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Release notes	Date
First release	15th May 2013
Revision A	29th July 2013
Revision B	
Revision C	
Revision D	

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Table of Contents

1 Introduction

This product has been developed to work on any properly configured version of the following Operating Systems:

- Windows XP (32-bit and 64-bit)
- Windows Server 2003 (32-bit and 64-bit)
- Windows Vista (32-bit and 64-bit)
- Windows 2008 (32-bit and 64-bit)
- Windows 7 (32-bit and 64-bit)
- Windows 8 (32-bit and 64-bit)
- Windows 2008 R2
- Windows Server 2012

Due to the nature of the anti-piracy security technology built into this product, using illegal keys may lead to software failure or instability.

Before running the setup file, make sure that all the other programs are closed. This includes anti-virus software and any other programs which are running. If you do not follow this procedure, it may interfere with the normal setup procedure.

To start installing the software onto your computer, just make sure your CD-ROM was placed into the CD-ROM player. Because of its "Autorun" functionality, the installation program will start automatically. When this doesn't happen, go to "My Computer" and double click the CD-ROM icon. Find the AUTORUN folder. Next: double click on the installer (*Autorun.exe* file) and follow the instructions displayed on screen.

Now, you are ready to install the application on your computer.

2 The installing procedure

For a complete installation, you must follow the next steps:

- Install the SystemChecker application.
- Install *CXSpectra*™ and run it once.
- Install the latest Service Pack for *CXSpectra*™
- Install the Drivers for HASP Protection Key.
- Configure *CXSpectra*™ for Windows 7 and Windows 8 Operating Systems.

2.1 Installing SystemChecker

Sometimes, during *CXSpectra*™ installation, some of the additional files required by this applications are not installed. This happens when the user doesn't have the full administrator privilege during the installation procedure, or from another unknown reason. In such a situation, you should also install in your computer the *SystemChecker* application. By doing this, the files required for *CXSpectra*™ will be installed or properly updated. The installed files are virus checked and are in accordance with the Microsoft recommendation.

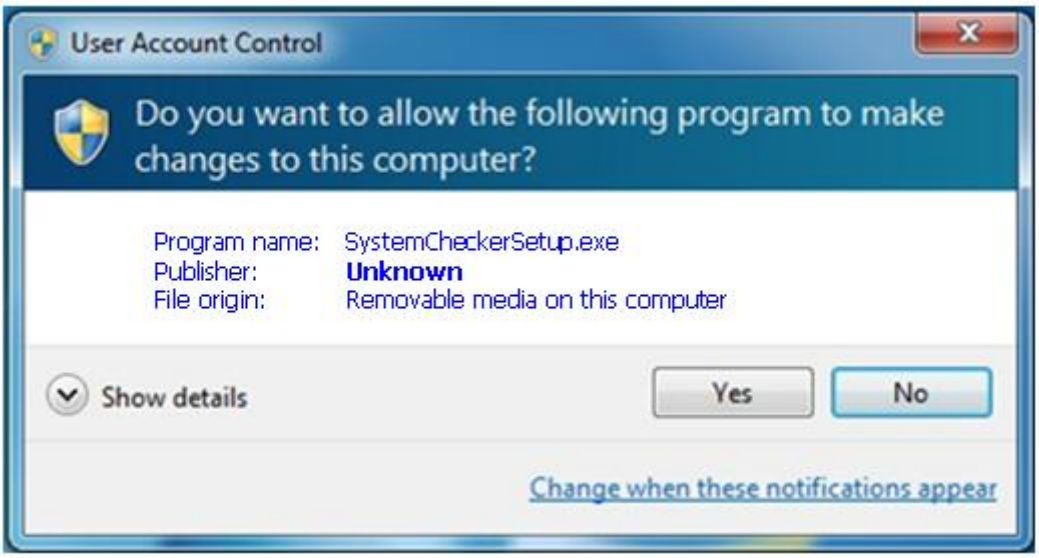
For more details, please read the following article:

Description of the cumulative update rollup for the Visual Basic 6.0 Service Pack 6 Runtime Extended Files on address:
http://support.microsoft.com/kb/957924

Click on:

Follow the instructions displayed on screen.

After clicking the SystemChecker label, the following warning message may occur:

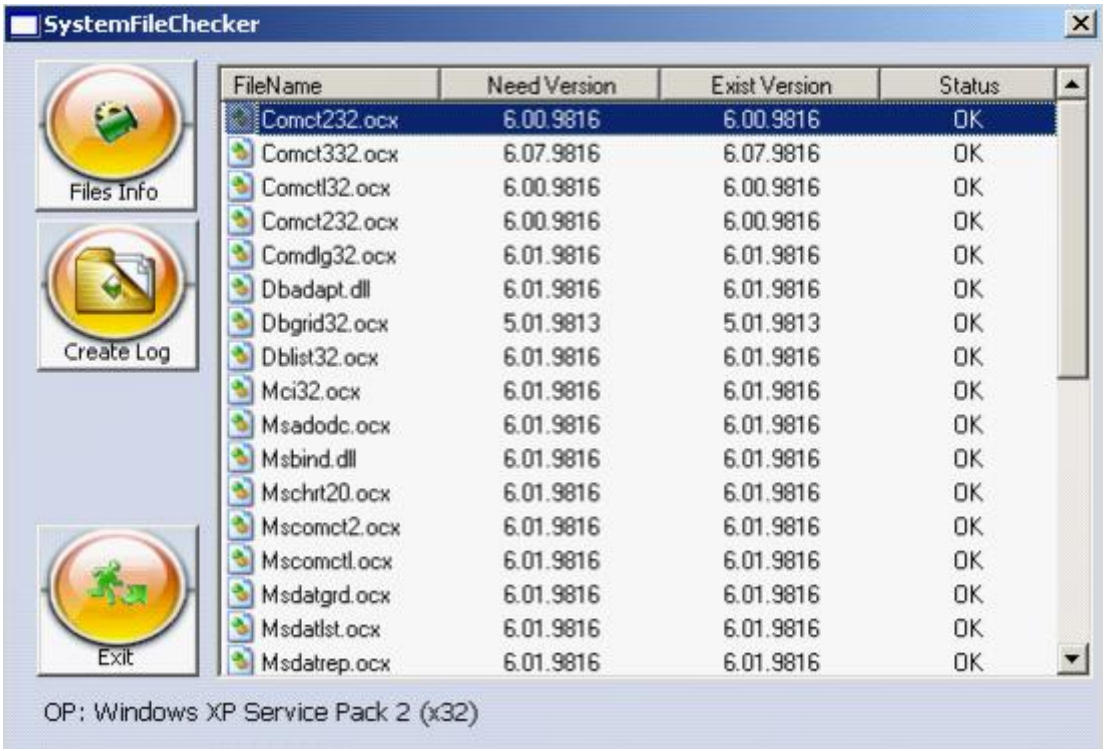


Windows 8
Windows 7

Just click **Yes** to continue with the installation.

Once the installation finished, just run the *SystemChecker* and look on the installed file status, to observe if they are all OK. If not, you may probably have a security issue and you should ask for your IT Administrator help.

The *SystemChecker* window looks as follows:



The file status appears on the right side.

2.2 Installing CXSpectra™

Click on:

Follow the instructions displayed on screen.

If you accept the default location, *CXSpectra™* will be installed on *C:\Program Files\CXSpectra* directory.

Windows 8
Windows 7

After clicking *CXSpectra* label, the window *User Account Control* may appear.

Just press **YES**.

When the installation is finished, you must run for the first time your *CXSpectra™* application.

Now, you can also select the software language.

You may use the icon placed onto your desktop. Because the application doesn't find any HASP Protection Key, you may run the *CXSpectra™* in Demo mode. Just access your application, and then close it.

From now on, the Operating System will know the location where your *CXSpectra™* has been installed.

2.3 Installing the latest Service Pack

The latest available *Service Pack* is always onto the CD-ROM.

Click on:

Follow the instructions displayed on screen.

After clicking the *Service Pack* label, the window *User Account Control* may appear.

Just press **YES**.

2.4 Installing the HASP Drivers

To run normally your *CXSpectra™* application, you need a proper HASP Protection Key, attached in any USB free hub. The Protection key won't be recognized by the Operating System, if the key drivers haven't been installed first.

Click on:

Follow the instructions displayed onto the screen, to complete the installation.

In a few seconds, the HASP Protection key will lit, indicating that the drivers were successfully installed.

For further information about the HASP Protection Key Drivers, please read the *readme.html* file, existing into the *HASP Drivers* folder or visit:
http://sentinelcustomer.safenet-inc.com/default.aspx

Please note Sentinel HASP product is now referred to as Sentinel LDK.

When the HASP Drivers have been installed, you may run and use the *CXSpectra™.*

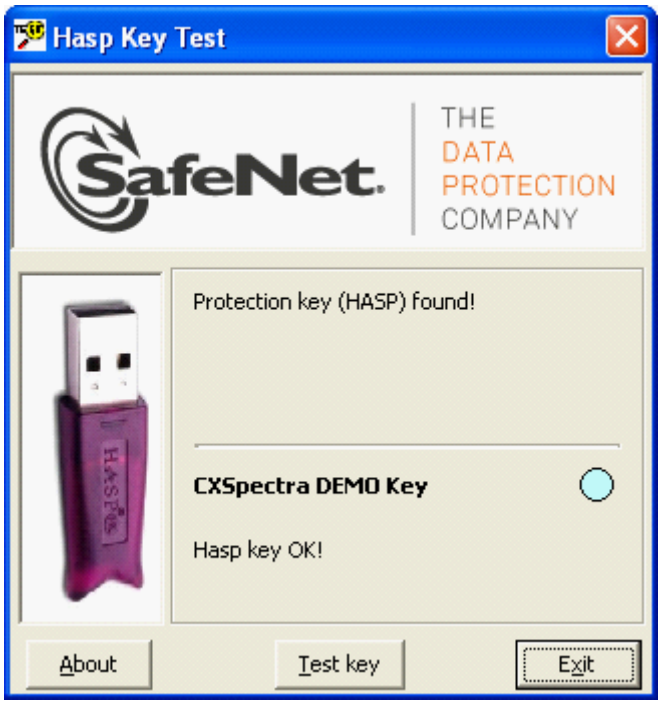
Before starting *CXSpectra™*, you can check if the USB protection key drivers were properly installed, by running the external software: **Start** > **Programs** > **CXSpectra** > **Test Protection Key**.

In Windows 8, all installed applications will appear as follows:

Just click the icon to open the desired application.

The **Test Protection Key** is simple software, used to detect any possible problem of the HASP Protection key. Make sure the protection key is inserted in any USB hub and press the **Test Key** button. If the protection key drivers are properly installed, the key type will be shown. Otherwise, an error message will be displayed on the screen.

If a *CXSpectra™* Key is found, the screen will appear as follows:

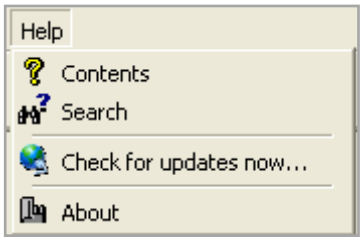


CXSpectra™ has associated three types of Protection Keys:

- User Key (light green)
- Demo Key (light blue)
- GraphView Key (Black)

The **Demo Key** is a trial key and cannot be used for commercial purposes.

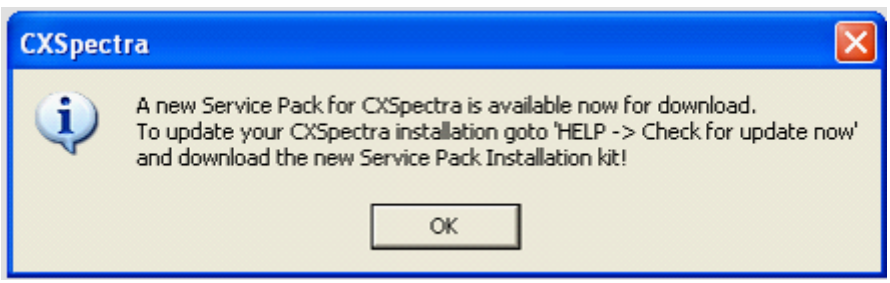
2.5 Updating the CXSpectra™ software



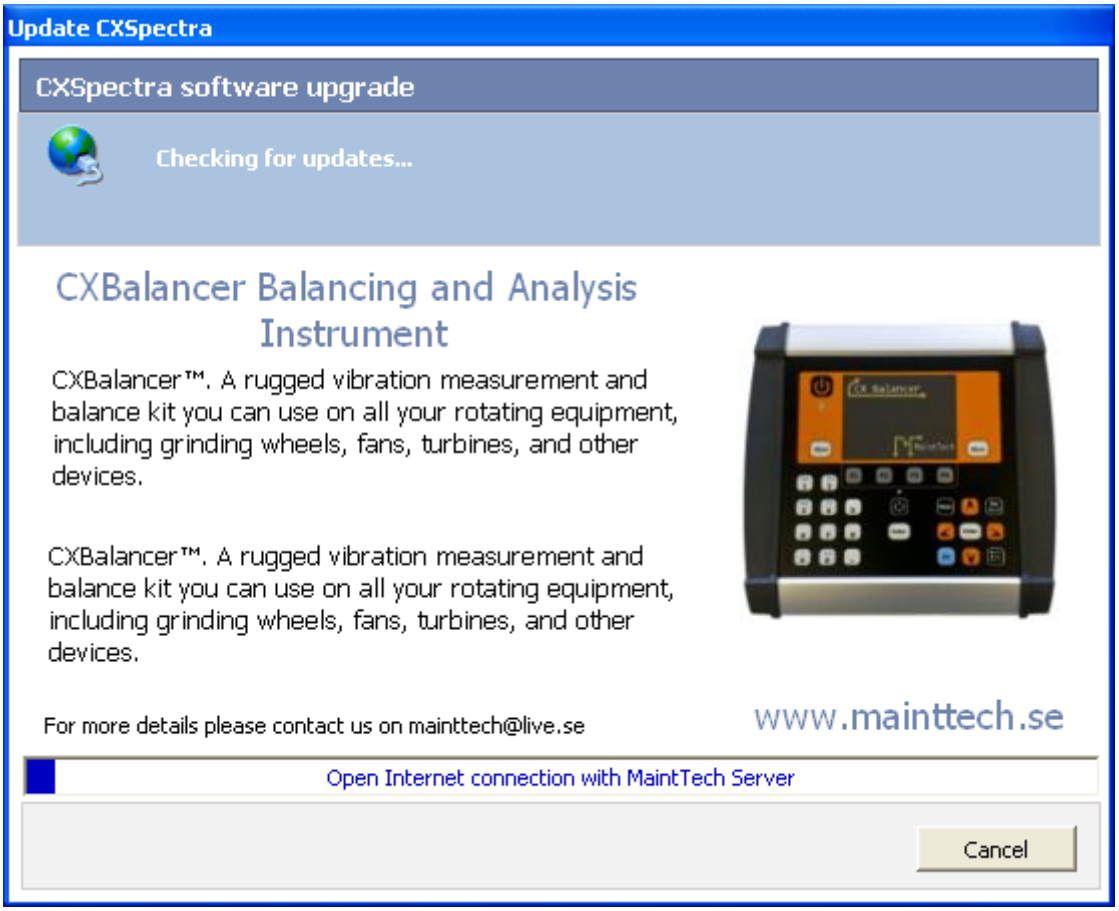
The *CXSpectra*™ software is equipped with an automatic software update check.
You can easily check if there is any free update available, by selecting:
Help > ***Check for Updates now...*** from the menu bar.
An Internet connection is required for this.

If a new update (*Service Pack*) is available, the downloading of the package will begin on your demand. Please, check regularly if a new *Service Pack* is available. The updating of the existing *CXSpectra*™ is free.

NOTE: If you start *CXSpectra*™ and you are connected to the Internet and a new *Service Pack* is available, you'll always get the next message box onto the screen:



This is just an announcement. Please, use the above described procedure, to download the newest *Service Pack:*



The updated files will be downloaded in your computer, in the **Download** folder, created in the **CXSpectra** directory.

2.6 Installed applications

By following the above instruction, you will install on your computer the following applications:

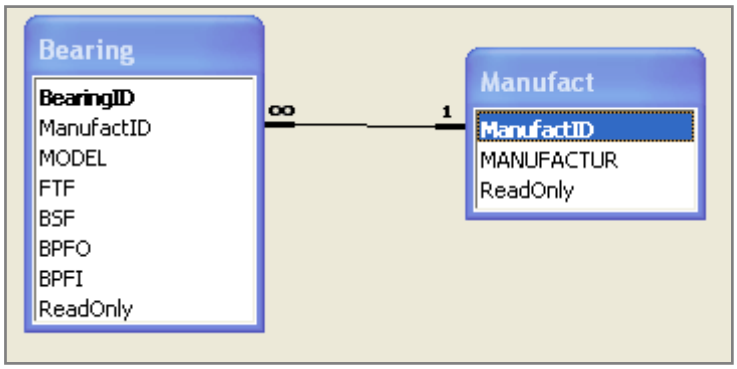
- *CXSpectra™* - Analysis and Proactive Maintenance Software
- *Test Protection Key* - A fast way to test the functionality of your HASP protection key
- *HASPUserSetup* - A kit to reinstall the drivers for the HASP protection key

2.7 Local resources

Once installed in a computer (workstation), CXSpectra™ can open many *Machine databases* existing in the computer or across the accessible Network.
During runtime, CXSpectra™ software creates temporary files in the application directory (..\CXSpectra). It also creates a temporary directory under application directory, where the Service Pack package will be downloaded by Internet.

CXSpectra™ always uses a series of files (databases or configuration files). The format of these databases is MS Access 2007. The databases described below are exclusively used by CXSpectra™ and they mustn't be accessible within the network. CXSpectra.dat databases and Template.mts will be created by the application, if they don't exist.

2.7.1 Bearing.dat

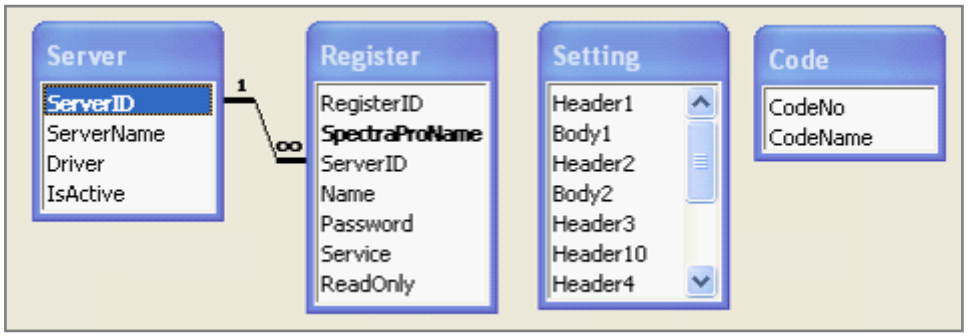


CXSpectra™ must have the right to:

- open exclusive the database;
- read a record;
- modify a record;
- delete a record;
- add a new record.

User access to database can be tested using an ODBC standard connection to a MS Access database.

2.7.2 CXSpectra.dat



- **Code Table** - Inspection codes for Route measurements
- **Setting** - Contain Report Headers and Body templates (in RichText Format)
- **Server** - List of available database server (MS Access)
- **Register**- Contains the link of the registered databases for CXSpectra™.

This database is created on the first run of the CXSpectra™ with default values. The Register Table contains only DemoCX.db3 database (included in the Installation package and placed in..*CXSpectra**Data* folder.
CXSpectra™ must have the right to:

- create the database;
- open exclusive the database;
- read a record;
- modify a record;
- delete a record;
- add a new record.

User access to this database can be tested using an ODBC standard connection to a MS Access database.

2.7.3 Template.mts

This is a complex structure database, similar with CXSpectra™ databases and it is used to store the Machine Template.
CXSpectra™ must have the right to:

- create the database;
- open exclusive the database;
- read a record;
- modify a record;
- delete a record;
- add a new record.

User access to the database can be tested using an ODBC standard connection to a MS Access database.

2.7.4 CXSpectra.ini configuration file

This is a standard Windows INI file, used to store some settings. Although the majority of the settings are stored in Windows Registry, the ".ini" file can be manually changed by the user. The user must be able to open the CXSpectra.ini file with a NotePad editor and to save the changes he has done.

CXSpectra™ must have right to:

- read items;
- add items;
- modify items.

2.7.5 Constants.ini file

It contains some coefficients used to create the Diagnosis Reports. The user must be able to open the Constants.ini file with the Notepad editor and to save the changes made.

CXSpectra™ must have the right to:

- read items only.

2.8 Public databases

The main purpose of **CXSpectra™** is to create and to update the so-called "Machine Databases" with measurements and notes. **CXSpectra™** can create an unlimited number of Machine Databases. **CXSpectra™** can create new databases or to register the existing Machine Databases created by another **CXSpectra™** instance.

The Installation Package includes a single machine database (MS Access type), named DemoCX.db3. This database is installed in...\CXSpectra\Data folder.

User databases are created as default in...\CXSpectra\Data folder, but the user can decide to create the database in a shared folder, from his computer.

The databases may be shared by many users across the network. Before using these databases, the user must register them (in his CXSpectra.dat database). The databases created by a user are automatically registered for its **CXSpectra™** instance.

After it has been created, the database can be populated and used by any **CXSpectra™** instance.

3 Running CXSpectra™ (for Win 7 and Win 8 only)

CXSpectra™ is a safe application. All the files required by CXSpectra™ are located in the CXSpectra™ installation folder (excepting the Machine databases).

CXSpectra™ uses its own Registers to save various settings, legally created in: HKEY_*CURRENT_USER**Software**VB and VBA Program Settings**CXSpectra* registry folder.

Also, the CXSpectra™ application doesn't need a *Write* access either to any system folder, or to any existing folder from the computer. CXSpectra™ is running properly having the administrative privileges, but can run also under a normal user account.

If CXSpectra™ cannot be run from a normal user account, you may need to give to the application more Administrative rights. This might be done in various ways.

A simple solution is to use the *RunasSpc* application, available on: http://www.robotronic.de/runasspcEn.html

It allows you to create a shortcut of CXSpectra™ with encrypted administrator credentials. So, CXSpectra™ will run with administrative privileges, even if starts from a normal user account.

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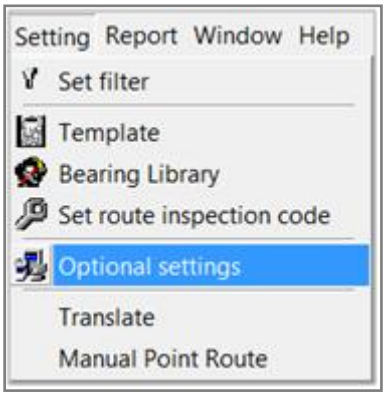
5 General Settings

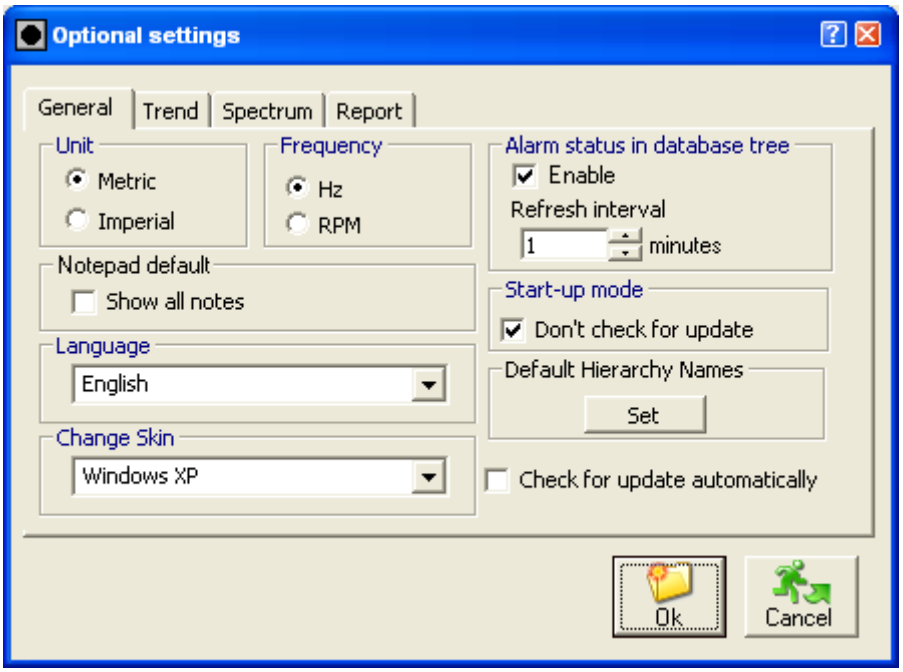
CXSpectra™ application can be configured using the **Optional Settings** command:

All settings can be done in the followings tabs:

- General
- Trend
- Spectrum
- Report

5.1 General tab settings



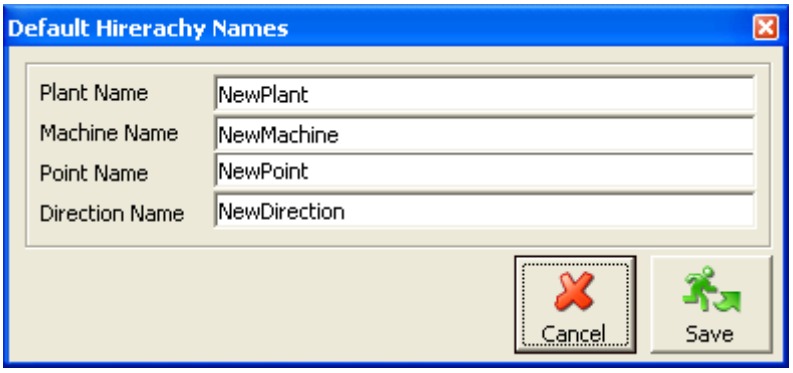


In the window above, you can set the following:

- ***Unit selection****: Metric* or *Imperial*
- ***Frequency default unit***: *Hz* or *RPM*. This setting can always be changed from the right-mouse popup menus, in the plots.
- ***Alarm Status***: Can be set on *Enable* or *Disable*. If the **Alarm status** is on *Enable*, the *Refresh* interval can also be adjusted. For further information read the *Updating Alarms* chapter.
- ***Show all notes***: As default, in the *Notepad* is shown only the record related to the

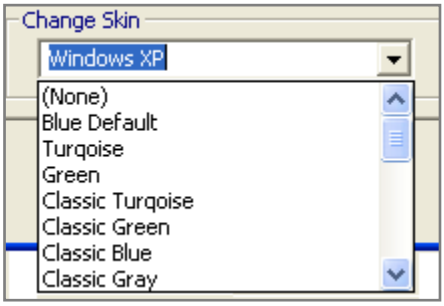
machine into the three. If you check this option, the *Notepad* will contain the whole machine history.

- ***Language***: Set the application Language.
- ***Default Hierarchy Names***: When a new item was added in the machine database, a default name appears for that item. You may change this default name in the *Default Hierarchy Names* window, as shown below:

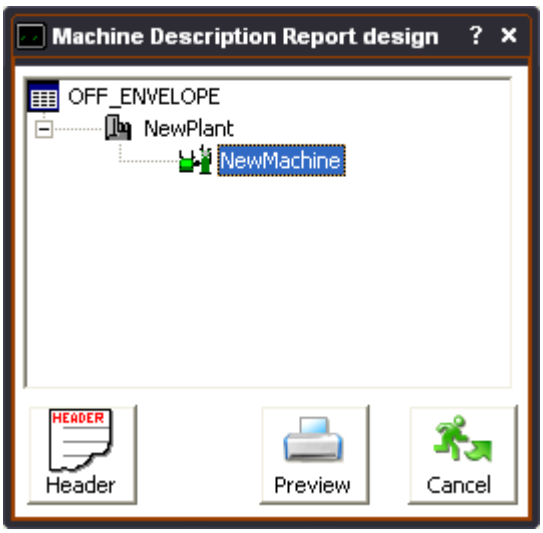


- ***Change Skin***: Apply a personalized skin to all the application forms.

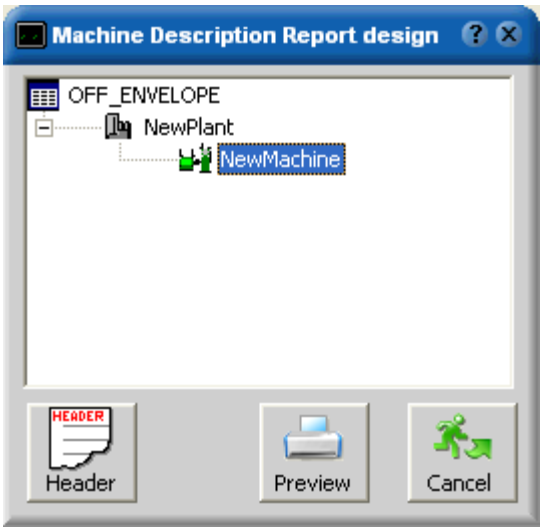
When CXSpectra™ starts for the first time, the *Operation System Color* scheme is used by all forms. You may change this, applying a "skin" from a pre-defined list:



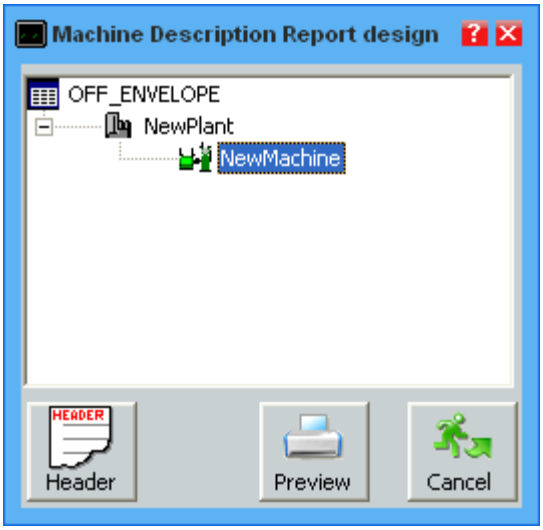
See bellow some images showing how the forms look with various skins:



Plain Black with Orange



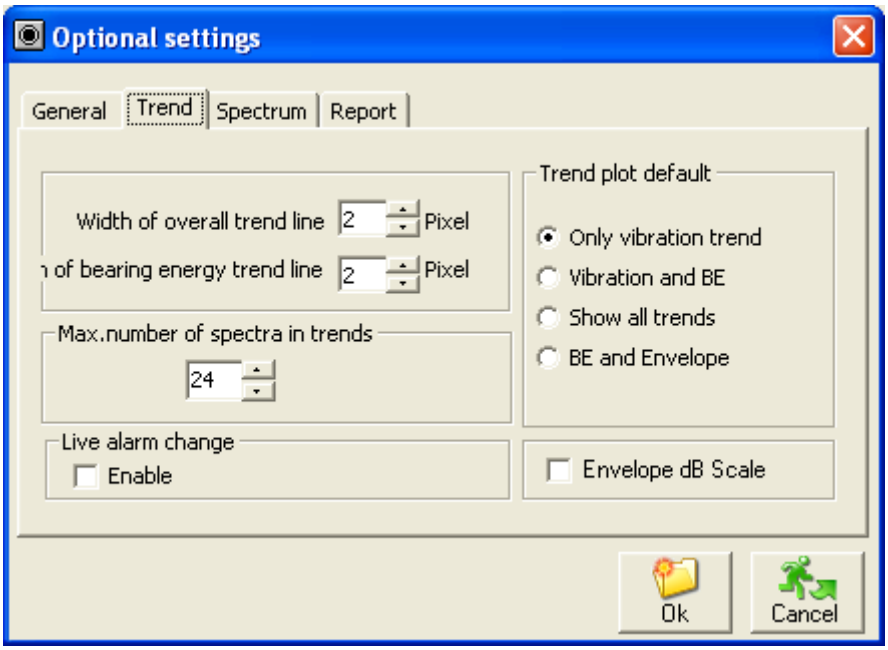
Blue Default



Win 8 Style

- ***Check for update automatically***: If this check box is checked, each time when the CXSpectra™ software starts, the application will check if a new Service Pack is available and will inform the user about this. If the computer doesn't have a connection to the Internet, on start-up, this action may take a while. Check this box only if you have a high speed access to the Internet.

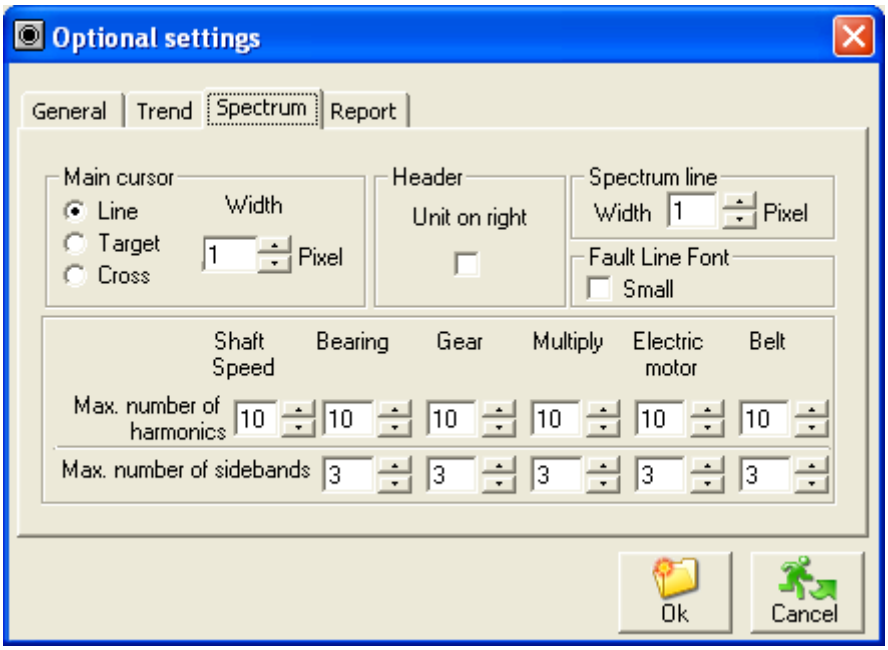
5.2 Trend tab settings



Max. Number of spectra in trends: As default, this number is set to the latest 23 measurements plus baseline (if exists). This number is adjustable to any reasonable value.

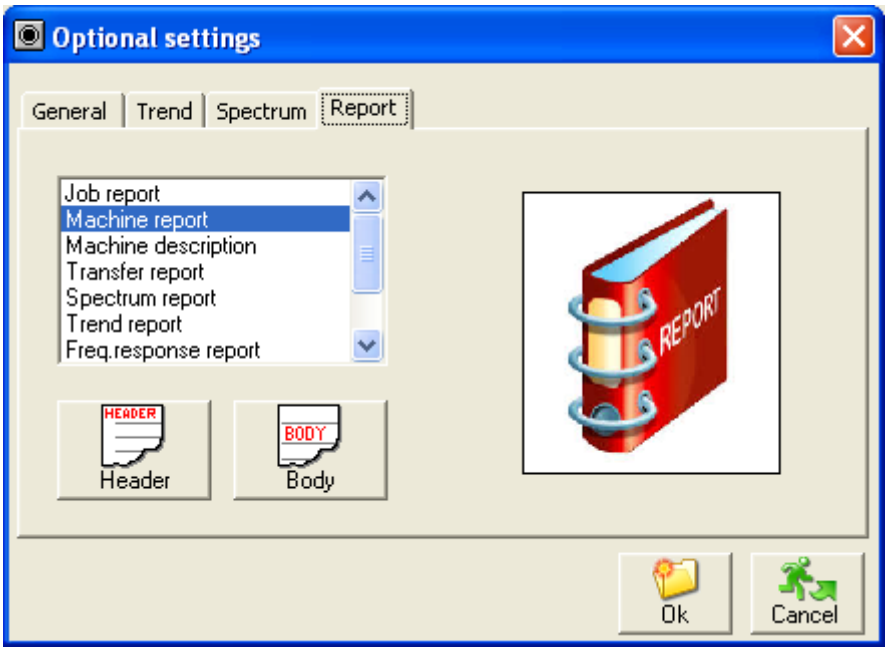
- *Line width* for trends can be adjusted to be 1 or 2 pixels thickness.
- *Live alarm* change. If this setting is checked, you will be able to adjust the alarm limit in any trend plot. Just place the mouse cursor on the alarm border and drag it. Then save the newest value. See *Trend plot* for more details.
- *Trend plot* default can be:
    - Only vibration (or spectra) trend
    - Vibration and BE trends
    - All trends (Vibration, BE and Envelope)
    - BE and Envelope
- *Envelope dB Scale*: if this is set, the trend amplitude scale will be shown in dB instead of the vibration engineering unit, set in the *Alarm* panel.

5.3 Spectrum tab settings



- *Main cursor* aspect (Line, Target or Cross)
- *Header* aspect. If it's set, the *Total values* will appear in the left side of the *Spectrum* window header.
- *Spectrum line* thickness can be adjusted to one or two pixels.
- *Fault line fonts*. This can be adjusted to be normal or small.
- *Number of harmonics* and sidebands for various faults can be adjusted.

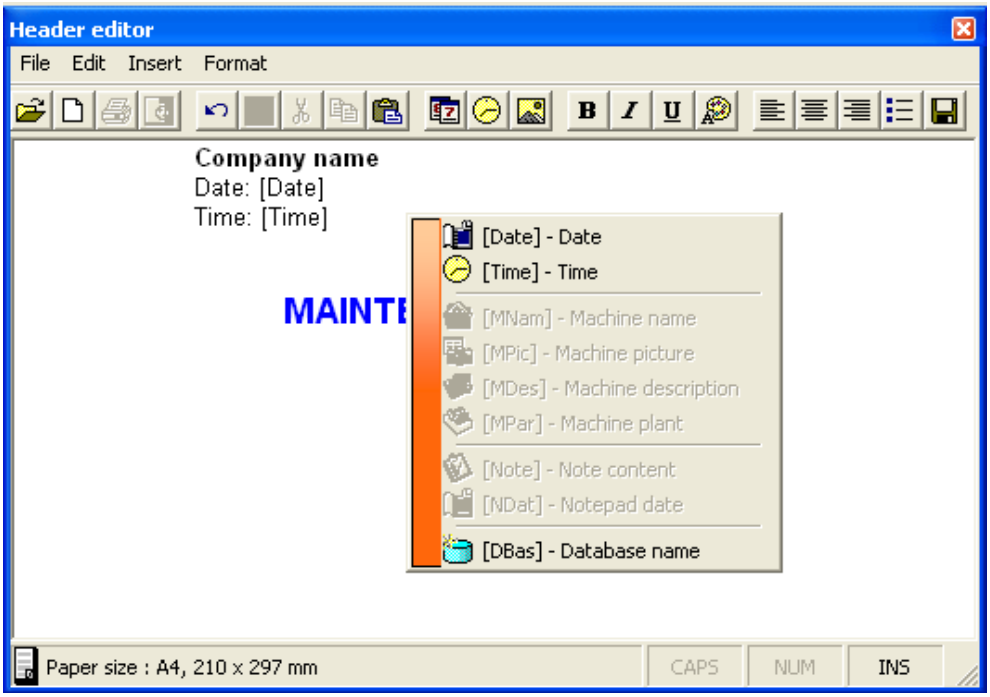
5.4 Report tab settings



The user can customize the **Header** and the **Body** of several available **Reports**.
First of all, you must select the *Report Title* from the list, and then you will be able to

customize the **Header** and the **Body**.

- **Header design**

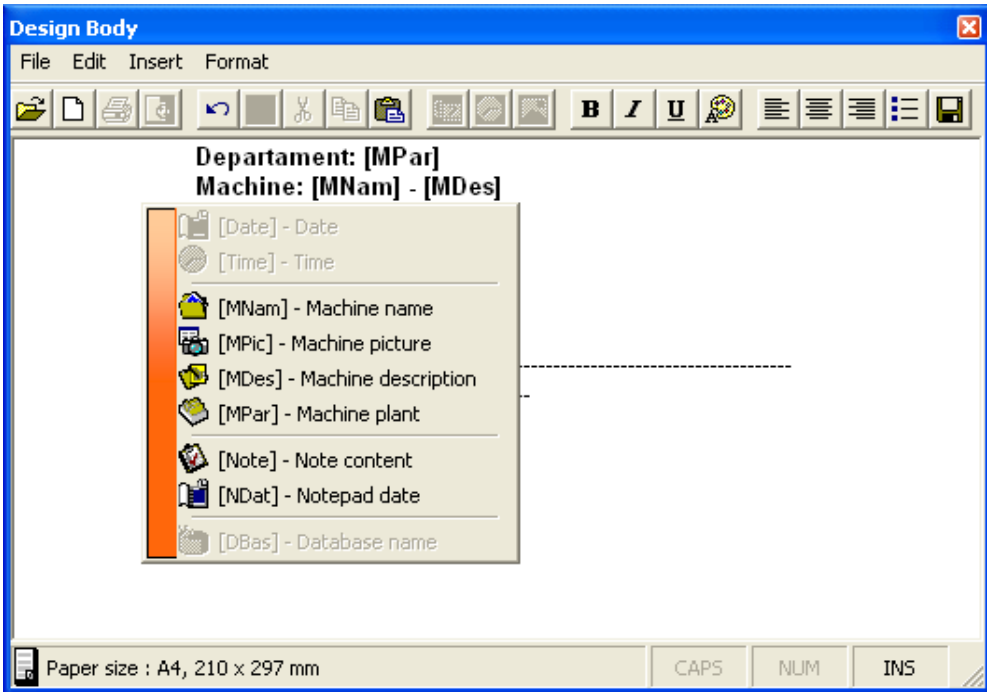


Header can be designed in the **Header Editor**.
From the popup menu some reserved words can be added in the **Header**. These words (included in squared bracket) will be replaced with the actual data:

- [Data] - Computer date
- [Time] - Computer time
- [DBas] - CXSpectra machine database name.

A designed **Header** can be saved into a file; so many headers can be used from the same report.

- **Body Design**



The body design decides the contents of the Report.
From the popup menu some reserved words can be added in the report body. These words (included in squared bracket) will be replaced with the actual data:

- [MNam] - Actual name of the machine
- [MPic] - Machine picture
- [MDes] - Machine description
- [MPar] - Machine plant (or Department)
- [Note] - Notepad contents, edited before by the user.
- [NDat] - The date when the notes have been edited.

6 CXSpectra™ Overview

CXSpectra™ software is mainly dedicated to implement a true ***Proactive Maintenance Program***.
For every plant, you can create a database, which can have an unlimited number of machines, points and directions. The spectra are stored at the level of the measurement directions. If you store more than two spectra for a direction, then you can display a trend. A trend can be shown for **Total Vibration** or for **Bearing Energy** Coefficient (BE). If the **Envelope** measurement is done, also **Envelope spectra** are available for **trending**.

On the Machine level, the Manual Entry point can be added. The **Manual Entry** points are not measured points, but values entered directly using the keyboard.

For the CXBalancer® Instrument you can also add **Manual Entry points** in the Route measurements.
By default, only the latest 24 measurements are shown for one direction, but you can change this number using Settings > Optional settings command.

The program allows to copy, via clipboard, any displayed graph (spectrum or trend) and to paste it later into a text editor (e.g. WORD) or in **CXSpectra™** *Notepad*. The customized professional reports of the machines can be made this way.
The machine **Database** stores machinery measurement, unloaded from the CXBalancer® instrument.
The users can add, in the application *Notepad*, information following the diagnosis procedure.
With the Database > Import command, external useful data can be added into the databases, regarding repair process, spare parts used etc. This information can come directly from CMMS or prepared, in a special format by the maintenance teams.
That's how valuable, complete information can be added, in time, for each machine in the databases.
Analyzing this information, periodically, you can act proactively and to discover the real causes of the failures.
The main purpose of using this software is to supply the maintenance team a periodical report regarding the necessary action, to maintain the machinery in od working condition. For this reason, **CXSpectra™** can create a Job report.

In order to analyze the collected data, you have on your choice many ways of viewing data:

- A collection of trends and spectra selected by you (View > Show selected information).
- A Quick View session, where you explore the machines, trends and spectra associated to the selected direction (View > Quick View). If Bands are defined, also Band Trends are available. Trends and spectra from the whole machine,

where you can see at once all these trends and spectra associated to the selected machine (View > Show spectra from whole machine).
- A List View, where you can see at once all Total values (Vibration, Bearing Energy and Envelope) for the whole machine (View > List View). The Alarm status is also indicated.
- A Band View, where you can see, at point level, all vibration total values and Band values (peak average for the band width). Alarm status for the above is also indicated (View > Band View).
- GraphView is a special mode of displaying the data. A GraphView protection key is required. The GraphView project can be customized using the View > GraphView command.

For all these views, a *Notepad* is available on the machine level, to type all the notes during the diagnosis process.

Finally, chose the Report > Job Report command and you can customize a report for the maintenance teams, using all the notes supplied. Once you customize a Job Report, the appearance of this will be saved, and next time the report can be created faster.

Job Report can be transferred into a text editor. You can then preview, modify and finally print the Job Report. You can also preview the report and send it directly to the system printer.

From time to time, you will want to make a report regarding all the history of a selected machine.

Use Report > Machine History command to do this.
You can also customize the History report and then preview, modify and print it.
The previously mentioned reports have distinct purposes:

- The Job Report is addressed mainly to the maintenance team.
- The Machine History is useful to take some proactive actions, before a failure of the machinery occurs.

The **CXSpectra™** software is a very flexible software and offers you many commands to do the same action in different ways. Before using the software, read carefully this document and, by using **DemoCX** databases provided in the installation kit, try to learn how to use efficient this powerful program.

If you run this software for the first time, then you can use **DemoCX** databases which are included in the installation kit. So, you can learn how to work with the software and to evaluate the special performance of it.

On the screen, a list of **Menus** and a **Toolbar** are displayed. In the **Status Bar**, on the bottom of the screen, the active database is also displayed. On the first run, the active database is **DemoCX**. Although you can create your own database, on the very beginning, just use **DemoCX** database to display spectra and trends.

If you run the program for the first time, select **Settings** > Optional Settings command. Select the units (metric or imperial) and the measurement unit for frequency (Hz or CPM). For the moment, don't change the number of spectra in trends. You can do this later. Click **Save** to save this setting.

Choose from View menu, the Show Selected information command. A specific window will appear on the screen and it will allow you to choose the department, the machine, the point and the wished direction. Choosing is done by selecting a certain direction, with the mouse, in the above-mentioned order. When the direction is selected, in the upper right

side of it, a list with all collected measurements for that direction will appear. Coloured small icons indicate also alarm conditions for the measurements. A check mark icon indicates the baseline spectrum, if set. Now, you can select a collection of trends and spectra to be shown.
Just double click any trend or direction and the item will be moved to the *show list.*

Instead of double – clicking, you can drag and drop any *Direction* or *Spectrum* to the *show list*.
If you want not to display some items from the show list, just double – click on that items and items will be remove from the list.

Finally, press the **Show** button, and the entire list will be shown.

After you have displayed some trends and spectra – set, the main window remains active and you can select other trends or spectra. Although it can display a large amount of information on a single screen, it is recommended to limit the number of simultaneously opened plots, because the plots will have smaller and smaller sizes and many details will be lost.

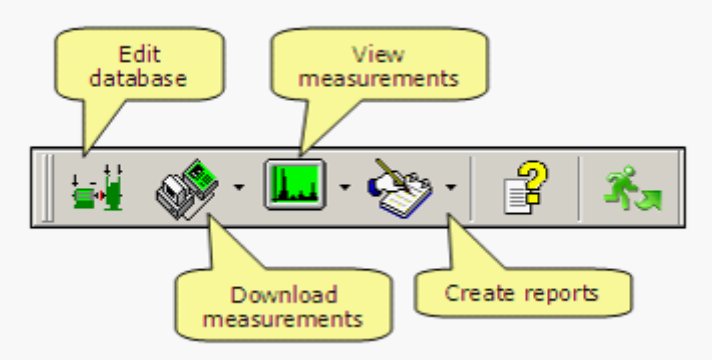
For details regarding an efficient way of using the spectrum and trend plots, see also:

- Spectrum plot
- Trend plot
- Frequency Response plot.

Other ways for displaying data are:

- Quick view
- Show Spectra for the whole machine
- List View
- Band View

Try also these commands to see the differences, but first read the help associated with the commands.



7 Creating, registering and editing databases

To make a functional program, every user has to create and edit its own database. For each part of a whole plant, it is recommended to create a separate database.

