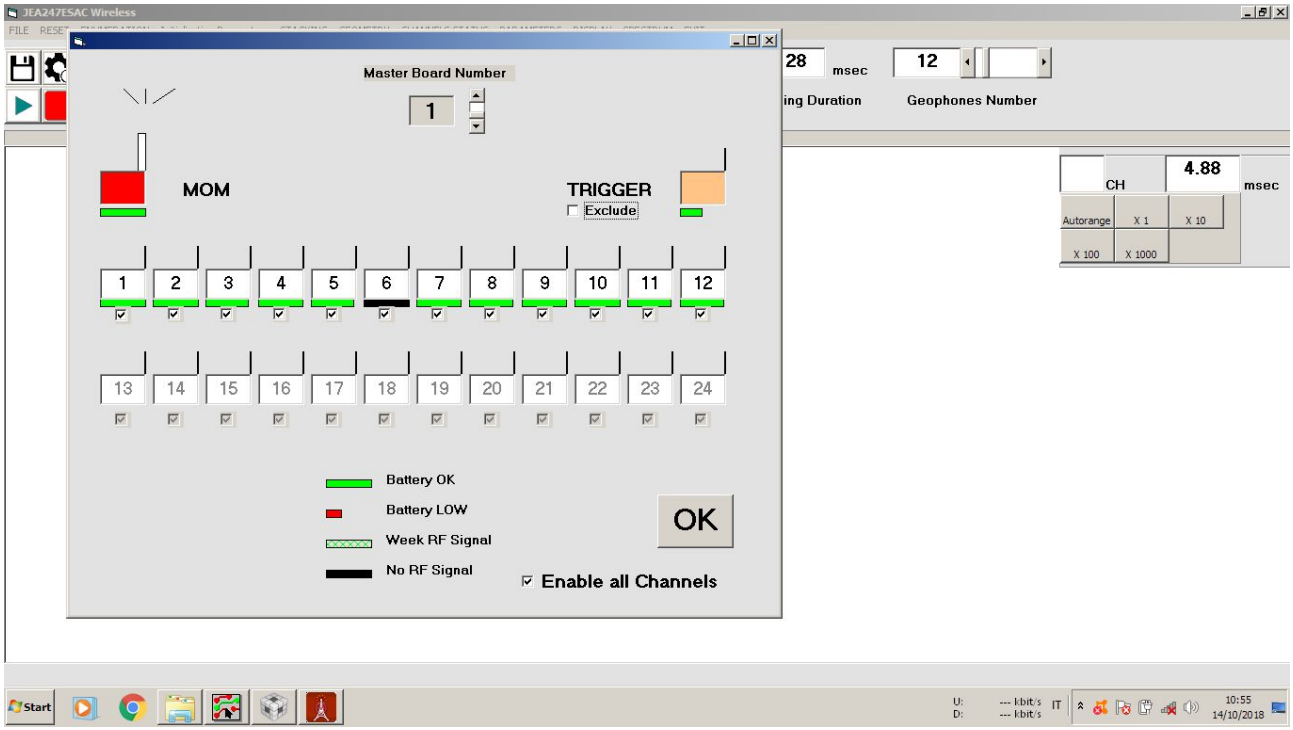
The number of enabled Units depend on the number of geophones that has been set.

Next picture shows 12 channels status:



Trigger green line is shorter; this means that its battery is not fully charged.
All lines are green, this shows that transmission is good.

Next image shows that unit number 6 has a black line:



Verify that unit 6 is ON. If it is ON, power it off and on again to reset it. Verify if unit 6 is in a position that radio transmission is impossible (in a ground hole, behind a thick wall….).

5 Setting for Acquisition - Running

Once you have entered the correct number of the communication port, enter the number of units (for ex. 24) in the box: Geophones Number.

If this is the first acquisition, after you have positioned all units, you must verify the signal strength.

Activate the menu: CHANNELS STATUS; see paragraph before.

Pressing the green arrow  starts Running mode. W2Z will acquire at pre set sampling frequency and Samples number.
Fs and N will be shown at the top left screen as: RUNNING Fs=2000 N=256 for example.
To vary this setting go to: Initialisation Parameters, see the pragraph down; this setting will be remembered every time you open the application.

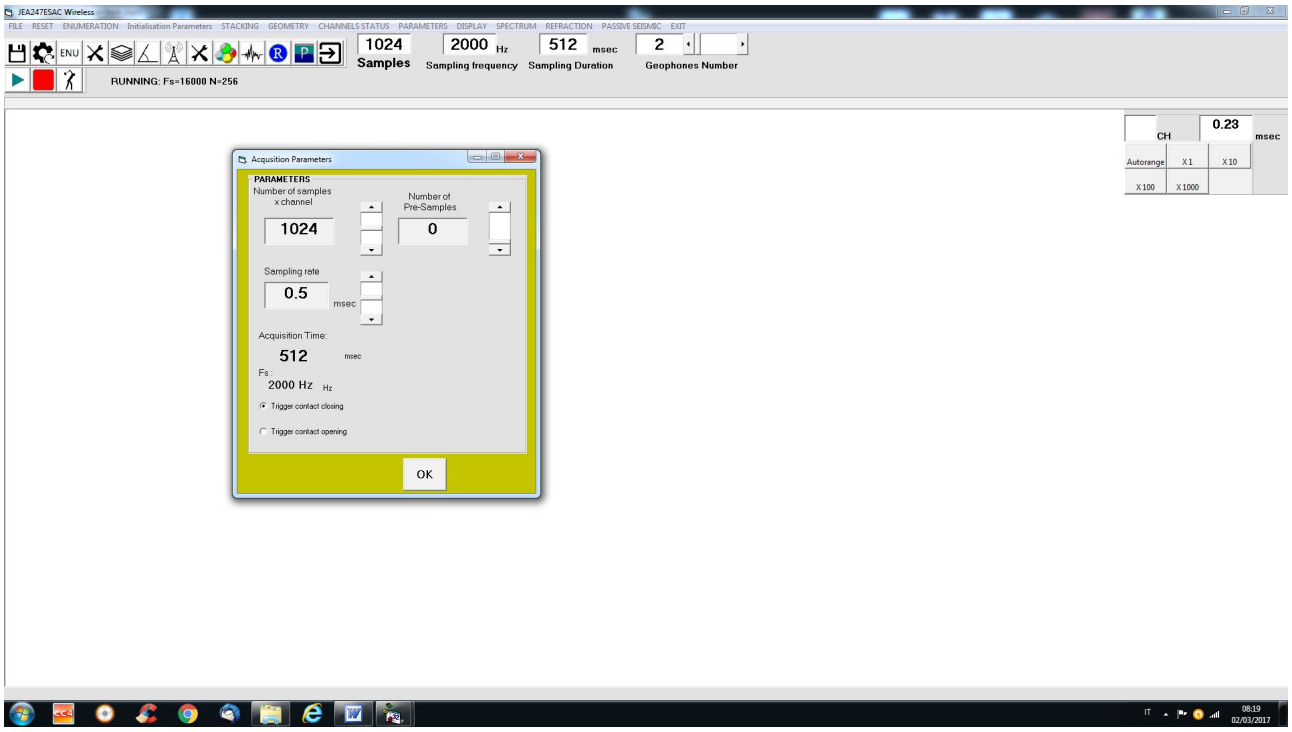
This function is useful to see if all is working. On the right a panel you can change the amplitude of the signals acquired.

