



# VIBER X5 MKIII™



## Instrument Manual

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## **Important information**

### Safety precautions

Vibration measurement and balancing involves measurement on rotating machines. Keep a safe distance from rotating parts and secure transducers and transducer cables away from rotating parts. Always follow internal, local and national security regulations! When working with weights on the rotor always secure the start switch with a locking device and also use the emergency switch for double safety. This is especially important when the machine can be remotely controlled.

VMI takes no responsibility for any accidents on people and machines.

VMI and our authorized dealers will take no responsibility for damages on machines and plants as the result of the use of VIBER X5 MkII™ measurements.

Even though great efforts are made to make the information in this manual free from errors and to make the information complete for the user, there could be items we have missed, because of the large amount of information. As a result of this, we might change and correct these items in later issues without further notice. Also changes in the VIBER X5 MkII™ equipment may take place that affect the accuracy of the information.

*VMI develops and manufactures vibration measurement instruments for solving vibration related problems and balancing of machinery on site. We have more than 30 years of field experience and product development. We continue to provide a measurement service, which means that we ourselves use the equipment we develop, and continuously improve it. Because of this we dare to call ourselves measurement specialists.*

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# Chapters

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# 1. Instrument Overview

This chapter provide a general introduction of the VIBER X5 MkIII™, it describes the scope of supply, the basics on how to use and navigate in the instrument and general settings.

## 1.1. Introduction

The VIBER X5 MkIII™ is an advanced 3 channel vibration analyzer. Together with SpectraPro® PC software it is a valuable tool for predictive maintenance.

The VIBER X5 MkIII™ is capable of measuring, processing, displaying and storing a wide range of measurement parameters. You can collect various types of field data; examples are vibration information, bearing measurements, temperature, speed and other process variables that enable you to expand its functionality by adding new modules to improve your analysis capabilities. You may also use the VIBER X5 MkIII™ for 1 or 2 plane balancing.

### Features of VIBER X5™:

#### ➤ FAST

VIBER X5 MkIII™ uses a new generation of floating point DSP processor from Texas Instruments (C6700 series), which ensures a very short data processing time.

#### ➤ RUGGED

Made for hard use in hard environments IP65 casing and operating temperature of -20 to +70 °C

#### ➤ COMPATIBLE

VIBER X5 MkII™ uses SpectraPro® condition monitoring software to manage data. Using an existing database, it may be used together with Easy VIBER, Easy Balancer and XVIBER instruments, just the way it is, with no other changes.

#### ➤ EASY TO USE

VIBER X5 MkIII™ has a graphical user interface, a right and left hand operated keyboard and a user friendly context sensitive HELP.

The measurements are grouped so that a novice user can easily handle them, but also the experienced users have access to the advanced measurement menus.

#### ➤ FLEXIBLE

The instrument works with all standard type of vibration transducer in the market.

In the Route measurement you may define a customized transducer for any measurement point; this makes most signals accessible, in order to get additional information that might improve the condition measurement quality.

The instrument is compatible with any external tachometer and also with standard 4-20 mA process transducers (flow, pressure, temperature a.s.o.).

#### ➤ OPEN SYSTEM

The storage device with all user data can be connected to a PC through a USB cable, as with any USB mass storage device. No driver is required.

All user data, including route data, is stored as files. To include this data into another monitoring system, you require the monitoring systems communication protocol specifications.

➤ RELIABLE

VIBER X5 MkIII™ is an essential tool for the monitoring of machine health. It has a high performance VS cost value and offers reliable measurements to ISO standards in combination with a range of features.

Portable vibration monitoring is important part of condition assessment. Regular vibration measurement offers a cost effective and advanced complement to online visual inspections and an outstanding analysis alternative.

VMI consciously follows the professional principles in all spheres of our activities to deliver competitive products and top-of-line services at competitive prices to our customers. Quality of products and services is of prime importance for us.

We welcome customer suggestions and feedback, in order to improve consistently and remain preferred suppliers of products and services.

## 1.2. Scope of supply

A standard delivery of the VIBER X5 MkIII™ will have:

- 1 pc. VIBER X5 MkIII™ with hand straps
- 2 pc. High performance accelerometers (VMI192)
- 2 pc. Transducer cables (1 m)
- 1 pc. Extension tip
- 1 pc. Battery charger
- 1 pc. USB cable for transfer data to PC,
- PC software
  - Balancing viewer
  - Data Logger viewer
  - Route viewer
  - XY Shape Application
- 1 pc Robust, airtight, chemical resistant, dust- and waterproof, IP68, carrying case.



Figure 1-1: Example of supply (example might differ from actual)

### 1.2.1. Optional Accessories

The VIBER X5 MkRII™ have a wide variety of accessories. Contact VMI or your local distributor for more information of what is available. Here are some examples:

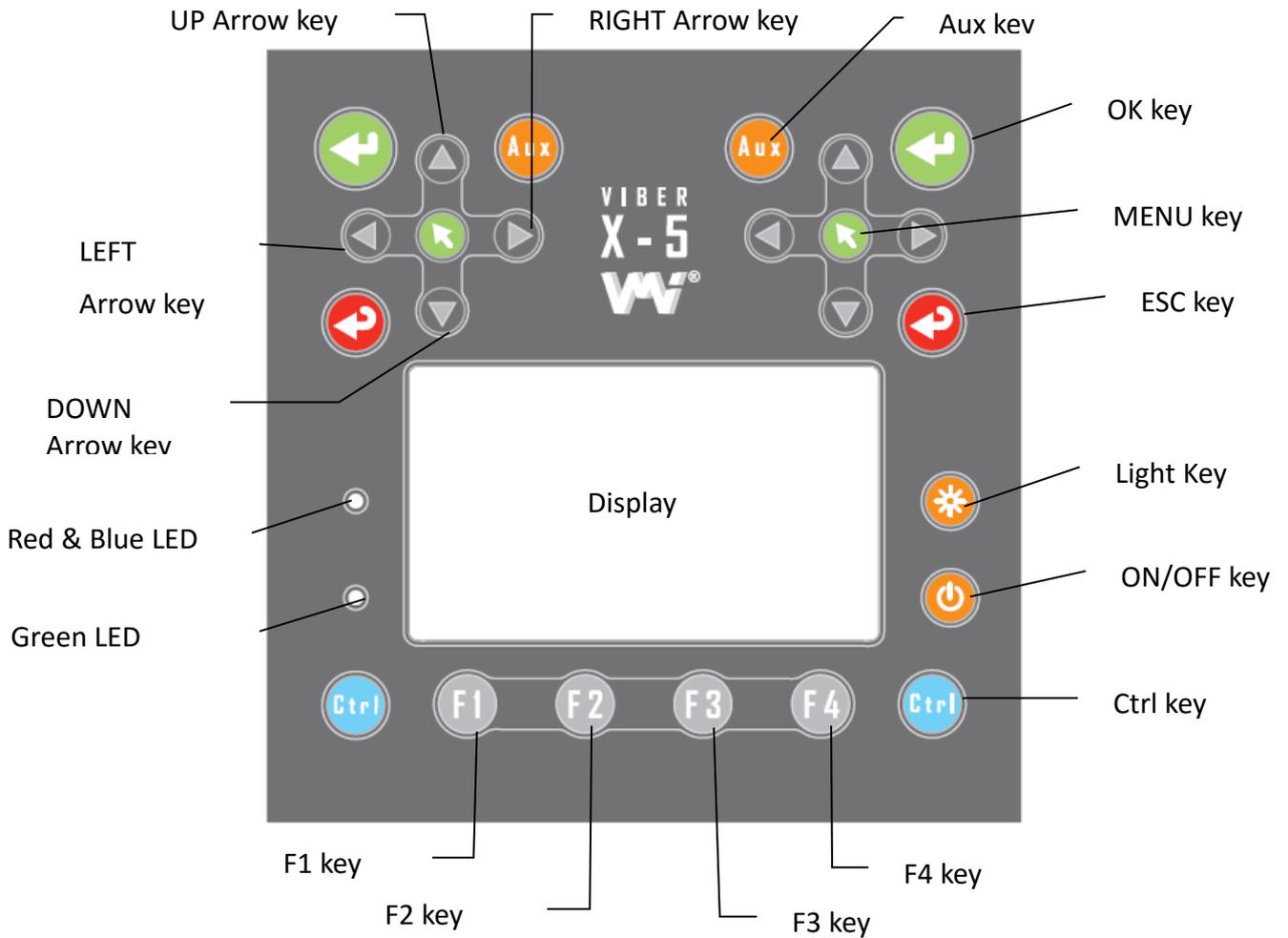
- **Additional applications**  
Expand your VIBER X5 MkIRI™ with additional software with a onetime license fee.
- **PC software**  
SpectraPro® Orange, route and analyzing program  
Vibshape™, modal analysis program
- **Balancing kit**  
Software for balancing, external laser tachometer with 5m cable, 5m extension cables for Vib1 and Vib2 transducers, adjustable magnet holder for the tachometer and a pocket scale. The VIBER X5™ case is designed with space for the Balancing kit items
- **Current probe**  
Enables speed measurement and analysis of electric motors without the need to stand close to or come in contact with rotating machine parts.
- **Carrying case shoulder strap**
- **Headphones**  
Standard or with noise cancelation.
- **Transducers**  
Accelerometers, Velocity transducers, Proximity probes.
- **RPM Transducers**  
Laser, Optical, Namur, Electromagnetic
- **Cables**  
Transducer cables, extension cables, armored cables etc.

### 1.3. Instrument basics

This section contains basic information about how to operate the instrument and what different keys and symbols means.

## Keypad

The VIBER X5™ has double sets of the most frequently used keys, that's too allow operation by both left and right hand.



Key	DESCRIPTION
	ON/OFF. Used to switch ON or OFF the Instrument.

	OK (Enter). Used to start a measurement(or resume the measurements from HOLD status), confirm an action or go forward in a menu.
	AUX. Used to stop a measurement.
	ESC (Escape). Used to Cancel an action or to return to the previous menu.
	Arrows (UP, DOWN, LEFT, RIGHT). Depending on the context, are used to change the selected items, move cursors or together with Light key change the LCD backlight intensity.
	MENU. Used to access MENU shortcut window. Depending on context it is also used to save changes in edit controls or to select an item.
	Ctrl. Used only together with other keys (mainly function keys), to generate alternative key codes.
	Light. Used together with UP or DOWN Arrow key, to adjust the LCD backlight intensity. Used alone to restore the set intensity, when the Instrument is in power saving mode.
	Function keys (F1, F2, F3, F4). Used to select an action in the shortcut bar displayed above the keys. They are also used together with Ctrl key to select actions shown in the second (blue) row of shortcut bar.

### 1.3.1.1. Keypad LED's

The keypad has two LED's with 3 colors (Blue & Red and Green):

**Blue& Red LED,** When the  key is pressed, the Blue LED will indicate that the next pressed key will generate a combined code (  key + Key pressed).

When  key is pressed, if a LED is ON, the LED will simply be turned off and no key code will be generated.

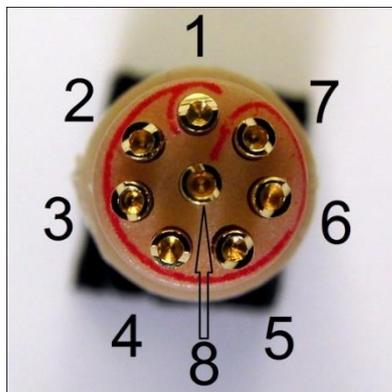
If automatic power save mode is activated the led will flash between red and blue a few seconds before the instrument will switch off to alert you, press any key if you want to keep the instrument running.

