

# ***FastTracer***

**PORTABLE VIBRATION ANALYSIS SOLUTION**



**Use and installation manual**

**Vibration monitoring expert solutions**

**Printed in February 2010**

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For further information and assistance, please visit our product section at [www.sequoia.it](http://www.sequoia.it) or e-mail us to [info@sequoia.it](mailto:info@sequoia.it)

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immunity: EN 61000-6-2 (2001).



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## TABLE OF CONTENTS

### 1 Introduction

1.2 Foreword	7
1.2.1 Prerequisites	7
1.2.2 Structure of the manual	7
1.3 Definitions	8
1.3.1 Technical specifications	8
1.3.2 Measurement with <i>FastTracer</i>	9
1.3.3 Diagnostics and machine or structure characterization	9
1.4 Philosophy of use	10

### 2 Installation

2.1 Preparation for use	11
2.2 System requirements	11
2.3 FTAnalyzer installation	11
2.4 Esplora 3D installation	12
2.4.1 Sensor positioning and fastening	12
2.5 Frequently Asked Questions (FAQ)	13

### 3 FTAnalyzer

3.1 Introduction	14
3.2 Philosophy of use	14
3.3 Start	16
3.4 Interface	16
3.4.1 Graphics area	17
3.4.2 Devices list	18
3.4.3 Menu	19
3.4.4 Global settings	19
3.4.5. Toolbar	20
3.5. New view	22
3.5.1 Time: time domain measurement	23
3.5.1.1 Time: display options	24
3.5.1.1.1 Time: selection of displayed values	25
3.5.1.1.2 Time: filters	25
3.5.2 Frequency: frequency domain measurement	25
3.5.3 Frequency: display options	26
3.5.3.1 Frequency: selection of displayed values	27
3.5.3.2 Frequency - scale changes: dB, linear	27
3.5.4 Triggered: event synchronized measures	28
3.6 File device	29
3.6.1 Measure recording	29
3.6.2 File device creation (virtual device)	30
3.7 Export to text file: measure export	32
3.8 Export to spreadsheet: measure export to MS – Excel files	34
3.8.1 Note on MS – Excel configuration	35
3.9 Perspective save and load	36

### 4 FTEditor

4.1 Philosophy of use	38
4.2 Start	39

4.3 Create new model	40
4.4 Add test	40
4.5 Add measure	41
4.6 Export database to file	43
<b>5 Esplora 3D</b>	
5.1 Philosophy of use	44
Model instance	45
Model DB	45
5.2 Start	45
5.2.1 Import model DB	46
5.3 Test model instance: model – machine selection	46
5.3.1 Create model instance: instance creation	47
5.3.2 Test selected instance: diagnostics	48
5.4 Browse model instance: see reports	49
5.5 Menu	50

# Introduction

# 1

## 1.2 Foreword

Thank you for choosing *FastTracer*.

*FastTracer* is a simple and reliable system which transforms a normal PC into a tool for vibration-based diagnostics of machines or structures. *FastTracer* is an innovative and highly flexible instrument that can also be used for experimental research on vibrations or for training purposes.

*FastTracer* is manufactured by SEQUOIA IT, a leading company in the development of expert vibration monitoring solutions.

This manual provides an introduction to the use of the *FastTracer* system and the related software in the various conditions of employment. It describes the different types of measurements which can be carried out and the various software characteristics, to help you use this flexible system to its full potential.

### 1.2.1 Prerequisites

The information in this manual is intended for readers with a basic IT knowledge and good knowledge of vibration analysis. Therefore, these aspects are not dealt with in detail, except in certain cases and when necessary in order to make the description more clear.

### 1.2.2 Structure of the manual

The manual consists of five chapters and covers all aspects of the use of the *FastTracer* system. The first chapter sets out the technical specifications of the *FastTracer* and its philosophy of use. The second chapter explains how to install the software and the minimum requirements for effective use of the solution. The third chapter provides an introduction to the *FTAnalyzer* and describes its philosophy of use and advanced features. The fourth chapter presents the *FTEditor* module of the *FTAnalyzer* software. The last chapter describes the features of the *Esplora 3D* software.

### 1.3 Definitions

Before explaining how to use the FastTracer, some aspects should be dealt with, such as the FastTracer technical specifications, the type of measurements which can be carried out and what information can be obtained from these data.

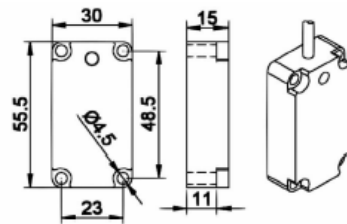
#### 1.3.1 Technical specifications

The FastTracer solution consists of an acquisition device (also called sensor or measurement device) and a software for data display and processing. The measurement device is fitted inside with an innovative MEMS triaxial capacitive accelerometer interfaced with a microprocessor processing and transmitting the digital signal to the PC through the USB 2.0 or via WiFi (opt.). The digital transmission of measurements ensures the data resistance to electro-magnetic disturbances while the MEMS technology provides the sensor with a self-diagnosis capacity thus minimizing the need for routine calibration. The software developed by Sequoia IT and provided with FastTracer are FTAnalyzer and Esplora 3D. These two types of software and their application for diagnostics and measurement are fully described in the pages below. The system is equipped with a complete solution which does not require any other software or hardware, offering an excellent acquisition device shock resistance up to 10,000g, the possibility of updating the firmware via software, reduced costs and IP67 protection level.

TECHNICAL SPECIFICATIONS	
Maximum acceleration:	+/- 5 g optional: 2g, 18g
Frequency band:	0 – 2500 Hz
Resolution:	0.0025 m/s <sup>2</sup>
Noise:	0.075 m/s <sup>2</sup>
Dimensions:	30 x 55 x15 mm
Weight:	55 g
Cable length:	3 -30 m
Communication:	USB 2.0 – Wi Fi (Optional)
Protection rating:	IP67
Shock resistance:	10,000 g
Temperature range:	0° C..+70°C
Conformity:	CEI UNI – EN 61000-6-2/4
Software:	FastTracer suite Software



axis orientation



FastTracer dimensions



### 1.3.2 Measurement with FastTracer

The FastTracer measurement device carries out a time-trend analysis of x-y-z acceleration components detected in the sensor application point of the sensor. The x-y-z reference tern is the one indicated on the sensor casing and shall be used to determine the direction of the measured accelerations.



*Acquisition device or sensor*

The device can acquire accelerations with maximum module corresponding to the full scale of your FastTracer ( $\pm 18g$ ,  $\pm 5g$ ,  $\pm 2g$ ) and frequency between 0 Hz and 2500 Hz. The FastTracer acquisition sample rate is 18113.21 sample/s, i.e. 18113.21 acceleration measurements are performed in the sensor positioning point in one second.

The signals acquired are digitally converted by a dedicated processor and digitally transmitted to the Sequoia IT software installed on your computer (FTAnalyzer, Esplora 3D). Through mathematical calculations, the software will provide all direct and indirect measurements needed for diagnostics or experimental research.

### 1.3.3 Diagnostics and machine or structure characterization

With FastTracer you can analyse the machine vibrational signature to characterize structures or monitoring of conditions.

#### ***Machine monitoring***

With FastTracer you can carry out diagnostics for predictive maintenance according to two levels:

#### **1. 1<sup>st</sup> level diagnosis: condition monitoring**

The repeated measurement of the machine vibration acceleration RMS level in the measurement point will identify the machine current operating condition and its progress in time.

#### **2. 2<sup>nd</sup> level diagnosis: cause inquiry**

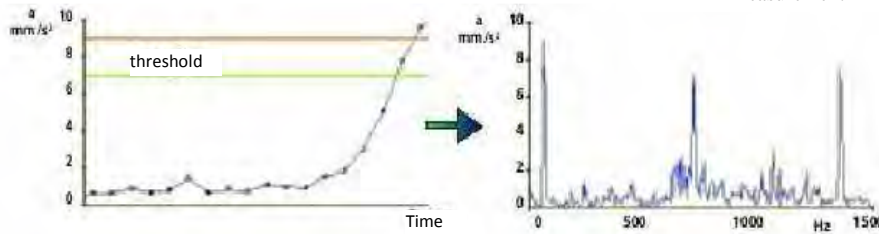
This level of inquiry is based on the FFT analysis of the acquired data and makes it possible to identify the problem according to the spectrum shape. This type of diagnosis is useful to identify faults such as rotor unbalancing, joint misalignment, damaged gears, etc.

### 1<sup>st</sup> Level: Monitoring

- Overall machine
- Long-term

### 2<sup>nd</sup> Level: Diagnosis

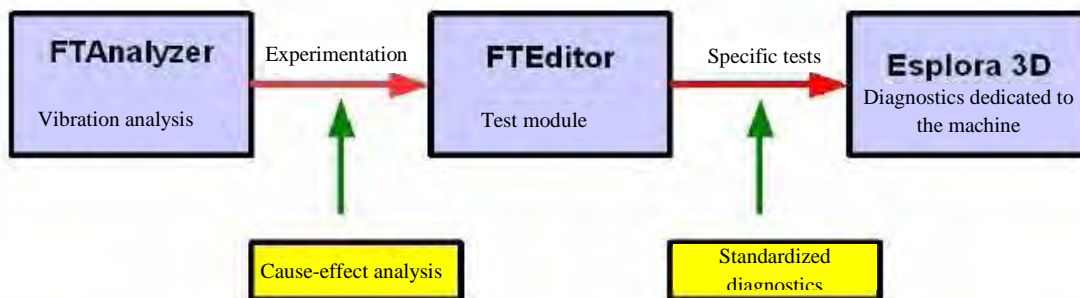
- Component diagnosis
- Occasional measurement



*Diagnosis levels*

## 1.4 Philosophy of use

As above mentioned, the software provided with FastTracer are FTAnalyzer and Esplora 3D. With the first, used to display and process measurement data, the user can analyse kinematic values such as displacement, speed and acceleration in order to identify possible faults and establish their effects. For example, to plan maintenance strategies for certain machine families, it is possible to monitor a testing machine showing signs of a forthcoming fault and determine its effect on the machine vibrational signature. After detecting the cause-effect relation, you can use the FTEditor module of the FTAnalyzer to develop a test model dedicated to the concerned machine family. As explained in chapter 5, this model can be used by less skilled users who, following the instructions provided by the Esplora 3D software, will be led in the fault diagnosis function. The use of the FastTracer for predictive maintenance reduces the number of inspections on the idle machine and the number of stops due to unexpected faults, thus maximizing the maintenance efficiency and effectiveness. Maintenance is simplified if you know in advance that a breakage or downtime is approaching, as you can plan several aspects, such as personnel, spare parts and tools to be used, thus saving costs and time.



*How to use the software provided with FastTracer*

# Installation

# 2

## 2.1 Preparation for use

To use the FastTracer simply position the sensor correctly and start up FTAnalyzer or Esplora 3D. This chapter describes the various aspects concerning the software installation and the correct sensor positioning and fastening.

## 2.2 System requirements

FastTracer works on normal desktop or laptop computers with Windows 2000, XP, Vista and Windows 7 and requires the following hardware:

	Minimum	Standard	Suggested
Processor	X86 – 500 MHz	X86 – 900 MHz	X86 – 1.6 MHz
RAM	128 MB	512 MB	1 GB
Hard Disk available space	20 MB	1 GB	5 GB
Video	SVGA	SVGA	SVGA
Ports	USB 2.0	USB 2.0	USB 2.0
Other	Mouse – CD Rom	Mouse – CD Rom	Mouse – CD Rom
Microsoft Office compatibility	Office 2000 or sub.	Office 2000 or sub.	Office 2000 or sub.

*System requirements*

## 2.3 FTAnalyzer installation

Before installation, all programs in execution on the computer should be shut down. **It is recommended not to connect the measurement device until the software installation procedure is complete.**



*Setup FTAnalyzer*

Proceed as follows for installation:

1. insert the CD-Rom provided with *FastTracer* into the CD player
2. find on the desktop the “computer resources” icon and double-click it or click start and then “computer resources”
3. find the CD-Rom player and double-click the icon
4. click the **FTAnalyzer\_setup** icon
5. follow the instructions on the screen and proceed with the software installation.

After installing FTAnalyzer, at least one of the *FastTracer* measurement devices must be connected to the computer to operate drivers and licence. Please notice that if the device is not connected it is not possible to start the software for the first time and to perform off-line operations.

## 2.4 Esplora 3D installation

Before installation, all programs in execution on the computer should be shut down. **It is recommended not to connect the measurement device until the software installation procedure is complete.** Proceed as follows for installation:

1. insert the CD-Rom provided with *FastTracer* into the CD player
2. find on the desktop the “computer resources” icon and double-click it or click start and then “computer resources”
3. find the CD-Rom player and double-click the icon
4. click the **Esplora 3D\_setup.exe** icon
5. follow the instructions on the screen and proceed with the software installation.



After installing Esplora 3D, at least one of the *FastTracer* measurement devices must be connected to the computer to operate drivers and licence. Please notice that if the device is not connected it is not possible to start the software for the first time and to perform off-line operations.

### 2.4.1 Sensor positioning and fastening

For the *FastTracer* correct use, the user shall position and fasten the acquisition sensor in the right way. The wrong positioning and loose fastening can lead to incorrect or misleading measurements.

Correct positioning requires the sensor to be set very close to the vibration sources to enable detection and the measurement point shall be chosen according to the type of analysed vibration. Sections [1] and [2] provide indications on the sensor positioning for machine monitoring.

Before measurement the user shall make sure the sensor is well secured, otherwise measures might be altered by vibrations. The acquisition device is equipped with magnetic adapters, an excellent solution for the sensor fastening; you can also consider using cyanoacrylate glues (e.g. Loctite). Tight fastening is extremely important, therefore the best solution is to fix the sensor by means of coach screws.

## **2.5 Frequently Asked Questions (FAQ)**

### **Q. The software does not see the connected device.**

*A. Open the Device List and click the Refresh Device List key.*

### **Q. The software does not start correctly.**

*A. Try to connect a FastTracer acquisition device; if the problem persists, reinstall the software following the procedure explained in paragraph 2.3.*

### **Q. How many FastTracer devices can be used at the same time?**

*A. The maximum number of FastTracer devices which can be used at the same time is not limited and depends exclusively on the computer hardware.*

### **Q. How can I receive technical assistance?**

*A. For Sequoia IT technical assistance e-mail to [info@sequoia.it](mailto:info@sequoia.it)*

### **Q. Can I copy or use different copies of Sequoia IT software and documentation on my company's computers?**

*A. The software and the documentation can be used and copied freely on every computer held by the FastTracer system purchaser.*

## 3.1 Introduction

FTAnalyzer is a software which transforms a normal computer into an instrument for the display, storage and processing of the measures obtained through *FastTracer* devices.