By default, the amplification is "autoranging", then you will see even the slightest signal.

If there are not connected geophones, what you will see is the electroinc noise of the apparatus.

6 Setting for Acquisition - Trigger

Once you have entered the correct number of the communication port, enter the number of units (for ex. 24) in the box: Geophones Number.
Before you acquire, parameters such as Sampling Frequency, Samples Number, Trigger mode and Pre Samples must be defined:



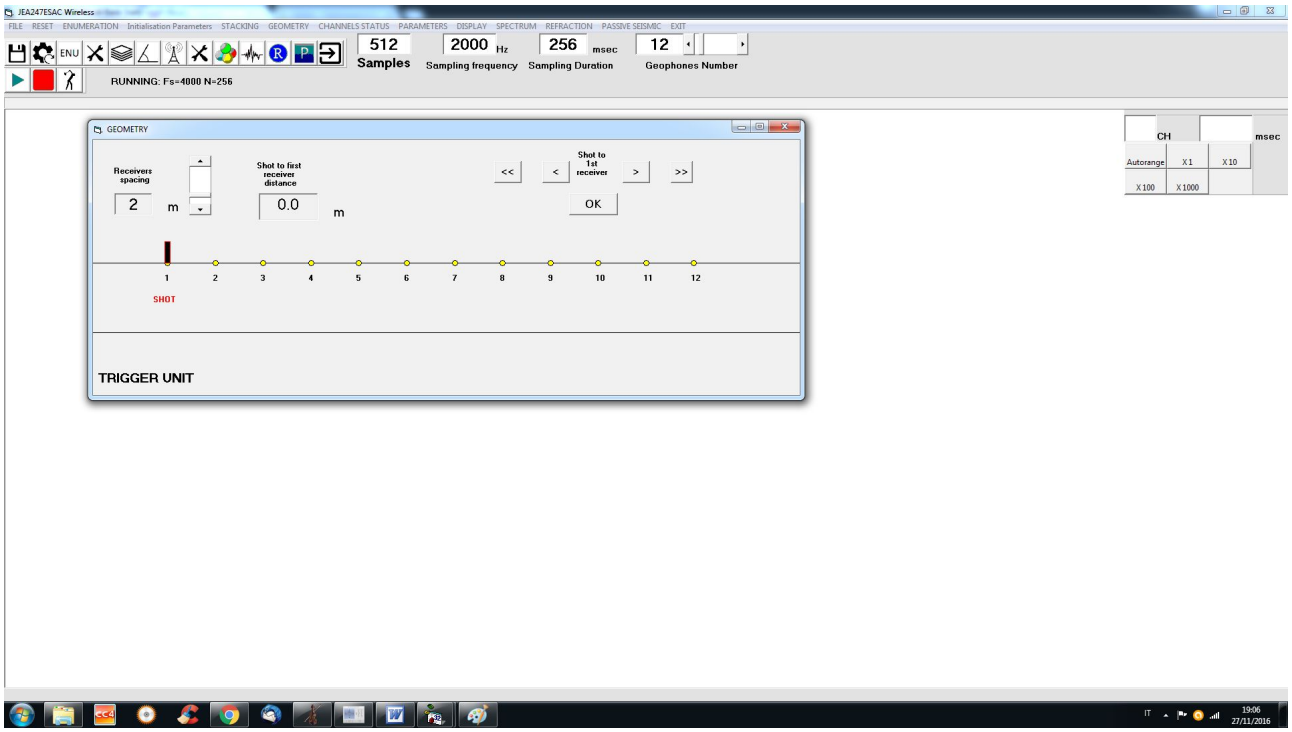
For operation with trigger, sampling frequency must be set equal to:

250Hz, 500Hz, 1000Hz, 2000Hz, 4000Hz, 8000Hz, 16000Hz

In the "Parameters" window, define whether the trigger signal will work in opening (eg. Explosion) or closing (eg. Hammer) of the contact.

For example, for a seismic refraction can be suitable the value of 512 samples and sampling frequency of 2000Hz.

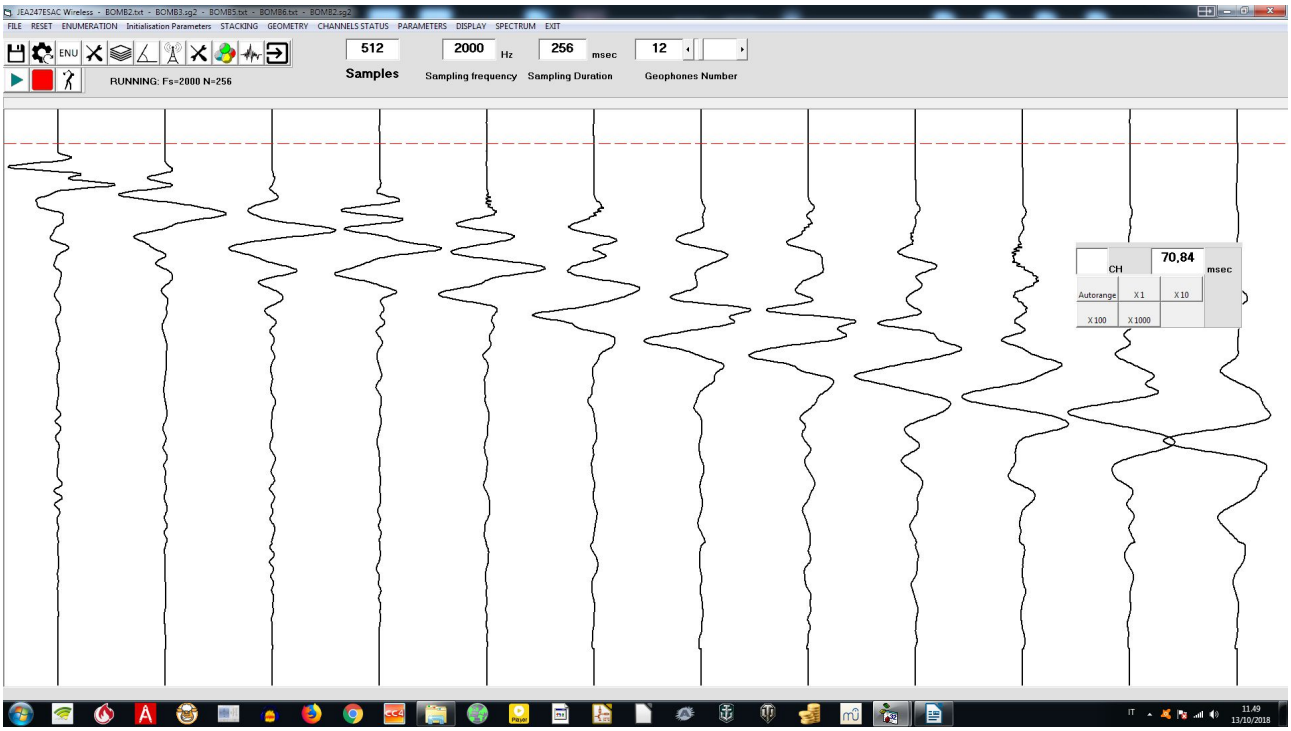
Then you have to set the geometry; top geometry menu will show:



Set the distance between geophones (which in the example is 2 meters) and the position of the trigger shot with respect to the first unit (now close to first unit).
By clicking OK, the geometry disappears and a message "WAITING FOR TRIGGER ..." will begin to flash.
The system is waiting for a trigger event, but if for some reason you want to leave this condition, you just have to click on exit.

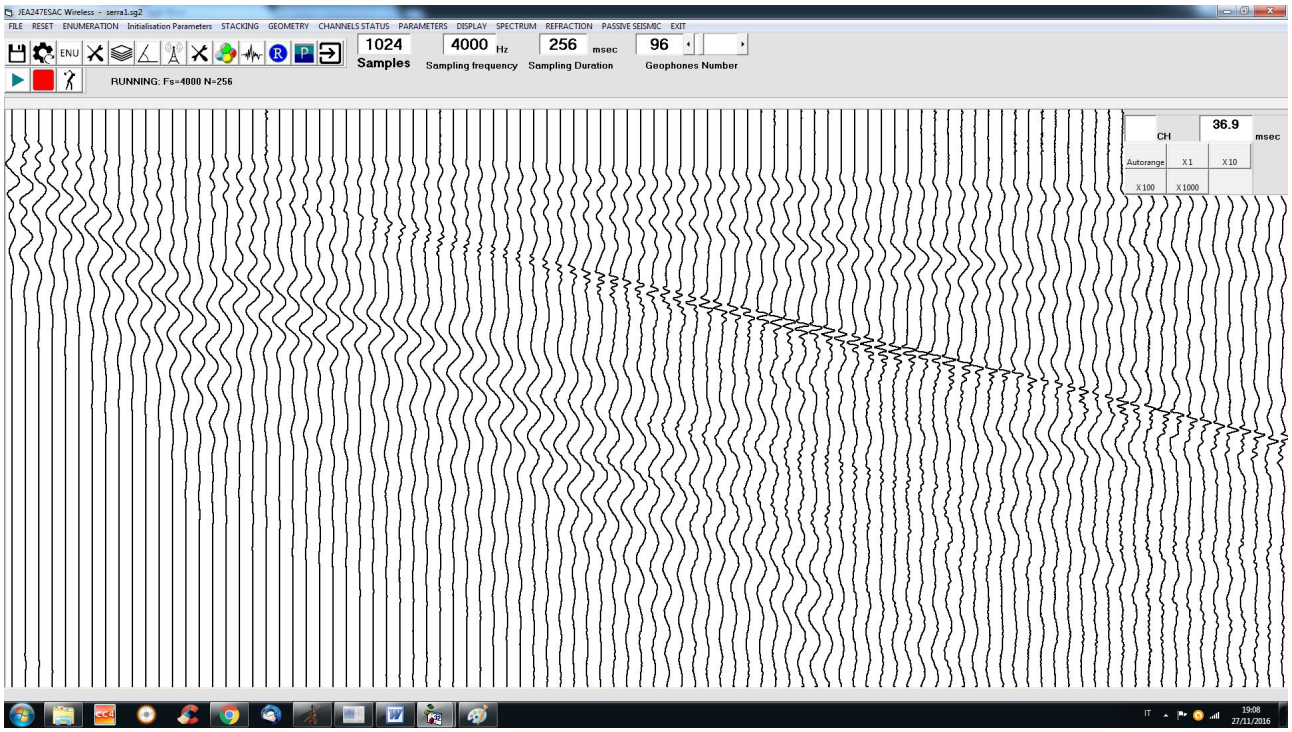
When the trigger acquisition is finished, the application will ask whether to save the acquired data. If you decide to save, two versions of the file will be saved, one with extension Sg2 and the other with extension txt.

Next image shows an acquisition of 12 channels; the red line is the pre trigger. It has been shown for the purpose to better put in evidence the beginning of the waves.