7.1 Create a new database

To create a new database use **Database** > **Create** command:

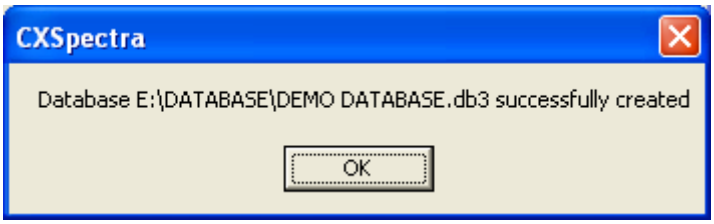
Just press the **Next** button to continue.

Enter the database file name.
Press **Browse** to locate the folder where the database will be created. If the database will be used in a Network environment it's important to place all your databases into a single shared folder. In this example, the database file name is DEMODATABASE and the folder is E:\DATABASE.

Optionally, you may give a friendly name for your database. In the CXSpectra™ this "alias" name will be used everywhere. If you don't give any "alias" name, the application will replace CXSpectra™ name with the file name.

***NOTE*: To create a backup copy of your database, just copy the .db3 file into a safe location.**

Press **Next** to continue. The database will be created and the following info windows will be shown:



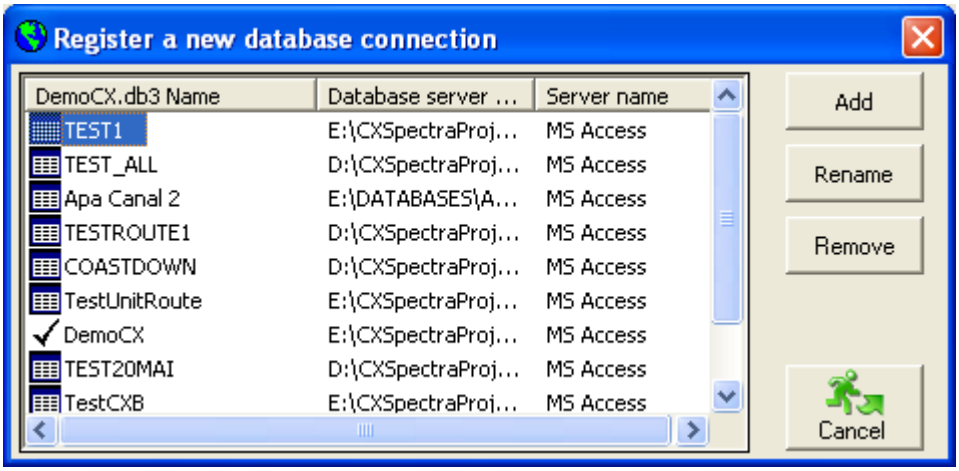
7.2 Database registration

Before using any **CXSpectra**™ database, you must register it.

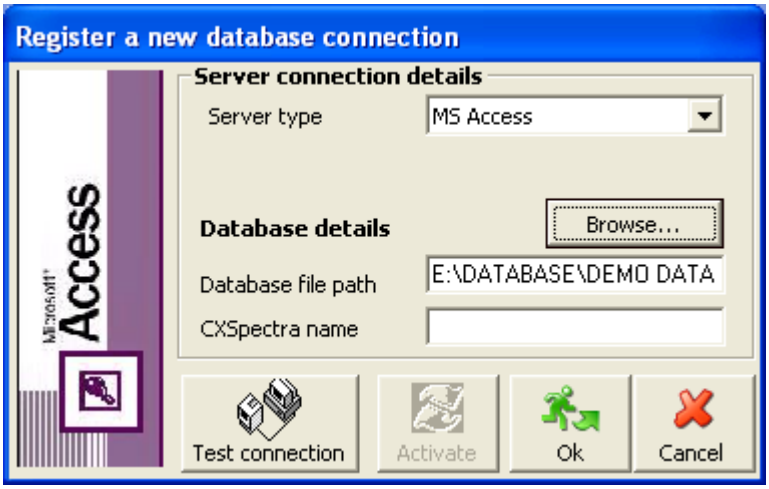
Use **Database** > **Registration** command to add an existing database to your registration list.

***NOTE*: The databases created as before, will be automatically added to the registered databases.**

To access another **CXSpectra**™ database into the network, you must register it first.



Click the **Add** button and select a valid **CXSpectra**™ database.
You can add any existing **CXSpectra**™ database.



Locate the database with the **Browse** button and click **Open**.
Once added, just press **Test connection** button. If the database can be connected the following message will appear:

Now, you can press **OK** to add the database in the list or you may press the **Activate** button first, to add the database to the list and activate it after pressing the **OK** button.

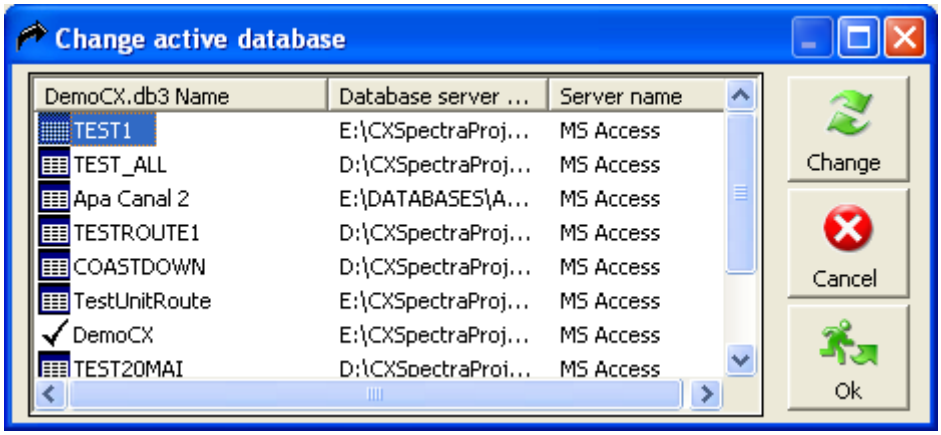
Only the registered databases can be activated in the **CXSpectra**™ software.
If the **CXSpectra**™ is installed into a network, each user can have his own database collection.

You can always **Remove** a registered database. This doesn't mean that you delete the selected database; you just remove it from the list. In addition, you can rename the "alias" name of the database.

7.3 Database change

CXSpectra™ can manage many databases, but not simultaneously. This means you must select a particular active database (from the registered database list).

Use **Database** > **Change** command to do this:



Double-click the item in the list or select the database with a click, then press the **Change** button.
To conclude, press the **OK** button. The name of the selected database will appear in the status bar (in the left side).

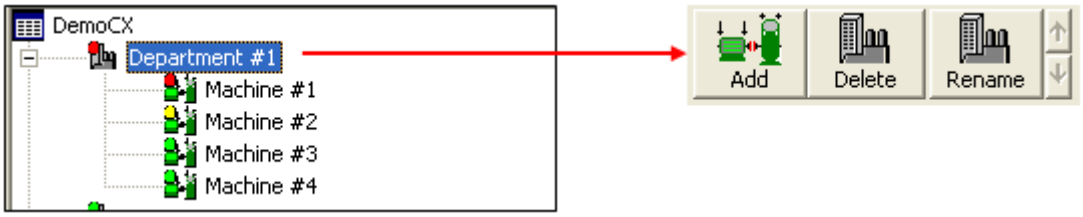
7.4 Database edit

Use **Database** > **Edit** command to edit a database. To do this, select this command from the main menu or press the dedicated button from the toolbar: 

This command is used for editing the active database (add, delete, rename items) and for database maintenance. In accordance with the selected item from the hierarchy tree, you can add machines, points or directions.

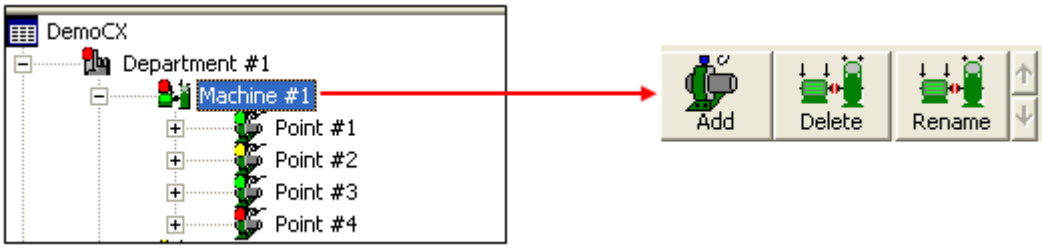
1. Database Level

On the **Database** level you can only add **Departments** (or plants):



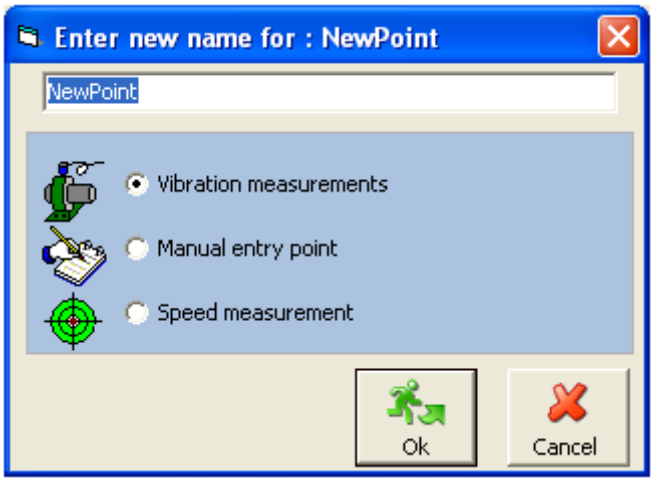
2. Departments Level

On the **Departments** level you can add **Machines** and you can also delete or rename Departments:



3. Machine Level

On the **Machine** level you can add **Points**. You can delete or rename the selected Machine:



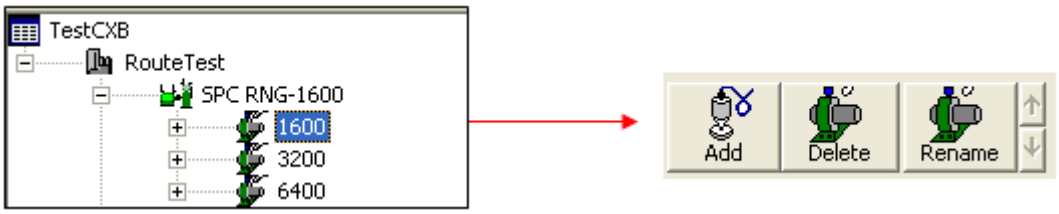
The following point types can be added:

- Vibration point
- Speed point
- Manual entry point

Only vibration points have **Directions**.

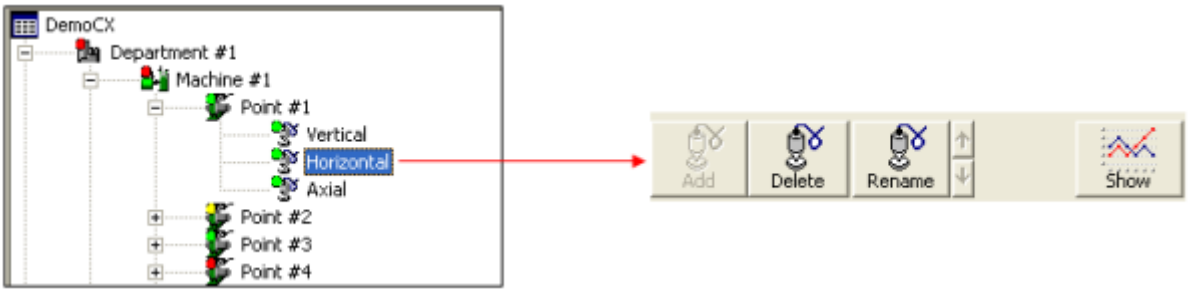
4. Point Level

On the **Point** level you can add a **Direction**. You can delete or rename the selected **Direction**.



5. Direction Level

On the **Direction** level you can delete or rename the selected **Direction**. You can also view the *Trend plot* (if any):



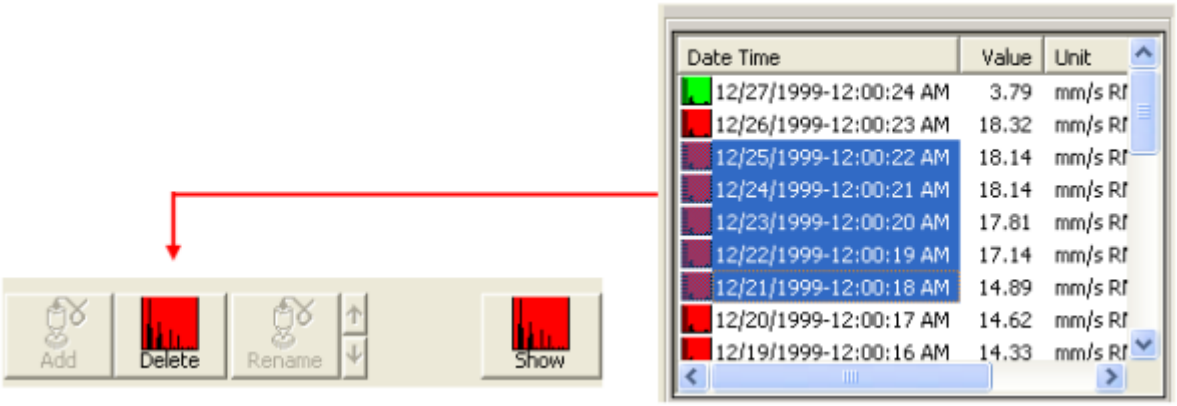
After adding a new item in the database, any selected item can be renamed. The new items are added with a default name, which can be changed whenever required. To do this, select the name of the item you want to change and press the **Rename** button. Then change the name using the keyboard and complete with **OK**. An empty name is not allowed.

To delete an item, just select it and press the **Delete** button.

If the item isn't the last one into the hierarchy tree or if there already are measurements stored in that particular direction, the item cannot be deleted.

As a general rule, the deleting procedure must be done in the following order:

- measurement
- direction
- point
- machine
- plant (department)



To delete spectra, you have to select one or more spectra and then to press the **Delete** button or the keyboard **Delete** key. The **baseline** spectrum can't be deleted. First, double-click on the item, to transform the **baseline** spectrum into a normal spectrum

and then you can delete it.

When you finish the machine definition (plant, machine, point and direction) on each level of the hierarchy, you can edit the fault frequencies that will be very helpful later.

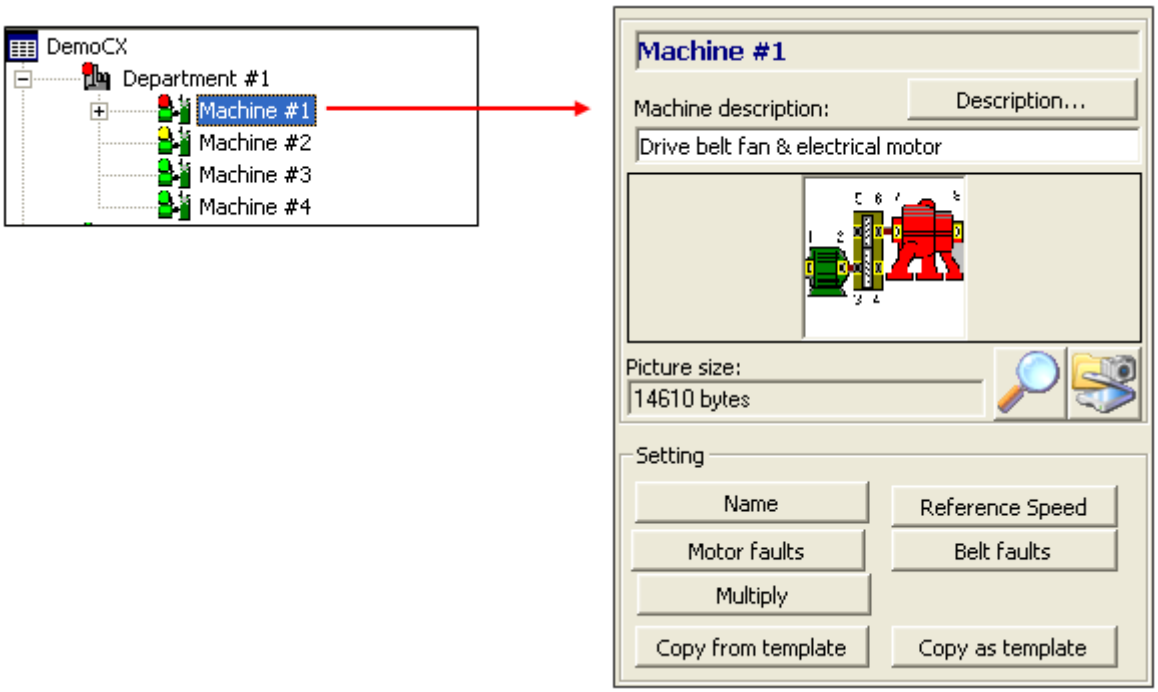
7.4.1 Editing on machine level

On **machine level** you can edit:

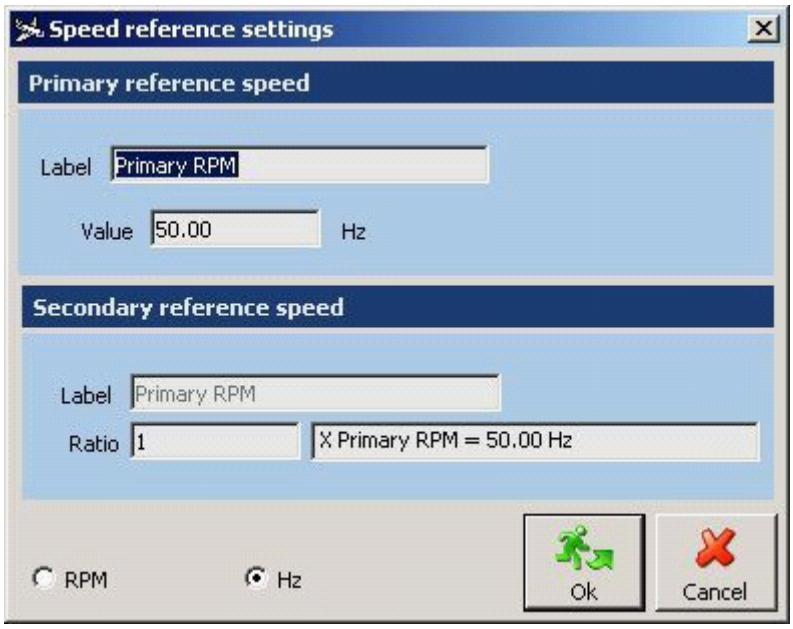
- **A short description** – This is a 30 ÷ 40 char length, description of the machine. This description can be used in reports.

- **A machine description** – pressing the Description button a text editor will appear. For each machine you can fill here as much information as you want. You can use different types of colours, letter sizes and alignments. You can import the contents of some external files (text or RTF file) or pictures. The contents of machine description can be printed with Report > Machine Description Report.

- **A Machine picture**: For each machine you can add a picture from the existing collection provided in the installation kit. The picture must be into a picture file format. Of course, you can make your own pictures with a digital camera. To add a picture to a machine, click **Browse** button and select any picture file.



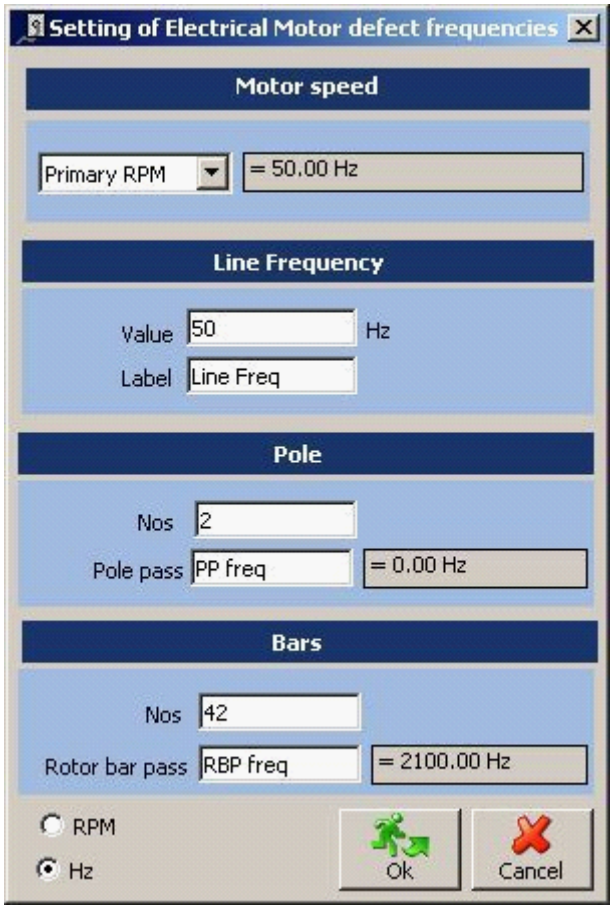
- **Reference speed**: For each machine you can define 2 reference rotational speeds. The first is the primary reference speed, and the other one is the secondary reference speed, related to the first one. These speeds will be useful later, on the shaft speed definition for each point. In this respect, you can label these two speeds for an easier recognition in future.



For variable speed machines, define the primary rotational speed as zero. The software will determine the real shaft speed using the latest measurement.

For more details see **Speed settings**.

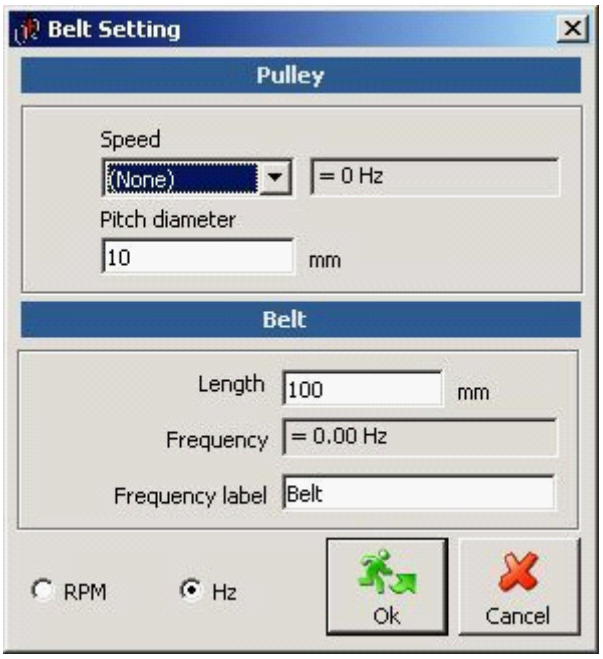
- **Electrical motor fault frequencies**



You can define the following fault frequencies:

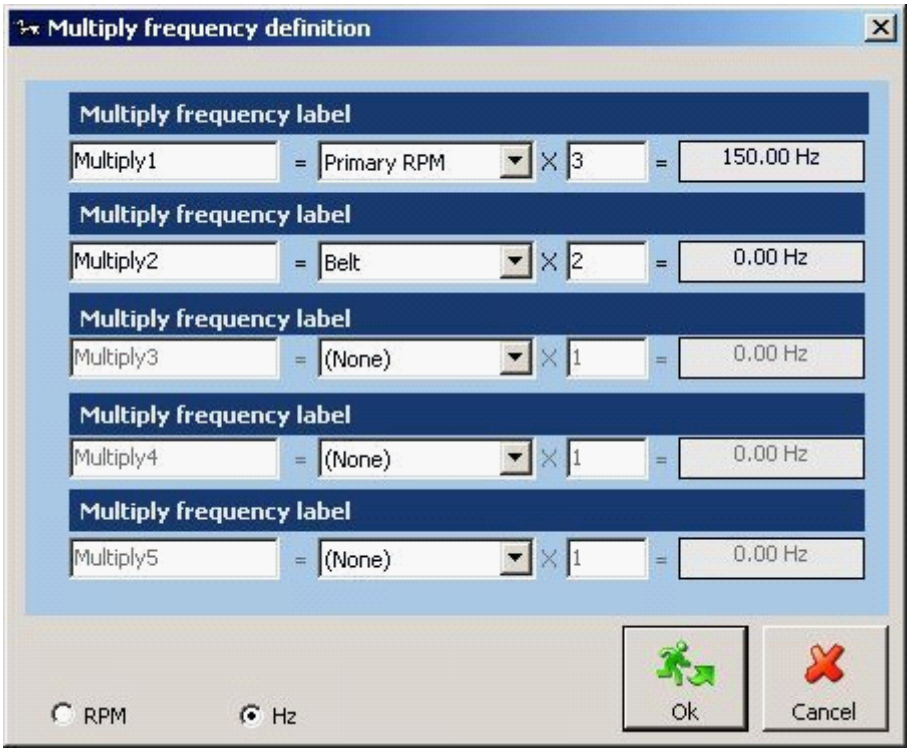
- Line frequency (LF)
- Pole pass frequency (PP)
- Rotor bar pass frequency (RBP)

- **Belt fault frequencies**



- **Multiply fault frequencies**

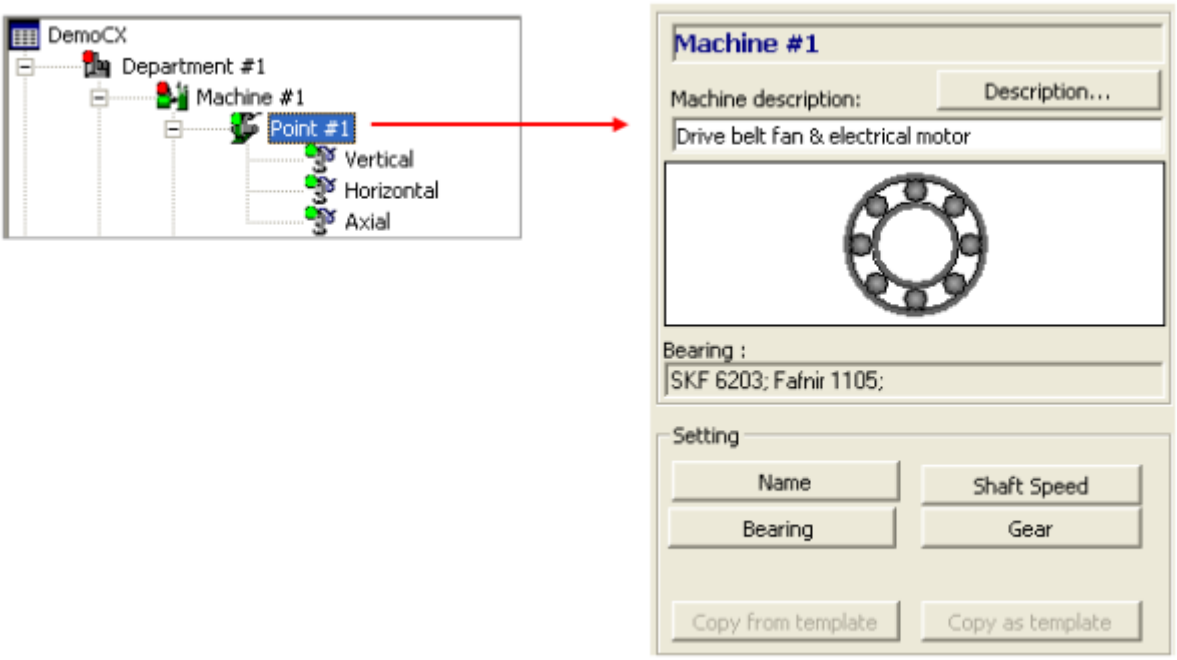
You can define five multiply fault frequencies for each machine:



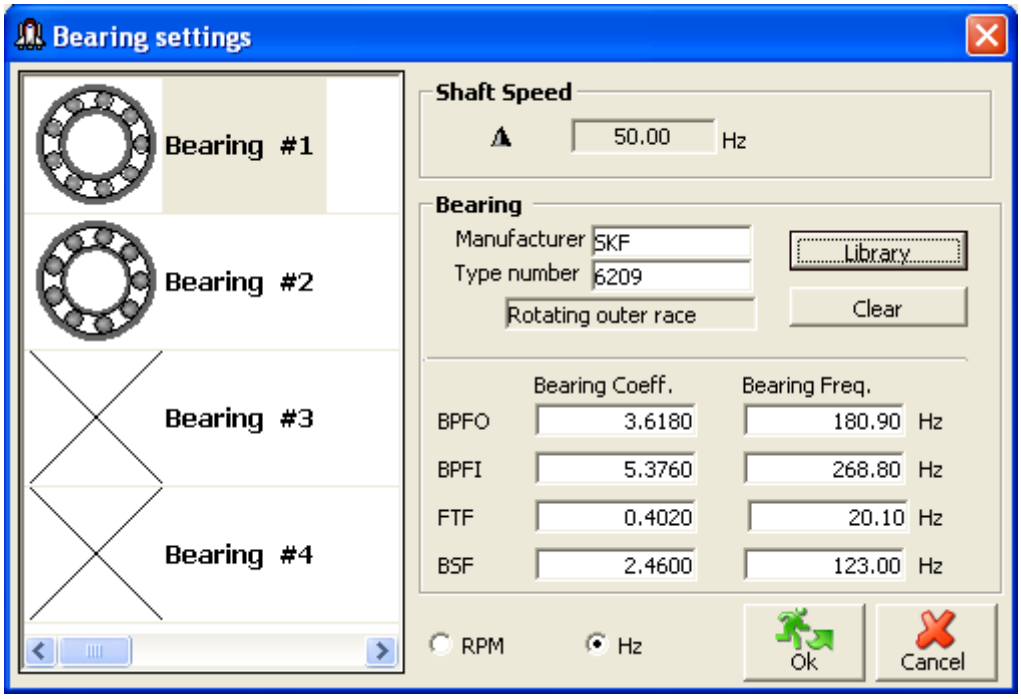
7.4.2 Editing on point level

On **point level** you can select or define a bearing and a shaft speed. The shaft speed can be one of the previously defined one or another related to the main reference speed, or a secondary reference speed. You can also edit the specific data for a gearbox.

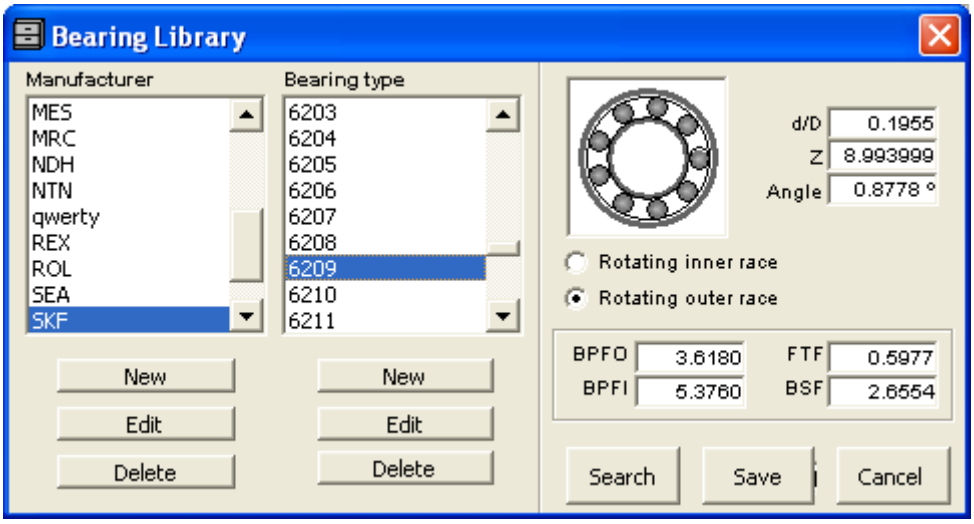
To select a bearing, press the **Bearing** button, then press the **Library** button.



On each point you can add up to 4 bearings:

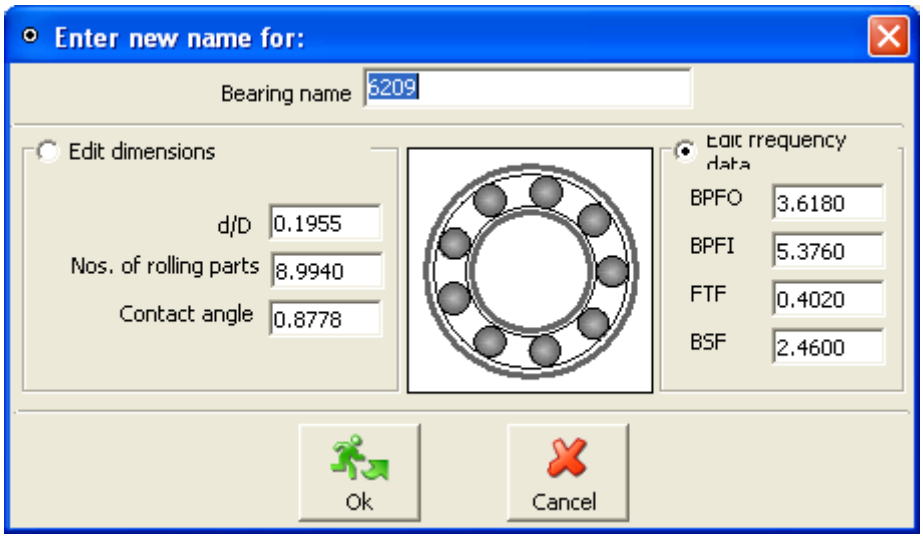


If the **Library** is selected, the **Bearing Library** window will appear. There are more than 6000 bearing definitions in the library. The user can also add new bearing definitions in the **Bearing Library Database**. The **Bearing Library** window appears as follows:



To add a new bearing into the **Library**, proceed as follows:

- Press **New** to add a new Manufacturer in the list.
- Press **New** to add a new bearing.

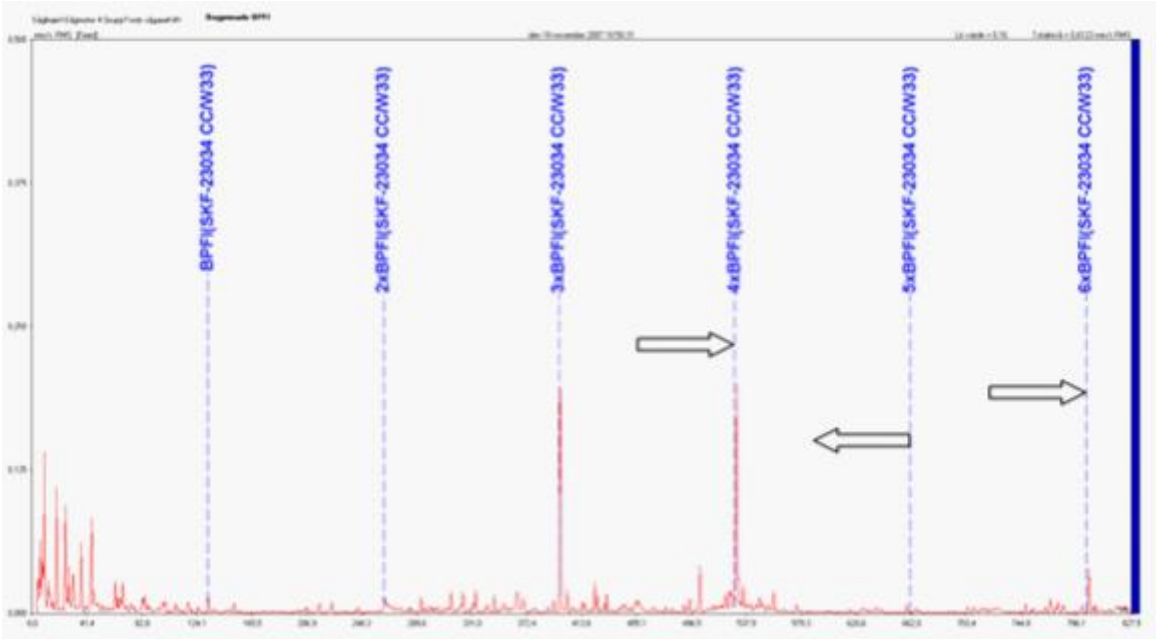


If you know the fault coefficients, select the **Edit frequency data** option.

If you know only the bearing dimensions, select the **Edit dimensions** option.

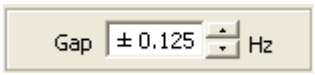
Finally, press **OK** to save the bearing definition.

7.4.2.1 The automatic adjustment of pre-calculated bearing fault frequencies



The bearing fault frequency can be displayed in any spectrum plot. A typical spectrum of a bearing with different faults was shown above. In most of the cases, the calculated and the measured frequencies will be separated by a small margin.

In **CXSpectra**™ software there is a function, where the basic fault frequency lines with multiples are moved to the nearest peak, if there are some, within the selected gap.

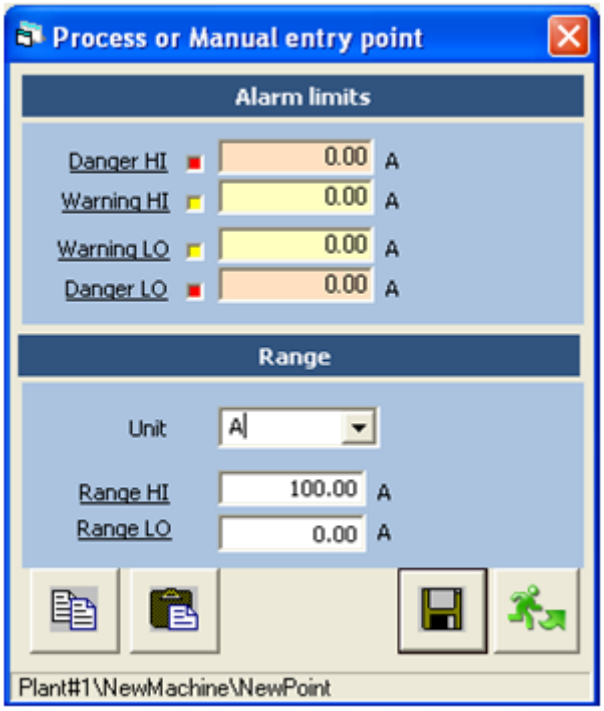


If there is more than one peak in this interval, the fault frequency line will be moved to the highest peak found.

If the basic fault frequency is moved, the side bands will also be moved with the same distance. Because the distance between the measured and the calculated frequency can slightly vary from multiple to multiple, this adjustment will be separately done for each basic bearing fault frequency.

7.4.2.2 Speed and Manual points

If the Point is *Manual Entry* or *Speed*, you can edit also the following:
- Alarm limits
- Unit name. Just add in the list a new name and this will be saved.
- Range scale (LO and HI).



Just press the **Save** button to save the settings.

Press the **Copy** button to copy the settings.

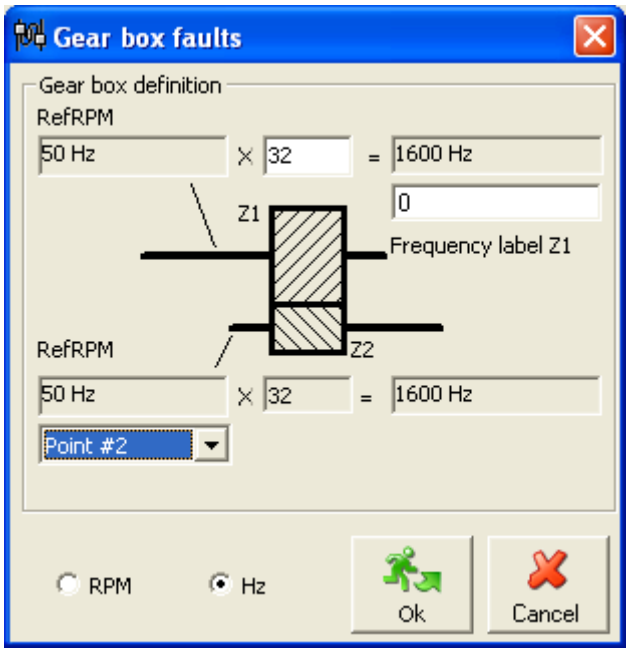
Move to the next point and press the **Paste** button.

7.4.2.3 Editing gear box fault frequency

Before setting the gear frequencies, set the proper calculated speed for each point of the machine.

To define the fault frequencies for a gear box proceed as shown below.

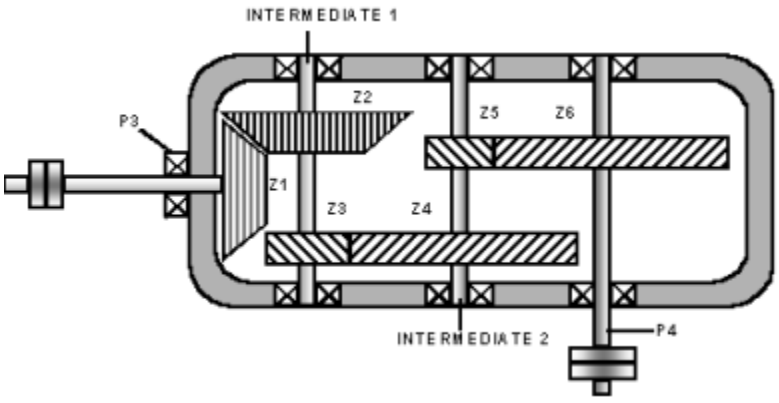
Press **Gear** button. The following window will appear:



For the selected point, type the number of the gear teeth and select the conjugate point. If the conjugate point was correctly selected, the number of conjugate gear teeth will be an integer number and the **OK** button will be activated. Otherwise you cannot save the settings.

Before saving the settings, type a label name for the gear mesh frequency.
In order to better understand the gear box settings, please analyze the following example:

The gear box has the following characteristics:



Type:
FLENDER Model KZN 280

Z1=16 teeth
Z2=26 teeth
Z3=17 teeth
Z4=47 teeth
Z5=14 teeth
Z6=45 teeth

The teeth numbers give the following relationships between the speeds:

$$\frac{Z1}{Z2} = \frac{16}{26} = 0.615385$$
$$\frac{Z3}{Z4} = \frac{17}{47} = 0.361702$$
$$\frac{Z5}{Z6} = \frac{14}{45} = 0.311111$$
$$\frac{Z1}{Z2} \cdot \frac{Z3}{Z4} = 0.615385 \cdot 0.361702 = 0,.22586$$
$$\frac{Z1}{Z2} \cdot \frac{Z3}{Z4} \cdot \frac{Z5}{Z6} = 0.615385 \cdot 0.361702 \cdot 0.311111 = 0.069249$$

On the machine level, set the main reference speed to 3000 RPM and the label as "*MotorSpeed*".
Set the secondary reference speed to the output shaft (*P4*): 207.7467 RPM with the label "*RollSpeed*".
Add measurement points *Intermediate 1* and *Intermediate 2*. They are required only for the calculations.

For the input shaft (*P3*) set the shaft speed to be 1×Motor Speed.
For the *Intermediate 1* shaft, set the speed to 0.61538×Motor Speed = 1846.1538 RPM.
For the *Intermediate 2* shaft, set the speed to 0.22258×Motor Speed = 667.75 RPM.
For the output shaft (*P4*), set the speed to 1×Roll Speed = 207.7467 RPM.

Press the **Gear** button for the P3 point and make the settings: Number of teeth to 16 and label "GM1/2". Select the conjugate point to be *Intermediate 1* (26 teeth for the conjugate point will appear).

Press the **Gear** button for the *Intermediate 1* point and make the settings: Number of teeth to 17 and label "GM3/4". Select the conjugate point to be *Intermediate 2* (47 teeth for the conjugate point will appear).

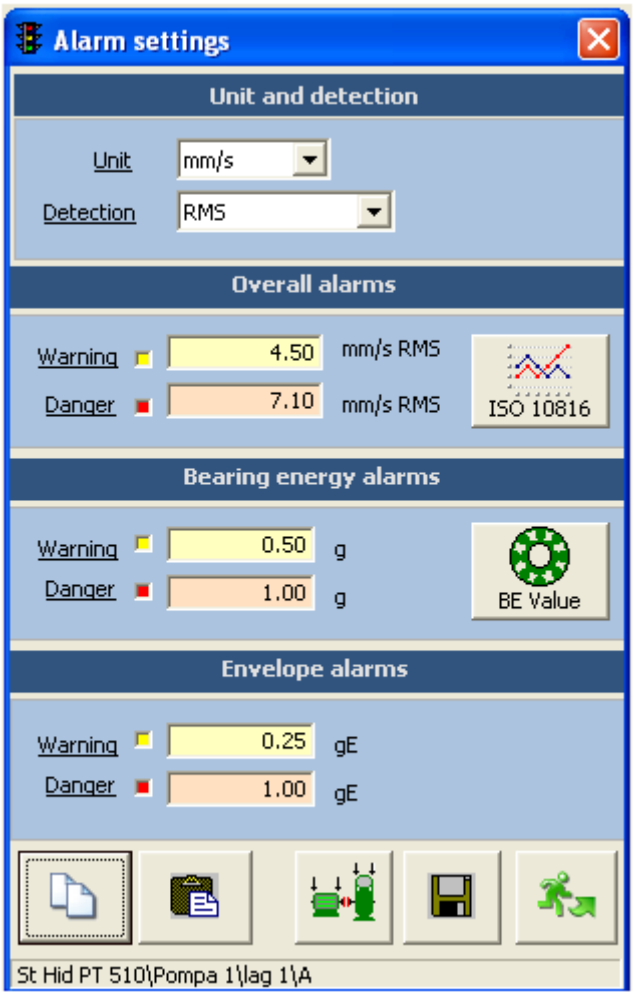
Press the **Gear** button for the point *Intermediate 2*. Number of teeth to 14 and label "GM5/6". Select the conjugate point to be *P4* point (45 teeth for the conjugate point will appear).

Press the **Gear** button for *P4* point. Set the number of teeth to 45 and label "GM5/6". Select the conjugate point to be *P4* point (14 teeth for the conjugate point will appear).

Now the setting is complete.

7.4.3 Editing on direction level

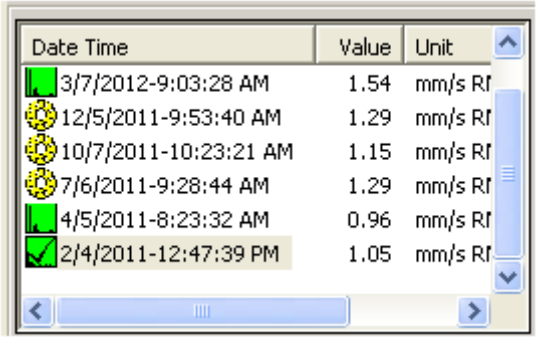
- **Alarm settings**



On the **direction level** you can edit the alarm limit for total vibration values of measurements and also to define the **Route** settings.

Press the **Alarm settings** button and you can edit two alarm levels for each overall vibration, BE and Envelope values. Two tables, the ISO 2372 diagram and the Bearing Energy Coefficient diagram, are on your disposition, to properly select the alarm value. Select the unit for total vibration values and the average type also.

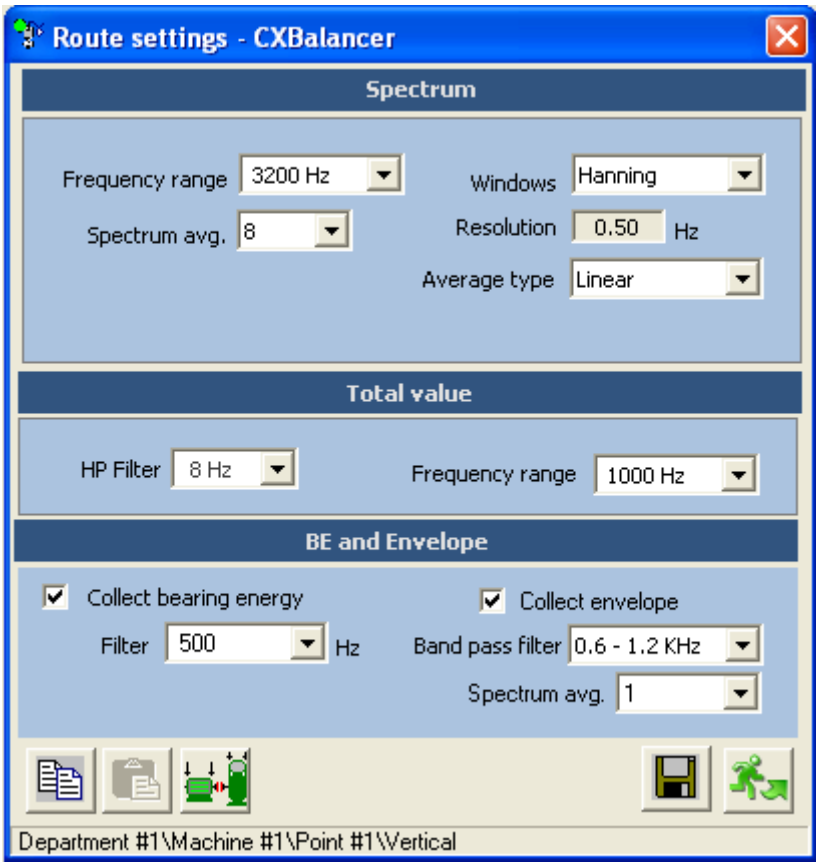
Note: If on **Directions** level there are already some stored measurements, you can declare, for each direction, one of them to be a *Baseline*. To do this, just double-click that measurement. Only one measurement can be a *Baseline*. All the other measurements are considered to be *Normal* measurements.