**Red LED** flashes when the Instrument does not start properly or refuses to start.

**Green LED,** this will be lit when a valid key is pressed.

### 1.3.2. Front Panel

Front Panel



Cable Connector (solder view)

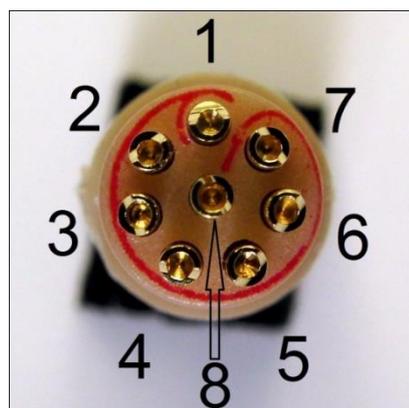
<u>Pin</u>	<u>Vib 1</u>	<u>Vib 2</u>	<u>Ext. Tachometer</u>
<u>1</u>	Signal X	Signal	Signal
<u>2</u>	Signal Y	NC	NC
<u>3</u>	Signal Z	NC	NC
<u>4</u>	AC	DC	5V
<u>5</u>	DI 1	DI 4	DI 6
<u>6</u>	Ground	Ground	Ground
<u>7</u>	DI 0	DI 3	DI 7
<u>8</u>	24V	24V	24V

## Auto Detection Transducer Connections

<u>Vib 1</u> Transducer Type	<u>Code</u>	<u>Data Input 1</u>	<u>Data Input 0</u>
<u>Accelerometer 1</u>	000	Com	Com
<u>Accelerometer 2</u>	001	Com	NC
<u>Triaxial Accelerometer</u>	010	NC	Com
<u>User Selected</u>	011	NC	NC

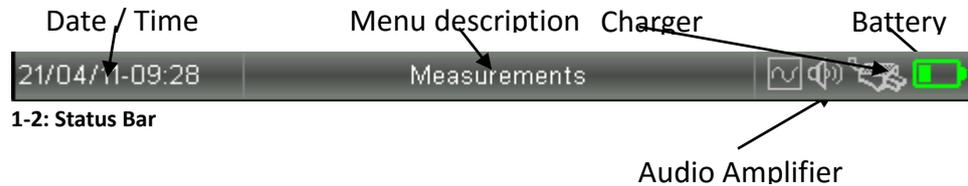
<u>Vib 2</u> Transducer Type	<u>Code</u>	<u>Data Input 3</u>	<u>Data Input 4</u>
<u>Accelerometer 1</u>	000	Com	Com
<u>Accelerometer 2</u>	001	Com	NC
<u>Triaxial Accelerometer</u>	Not Allowed		
<u>User Selected</u> (Not in Auto Detect Mode)	011	NC	NC

<u>External Tachometer</u> Transducer Type	<u>Code</u>	<u>Digital Input 6</u>	<u>Digital Input 7</u>
<u>Coil (Current Clamp)</u>	00	Com	Com
<u>Not Used</u>	01	NC	Com
<u>External Tacho</u>	10	Com	NC



## Cable Connector (solder view)

### 1.3.3. Status Bar



Most of the screens have a header showing the system status.

The window header displays:

- Current date and time
- Current menu description
- Audio amplifier status (when the function is activated)
- Charging status (when the function is activated)
- Battery status

#### Battery icon indicates:

- Green= charged battery
- Yellow= weak battery.
- Red= you should charge as soon as possible.

#### Charger icon may be:

- Green= indicates that the battery is charging.
- Red= the external charger stopped the charging process. The external charger still supplies the Instrument. The red indication shows that the battery temperature is too high or the charging process is in idle mode. Normally, after a while the charging process automatically starts.
- Blue= charger is connected but the battery charging has ended
- Not showing= not connected

#### Audio amplifier icon may be:

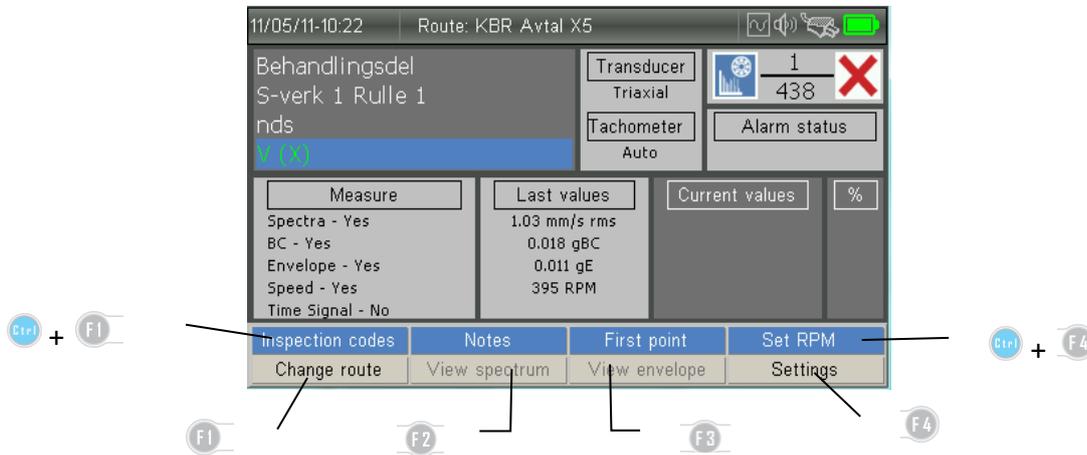
- Green= enabled
- Not showing= disabled

### 1.3.4. Shortcut bar

On the bottom of the screen, the program will display the present available shortcuts that can be used by pressing the function keys.