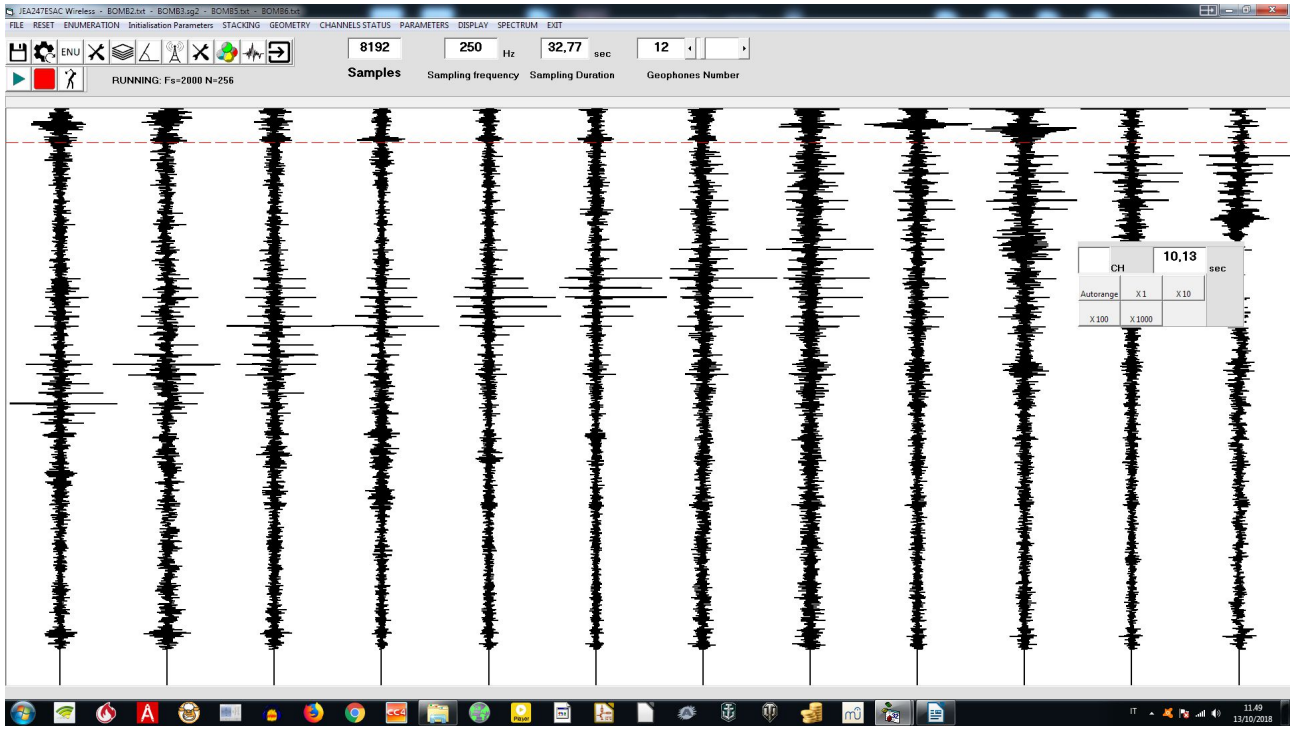


Just after trigger acquisition a window will appear for saving the file; it automatically saves in "data" directory, in JEA WIRELESS directory.
The data saved is what is shown on the diplay.
Moving the mouse over a track and clicking, in the CH box will be displayed its number.
Moving the mouse over a point in a track, in a window will be visible the relative time from trigger instant.

Below is an example of acquisition of 96 channels:



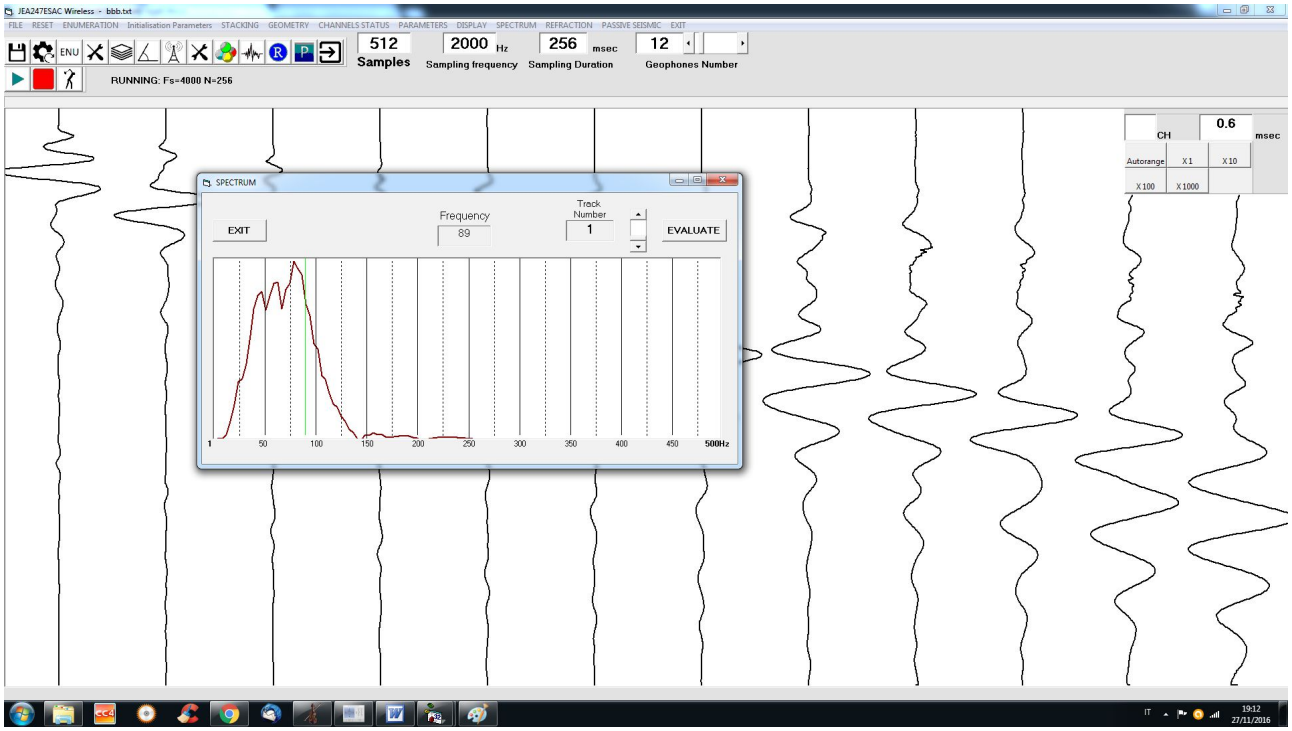
Next image is an example of long acquisition of passive noise; as you can see, recording has lasted for almost 33 sec:



7 Spectrum

In the menu you can select "Spectrum", to carry out the spectral analysis of a track.
In following example has been selected track 1.

Moving the mouse over the graph, we can determine the value of the frequency accurately.