Click the **Route settings** to set some parameters for route measurements.

- ## Route settings

In the ***Database Edit*** window, press the **Route Settings** button:



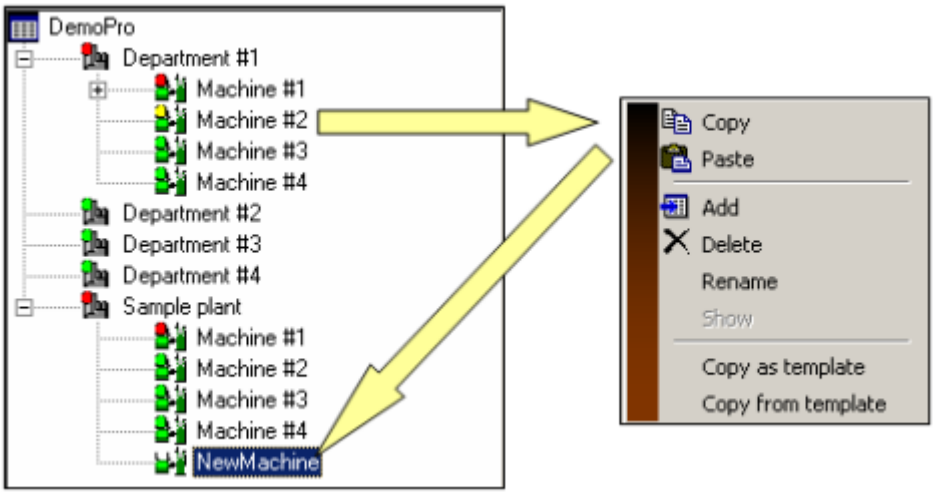
In the route can be set extra items:
- Frequency range – can be selected from a list (1600, 3200, 6400 Hz)
- Spectrum averages
- Total value HP (none, 4, 8, 10 Hz)
- Total value Frequency range–can be selected from a list (1000, 1600, 3200, 6400 Hz)
- HP Filter for BE
- Band pass filter for Envelope
- Envelope spectrum averages.

- ## Copy and paste settings

Route settings can be copied and pasted to another direction or to the whole machine (for all directions belonging to the selected machine). Before copying the settings, you must press the **Save** button to save the existing setting of the selected direction.

7.4.4 Editing machine in batch

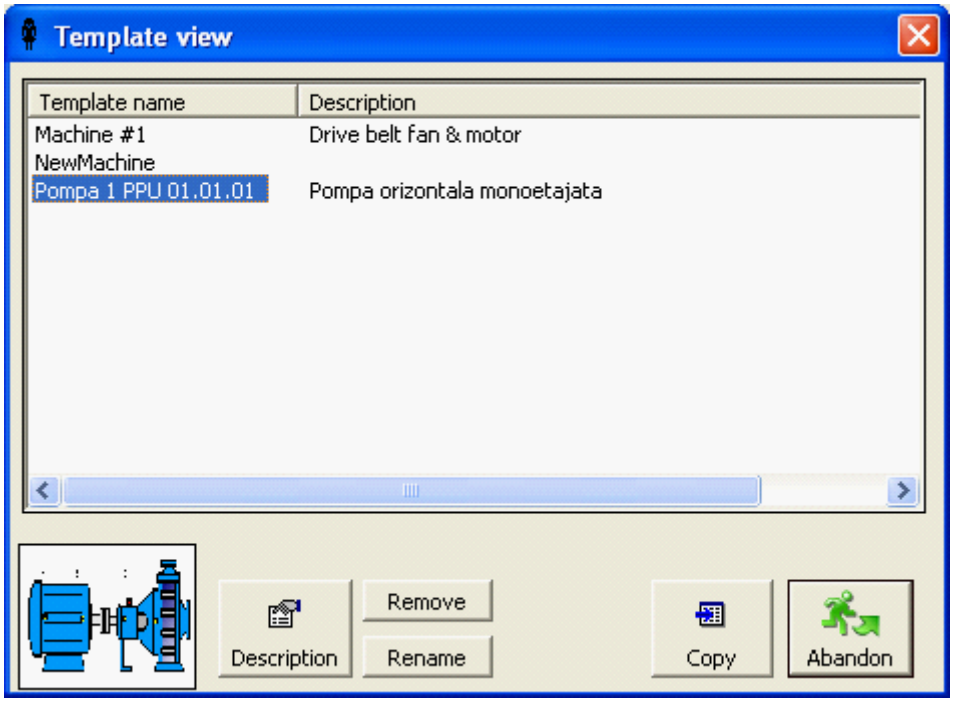
If there are several identical machines in your database, you will edit only one machine and then copy and paste it several times.



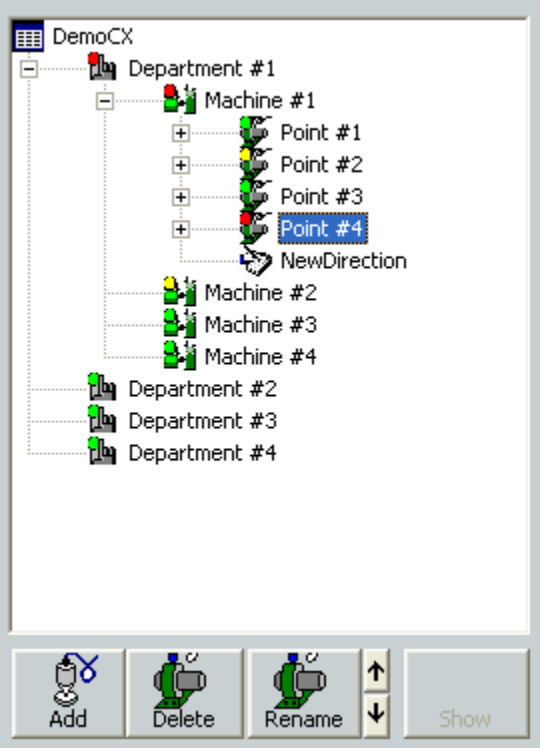
Before copying, the new machine **must exist** (only as name, the machine hierarchy can be empty). You can save a just created machine into a template database, or use the template database to copy a pre-defined machine into your database. When the **CXSpectra**™ starts for the first time, a file named: *Template.mts* will be created as default. The template file is empty. In this file you can add as much machines as you want. From the template file you can export some machine templates into other template files. Or from any template file you can import in your template file a series of machines (See **Settings -> Template** command).

In the window above you can:

- Rename a machine (name, description and machine picture)
- Remove a machine from the Template file
- Edit the *Machine Template* description.



7.4.5 Change the hierarchy order



The user can change the hierarchy.
Any item can be moved, but only inside of the hierarchy (The Machines only under Departments, the Points only under Machines etc).
To change the order in the hierarchy, proceed as follows:

Select the item to be moved.
Press the **CTRL** button. The buttons used to move the item will become *Enabled*.
Now, you can move the item in the hierarchy in two ways:

- By using the UP and DOWN arrows
- By clicking the mouse onto the UP and DOWN buttons.

8 Off-route transfer for CXBalancer®

The Off-Route measurements saved into CXBalancer® Instrument are normally binary files. Each measurement type is saved into files with the following extensions:

- ❖Spectra files: .cxs
- ❖Envelope files: .cxe
- ❖Frequency Response files: .cxr
- ❖Balancing files .cxb

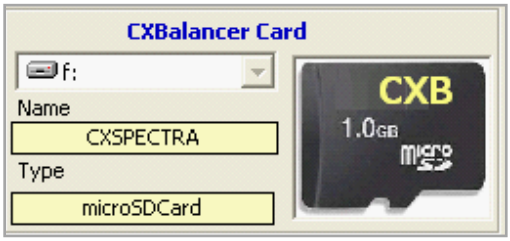
Other files can also be created by special measurements into the CXBalancer® Instrument.

There are two ways for files (measurements) transfer:

- Direct transfer, from CXBalancer® Instrument
- Indirect transfer, from any measurement file.

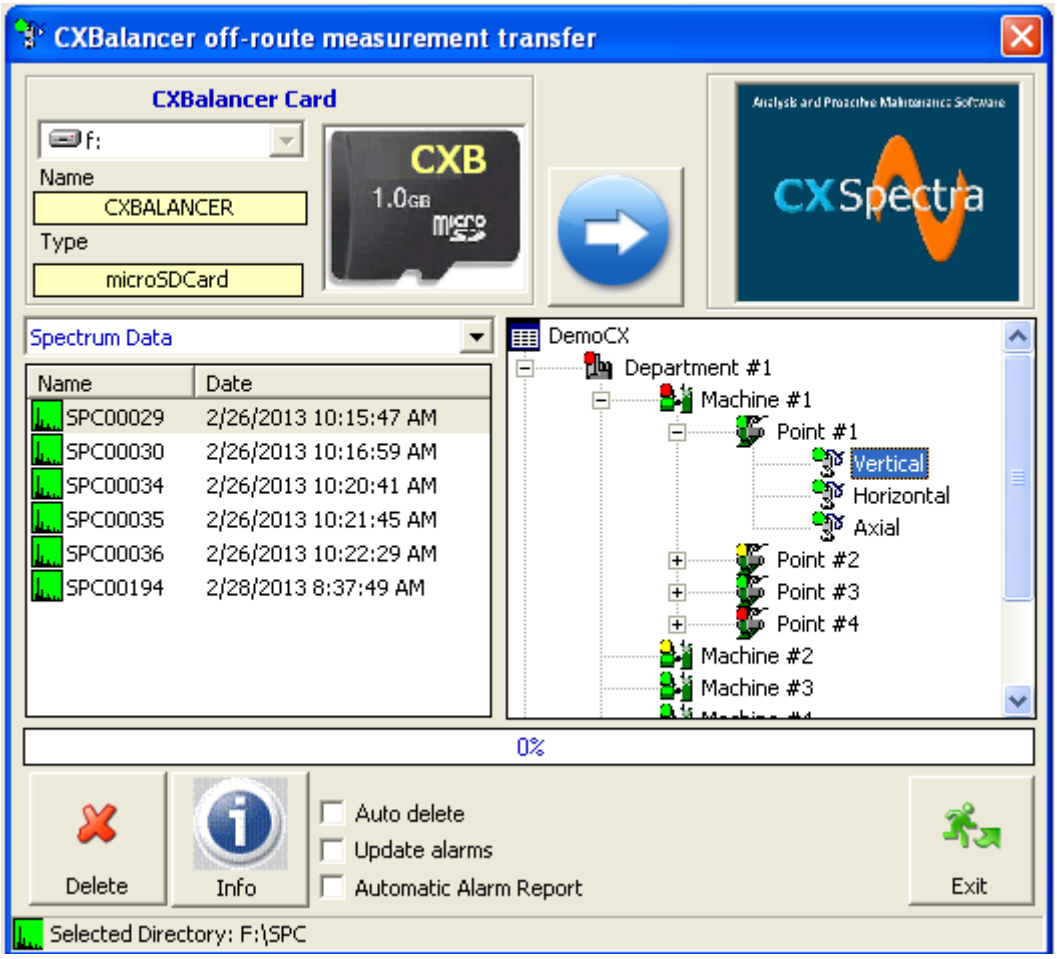
8.1 Direct transfer

Select the command **Off route -> From Instrument**



If the USB cable is plugged-in, in the CXBalancer® a transfer window will appear. Normally, the CXBalancer® will automatically detect the microSD Card of CXBalancer®. If this doesn't happen, you must manually locate the CXBalancer® mass storage unit:
Now select the file type from the list:

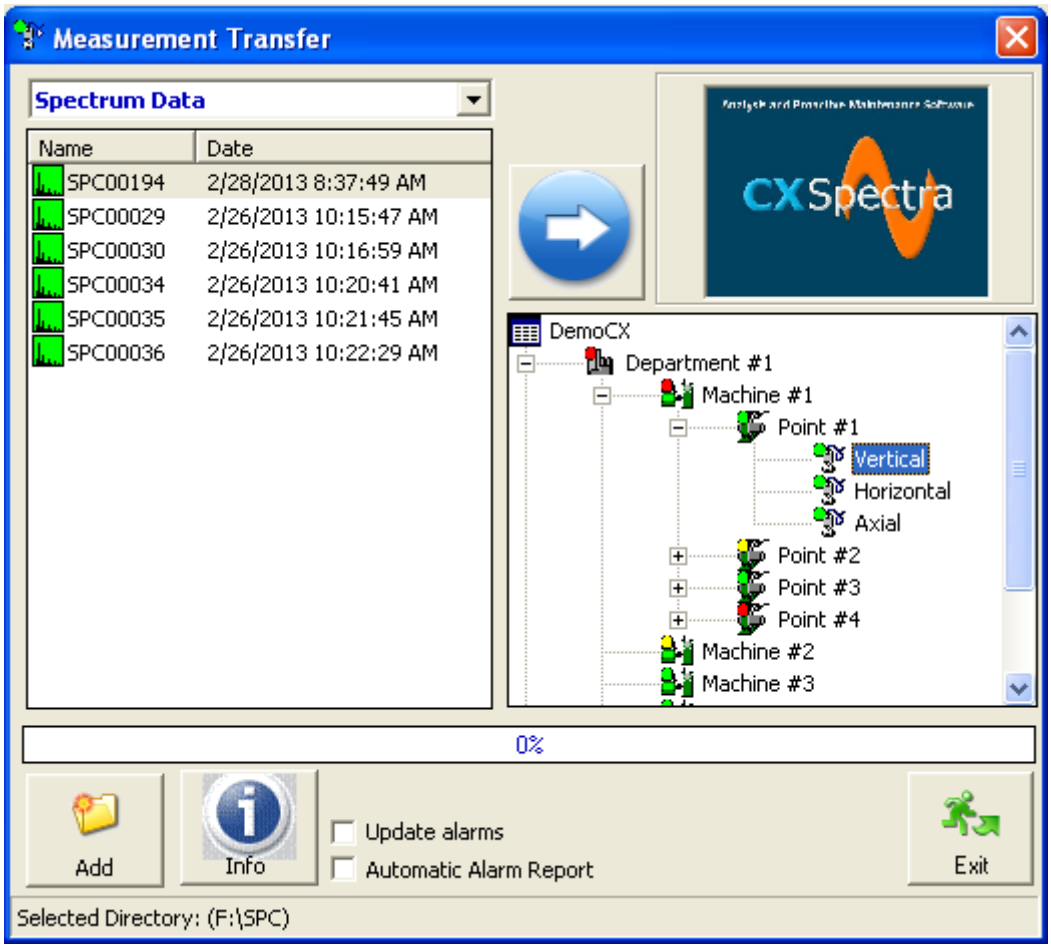
The existing files from the microSD Card will appear as follows:



You can show more information regarding the file contents, pressing the **Info** button.
From the database tree, select a direction and then the **Transfer** button.
In similar way, you can transfer any measurement type.

8.2 Indirect transfer

Select the command: **Off route** > **From Files**
When this command is executed, the following transfer windows will appear:



First, you must select the measurement type from the combo box.

Press the **Add** button to add files in the left list. Multi-selection is also allowed.

Select the disk unit, folder and the files. You can select one or more files to be added in the transfer list (multi-selection).

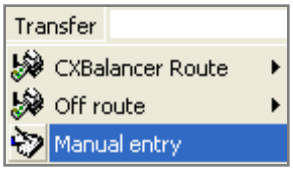
You can press the **Add** button several times to add files from various locations.

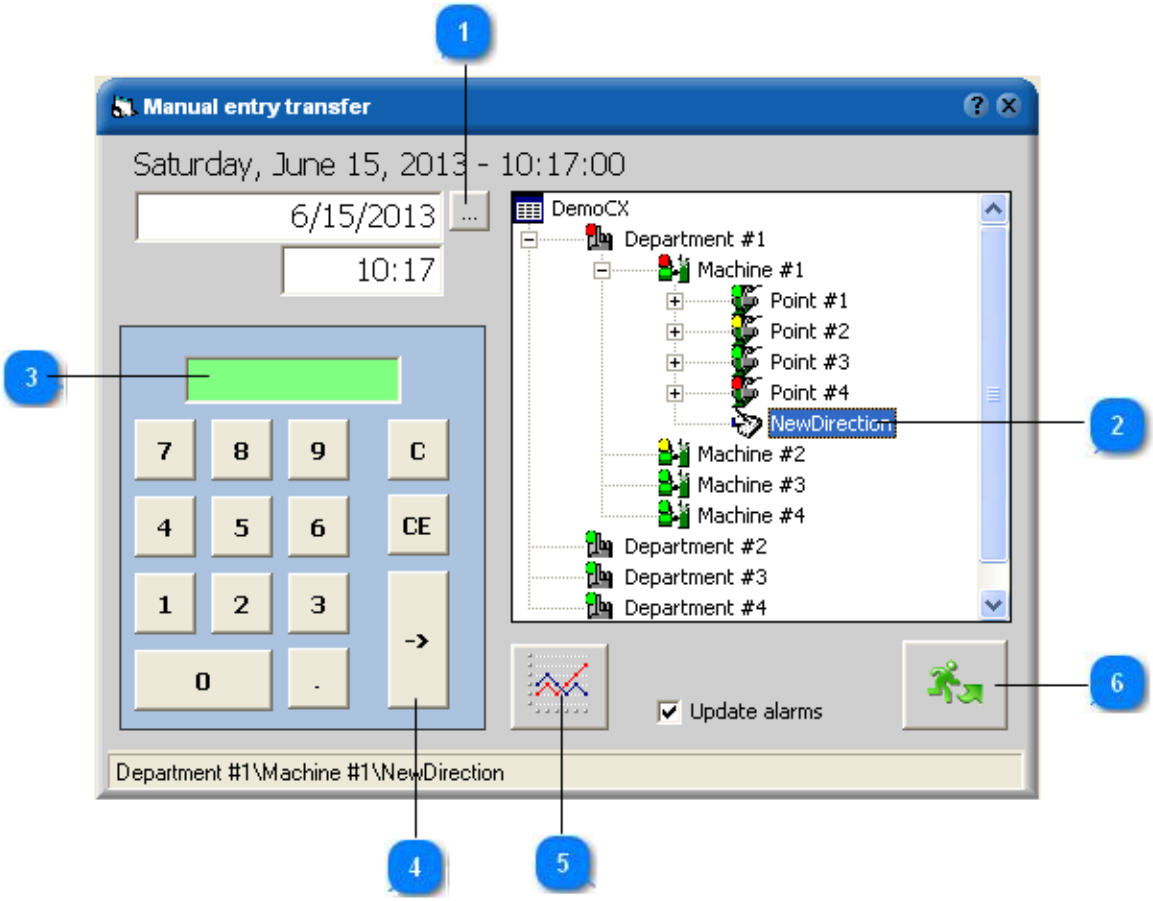
When consider the list was completed, you can transfer the file into database, on the *direction* level.

You can also show more information regarding the files contents, pressing the **Info** button.

8.3 Transfer Manual Points

The points defined to be *Manual* can be included into the measuring routes and can be transferred together with them.
The user can transfer values to any Manual Point using the next command:





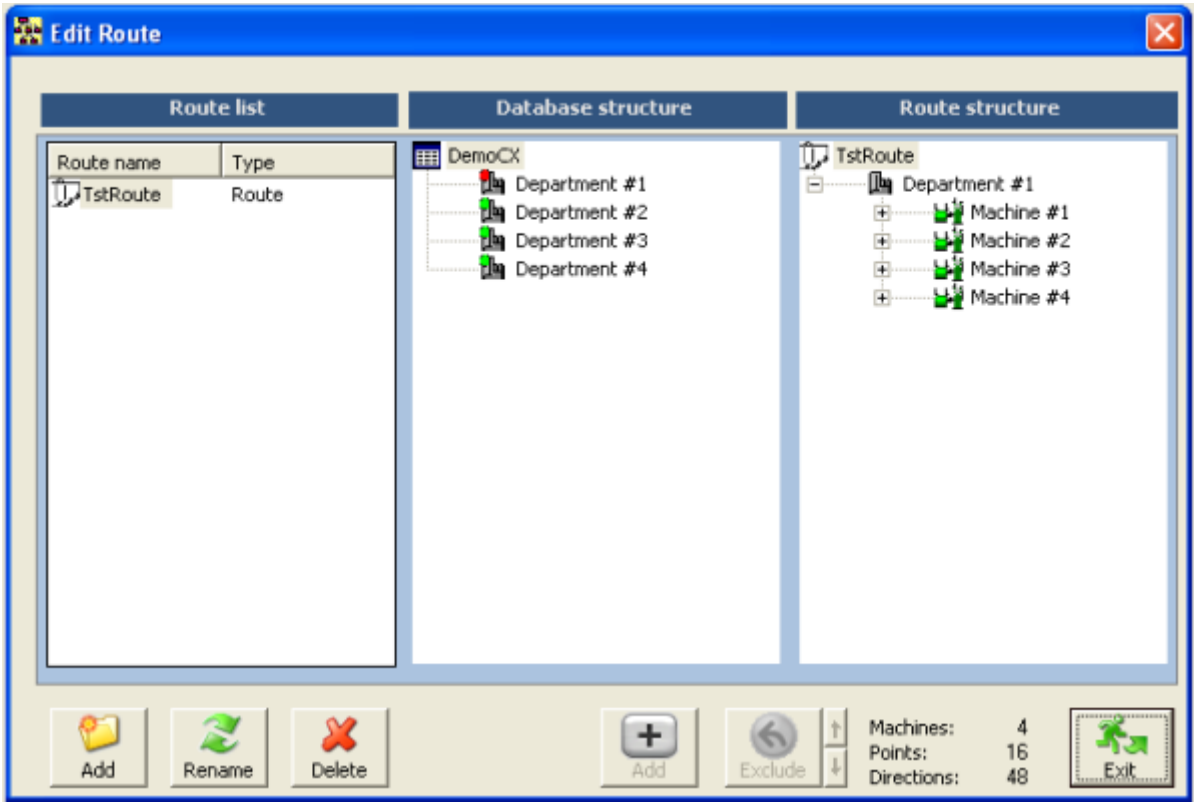
1. Select or type the measurement date and time.
2. Select the *Manual Point*.
3. Type the measurement value (using the keypad or the virtual keypad).
4. Press the ***Transfer*** button
5. Optionally, you may show the trend plot.
6. Continue as above for another *Manual point* or Exit.

9 Route transfer

The following steps must be done in order to use the route transfer:

- Create a route;
- Download the route definition into CXBalancer® Instrument;
- Perform the measurements;
- Download the route measurements.

To create a new route:
Select **Database** > **Edit Route** menu.

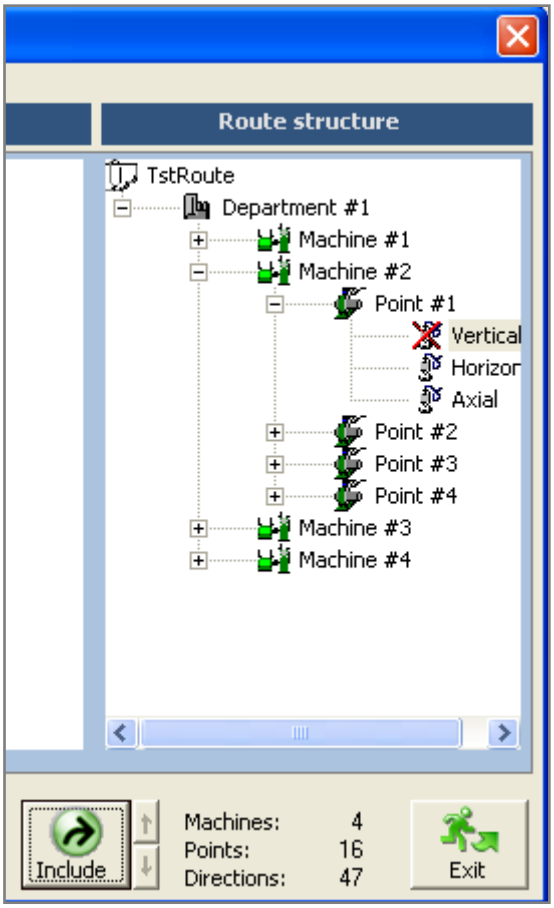


Press the **Add** button to add a new route in the list.
From the machine database tree, select the first machine and press **Add** button.

The selected machine will be added to the route structure.

Proceed as above with all the machines.

From the route structure, you can remove some points or directions. The removed items won't be deleted from the database, but they only won't be transferred into the *Data Collector*.



To remove an item, select it and press the **Exclude** button.

Finally, press **Exit** to save the route definition.

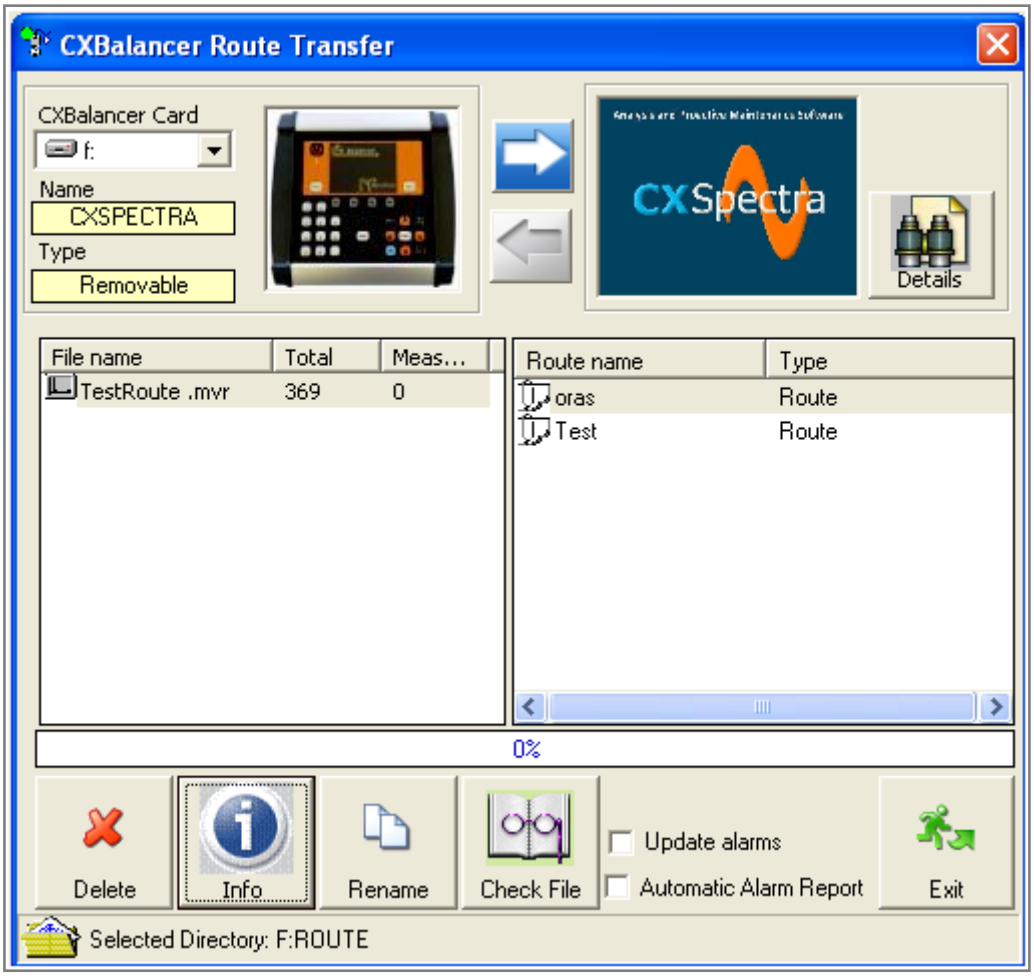
9.1 Download the route to/from CXBalancer® Instrument

Select **Transfer** > **CXBalancer Route** > **To/ From Instrument** menu.

Transfer can be done in two different ways:

- **Direct transfer**, from **Transfer**> **CXBalancer Route** > **To/From Instrument** menu
- **Indirect transfer** - In this case, using **Transfer**> **CXBalancer Route** >**To/From Route file**, the Route is converted to a file first. Then, the file can be simple copied onto the microSD Card of CXBalancer® Instrument (using Windows Explorer).

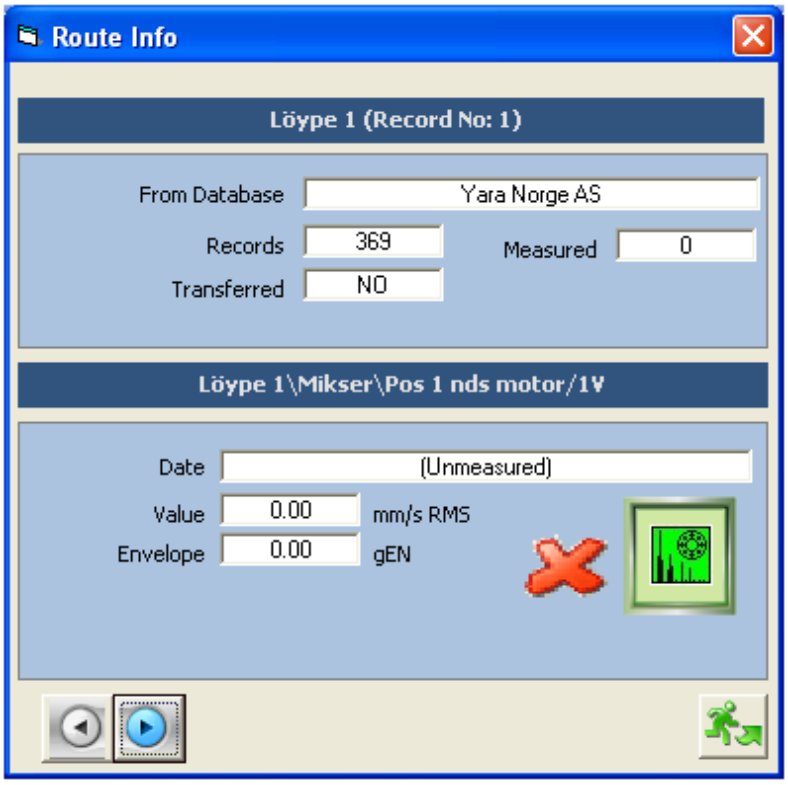
If you have the Instrument and a computer with CXSpectra™ installed, the simple way to do this job is to use the first method.
The following windows will appear:



If the microSD Card has the name "CXBalancer" and the USB cable is connected to the instrument, CXSpectra™ will automatically recognize the Instrument microSD Card. If this doesn't happen, the user can manually browse to search the Card.

Before transferring any *Route contents* into the machine database, use the **Check File** button and the selected file will be checked for integrity. If the file is OK, the following message will appear on the screen:

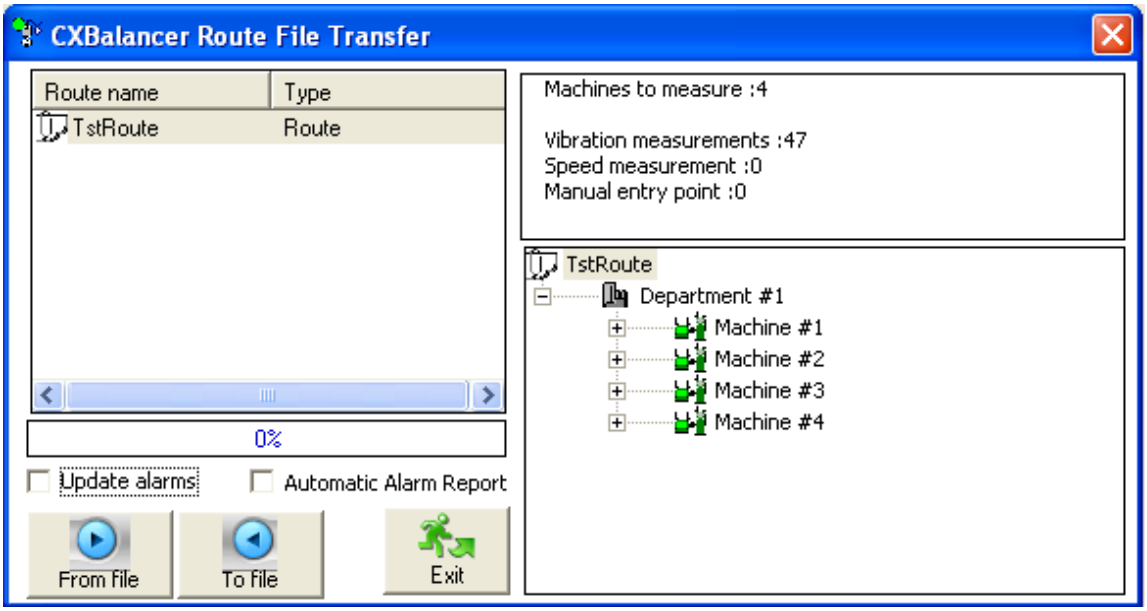
The number of measurements will also appear in the Route List. For the unchecked files, a question mark appears. Another facility before transferring files is to have a look inside the selected route. Just press the **Route Info** button and you will be able to browse in the *Route records*:



Use the arrow buttons to make movements in the route list. You can see useful information regarding the route records. Finally press the **Transfer** button and the measurement will be transferred from/ to the Instrument.

As you can see, any Route in the Instrument is a file. Transferring routes means to transfer files from and to the computer. In CXSpectra™ you can transform any Route definition into a Route file, using the indirect transfer mode.

Use the commands **Transfer**> **CXBalancer Route** >**To/From Route file.**
The window below will appear:



Use **To file** button to transform a Route definition into a Route file. In addition, you can press the **From File** button and browse for a specific Route file. When the route file is opened, the measurements will be directly transferred into the machine database.

9.2 Using transfer options

When the route was transferred from the Instrument, before exit, you can select the following options:

- **Automatic Alarm Report**: If this option is checked, after exiting the transfer window, a *Transfer Report* will be shown.
- **Update alarm**: If this option is checked, after exiting the transfer window, the *Alarm Status* of all measurements in the database will be automatically updated.

10 Importing data

External data can be imported in the machine Notepad using **Import notes** command from the **Database** Menu. With this command, you can complete your notes using helpful information from the maintenance team. The **Import command** is an easy way to add information regarding the repair process, the spare parts used or any other useful information, even picture or text file.

To do this, you must prepare a text file first, with any name, but with the *.imp* extension. The following reserved words can be included into this text file, between square brackets:

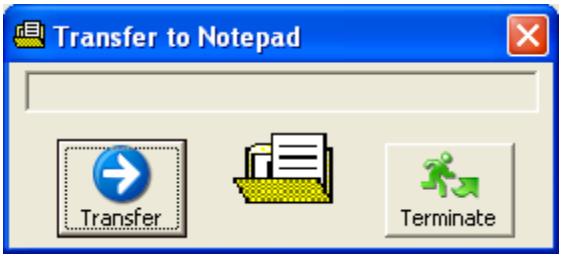
[**PLANT**] < plant name>	<plant name> must exist in the database
[**MACHINE**] < machine name>	<machine name> must exist in the database
[**DATE**] < date>	in computer format (e.g. dd/mm/yyyy)
[**RTF**] < file name>	full path and name of a "Rich Text Format" file
[**FILE**] < file name>	full path and name of a text file
[**PICTURE**] < file name>	full path and name of a picture file in Windows graphic format
[**NOTE**]	Next lines will be considered to be notes to be added. Finish with other reserved words or with [ENDNOTE]
[**ENDNOTE**]	
*	It is considered to be comments. It is not transferred.

For the **DemoCX** database, provided in installation kit, an import file example is:

```
 * Sample import file
 [PLANT] Department #1
 [MACHINE] Machine #1
 [DATE] 23/08/1999
 [NOTE]
Notes for Machine #1
 [ENDNOTE]
 * Next machine
 [MACHINE] Machine #2
 [NOTE]
Notes for Machine #2
 [ENDNOTE]
 * End of the import file
---------------------------
```

Usually, the import files can be automatically generated by other computer software used in the maintenance activity.

If **CXSpectra**™ cannot find a plant or a machine in your active database, an error message will be generated. If the software cannot find a specific date, it will add a new record to your database.



When you execute this command, first press the **Transfer** button. A specific window will appear and you will be asked to select the transfer file, somewhere in the accessible network.

Select the file and press **Open**.
The import procedure will begin.

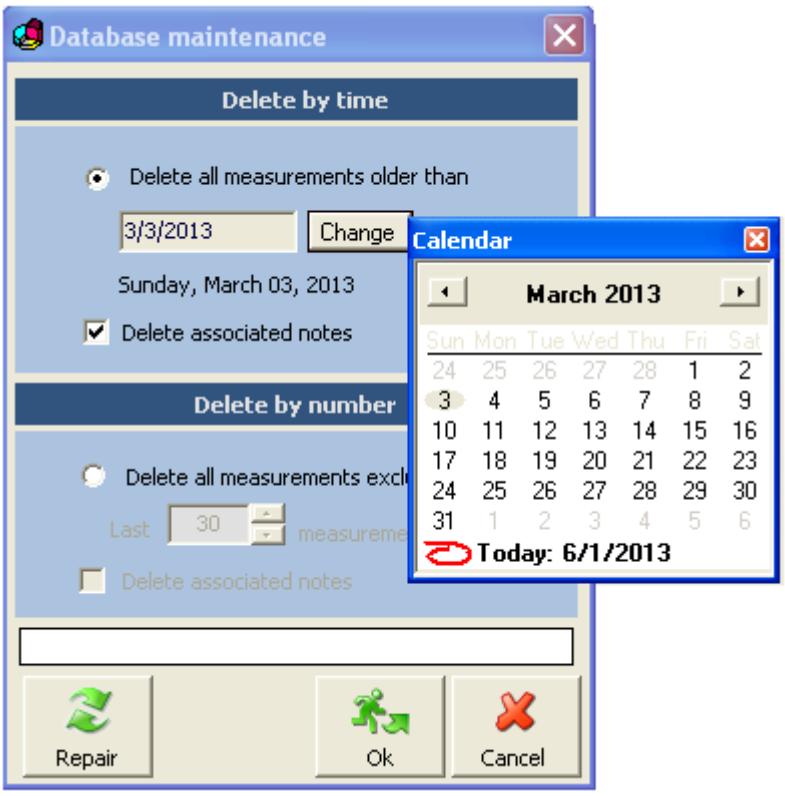
Finally, press the **Terminate** button to finish the import procedure.

11 Database maintenance

From time to time, just run the **Maintenance** command to optimize the dimensions of your databases.

You can select two ways to delete some old measurements:

- by date
- by number



The baseline spectrum will not be deleted.

Notepad records associated with the measurements can be deleted only if the checkbox "**Delete associated notes**" is checked.

The deleting procedure can take a long time, especially for long databases.

Repair command can reduce the database size.

12 Database filters

- ## Why to use a Filter?

When a large **CXSpectra**© machine database is managed, you will find that is difficult to access a specific machine, point or direction. That's why; the user can use a "filter" condition applied to the machine database, to reduce the items number. A filter is in fact a collection of some machines, points and directions, defined as a route. Many filters can be created for a machine database. This filter is named also *Route*.

- ## How to build a filter?

Any number of filters can be built using the **Edit Filter** command from **Database** menu. Activate this command and the **Filter Editor** will be activated. Press the **Add** button to add a new filter.

An existing *Filter* can be renamed or deleted by pressing the **Rename** or the **Delete** button. Once a new filter was created, you can add to the Filter as much machines as you want. To do this, just select any machine from the machine database tree area, and then press the **Add** button. In the same Filter a machine can't be added twice. Instead of adding only one machine, you can directly add all the machines from a department.

To do this, just select a department and press the **Add** button:
All the machines belonging to the selected *Department* will be added.

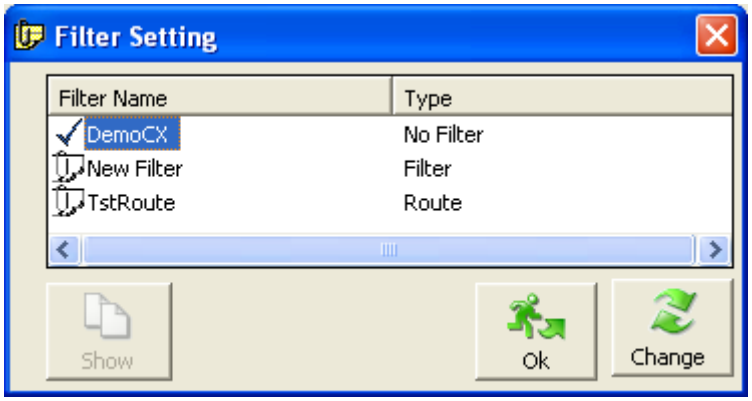
To remove a machine from the *Filter tree*, select the machine and push the **Remove** button:
You can also remove a whole *Department*. To do this, select a *Department* from the *Filter tree* and press the same **Remove** button.

From an existing *Filter* you can exclude any *Direction*:

In a filter you can arrange the items using the **Arrange** buttons. To do this, first press **CTRL** key from the computer keyboard, and then click on **Up** or **Down** arrange buttons.

- ## Filter activation

To activate a filter, proceed as follows:
Select **Settings** > **Set filter**.



Select a *Filter definition* or a *Route* (A Route can be used whenever you want as a Filter).

You can press the **Show** button to see the *Filter* contents. The **Filter Edit** window must be open.

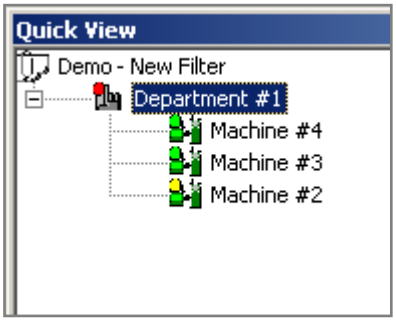
Pres the **Change** button to activate the filter.

You can do the same from the **CXSpectra**™ *Status bar*. Just click the **Filter** icon:

If a filter is active, the filter name will appear in the *Status Bar* also.

In order to cancel the filtering, just select the whole database as a filter. In the above example the database name is **DemoCX.**

***NOTE*: When a machine is excluded while filtering a database, it is not visible in the database tree.**



In the below example, the **DemoCX** database tree will appear as follows:

Only Department #1 is visible, because the *Filter* includes only this Plant.

After the database name, the *Filter* name is also shown.

13 Viewing plots

CXSpectra™ can display the followings plots:

- *Trends* (for total value, BE, Envelope, Speed, Manual Entry values)
- *Spectra* (for vibration measurement and Envelope).
  - Frequency Response graph
  - Waterfall plots

13.1 Trend plots

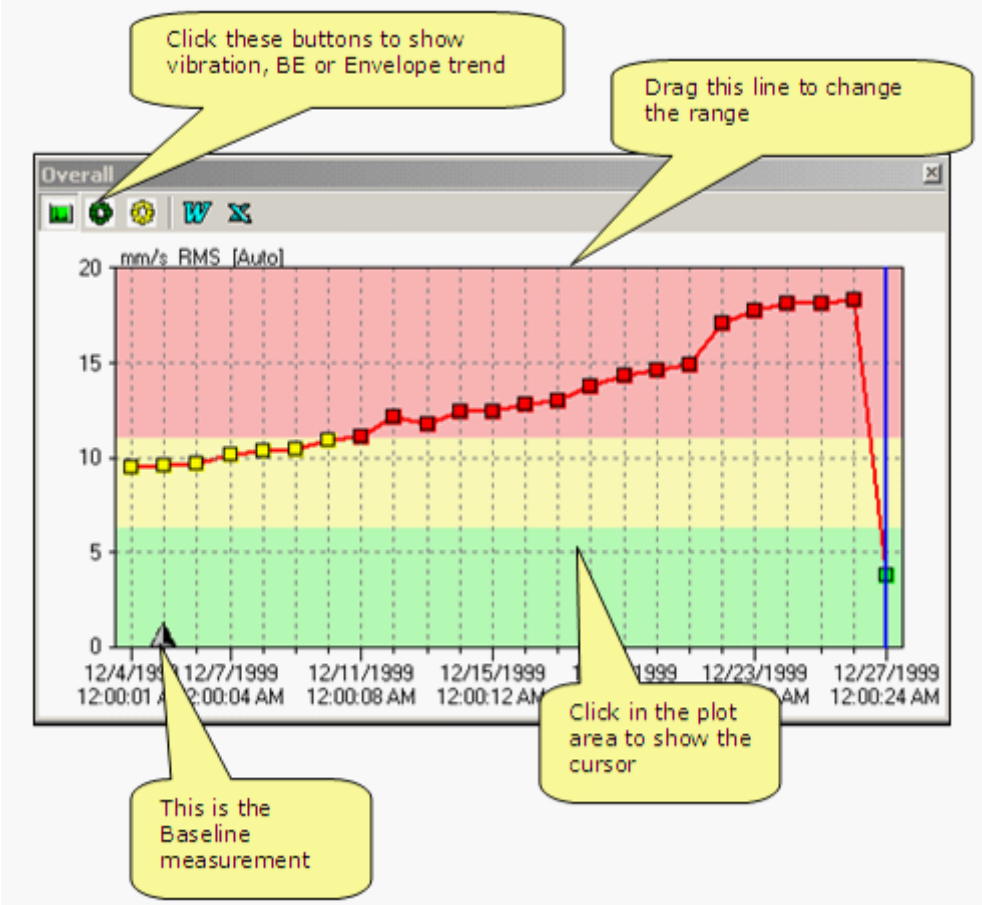
Trend plots can be shown for any *View* or from *Edit* window.

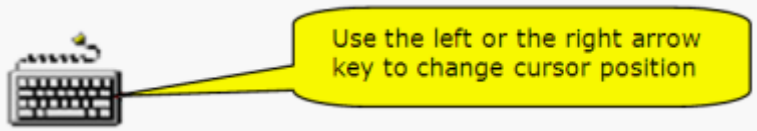
When a *Trend Plot* is shown, you can take a large number of actions to customize the graph. Most of these actions can be done using the **pop-up** menu, activated by the right-mouse button. Other actions may be taken using the mouse or/and the keyboard.

You can also use the dedicated buttons from the *Toolbar*.

13.1.1 Actions with the mouse and/or keyboard

In the next picture you can see all the actions you can take using the mouse or the keyboard.





Unit and average – The trend unit for the *Total value* of vibration is, always, in accordance with the *Alarm levels* setting (in *Edit Database* window). The unit and the average can't be changed.

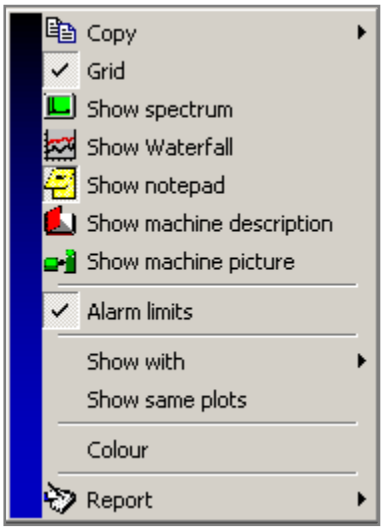
Gain – When the trend is shown for the first time, the gain is set in respect of the highest *Total value* from the trend (*AUTO mode*). The gain can be changed by clicking and dragging the upper horizontal line of the grid. If you drag it down, the gain will decrease; if you drag it up, the gain will increase. A double click into the Y-axis label area will restore the auto-gain. The gain for BE can't be adjusted.

Cursor – When a trend is shown, the cursor is placed onto the last (most recent) measured point. You can also place the cursor into another position, using the mouse (click in the new position) or using the left and the right arrows from the keyboard. If the synchronize cursor command is checked, depending on link level (Synchronize to menu), the cursors will move into other trend.

Live alarm limit change – When the option "Live alarm" is activated in Optional Setting menu, you can change live alarm limits. Just place the cursor on the alarm limit border, click and drag to modify the alarm level. In the **Trend** toolbar press the **Save** button to store the new alarm limit into the **Machine Database**.

13.1.2 Actions from the pop-up menu

The **Trend Menu** can be activated in each **Trend Plot**, with a right click on the mouse. The menu has the following actions:



Copy – This action copies the plot onto the clipboard or in a text editor. You can also use CTRL+C. You can paste the clipboard contents in the Notepad, with CTRL+V.

Grid – The grid of the trend can be shown or hidden using this action.

Show spectrum – Selecting this action, the spectrum associated with the trend cursor will be shown.