Example shortcuts in Route:



Depending on the context, some shortcuts may be disabled (as **F2** (F2)-"View Spectrum" in the example above) or not assigned.

The shortcut bar may have one or two rows depending on the context.

The bottom row (the background have gray color) refers to the actions selected with **F1** (F1), **F2** (F2), **F3** (F3) and **F4** (F4).

The upper row refers to the actions selected with key combinations **Ctrl**+**F1** (F1), **Ctrl**+**F2** (F2), **Ctrl**+**F3** (F3) and **Ctrl**+**F4** (F4), to indicate that the blue **Ctrl** key should be used for this action the background for the second row is also blue.

### 1.3.5. Application Selection

The instrument has a graphical interface to access different application programs.

In the application selection menus, each of the applications is represented as a small picture/icon with a short description beneath.

The applications are hierarchically organized.

A selected task/icon will have a green color. In Figure 1 the application menu “System Tools” is selected.



Figure 1-3: Instrument Settings menu

Tip: By keeping the Arrow pressed the selected task will automatically change to the next in line. When reaching the last task in the line press the Arrow key once more if you want to jump to the first task.

To run a task, select it by using the arrow keys and press (OK).

To return to higher hierarchy press (ESC) key.

### 1.3.6. Settings menus

When you select a measurement you first enter into the settings menu for that measurement.

To edit the value of a specific parameter, first select it, using (UP) or (DOWN) Arrow keys. It will be highlighted.

To start editing, press (RIGHT) Arrow key. Depending on the parameter type, editing may consist of:

#### 1. Selection from a list

Last selected value has a check mark before description. The current value is highlighted.

To change the current value, just move the selection using

(UP) or (DOWN) Arrow keys and press (OK) or (MENU) to save. To exit without changes, press (ESC).

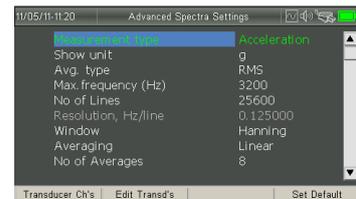


Figure 1-4: Highlighted parameter



Figure 1-5: List Selection

#### 2. Edit a numeric value or a description

On the right side of the parameter description, a single line editor is displayed.

The shortcut bar will change, to indicate the available options:

- (F1)-Delete one character on the right side of the cursor
- (F2)-Delete one character on the left side of the cursor
- (F3)-Delete all characters
- (F4)-Toggle edits procedure between insert and overwrite mode.

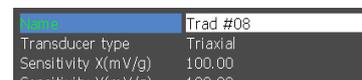


Figure 1-6: Single line editor

The program filters the keys to be valid for parameter value. If a number is required, an alphanumeric character will be ignored. If a file name is required, the first character must be alphanumeric.

To **save** the new value, press  (OK). To remove changes press  (ESC).

After changing the parameters, you may press  (ESC) to return to higher level menu or  (OK) to continue with a measurement menu.

### 1.3.7. Virtual Keyboard

Virtual keyboard is used to write user notes to be saved together with the measurements.

Notice that the status bar will change, to indicate the available shortcuts:

 (F1)-Delete one character on the right side of the cursor

 (F2)-Backspace, delete one character on the left side of the cursor

 (F3)-Clear

 (F4)-Insert

 (Arrow keys) – Change character

 (Ctrl) +  (Arrow keys) move cursor

Select a character with  (MENU) key.

To save, press  (OK).

To discard changes, press  (ESC).

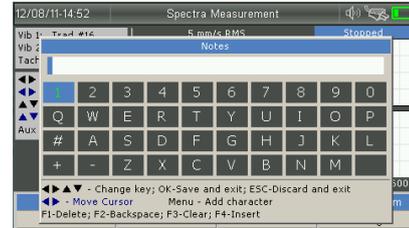


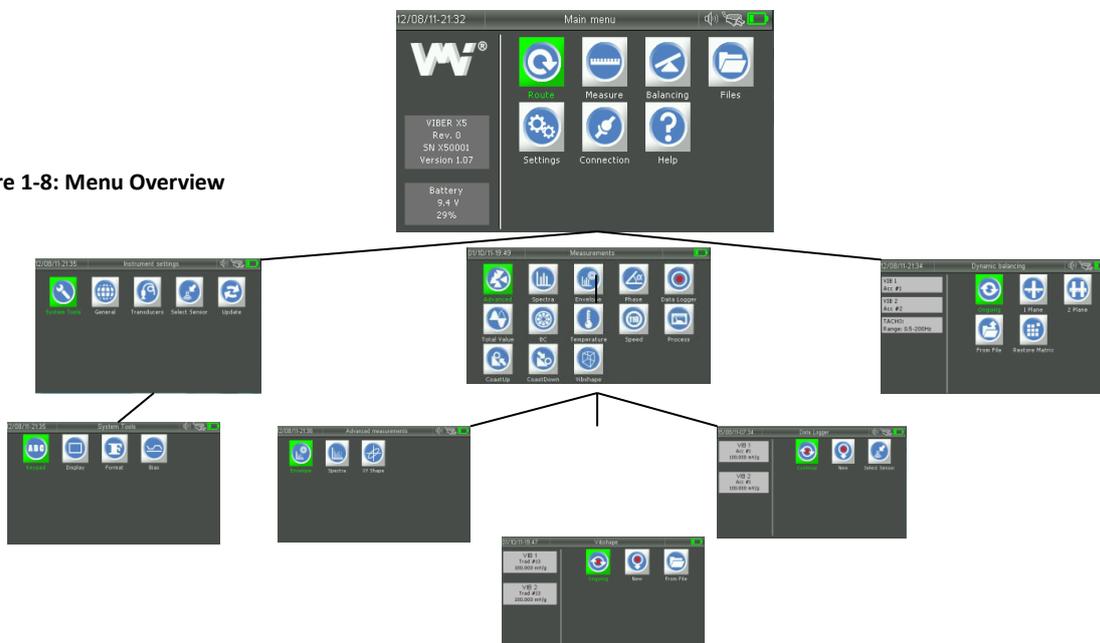
Figure 1-7: Virtual Keyboard

### 1.3.8. Menu Overview

Figure 1-8 is an overview of how the different application/icon menus are organized (note the picture is only an explanatory example, some applications existing and available for the instrument may not be included).