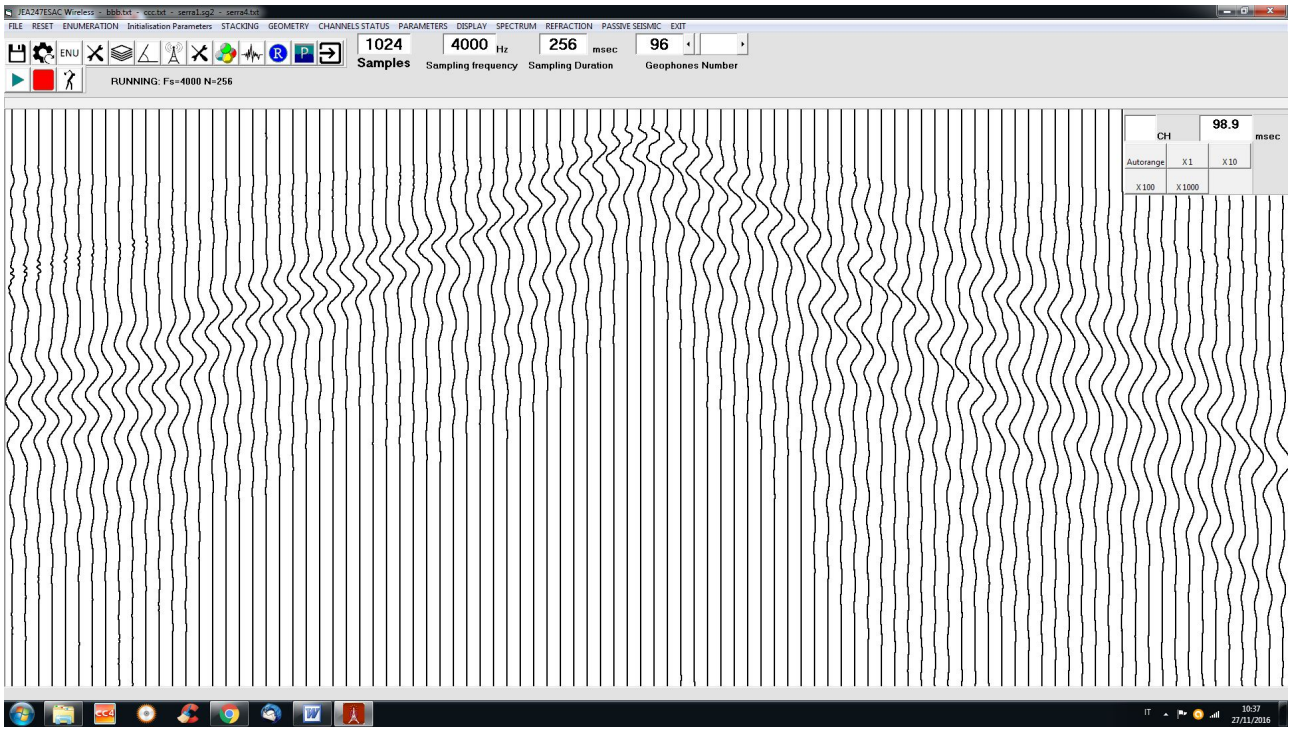


Being 2000Hz the acquisition frequency, the maximum frequency of 1000Hz is displayed in the graph, in accordance with the sampling theorem.

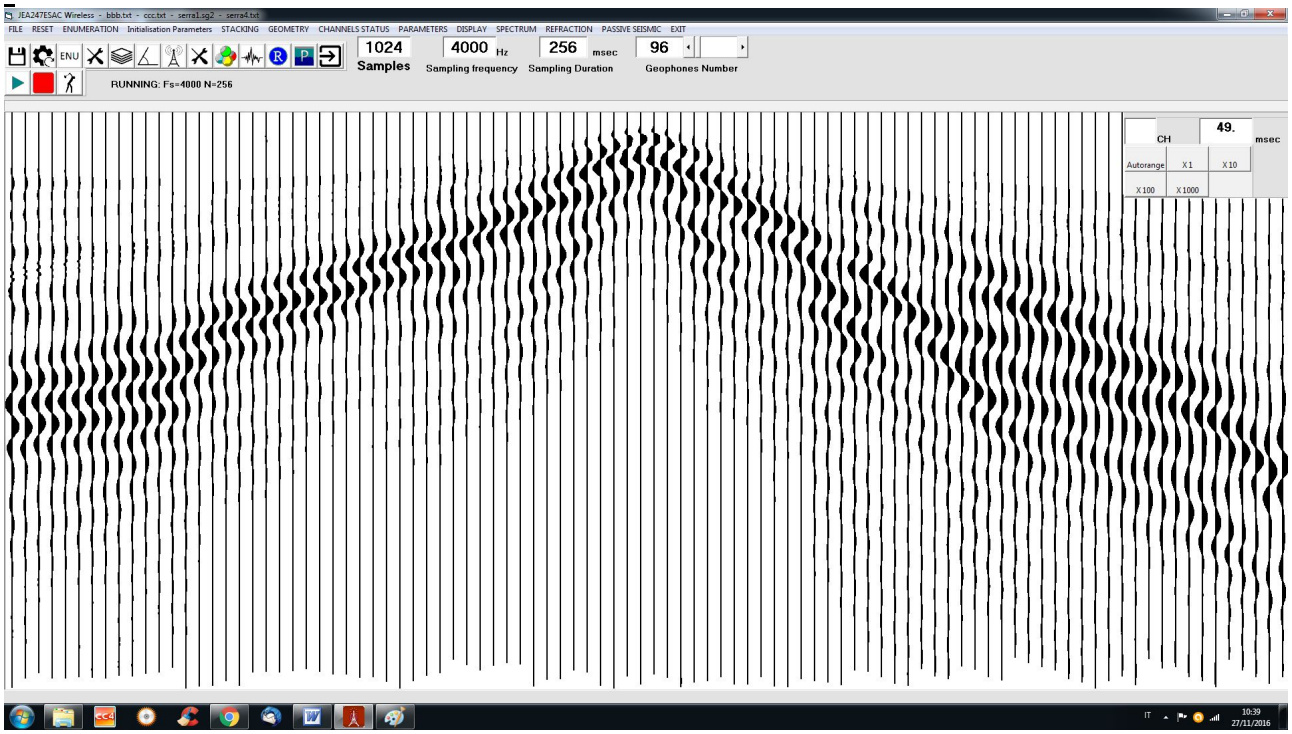
8 Display

This menu is only active in the acquisition triggered.
Going to the menu "Display", you can choose the type of visualization of the acquired traces.
For example, the following shows three different views:

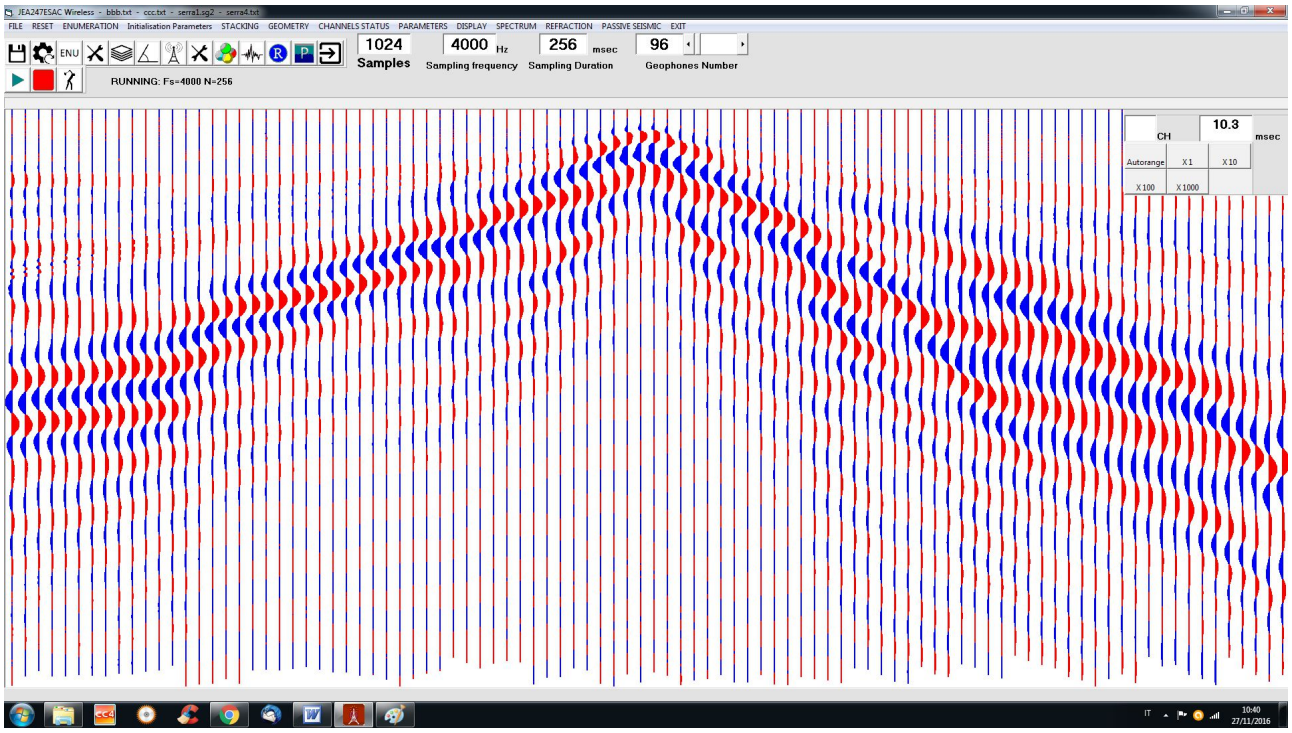
normal:



black:



Blue / Red:



9 "File" menu:

From the "File" menu, you can reload the acquisitions done in the "Trigger" mode.
Go to the folder where you saved the files relating to previous acquisitions and download the file with the extension .txt or .sg2.

All parameters set to the new values; even geometry will be updated to the geometry of the file.

Files xxx.txt and data_trigger.txt

The application creates, for each acquisition with trigger, a file: data_trigger.txt and another: xxx.sgy, and xxx.txt.
The name xxx must be provided by the user.

File: data_trigger.txt is updated every acquisition and located in JEA247E500 directory; it is necessary for internal use.

In running operation is not saved any file.

10 Sampling Rate

To perform a correct acquisition should be thoroughly learned what it means "signal", what is its spectrum, filtering, reconstruction of signal from its samples, sample rate etc ...., otherwise you may set the parameters without understanding why and do not correctly interpret what happens.

The basic parameters of the process of acquisition is the sampling frequency
(Fs, from sampling frequency) and resolution (see below).

The reciprocal value of Fs is the sampling interval (Ts, by sampling time).

In the application, in the Parameters window, it acts directly on Fs (Hz) and as a result, of Ts (milliseconds).

To find out how long is the acquisition process, the formula is as follows:

Acquisition Time = Number of samples / Fs

or

Acquisition Time = Number of samples x Ts

For example, if I want a long acquisition time at a high Fs, I expect a large number of samples.

It is not simple to deal with a large number of samples; for cases where it is required a long period of acquisition, a low Fs is used.

A basic rule of sampling is that Fs must be at least twice the highest frequency contained in the signal to be acquired (Nyquist theorem).

If the rule is broken, the acquired signal contains errors (aliasing).

By the nature of the signals to be acquired, which are coming from a geophone, the spectrum barely reaches a few hundred Hz, starting from a minimum of a few Hz, depending on the geophone used, thus not requiring a high Fs.

So in the case of a geophone that, when triggered, it is expected to provide signals until 300/400Hz, the sampling frequency must be at least twice, or 800Hz.

This consideration is only theoretical, because in reality, to acquire a signal that has any practical value, you must acquire a much higher frequency. Otherwise, the available samples would be too few to easily reconstruct the original signal.

The application JEA247E500 acquires always at Fs = 32000Hz.

The lower sample rates are derived from the actual 32000Hz averaging.
For example the frequency of 4000 Hz is obtained from the average of 8 samples.
This process of "downsampling" carries out an average on the signal that corresponds to a low pass filtering, which is useful to diminish any higher frequencies and noise present.
Nevertheless, to acquire 250Hz, the minimum expected Fs, exposes us to possible aliasing errors in case in the signal was a strong component over the 125Hz.

A hardware filter on this unit provides to eliminate / mitigate frequencies not useful coming from geophone.

In sampling without trigger, even if you can acquire at 250Hz, it is better to opt for the higher frequency of 500Hz, to avoid the danger of aliasing error.

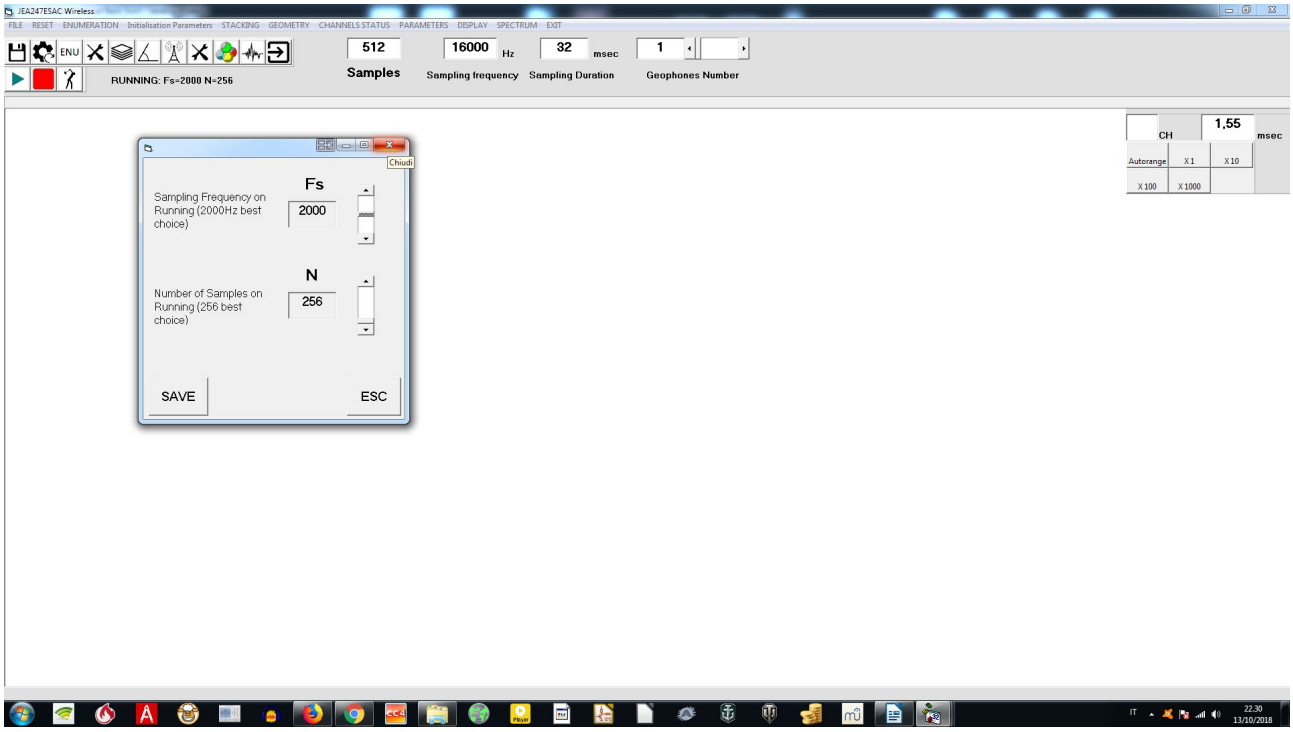
11 Initialisation Parameters

With this menu you have to choose between;

- Running Parameters
- TRG Setup

11.1 Running Parameters

Clicking it will be shown:



You can predispose what will be the sampling frequency and the number of samples, when you hit the command “RUN”.
When changed these parameters, remember to Save them.