Show waterfall – Selecting this action, the waterfall spectra associated with the trend will be shown.

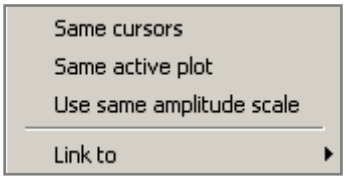
Show Notepad – Selecting this action the Notepad associated with the trend will be shown. Notepad can also be activated with the specific button from the toolbar.

Show machine picture – If you select this action, the machine picture will be shown into a separate window.

Alarm limits – You can make visible the alarm limits for the selected trend using this action,

Show same plots – can be used, when more than a single trend window is visible. If this line item is checked, when you select into a trend one of the graphs, the same graph

will also be selected in all the visible trends.



Same cursor – this action activates or deactivates the linking between the cursors for the other trend plots. If a large number of trend plots are displayed, it is better not to synchronize the cursors.

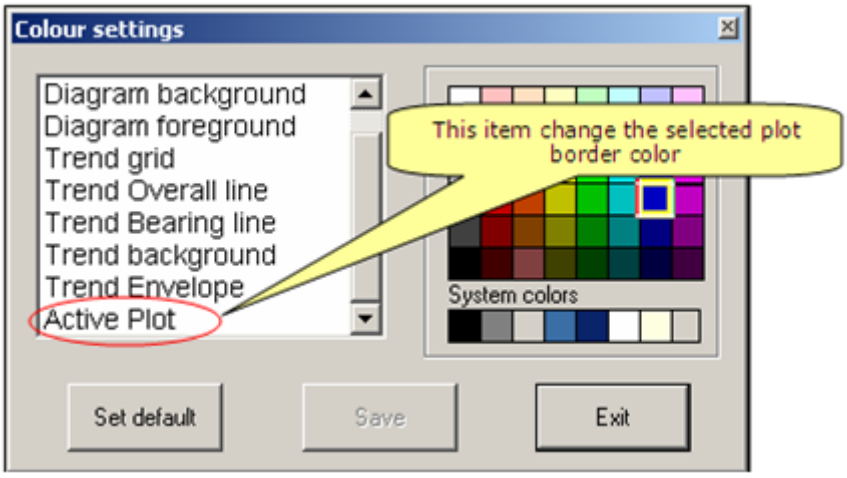
Use same amplitude scale for all – This command is an action that adjusts the gain for all trends in accordance with the active trend gain, depending on the link level.

Same active plot can be used, when more than a single trend window is visible.
If this line item is checked, when you select one of the graphs in a trend, the same graph will also be selected in all the visible trends.

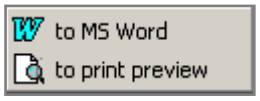
Link to – You can synchronize trend cursors and make the same gain for all the trend plots, depending on link level: global (for all active trends), machine or point level.

Colours – You can customize the colour for:

- Main cursor
- Axis background
- Axis foreground
- Trend grid
- Trend - overall line
- Trend - bearing line
- Trend - Envelope line
- Trend background
- Active plot border



You can save these new colours using the **Save** command. You can restore the default colours using the **Set Default** command.



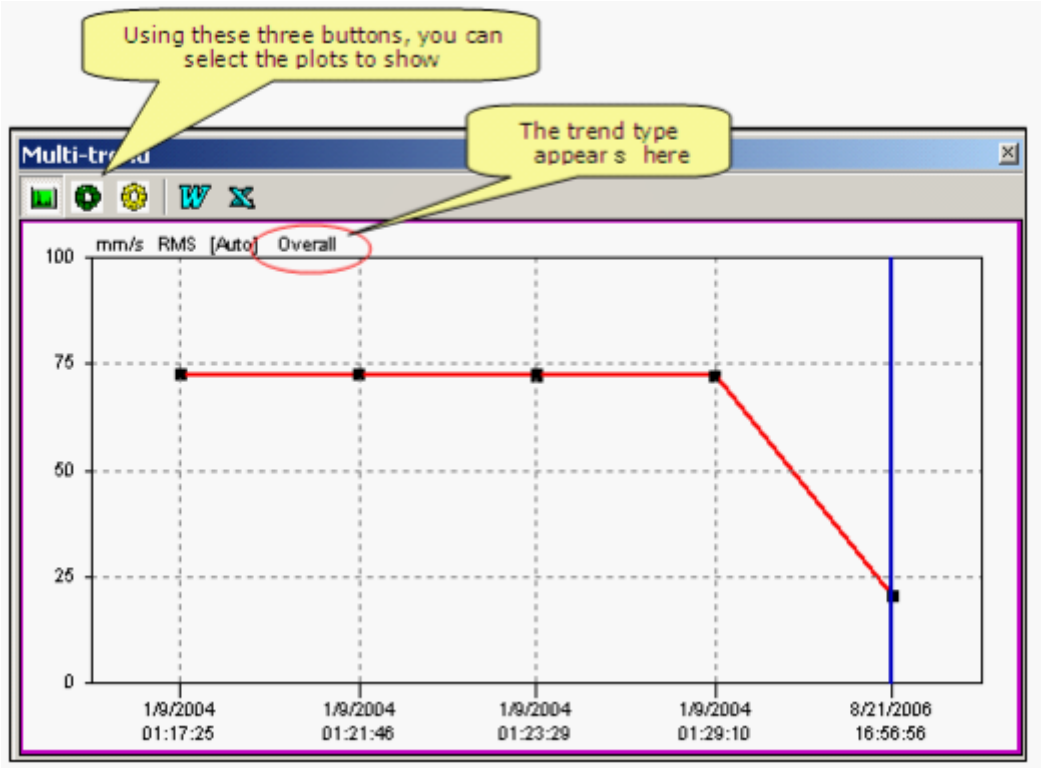
Report - Using this command, a trend report will be generated. After previewing, you can print the report to the system printer. The **Report** can be also directly made in a text editor.

13.1.3 Actions from the Main Toolbar

Notepad button – When this button is pressed, the Notepad will be activated in accordance to the active *Trend plot.*

13.1.4 Multitrend

When a trend is shown, it appears as it follows:



The default plot is *Total value* (or *Overall*) trend.
The name of the plot appears now in the upper part of the trend graph.

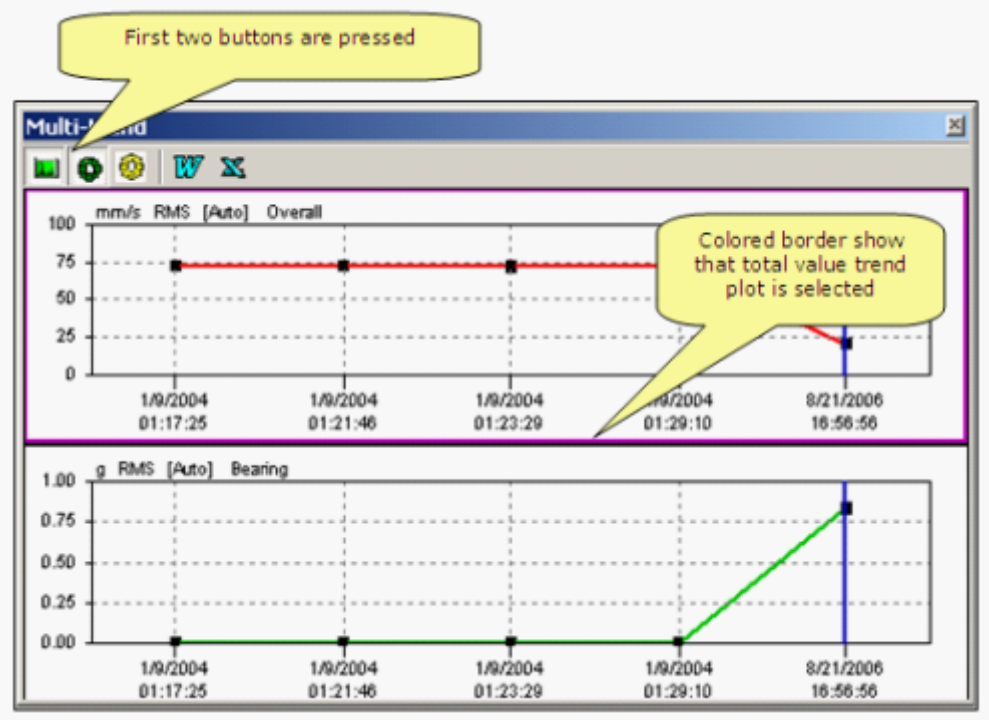
Pressing the first three buttons from the toolbar, you can select the plots to be shown in a single window.

The selection can be:

- Total value trend only;
- Bearing Energy trend only;
- Envelope trend only;
- Any combination of above.

There are two examples below:

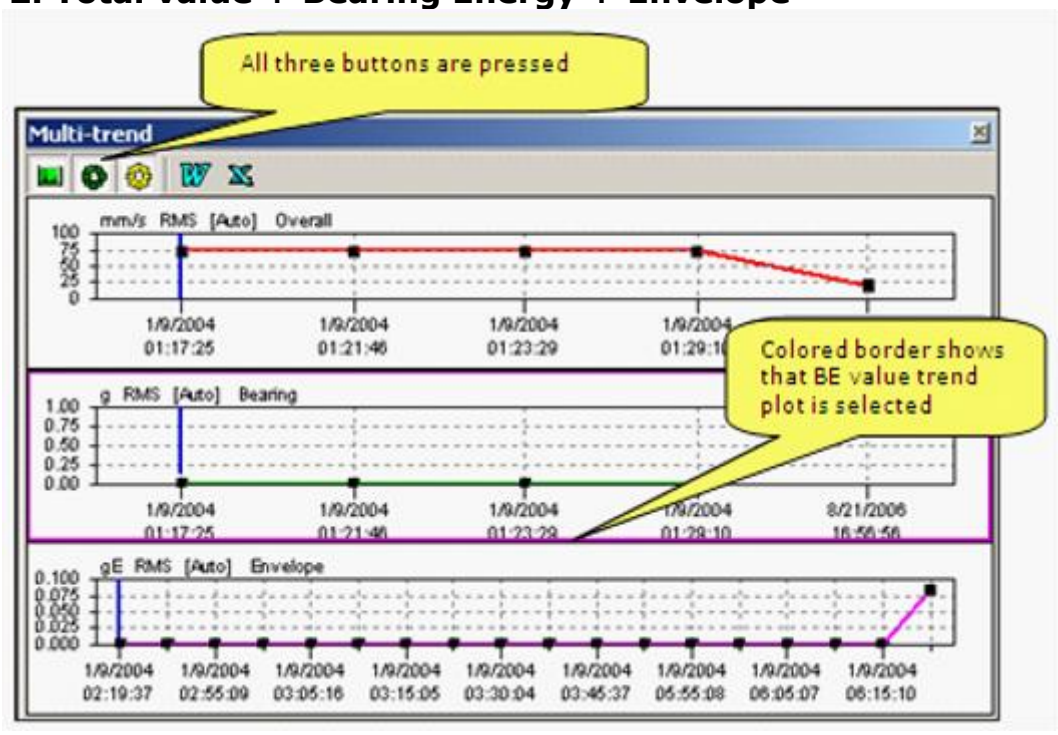
1. Total value + Bearing energy



The selected plot has a coloured border. The cursor may be moved with the left and the right arrow keyboard keys in the selected plot. Because the cursors in the plots are synchronized, the cursor will also be moved in the remaining plots, but if the same date is not available, the cursors will be placed onto the closest position, in respect with the cursor of the selected plot.

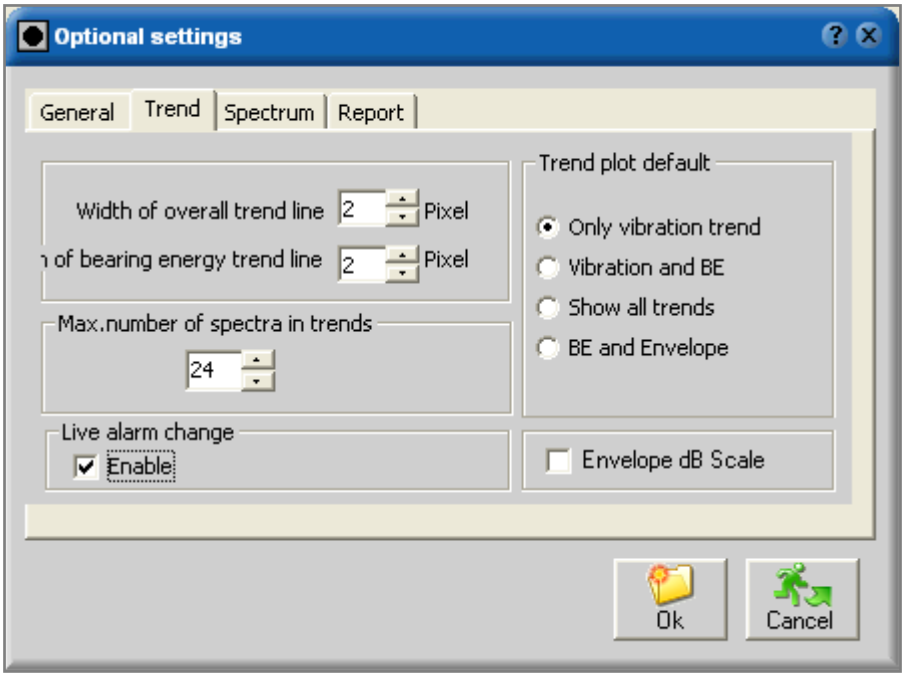
The amplitude scale can be individually changed for each plot. Just drag the upper graph line and the amplitude scale will be changed. You can drag the line up or down to increase or decrease the scale. In the trend plot, the unit and the average can't be changed. You can do this only in the **Database** > **Edit** > **Alarm settings window**.

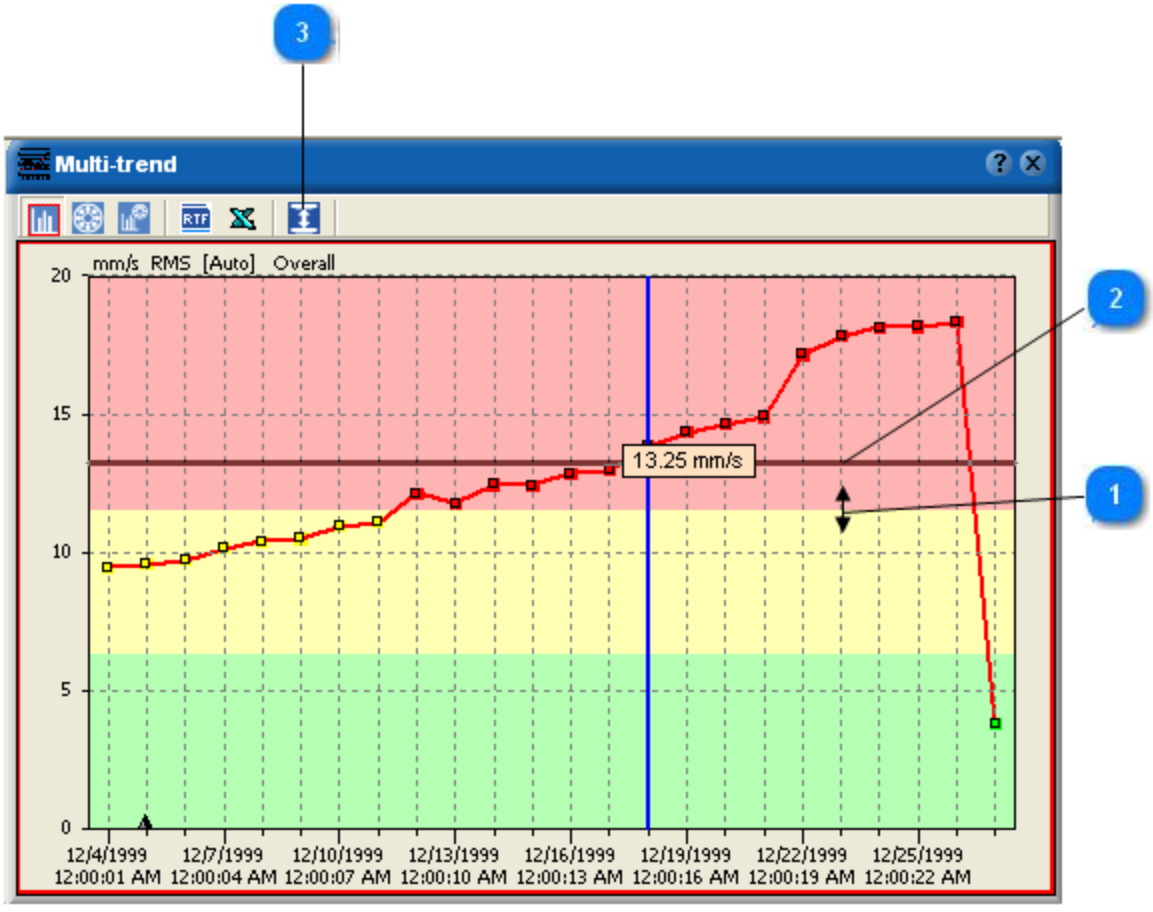
2. Total value + Bearing Energy + Envelope



13.1.5 Live Alarm limits changing

If in **Setting -> Optional settings -> Trend** you will enable the option **Live alarm change**, then the alarm limits in trend might be changed "live":





1. Click on the edge limit of the alarm.
2. Drag the alarm limit line up to a new position
3. Press the **Save** button to change the alarm limit permanently.

Both *Warning* and *Danger* limits can be changed.
"Live" alarm limits can be changed in Vibration, BE or Envelope plot.

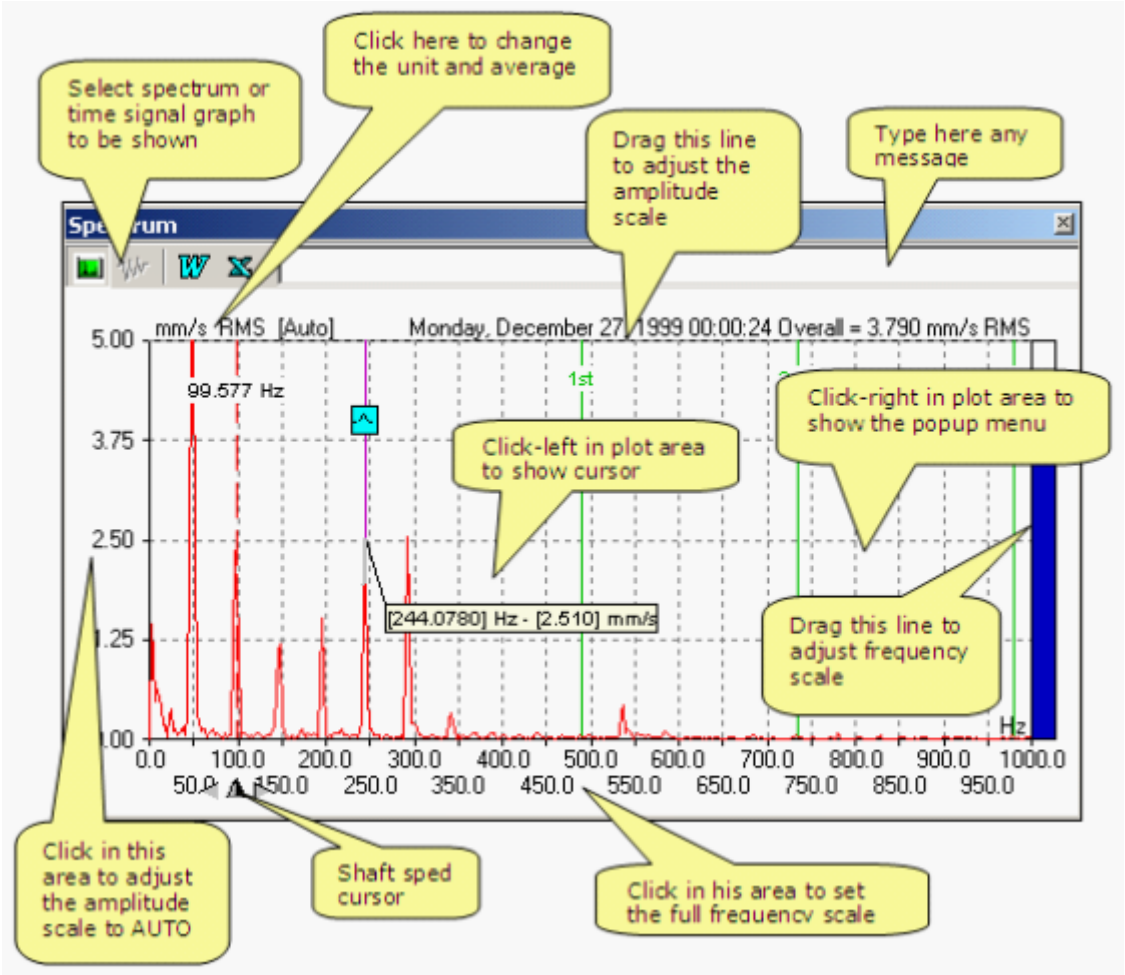
13.2 Spectrum plots

When a spectrum plot is shown, you can take a large number of actions to customize the graph. The majority of these actions can be done using the pop-up menu, activated by the right-mouse button.
Other actions can be taken using the mouse or/and keyboard.

You can also use the dedicated buttons from the *Toolbar*.

13.2.1 Actions with the mouse and/ or the keyboard

In the following picture you can see all the actions you can take using the mouse or the keyboard.

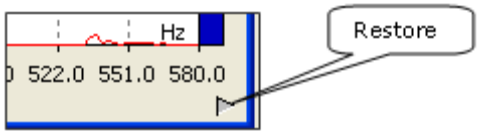


Gain – When the spectrum is shown for first time; the gain is set in respect with the overall value of the vibration (AUTO mode). The gain can be changed by clicking and

dragging the upper horizontal line of the grid. If you drag and drop the line down, the gain will decrease and if you drag it up, the gain will increase. A double – click in Y-axis label area will restore the *Auto gain*.

Frequency range – If you click and drag the Y–axis of the plot, you can adjust the minimum frequency. If you drag and drop the line to the right, the minimum frequency will increase.

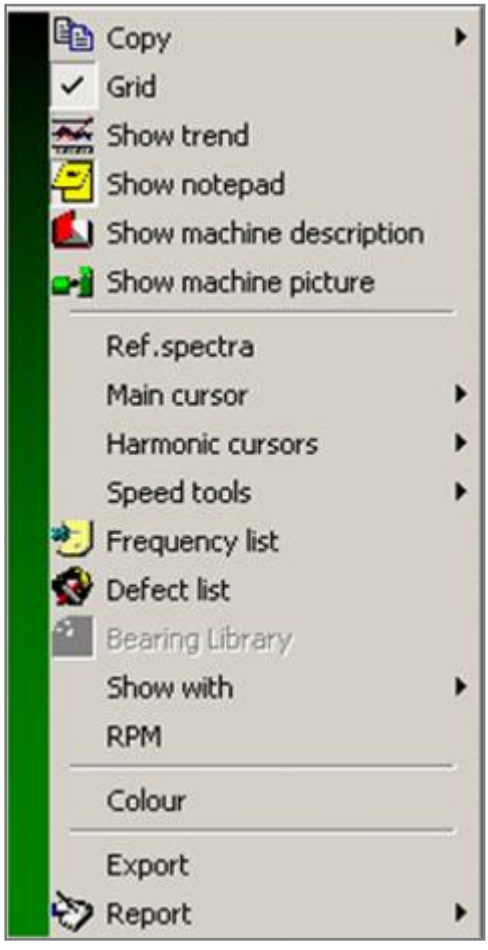
Similarly, you can increase the maximum frequency, by clicking and dragging the last vertical line of the grid. The difference between the maximum and the minimum frequency should be at least 50 Hz (3000 RPM). A double click onto the X-axis label zone will restore the whole frequency range. You may press also the Restore icon:



Zoom – You can enlarge the plot by double-clicking anywhere into the blue banner area. To restore the spectrum plot at the initial size, just press the **Restore down** button in the gray spectrum plot banner area.

Main cursor – The *main cursor* may be activated with a click into the plot area. The *main cursor* has an associated label. You can also use the Left or the Right arrow keys for a smooth movement of the cursor or CTRL + Left (CTRL + Right) arrow keys for a fast movement of the cursor. Press keys 0 to 9 to move the cursor to the shaft frequency or to its harmonics. Move the cursor label up or down using the UP/DOWN arrow keys.

Shaft Speed cursor – The shaft speed cursor is shown as a small triangle near the X-axis; using the mouse, you can adjust the position of this cursor.



13.2.2 Actions from the pop-up menu

The **Spectrum Menu** can be activated in each **Spectrum Plot** with a right click on the mouse. The **Menu** has the following actions:

Copy – This action copies the plot onto the Clipboard. You can also use CTRL+C. You can paste the clipboard contents in the *Notepad* with CTRL+V. You can also copy the plot in a *MS Word* document file. The first copy action in *MS Word* will open a new document. Consecutive copy actions will insert the plots (any of them) in the same document file.

Grid – The grid of the spectrum can be shown or hidden, using this action.

Show trend – Selecting this action, the trend associated with the spectrum will be shown.

Show Notepad – Selecting this action, the *Notepad* associated with the spectrum will be shown. The *Notepad* can also be activated with the specific button from the toolbar.

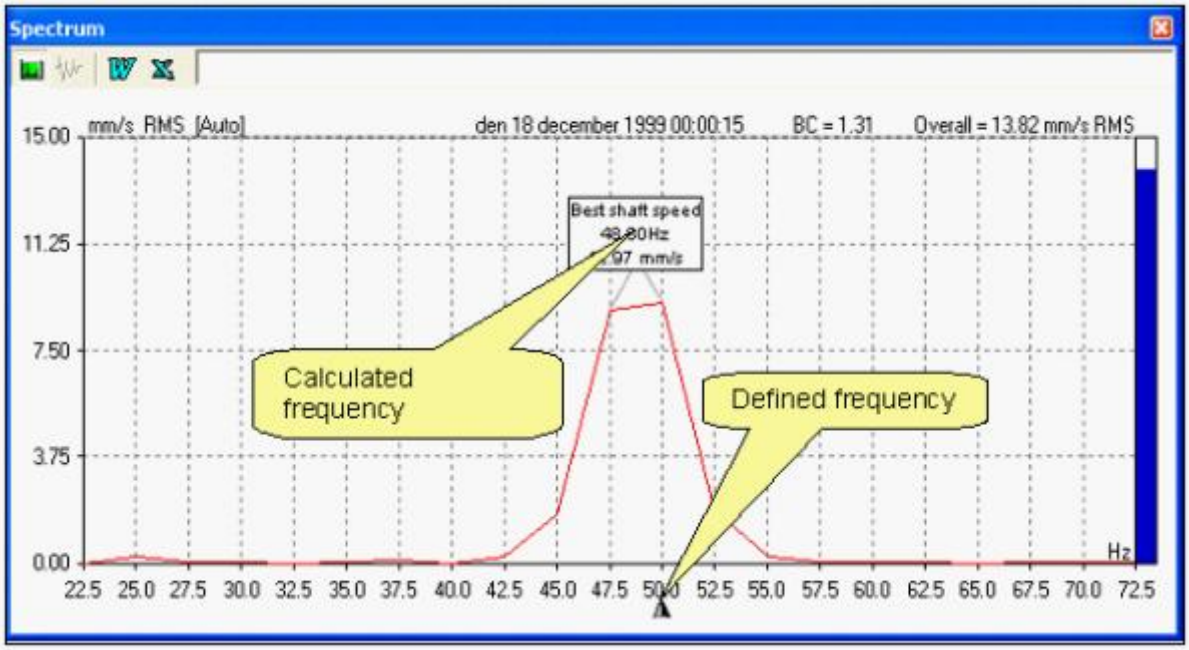
Show machine description – The machine

description editor will be opened.

Show machine picture – The machine picture will be shown.
Reference spectrum – The reference spectrum (*Baseline spectrum*), if exists, will be drawn in the same plot with black lines. The *Reference spectrum* has its own cursor, synchronized with the *Spectrum cursor*. Using the mouse, pointed in the origin of the *Reference spectrum* axis, you can move the reference spectrum wherever you want onto the plot area. If you want, you can place the reference spectrum over the actual spectrum.

Main cursor – Determine how the cursor will move in the plot:

- **Peak locked** – When a peak is detected, the cursor will be placed on the maximum calculated peak. A small blue icon will indicate the peak detection. If a peak is not detected, the cursor will move with spectrum resolution steps.
- **Frequency line** – The cursor will follow the spectrum lines.
- **Free** – The cursor is moved with one pixel step. The peak amplitude will be calculated with a linear interpolation between the spectrum lines.
- **Speed tools** – Determine how the software will place the speed arrow:
- **Calculated** – The speed arrow will be placed onto the position calculated from the actual spectrum (around the defined values). The software tries to detect a peak (a higher line between other two smaller lines), around the defined shaft speed. If a peak is found, the exact frequency and peak amplitude are calculated. If a peak isn't found, the speed arrow is placed on the defined frequency. If the defined frequency doesn't exist, the cursor is placed onto the calculated frequency, near the highest top in the spectrum.
- **Defined** – The speed arrow will be placed in the frequency defined in **Database edit** menu.
- **Measured** – The speed arrow will be placed where it was measured. If the shaft speed wasn't measured in the meantime of spectrum acquisition, the cursor will be placed into the defined position.

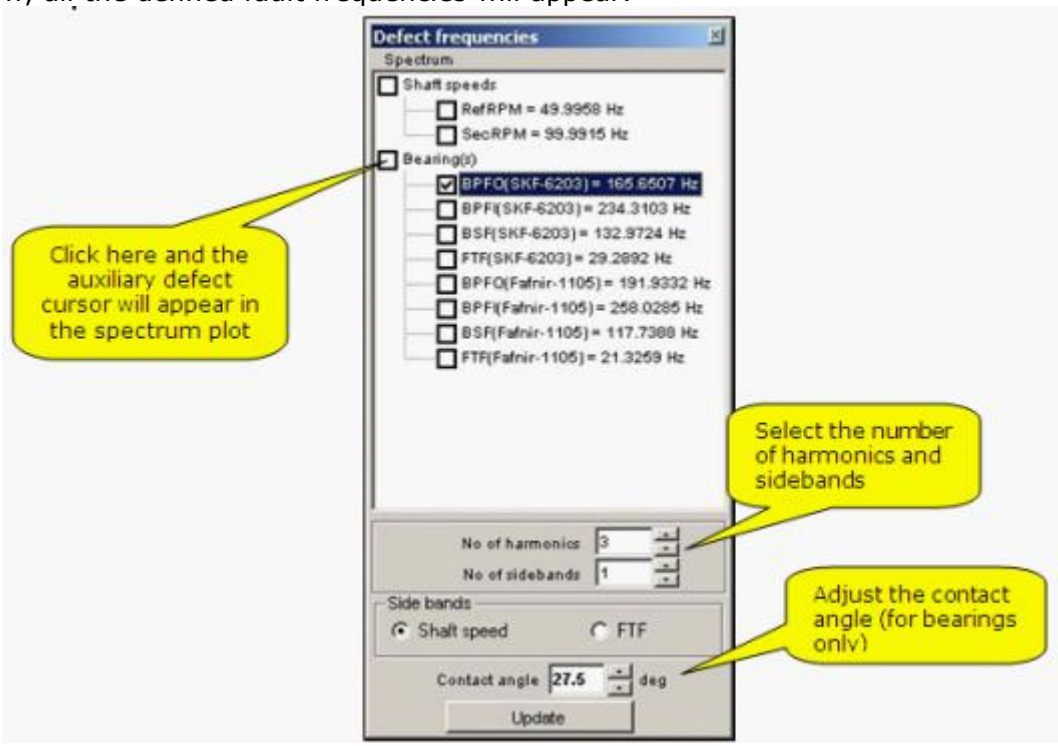


- **Saved shaft speed** – The speed arrow will be placed in the position saved before, using the *Save speed current* command. The speed value is saved only for the selected spectrum or for all spectra belonging to the machine (see *Adjusting speed* paragraph).

***Warning*: The highest top in a spectrum is not necessary the same with the revolution. It can be due to misalignment (twice the revolution frequency) or for example by a gear box.**

Harmonic cursors – By default, up to 10 harmonic cursors can be shown, together with the *main cursor*, but you can change this number in the **Settings** > Optional settings menu.
Side band cursors – As default, up to 10 side band cursors can be shown, together with the main cursor, but you can change this number in the **Settings >** Optional settings menu.

Defect frequency cursors – This is a powerful tool for fault identification. In a toolbox window, all the defined fault frequencies will appear.



Any selection will update into the real time the spectrum plot. The last selection is also saved to be available later on.

Fault list – The *Fault list* table will be displayed. You can also do this action from the **Main** menu toolbar. Depending on the gap setting, the labels attached with the fault frequencies will also be displayed accordingly.

Show with- Same cursors – If, on the screen, more than one spectrum are displayed and you select this action, the cursors from all spectra plots will be synchronized, depending on the link level (*Link to action*).

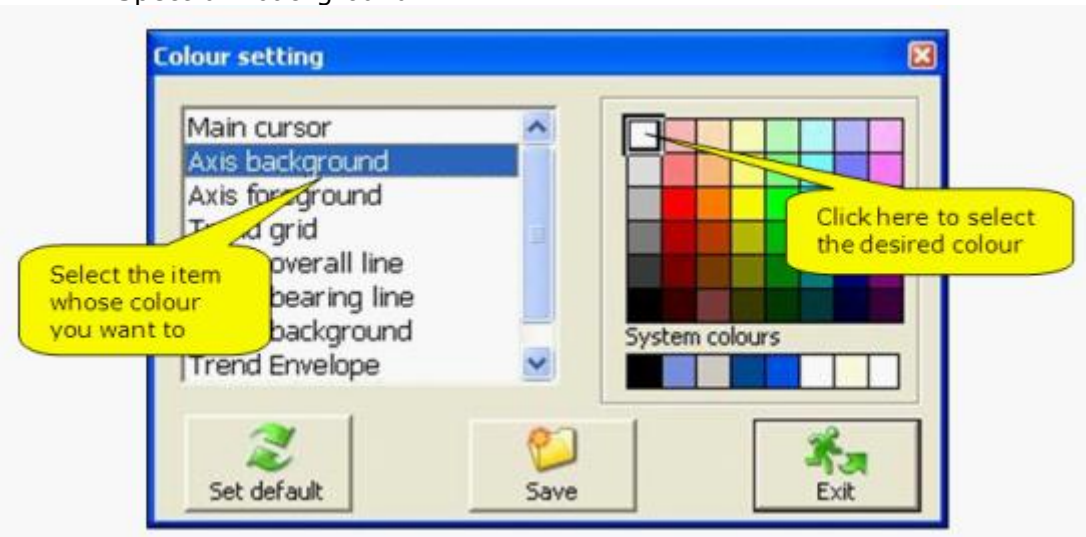
Show with - Use same – This action sets the synchronism level for range, if more than one *Spectrum* is shown. You can select between the *Frequency range* and the *Amplitude range* or for both.

Show with - Link to – This action sets the synchronism level if more than one *Spectrum* is shown. The synchronism level can be *Global* (for all the spectra plots), on machine level, on point level or on direction level.

CPM/ Hz – You can change anytime the Y-axis unit, selecting CPM or Hz.

Colours – You can customize the colours in the spectrum plot. You can change the colours for:

- Main cursor
- Harmonics cursors
- Bearing cursors
- Axis background
- Axis foreground
- Overall bar graph
- Spectrum grid
- Spectrum line
- Spectrum background



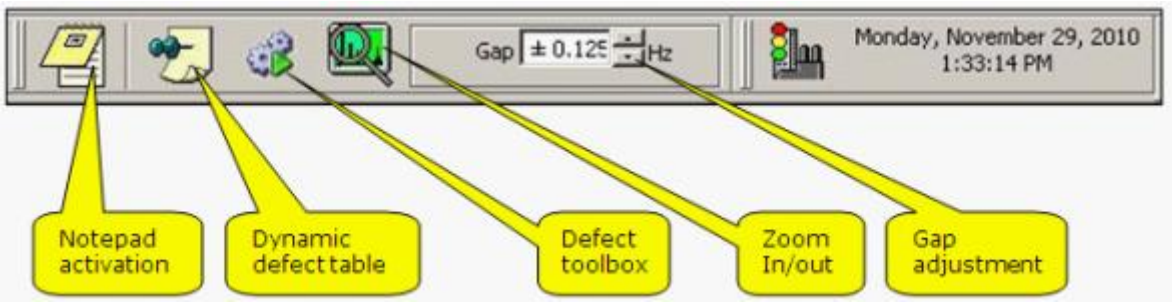
You can save these new colours for your database, or to restore the original colours, using **Set default** command.

Export – You can export the whole spectrum in any transfer file (having extension .tr3)

Report – Using this command, a spectrum Report will be generated. After previewing, you can print the report to the system printer. For more details see **Report preview**.

The **Report** can also be transferred in a MS Word Document. If there is no document opened, a new document will be opened. Consecutive reports will be inserted in the same document file.

13.2.3 Actions from the Main Toolbar

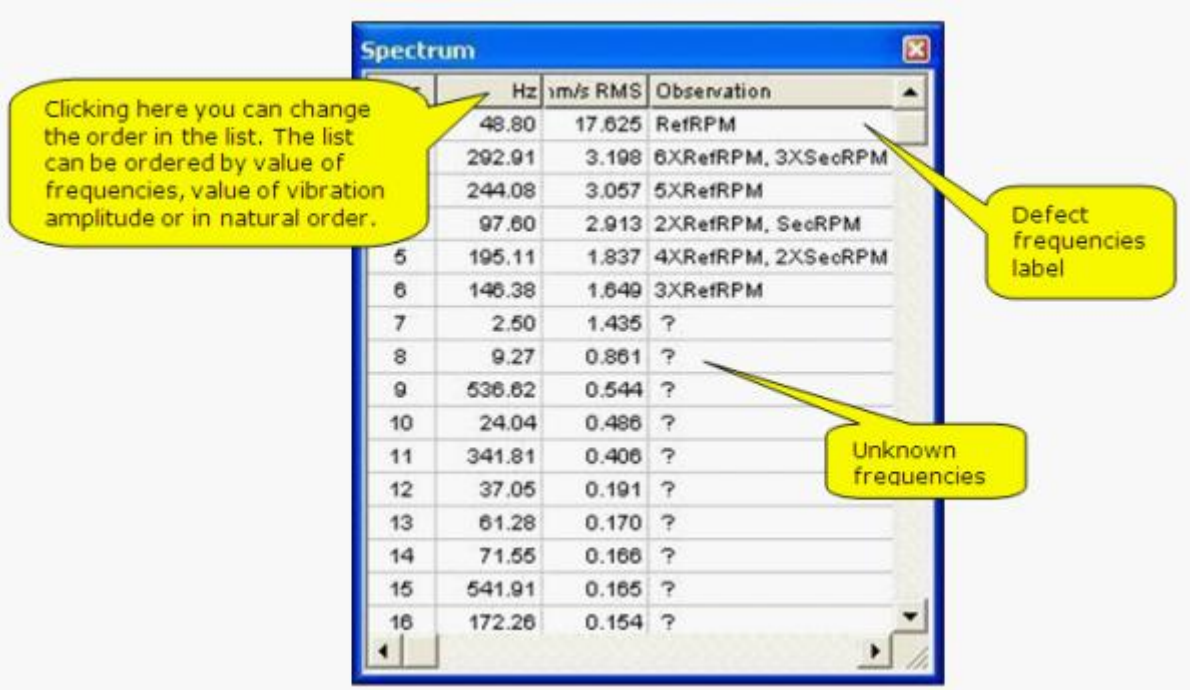


In the **Main Menu** some *Toolbar* buttons are dedicated for *Spectra Plots*:

Notepad button – When this button is pressed, the *Notepad* will be activated in

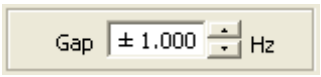
accordance with the active *Spectrum plot*.

Dynamic table – A table with the first 30 fault frequencies can be displayed:



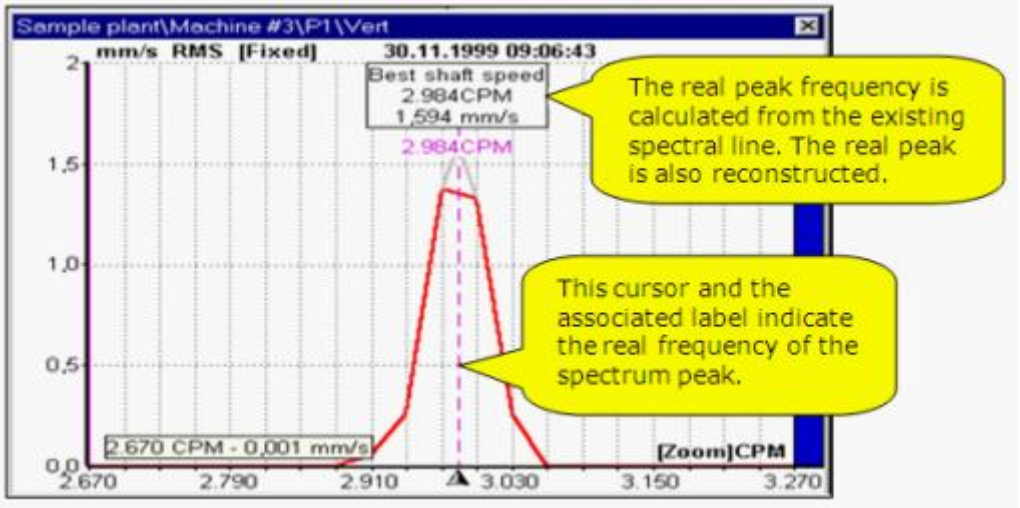
Fault toolbox – Activating this action, the *Fault frequencies* toolbox window will be displayed.

Gap – Depending on the gap, in the dynamic table less or more frequencies can be labeled.



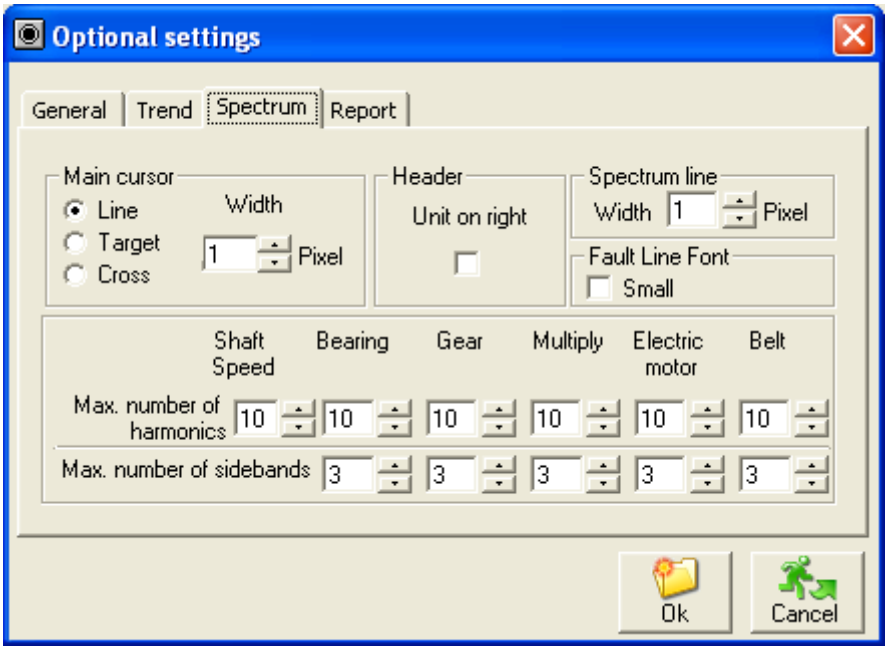
If the gap is too small and the fault frequencies aren't equal with the fault definition, plus or minus the gap value, in the place of the label a question mark will be displayed. If the gap is too large, for the same frequency, more than one label will be displayed.

Zoom – This action can be used for a fine tuning of the shaft speed:



13.2.4 Other settings for the spectrum plot

The main cursor shape can be selected using the **Optional Settings** command from the main **Settings** menu.



Main cursor can be:

- Line (default)
- Target type
- Cross type

Just click the option you want and the cursor shape selected will be displayed into the spectrum plot from now on. You can also adjust the cursor thickness (default is 1 pixel).

The **thickness** of the spectrum line can be adjusted with a proper setting of the *Width*.

Maximum number of harmonic cursors and sideband cursors can be adjusted in the same tab. Once set, any of the above will be saved into the *CXSpectra.ini* file.

13.2.5 Adjusting speed

A major task in the spectrum analysis is to determine, with a higher accuracy, the correct speed for each spectrum. Almost all fault frequencies are associated with the shaft speed. Any small error in shaft speed determination can produce larger errors in the fault frequencies calculation and, as a consequence, a poor diagnosis process.

A proper solution might be to measure the spectrum from the route, using speed reference (active tachometer input). This action is difficult to be done in most of the cases, because a speed sensor must be fitted to each machine shaft.

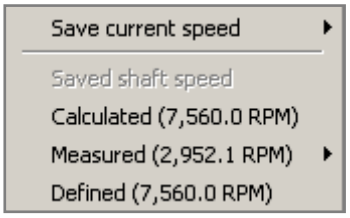
The method of the *Measured speed*, described below, allows a correct shaft speed

calculation, even if only a single measurement belonging to the machine has a speed reference. The algorithm also works if the machine has different shaft speeds.

The method using the *Saved speed*, allows a correct shaft speed calculation, without collecting any spectra with the speed reference sensor. For a single spectrum belonging to a machine, the speed must be manually set. Then, using a back-calculation, all the spectra will appear with the correct speed cursor.

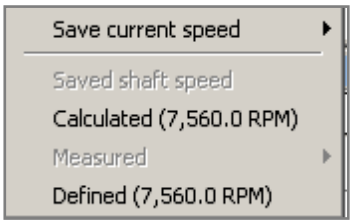
13.2.5.1 Using the Measured Speed

For a new unloaded spectrum, having the speed measured during the data acquisition, the **Speed tools** menu appears as below:



In this example, the *Measured shaft speed* is 2952.1 RPM. The *Saved shaft speed* item is disabled, because no other speed was saved before. Because the *Defined speed* is set to 7560 RPM, the *Calculated speed,* in our example, is the same. The *Calculated speed* is calculated around the *Defined shaft speed* (± 20%).

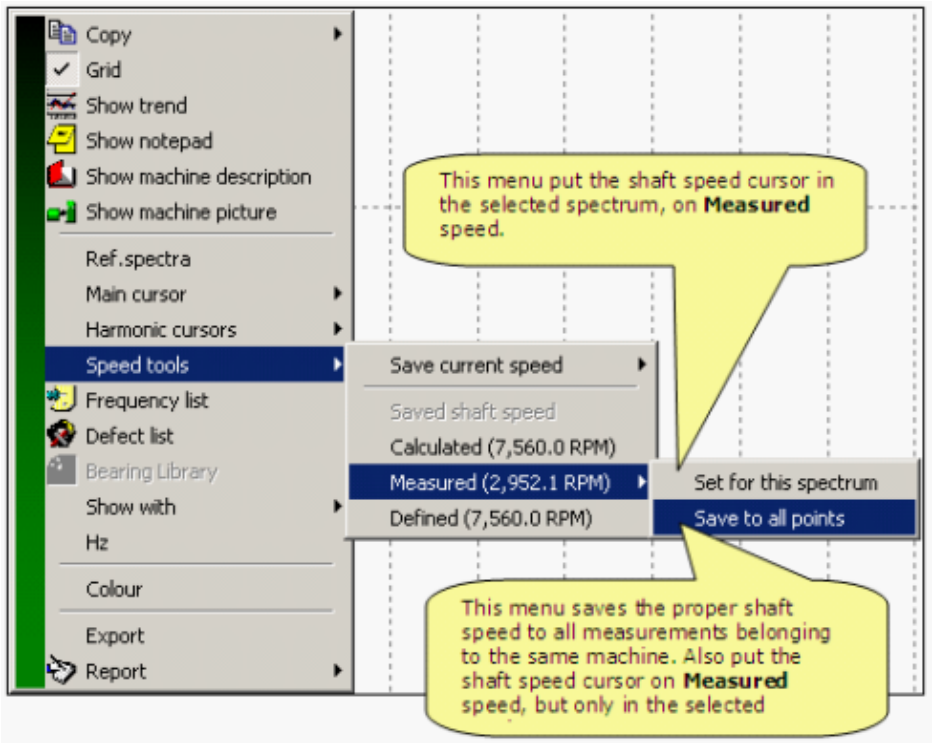
For a new unloaded spectrum, without speed measurement during the data acquisition, the **Speed Tool** menu appears as below:



The *Measured item* is disabled, because the speed wasn't measured during data acquisition.
The other items remain the same.