The menus are organized in hierarchy with the main menu on top.

Figure 1-8: Menu Overview



### 1.3.9. Main menu

In the main menu, besides being the first screen from which you navigate to the different application programs, you can also see:

- The battery status in V (Volt) and % (Percent)
- The serial number of the instrument
- Program version running



Figure 1-9: Main menu

When pressing  (ESC) key (jumping back in hierarchy) this is where you will finally end up (sometimes you need to press the  (ESC) key several times since you only go back one step in hierarchy for each press on the button).

In the main menu you can choose between:

- **Settings.** This group of programs provides the configuration procedures for the instrument
- **Connection.** This is used when connecting to a PC.
- **Help.** This menu is a direct access to the help system in the actual context. The Help menu is also available in any static menu by pressing the  (MENU) key and select Help.
- **Route.** Is used when machines are measured on ordinary basis
- **Measure.** In this menu all measurements (off route) applications are located.
- **Balancing.** Enter into the balancing menu.
- **Files.** Files menu is used when you want to view, copy or handle your stored files.
- **Signal Generator Function.** Enter to Enable/Disable and to configure the signal settings.

### 1.3.10. Instrument Settings



This group of programs provide the configuration settings for the instrument.

From the **Main menu** select **Settings**.



Figure 1-10: Instrument Settings Selection

In Instrument Settings Menu you have the following applications:

- **System Tools.** Check the instrument functions
- **General.** set the general instrument parameters
- **Transducers.** Edit the Transducers to be used
- **Select Sensor.** Choose which transducer to be used
- **Update.** Update the instrument firmware and applications.
- **Factory Reset.** Restore default settings.

When using the Instrument for the first time, we recommend you to make your own settings, depending on application. Check that the instrument date/time is properly configured so that the saved data can be identified with ease.

### 1.3.11. System Tools



System tools are used in order to check the instruments functions and have following sub

menus: Keypad, Display, Format and Bias

From **Main menu** select **Settings** and **System Tools**.



Figure 1-11: System Tools selection

#### 1.3.11.1. Keypad



This tool performs a keypad test. When you are not sure that one or more keys are working properly, you can perform this test.

From **Main Menu** select **Settings**, **System Tools** and **Keypad**.



Figure 1-12: Keypad selection

Every time you press a key, that key name and the corresponding key code will be shown, like in Figure 1-13.



Figure 1-13: Key code

#### 1.3.11.2. Display



This tool performs a color display test. You can visually observe if the screen colors are as expected and if some pixels are defective.

From **Main Menu** select **Settings**, **System Tools** and **Display**.



Figure 1-14: Display selection

In Display test, the screen is filled with a color as the other half contains procedure instructions.

- Press **F1** (F1), **F2** (F2), **F3** (F3), **F4** (F4) keys to change fill color to white, red, green or blue.
- Press **OK** to change the half of the screen which is currently tested.
- Press **ESC** to exit.



Figure 1-15: Display instructions

If the colors do not appear correctly, the display unit should be changed in a VMI Service Centre.



### 1.3.11.3. Bias

With this tool you can check for transducer faults.

From **Main Menu** select **Settings, System Tools** and **Bias**.

When using displacement transducers this tool can be used to adjust the proper position (usually when the bias reaches half of the supply voltage).

The instrument will start measuring bias using the power settings of installed transducer. The data collection may be temporary suspended by pressing the **Aux** key.

To resume, just press the **(OK)** key.

To save the screen, press **(MENU)** key and select Save screen.

By pressing **(F4)**-Settings, measurement parameters can be changed.

In Bias Measurement Settings you may alter:

- Averaging (Disabled, Linear, Smart)
- Number of Averages (2, 4, 8, 16, 32 or 64)

Shortcuts to Select Sensor and Transducer Settings are also available.

By pressing **(F4)**, bias measurement parameters will be set to default.



Figure 1-16: Bias selection



Figure 1-17: Bias Measurement



Figure 1-18: General Settings selection

### 1.3.12. General Settings



This **menu** is used to set the general instrument parameters: From the **Main Menu**, select **Settings** menu and **General**.

Available settings:

- Instrument date
- Instrument time
- Unit system ( Metric or Imperial)
- Language
- Backlight off time (sec)
- Auto Off time (min)
- Backlight level
- Default audio start volume

#### Set date and Set time

Set the clock of the Instrument which is also used whenever data is stored.

#### Unit System (Metric or Imperial)

Depending on this setting, the measuring units available in different menus will be restricted by the selected system.

Example: For vibration velocity measurements setting Metric has [mm/s] as measuring units while it is [in/s] for the Imperial System.

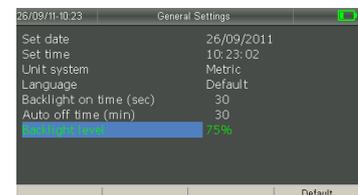


Figure 1-19: General Settings

## Language

The default instrument language is English. Almost any language may be implemented. Please check the VMI Internet Download page for available languages. If you would like to use a language that is currently not available, contact your local distributor for files to translate.

To set a new language in the instrument first make sure you have placed the new language file in the language folder, thereafter go to Update menu and update language. After this procedure you may change the language with this setting.