11.2 Trigger Setup

This procedure allow you to change the time of triggering!
Do not effect any change if you have not understood your problem and it is not strictly necessary!

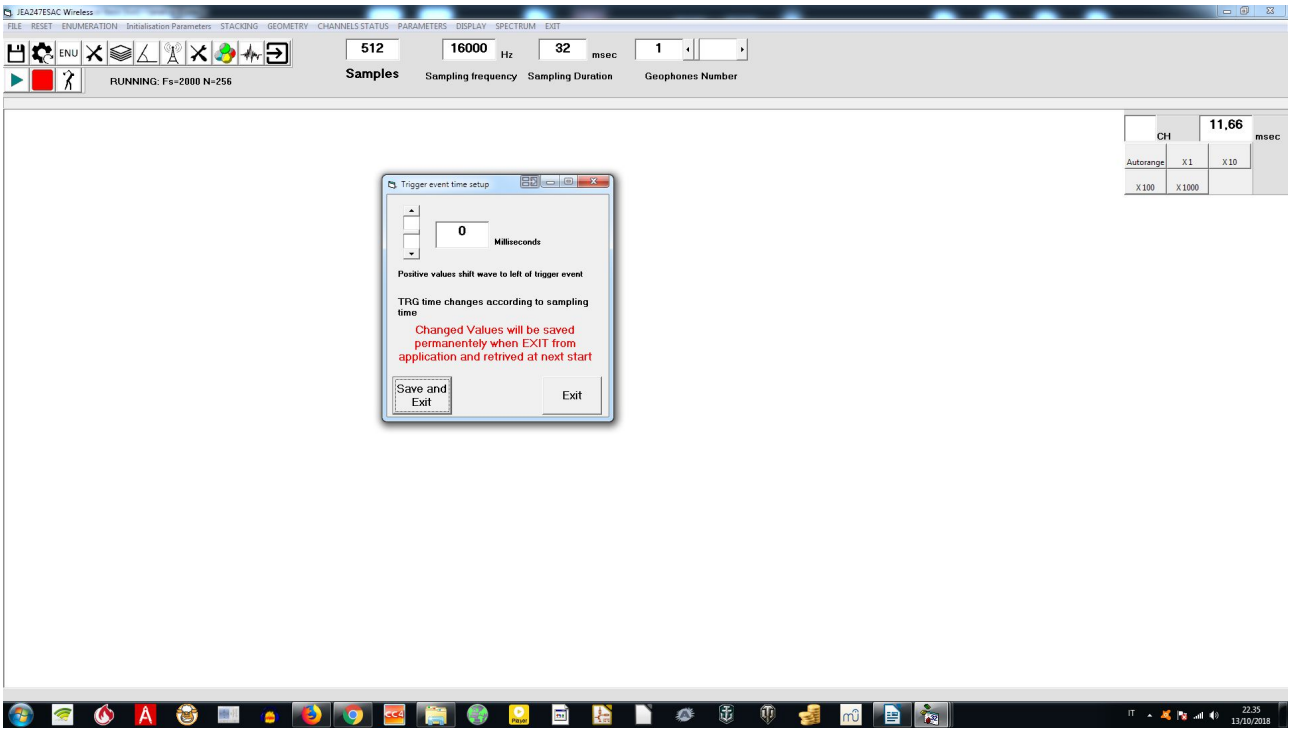
This procedure should not be necessary, but it could be used in very particular cases, for example to verify the correct relation between the trigger event and the zero time line.

Triggering is a mechanical operation that is not fast and clean as an electronic one.
You can expect some randomness of the fraction of millisecond.

If you realy want to execute this procedure, set the sampling frequency you intend to work with, 256 samples and a pre trigger of some sample, to help you to appreciate the beginning of the wave you will acquire.
Set a trigger acquisition and put the triggering plate close to some unit, to expect zero delay from the zero time level, now the pre trigger red line.

Hit the plate and verify the wave of the unit that you have considered for the test.

If its beginning is visibly not coincident with the red line, move the mouse to determine the time the wave is shifted from zero line, then activate the procedure:



Write the time of correction and Save it.

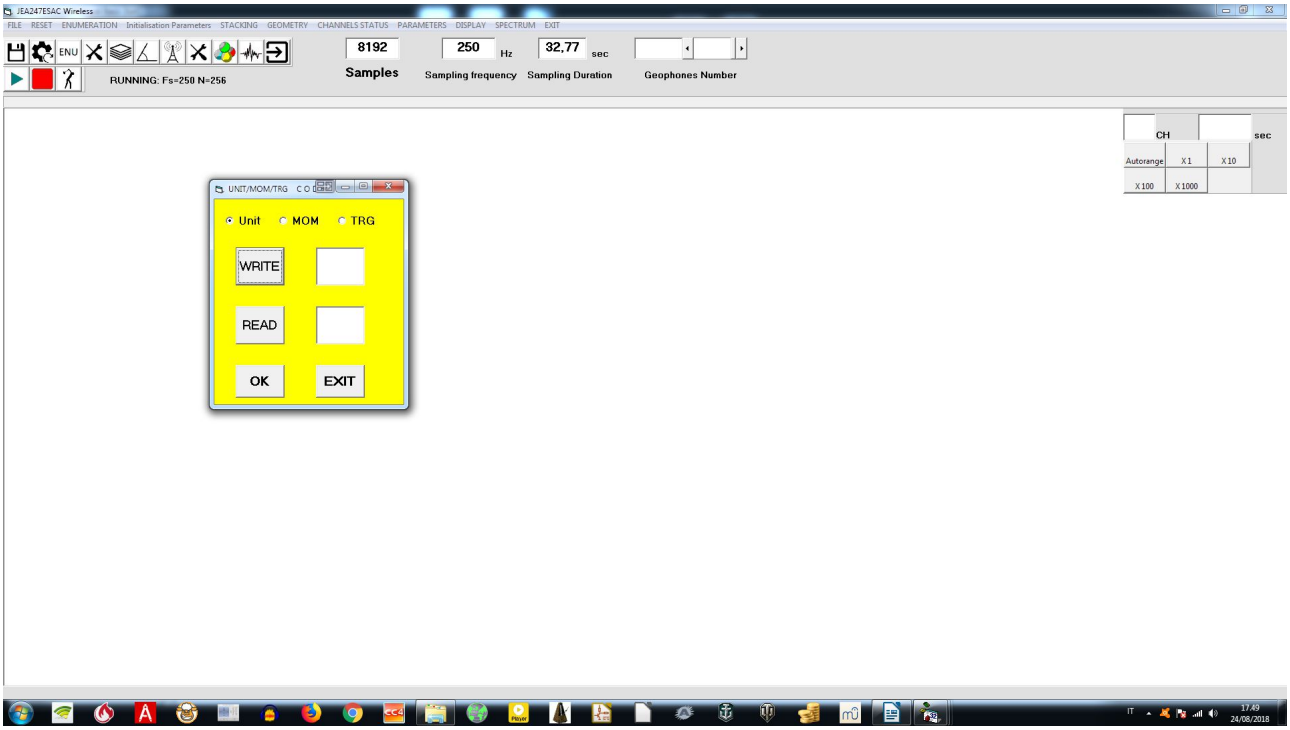
Generate another trigger and verify if you are satisfied. If yes, exit from the application to write in the initialization file the correction.