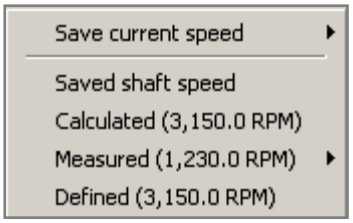
To set the proper shaft speed for all machines directions, proceed as follows:

- Identify the spectrum having the Measured item enabled.
- Click onto the Measured item to extend the menu lines:



- Select *Set to all points* menu. The proper shaft speed will be back-calculated, using the speed settings in the database, for all the measurements belonging to the same machine and having the same transfer time (in fact, this means that all the transferred measurements from the route belonging to the same machine will be set with the *Measured speed*).

The result can be immediately seen; just select another spectrum of the same machine and the **Speed Tool** menu will look like below:



In our example, the measured speed for this shaft is back-calculated to be 1230 RPM.

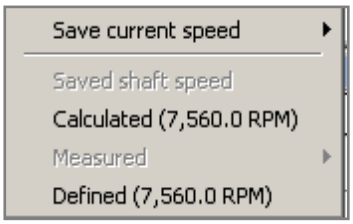
The calculation uses the measured speed of the previous point as reference.

In the **Quick View**, you can do the settings in seconds.

Now, all the spectra of the same machine, without being collected with speed reference, have the speed cursor in the correct position. Of course, it is assumed that during data acquisition, the machine speed remains the same.

13.2.5.2 Using the Saved Speed

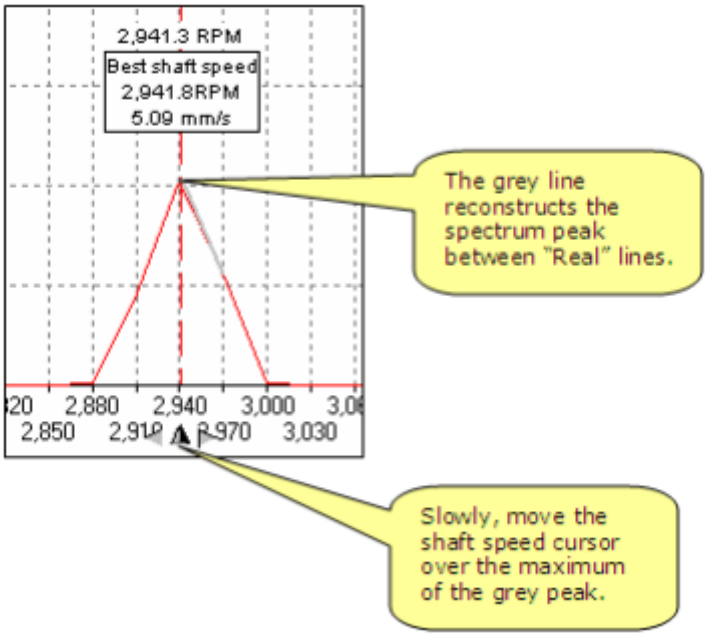
For a new uploaded spectrum, without speed measurement during the data acquisition, the **Speed Tool** menu appears as below:



Measured item is disabled, because the speed wasn't measured during data acquisition.

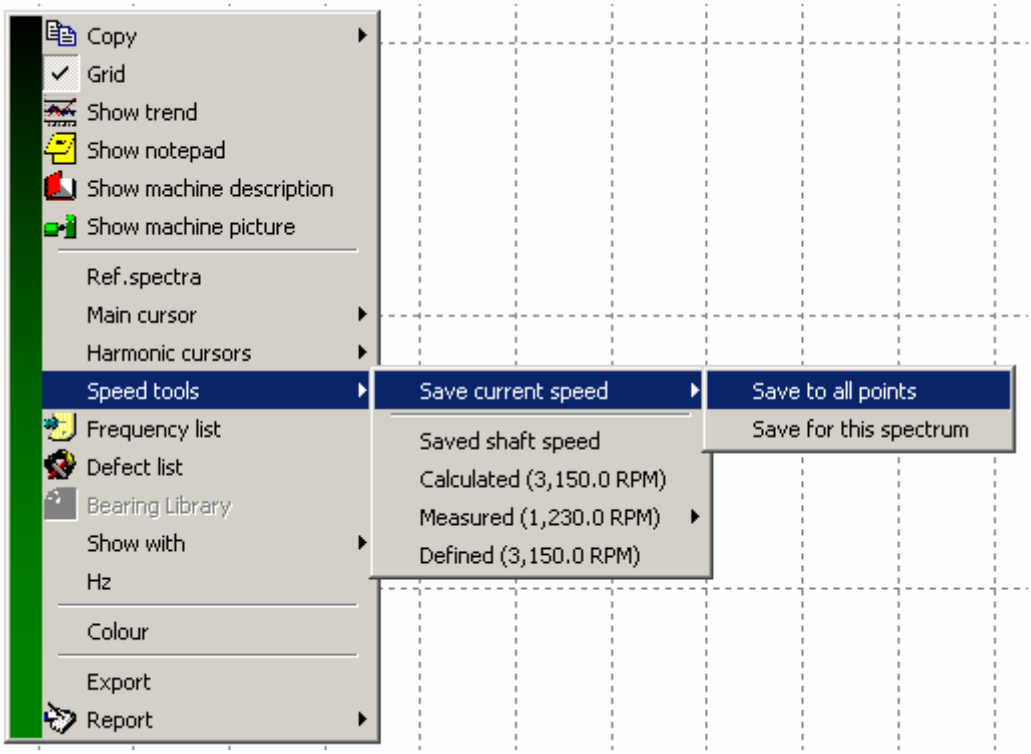
Saved shaft speed item is also disabled, because no other shaft speed was saved.

To set the proper *shaft speed* for all machines directions, proceed as follows:

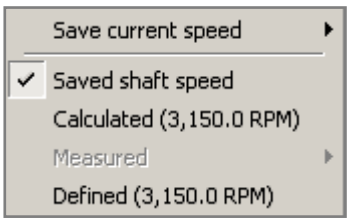


Select any spectrum of the same machine.

- Manually move the shaft speed cursor near the frequency where you consider that the speed is correct.
- From the **Main** menu toolbar, press the  button.
- In the enlarged spectrum graph, locate the Best shaft position. This is the top of the peak, as beside:
- Now press again the  button to display the whole spectrum.
- From the **Speed tools item**, select the **Save current speed** and **Save to all points** items. The proper shaft speed will be back-calculated, using the speed settings in the database, for all the measurements belonging to the same machine and having the same transfer time (in fact, this means that all the transferred measurements from the route, belonging to the same machine will be set with *Saved shaft speed*).



The result can be immediately seen; just select another spectrum of the same machine and the **Speed Tool** menu will look as below:



The *Saved shaft speed* is checked, even if it wasn't saved for this measurement.

The calculation uses the measured speed of the previous point as reference and the speed cursor in the spectrum is placed according with the calculation.

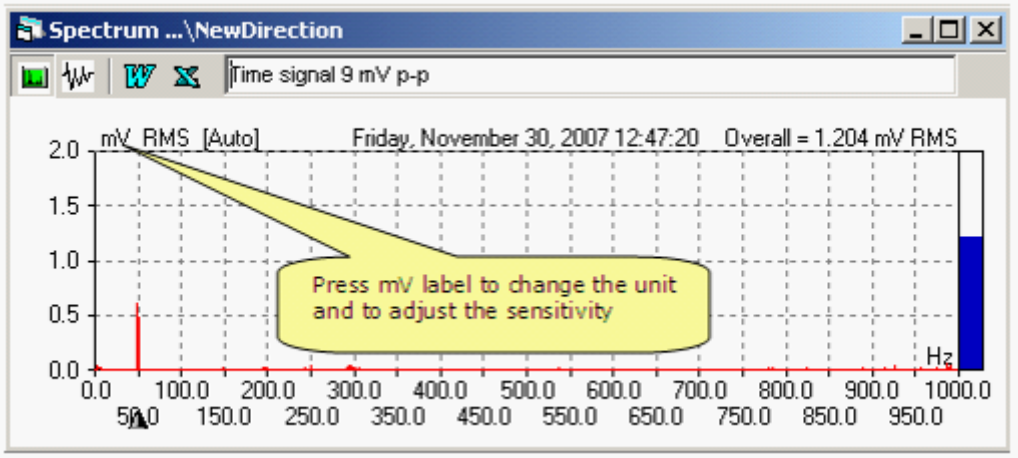
In the Quick View, you can do the settings in seconds.

Now, all spectra of the same machine have the speed cursor in the position that you decided. Of course, it's assumed that during data acquisition, the machine speed remains the same. In such cases, the fault frequencies are calculated with a high error margin. Besides, all the other spectrum lines have zero amplitude values.

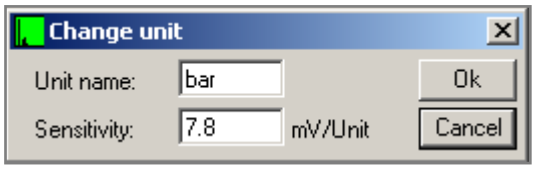
13.2.6 Spectrum in mV unit

With the CXBalancer® Instrument, *mV spectra* can be measured, but only off-route. These spectra have a special meaning: the engineering unit can be any, not only vibration units.

The *mV spectra* can be shown only in the **Edit** window and in **List View**.
An *mV spectrum* is shown below:



When the *mV* label is selected, the following window will be displayed:



Now, you can edit the unit and set the correct transducer sensitivity (in mV/unit). The settings will be saved in the database.

13.2.7 dB Scale in the Envelope Spectrum (ESP)

13.2.7.1 The Decibel (dB) Scale

Envelope data is often displayed in a logarithmic scale called the Decibel (dB) scale. This scale is useful, because vibration levels can vary from very small to very large values. When plotting the full data range on most scales, the small signals become virtually invisible. The dB scale solves this problem, because it compresses large numbers and expands small numbers. A dB value can be computed from a linear value by the equation:

$$Y[dB] = 20\log\left(\frac{x}{x_{ref}}\right)$$

For acceleration, zero reference (x_{ref}) is set 1 µg, or 10^{-6} g.
Any increase in level of 6 dB represents a doubling of amplitude, regardless of the initial level. In such a manner, any change of 20 dB represents a change in level by a factor of ten. Thus, any constant ratio of levels is seen as a certain distance on the scale, regardless of the absolute levels of the measurements. This makes very easy to evaluate trended Envelope spectral data; 6 dB increases always indicate a doubling of the magnitudes.

13.2.7.2 dB Values vs. Amplitude Level Ratios

The following table relates dB values to amplitude ratios:

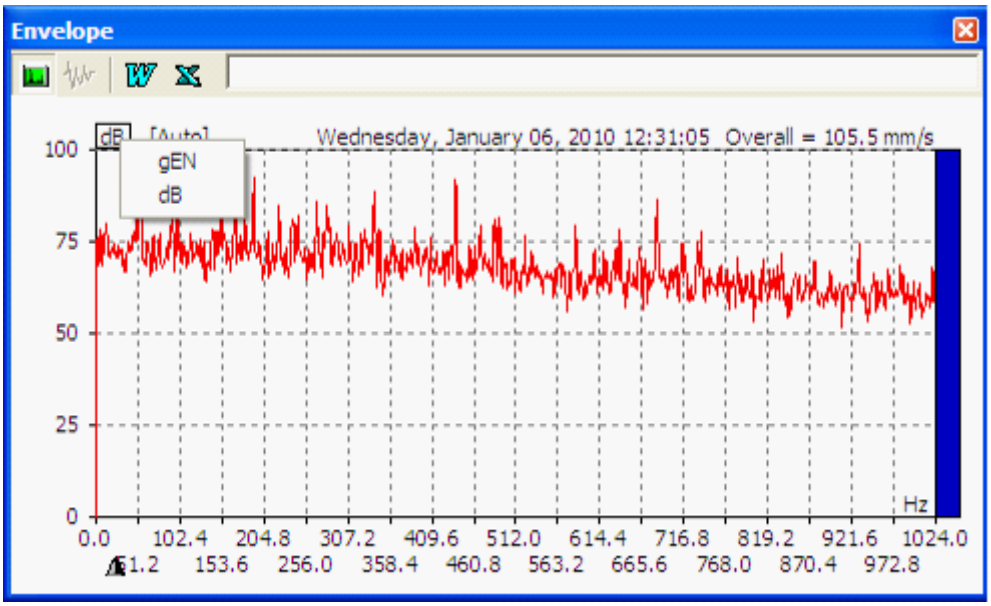
dB Change	Linear Level Ratio	dB Change	Linear Level Ratio
0	1	30	31
3	1.4	36	60
6	2	40	100
10	3.1	50	310
12	4	60	1000
18	8	70	3100
20	10	80	10,000
24	16	100	100,000

13.2.7.3 Showing Envelope trends in dB

The **Envelope trend graph** can show the amplitude in g (EN unit as default) or in dB. Only one of the above can be used for all Envelope graphs.
Selecting the way of displaying the Envelope scale can be done in the *Optional Settings*, tab *Trend*.

13.2.7.4 Showing Envelope spectrum (ESP) in dB

The **Envelope spectrum** will be shown, as default, with the above settings.
You can still change live the scale style:



Just click on the on the list and select it. The unit selection is valid only for that Envelope Spectrum graph and it will not be changed in any other graph from the screen.
The **Defect List** will be changed and it will show the Envelope lines amplitude in the selected unit.

13.2.7.5 Determination of Bearing Damage Severity

The decibel scale can be used very easily to diagnose bearing defect.
As nominally healthy rolling element bearings will exhibit vibration at the particular defect frequencies, it is extremely important to be able to accurately gauge the presence and indeed the severity of bearing deterioration.
Fortunately, a convenient rule-of-thumb can be established for severity assessment. This involves measuring the amplitude of the specific component in dB above the "*carpet level*" of the Envelope spectrum (Carpet level is the middle of the signal level, in dB).

- 10 dB above the carpet level of the spectrum is considered as indicative of the onset of bearing failure.
- 15÷20 dB above the carpet level of the spectrum is generally considered as sufficiently high to trigger some form of remedial action, either increased monitoring or, at least, bearing lubrication.
- 20÷40 dB above the carpet level of the spectrum combined with sidebands (usually at 1 x RPM or Cage defect frequency - FTF) is considered to require immediate action.
- The final sign of bearing deterioration is a 20÷30 dB rise of the carpet level.
- A carpet increase of 10 dB without defect frequency tonal can indicate a poor lubrication.

Note: In extremely badly damaged bearings, the carpet level can rise to obscure the bearing fault frequencies. As the carpet level begins to rise, a vibration reading in units of velocity will start to exhibit a small spike at the bearing fault frequency. A spike of 0.2 to 1 mm/s indicates definite spalling of the bearing.

Figures 1 and 2 illustrate the ESP (Envelope Signal Processing) Spectrum data collected from the **Motor Non Drive end bearing positions** of two identical Compressors.

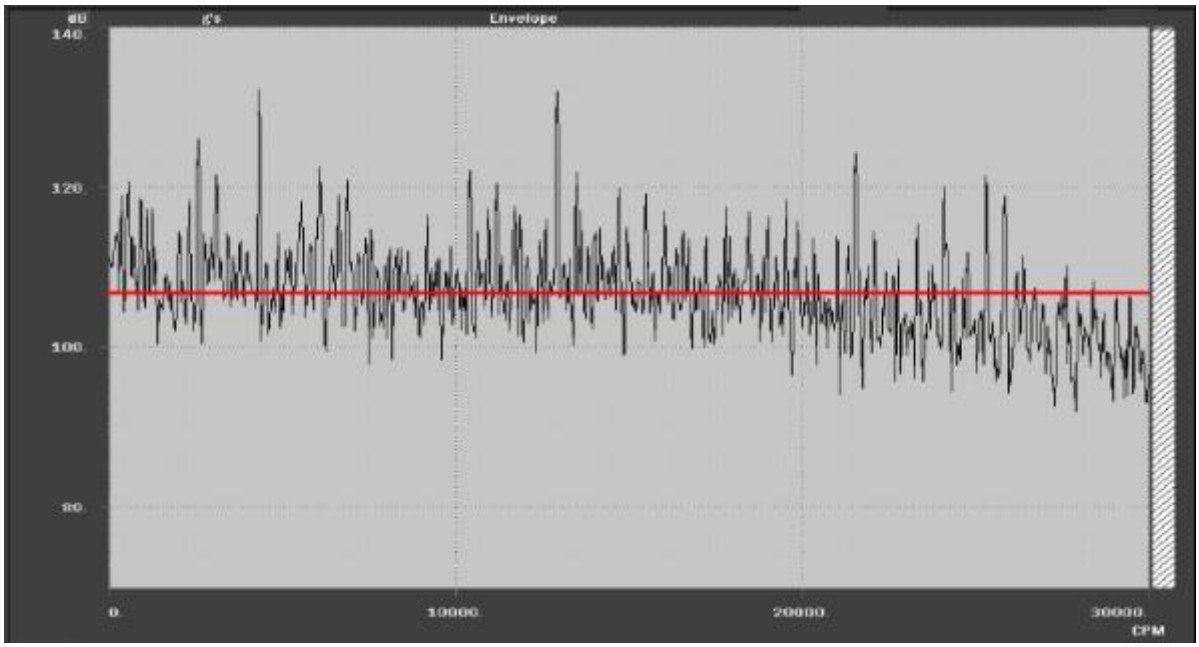


Fig. 1- Compressor 1 Motor NDE ESP Spectrum

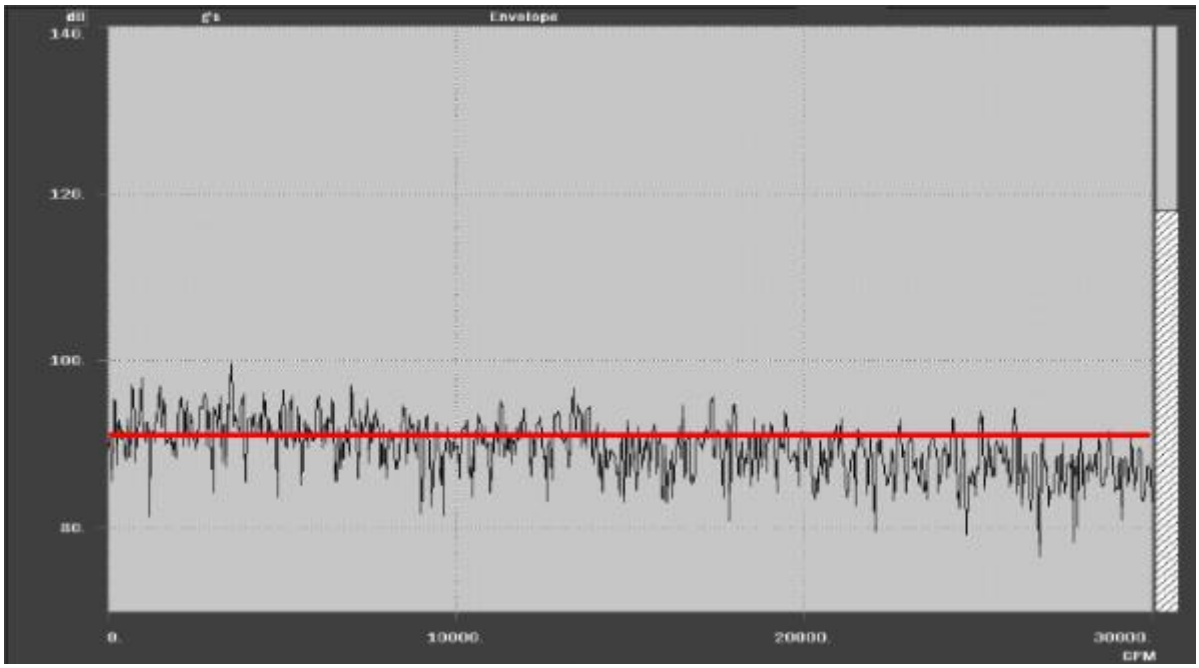
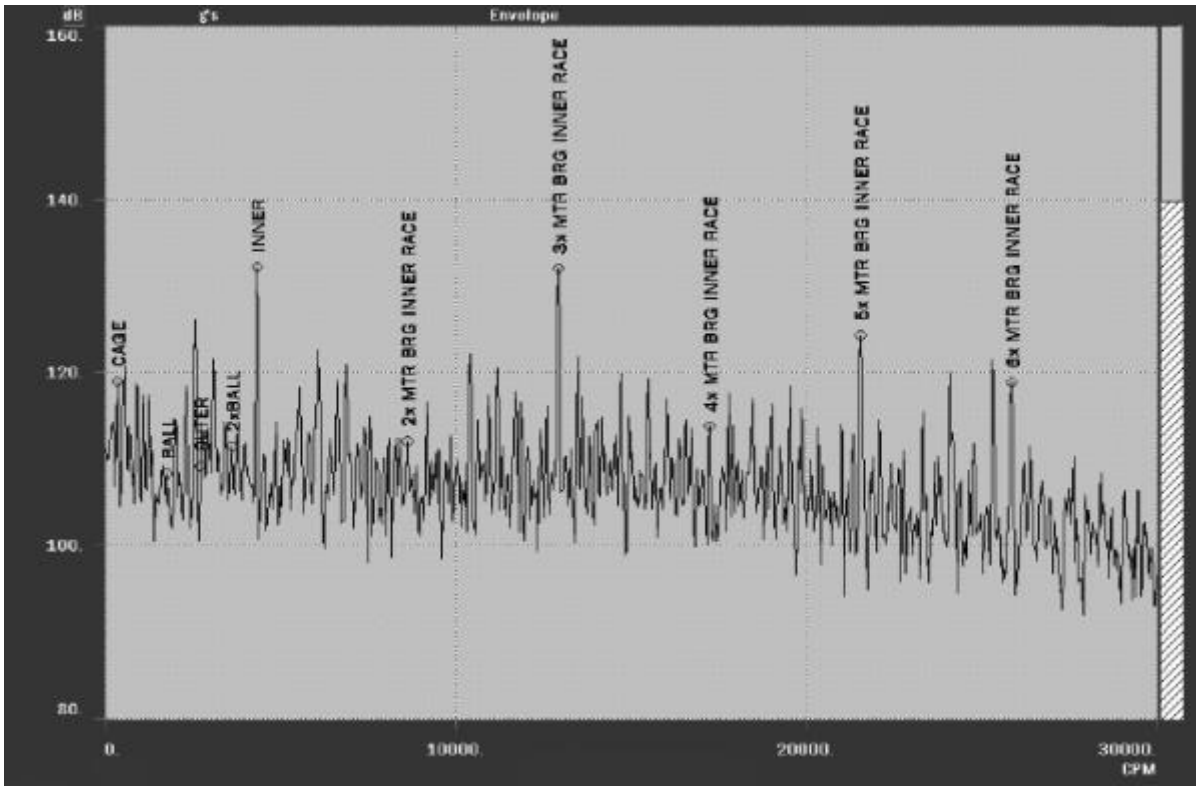


Fig. 2 - Compressor 2 Motor NDE ESP Spectrum

The carpet level comparison reveals a carpet or threshold of 90 dB exhibited by Figure 2 as compared with 105 dB exhibited by Fig.1. This is a difference of some 20 dB, or approximately 1000%.



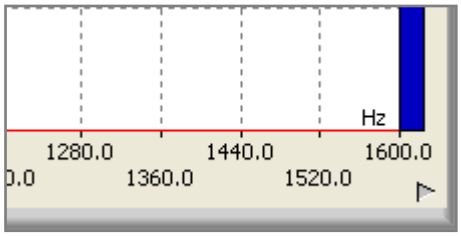
In the figure above, the software diagnostic features have been utilized to highlight the peaks of interest on the ESP data collected from Compressor 1. The speed and bearing type have been entered, and the system has generated the bearing fault frequencies associated with this particular type of bearing.
The conclusion is that there is clearly a defect on the INNER RACE of this bearing.

The fault frequency is some 15÷20 dB above the carpet, which would not usually cause great concern, however, the presence of harmonics at 2 x INNER, 3 x INNER and 4 x INNER combined with the high carpet level led to a recommendation to replace the bearing.

13.2.8 Viewing whole frequency range

When viewing the vibration spectra, the frequency range is 1 kHz set by default.
So, the 1× RPM, 2× RPM a.s.o. peaks might be seen better.

If the spectrum range is larger than 1 kHz, the amplitudes exceeding this value won't be visible, but this aspect might be changed, because in the right side down of the graph appears an icon that indicates the range might be expanded:



To expand the frequency range, just make a mouse-click anywhere in the lower part of the graph, where appears the frequency range.

13.2.9 Zoom Tool Options

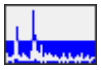
A series of zooming tools is available in the spectrum plot.

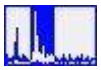
This can be activated in two ways:

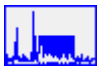
- By pressing the Zoom button from the spectrum toolbar
- By moving the mouse pointer in the far left side of spectrum plot.

In both cases, the *Zoom Tools* will appear:

Just click on the magnifying glass icons to give a different zoom option for a closer examination of the spectrum plot.
These tools allow the user to zoom in/out on the horizontal or vertical axis and pan left, right and top.

 Zoom the plot on vertical direction. When this icon was selected, just place the mouse anywhere in the plot area, click the right - button and drag the mouse pointer.
When the mouse right - button is released, the plot will be zoomed according with the highlighted region:

 Zoom the plot onto horizontal direction. Proceed as above.

 Zoom the selected region. Proceed as above.

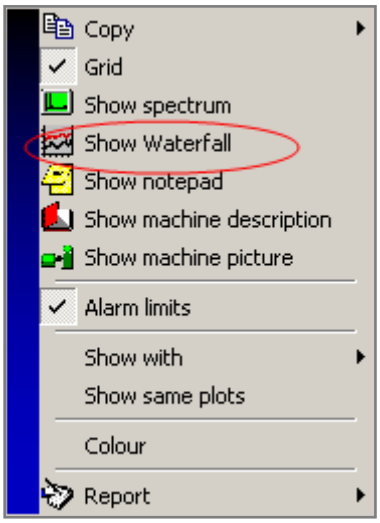
 Zoom spectrum to optimum zoom. To do this, just click on the icon.
This action can also be done by clicking on the left plot side and then on the bottom plot side.

Pressing **X1**.... **X10** button, the cursor will be place on the selected harmonic. (These buttons are disabled in Spectrum ZOOM mode and in the time - signal plot).

MAX - Find the maximum amplitude peak in the plot area. (This button is disabled in the time - signal plot).

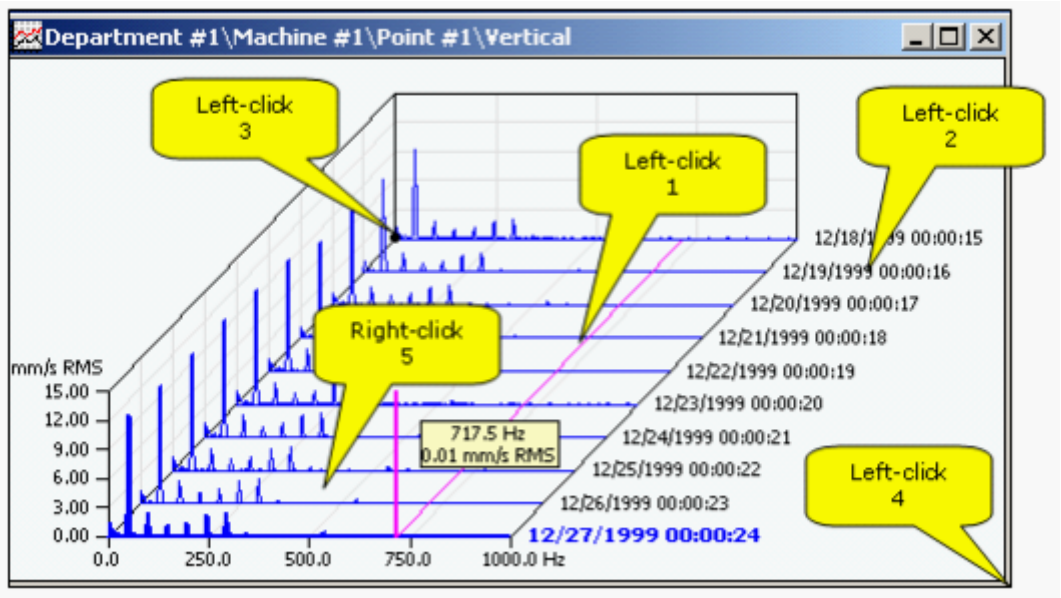
13.3 Waterfall spectra

Waterfall spectra can be shown from the Trend pop-up menu:



Select **Show Waterfall** command.

The waterfall graph for the last ten spectra will be shown.

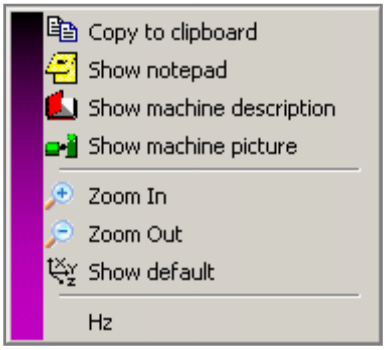


Using the mouse you can:

1. Left-click in the plot area. This action will make the spectrum cursor visible (for the active spectrum)
2. Left-click on the date labels. You will change the active spectrum.
3. Left-click and drag the small black circle. This action will change the graph perspective.
4. Left-click and drag the windows to zoom-in or out the whole graph.
5. Right-click to show the windows pop-up menu.

With the Keypad:

- Press Up or Down keys to change the active spectrum
- Press Left or Right keys to change the cursor position in the plot.



Using the pop-up menu you can:
*Copy the graph in the clipboard
*Show/hide the *Notepad*
*Show machine description
*Show machine picture
*Zoom in or out the frequency scale
*Show default graph. The perspective and the frequency scale will be changed to initial values.
*Change the frequency scale from Hz to RPM or reverse.

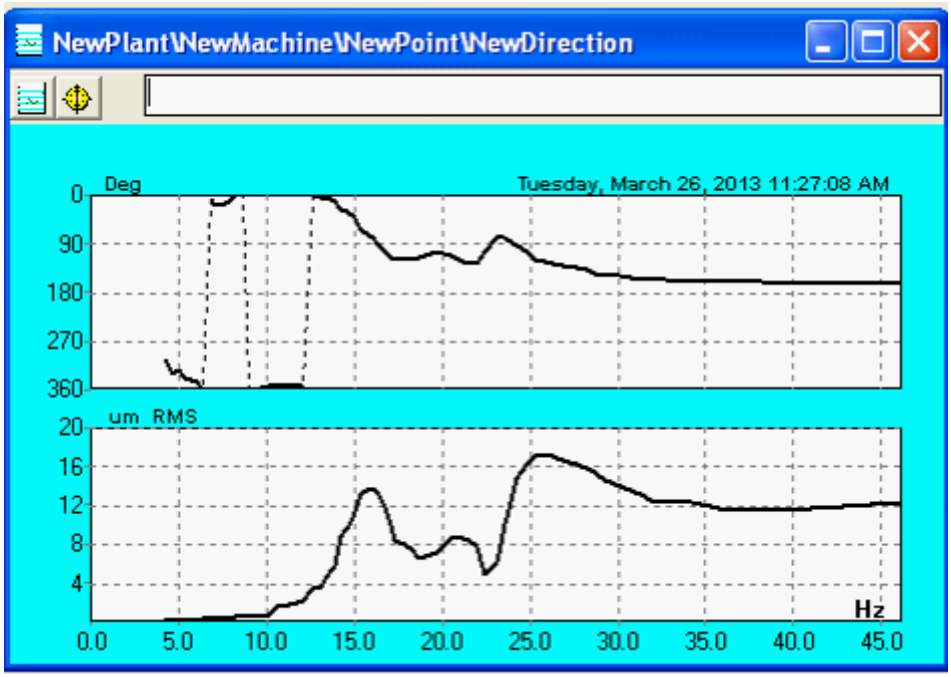
You can open as many **Waterfall** windows you need. The spectra contents will not be updated when you change the active trend.

13.4 Frequency Response plots

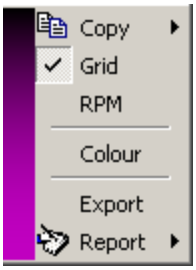
The **Frequency Response** graphics may be collected off-route only.

These graphs can be viewed only in the **Edit** window or in **Show** selected information view. The plot can be:
- **Bode Plot** (as in the picture below)
- **Polar Plot**.

- **Bode Plot**



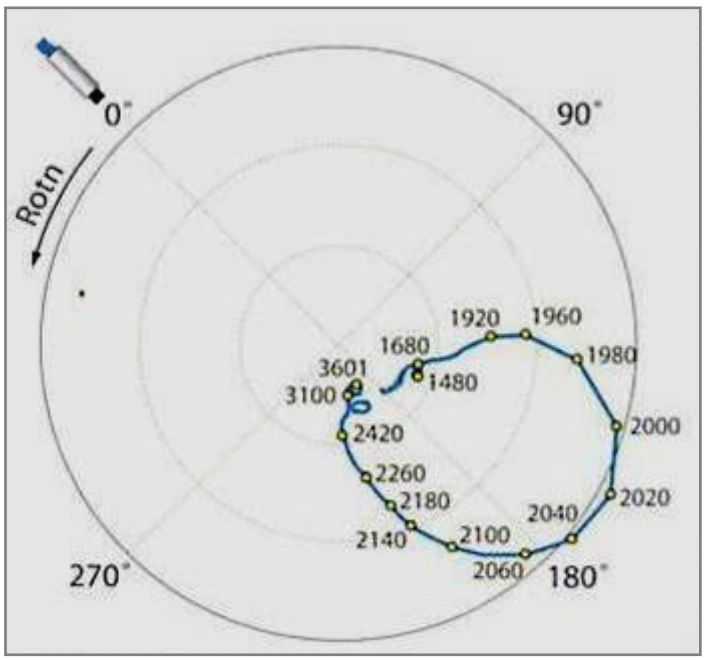
Each **Bode plot** has a pop-up menu:



The user can change the frequency unit (RPM or Hz).
The plot colours can be changed using the **Colour** menu item.
From the pop-up menu, the user can copy the graph onto the Clipboard or in MS Word and also create a report.

- **Polar plot**

Polar plot is made up of a set of vectors at different speeds.

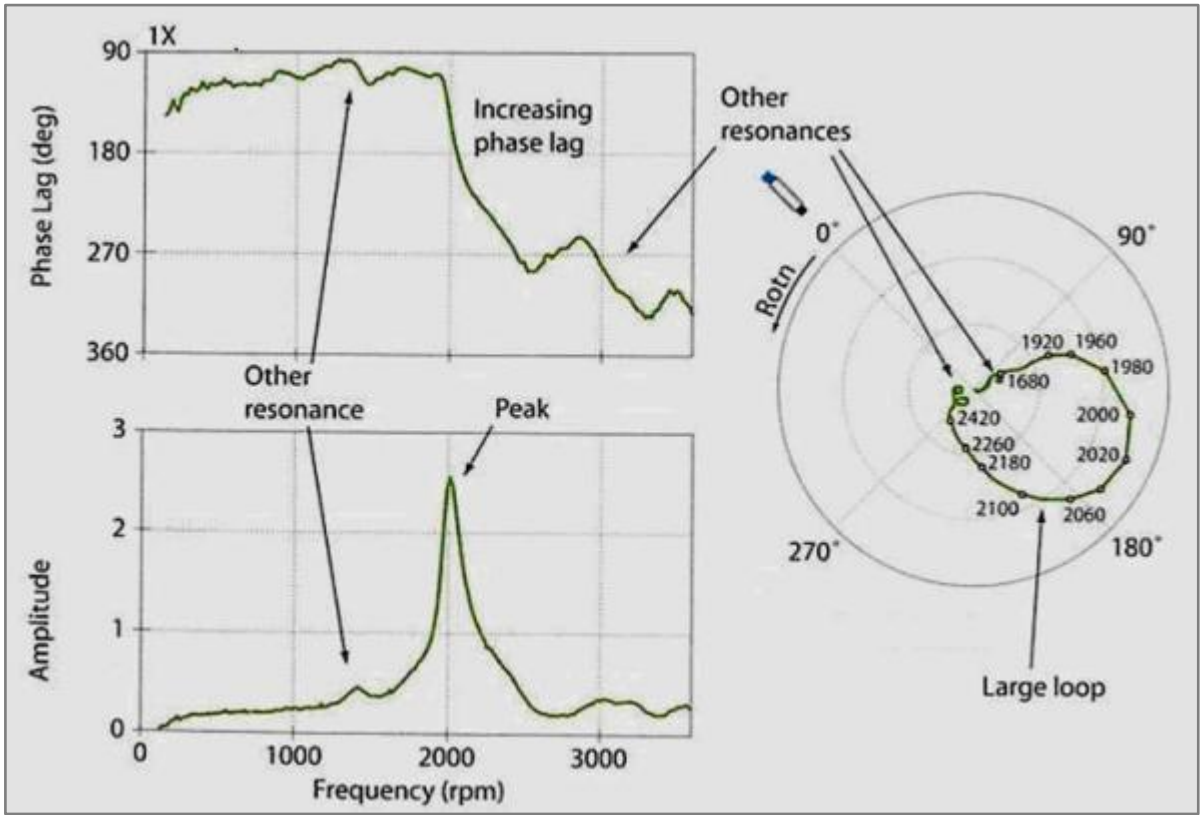


- Vector arrow is omitted and the points are connected through a line.
- Zero degree is aligned with transducer location.
- Phase lag increases in the reverse direction of rotation.

Bode Plot and **Polar Plot** show the same details:

- **Polar Plot** displays the same "vibration vector data" as the **Bode Plot.**
- In **Bode Plot** vibration amplitude and phase are separately plotted on two plots with the speed on the horizontal axis.

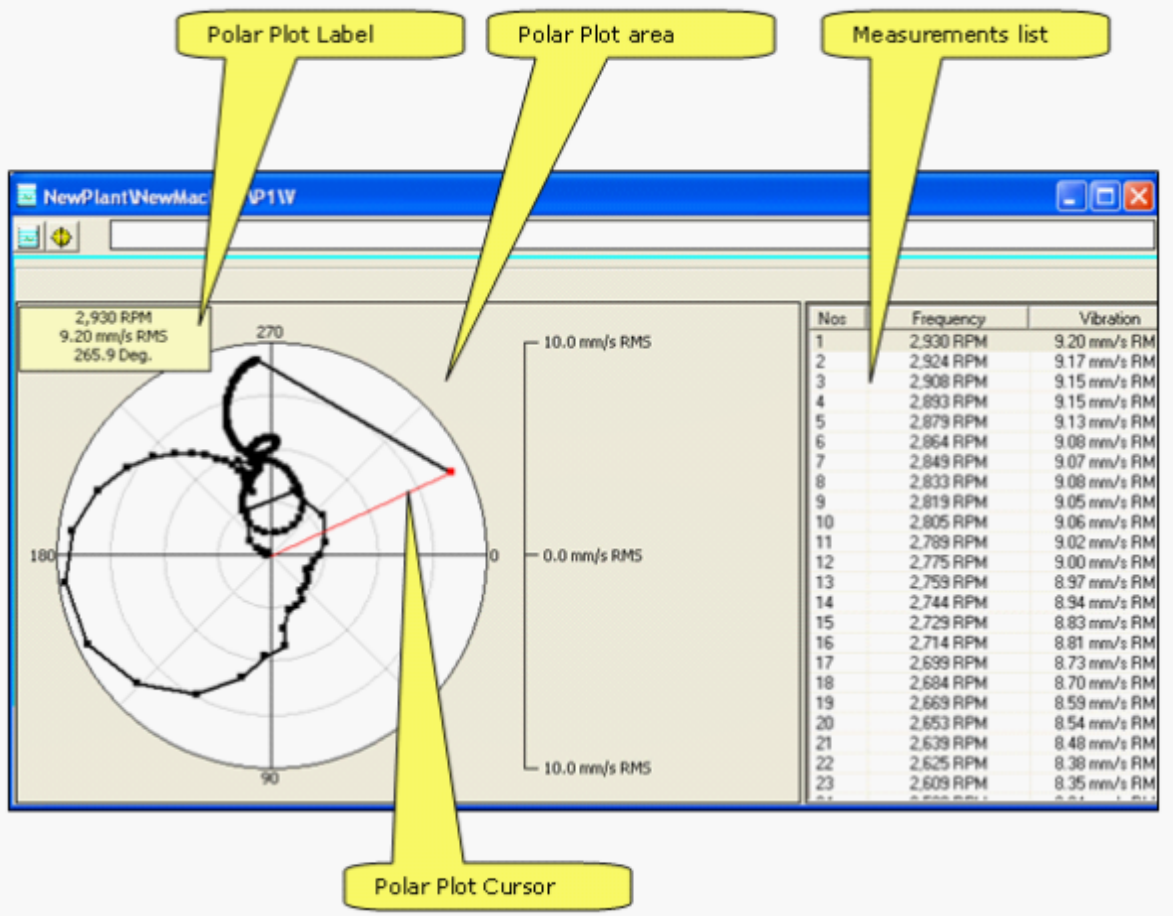
13.4.1 Detecting Resonance with Bode & Polar Plots



In a **Bode plot**, the resonance is indicated by peak amplitude and sharp, significant change of phase at peak frequency. On the **Polar plot**, resonance will produce large, curving loops. Small system resonances are more easily visible as distinctive small loops. **Polar Plot** can be shown in the **Coast-Up**/ **Coast-Down** (**Bode Plot**) window, just pressing the **Polar Plot** button from the toolbar.

The **Polar Plot** windows have two parts:

- The Polar Plot diagram (on the left side)
- The measurement list (on the right side).

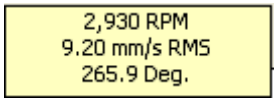


The cursor position can be settled in two ways:

- Click on **Polar Plot** area and use Left and Right arrow key.
- Click into the **Measurements List** area and use the **Up** and **Down** arrow keys.

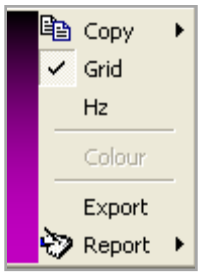
You may directly select a vector in three ways:

- Click on any measurement dot (small black square).
- Click on any item from the **Measurements List**.
- Click on the **Bode Plot** toolbar button to return to the **Bode Plot** windows and select any point from the graph. Click to the **Polar Plot** toolbar button again, to return to the Polar graph. As can be seen, the cursors from Bode and Polar plots are synchronized.



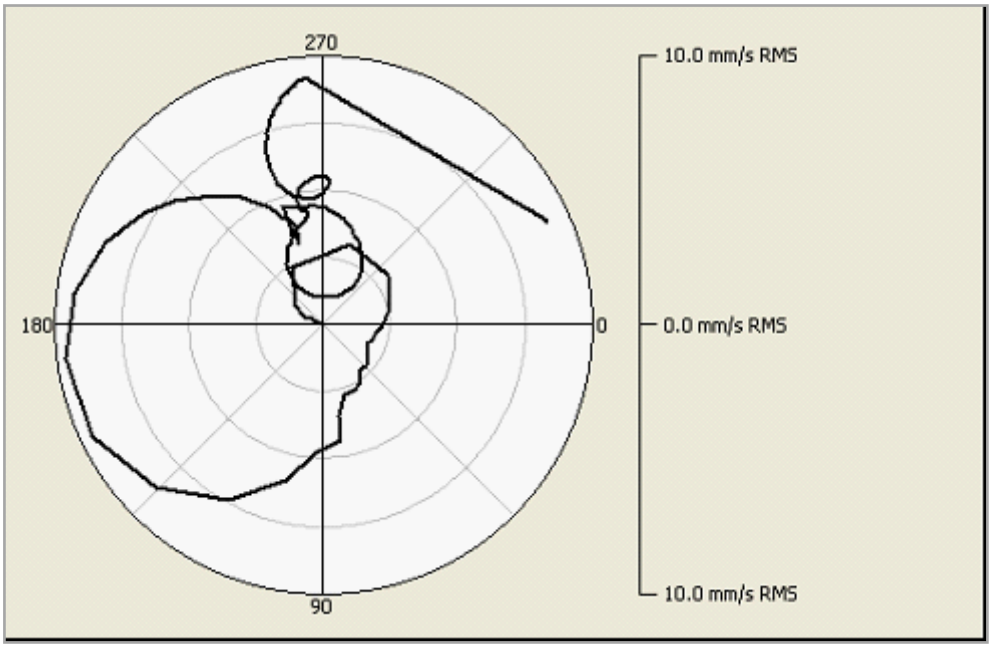
The **Polar Plot** label shows the selected point details, as follows:

The label can be moved with the mouse (just click on the label and drag it in a convenient position).
With a right mouse click you can activate the Polar Plot popup menu, having the following commands:



- **Copy** to clipboard or in MS Word the **Polar Plot**
- Show/hide **grid**
- Change the frequency unit (**RPM** or **Hz**)
- **Export** the measurements into a transfer file
- Create a **report** (in Print Preview or in MS Word).

The copied **Polar Plot** appears as follows:



The report also contains the whole measurements list.

13.4.2 Multiselection

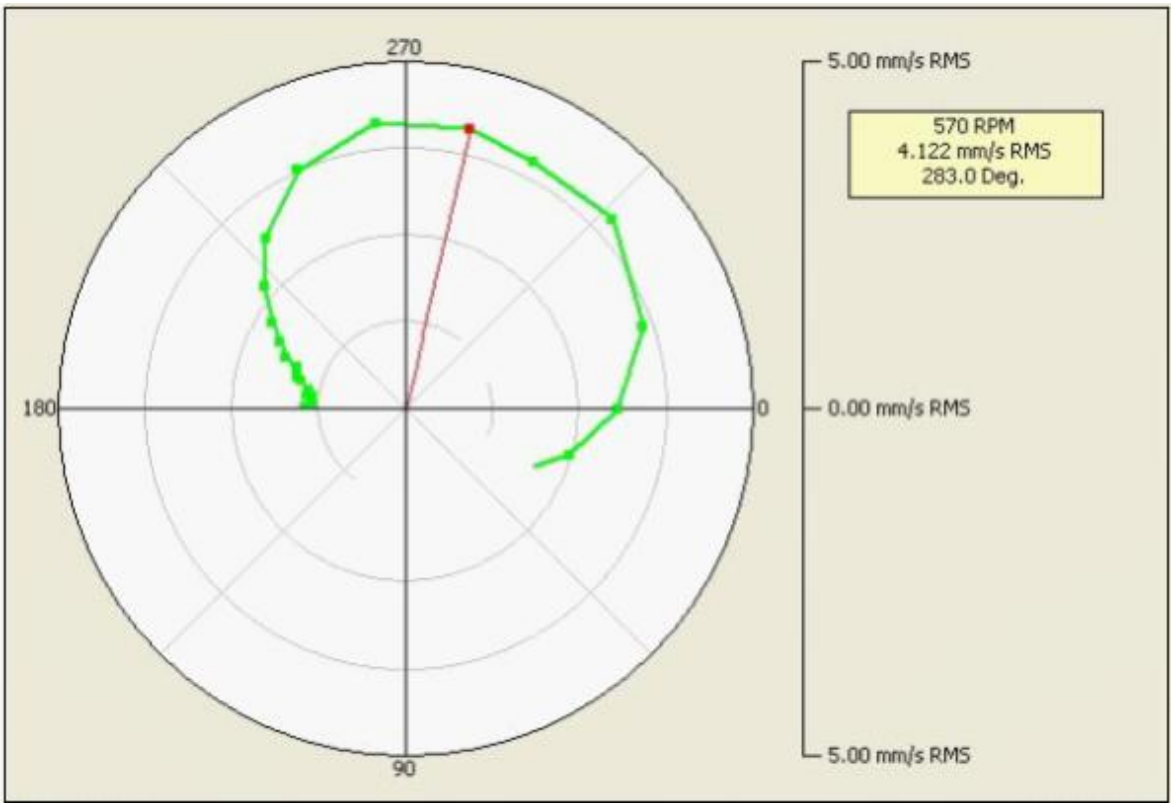
To see only a part of the **Polar Plot**, you must select first the measurements:

Nos	Frequency	Vibration	Phase
1	2,128 RPM	0.115 mm/s RMS	180.0 Deg.
2	2,114 RPM	0.189 mm/s RMS	191.9 Deg.
3	2,099 RPM	0.170 mm/s RMS	198.5 Deg.
4	2,085 RPM	0.221 mm/s RMS	187.9 Deg.
5	2,068 RPM	0.256 mm/s RMS	193.9 Deg.
6	2,054 RPM	0.272 mm/s RMS	194.2 Deg.
7	2,040 RPM	0.320 mm/s RMS	199.5 Deg.
8	2,025 RPM	0.348 mm/s RMS	197.1 Deg.
9	2,009 RPM	0.375 mm/s RMS	197.5 Deg.
10	1,993 RPM	0.416 mm/s RMS	193.1 Deg.
11	1,980 RPM	0.427 mm/s RMS	196.4 Deg.
12	1,963 RPM	0.467 mm/s RMS	196.2 Deg.
13	1,950 RPM	0.517 mm/s RMS	197.2 Deg.
14	1,934 RPM	0.524 mm/s RMS	195.3 Deg.
15	1,920 RPM	0.566 mm/s RMS	195.0 Deg.
16	1,904 RPM	0.606 mm/s RMS	192.1 Deg.
17	1,890 RPM	0.623 mm/s RMS	191.3 Deg.
18	1,874 RPM	0.653 mm/s RMS	189.6 Deg.
19	1,858 RPM	0.689 mm/s RMS	187.5 Deg.
20	1,843 RPM	0.704 mm/s RMS	182.4 Deg.
21	1,830 RPM	0.723 mm/s RMS	182.4 Deg.
22	1,815 RPM	0.745 mm/s RMS	178.0 Deg.
23	1,800 RPM	0.774 mm/s RMS	176.4 Deg.
24	1,784 RPM	0.791 mm/s RMS	179.3 Deg.
25	1,769 RPM	0.818 mm/s RMS	172.6 Deg.
26	1,755 RPM	0.856 mm/s RMS	170.6 Deg.
27	1,739 RPM	0.893 mm/s RMS	164.9 Deg.
28	1,725 RPM	0.902 mm/s RMS	163.6 Deg.