## Backlight Off Time

The time (seconds) it will take from the last key pressed by the user and the automatic turn off of the LCD backlight, to save power. You can select between NEVER or 10, 30, 60, 120 and 300 seconds.

## Auto Off Time

The time (minutes) from the last key pressed by user until the Instrument will shut down, in order to save power. The user can select between NEVER or 1, 2, 5, 10 and 30 minutes.

## Backlight Level

With this you set the backlight level in which the instrument starts. Whenever you press the  (Light) key you will restore the backlight intensity to this setting.

In any menu to temporarily (until you switch off the instrument) adjust the backlight level setting, press  (Light) +  (DOWN) Arrow key to decrease the backlight intensity or  (Light) +  (UP) Arrow key to increase.

## Default Audio Start Volume

Sets the start volume for the audio output for all measurements where audio is an option. When the level is set to 40% or higher a warning message will appear in the window when you initialize the audio during measurements. If you are using audio during route measurements, the warning message will appear only on the first measurement, or if you enter the route again after having exiting, or if you during the route increase the volume default level to 40% or higher.



### 1.3.13. Transducers

In this menu, you can edit a list of sixteen transducers, which may be used for the measurements. From the **Main** menu, select **Settings** and **Transducers**.



Figure 1-20: Transducers Selection

Edit Transducer's is an option in most Measurement Settings accessible by pressing **F2** (F2) on the shortcut bar.



Figure 1-21: Transducer Settings

In the upper right corner, the Instrument displays the transducer index (01 to 16).

To select a transducer that will be edited (change current index), press **F1** (F1) (previous index) or **F2** (F2) (next index).

Accelerometer #1 and #2 as well as Triaxial accelerometer (index 01, 02 and 03) are auto-detectable by the instrument through the cable.

This means that when setting "**Select Transducer**" to "**Auto**" the instrument will automatically select the transducer with the index set in the cable.

Cables and transducers for Acc. #1 and Acc. #2 (index 01 and 02) are delivered together with the instrument in the standard delivery.

#### The available transducer settings are:

- **Name** - Transducer description [max 15 characters] - This will appear whenever the program displays transducer characteristics or asks for transducer selection.
- **Transducer type** - Transducer type - This may be Triaxial (standard VIBER X6™, option for VIBER X5 MkII™), Accelerometer, Velocimeter, Displacement or Process AC.
- **Sensitivity X** - Transducer sensitivity, in [mV/Unit]. Notice that the unit may be different, depending on the type of transducer. On triaxial transducers, this is the sensitivity on X-axis. The value can be set between 1 and 10000.
- **Sensitivity Y** - (Triaxial or biaxial transducers only) Transducer sensitivity on Y-axis, in mV/Unit. Notice that the unit may be different, depending on the type of transducer. The value can be set between 1 and 10000.
- **Sensitivity Z** - (Triaxial transducers only) Transducer sensitivity on Z-axis, in mV/Unit. Notice that the unit may be different, depending on the type of transducer. The value can be set between 1 and 10000.
- **Bias Low**- The lowest bias voltage accepted. Used to determine if the transducer works properly if Check Bias option is selected. The set value can be between -24 to +24 V.
- **Bias High**- The highest bias voltage accepted. Used to determine if the transducer works properly if Check Bias option is selected. The set value can be between -24 to +24 V.
- **Power supply** - The Instrument will supply a current of 4 mA (at max. 24 V) for the transducer, if this is enabled by setting.

- **Stabilization time(sec.)** – The minimum time to wait for a transducer to be stable after power supply - This can differ between 0,5-10 seconds.
- **Check Bias** - The Instrument will measure and compare the bias voltage with the Bias Low and Bias High values. If the measured bias is lower or higher than the set values, the Instrument will indicate a transducer error.
- **Additional power 24V** –This enables 24V supply to the transducer.

A list with the predefined transducers is shown in Table 1-1

Table 1-1: Transducer List

INDEX	Default Name	Transducer type	NOTES	AUTO DETECT CODE
1	Acc. #1	Acceleration	Auto-detectable	000
2	Acc. #2	Acceleration	Auto-detectable	001
3	TRIAXIAL	3-axial Acc.	Auto-detectable	010
4	PROCESS AC	-	User defined	011
5	DISP #1	Displacement	User defined	011
6	DISP #2	Displacement	User defined	011
7	AC 135	Low frequency	User defined	011
8	VMI 192	Acceleration	User defined	011
9	AC 102	Acceleration	User defined	011
10	AC 905	Acceleration	User defined	011
11	HG 91	Velocity	User defined	011
12 to 16	Transducer #12 to #16	User defined	User defined	011

### 1.3.14. Select Sensor



This menu contains configuration settings for Tachometer and Vib1/2 inputs. The settings will apply to all measurements.

From the **Main** menu, select **Settings** menu and **Select Sensor**

In most measurement settings this menu is accessible by (F1) on the shortcut bar.



Figure 1-22: Select Sensor selection

**Note!** The Select Sensor settings may be ignored in Route measurement by the instrument, depending on which settings you choose in the SpectraPro® software.

The two input channels Vib1 and Vib2 are independent of each other and you can have different types of transducers with different units and sensitivity for the two channels.

Available settings are:

- **Auto:** In Auto mode, the Instrument will automatically detect any of the connected auto

detectable transducers. If a non-auto detectable cable/transducer is connected this mode will display a message alerting the user.

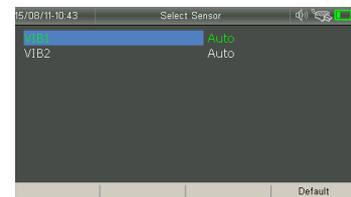


Figure 1-23: Select Sensor

**Tip!** When using only standard transducers, assign **Auto** to all inputs.

- **Disabled:** (Applies to Vib2 only) Channel unused.
- **Any of the predefined transducers(1 to 16):** This is recommended whenever you want to connect a transducer which has no auto detectable cable assigned. If the user connects an auto detectable cable/transducer, but not the specified one, the Instrument will display a message alerting the user.