Be aware of the following features before the software presentation:

- *FastTracer* acquisition devices measure acceleration in the device application point according to the  $x,y,z$  tern indicated on the sensor casing; this tern will be used as reference for directions and points of measurement;
- The fixed sensor acquisition sample rate is 18113.21 *sample/s*;
- The device can acquire accelerations with maximum module corresponding to the full scale of your *FastTracer* ( $\pm 18g, \pm 5g, \pm 2g$ ) and frequency between 0 Hz and 2500 Hz.

For the best use of *FastTracer* devices, carefully read the pages below as they provide a description of FTAnalyzer functions.

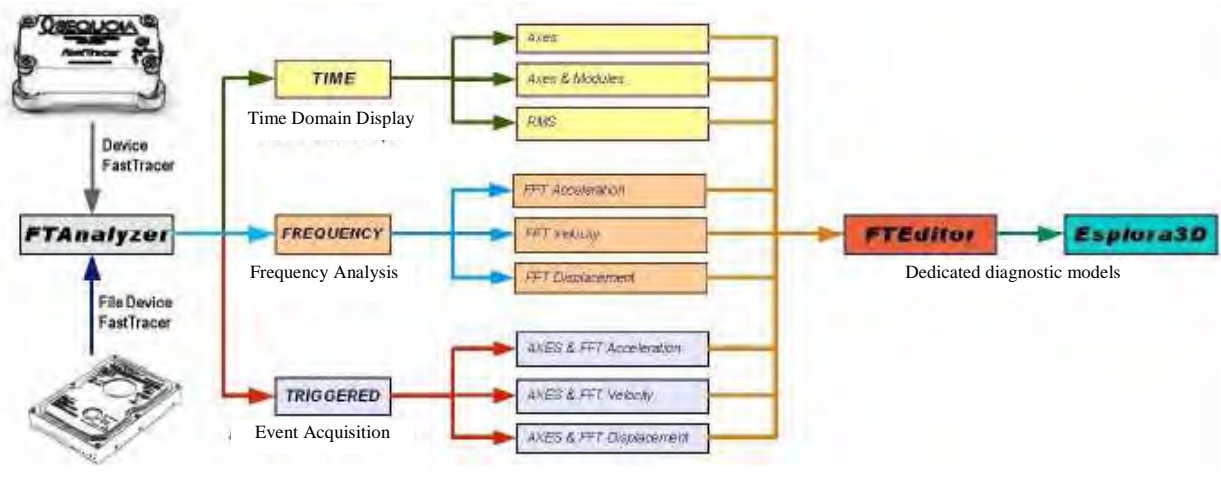
## 3.2 Philosophy of use

FTAnalyzer processes and displays the values acquired in real time or off-line by one or more measurement devices. The maximum number of *FastTracer* devices which can be used at the same time is not limited and depends exclusively on the computer hardware. FTAnalyzer can:

- process or display values measured at different times (off-line) and save them to file;
- save measures to file during acquisition;
- export measures to other numerical software;
- export data to a Microsoft Excel or text document;
- filter measures through high/low pass filters;
- compare measures taken at different times.

The last function is particularly useful for condition monitoring: comparing measures taken on the same machine at different times can help define the machine operating condition. Of course, the analysed event must be the same and measurements shall be taken by positioning the sensor in the same point at all times. This way it is possible to provide a time-trend analysis of the machine general conditions and determine its operating state. Sections [1] and [2] provide indications on the events to be analysed and the sensor positioning for the machine condition monitoring.

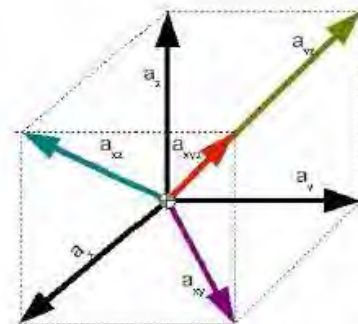
As already said, FTAnalyzer can also process filed measures recorded before processing. The data files are viewed by FTAnalyzer as virtual devices called *File Devices*.



*FTAnalyzer: measurements and diagnostics*

FTAnalyzer enables to analyse the acquisition device measures in time domain, frequency domain or both. In time domain you can view the acceleration components in the measurement point or indirect measures resulting from processing, such as Rms values or  $xy$ ,  $xz$ ,  $yz$  and  $xyz$  modules.

In the frequency domain you can view the acceleration, speed or displacement component spectrum in the sensor application point through the FFT analysis. The *Triggered* display mode is particularly useful in this respect as it makes it possible to synchronize data acquisition with vibrational events whose characteristics have been specified by the user for an established time. FTAnalyzer functions enable skilled users to study vibrational phenomena, to understand cause-fault relations (forthcoming fault, part slackening, etc.) and the resulting effect on the machine vibrational signature or other parameters (e.g. high Rms values, abnormal widths, etc.).



*FTAnalyzer: x-y-z acceleration components; flat projections*

After detecting the cause-effect relation, the FTEditor of FTAnalyzer can be used to work out a test model dedicated to the analysed machine. Less skilled users can apply this model through the Esplora 3D software and follow the instructions (set out by the skilled user in the FTEditor model) to carry out the fault diagnosis operation. See chapters 4 and 5 for the use of FTEditor and Esplora 3D.

### 3.3 Start

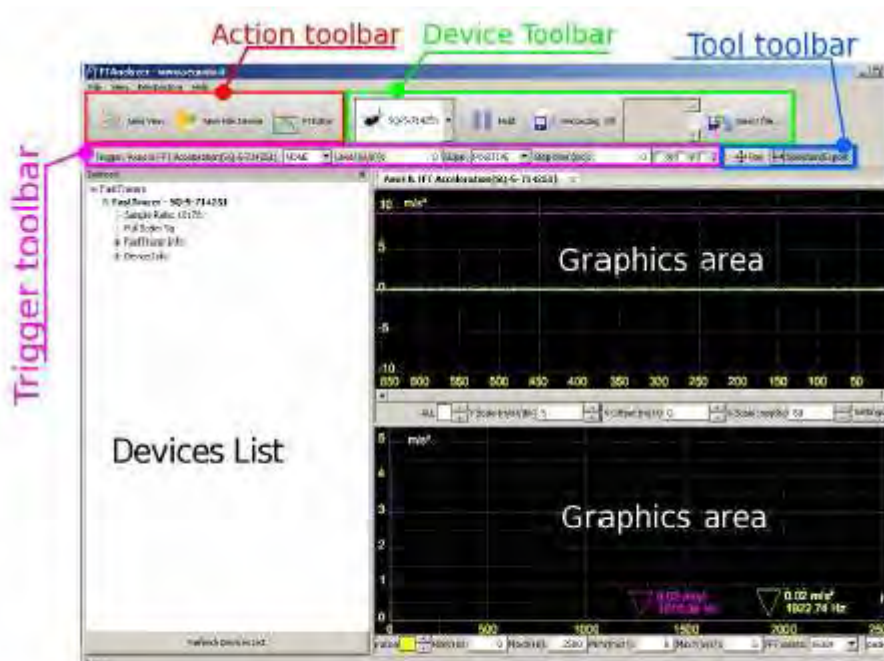
To start FTAnalyzer, find the Windows start button and click as follows:

*Start>Programs>SequoiaIT>FTAnalyzer>FTAnalyzer 1.2.z.t*

Should the program not start or any error messages be displayed, follow the suggestions provided in paragraphs 2.3 and 2.5 of the present manual.

### 3.4 Interface

The FTAnalyzer interface is similar to that of many modern programs and consists (see figure below) of an action toolbar, a device toolbar and different tool toolbars (highlighted), a Devices List (highlighted) and various *Graphics areas* (highlighted). This paragraph will present the above mentioned FTAnalyzer interface components.



*FTAnalyzer: Interface*



### 3.4.1 Graphics area

FTAnalyzer uses special graphic view called *Graphics area* to display measures. These views are mainly of two types and have different functions.

#### Graphics area for time domain analysis (oscilloscope)

This view can be used as an oscilloscope screen which displays the time trend of the analysed measures.

#### Graphics area for frequency domain analysis (spectrum analyzer)

This view can be used as a spectrum analyzer screen which displays the Fast Fourier Transform (FFT) of acquired measures. In these views, the FTAnalyzer applies the Fast Fourier Transform to the acquisition signal and displays its frequency spectrum.



*FTAnalyzer: different Graphics areas displayed in the active view*

The FTAnalyzer can display different *Graphics areas* in the same screen view at the same time. Proceed as follows to drag a *Graphics area* into the screen view:

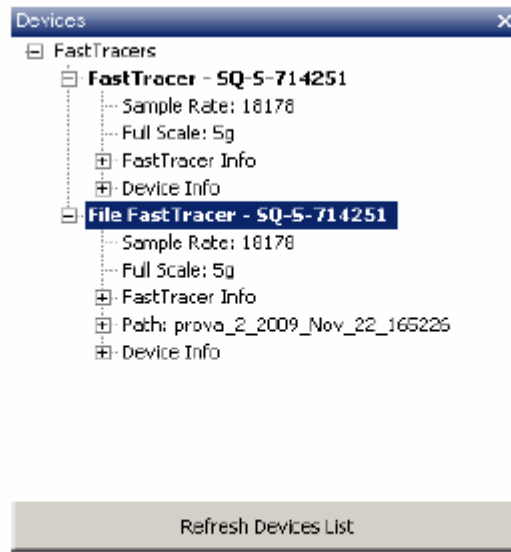
- click the title label with the left mouse button and keep it pressed;
- drag the pointer to the external border centre of the area where you wish to position the *Graphics area*. Please notice that the colour of the view part including the *Graphics area* is blue;
- release the left mouse button.

### 3.4.2. Devices list

The *Devices* view provides information on connected devices or open *File Devices*.

The *File Devices* are virtual devices reproducing the data stored in a file, while the *Devices* are the *FastTracer* measurement devices connected to the computer.

Obviously, the *File Devices* reproduce the measures which have already been taken (Off-line), but actually work as connected devices.



*FTAnalyzer: Devices List*

In the *Devices List* all the *FastTracer* connected acquisition devices are displayed with the following acronym:

**FastTracer -SQ-S-xxxxxx**

while device files are indicated with the acronym:

**File FastTracer -SQ-S-xxxxxx.**

The **Refresh Device List** key, located at the bottom of the *Devices List*, is used to refresh the list of connected devices and to check their state.

If you right click on the *Devices List*, a pop-up menu will be displayed to create *File Devices* or refresh the connected device list.

### 3.4.3 Menu

The menu toolbar (FTAnalyzer) consists of four pop-up menus which allow the user to carry out different actions. The table below shows the different menus with a general description.

File	
Exit	To exit the program
View	
New View...	To carry out measurements (see paragraph 3.5)
New File Device...	To load a file as file device
Show Device	To display the device list
Show global settings	To display FTAnalyzer settings
Device Toolbar	
Action Toolbar	To display the toolbar
Tool Toolbar	
Trigger Toolbar	
Fullscreen	Full-screen application
FTEditor	To start FTEditor
Default Toolbar	To restore toolbar default conditions
File device xxx	To display the <i>Graphics area</i> for the data overview
Perspective	
Load Perspective	To recall the stored view configuration
Save Perspective	To save the view configuration
Help	
About	Information about FTAnalyzer



### 3.4.4 Global settings

To display settings (FTAnalyzer), proceed through the menu as follows:

**View>Global Settings**

in this view you can change different FTAnalyzer parameters.






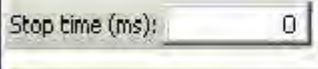


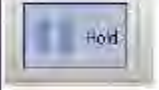
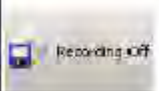




FTAnalyzer: Default Settings



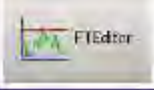
	Concept expressed by the parameter	Default(opz)
<b>Oscilloscope X Scale</b>	To set diagram X axis scale in current units	100
<b>Oscilloscope Y Offset</b>	To move displayed signals in Y direction of the set quantity	0
<b>Oscilloscope Y Scale</b>	To set diagram Y axis scale in current units	5
<b>Spectrum Y Scale Type</b>	To set the type of diagram Y axis scale in the frequency domain	Linear (dB)
<b>Spectrum Minimum Hz</b>	To set the minimum value of the diagram X axis scale in the frequency domain	0
<b>Spectrum Maximum Hz</b>	To set the maximum value of the diagram X axis scale in the frequency domain	2500
<b>Spectrum Minimum Magnitude</b>	To set the minimum value of the diagram Y axis scale in the frequency domain	0
<b>Spectrum Maximum Magnitude</b>	To set the maximum value of the diagram Y axis scale in the frequency domain	5
<b>Spectrum Horizontal Axis Unit</b>	To set the unit of measurement of the diagram X axis in the frequency domain	Hz (rpm)
<b>DeciBell Reference Level m/s<sup>2</sup></b>	Reference value for calculation of decibels in case of type dB scale display on Y axis	0
<b>Last Spectrum Weight</b>	Displayed spectrum weighted average	1
<b>FFT Spectrum Sample</b>	X axis resolution in the frequency domain	16384
<b>FFT Peak Mode</b>	Display of analysed event parameter	Peak (pk-pk ; rms)
<b>FFT Low Frequencies Row Zeroed</b>	Number of lines set to zero starting from 0 Hz. (This parameter is applied only to velocity or displacement spectra)	25

It is also possible to set the grid colour (foreground) and the diagram background colour (background) by pressing the two *choose..* keys.

### 3.4.5 Toolbar

The FTAnalyzer has different toolbars to quickly recall functions by means of icon keys. For the correct use of FTAnalyzer, users are recommended to know the meaning of the different icons and their functions. The table below provides a list of the different toolbars, icons and related functions.

Trigger Toolbar	
	<p>SINGLE to enable the trigger function.            NONE to disable the trigger function</p>
	To set the trigger value
	<p>POSITIVE the acquisition starts when the signal goes up through the trigger value.            NEGATIVE the acquisition starts when the signal goes down through the trigger value</p>
	Stop time after trigger in ms
	<p>Axis where the trigger function shall be enabled.            Conditions are based on the <b>OR</b> logic</p>
Device Toolbar	
	To display the device sending data to the viewed graphics area
	When active, the data acquisition is blocked
	<p>To start/turn off the data recording on file.            For further information on the icon functions, see the section on <i>File Devices</i></p>
	To display files and the related information storage path
	To set the file name where the data will be stored if recording has started
Tool Toolbar	
	To move display in the active graphics area
	To identify a diagram area to export to spreadsheet, save to file image or print
Action Toolbar	

	To create a new graphics area to display the data acquired from a connected device or a file with stored data
	To create a virtual acquisition device starting from a file on disk
	To start FTEditor for compiling the models to be used with Esplora 3D



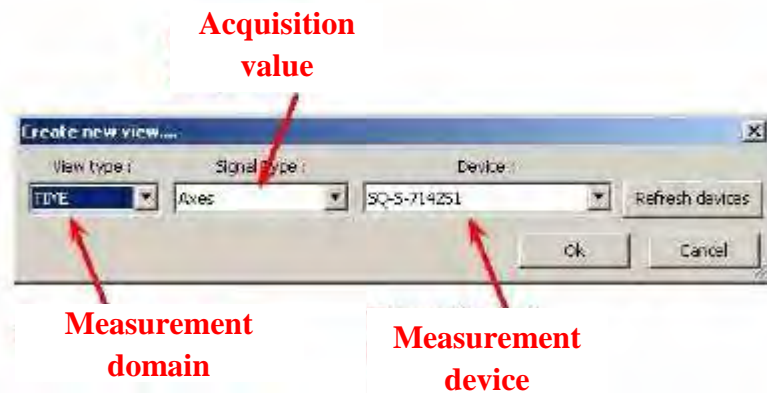
*FTAnalyzer: Start of a new acquisition*

### 3.5. New view

To carry out measurement the *New View* function needs to be recalled. This function can be recalled through the *New View* key of the **Action Toolbar**. You can access the *New View* function also through the Menu Toolbar as follows:

**View>New View...**

After accessing the *New View* function, FTAnalyzer will ask the user to select the measurement domain, the value to be acquired and the acquisition device to be used.