Click on first item. Press **Shift** key and select the last item.
Selection will be shown as above.

Press **Refresh** button  .

Now, in the **Plot area** only the selected point will appear.
The plot will be re-scaled to the optimum zoom.



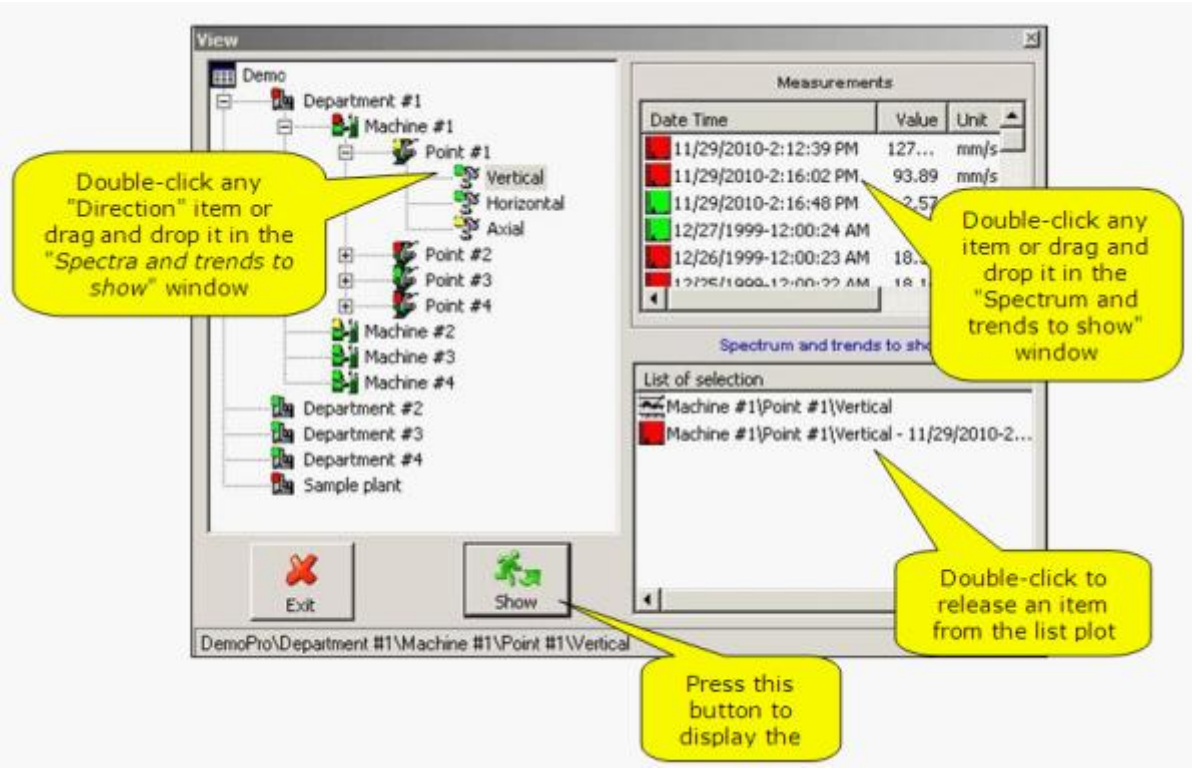
14 Viewing data

In order to analyze the collected data, you have on your choice many ways of viewing data:

- A collection of trends and spectra selected by you (**View** > **Show selected information**).
- A **Quick View** session, where you explore the machines, to see the trends and the spectrum associated with the selected direction (**View** > **Quick View**). If *Bands* are defined, also **Band Trends** are available.
- Trends and spectra from the whole machine, where you can see at once, all these trends and spectra associated with the selected machine (**View** > **Show spectra from whole machine**).
- A **List View,** where you can see at once, all *Total values* (vibration, Bearing Energy and Envelope) for the whole machine (**View** > **List View**). The *Alarm status* is also indicated.
- A **Band View,** where you can see, at point level, all total values of the vibration and Band values (peak average for the bandwidth). The alarm status for those above mentioned is also indicated (**View** > **Band View**).

14.1 Show selected information

When you select this command, a specific window will appear on the screen and will allow you to choose the department, the machine, the point and the wished direction.



The choice is made by selecting a certain direction, with the mouse, in the above-mentioned order. When the direction is selected, in the upper right side will appear a list with all collected spectra for that direction. The coloured small icons also indicate an alarm condition for the measurements.

A check mark icon indicates the baseline spectrum, if any. The *Coast-down* measurements are marked with a blue icon. Now, you can select a collection of trends and spectra to be shown. Just double – click on any trend or direction and the item will be moved to the show list.

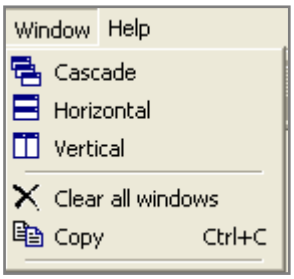
Instead of double – clicking, you can drag and drop any *Direction* or *Spectrum* to the show list.

If you don't want to display some items from the shown list, just double – click on that items and they will be removed from the list.

Finally, press the **Show** button, and the entire list will be shown.

After you have displayed some trends and spectra – set, the main window remains active and you can select other trends or spectrum. Although a large number of information can displayed on a single screen, it is recommended to limit the number of simultaneously opened plots, because the plots will have smaller and smaller sizes and many details will be lost.

When one or more plots are displayed, you can use **Window** Menu to arrange the plots on the screen. You can clear the screen using **Clear All** command or you can copy on the Clipboard any plot using the **Copy to clipboard** command.



For details regarding an efficient way of using the spectra and trends plot, see also: Spectrum plot and Trend plot.

The advantage of using **Selection** view:

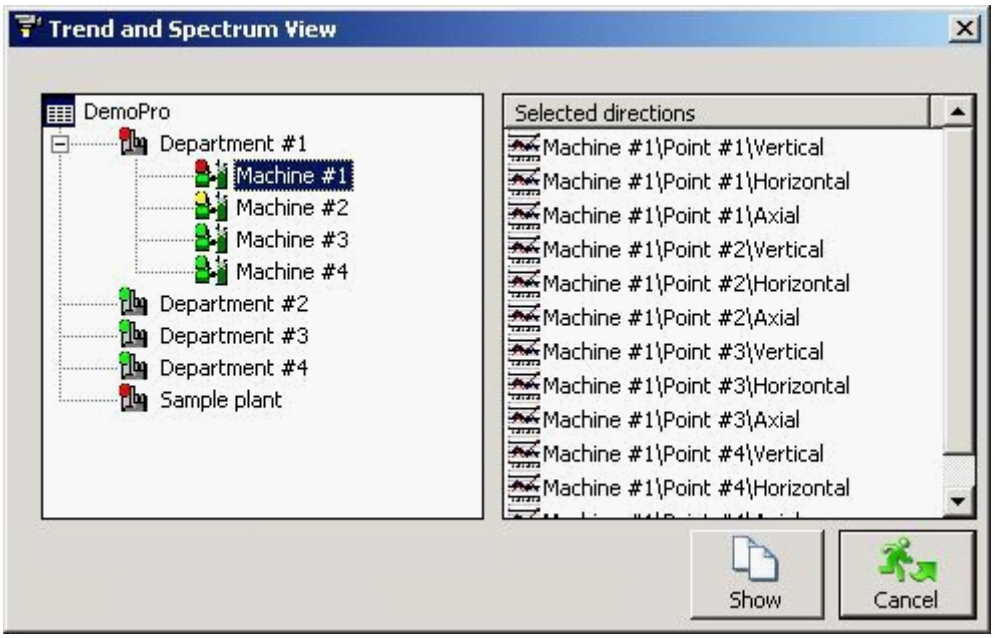
- Any trend, spectrum or coast-down measurement can be displayed onto a single screen.
- The number of displayed plots is limited only to the screen size.

A disadvantage of using **Selection** view:

- Long time to select the plots.

14.2 Trends and spectra for the whole machine

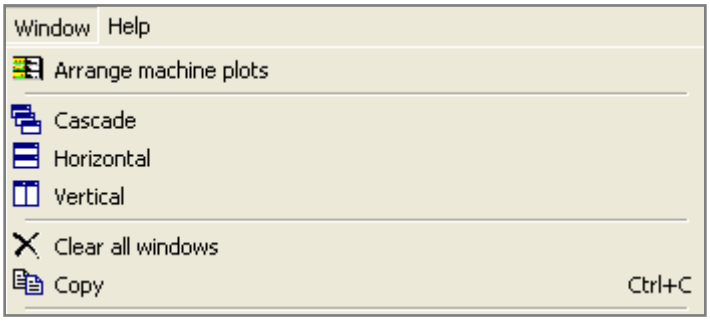
With this command, you can see in a single "scrolling" screen all the trends and spectra associated with a machine. The last measurements will be displayed onto the spectrum plots.



First, select from the hierarchy tree the desired machine. In the right part of the selection window, a list with all directions of the selected machine will appear.

You can rearrange the list before showing, by dragging the items.

Now you can remove some items from the list (by double-clicking on them) or show the list by pressing the **Show** button. The plots will be shown in trend-spectrum pairs. If you don't need all the plots, close some of them and use the **Arrange machine plots** command from **Windows** menu, to rearrange the plots on the screen.



If you move the cursor in a trend plot, the contents of the associated spectrum plot will also be changed, to reflect the actual position of the cursor.
You can synchronize the cursor in the spectrum or trend plots.

For more details, see also: Trend plot and Spectrum plot.

Finally, use the **Clear All** command from **Windows** menu to close all plots.

The advantage of using **Machine plot view**:

- All trends and spectra associated with a machine can be displayed in a single screen.

A disadvantage of using **Machine plot view**:

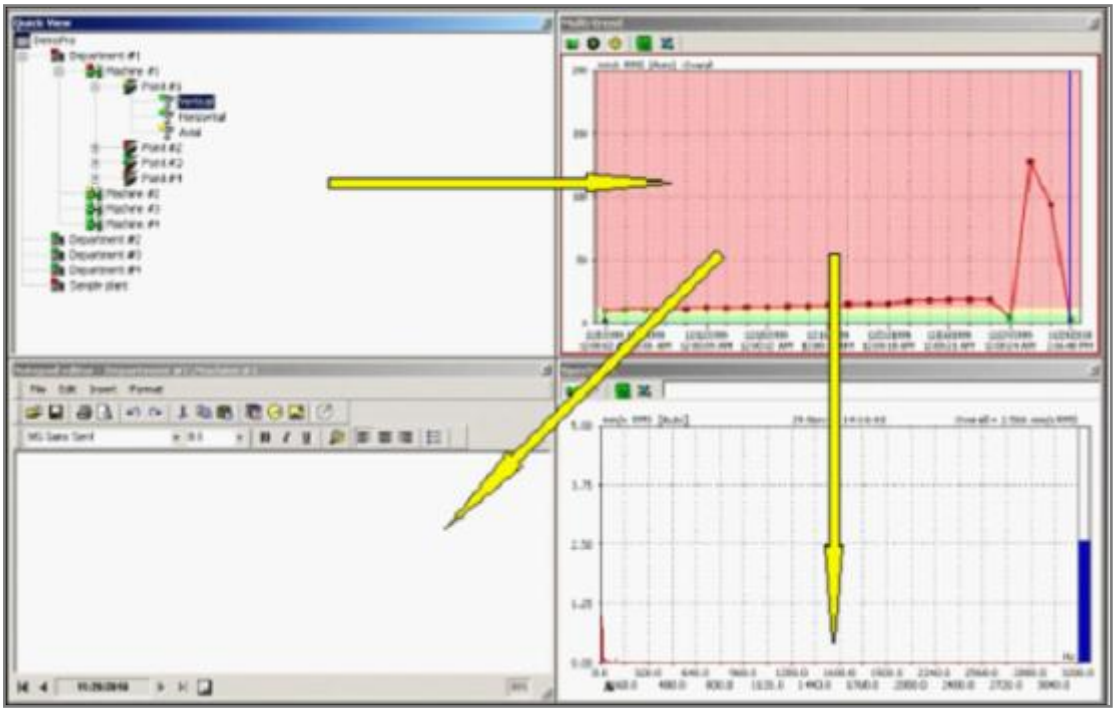
- Only plots belonging to a single machine can be shown.

14.3 Quick View

This command shows trends and spectra in a special way. When you select this command a four-window screen will appear:

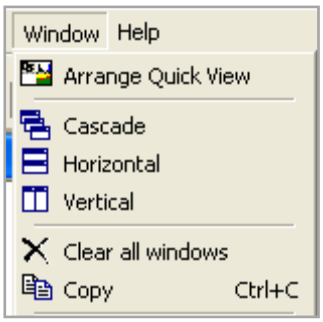
- Database tree
- Trend plot
- Spectrum plot
- Notepad editor

All four windows are synchronized. If you move the cursor in the database tree, all the other windows will be refreshed. If you change the position of the cursor in the trend plot, the spectrum plot and the notepad contents will be changed. That's how you can immediately see all the information you need for the whole database.



You can change the position of the windows on the screen, but you can't close plot windows. If you close the tree window, all the windows will also be closed. The last position of the windows will be saved.

Use **Arrange Quick View** command from the **Windows** menu to rearrange the window in a convenient way.



The **Notepad Window** can be closed whenever you want.

The advantage of using **Quick View**:

- Any trend or spectrum from any part of the database can be displayed.
- Quick access to any plot from the whole machine database.

The disadvantage of using **Quick View**:

- Only a single pair trend-spectrum can be displayed at the same time.

14.4 Band View

A band is a defined portion of a FFT spectrum. The bandwidth can be calculated with the following formula:

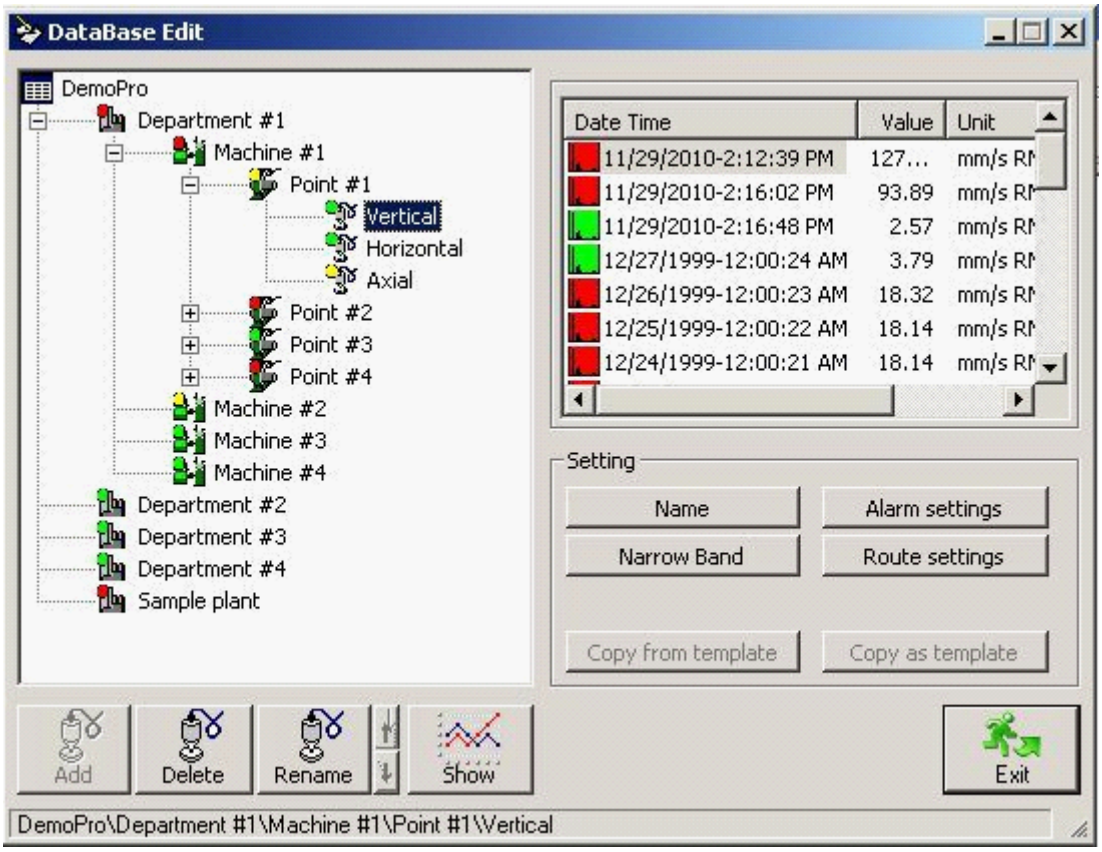
$$Band\ Width = (Central\ Freq + Gap) - (Central\ Freq - Gap) = 2 * Gap$$

The amplitude value of the band is calculated with the formula:

$$Amplitude = \sqrt{\sum L_i^2}$$

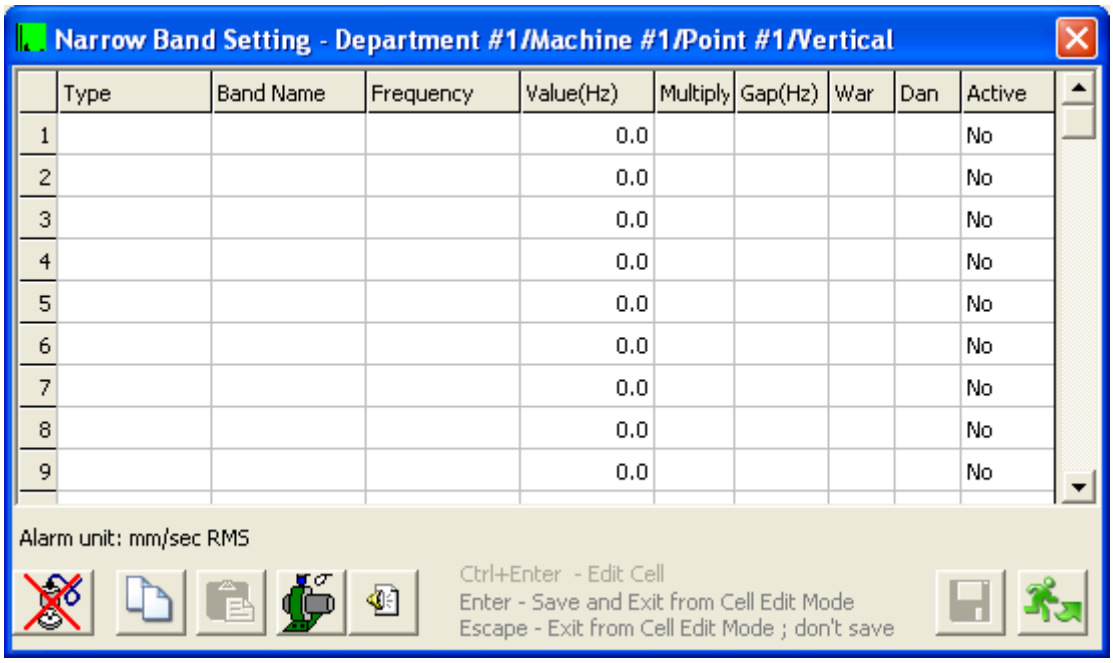
where L_i = Spectrum line inside of Bandwidth

Each band has a specific frequency, generally a fault frequency or a multiple of it.
In **CXSpectra**™, for each Direction, up to 32 narrow bands may be defined.



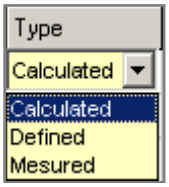
14.4.1 Defining Bands

The bands can be defined in the **Database Edit** menu, on each *Direction* level.
Band definition can be made after all the fault frequencies and the alarms were defined for the selected *Machine*.
To start an editing session, just press the **Narrow Band** button:
The **Narrow Band Setting** window will appear:



The editing window contains a spreadsheet (or a table) where you can edit up to 32 Bands.

The table has the following columns:



- **Type** – In this column you can select from a combo box one of the following types for the central frequency:
- **Defined** – The *Band central frequency* won't be calculated from the spectrum, just the defined frequency will be used to calculate the *Band amplitude*.
- **Calculated** – The *Band central frequency* will be re-calculated in accordance with the real shaft speed from the *Spectrum*. The actual frequency is calculated around the *Defined frequency* with a gap of ± 2 × Spectrum Lines. If in this range a spectrum peak isn't detected, the *Defined frequency band* will be used instead. If the *Defined frequency* is zero (normal setting for variable speed machines), the best shaft speed is considered to be the highest peak in spectrum.
- **Measured** – The *Band central line* is calculated in relation with the measured speed, during data acquisition. If the speed wasn't measured, the frequency of the band will be zero! Never define the *Band* with *Measured type*, if you are not sure that the speed will be measured together with the spectrum.

Band name – This item must be added by the user, in order to identify the band later.
Frequency – This is the central frequency of the band. The frequency must be selected from a list during the editing process. 29 possible fault frequencies are available in **CXSpectra**™. These frequencies must be previously defined. Only the defined frequency will appear in the list. In the following table, there are described the fault frequencies defined in **CXSpectra**™:

Frequency	Description
Primary reference speed	Defined at *Machine level*, usually is the drive rotational speed (it always exists)
Secondary reference speed	Defined at *Machine level*, usually is the driven rotational speed
Line frequency	Defined at *Machine level*, this is the line frequency, 50 or 60 Hz.
Pole pass	Defined at *Machine level*, this is the Pole pass for asynchronous electrical motors.
Rotor bar pass	Defined at *Machine level*, this is the Rotor bar pass for asynchronous electrical machine
Belt	Defined at *Machine level*, this is Belt fault frequency
Multiple frequency	Defined at *Machine level*, this is any multiple frequency for the above. In **CXSpectra™**, up to 5 Multiple can be defined.
Shaft Speed	Defined at *Point level*, this is the shaft speed defined as a multiple of the primary or secondary reference speed (it always exists).
BPFO, BPFI, BSF, FTF	Defined at *Point level*, these are the bearing frequency faults. In **CXSpectra™**, for each Point, up to 4 bearings can be defined
Gear box fault	Defined at *Point level*, this is the gear mesh fault frequency.

A special, **1 Hz** fixed frequency can also be added as *Band frequency definition*.

Value (Hz) – This column can't be edited. In the column it was indicated as reference only, the actual frequency of the fault as it was defined previously. During showing data, this frequency is re-calculated according to the Type setting.

Multiple –This is a multiple of the fault frequency selected in the Frequency column. Using the *Multiple factor*, many *Bands* can be defined, having the same fault frequency as reference.

Gap (Hz) - This is the gap of the *Band*. The gap can be selected from a list and can be from 0 to 50 Hz. As a general rule, the gap can be at least the spectrum resolution. If the gap selected below is the spectrum resolution, the band will be the peak amplitude.
If you select a zero value for the gap, the band will be the peak amplitude. Use a zero gap value, if you intend to have a trend for a peak instead to have a trend for a *Band*. In run-time, for each measurement in the *Trend*, the correct frequency will be calculated, but only if you select **Calculated type Band**. If you select **Defined type Band**, because the peak value can shift, the Trend results can be erratic. Using fixed frequency of 1 Hz and gap, you can define fixed **Bands**. To define a band for low frequencies from 0 to 6 Hz, select as Frequency a Fixed (1 Hz) frequency, Multiple to be 1 and Gap also 5 Hz. The band will have a range from 0 to 6 Hz.

Warning – This is the *Warning level of alarm*, defined in the unit and the average selected in the **Alarm Settings**. An automatic setting is also possible, if a *Baseline spectrum* is defined.

Danger – This is the **Danger level** of alarm, defined in the unit and the average selected in the **Alarm Settings**. An automatic setting is also possible, if a *Baseline spectrum* is defined.

Active – If active is set to **YES**, the band can be shown in "**Quick View"** or in "**Band View**". If the setting is **NO**, the band is only defined, but it cannot be shown.

In the **Band definition** window, a series of buttons are available in editing time:

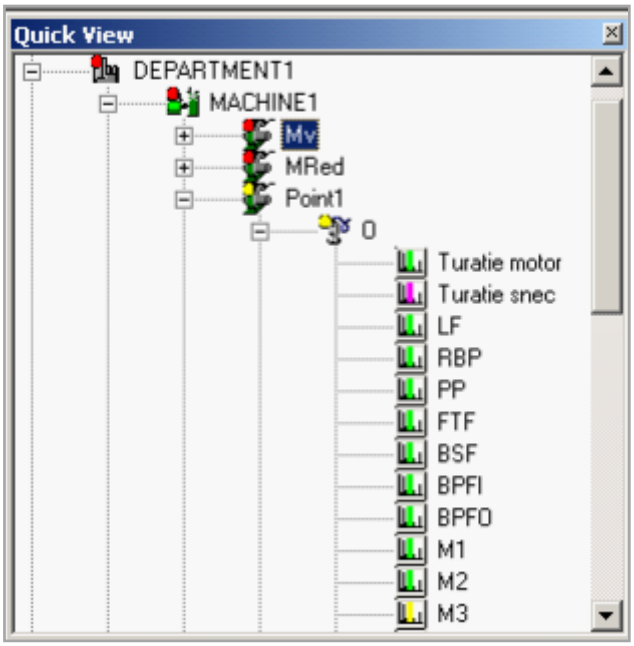
Delete – Use this action to delete the selected portion from the table.

Copy – Copy all table contents in the Clipboard. Later, you can **Paste** the table contents to another Direction in Tree.

Paste – If is enabled, you can **Paste** the table contents previously copied.

Copy to all – Copy the contents of the table definition and apply the contents to all *Directions* from the selected *Point.*

Alarm – Automatically applies a calculated level alarm for all the defined faults, based on *Baseline spectrum*. On the same *Direction* a *Baseline* must exist, otherwise the action fails.



Save – Save the definition in the *Machine Database*. Always, when you have changed an item in the table, before **Exit**, you must save your changes. An automatic saving is done after **Delete** and **Paste** actions. After **Copy to all** action, the band definitions from other Directions are also saved also.

Editing items in the table is very simple: Move the cursor into the cell where you intend to change something. Just type directly the new value. If a combo box appears, use the up and down arrows to select the proper item and press **Enter** to complete. If the cell is a direct editing field, just type the numbers or letters.

To complete, press the **Enter** key. You can also use the mouse, just clicking in the cell you intend to edit. Once you click the mouse into another cell, the previous cell editing mode ends.

14.4.2 Recommendation for Band definition

A large number of bands can be added in the *Database*. Some of them can be useful, but some of them not. Follow the rules described here, to save your time and to add more functionality in your software.

- Add bands for *Shaft Speed* and also for 2 × Shaft Speed and 3 × Shaft Speed. The best *Gap setting* is the spectrum resolution, but not less than 1 Hz. *Band Type* must be set to *Calculated*.
- Add a band to *Line frequency* and to 2 × Line Frequency (if you have an asynchronous electrical motor). The best *Gap resolution* must be set as above. *Band Type* must be set to *Defined*.
- Add *Belt fault*, if the assembly has a belt. The best *Gap setting* is 2 × spectrum resolution. *Band Type* must be set to *Calculated*.
- Add *Multiple* for motor fan blade and also for pump blade. The best *Gap* is 2 × spectrum resolution. *Band Type* must be set to *Calculated*.
- Add bearing fault frequencies, if you have roll bearings. *Band Type- Calculated.*
- Add a fixed 0 to 5 Hz band frequency. *Band type – Defined*.

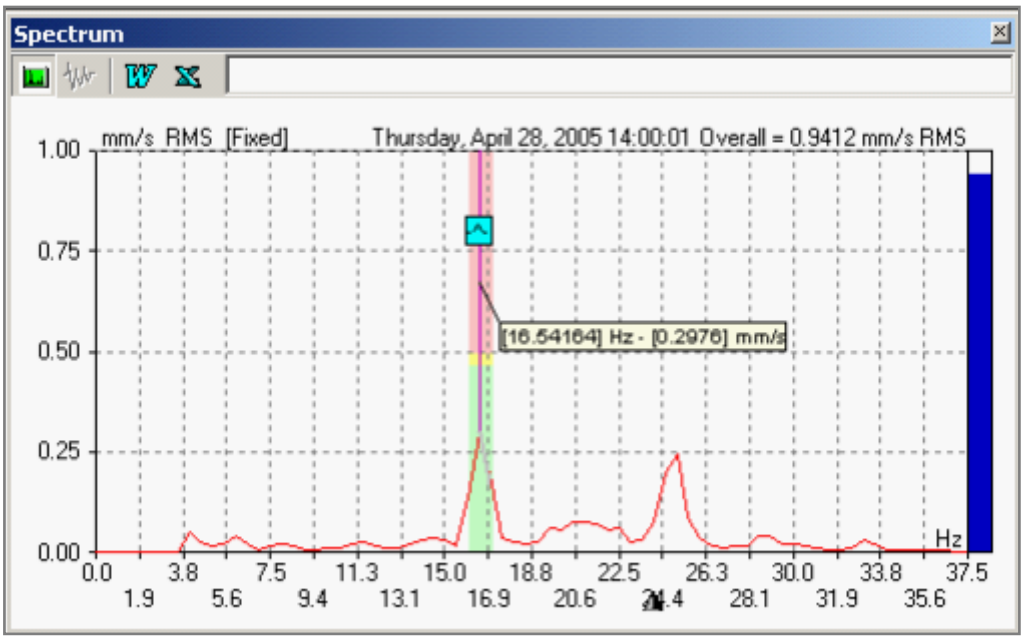
Usually, the above mentioned bands are required during the diagnosis procedure.
More bands can be added for special machines or for specific purposes.

14.4.3 Showing Band in Quick View Mode

The bands can be shown in Quick View or in Band View:

In the **Quick View**, select a Direction and extend the tree. All defined bands will appear in the tree.
The **Trend Plot** will be shown in the right side (for the selected band).
The **Spectrum Plot** will be shown below.

In the spectrum the selected band will be clearly marked. If the band has also an alarm defined, the band will be tri-colour, showing the **Warning** and **Danger levels**.



NOTE: In the spectrum, the alarm levels are shown only in reference purpose. Remember that the alarm levels are for the Bands and not for the peak. Always, the Band alarm limits will be higher than peak height, because the band value is an average of all the band peaks. Only if the band contains a single peak, the alarm level will be valid also for peak.

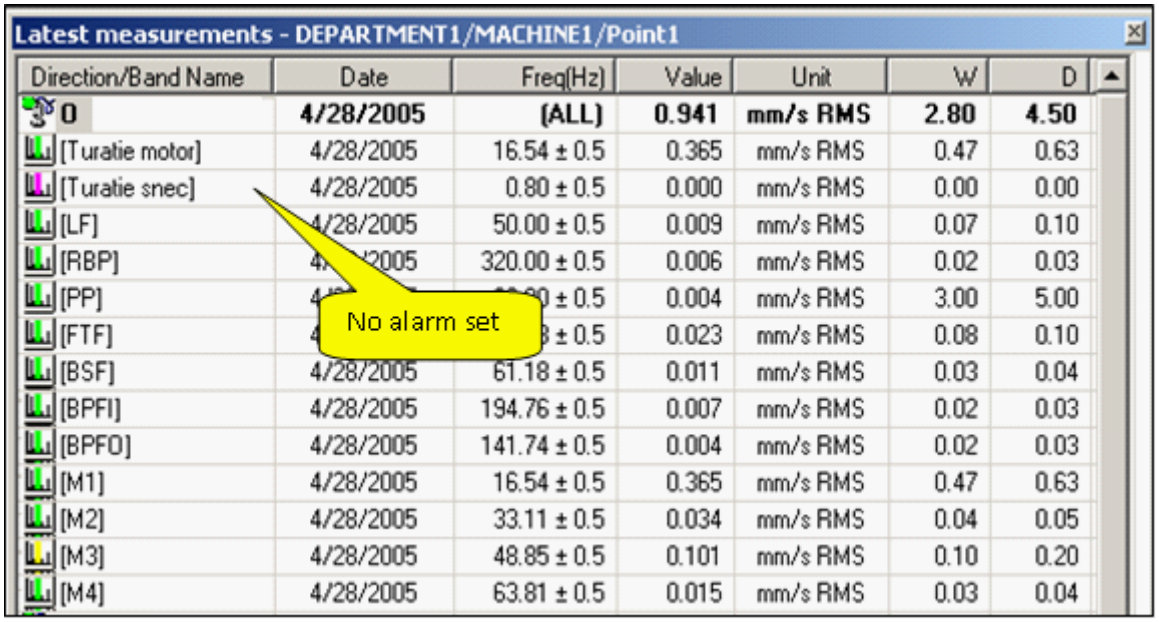
NOTE: If the Gap value is zero, a single line will mark the Band.

A **Band report** is available from the menu in the trend window and the spectrum report from the pop-up menu for the spectrum plot.

14.4.4 Showing Band in Band View Mode

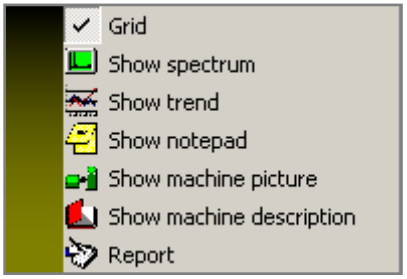
Showing bands in Band View is very similar with showing bands in the Quick View mode. In the left tree only the *Database* hierarchy up to Point level appears. Once a *Point* is selected, in the right side appears a list showing *Total values* for all *Directions* and also the bands values.

The items have coloured icons to indicate the band alarm status. Magenta colour denotes that the **Warning** and **Danger** limits are zero (no alarm set).



Direction/Band Name	Date	Freq(Hz)	Value	Unit	W	D
0	**4/28/2005**	**(ALL)**	**0.941**	**mm/s RMS**	**2.80**	**4.50**
[Turatie motor]	4/28/2005	16.54 ± 0.5	0.365	mm/s RMS	0.47	0.63
[Turatie snec]	4/28/2005	0.80 ± 0.5	0.000	mm/s RMS	0.00	0.00
[LF]	4/28/2005	50.00 ± 0.5	0.009	mm/s RMS	0.07	0.10
[RBP]	4/28/2005	320.00 ± 0.5	0.006	mm/s RMS	0.02	0.03
[PP]	4/28/2005	61.18 ± 0.5	0.004	mm/s RMS	3.00	5.00
[FTF]	4/28/2005	3.08 ± 0.5	0.023	mm/s RMS	0.08	0.10
[BSF]	4/28/2005	61.18 ± 0.5	0.011	mm/s RMS	0.03	0.04
[BPFI]	4/28/2005	194.76 ± 0.5	0.007	mm/s RMS	0.02	0.03
[BPFO]	4/28/2005	141.74 ± 0.5	0.004	mm/s RMS	0.02	0.03
[M1]	4/28/2005	16.54 ± 0.5	0.365	mm/s RMS	0.47	0.63
[M2]	4/28/2005	33.11 ± 0.5	0.034	mm/s RMS	0.04	0.05
[M3]	4/28/2005	48.85 ± 0.5	0.101	mm/s RMS	0.10	0.20
[M4]	4/28/2005	63.81 ± 0.5	0.015	mm/s RMS	0.03	0.04

In the **List**, a pop-up menu is available:



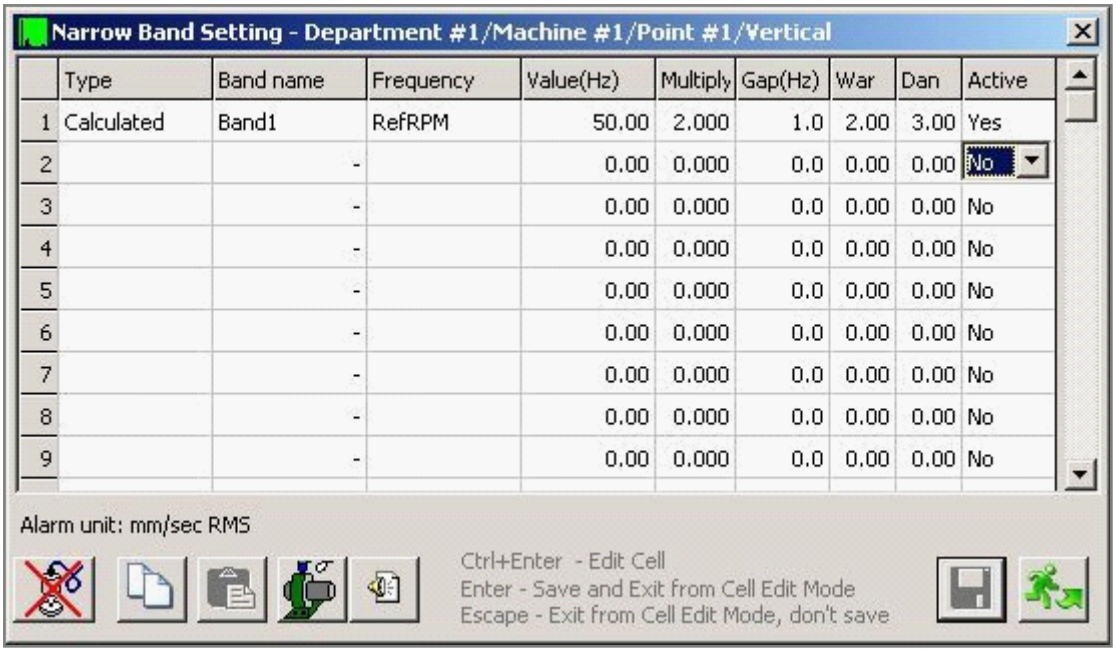
Using this menu, you can display the whole spectrum or the band trend.

This feature is not the same as in **Quick View**. Each plot required in the **Pop-up** menu above is displayed for the selected item from the table. The plots do not reflect the selection changes and must be closed manually.

You may copy the relevant plots in the ***Notepad*** or in ***MS Word***, *Spectrum* also to ***MS Excel***. For ***MS Word*** and ***Excel*** there are buttons to be pressed. If you want to copy a plot to the *Notepad*, select trend plot, press **CTRL+C**, open the ***Notepad*** and press **CTRL+V** or select paste from the mouse right button pop-up menu.

A *Band Report* is available to be shown in **Print Preview** or to be inserted in a MS Word document.
If you intend to re-arrange the **Band View** window, just select from the **CXSpectra**™ main menu the **Windows/Arrange Band View** option.

In the following simple database, 4 bands are defined for each *Direction* as follows:



	Type	Band name	Frequency	Value(Hz)	Multiply	Gap(Hz)	War	Dan	Active
1	Calculated	Band1	RefRPM	50.00	2.000	1.0	2.00	3.00	Yes
2		-		0.00	0.000	0.0	0.00	0.00	No
3		-		0.00	0.000	0.0	0.00	0.00	No
4		-		0.00	0.000	0.0	0.00	0.00	No
5		-		0.00	0.000	0.0	0.00	0.00	No
6		-		0.00	0.000	0.0	0.00	0.00	No
7		-		0.00	0.000	0.0	0.00	0.00	No
8		-		0.00	0.000	0.0	0.00	0.00	No
9		-		0.00	0.000	0.0	0.00	0.00	No

- A narrow band for the **Primary RPM** (17.4 Hz ± 1 Hz)
- A narrow band for the **Secondary RPM** (24.71 Hz ± 1 Hz)
- A wide band alarm covering the range of 290 Hz ± 50 Hz
- A wide band alarm covering the range of 190 Hz ± 50 Hz.

Alarm settings for the bands are automatically calculated from the Baseline.

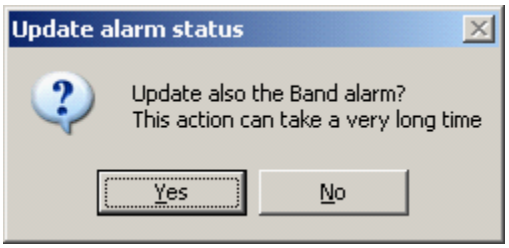
Open **Quick View** and extend the tree up to bands level. Select any band you want to. In the right side, the trend plot will be changed to show the trend for the selected band. Also in the spectrum plot, the band will be marked.

Notice that to display the normal **Quick View** style, just not extend the *Direction* item. Now, you can move the cursor in the trend and the spectrum plot will be refreshed. Any time you move the cursor, the peak found in the spectrum plot is slightly moved, but a peak is always correctly found. The wide bands cover a 200 Hz range, above the **Secondary RPM** frequency.

Now you can return to Database Edit and add more band definitions for all the major faults detected.

14.4.5 Band Alarm in tree

When you update the alarms in the **Database** (**Command Update Alarm Status** in **Database** menu), the following attention message will appear:



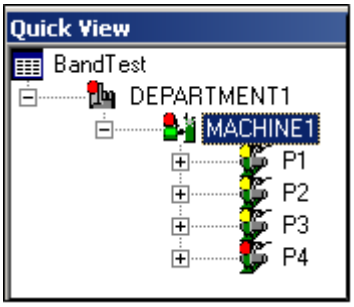
Now you have two options:

* To press **NO** and the bands alarm won't be updated in the database tree
* To press **YES** and the bands alarm won't also be included in the database tree.

If the database is large and many bands alarm are defined, the above action can take minutes. You also must consider the following aspects:

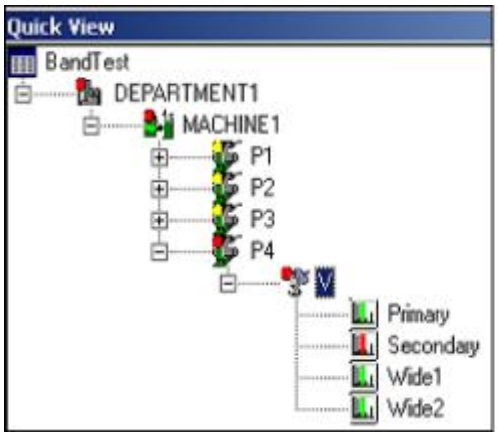
* The alarm in tree (coloured icons) is a good indication for you that something wrong was happened with your machine. In fact, this is the first information regarding machines running conditions.
* If you also add alarms, the band alarm and many band alarms are defined for the machine, the probability to obtain a "coloured" icon for the machine is very high. In most of the cases, the machines alarm will be in "red" status.

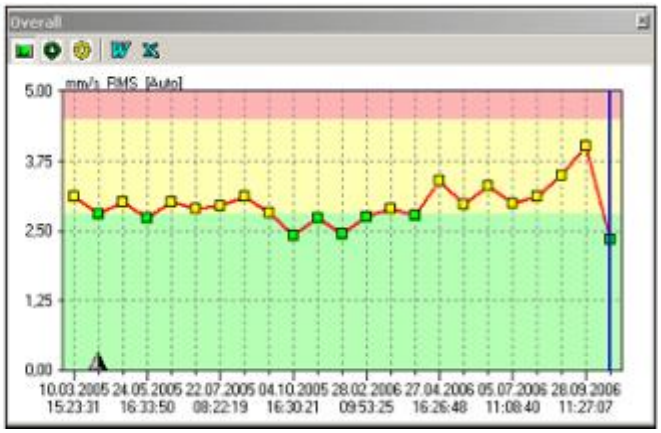
Let's have a look:



In the machine tree, the ***MACHINE 1*** is in **Danger** condition:
Because the point P4 is in *Danger* alarm, also the ***MACHINE 1*** and ***DEPARTMENT 1*** are in *Danger* alarm. If you expand the tree more, you can see that the problem isn't the total value of the point P4, but the "Secondary" band, because the total value of the vibration in point P4 is below the *Warning* limit.

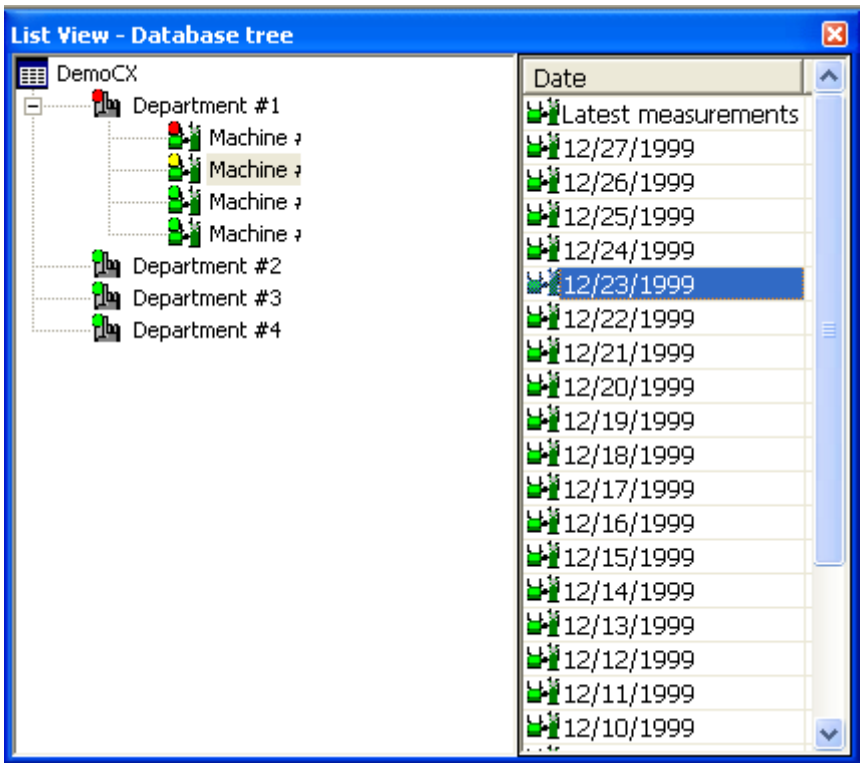
***NOTE*: Showing band alarm in tree can create confusion, so it's always your decision if the band alarms will be added or not to the database alarm update.**

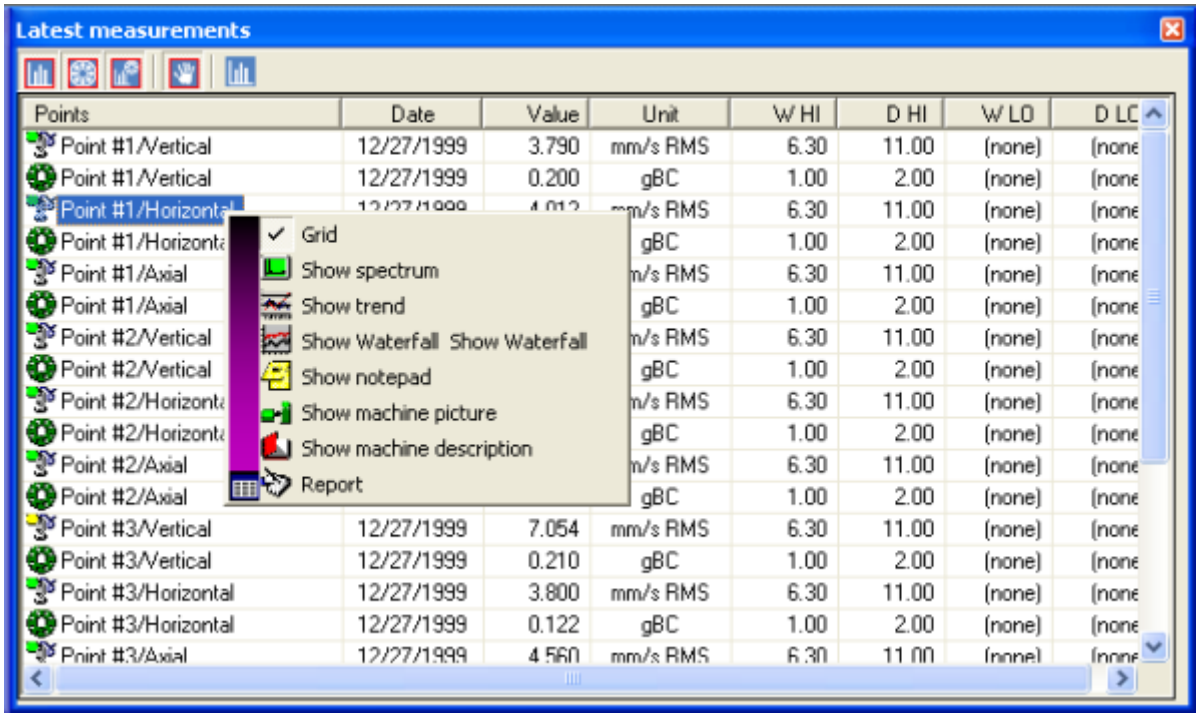




14.5 List view

Using **List View,** you can see the alarm status for all *Machine Points* in a single list, without the bands alarm included.
List View never includes the bands alarm.