Remember that this correction is valid only for the frequency you have chosen for the testing.

12 Units Enumeration

Each of these parts has a “number”, to be recognised during radio transmission.
You will receive the W2Z Seismograph with all units enumerated, anyway, if you have to change some number, you have to plug to PC the unit you want to enumerate or verify.
Perform this operation only if you have well understood what you are doing! Inappropriate enumeration can stop your system working properly.

Connect a Unit you want to enumerate and press ENUMERATION, the YES:



Now you have to set the type of Unit you are enumerating, if a Geophone Unit, a MOM, or a trigger Unit. A different colour will signal the Unit set.
If the Unit is a MOM (unit always USB connected to PC during working sessions), a letter will be needed for enumeration.
Press Read to read the number and Write to write and memorize a different number.

Unplug the unit, now the new number will be memorized on Unit.

13 Resolution

The resolution is determined by the number of bits of the AD converter.
The higher the resolution, the more the sampling system can "see" small signals.
W2Z uses a 24-bit converter, so if it is assumed that the geophone can give a maximum signal between 1V and -1V, matching the range of AD converter, the theoretical minimum measurable signal is:
2volt / 2 ^ 24 = 119 nV = 0.119 microvolts = 0.000119 millivolts = 0.000000119 volts
It corresponds to 84 nV of effective value.
Although this measure is theoretical and is incredibly low, the amount of bits of the word produced by the Ad converter gives us another factor to measure the goodness of an acquisition.

An acquisition at 16-bit, at least theoretically, is 256 times worse than at 24-bit.

13 Signal / Noise Ratio

This parameter is very important , as it can measure and tell us when is actually possible to discriminate a signal acquired in the presence of noise.
The problem to recover a signal from the noise is universal and always present in every practical situation .
If you remove the geophone and short-circuit the inputs of the unit , the only input signal is the noise generated internally the equipment, or from electromagnetic interference , and eventually due to the digital conversion process , which gives rise to the quantization noise. The quantization noise decreases with the increase of the number of bits of conversion.
We can see that even with no geophone inserted, a signal (noise) will be always present.

Here we can appreciate the goodness of the hardware and the fact that the geophone is connected directly to the acquisition board, avoiding an analogic dangerous electric path, needed in conventional seismic systems.

Another way of reducing noise is performing averages of data acquired.
This reduces Fs. For example, at 4000Hz there is a quantization noise slightly lower than 8000Hz and even less than 16000Hz.
Four samples al 16000Hz are required to get a sample at 4000Hz.
The real sampling frequency of the Ad converter is higher than that showed in the application software.
This process of noise reduction is called " Noise Shaping " .

The equipment in question provides a value for this ratio , better than 124dB for Fs = 1 kHz or so, which is a very good result .

If the noise was completely not existent, except the quantization noise , with a 24 bits converter we get approximately 144dB of signal/noise, which is a theoretical ideal value , even remotely achievable.
This value is often not very seriously declared on many devices , along with other parameters more or less invented.

14 Battery & Recharging

Before using W2Z for a seismic survey, verify the state of charge of all the units.
You must switch them on and open the software application; than open: CHANNEL STATUS and verify the length of the line under each unit.
If it is less then half its length or it is red, recharge the unit with the USB battery-charger; remember that it needs an AC power to work.
Even if the under line is half its length, you are allowed to work some hours yet.
The time of charge depends on the state of the battery; if completely discharged, consider at lest 8h of charging.

15 Limits of W2Z

W2Z operates with radio transmission in the ISM (industrial, scientific and medical) band.
The frequency span is from 2.4Ghz to 2.525Ghz.
The characteristic of ISM band is that it could be disturbed by other devices that are operating in the range of the W2Z.
This is a situation that must be taken in account and can interfere with the correct function of W2Z.
Anyway, this may happen very rarely.

Other situation in which W2Z can have malfunctions depend on the wrong geometrical disposition of the units.

You must know that W2Z is equipped with directional antennas, so radio transmission is directional; units must be oriented in the correct position, they must face the MOM, otherwise the signal could be too low.

Technical Data of JEA Wireless

> WATER PROOF <

Structure	2.4 GHz multichannel seismic system
Working Range	500m in open field
Max geophonic units number	256
Resolution in Acquisition	24 bit
AD Converter	Successive Approximations with downsampling and averages
Sampling Frequency (Fs)	250Hz, 500Hz, 1000Hz, 2000Hz, 4000Hz, 8000Hz, 16000Hz
Number of samples in trigger mode	128, 256, 512, 1024, 4096, 8192
Trigger	A dedicated radio unit works for triggering; it works in opening or closing contact.
Power	Each unit is equipped with a Li-Ion battery. MOM unit is powered by USB and battery.
Battery Autonomy	More than 14h in continuous acquisition (unrealistic condition) More than 24h in stand by.
Recharging	Common wall adaptor with USB port. At least 8 hours for completely discharged battery
Battery Control	Charge state visible on software. Hardware equipped to prevent battery damage.
Bandwidth	Up to 800Hz, 2 poles low pass filter
Input impedance	47k ohm
Nyquist frequency	8000Hz at every Fs
Signal/RSM noise ratio	>124dB at Fs=1000Hz, geophonic input shorted
Software	Application for Windows XP, 7, 8 and 10 allows easy setting of all acquisition parameters and produces a seg2 file for further analysis
Geophones	Each Unit (corresponding to a channel) can be connected to a geophone with desired specifications