*FTAnalyzer: selection of measurement domain and acquisition values*

Measures can be displayed in the time domain, frequency domain or both with or without starting the vibrational event synchronized acquisition.

### 3.5.1 Time: time domain measurement

To carry out measurements in the time domain, select **TIME** in the *View Type* combo box. Measurements will be displayed in the oscilloscope *Graphics area*.

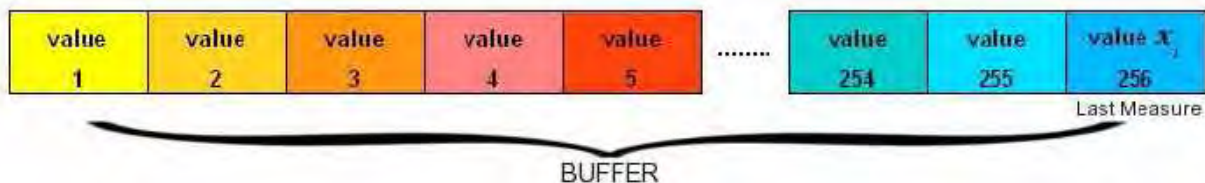
The diagram will show time on the abscissa axis and the selected event on the ordinate axis. To select the event to be measured, find the corresponding option in the second box.

The terms used in the “signal type” combo box are explained below:

**Axes:** to measure and display the acceleration  $x$ ,  $y$ ,  $z$  components measured by the acquisition device.

**Axes & Modules:** to measure and display the acceleration  $x$ ,  $y$ ,  $z$  components measured by the acquisition device, as well as the acceleration vector projection modules on  $xy$ ,  $xz$ ,  $yz$  and  $xyz$  planes.

**Rms:** to measure and display the acceleration  $x$ ,  $y$ ,  $z$  components measured by the acquisition device, but also to calculate and display the Rms value (root mean square) for each acceleration component.



*FTAnalyzer: measurement buffer*

The Rms value is reckoned by an algorithm based on a 256-measure buffer. The algorithm starts calculation from the moment of measurement.

At the start, the algorithm only considers the first measured sample, here called  $x_1$ , and the remaining 255 values in the buffer amounting to zero. Next, the algorithm reads measure  $x_2$  and uses  $x_2$  and  $x_1$  to calculate the Rms, considering the previous 254 corresponding to zero.

The algorithm will consider all the values prior to  $x_1$  corresponding to zero until the  $x_{255}$  value is read (255<sup>th</sup> value), with the RMS value taking into account the previous 254 measured values.

When the algorithm reads the 256<sup>th</sup> measure (256 values in the buffer) and the measure is complete, the algorithm will proceed as follows:

1. Reading of the sampled  $x_1$  value transmitted by the acquisition device;
2. The square of the  $x_1$  value is calculated and copied in the buffer position 256;
3. The RMS value will be reckoned by means of:

$$RMS_i = \frac{(x_i^2 - RMS_{i-1})}{T_k} + RMS_{i-1}$$






Please note that in the  $RMS_{i-1}$  formula, the RMS value is prior to the  $i$ -th measure and  $T_k$  is the time constant.

4. The value is set in the buffer position 1;
5. Calculation continues starting from point 1.

To be noticed that the algorithm calculates the Rms instant value of the analysed event.

### 3.5.1.1 Time: display options

The text boxes and buttons below the scroll bar of each *Graphics area* showing time domain measurements can be used to change display parameters. The table below provides the different options and related explanation.

Time domain Graphics area display parameters	
Acceleration X 	To highlight the colour of the analysed event
Y Scale (m/s <sup>2</sup> /div) 20 	To set up the diagram Y axis scale
Y Offset (m/s <sup>2</sup> ) 0 	To offset the displayed signals by the set up quantity
X Scale (ms/div) 200 	To set up the diagram X axis scale
Settings... 	Advanced settings

Through the Settings button, you can access the advanced settings to select the events to be displayed or to apply filters to the acquisition measures.



### 3.5.1.1.1 Time: selection of displayed values

To select the track to be displayed, proceed as follows:



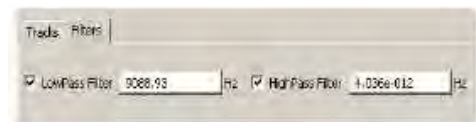
*FTAnalyzer: track selection – Time*

#### **Settings > Track**

the different options allow to include/exclude the analysed event through check boxes, colour and type of line used for display.

### 3.5.1.1.2 Time: Filters

To filter acquisition measures, proceed as follows:



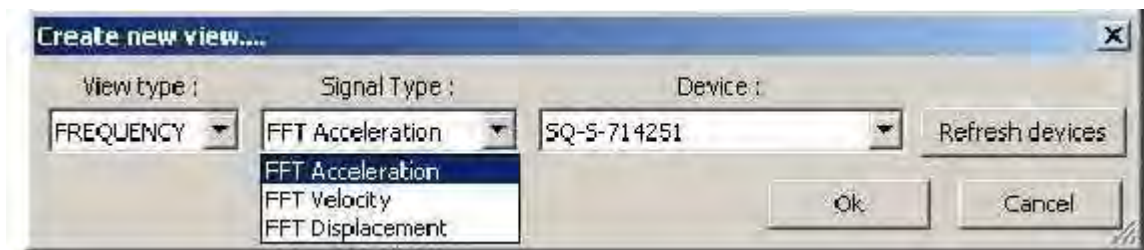
#### **Settings > Filters**

*FTAnalyzer: filter activation*

the different options allow the filter selection and its cut-off frequency setting through check boxes. As shown in the figure, you can enable Low Pass and High Pass filters. Both are 4<sup>th</sup>-order filters with 80dB/decade gradient.

## 3.5.2 Frequency: frequency domain measurement

To display measures in the frequency domain, select **FREQUENCY** in the *View Type* combo box, and then select the event whose frequency spectrum is to be examined in the second combo box. The program makes it possible to analyse the spectrum of one of the following events:



*FTAnalyzer: Frequency domain analysis*



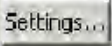
- **FFT Acceleration:** to display the frequency spectrum of acceleration *x*, *y*, *z* components measured by the acquisition device;
- **FFT Velocity:** to display the frequency spectrum of velocity *x*, *y*, *z* components measured by the acquisition device;

- **FFT Displacement:** to display the frequency spectrum of displacement  $x$ ,  $y$ ,  $z$  components measured by the acquisition device.

### 3.5.3 Frequency: display options

The text boxes and buttons below the scroll bar of each *Graphics area* showing frequency domain measurements can be used to change display parameters.

The table below provides the different options and related explanation.

Frequency domain Graphics Area display parameters	
Acceleration X 	To highlight the colour of the analysed event
MinX(Hz): <input type="text" value="0"/>	To set up the minimum value of the diagram X axis scale
MaxX(Hz): <input type="text" value="2500"/>	To set up the maximum value of the diagram X axis scale
MinY(m/s <sup>2</sup> ): <input type="text" value="0"/>	To set up the minimum value of the diagram Y axis scale
MaxY(m/s <sup>2</sup> ): <input type="text" value="5"/>	To set up the maximum value of the diagram Y axis scale
FFT points: <input type="text" value="16384"/>	Number of points used to display the FFT diagram
peak 	Y axis value (peak, peak-to-peak, rms)
Settings... 	Advanced settings

The *FFT points* parameter also provides the frequency resolution, i.e. the number of points (called samplings) allocated to the frequency field from 0 Hz to 2500 Hz, as follows:

$$Resolution = \frac{F \text{ sampling}}{FFT \text{ points}}$$

If the user requires a high frequency resolution, a high number of points shall be used, i.e. a high value of the *FFT points* parameter. However, the data buffer used for the spectrum calculation shall include a sampling number twice the *FFT points* number. As a result, for a high resolution the time needed to acquire this points number ( $2 * FFT \text{ points}$ ) can last a dozen of seconds.

For the correct assessment of the time needed to acquire  $2 * FFT \text{ points}$ , use the following relation:

$$Acquisition \ time = \frac{2 \text{ FFT point}}{\text{Sample Rate}}$$

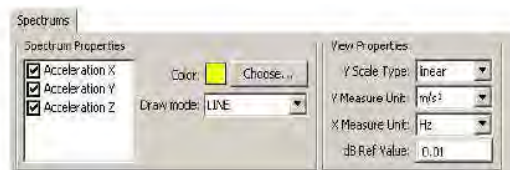
The table below shows the acquisition time needed for a given number of *FFT points* considering a sampling speed of 18113.21 *samples/s*.

FFT points	Time Request [s]
256	0.03
512	0.06
1024	0.11
2048	0.23
4096	0.45
8192	0.9
16384	1.81
32768	3.62
65536	7.24
131072	14.47
262144	28.95
524288	57.89

### 3.5.3.1 Frequency: selection of displayed values

To select the track to be displayed, proceed as follows:

**Settings>Track**



### *FTAnalyzer: Selection of tracks and display parameters – frequency*

You can select the analysed event, the colour and type of line for display by using the check boxes.

### 3.5.3.2 Frequency – scale changes: dB, linear

The software makes it possible to change scales and frequency spectrum diagram values, in particular:

**Y Scale Type:** to set the type of scale (linear; dB);

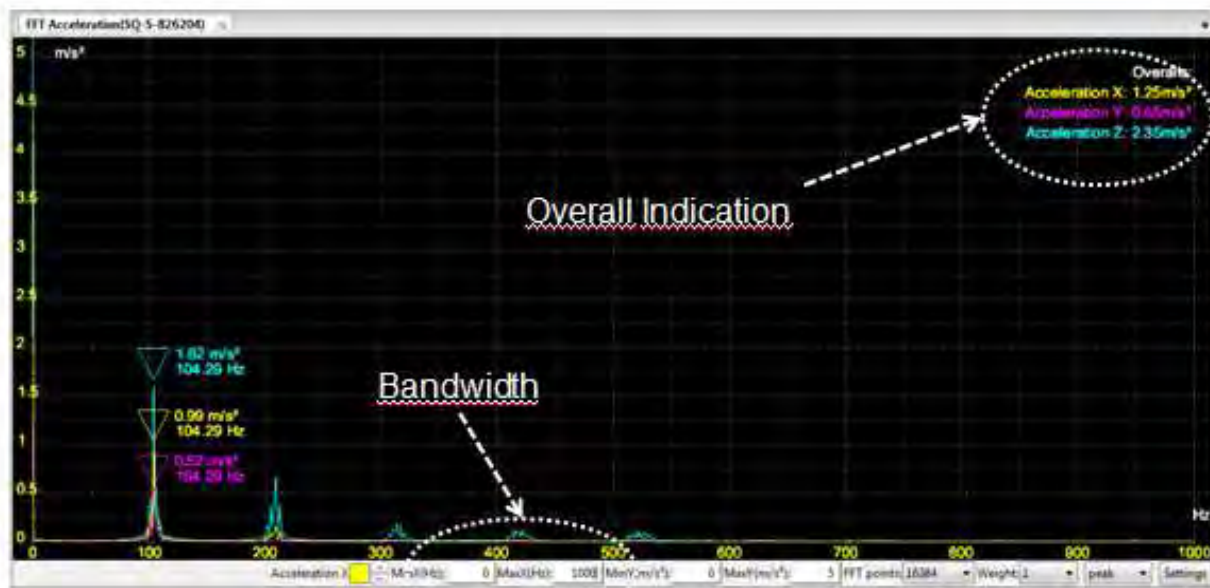
**Y Measure Unit:** unit of measurement used on y axis (m/s<sup>2</sup>; g);

**X Measure Unit:** unit of measurement used on x axis (Hz; rpm);

**dB Ref Value:** reference value setting to calculate decibels for the display with scale type dB on Y axis.

### 3.5.3.2 Overall measurement

Opening a new FFT view the three axes Overall indication appears on the upper right side of the window.



The Overall is an algorithm able to evaluate, inside a well-defined bandwidth, the vibration total value; this computation shows an idea of the total vibration effect but doesn't offer an evaluation of the magnitude distribution at the single frequency component.

Once the bandwidth is defined (between MinX(Hz) and MaxX(Hz)) the Overall is computed according to the following formula

$$Overall = \sqrt{\sum_{i=0}^n A_i^2}$$

Where n is the total rows number in the defined bandwidth and Ai is the amplitude of each row of all the rows in the vibration spectra in the same bandwidth.

### 3.5.4 Triggered: event synchronized measures

The **TRIGGERED** mode enables the synchronization of data acquisition with vibrational events whose characteristics have been set by the user (called trigger levels or thresholds) for an

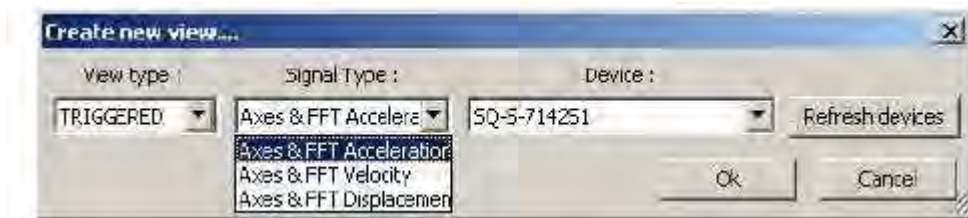
established time. Trigger thresholds can be set only for acceleration components and the trigger function can be enabled on more axes at the same time according to the OR logic.

When the acceleration component size exceeds an established trigger level, the FTAnalyzer will detect the related event. In particular, if the trigger function is set up as *positive*, the FTAnalyzer will detect the event when the signal exceeds the threshold up the slope; if the trigger function is set up as *negative*, the FTAnalyzer will detect the event when the signal exceeds the threshold down the slope.