In the **List View** the following items are displayed:

- Total vibration values
- Total BE
- Total Envelope values
- Manual entry point
- mV Measurements

15 CXSpectra™ Reports

The following pre-defined reports are included in the **CXSpectra**™ software:

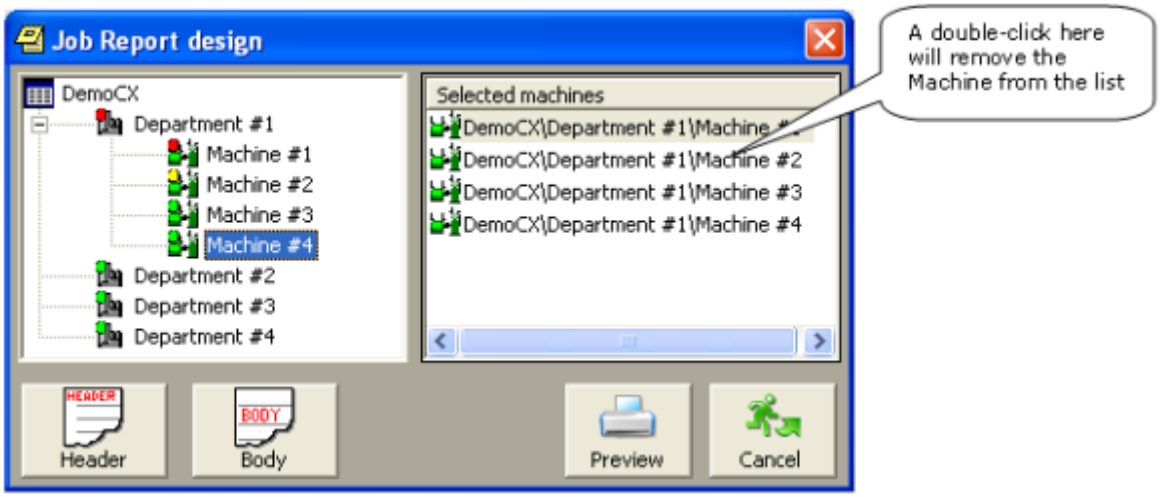
- Job Report
- Total Value Report
- Machine history Report
- Machine description Report
- Excel Quick Report
- Transfer Report
- Unmeasured Machine Report
- Diagnosis Report
- Balancing Report.

Most of them can be user customized by the user.

Any report can be send to a text editor for more changes.

15.1 Job Report

The **Job Report** contains the last notes made by you for the selected machines. This report is dedicated to the maintenance team.

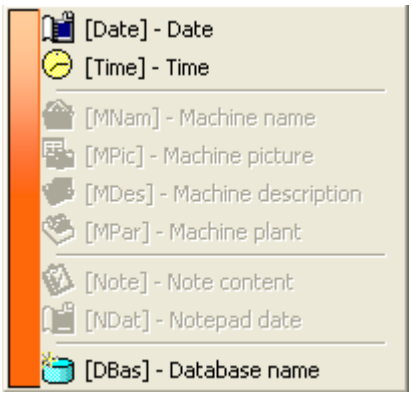


The notes are a consequence of the diagnosis process, using the measurements unloaded from the data-collectors.

First, select the machines from the hierarchy tree. Just double-click on each machine or drag and drop the machines in the selected machine list. You can remove some machines from this list, by double-clicking the mouse. Now, if you use the software for the first time, you must customize the header and the body of this report.

To edit the header press the **Header** button. A specific window will appear.

In the pop-up menu (activated with a right-mouse click) you have some reserved words, all included in square brackets. These words will be replaced in the final report, in accordance with the actual contents of the database. In the **Job Report Header** you can add the following items:



[Date] – Current date
[Time] – Current time
[DBas] – Active Database name

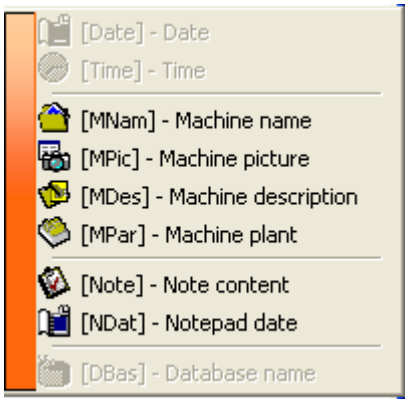
You can preview a sample of the header pressing the **Preview** button from the toolbar.

The latest contents of the header will be automatically saved for a later usage. If you want to have more than one type of header, save the contents in a file! That's how you can customize as many header types as you want.

Next time, you can restore the contents of the header from the saved file. Pressing the **Picture** button from the toolbar, you can include a picture in your header (e.g. company logo). The **Header Edit Window** shows the header at 1:1 scale, depending on your printer settings.

In a very similar manner you can customize the body. Press **Body**.

In the pop-up menu (activated with a right-mouse click) you have some reserved words, all included in square brackets. These reserved words will be replaced in the final report, according to the actual contents of the database. In the **Job Report Body** you can add the following items:



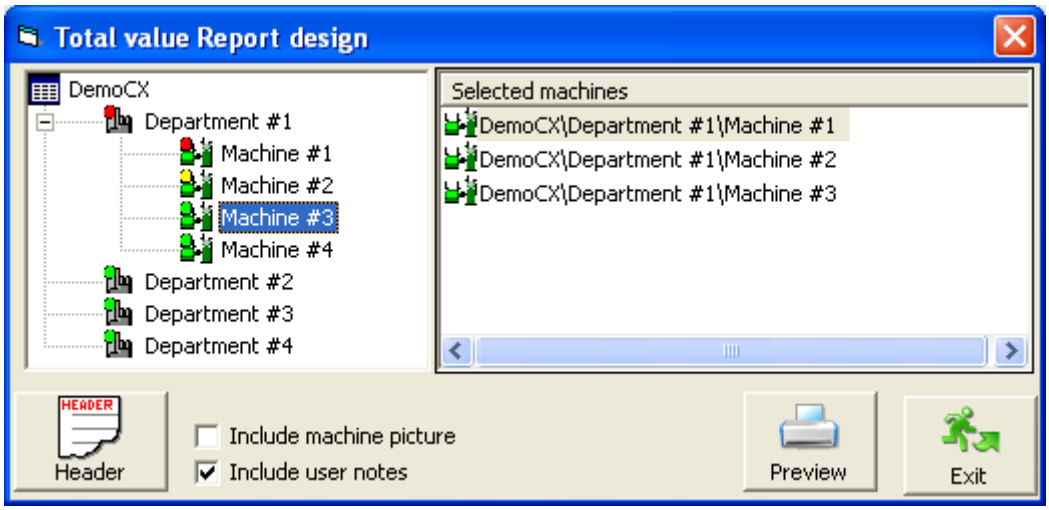
[MPic] – Machine picture, defined in the **Database Edit**
[Note] – Contents of the last *Notepad* contents
[MPar] – Department name
[MNam] – Machine name
[MDes] – Machine short description
[Ndat] - Last *Notepad* entry date
[DBAs] – Active *Database* name

Before printing, you can edit the contents of the notes. Use **Notepad** button, but first select the desired machine from the **Selected machine list**.
Finally press the **Print** button and the **Report Preview** window will be activated.

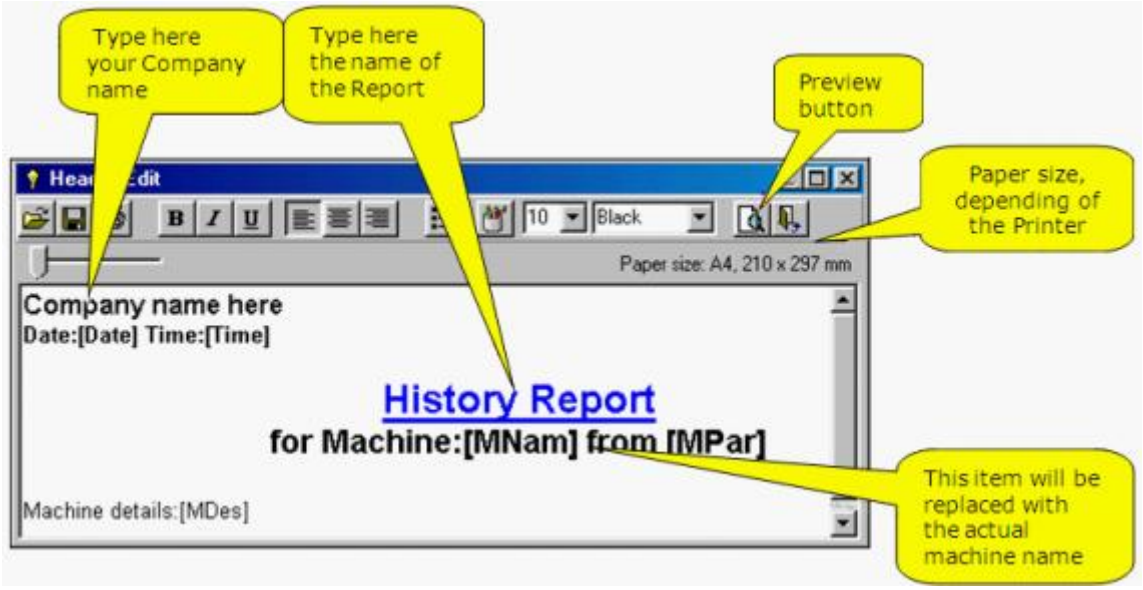
See **Report Preview** for more details.

15.2 Total Value Report

The **Total Value Report** is similar with the **Job Report**, but also contains a table with the **Total Value** for every machine:



First select the machines from the hierarchy tree. Just double-click on each machine or drag and drop the machines in the selected machine list. You can remove some machines from this list, by double-clicking the mouse.



Now, if you use the software for the first time, you must customize the header and the body of this report.

To edit the header press the **Header** button.

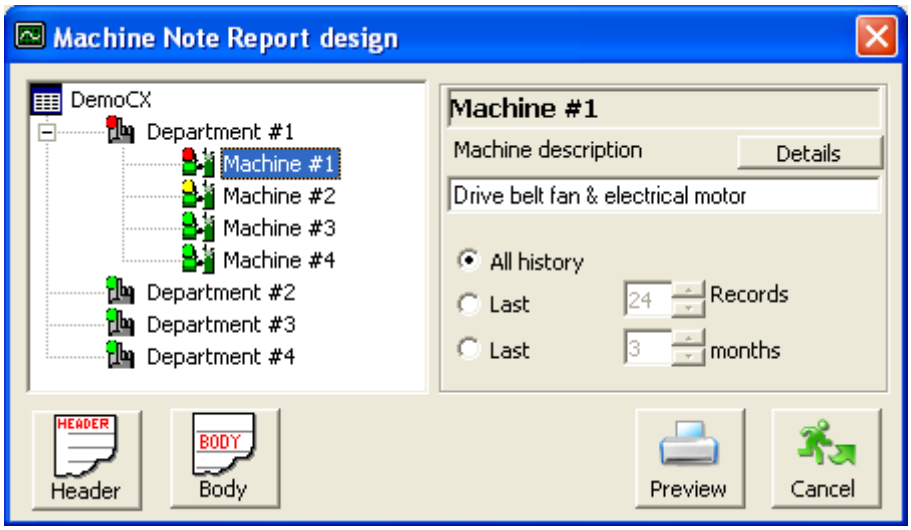
Additionally, you can include in the report the machine picture and the user notes.

Press **Preview** button to visualize the report contents.

15.3 Machine History Report

The **Machine History Report** contains all the notes for a selected machine.

First, select the desired machine, and decide if you want a report with the whole history or just a partial report. Now, if you use the software for the first time, you must customize the header and the body of this report. To edit the header press **Header** button! A specific window will appear.



In the pop-up menu (activate with a right-mouse click) you have some reserved words, all included in square brackets. These words will be replaced in the final report, in accordance with the actual contents of the database.

You can preview a sample of the header just pressing the **Preview** button from the toolbar. The latest contents of the header will be automatically saved for a later use. If you want to have more than one type of headers, save the contents into a file! That's how you can customize how many header types you want. Next time, you can restore from the saved file the contents of the header.

Pressing the **Picture** button from the toolbar, you can include a picture in your header (e.g. company logo). The **Header Edit Window** shows the header at a 1:1 scale, depending on your print setting.

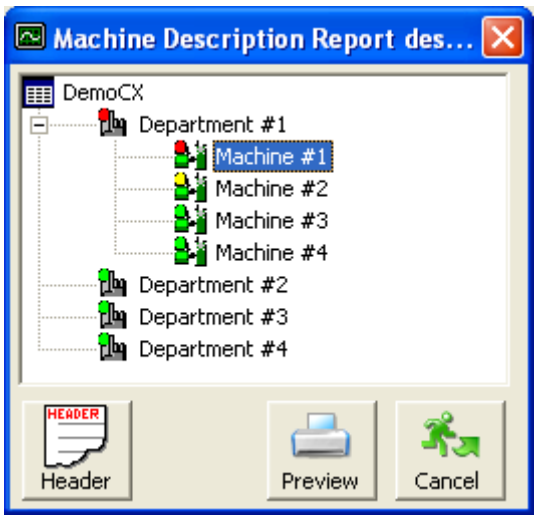
In a very similar manner, you can customize the body. Press **Body**.

Finally, press **Print** button and the **Report Preview** window will be activated.

See **Report Preview** for more details.

15.4 Machine Description

The **Machine Description Report** contains in the body the description of the selected machine.



First select the desired machine.

Now, if you use the software for the first time, you must customize the header and the body of this report. To edit the header, just press the **Header** button. A specific window will appear. In the pop-up menu (activated with a right-mouse click) you have some reserved words, all included in square brackets. These words will be replaced in the final report, in accordance with the actual contents of the database.

You can preview a sample of the header, by pressing the **Print** button from the toolbar. The last contents of the header will be automatically saved for later use. If you want to have more than one type of headers, save the contents of the header in a file! That's how you can customize how many header types you want. Next time, you can restore from the saved file the contents of the header.

Pressing the **Picture** button from the toolbar you can include a picture in your header (e.g. company logo). The **Header Edit Window** shows the header at a 1:1 scale, depending on your print settings.

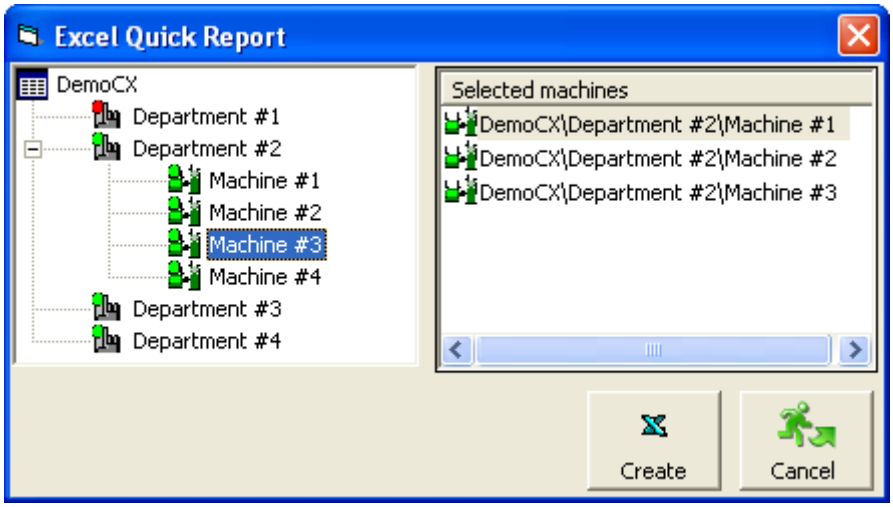
Finally, press the **Print** button and the **Report Preview** window will be activated.

15.5 Excel Report

This report is available only when **Quick View** is active.

First select the machines from the hierarchy tree. Just double-click on each machine or drag and drop the machines in the selected machine list. You can remove some machines from this list, by double-clicking the mouse.

Press **Create** button and the report will be created into an *Excel spreadsheet*.



Please note that ***Microsoft® Excel*** must be installed into your computer.

15.6 Transfer Report

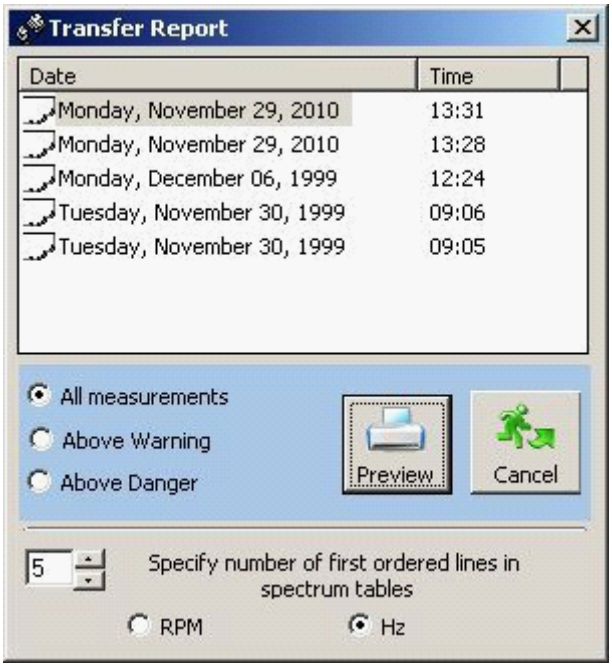
Transfer Report can show any route transfer in the **CXSpectra**™ database.

From the list, select the transfer date.

Press the **Print** button to show the report.

The report can contain all measurements or a selection, depending on the *Alarm conditions*. The alarm limits are collected from the route settings.

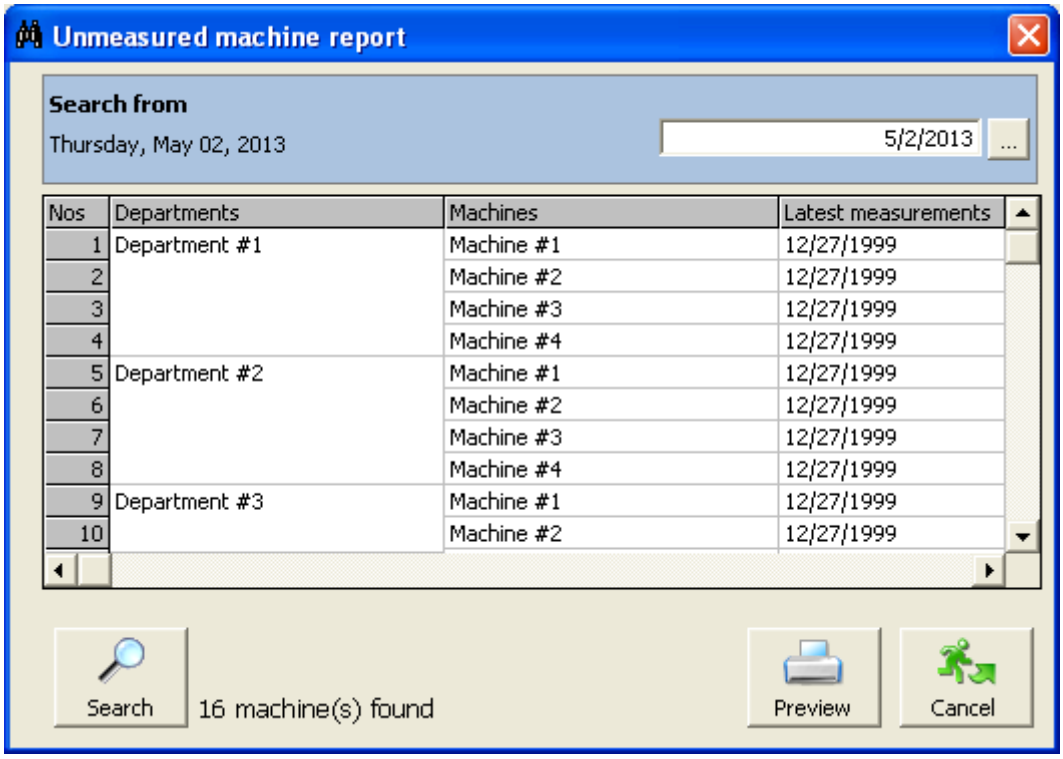
The specified number of the highest peaks from spectrum can also be shown.



15.7 Unmeasured machine Report

This report can be useful to find the unmeasured machines since a specific date.

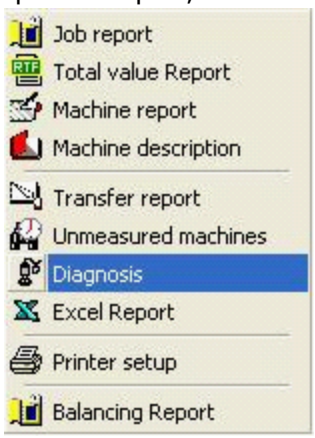
Select the date first and press the **Search** button. The report will be displayed in the print preview window.



15.8 Diagnosis Report (Defect List Report)

This paragraph describes how to use the Defect List Report to perform the diagnosis.

In a machine diagnosis task, the major difficulty occurs because of the amount of information required for a precise diagnose. The computer size is limited, so not all the necessary spectrum plots can be simultaneously displayed in the same time. In the spectrum plot, the fault lines can be shown, but if they are many, these can't be usable.



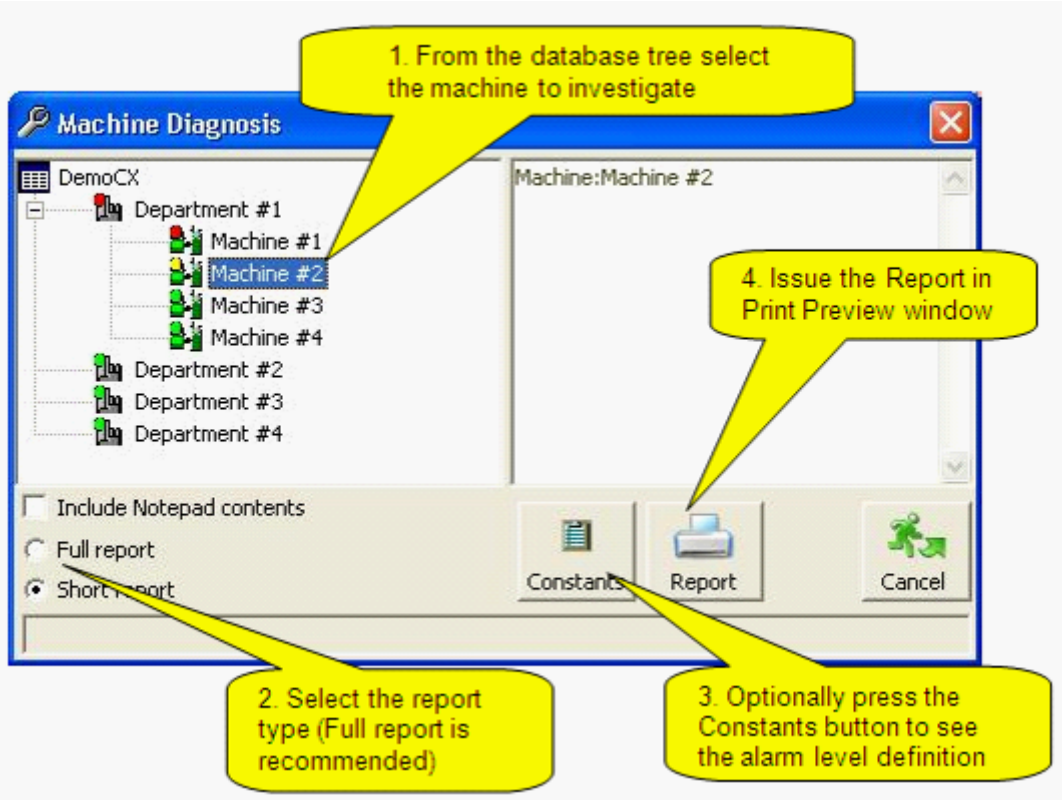
The *Baseline spectrum* and the latest measurement are very useful for diagnosis also. The alarms limit set during the machine **Edit** also can provide valuable information. Using this new report, the user can access at once all the relevant information regarding machine condition.

Diagnosis is a valuable tool to speed-up the diagnosis process. **Diagnosis** is available in the **CXSpectra**™ application beginning with **SP8.**

The command is available in the **Main** menu, under **Report** menu:

15.8.1 Using Machine Diagnosis

When this command is selected, the window beneath will appear:



The **Constants** window show the alarm level, for all the types of faults available in the **CXSpectra**© software.

The alarm levels are calculated using the alarm defined for *Total Vibration values* (Warning and Danger limits.

In this release, the constant values can't be adjusted by the user.

The report has several tables for each *Direction*:

- Total value table
- Fault frequency table – latest measurement
- Fault frequency table – baseline
- Highest peak value in spectrum – latest measurement
- Highest peak value in spectrum – baseline

If *Baseline* is not defined, the table with baseline information will not appear. It is highly recommended to define a baseline measurement for each *Direction*. This can be done in **Edit** command.

15.8.1.1 Total value table

Name	Last value	Prev value	Base Line	Unit	W HI	D HI
Total	**3.790**	3.790	9.564	mm/s RMS	6.30	11.00
BC	**0.200**	0.200	0.230	gBC	1.00	2.00

In the table above, the latest two measurement values appear together with the baseline value. If the Envelope measurement is defined, also the Envelope magnitude will appear. If the alarm limits are exceeded, the values appear coloured in yellow or red.

15.8.1.2 Fault frequency table – latest measurement

In the table below, the values for all defined fault frequencies are displayed.

Fault frequency can be defined in the Edit Window. The fault frequency can be defined on the Machine, the Point or the Direction level. The shaft speed, the fist two harmonics and the Low frequency are always shown.

If the fault frequency represents a peak in the spectrum, the value is marked with a trusty flag. If the fault frequency is not a peak, but closed, the values are marked as not trusty. In this last case, the displayed value, in the majority of cases, DOESN'T represent a fault.

Defect Name	Bearing	Value	Unit	Freq	W	D	Trusty
ShaftSpeed		14.517	mm/s RMS	48.80 Hz	5.04	8.80	Yes
X2 ShaftSpeed		2.368	mm/s RMS	97.60 Hz	3.15	5.50	Yes
X3 ShaftSpeed		1.365	mm/s RMS	146.38 Hz	1.89	3.30	Yes
LOW FREQ		1.489	mm/s RMS	3.10 Hz	0.63	1.10	Yes
LINE FREQ		0.000	mm/s RMS	0.00 Hz	0.63	1.10	No
LF X 2		1.258	mm/s RMS	100.00 Hz	0.63	1.10	No
BELT		0.183	mm/s RMS	15.00 Hz	1.26	2.20	No
BPFI[1]	6203	0.013	mm/s RMS	227.50 Hz	0.32	0.55	No
BPFI[1] X 2	6203	0.008	mm/s RMS	457.50 Hz	0.32	0.55	No
BPFO[1]	6203	0.051	mm/s RMS	162.27 Hz	0.32	0.55	Yes
BPFO[1] X 2	6203	0.032	mm/s RMS	322.50 Hz	0.32	0.55	No
BSF[1]	6203	0.032	mm/s RMS	130.00 Hz	0.32	0.55	No
FTF[1]	6203	0.089	mm/s RMS	27.50 Hz	0.32	0.55	No
BPFI[2]	1105	0.123	mm/s RMS	252.50 Hz	0.32	0.55	No
BPFI[2] X 2	1105	0.027	mm/s RMS	502.50 Hz	0.32	0.55	No
BPFO[2]	1105	0.072	mm/s RMS	186.64 Hz	0.32	0.55	Yes
BPFO[2] X 2	1105	0.040	mm/s RMS	373.82 Hz	0.32	0.55	Yes
BSF[2]	1105	0.040	mm/s RMS	115.09 Hz	0.32	0.55	Yes
FTF[2]	1105	0.023	mm/s RMS	20.00 Hz	0.32	0.55	No

15.8.1.3 Fault frequency table – baseline

This table is similar with the previous, but it refers to the baseline spectrum.
A simple analysis of these tables can give a first impression regarding the faults evaluation.

15.8.1.4 The highest peak value in spectrum – latest measurement

Frequency	Value	Unit	Defect name	% Change	Warning	Danger
48.80 Hz	14.517	mm/s RMS	ShaftSpeed	+ 96.30	5.04	8.80
292.91 Hz	2.594	mm/s RMS	[X 6] ShaftSpeed (Multiply 6)	+ 96.30	0.84	1.47
244.08 Hz	2.510	mm/s RMS	[X 5] ShaftSpeed (Multiply 5)	+ 96.30	1.01	1.76
97.60 Hz	2.368	mm/s RMS	X2 ShaftSpeed	+ 96.30	3.15	5.50
195.11 Hz	1.511	mm/s RMS	[X 4] ShaftSpeed (Multiply 4)	+ 96.30	1.26	2.20
2.50 Hz	1.435	mm/s RMS		+ 96.30	(none)	(none)
146.38 Hz	1.365	mm/s RMS	X3 ShaftSpeed (Multiply 3)	+ 96.30	1.89	3.30
9.27 Hz	0.646	mm/s RMS		+ 96.30	(none)	(none)
536.62 Hz	0.450	mm/s RMS	[X 11] ShaftSpeed	+ 96.30	0.46	0.80
24.04 Hz	0.399	mm/s RMS	[X 0.5] ShaftSpeed	+ 96.30	2.52	4.40

In this table, only the first ten fault frequencies are shown, but the change in magnitude since the last measurement is also shown.

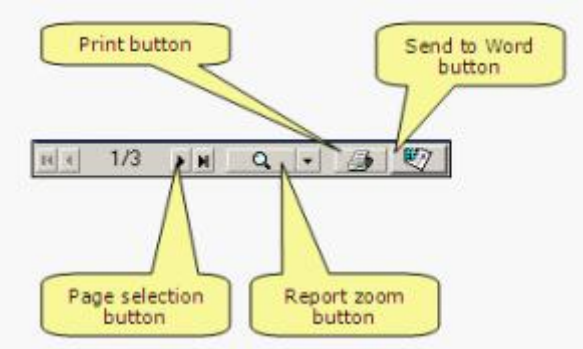
If a peak is not identified, the *Fault name* is missing. If this happens for the majority of the highest magnitude lines, it seems that the fault frequencies are not completely defined for that *Direction*. Return to **Edit** menu and add all the available fault frequencies associated with the *Machine*.

15.8.1.5 Highest peak values in spectrum – Baseline

The table is similar to the table above, but it shows the highest magnitude peak for the baseline spectrum.

15.8.2 Best practice for a suitable Defect List Report

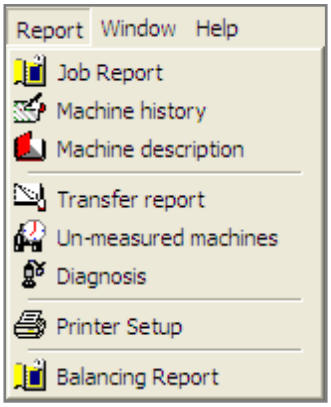
The **Report** contains only the existing information from the database. Lack of information will give a poor **Report:**



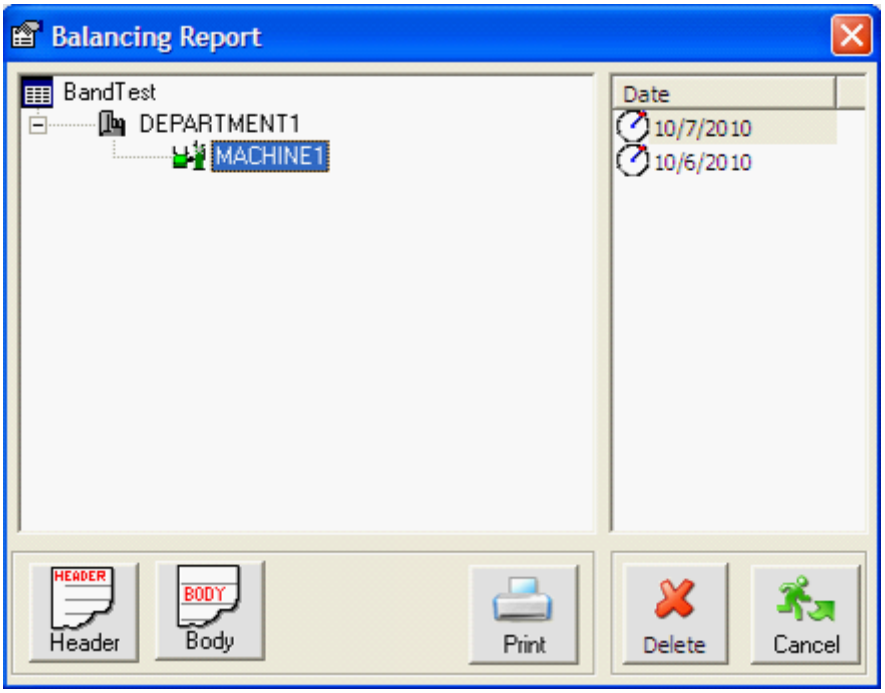
Follow the rules below, to produce a useful **Report**:

- Always define a baseline spectrum for each *Direction*
- Define as many fault frequencies as possible.
- Adjust the correct shaft speed in spectrum, before using this command. Measuring the speed during data acquisition is the best practice, at least for a single *Direction*. If this isn't possible, adjust manually the correct shaft speed for a single *Direction* belonging to a *Machine* and use the **Speed Tool** menu to set the proper shaft speed to all *Machine Directions*.
- The magnitude values are important. Even low magnitude peaks can be relevant for the machine condition.
- Set the *Total value alarms* according with a well known standard. Be careful to set other smaller limits for Vertical and Axial directions. Don't use the same limits for all measurement directions!
- Add your comments from the Notepad to the **Report**. They will be very helpful during the diagnosis process.
- From the information provided by this **Report** first try to find what faults the machine **DOESN'T** have, rather than trying to detect the existing possible fault. Eliminate, one by one, the inexistent faults and finally you will obtain a short list with all possible faults. Now it will be easier to determine the real faults!

15.9 Balancing Report

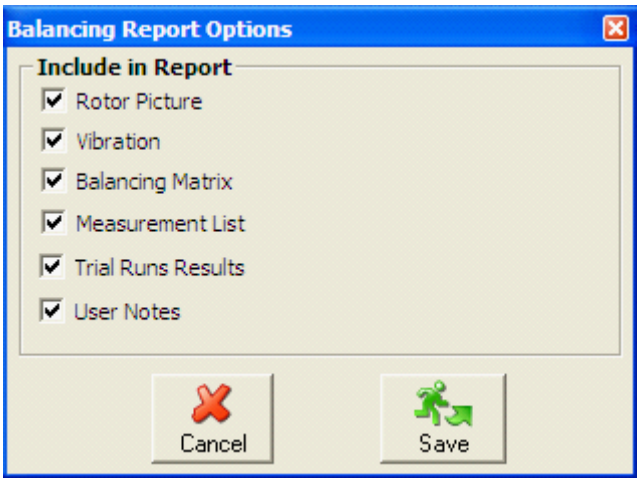


This command can be used to create a *Balancing Certificate*, using the *Balancing Files* downloaded from CXBalancer® Instrument (.MV4 extension files). *Balancing Files* must exist in the machine *Database*.



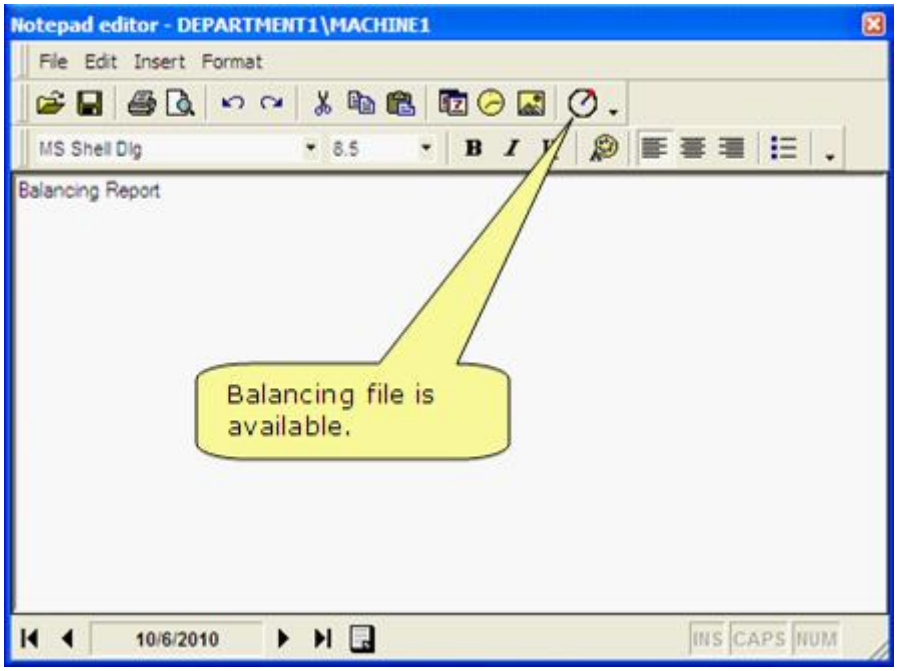
Report *Header* can be customized by pressing **Header** button.
Pressing **Body** button, the user can customize the report as follows:

- **Rotor picture** - Adds also the rotor picture to the *Report.*
- **Vibration** - Includes also the initial and final vibration measured during the balancing session.
- **Balancing Matrix** - Includes the calculated *Balancing Matrix* in the *Report.*
- **Measurement list** - Includes all the *Fine Balancing* measurement. As default, only the latest fine balancing is included.
- **Trial Run Results** - Includes the trial run details in the Report.
- **User Notes** - Includes also the *User Notes* (if exist).



From the left *List* the user can select the **Balancing Report** to be printed. When the **Print** button is pressed, the **Balancing Report** is shown into a *Preview Window*. From here, the report can be printed. When a *Balancing File* exists in the machine database, in the **CXSpectra© Notepad** appears a new icon, in the upper-right corner.

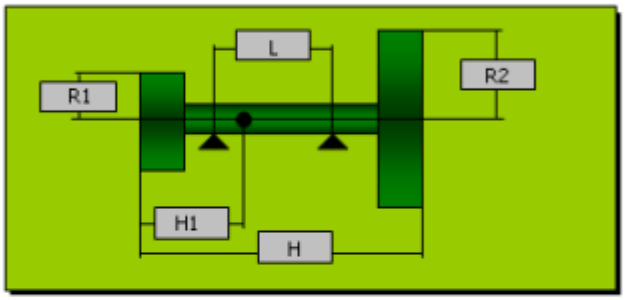
The report can be printed also from here:



See below a part of the report:

Balancing date: 10/7/2010 8:57:26 AM

Rotor data	
Rotor type: Double overhung rotor	Balacing speed: 1200 RPM
Rotor mass: 200.0 Kg	Service speed: 1500 RPM
Correction radius R1: 100 mm	Correction radius R2: 100 mm



H = 800 mm
H1 = 400 mm
L = 600 mm

Initial unbalance		
Parameter	LEFT	RIGHT
Initial unbalance	29.3 Kgmm	35.1 Kgmm
Initial mass	293 gr	351 gr

Final unbalance		
Parameter	LEFT	RIGHT
Residual unbalance	173.55 Kgm	121.85 Kgm
Residual mass	1.7 Kg	1.2 Kg

Final Vibration (x1RPM)			
Vibration LEFT		Vibration RIGHT	
Initial	2297.82 mm/s RMS @ 358.7°	Initial	2293.26 mm/s RMS @ 358.7°
Final	2298.66 mm/s RMS @ 358.7°	Final	2294.11 mm/s RMS @ 358.7°

15.10 Print Preview

Before printing a **Report**, the contents are shown in a **Print Preview** window. Page selection is used to browse between the report pages.

Using **Zoom** button you can adjust the report size on the screen.

Press the **Print** button to print the report.

Press **Save** button to save the report in a file.

Press **Word** button to copy the report contents in a MS Word document (the MS Word must be installed on your computer).

16 Updating alarms

16.1 Introduction

When the machine tree is shown, the item icons are coloured according with the current alarms levels.

This is true only, if the latest alarms were updated recently.

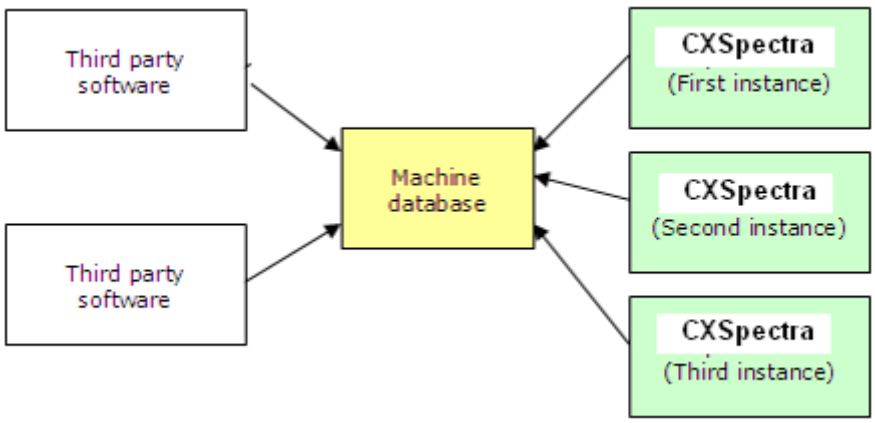
The actual **Alarm Status** can be seen looking at the **Manual Alarm Update** button from the **Main** Menu toolbar:

If the button is pressed (the middle picture) the alarms are correctly shown and no update is required.

If the button isn't pressed (the right picture), the alarms need to be manually refreshed. To do this, just press the **Manual Alarm Update** button.

Because the machine databases can be accessed at the same time from many computers across a network, in a network environment only, might be possible that the user hasn't been informed about the real status of alarm in the database tree.

See the schematic below. This is a typical accessing diagram for the machine database in a network:



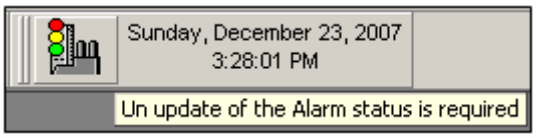
Any of the users above can make some changes in the machine database adding new measurements. There is further described how the user can set the **CXSpectra**™ in a way to be always informed in time about any change in the alarm status and also how the alarms update might be done.

16.2 Settings alarm of CXSpectra™ application

In order to receive periodical information regarding alarm update status, the user has to set some options in the **Setting** > **Optional** settings window.

***NOTE*: The alarms are not automatically updated, but just the database is checked for new measurements.**

If new measurements exist in the database, the **Manual Update Alarm** button will be changed to not pressed, as it follows:



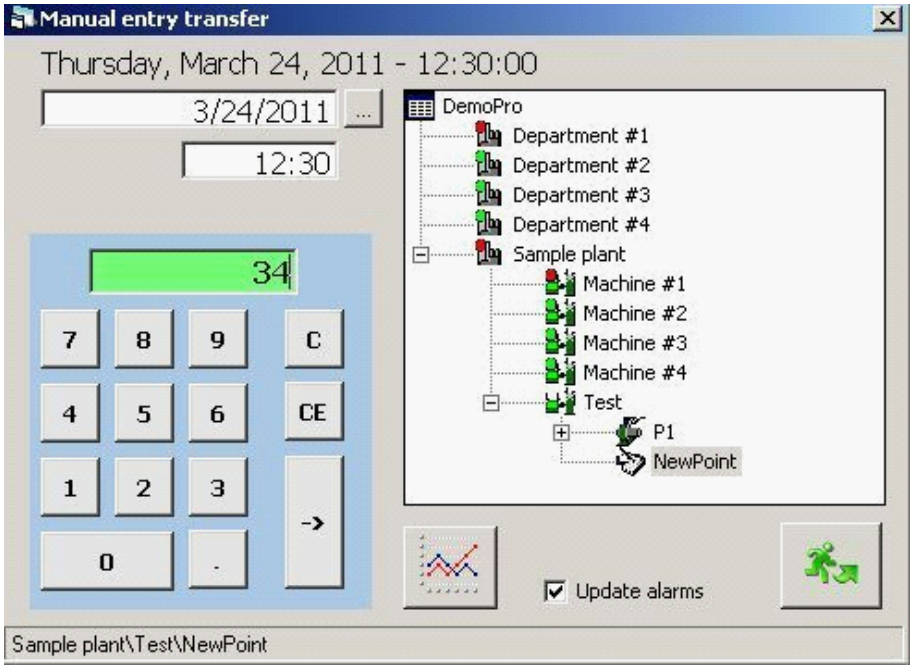
If the mouse cursor is moved in the button area, the tool tip text will indicate, if the alarm update is required or not.

If the alarm update is required, a manual update is necessary. Just press the button and the update procedure will begin.

***NOTE*: For medium and large machine databases, a complete updating procedure can take minutes. During the alarm update, the software is locked for the user. That's why a full automatic procedure can't be implemented.**

16.3 Semiautomatic alarm update

If, for instance, in **CXSpectra**™ a measurement download occurs, the user can decide, if also the alarm update must occur, when the transferring measurement is over.



In any transfer window a check box is placed into the window lower side.

The **Manual Entry transfer** window is shown in the left side picture:

Update alarm box is checked as default.

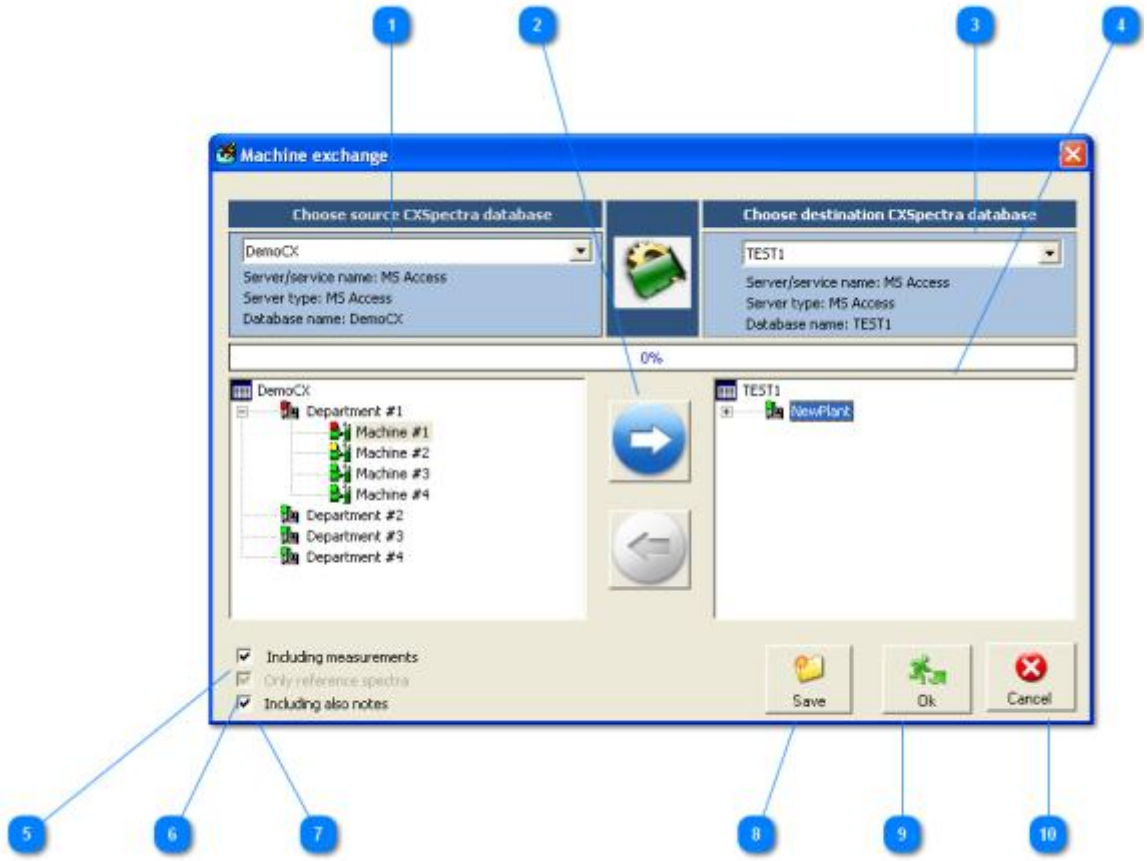
When the **Exit** button is pressed, an automatic alarm update will also occur.