**NOTE:**VIB 1 channel cannot be disabled. Transducer selection for Route measurements should be done in accordance with the route settings in SpectraPro® software.

- **Tacho:** In **Auto** mode this setting will select an external tachometer if one is connected, if not the built in tachometer will be selected. The option for **External**, **Internal** and **Coil**(current clamp) can also be selected.
- **Tacho Idle:** This setting is to configure when the tachometer will trigger each rotation. When **Low** is selected the leading edge of the reflective tape will initiate the count and when **High** is selected the following edge will trigger the count.

### 1.3.15. Update



The Instrument runs a dedicated firmware which can easily be updated.

From **Main Menu** select **Settings** and **Update**.

The files that can be updated are:

- **Pictures** (Icons)
- **Font**
- **Program** (firmware)
- **Message**(Translation file, used to change the Instrument language, the default language is English)
- **Help** (containing the context sensitive help)
- **Licenses**



Figure 1-24: Update Selection

**NOTE:** The file or files to be updated must be placed in their designated folder before starting an update procedure

To avoid any problem due by a sudden power failure (low battery), connect the battery charger before starting an update.

The instrument will display a screen with information regarding the current running programs and resources.

Depending on the desired action, press:



Figure 1-25: Update Screen

 (F1) = Update picture and icon file

 (F2) = Update font file

 (F3)=Update program (Firmware). If you have many program versions available (loaded in the instrument), select by file and date name the version to load.

 (F4)= Update language (Messages and Help). The first three letters of the file name determine the language of the files. If you have many language files in you language folder, select by file name and date the version to load.

 (Ctrl)  (F1) = Update license file

Table 1-2shows the different files that may be updated their extension and where to place them on the SD card.

Table 1-2: Update Files

Description	Extension	Folder on SD Card	Example name
Pictures	BIN	SYSTEM	PIC0001.BIN – Graphic resources according with specification version 1.
Fonts	BIN	SYSTEM	FON0001.BIN – Character drawing instructions according with specification version 1.
Program	PRG	SYSTEM	X5_V104.PRG – firmware version 1.04
Messages	MES	LANGUAGE	SWE_100.MES – Swedish language messages according with specification version 1.
Help	HLP	LANGUAGE	SWE_100.HLP - Swedish language help according with specification version 1.
Licenses	LIC	SYSTEM	X50001 Orbit.LIC – Orbit license for X5 instrument with serial number 0001.

**NOTE:** Whenever you download a new firmware, read on release notes if there are some compatibility problems and proceed as required. Use failsafe update if the program reports any compatibility problem (error messages as “invalid file”)

Update order of the recourses is not important, but if the program requires new resources, all of them should be updated before exiting update menu or restarting the instrument.

**NOTE:** You must restart (press  (ON/OFF) key) the instrument in order to run the new program or to use the new resources

### 1.3.15.1. Failsafe Update Procedure

This applies when:

- The Instrument does not start properly or refuses to start (Red LED flashes and nothing appears on the screen)
- The user decide to down grade (load a firmware version with a lower major release version).
- The new software version requires resource files that are not compatible with older versions. This situation may happen with significant firmware changes and will be specified by VMI on the download page of the new firmware release.

**Step 1: Stop the instrument and connect to a PC** using USB cable. Copy the firmware program file and the associated resource files in to the designed folders. For downgrade, remove the newest firmware files.

#### Step 2: Start the instrument in boot loader mode

2.1 Press the **F2** (F2) key.

2.2 While keeping **F2** (F2) pressed, press the ON/OFF key start the instrument.

The Instrument will now start in BOOTLOADER mode, showing the boot loader screen (presented on the right).



Figure 1-26: Bootloader

#### Step 3: Load from Card in RAM (recommended)

The Instrument will load the newest program file from the SD Card (the SYSTEM folder) in program memory and enter automatically in Update menu.

#### Step 4: Update program file(**F3** (F3)) and resources as necessary

This step is performed in the usual way, once the program is loaded in memory.

#### Step 5: Restart the instrument

## 2. Data Storage and Transfer

This chapter covers how the files are stored in the instrument and how to transfer them internally, to a PC or network for further analysis.

### 2.1. Files



All the data is stored in files. The instrument uses a predefined set of folders to store the files.

From the **Main menu**, select **Files**.



Figure 2-1: Files Selection

VIBER X5 MkIII™ is able to use either a USB Drive or micro SD Card for storage (total available storage capacity is depending on hardware revision and formatting parameters, minimum storage is 1 GB the Viber X5 MkIII has 4GB).

In the instruments file manager you can View, Copy, Delete or see the files properties.

The screen is divided in two panels. On the left side, there is a panel with the devices and their folders:

- **SD Card** - Is the internal micro SD that can be viewed by the computer as a Mass Storage device.
- **USB Storage** – When connected files can be copied into a USB storage device.
- **Internal memory** - A virtual device having internal used data (as a configuration file).

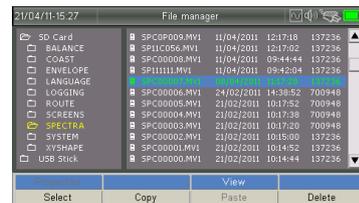


Figure 2-2: File Manager

The right side contains the list of the files in the selected folder.

Initially, the devices/folders are closed and the cursor is on the left panel.

To show the content of a device/folder, just select it with the (UP)/ (DOWN) Arrow keys and press (OK) key to open. The folders will be shown in a tree-like structure.

**NOTE:** The file manager displays only the first level folders (having as parent the root folder), it will not show files stored in the root folder of a device. If the device has many folders on many levels, these will be ignored.