After the trigger event, the FTAnalyzer will be waiting for the time established by the user to elapse and then stop the measure acquisition.

To select the trigger function, click on **TRIGGERED** in the *view type* combo box. Measurements taken this way will be reported both in the time and frequency domain.

To select the value to be measured, select one of the following terms in the Signal Type combo box:



*FTAnalyzer: trigger function*

**Axes & FFT Acceleration:** the Graphics area is subdivided into two parts displaying the time progress and the frequency spectrum of acceleration *x*, *y*, *z* components measured by the acquisition device;

**Axes & FFT Velocity:** the Graphics area is subdivided into two parts displaying the time progress and the frequency spectrum of velocity *x*, *y*, *z* components measured by the acquisition device;

**Axes & FFT Displacement:** the Graphics area is subdivided into two parts displaying the time progress and the frequency spectrum of displacement *x*, *y*, *z* components measured by the acquisition device.



*FTAnalyzer: trigger parameters*

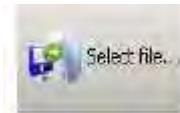
To enable the trigger function, set the threshold values in the trigger toolbar as shown below.

Trigger Toolbar	
Trigger: Axes & FFT Velocity(SQ-5-714251) <span style="border: 1px solid gray; padding: 2px;">NONE ▾</span> <span style="font-size: small; margin-left: 100px;">SINGLE</span> <span style="font-size: small; margin-left: 100px;">NONE</span>	SINGLE to enable the trigger function. NONE to disable to trigger function
Level (m/s <sup>2</sup> ): <span style="border: 1px solid gray; padding: 2px 10px;">0</span>	To set the trigger value
Slope: <span style="border: 1px solid gray; padding: 2px 10px;">POSITIVE ▾</span>	POSITIVE acquisition starts when the signal exceeds the trigger value up the slope. NEGATIVE acquisition starts when the signal exceeds the trigger value down the slope
Stop time (ms): <span style="border: 1px solid gray; padding: 2px 10px;">0</span>	Stop time after trigger event in ms
<span style="border: 1px solid gray; padding: 2px;"> <input type="checkbox"/> X <input type="checkbox"/> Y <input type="checkbox"/> Z         </span>	Axis for trigger detection according to <b>OR</b> logic

### 3.6 File device

The files including acquired measures can be processed by FTAnalyzer. The software will process these files as virtual devices called *File Devices* which provide the time records of the stored acceleration components.

#### 3.6.1 Measure recording



To save measures to a file, click the toolbar **Select File** icon

The file save view will be displayed with the directory where measures can be stored and the archive named.

#### Note

The file name will include some information set by default as follows:

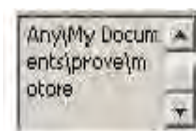
*Filename\_Year\_Month\_Day\_hourminutesseconds*

e.g. if the file name assigned by the user is *motor*, the following will be created:



***motor\_2009\_Dec\_03\_111732***

FTAnalyzer files do not have any default extension, therefore the user is free to choose any.

After creating the file, the Device Toolbar text box will display the file path and name.



Use the following keys to record measures.

	Recording state	Possible Action
	OFF	single click to start recording
	ON	single click to stop recording

Please note that if you press the Hold key during recording, you will stop scrolling the measure diagram; anyway measures will be saved in the file.

### 3.6.2 File device creation (virtual device)

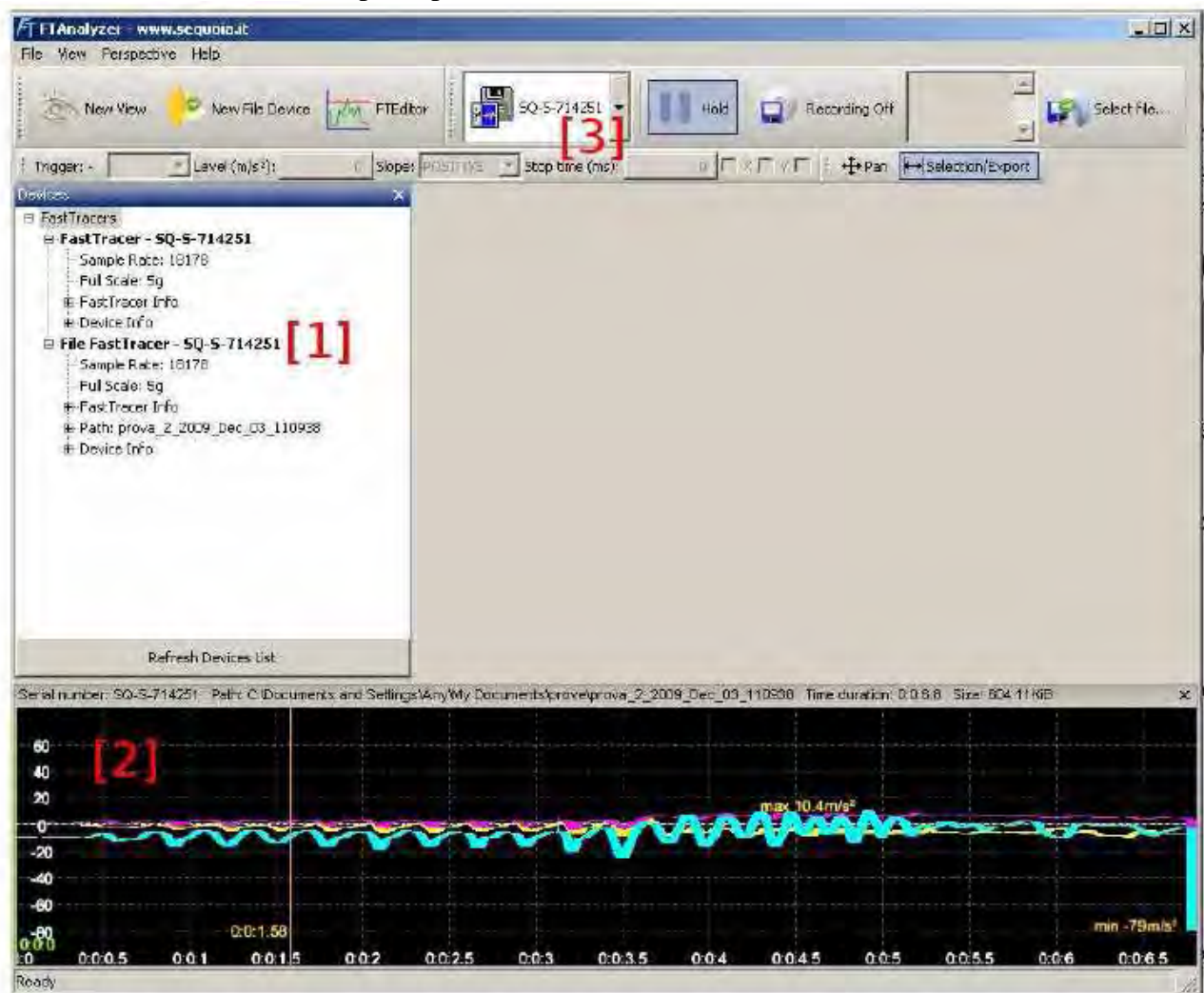
As stated above, FTAnalyzer processes stored measures as virtual devices. To create a *File Device* and load stored measures, proceed as follows:

- Click on the *New File Device* icon;
- Use the combination of *Ctrl + F*;
- Click with the right button on the *Device List* and select *new device from file*.

then find the file to be loaded and click **open**. If the file is valid (see figure on the next page) and the data are valid, the following information will be displayed:

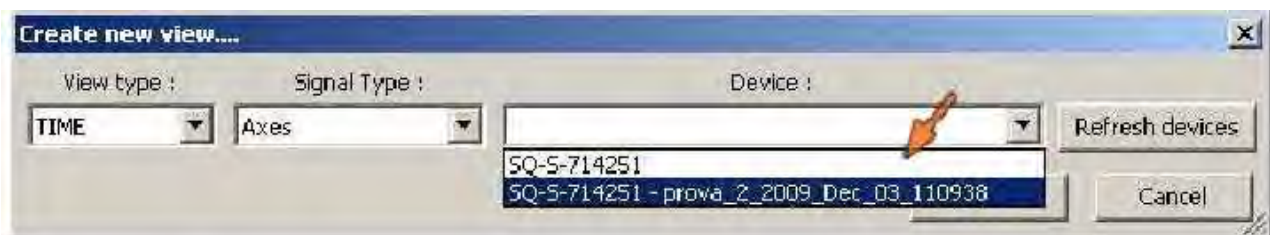
- the Device List shows a new device named [1] (see figure);

- The lower part displays a sort of graphics area [2] providing an overview of the performed measurement and some information on sensor used, measure recording path, measurement time duration and occupied space;



*FTAnalyzer: opening and reproduction of data stored in a File Device*

- The combo box [3] displays a floppy icon showing the virtual device. To reproduce or analyze the measure, open a new view by clicking **New View** and select the type of diagram to be displayed [time, frequency, trigger], making sure you choose the correct device in the third combo box.

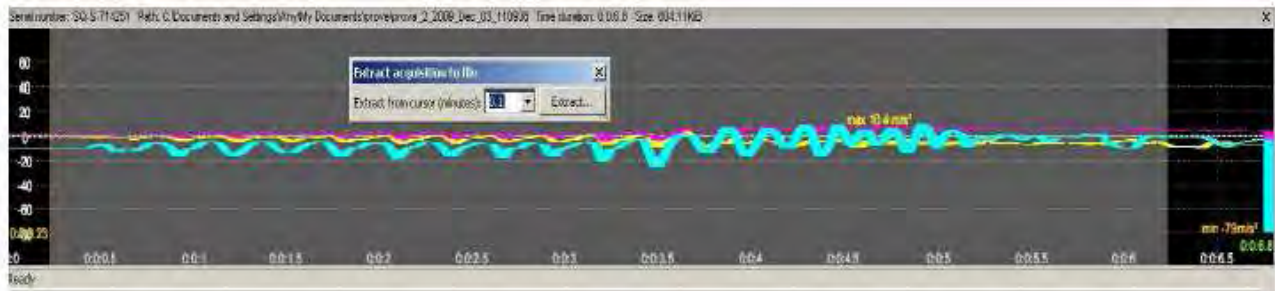


*FTAnalyzer: Measure display in the File Device*



After opening the *Graphics area*, click twice on the view [2] to display measures: two vertical lines will indicate the measurement starting point (start cursor – yellow line), while the green line will scroll along the diagram to indicate the measurement point currently being read.

You can also extract to another file some of the measures stored in the *File Device* and displayed in the *Graphics area* [2]. For this purpose, click on the Graphics area [2] by positioning the start cursor (yellow line) on the starting point of the interval to be extracted, open the pop-up menu by clicking with the mouse right button on the *Graphics area* [2] and select **Extract to file from cursor start**. The displayed view will indicate the interval minute length of the measure to be extracted.



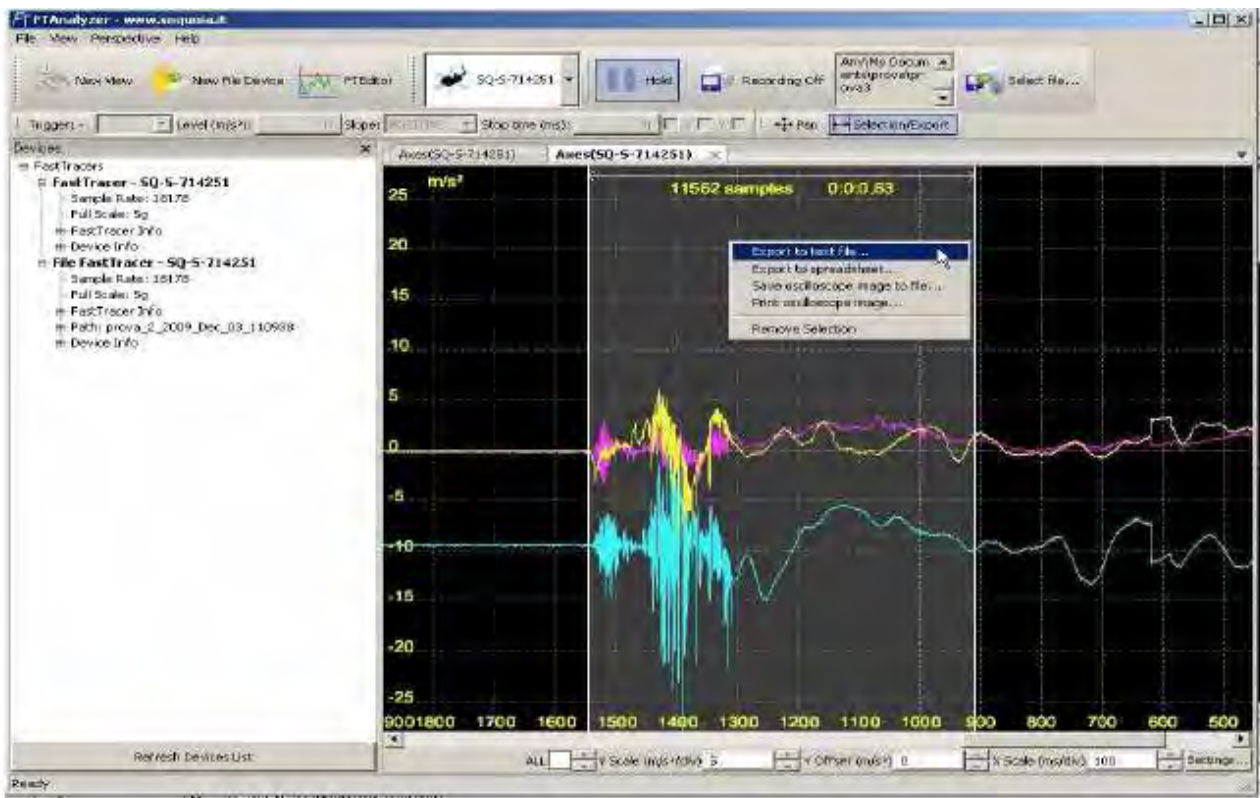
*FTAnalyzer: extract data from File Device*

Please note that if a device has been created and a view has been closed by mistake, it can be opened again as follows:

*View>File Device>File Device name*

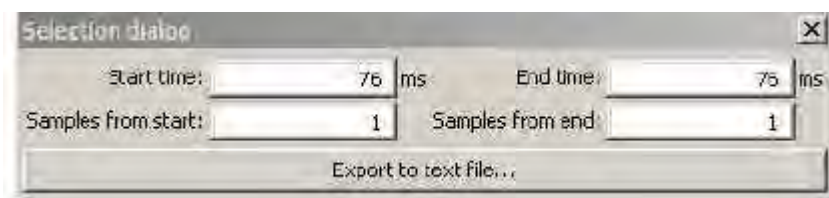
### 3.7 Export to text file: measure export

To export measures being acquired or saved to file, click the **Hold** key to stop scrolling information in the *Graphics area*. Click on the diagram and find the starting point so that a vertical bar will be displayed, then drag the latter up to the point where data shall be exported. Now open the pop-up menu with the mouse right button and select **Export to text file...**Please note that data will be exported consistently with the domain where measures are extracted from. From the pop-up menu you can also print out the Graphics area or save a file.jpg with the graphics area image. To remove selection, click **Remove Selection...**



*FTAnalyzer: data selection for export to text file*

In case of time domain measurements, the FTAnalyzer will display the following view where you can set up start time, end time and the respective associated samples.