***NOTE*: If any user in the network performs an alarm update procedure, all the other users will be informed about this. The Manual Update Alarm button will change the status to un-pressed.**

17 Exchange machines

Sometimes, you will need to move or copy a machine from one database to another. **CXSpectra**™ offers the possibility to move or copy machines between any two databases.

Select **Database** > **Machine exchange** command.



1. Source database
2. Move button
3. Destination database
4. Select Department (Plant)

5,6,7 Select transfer options

8. Save (move) the added machines
9. Exit button
10. Cancel button

Both databases must be registered.

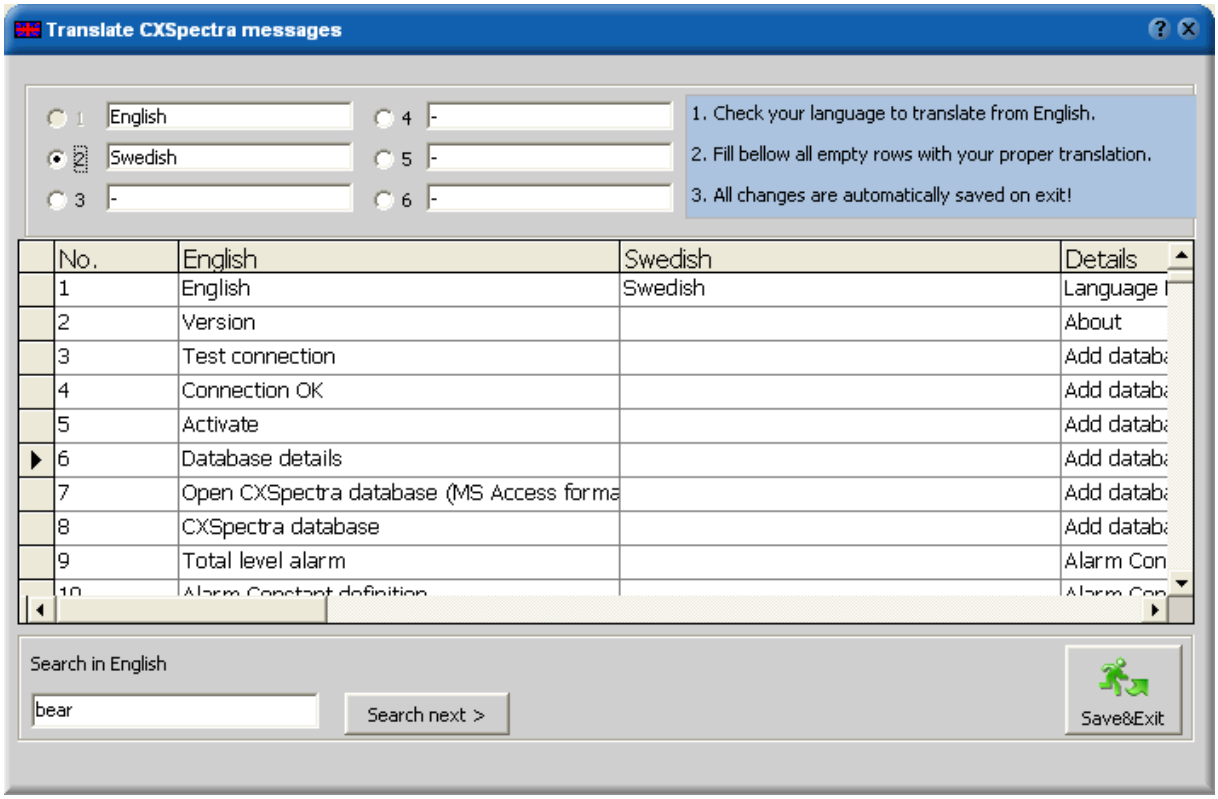
Proceed as follows:

- Select the source database from any registered databases(1).
- Select destination(3). The destination database must have at least one *Department* (or *Plant*). You can't copy a machine in an empty database. If you intend to move the whole source database in a new destination database, first use **Edit** command and create the same *Departments* as in the source database.
- First select the *Department(4)*, where you intend to copy a machine.
- Select the machine. The **MOVE** button (2) will be activated. Press the button and the machine name will be moved to the destination. The contents will not be transferred, yet. After transferring one machine, the item in the source tree will advance to the next machine. Press the **MOVE** button again, until all the machines are "moved" into the desired destination.
- Select the copy options (5,6,7): you can copy only the machine definition or the measurements.
- Finally, press the **SAVE** (8) button. All the selected machines will be copied to the destination. This action can take a few minutes.

Using the **Exchange Machine** command, you can create a single database using the machine stored in several databases. This action can be helpful to move your databases into another computer.

18 CXSpectra™ translation

CXSpectra™ is multi-lingual software. The entire program message is stored in *MessageCX.mdb* file, a **Microsoft Access** database. In order to have a **CXSpectra**™ version in a specific language, the entire database must be translated.



Just select **Settings** > **Translate** command.
First select any empty text box and fill it with your language name.

In the table, complete the item 1 with your language name (can be typed in your local language).

Now, begin the translation. Be careful, in English all the messages are shorter than in most of the other languages! If you don't understand completely how to translate some sentences, just skip the row. You can do this later.

When you finish, close the translation window. Your work will be saved in the *MessageCX*.mdb file. If you update **CXSpectra**™ with a new **Service Pack**, don't worry! The **Service Pack** won't delete your translation file, but will just add the newest words or sentences (in English). Just run again the *Translation software* and translate the latest messages.

Your language will appear in the translation list. Just select your language from the list and next time, when you will start **CXSpectra**™ messages will be in your language.

The latest saved language is saved in **CXSpectra**™, as shown above.
If some messages aren't translated, you have the possibility to make the translation when you run the **CXSpectra**™.

To do this, proceed as follows:

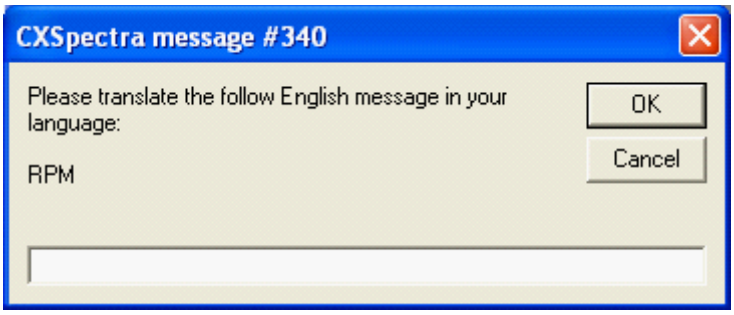
- Locate *CXSpectra* on your computer (in a default installation the file will be in **C:\CXSpectra**).
- Just double-click the file to be opened in *Notepad*.

The first part of this file is shown below:

```
[General]
Language=1
MessagePro=C:\CXSpectra\MessageCX.mdb
TranslateMode=0
;  TranslateMode=0  Un-translated  message  will  be  shown  in
English
;  TranslateMode=1  Un-translated  message  will  be  shown  as
#NoMessage = Message in English
; TranslateMode=2 Un-translated message can be edited on fly
```

Change *TranslateMode* to 2 and save the file.

Always, when you will run **CXSpectra**™ again and un-translated messages will be found in the translation file, an edit window will be shown:



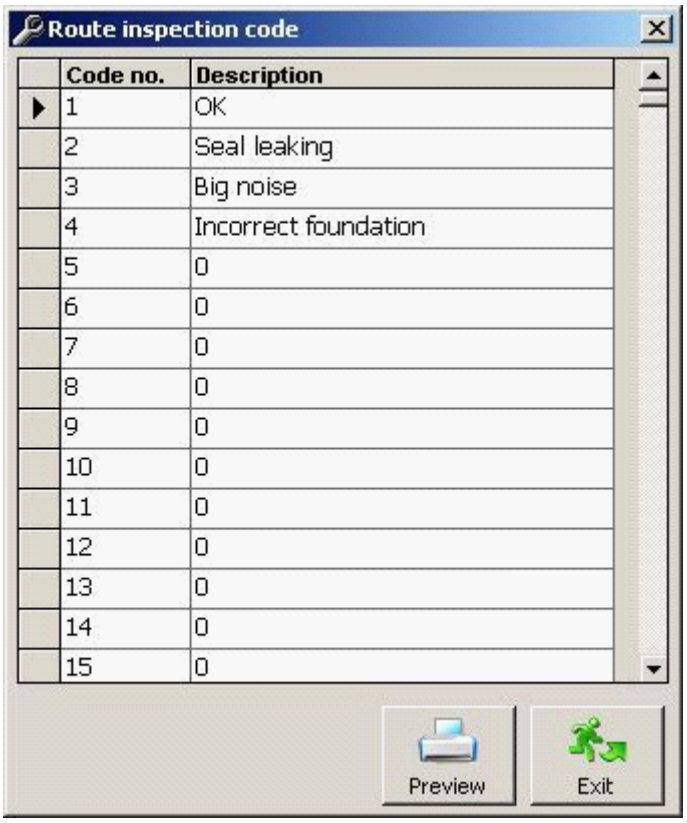
Now you have the possibility to translate on-fly the message.

Don’t use this setting when there are too many un-translated words!

The running of CXSpectra™ will be interrupted often and you will be unable to use the software. Don’t forget to set back the TranslateMode in the CXSpectra.ini file.

19 Route inspection code

In the **Settings** > **Route inspection code** menu you can activate the window below:



In this table you can add up to 64 inspection codes.

When a measurement is done, you will always have the possibility to select one or more *Inspection Codes* from a popup list, in the Instrument.

When the measurements will be downloaded in the machine database, in the *Notepad* also the contents of the inspection code will be added.

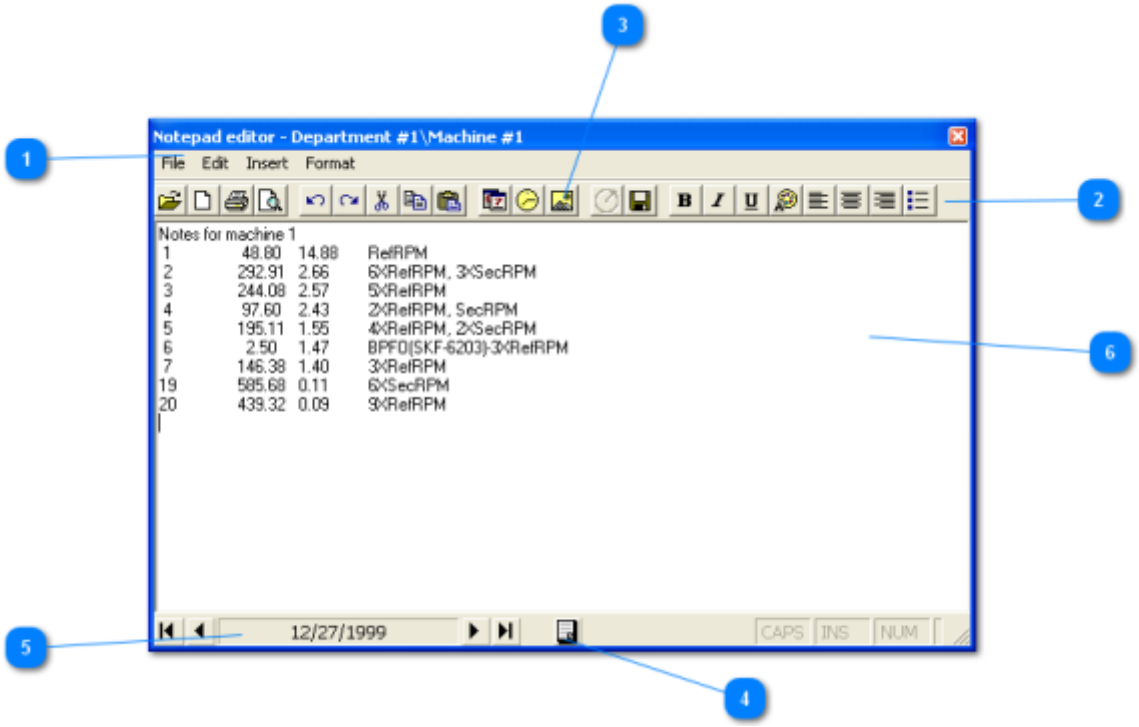
20 Using Notepad

Notepad is always available when a plot is visible on the screen.

The **Notepad** can be activated from the main toolbar menu:

The **Notepad** can also be activated from the pop-up menus of each plot (**Show notepad** command line).

The **Notepad** date appears in accordance to the plot date. From a trend plot, the **Notepad** will appear with the cursor date.
Because the **Notepad** contents appear in many *Reports*, a proper documentation done in the **Notepad** will ensure a good report also.



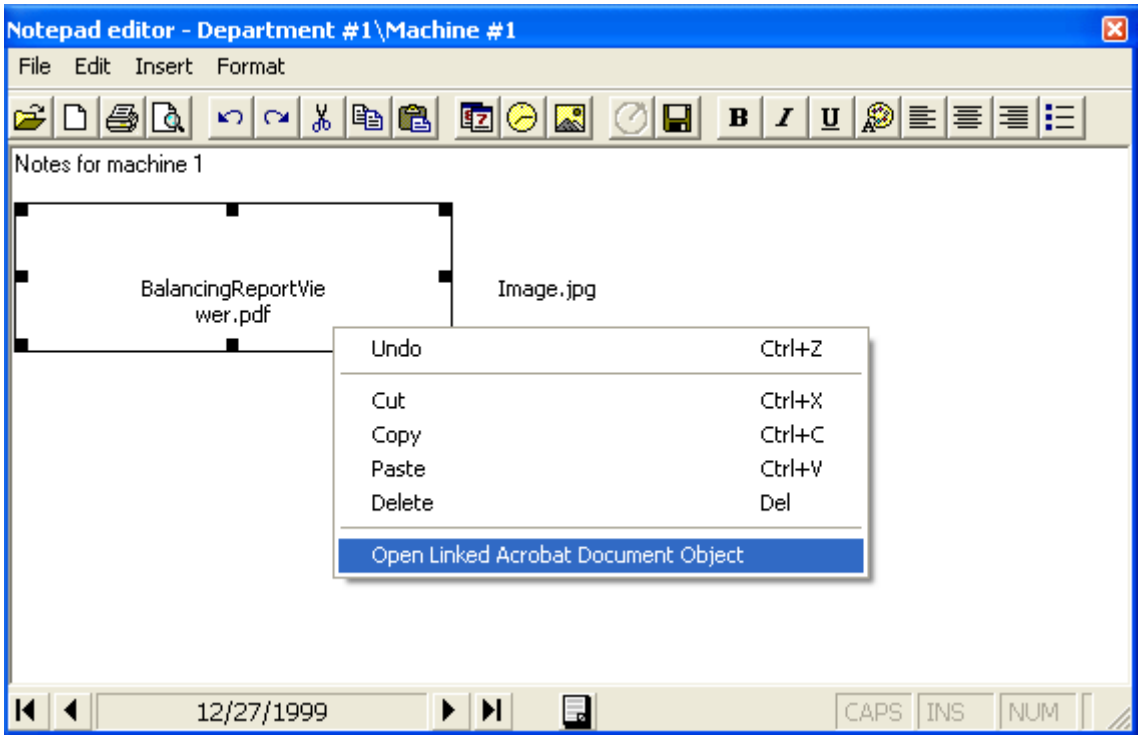
1. Menu bar
2. Toolbar
3. Insert picture
4. Show all notes button
5. Notepad date and time
6. Edit area

The **Notepad** must be used to document your diagnosis process.

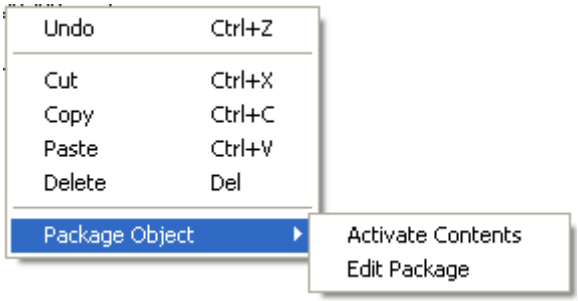
In the **Notepad** can be added:
- Any plot from the screen
- Any text using copy and paste
- Any text or *rtf*. external file
- Any picture (including digital camera picture).
- Any link to a file (pdf, image files, document files, etc). The source link must remain in the same location (to be opened later).

In the following example two links has been added in the **Notepad**:

- First link to a PDF files
- Second link to an image.



When you right-click onto link, in the popup menu a new item will appear (depending on file added).



You may open the file directly (or edit it):

Popup for the second link (image file):

The text can be formatted as in any standard text editor. The contents of a page can be saved in an *.rtf* file type.

Notepad is page and machine oriented. Each page has its own date. The **Notepad** is synchronized also with the plots. When a plot sets focus and the **Notepad** is visible, the **Notepad** page will be automatically changed to the plot date and to the machine. If only the point or direction of the same machine is changed in the plot, the **Notepad** contents won't be affected. This means that the **Notepad** always has the active page for the right date and for the active machine.

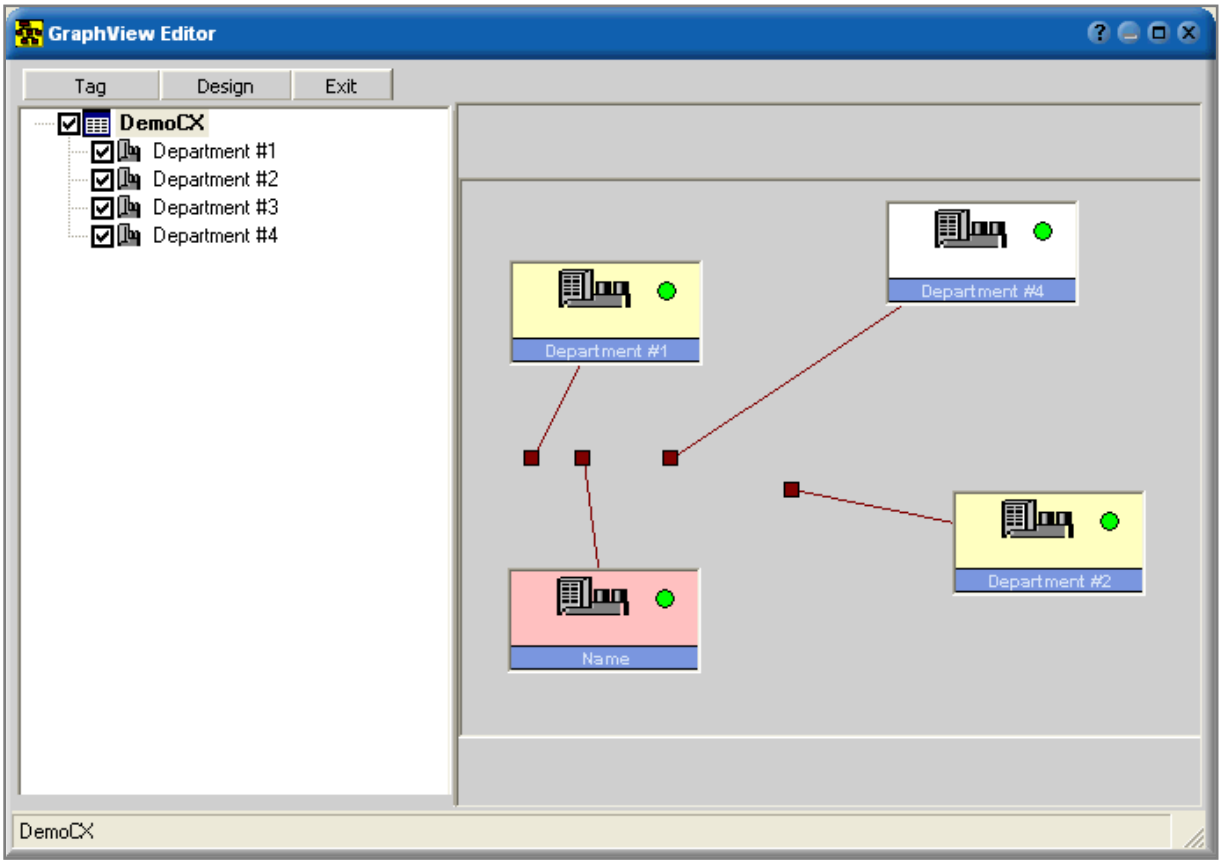
You don't need to save explicit the *Notepad* contents. When the page will be changed, the current contents are always automatically saved in the database.

21 GraphView

If the machine database is accessible in a network, it is possible to present data in a simple, graphical way.

A "black" protection key is required for each workstation.
To create a **GraphView** data presentation follow the steps:

1. Run **Database > GraphView Editor**.
2. The following window will appear:

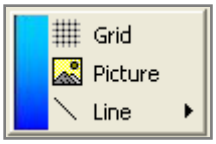


3. Check one by one the *Departments* to be moved into the graphic area.
4. Move the icons in the convenient location by mouse.
5. Right-click the *Department* icon and a pop-up menu will be shown:

From the above menu you can:

- Rename the *Department*
- Adjust the icon size (small, medium or large)
- Select a background colour for the icon.

6. Right-click in the graphic area. The following pop-up menu will be shown:



From the above menu you can:

- Show-hide the grid in the graphic area
- Add a background picture
- Show hide lines for tags and change the lines colour.

7. You can do the following actions:
   - Add a temporary grid to the graphic area.
   - Select a background picture. The picture must have an approximate size to cover all the display area. Any type of picture file is accepted.
   - Add some position lines to the icons.
   - Preview the final graphic aspect of the page.
8. Double-click on each *Department* icon. In the left side of the window, the machine list will be shown. Proceed as before and add a machine. For each *Department* a new graphic page will be created.
9. On each new page, double-click on each machine. In the left side of the window the *Point* list will be shown. Add the points (*Directions* will be added also) for each machine. For each machine a new graphic page will be created.
10. In each page you can add a background picture.
11. When you finish, just exit the **GraphView** Editor. The pages will be automatically saved in the machine database.

Now, any computer in the network can be configured to show a graphic format of the database.

To do this, proceed as follows:

1. Install **CXSpectra**™ on the computer (and the latest **Service Pack**). Use a normal protection key to start **CXSpectra**™. Select the desired database and close **CXSpectra**™. Remove the normal HASP protection key.
2. Insert in any available USB hub, a "black" protection key.
3. When the **CXSpectra**™ starts, instead to open the normal window, it will show a graphical view of the database.

In **GraphView** mode, the user can't change anything; the database is read-only.

If alarm limits are set, also the icons will be coloured according with the alarm levels in the machine tree.

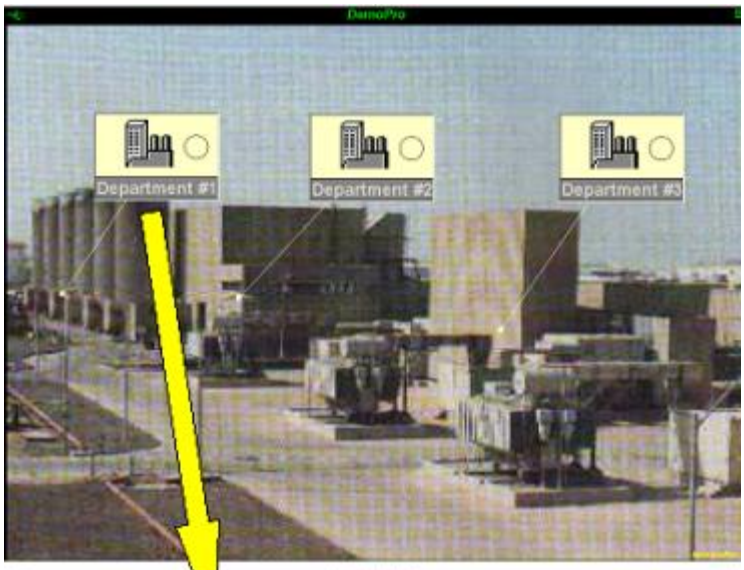
By clicking a *Department* icon, the *Machine* page will be shown.

By clicking a *Machine* icon, a *Point* page will be shown.

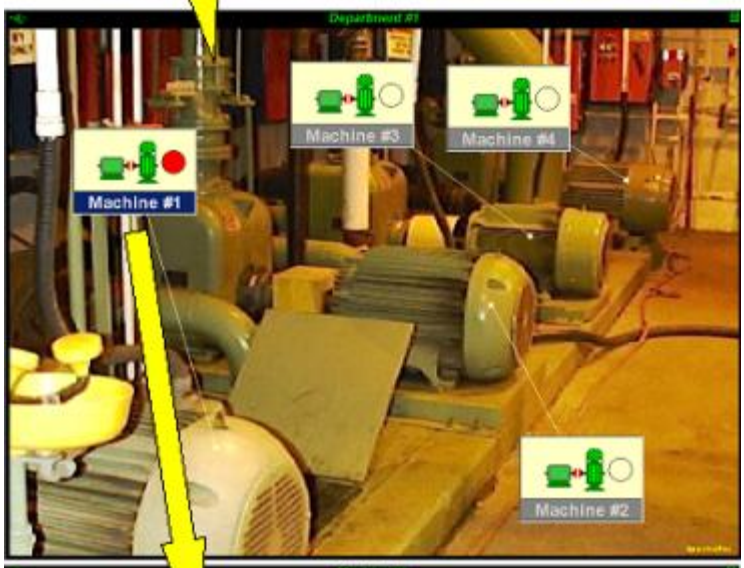
By clicking a *Point* icon, a special kind of **QuickView** will be shown.

For testing purpose you may open the **GraphView** from the **View** menu:

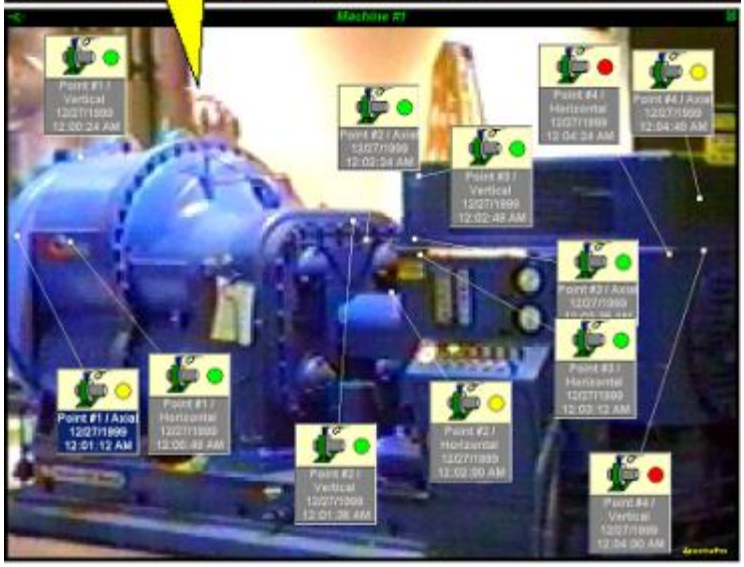
This is what the user can see in **GraphView** mode:



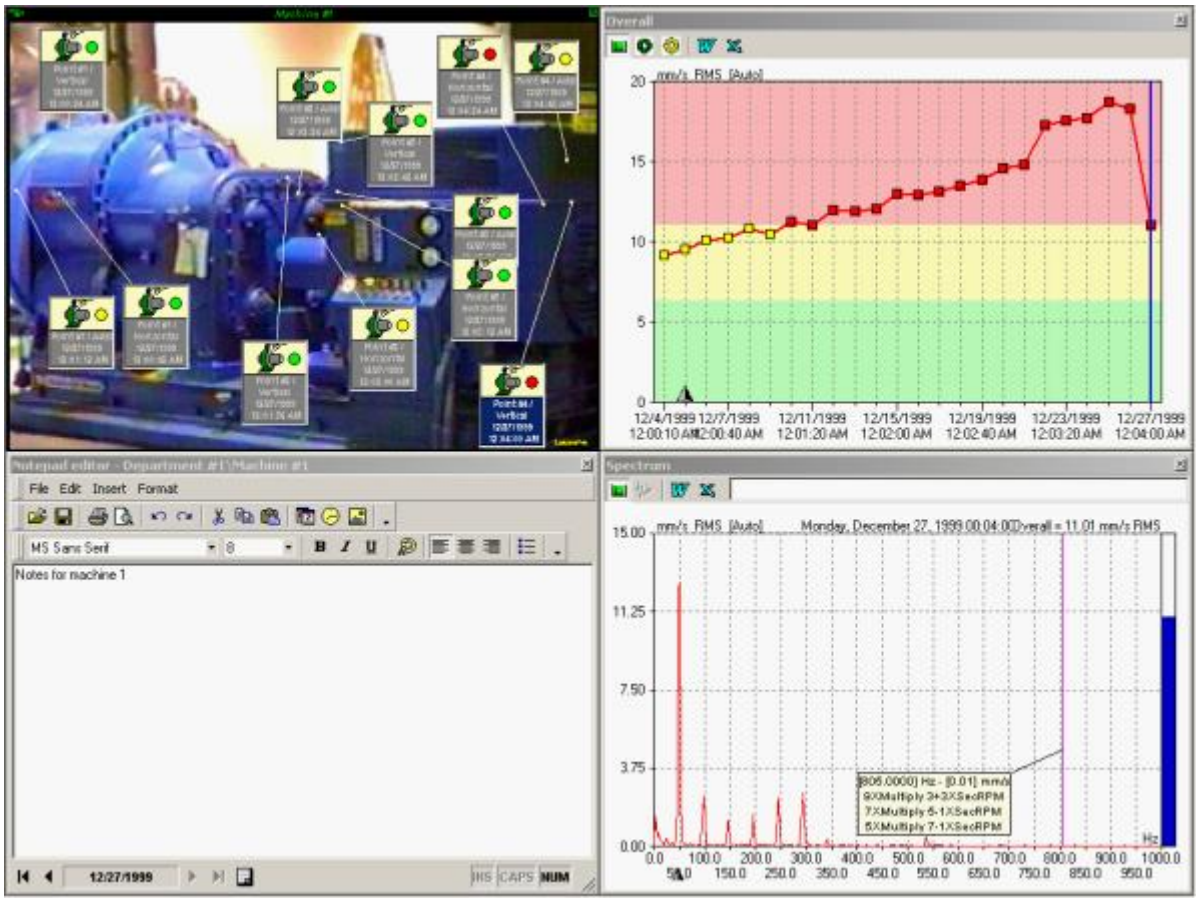
On *Department l*evel



On *Machine* level



On *Point* level



The number of workstations you can show the machine database in **GraphView** is unlimited.

Contact **MaintTech** to obtain **GraphView** Protection Key.

22 USB Drivers

No driver is required to connect the **CXBalancer®** Instrument to the computer.

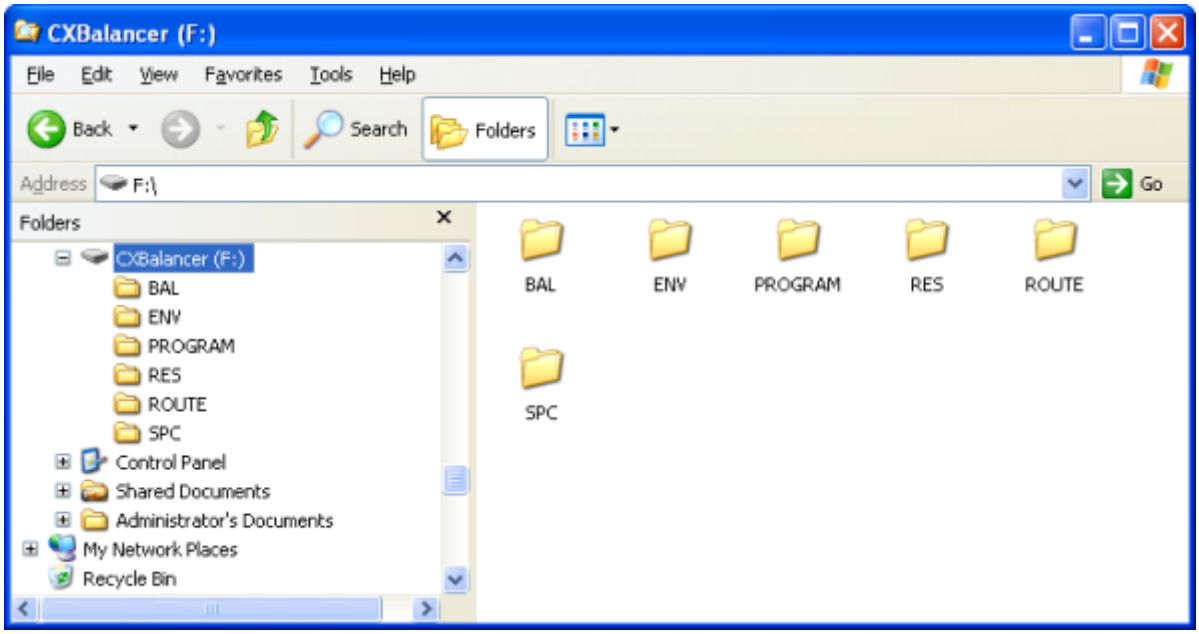
When you insert the connection cable in any USB hub, the *Windows Operating System* will recognize the Instrument microSD Card as a standard mass storage device and it will publish this. For the first time, this may take 20÷30 seconds. Then, the connection will be established in 2÷3 seconds.

The single condition to establish the connection is:

When you connect the USB cable to the PC and to the Instrument, the Instrument must be started and the user must select the* Communication *menu.

The whole contents of the card can be viewed in the *Windows Explorer*, as any ordinary *Removable Device*. In the PC, you can copy, delete or remove files. You can also directly format the microSD Card, when the CXBalancer® is connected to the PC.

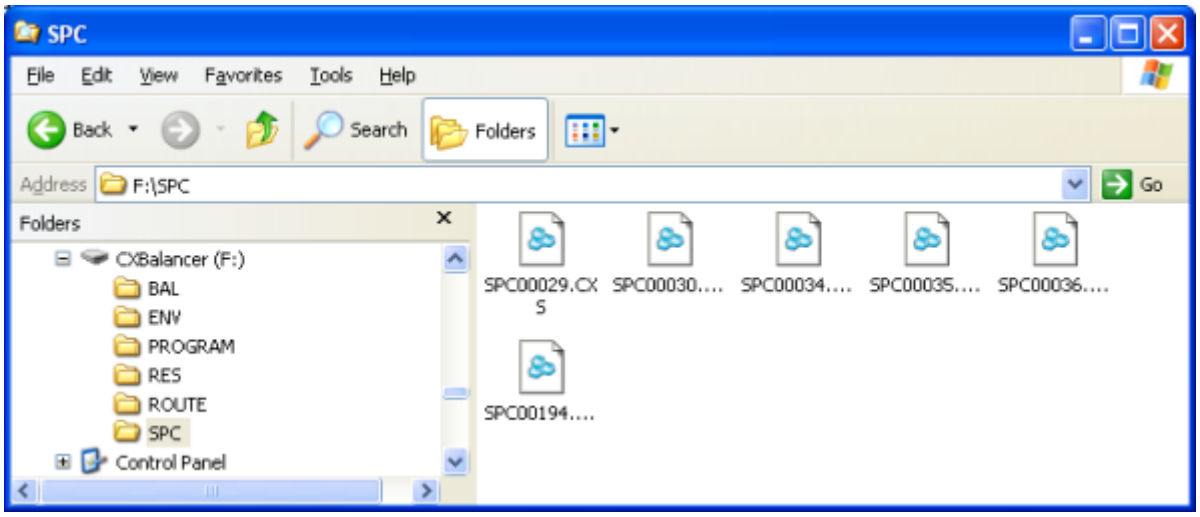
This is what appear when browse to the CXBalancer® memory card:



In above example, the CXBalancer® is recognized to be F:\ removable unit.

Each folder is storing specific files.
You may copy, delete or open the files.
Also you may format the Memory card, but the stored data will be lost.

In the example below, the contents of spectra files are shown:



NOTE: The card accepts in the Instrument only **short name** files. If **long name** files are added, into CXBalancer®, these files will appear truncated.

23 Spectrum peak calculation

23.1 Introduction

When a peak in the spectrum plot is between the spectrum lines, the value of peak amplitude and its frequency must be calculated between lines.
In this addendum the calculation algorithm is described.

23.2 Peak calculation between spectrum lines

Considering the spectrum line to be:
Line(0), Line(1),….. Line(i),…….Line(n).
Between two consecutive lines is a frequency gap equal with the spectrum resolution.
A peak exists, if the following condition is true:

$$Line(i-1) <= Line(i) >= Line(i+1) \quad [1]$$

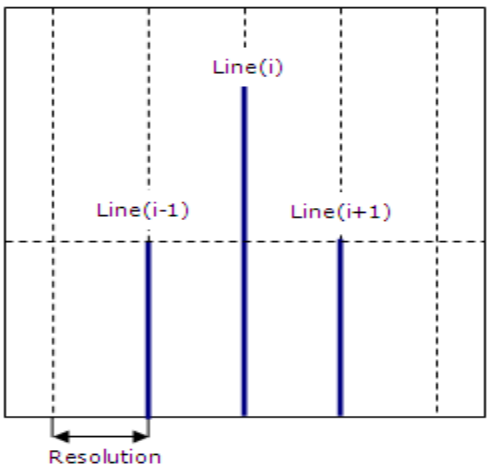


Fig.1 CASE 1

Considering that, the *Ampl* is the peak amplitude and Freq is the peak frequency.
There are three cases, when formula [1] is used:

CASE 1:

$$Line(i-1) = Line(i+1)$$

If the above condition exists when:

$$Ampl = \sqrt{(Line(i-1)^2 + Line(i)^2 + Line(i+1)^2)}$$

$$Freq = i * Resolution$$

This is a particular case, in practice this condition never exists.

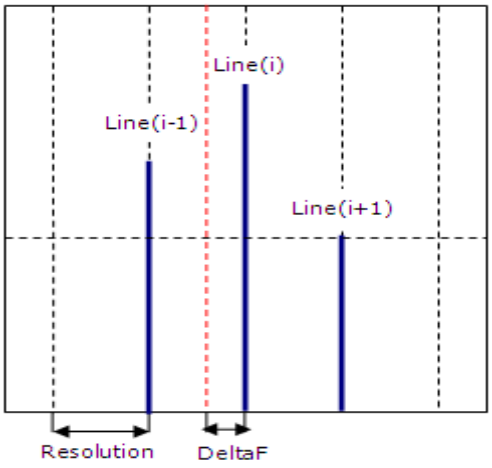


Fig.2 CASE 2

CASE 2:

$$Line(i-1) > Line(i+1) \quad [2]$$

If the condition besides exists, when the peak is located between Line(i) and Line(i+1).

The frequency gap (distance between the Line(i) frequency and the peak frequency) can be calculated with the formula:

$$deltaF = \frac{2 - \left(\frac{TempValori\ (i)}{TempValori\ (i+1)} \right)}{1 + \left(\frac{TempValori\ (i)}{TempValori\ (i+1)} \right)}$$

DeltaF is normalized frequency (for 1 Hz spectrum resolution).
After calculation the *DeltaF* value will be negative, in range (0 ….. -0.5).

CASE 3:

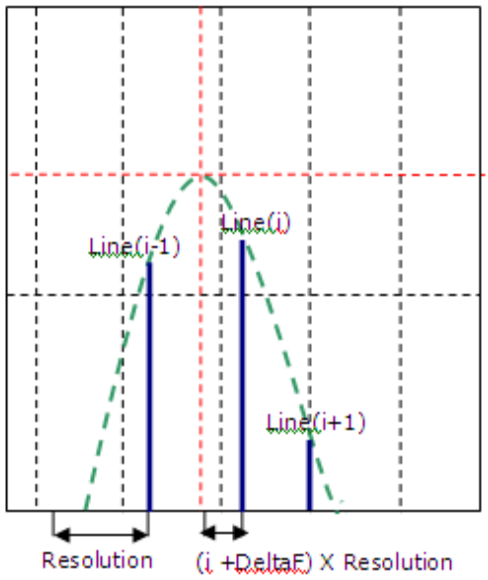


Fig.3 FINAL RESULT

$$Line(i-1) < Line(i+1) \quad [2]$$

If the condition above exists, the peak is located between Line(i-1) and Line(i).
The frequency gap (distance between the Line(i) frequency and the peak frequency) can be calculated with the formula:

$$deltaF = \frac{\left(\frac{TempValori\ (i)}{TempValori\ (i-1)} \right) - 2}{1 + \left(\frac{TempValori\ (i)}{TempValori\ (i-1)} \right)}$$

After calculation the *DeltaF* value will be positive, in range (0 ….. +0.5).
The calculated peak frequency in both CASE 2 and CASE 3 can be calculated as it follows:

$$Freq = Resolution\ * (i + dF) \quad [3]$$

The calculated peak amplitude in both CASE 2 and 3 can be calculated with the formula:

$$Ampl = \sqrt{Line(i-1)^2 + Line(i)^2 + Line(i+1)^2}$$

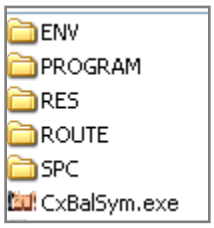
The result is presented in the picture above:

24 Virtual instrument

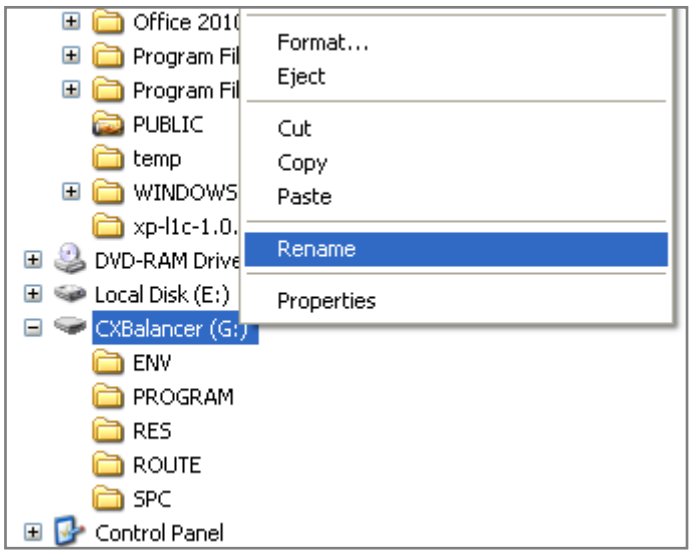
Just for training, you may use the CXSpectra™ software, even if you don't have a CXBalancer® instrument, or if you want to see the screen of your CXBalancer® instrument onto the projection screen of video-projector.

24.1 How to do a virtual CXBalancer®

Use an empty and ordinary USB Memory stick.
Copy the contents of CXBalancer® memory card into your stick root.
You must also copy the CXBalSym.exe file.



Into Windows File Browser name the memory stick as *CXBalancer*.

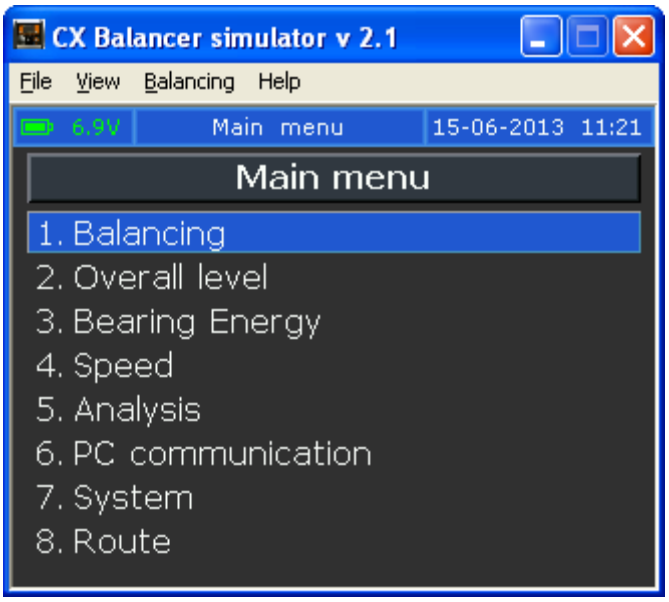


You just got a virtual CXBalancer®.

You can transfer a route from CxSpectra™.
CXSpectra™ will consider your stick is a CXBalancer® instrument.

Now, you can "*collect data*" into the route.

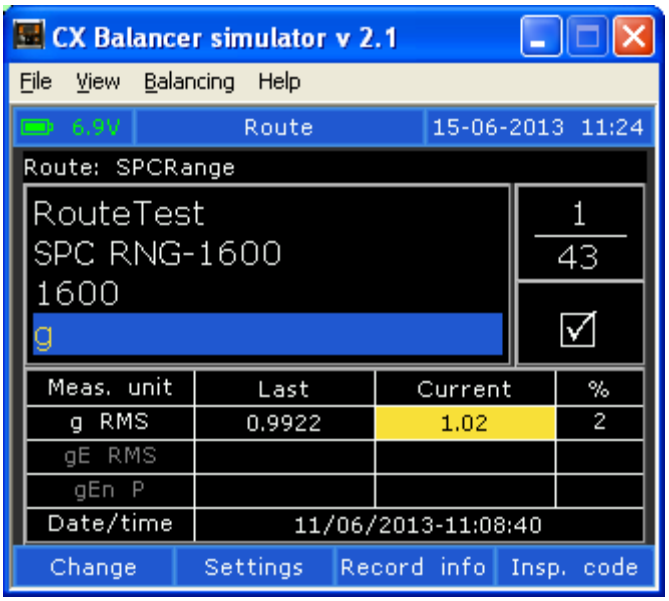
Start your CXBalSym.exe application directly from the stick:



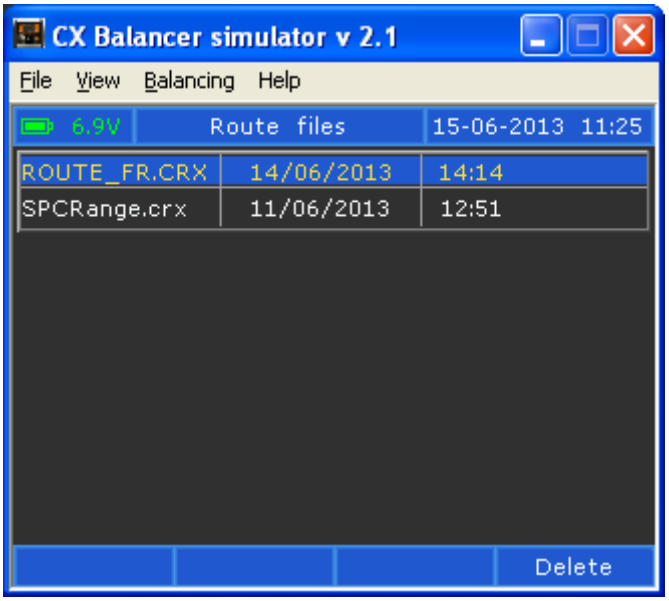
Use the "virtual" instrument, exactly the same you are doing with CXBalancer®.

NOTE:
You won't be able to use the mouse, but only the keypad.
To make the equivalence between the buttons of CXBalancer® and those of the virtual instrument, just read the user manual of CXBalSym application..

Press the **8** key to see the route screen:



Press the **F1** key to select the new route:



Now, you can simulate you are collecting vibration measurements in the virtual route and then you download them back to the CXSpectra™ application.

Following the same procedure, you can make spectrum measurements, Envelope or Frequency response. Then you have the possibility to download them all in the CXSpectra™ software.

Documentation Feedback

Any suggestions and comments for improving this Application Notes should be e-mailed at mainttech@live.se
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Technical Support

Contact Details

For any problem regarding this application, feel free to contact our support team at:
mainttech@live.se
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