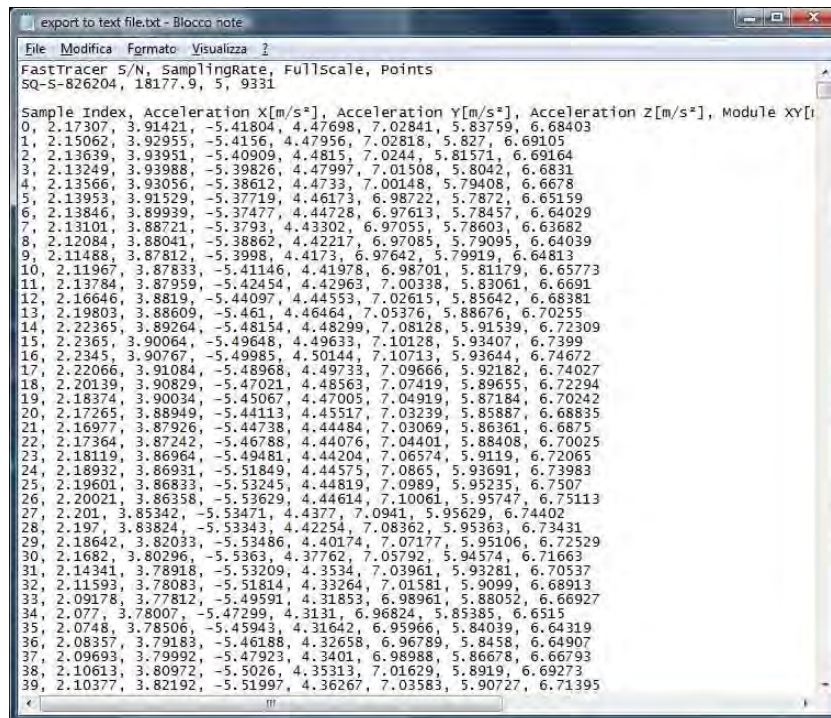


*FTAnalyzer: export parameters*

After confirming, add the output file name. The whole selected part will be exported at a sampling speed of 18113.21 *samples/s* for time domain. If the frequency spectrum of one or more events is exported, the file points will correspond to the points used to display the selected part of the FFT diagram.

The output file has a text structure, all data are organized in a column and separated by a comma.

The first two lines provide information on sensor and measure, the third line is usually empty, while the fourth line provides the event label for each column.



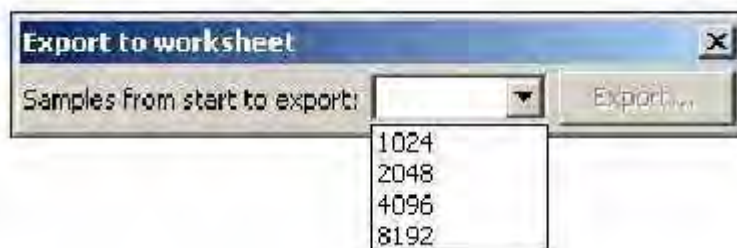
*FTAnalyzer: acquisition of data exported to text file*

### 3.8 Export to spreadsheet: measure export to MS – Excel files

As mentioned above, FTAnalyzer can export measures in the native way to Microsoft Excel files: with this function the user can draw up office documents with the analysed measures, carry out additional calculations or take indirect measurements.

To export measures being acquired or saved to file, select the *Graphics area* where the measures will be extracted from. Click on the diagram and find the starting point so that a vertical bar will be displayed, then drag the latter up to the point where data shall be exported. Now open the pop-up menu with the mouse right button and select **Export to Spreadsheet**.

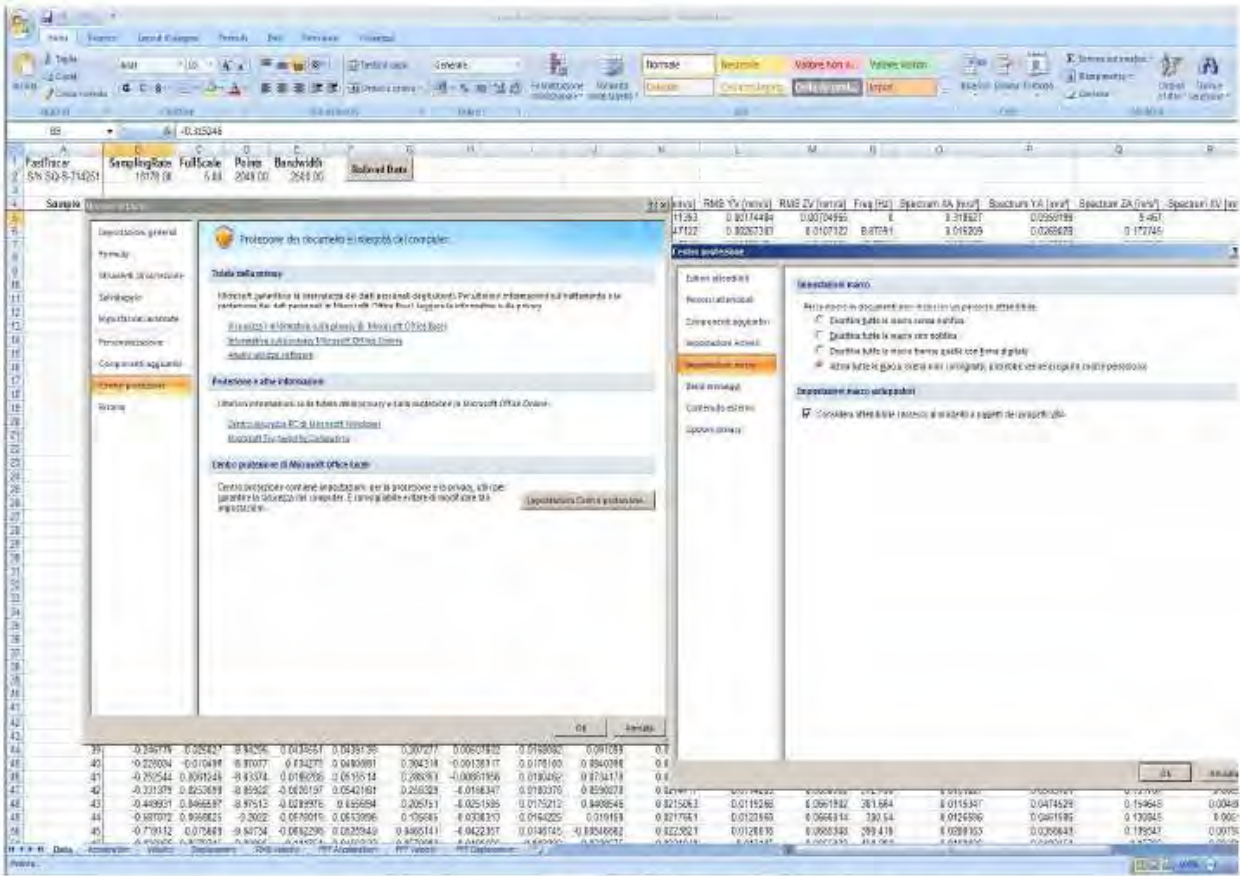
When the “Export to worksheet” view is displayed, set the number of points to be exported and click *Export....* The next view will ask the user to enter the text file name, proceed and click save as.



*FTAnalyzer: selection of number of samples to be exported to Microsoft Excel*

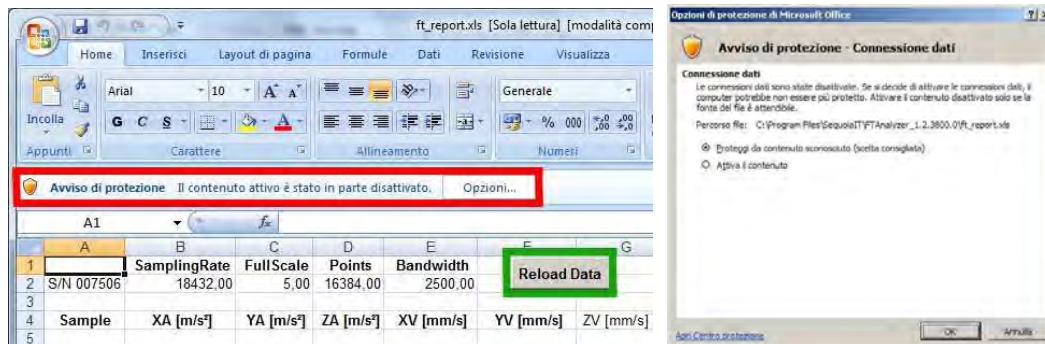
After saving the file, Microsoft Excel is started automatically; if you click **Reload Data** and select the previously acquired file, the data will be loaded and displayed on the screen.

Sample	tV (ms)	ZV (mm)	XD (mm)	YD (mm)	RMS XV (mm/s)	RMS YV (mm/s)	RMS ZV (mm/s)	Frequency (Hz)	Spectrum XA (m/s <sup>2</sup> )	Spectrum YA (m/s <sup>2</sup> )	Spectrum ZA (m/s <sup>2</sup> )	Spectrum XV (mm/s)	Spectrum YV (mm/s)	Spectrum ZV (mm/s)	Spectrum XD (mm)	Spectrum YD (mm)	Spectrum ZD (mm)
0	-0.021879	-0.798934	0.049211	-0.022207	-0.00332	0.00305991	0.0031924	0	0.002025	0.0014876	0.001920						
1	-0.022086	-0.79855	0.049157	0.0014526	-0.00020	0.00324564	0.0034016	0.00000	0.00304756	0.0021420	0.0021731						
2	-0.022292	-0.79818	0.049103	0.0027474	-0.00045	0.00339625	0.0034604	0.00000	0.0031591	0.0024275	0.0024587						
3	-0.022498	-0.79782	0.049049	0.0040422	-0.00070	0.00354686	0.0035187	0.00000	0.0032762	0.0027130	0.0027442						
4	-0.022704	-0.79746	0.048995	0.0053370	-0.00095	0.00369747	0.0036693	0.00000	0.0033933	0.0029991	0.0030303						
5	-0.022910	-0.79710	0.048941	0.0066318	-0.00120	0.00384808	0.0038200	0.00000	0.0035104	0.0032850	0.0033162						
6	-0.023116	-0.79674	0.048887	0.0079266	-0.00145	0.00399869	0.0039706	0.00000	0.0036275	0.0035709	0.0036021						
7	-0.023322	-0.79638	0.048833	0.0092214	-0.00170	0.00414930	0.0041213	0.00000	0.0037446	0.0038568	0.0038880						
8	-0.023528	-0.79602	0.048779	0.0105162	-0.00195	0.00430000	0.0042720	0.00000	0.0038617	0.0041427	0.0041739						
9	-0.023734	-0.79566	0.048725	0.0118110	-0.00220	0.00445061	0.0044226	0.00000	0.0039788	0.0044286	0.0044598						
10	-0.023940	-0.79530	0.048671	0.0131058	-0.00245	0.00460122	0.0045734	0.00000	0.0040959	0.0047145	0.0047457						
11	-0.024146	-0.79494	0.048617	0.0144006	-0.00270	0.00475183	0.0047238	0.00000	0.0042130	0.0050004	0.0050316						
12	-0.024352	-0.79458	0.048563	0.0156954	-0.00295	0.00490244	0.0048746	0.00000	0.0043301	0.0052863	0.0053175						
13	-0.024558	-0.79422	0.048509	0.0169902	-0.00320	0.00505305	0.0050250	0.00000	0.0044472	0.0055722	0.0056034						
14	-0.024764	-0.79386	0.048455	0.0182850	-0.00345	0.00520366	0.0051758	0.00000	0.0045643	0.0058581	0.0058893						
15	-0.024970	-0.79350	0.048401	0.0195798	-0.00370	0.00535427	0.0053262	0.00000	0.0046814	0.0061440	0.0061752						
16	-0.025176	-0.79314	0.048347	0.0208746	-0.00395	0.00550488	0.0054770	0.00000	0.0047985	0.0064299	0.0064611						
17	-0.025382	-0.79278	0.048293	0.0221694	-0.00420	0.00565549	0.0056274	0.00000	0.0049156	0.0067158	0.0067470						
18	-0.025588	-0.79242	0.048239	0.0234642	-0.00445	0.00580610	0.0057784	0.00000	0.0050327	0.0070017	0.0070329						
19	-0.025794	-0.79206	0.048185	0.0247590	-0.00470	0.00595671	0.0059287	0.00000	0.0051498	0.0072876	0.0073188						
20	-0.025999	-0.79170	0.048131	0.0260538	-0.00495	0.00610732	0.0060793	0.00000	0.0052669	0.0075735	0.0076047						
21	-0.026205	-0.79134	0.048077	0.0273486	-0.00520	0.00625793	0.0062299	0.00000	0.0053840	0.0078594	0.0078906						
22	-0.026411	-0.79098	0.048023	0.0286434	-0.00545	0.00640854	0.0063805	0.00000	0.0055011	0.0081453	0.0081765						
23	-0.026617	-0.79062	0.047969	0.0299382	-0.00570	0.00655915	0.0065311	0.00000	0.0056182	0.0084312	0.0084624						
24	-0.026823	-0.79026	0.047915	0.0312330	-0.00595	0.00670976	0.0066816	0.00000	0.0057353	0.0087171	0.0087483						
25	-0.027029	-0.78990	0.047861	0.0325278	-0.00620	0.00686037	0.0068323	0.00000	0.0058524	0.0090030	0.0090342						
26	-0.027235	-0.78954	0.047807	0.0338226	-0.00645	0.00701098	0.0069829	0.00000	0.0059695	0.0092889	0.0093201						
27	-0.027441	-0.78918	0.047753	0.0351174	-0.00670	0.00716159	0.0071335	0.00000	0.0060866	0.0095748	0.0096060						
28	-0.027647	-0.78882	0.047699	0.0364122	-0.00695	0.00731220	0.0072842	0.00000	0.0062037	0.0098607	0.0098919						
29	-0.027853	-0.78846	0.047645	0.0377070	-0.00720	0.00746281	0.0074348	0.00000	0.0063208	0.0101466	0.0101778						
30	-0.028059	-0.78810	0.047591	0.0390018	-0.00745	0.00761342	0.0075854	0.00000	0.0064379	0.0104325	0.0104637						
31	-0.028265	-0.78774	0.047537	0.0402966	-0.00770	0.00776403	0.0077360	0.00000	0.0065550	0.0107184	0.0107496						
32	-0.028471	-0.78738	0.047483	0.0415914	-0.00795	0.00791464	0.0078866	0.00000	0.0066721	0.0110043	0.0110355						
33	-0.028677	-0.78702	0.047429	0.0428862	-0.00820	0.00806525	0.0080372	0.00000	0.0067892	0.0112902	0.0113214						
34	-0.028883	-0.78666	0.047375	0.0441810	-0.00845	0.00821586	0.0081878	0.00000	0.0069063	0.0115761	0.0116073						
35	-0.029089	-0.78630	0.047321	0.0454758	-0.00870	0.00836647	0.0083384	0.00000	0.0070234	0.0118620	0.0118932						
36	-0.029295	-0.78594	0.047267	0.0467706	-0.00895	0.00851708	0.0084890	0.00000	0.0071405	0.0121479	0.0121791						
37	-0.029501	-0.78558	0.047213	0.0480654	-0.00920	0.00866769	0.0086396	0.00000	0.0072576	0.0124338	0.0124650						
38	-0.029707	-0.78522	0.047159	0.0493602	-0.00945	0.00881830	0.0087903	0.00000	0.0073747	0.0127197	0.0127509						
39	-0.029913	-0.78486	0.047105	0.0506550	-0.00970	0.00896891	0.0089409	0.00000	0.0074918	0.0130056	0.0130368						
40	-0.030119	-0.78450	0.047051	0.0519498	-0.00995	0.00911952	0.0090915	0.00000	0.0076089	0.0132915	0.0133227						
41	-0.030325	-0.78414	0.046997	0.0532446	-0.01020	0.00927013	0.0092421	0.00000	0.0077260	0.0135774	0.0136086						
42	-0.030531	-0.78378	0.046943	0.0545394	-0.01045	0.00942074	0.0093927	0.00000	0.0078431	0.0138633	0.0138945						
43	-0.030737	-0.78342	0.046889	0.0558342	-0.01070	0.00957135	0.0095433	0.00000	0.0079602	0.0141492	0.0141804						
44	-0.030943	-0.78306	0.046835	0.0571290	-0.01095	0.00972196	0.0096939	0.00000	0.0080773	0.0144351	0.0144663						
45	-0.031149	-0.78270	0.046781	0.0584238	-0.01120	0.00987257	0.0098445	0.00000	0.0081944	0.0147210	0.0147522						
46	-0.031355	-0.78234	0.046727	0.0597186	-0.01145	0.01002318	0.0100000	0.00000	0.0083115	0.0150069	0.0150381						
47	-0.031561	-0.78198	0.046673	0.0610134	-0.01170	0.01017379	0.0101506	0.00000	0.0084286	0.0152928	0.0153240						
48	-0.031767	-0.78162	0.046619	0.0623082	-0.01195	0.01032440	0.0103013	0.00000	0.0085457	0.0155787	0.0156099						
49	-0.031973	-0.78126	0.046565	0.0636030	-0.01220	0.01047501	0.0104519	0.00000	0.0086628	0.0158646	0.0158958						
50	-0.032179	-0.78090	0.046511	0.0648978	-0.01245	0.01062562	0.0106025	0.00000	0.0087799	0.0161505	0.0161817						
51	-0.032385	-0.78054	0.046457	0.0661926	-0.01270	0.01077623	0.0107531	0.00000	0.0088970	0.0164364	0.0164676						
52	-0.032591	-0.78018	0.046403	0.0674874	-0.01295	0.01092684	0.0109037	0.00000	0.0090141	0.0167223	0.0167535						
53	-0.032797	-0.77982	0.046349	0.0687822	-0.01320	0.01107745	0.0110543	0.00000	0.0091312	0.0170082	0.0170394						
54	-0.033003	-0.77946	0.046295	0.0700770	-0.01345	0.01122806	0.0112049	0.00000	0.0092483	0.0172941	0.0173253						
55	-0.033209	-0.77910	0.046241	0.0713718	-0.01370	0.01137867	0.0113555	0.00000	0.0093654	0.0175800	0.0176112						
56	-0.033415	-0.77874	0.046187	0.0726666	-0.01395	0.01152928	0.0115061	0.00000	0.0094825	0.0178659	0.0178971						
57	-0.033621	-0.77838	0.046133	0.0739614	-0.01420	0.01167989	0.0116567	0.00000	0.0095996	0.0181518	0.0181830						
58	-0.033827	-0.77802	0.046079	0.0752562	-0.01445	0.01183050	0.0118074	0.00000	0.0097167	0.0184377	0.0184689						
59	-0.034033	-0.77766	0.046025	0.076													



Microsoft Excel configuration

In case of Microsoft Excel protection notice, click on the Option... key in the protection notice and select "Enable content".



Microsoft Excel configuration – protection notice

### **3.9 Perspective save and load**

To save the view configuration, find the Perspective menu and proceed as follows:

***Perspective>Save perspective...or Ctrl + S***

To restore the previously saved view configuration, proceed as follows:

***Perspective>Load perspective...or Ctrl + O***

# FTEditor

# 4

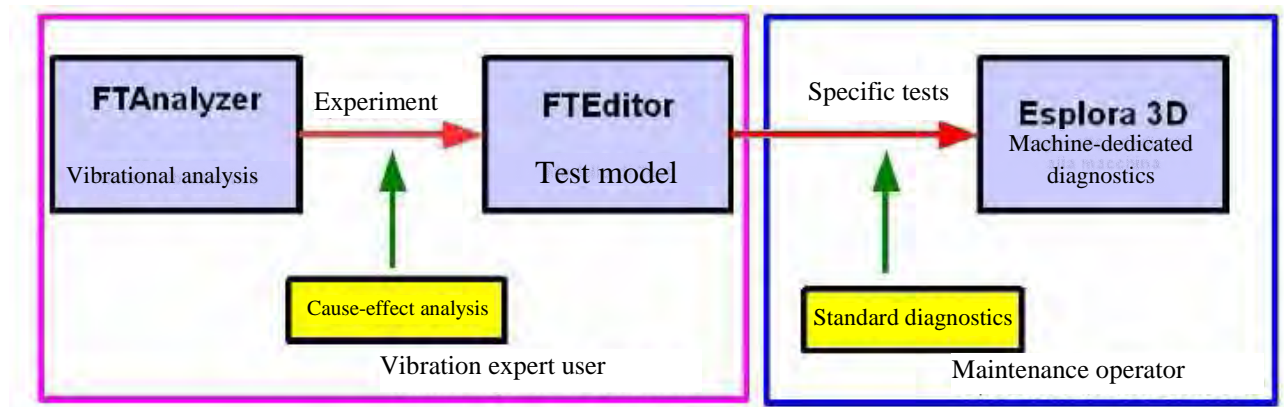
## 4.1 Philosophy of use

As stated in the previous chapter, the analysis of vibrational problems with FTAnalyzer allows to define the cause-fault relation affecting the machine vibrational signature.

For the best use of your software and to provide instruments improving your service, Sequoia IT has developed the FTEditor module of FTAnalyzer.

FTEditor has been designed for diagnostics applications and its purpose is to help vibration experts to define diagnostics “paths” based on pre-established tests which can also be used by less skilled users.

Before explaining how to use FTEditor, it is necessary to outline the involved professional figures and the way they can directly or indirectly interact with Sequoia IT software.

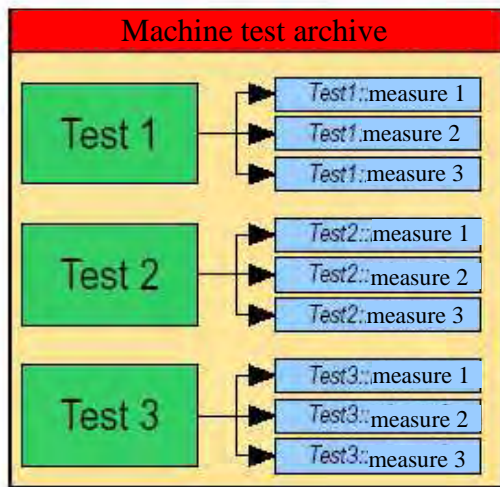


*Architecture for use of Sequoia IT software*

First, it is necessary to make a distinction between the vibration expert user (master) who will define the diagnostics paths for the different machines (according to a documented experience) and the maintenance operator who will implement the established models with FTEditor through the Esplora 3D software.

In other words, the expert user will set up an archive with the different tests and related guidelines through FTEditor, while the maintenance operator will implement these tests for the machine state monitoring through the Esplora 3D software.

And now we can analyse how FTEditor works at a first conceptual level. To understand FTEditor operation, see the figure below which presents the reference conceptual model of an archive (Model Database) used to monitor a given machine.



*FTEditor: Model DB structure*



*FTEditor: FTEditor module start*

As shown in the first figure, the archive includes several tests (three in the figure) each based on a set of measurements.

This archive, drawn up by an expert user, is a virtual maintenance tool consisting (in this case) of three tests and related measurements. For the machine diagnosis, the maintenance operator shall implement the three tests and carry out the required measurements.

Of course, for each test it is advisable to work out a consistent set of measurements to be repeated an appropriate number of times. Each test will provide information on the machine state. Therefore, the established number of tests making up the archive shall cover all the machine aspects which need to be checked.

The next chapter will deal with the creation of a specific machine-dedicated archive.

## 4.2 Start

To access FTEditor, start up FTAnalyzer.

To start up FTAnalyzer, find the start key and proceed as follows:

***Start>Programs>Sequoia IT FTAnalyzer>FTAnalyzer x.y.z.t***

Should the program not start or any error messages be displayed, follow the suggestions provided in paragraphs 2.3 and 2.5 of the present manual.

To start FTEditor, proceed as follows:



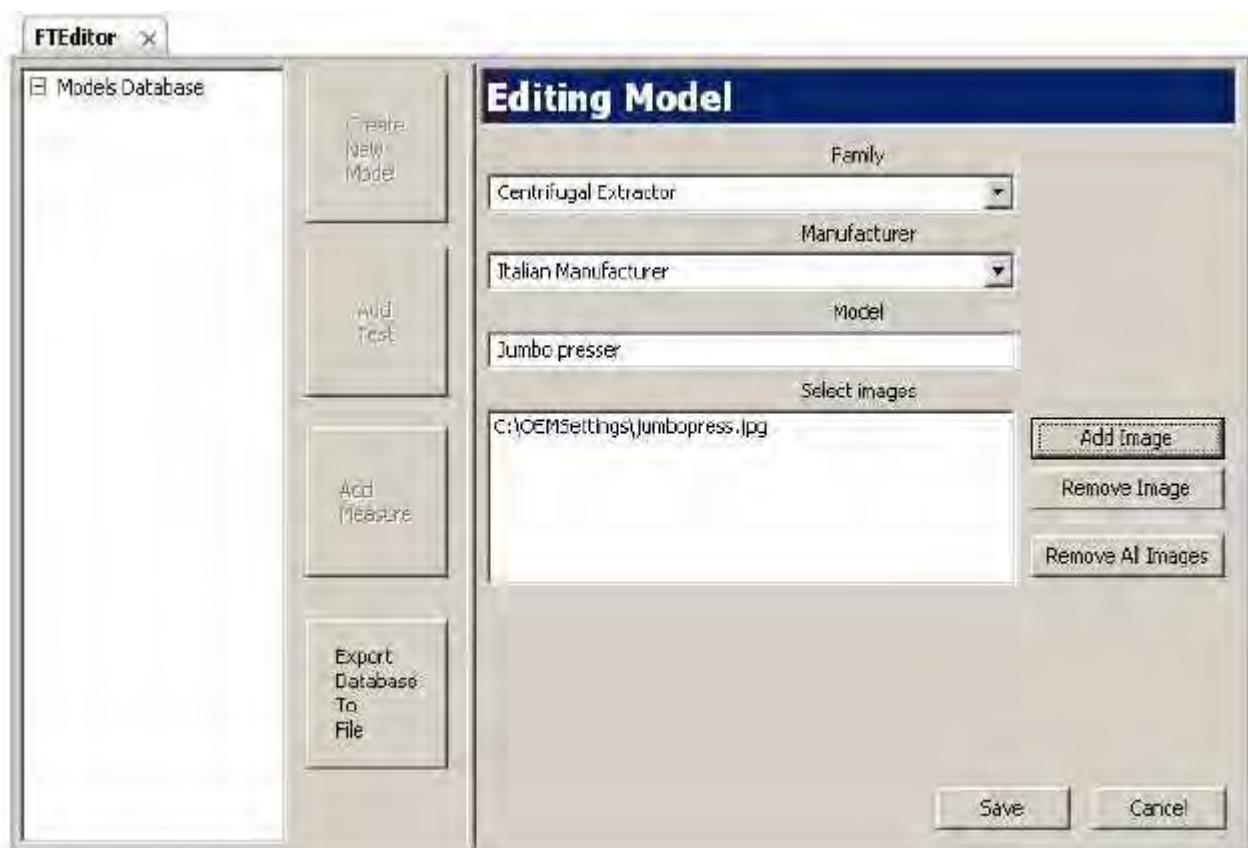
- click FTeditor on the action toolbar;
- click *View>FTeditor* in the text menu

### 4.3 Create new model

By clicking on *Create New Model*, you can create a new set of tests for the machine condition monitoring.

These models are useful mainly because they gather all the tests dedicated to a machine in one single file, thus becoming virtual diagnostics tools.

To create a new archive, click on *Create New Model* to display a mask called Editing Model inside the main view; to set the archive, fill in the mask with machine description, machine family, manufacturer, reference model and machine images, and finally click **Save** to save the model.



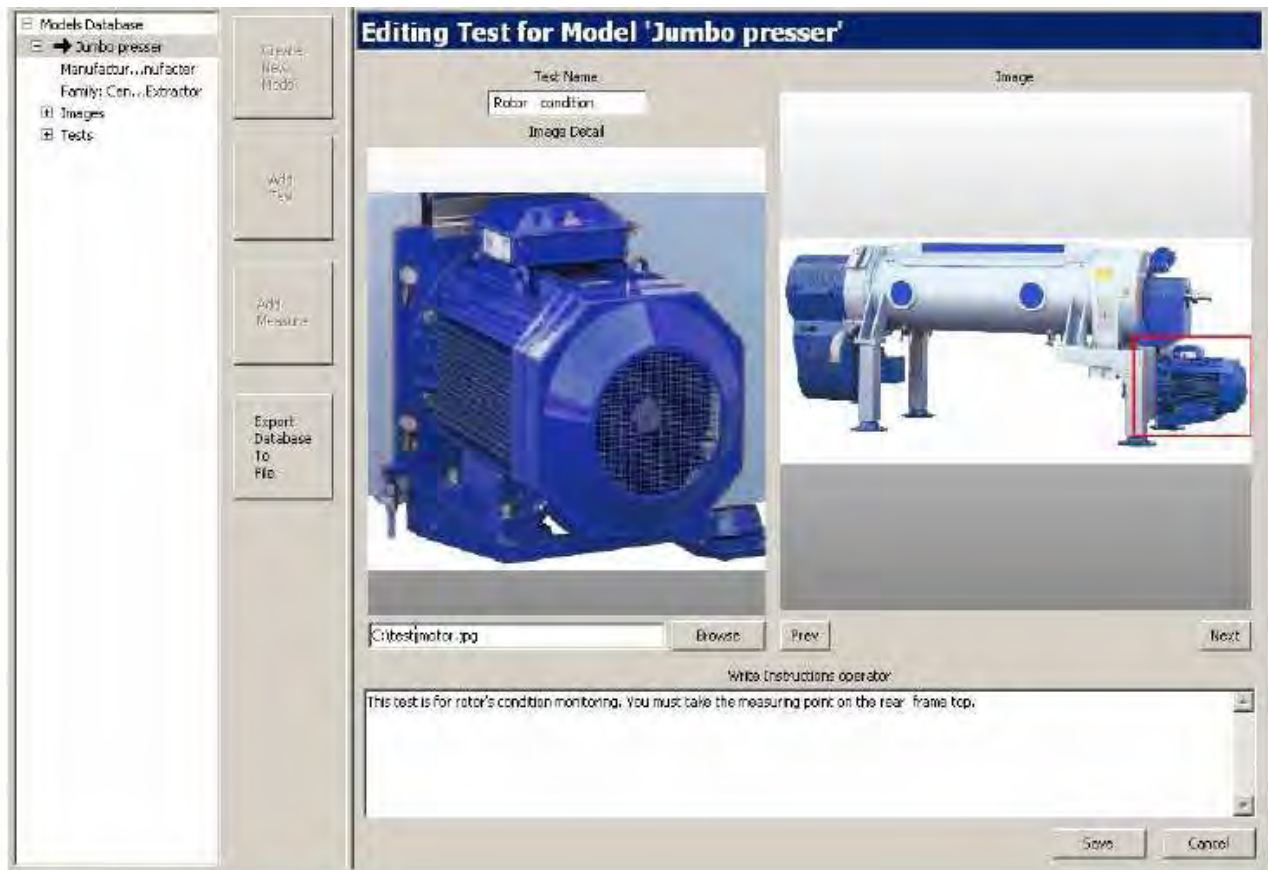
*FTeditor: creation of a new model*

Please note that after saving the archive, on the mask left-hand side a model will be created with the same ID entered in the **model** field.

### 4.4 Add test

After describing the machine to be examined, you must define the condition monitoring tests. To create a test, select the reference archive (which has the machine name) and click **Add Test**.

A mask will be displayed (as shown in the figure) called **Editing Test Model 'ArchiveName'**.



*FTEditor: creation of a new model – add images*

On the mask right-hand side, under the Image label, one of the analysed machine images defined during the model setting up will be displayed.

It is possible to draw a red rectangle on the figure to highlight the area under examination. To draw the rectangle, click on the figure and drag the mouse until reaching the desired size. The rectangle will help the operator find the area to be measured.

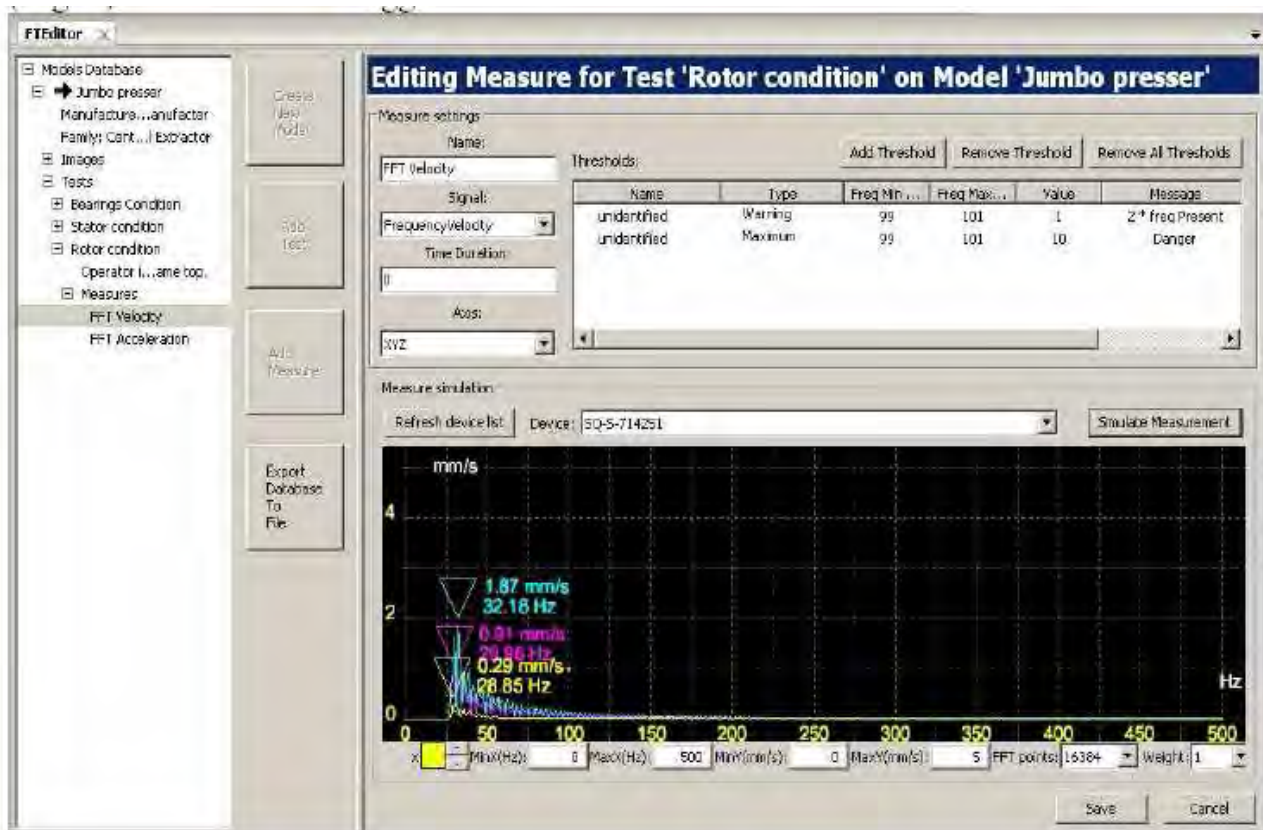
In the figure on the left, an additional image can be loaded (e.g. on the sensor positioning) to further help the operator.

The text box shall give instructions to the operators taking measures, therefore it is recommended to compile it accurately.

#### **4.5 Add measure**

After setting up the machine test, you must define the measures to be carried out on the machine. To add a measure, click on **Add Measure...**

The displayed mask shall be used by the compiler user to set up the measures to be carried out by the maintenance operator, as well as the alarm reference values (thresholds) and related messages.



*FTEditor: creation of a new model – test simulation*

The table below shows the measure setting fields.

Measure settings	
<b>Name</b>	Measure name
<b>Signal</b>	Domain and event to be measured (e.g. time – frequency – Rms)
<b>Time Duration</b>	Measure time duration
<b>Axis</b>	Reference axis

The **Thresholds** field defines thresholds in the frequency or time domain. When these thresholds are exceeded, the program will display messages informing the operator. As the aim of these messages is to help the operator perform diagnostics, they must be clear and easy to understand.

Measure simulate	
<b>Refresh Device List</b>	To refresh the device list
<b>Device</b>	Device used during simulation
<b>Simulate Measure</b>	To simulate measures on the field

<b>Thresholds</b>	
<b>Name</b>	Threshold name
<b>Type</b>	Type of threshold constraint: maximum, minimum or warning
<b>Freq. Min</b>	Lower end of threshold field in frequency domain
<b>Freq. Max</b>	Upper end of threshold field in frequency domain
<b>Value</b>	Threshold value
<b>Message</b>	Message to be communicated to the operator
<b>Action</b>	Action to be taken by the maintenance operator

The Graphics area below can be used to simulate measures to check the efficiency of the set parameter.

<b>Measure simulate</b>	
<b>Refresh Device List</b>	To refresh the device list
<b>Device</b>	Device used during simulation
<b>Simulate Measure</b>	To simulate measures on the field

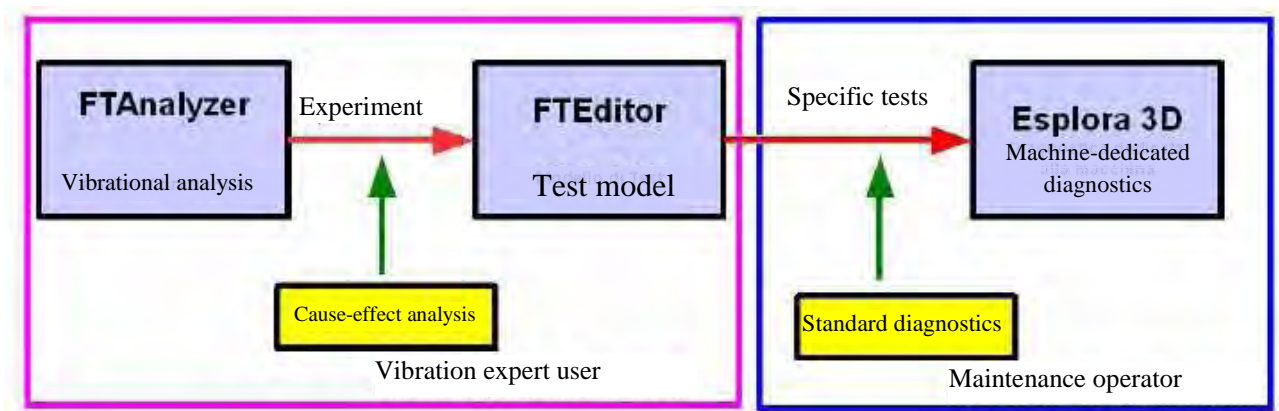
#### **4.6. Export database to file**

To export the database set up with FTEditor and use it on Esplora 3D, click on *Export Database to file*.

## 5.1 Philosophy of use

Esplora 3D is Sequoia IT software solution designed for maintenance operators in charge of machine or installation diagnostics. Esplora 3D makes it possible for the maintenance operator to carry out predictive diagnosis by following the program instructions based on the comparison of threshold values.

As outlined in the previous chapter, the expert user sets up an archive of the different tests and related guidelines with FTEditor, while the maintenance operator will perform these tests through the Esplora 3D software for the machine state detection.



*Architecture for use of Sequoia IT software*

Through the Esplora 3D specific module, it is possible to save these tests for the creation of automatic reports and maintenance sheets regarding the examined machine.

Esplora 3D is based on the *Model Instance* and *Model DB* concepts explained below.

### *Model Instance*

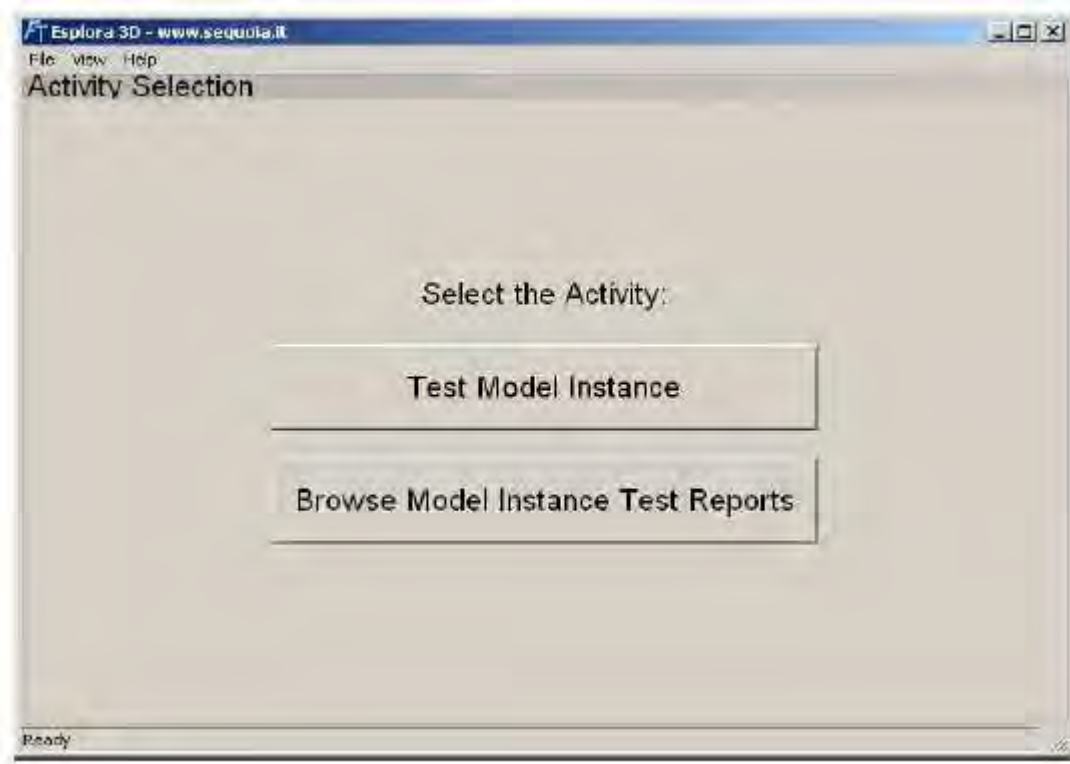
The diagnosis made by a maintenance operator on a machine is based on data such as, manufacturer, serial number, location and main features (e.g. colour, processed substance, etc.); basically, every machine represents a specific case, therefore each machine is considered by Esplora 3D as a **Model Instance**.

As a result, for the machine identification it is necessary to create a Model Instance by setting at least two of the parameters shown in the table.

Parameter	Meaning
Serial Number	Machine serial number
Machine Identification	Machine identification
Location	Machine location also in relation to a plant
Machine Model	Mode

### *Model DB*

**Model DB** is the archive regarding a specific machine family. It includes tests and related guidelines, as well as any actions to be taken in case of faults.



*Esplora 3D: start*

## **5.2 Start**

To start up Esplora 3D, click start and then proceed as follows:

*Start>Programs>Sequoia IT Esplora 3D>Esplora 3D 1.2.z.t*

Should the program not start or any error messages be displayed, follow the suggestions provided in paragraphs 2.3 and 2.5 of the present manual.

When Esplora 3D is started, the program main view will display two options: **Test Model Instance** and **Browse Model Instance Tests Reports**. The **Test Model Instance** key will start the machine diagnostics procedures, while the **Browse Model Instance Tests Reports** key will browse stored reports. Before diagnostics, always make sure that the software has loaded the suitable archive (**Model DB**).

### 5.2.1 Import Model DB

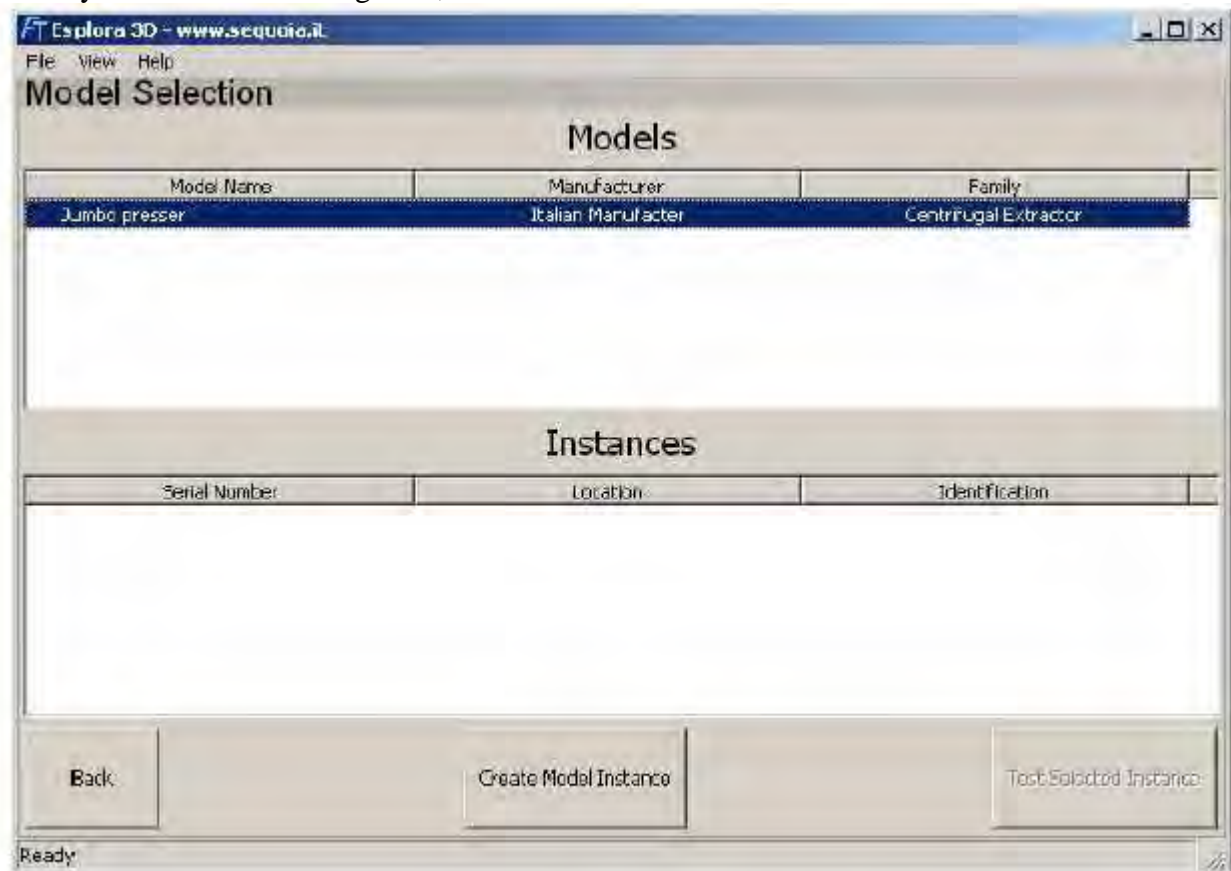
As stated above, make sure that Esplora 3D has loaded the **Model DB** concerning the analysed machine. Proceed as follows:

*File>Import Model DB* or press *Ctrl + I*

An *open file ...* view will be displayed, select the reference database and click **open**.

### 5.3. Test model instance: model – machine selection

To carry out the machine diagnosis, click on **Test Model Instance**.



*Esplora 3D: model selection*

A view will be displayed with two sections: the top one is called **Models** and the bottom one **Instances**. The **Models** section shows the models available in the database, while the **Instances** section shows the **Model Instances** concerning the selected model. Should the **Models** section not show the class of the examined machine, make sure the database is correct (see previous point). The view also displays three buttons with the following functions:

- **Create Model Instance** to create an instance of the loaded model;
- **Back** to cancel operation and return to the previous view;
- **Test Selected Instance** to carry out tests.

Select the model in the **Models** section and the created instance in the **Instances** section, then click on **Test Selected Instance** and carry out diagnosis.

It is necessary to select the machine model (**Model**) and the instance (**Model Instance**) which must be created as explained below.

### 5.3.1 Create model instance: instance creation

To create a new instance, click on **Create Model Instance** and fill in the displayed mask with at least two information on the examined machine.



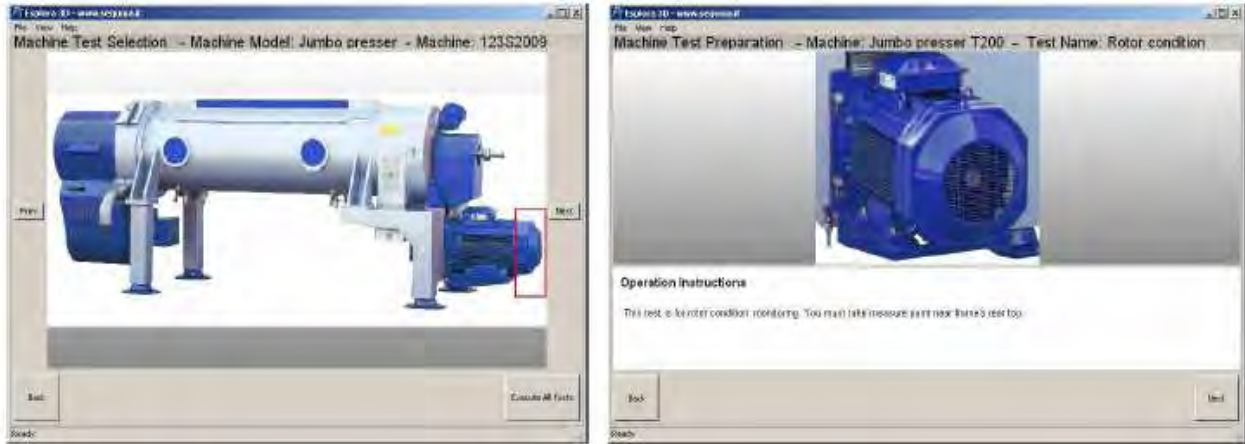
*Esplora 3D: Model Instance creation*

Indicate as many data as possible for future quick report identification.



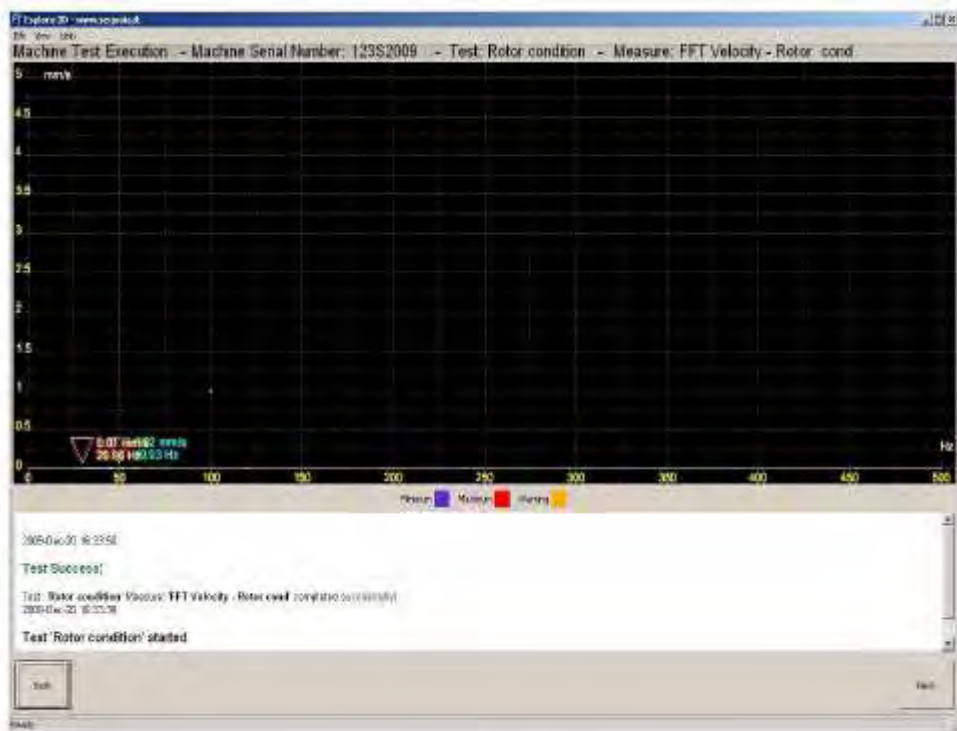
### 5.3.2 Test selected instance: diagnostics

To start testing, click on **Test Selected Instance**. A new view is displayed with the image of a machine like the one being tested. Moreover, the concerned area of the machine is highlighted by a red rectangle drawn on the image. **Next** and **Prev** keys can be used to display other images, if loaded.



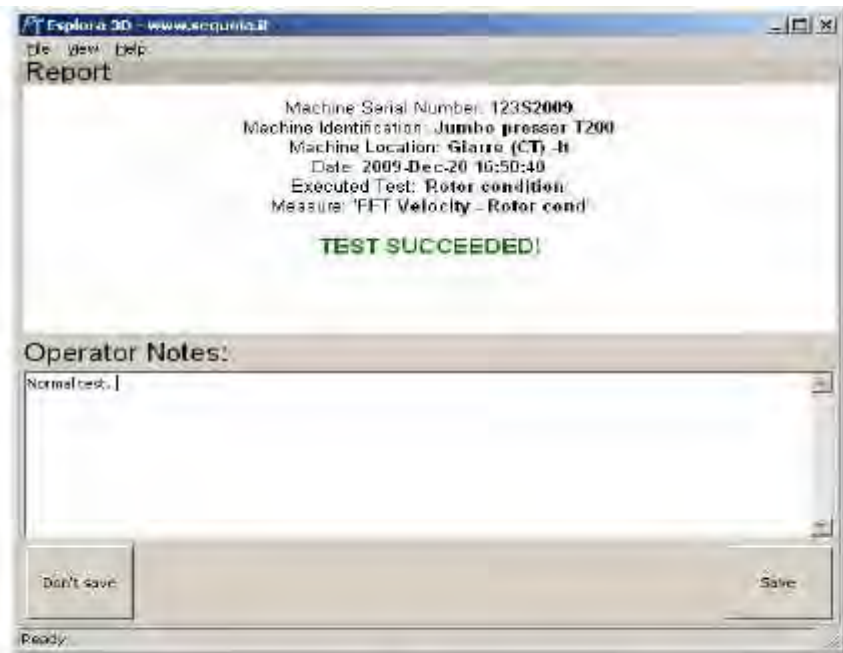
*Explora 3D: Operator instructions*

After identifying the sensor positioning area, you can perform tests by clicking **Execute All Tests**. Another view will be displayed with the operator instructions and an image providing further information to the user. The view top part also shows the machine identification and the name of the test being prepared. After clicking **Next**, the program will ask to find the acquisition device to be used, if more devices are connected.



*Explora 3D: Test*

The test time duration was established by the expert user who set up the test model, therefore the operator does not have any control over the acquisition time length.

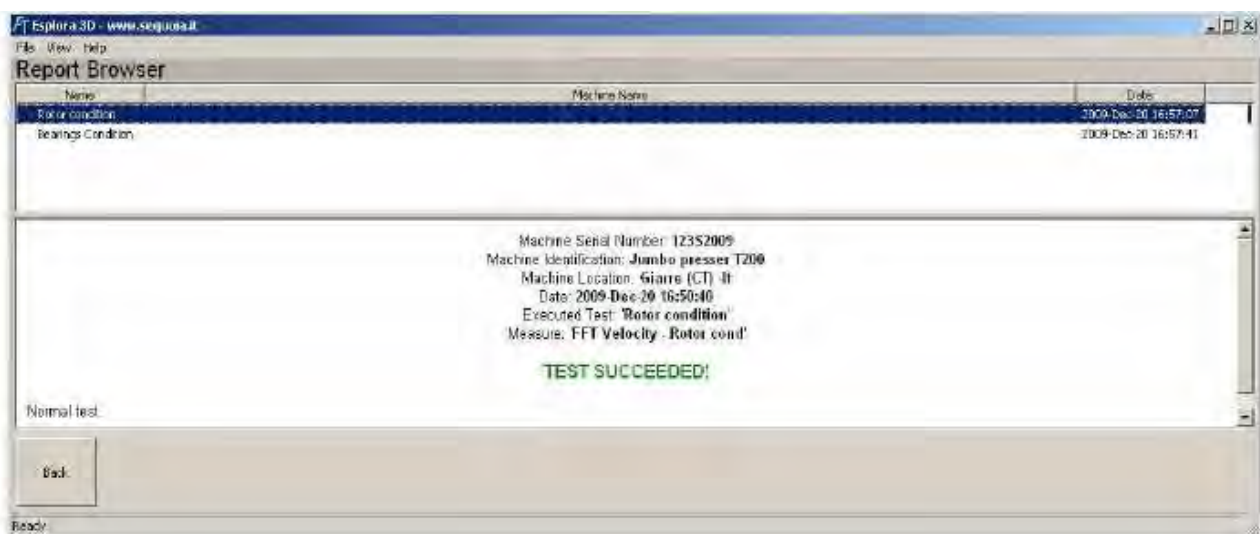


### *Esplora 3D: esito del test*

When the test is complete, the program will show the result in the section below the *Graphics area*. In case of failure, the database message will be displayed again with the related suggested action to be taken. When the test is concluded, the operator can decide to draw up a report and save it on disk. The program will execute all the tests in the machine archive.

### **5.4 Browse model instance: see reports**

By clicking **Browse Model Instance Tests Report** the user can see the stored test results, as in a virtual test archive.

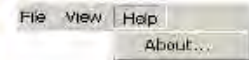


### *Esplora 3D: browse reports*

## 5.5 Menu

The pop-up menu toolbar of Esplora 3D consists of three pop-up menus offering different actions. The table below provides the list of menus and their general description.

File	
Import Model DB	To import a test archive
Exit	To exit the program
View	
Show Device	To view the device list
Fullscreen	Full screen application
Help	
About	Information on <i>FastTracer</i>



## **Bibliography**

- 1. - Analysis I - "How to implement an effective condition monitoring program using vibration analysis " - Technical Associates of Charlotte, P.C.**
- 2. - Analysis II - "Concentrated vibration signature analysis and related condition monitoring techniques" - Technical Associates of Charlotte, P.C.**
- 3. - "An introduction to random vibration, spectral & wavelet analysis" Shock and Vibration Handbook - Cyril M. Harris**

## Notes

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