To move the cursor between the two panels, use (RIGHT) and (LEFT) Arrow keys. While the cursor is in the files (right) panel, you can:

- Select a file (for copy a list of files), by pressing (F1)
- See its properties by pressing (Ctrl) + (F1)
- Copy a file, by pressing (F2).
- View a file by pressing (Ctrl) + (F3)
- Delete a file, by pressing (F4)

Table 2-1: File Types shows the different file types and their location on the SD card

Table 2-1: File Types

File type	Folder	Extension
Balancing	BALANCE	MV4
Coast Up-Down	COAST	MV3
Envelope	ENVELOPE	MV2
Data logging	LOGGING	MV5
Route files	ROUTE	X5R
Screens as pictures	SCREENS	BMP
Spectra	SPECTRA	MV1
XY Shape (Orbit)	XYSHAPE	MV7
Font resources	SYSTEM	BIN
Picture resources	SYSTEM	BIN
Instrument firmware	SYSTEM	PRG
Translated messages	LANGUAGE	LNG
Translated Help	LANGUAGE	HLP

Note!

Applications and external viewer programs search for files only in their specific folders.

### 2.1.1. View Files

In the file manager it's possible to view files that have been saved.

Select the file by pressing  (F1).

If the file can be viewed the shortcut bar will enable  (Ctrl)+  (F3). Once you press this shortcut, the file will be opened and exposed, same as during data collection.

**NOTE:** The file viewer routines are specially designed not to modify the file content. All measured parameters or notes are read only.

The best way to really analyze the files (measurements) is to use the SpectraPro® PC software package.

## 2.2. Connection



Connection to a PC to transfer files can be established in two ways:

1. With the VIBER X5 MkIII™ turned Off, insert the USB cable.
2. With the VIBER X5 MkIII™ turned On, From the **MAIN menu**, select **Connection**.

Both ways of connecting the instrument to a computer, the VIBER X5™ micro SD card content will be read in the PC, as a Mass Storage Device (MSD) similar to a USB memory stick or an external hard drive.

When choosing the connection menu the instrument will inform you if the SD card is published in the PC.

When exit from the Connection menu by pressing the  (ESC) button, the instrument close the connection with the PC.

When published in the PC, any file manager may be used to copy, paste, delete or in other ways handle files in the instruments SD card, no driver needs.



Figure 2-3: Connection Selection

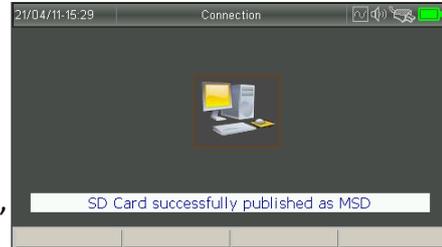
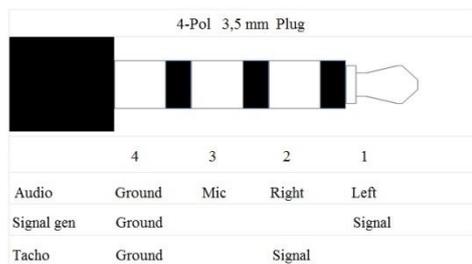
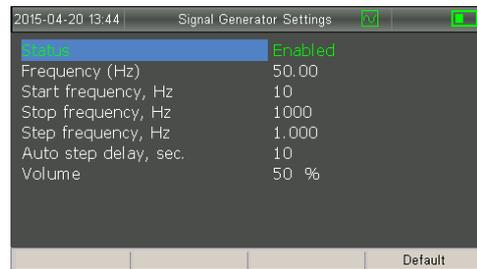


Figure 2-4: SD card as MSD

## 2.3. Signal Generator Function

The Signal Generator Function gives the Viber X5MkIII compatibility with a range of external devices including strobe light indicators and Vibration Inducers. By using the Audio connection you can connect your external device to the Viber X5MkII. Then in the Signal Generator menu you can select your settings for the required signal. The menu contains **Status - Enable/Disable**, **Frequency(Hz)** from 4 - 999.99Hz , **Start and Stop Frequency's(Hz)** for sweep generation, **Step Frequency(Hz)** used to control the sweep, **Auto step delay (sec)** is the time the generator will send a signal at each step frequency and **Volume (%)** to control the amplitude which is between 0 - 4.7Vp-p and is frequency dependant.



## 2.4 FAQ regarding Data Storage and Transfer

- *Before having access to the VIBER X5 MkIII™ content in the windows Explorer, what driver shall I install?*  
**Answer:** No driver is necessary to install in the PC. The PC will automatically recognize the micro SD Card, as a mass storage device. When you connect VIBER X5 MkIII™ for the first time, the Windows operating system will need a few seconds to configure the system.
- *Can I replace the micro SD Card with a standard card from the market?*  
**Answer:** Yes, but you must send the instrument to a VMI service center. However not all cards have the same performance some cards can be up to 4 times slower than the one originally delivered from VMI, also not all cards have compatibility with Windows 7. For best performance you should format the card with the instrument.
- *If necessary, how can I format the micro SD Card?*  
**Answer:** In case of a card corruption, you can format the card from the PC. If the VIBER X5 MkIII™ is running, the best choice is to format the card inside the Instrument, for a better performance.
- *If the software of VIBER X5 MkIII™ is asking me to edit a file name, what names are valid for the micro SD Card?*  
**Answer:** The file system for the SD Card accepts file names up to 8 letters (or numbers), a dot and an extension of 3 letters (example: BAL00005.MV4). Other symbols (example: minus, space) are not accepted. Files without any extension are also accepted.
- *Can I work simultaneously together with the SD Card inside of VIBER X5 MkIII™ and the Windows Explorer?*  
**Answer:** No, you can't. When you are in the Windows Explorer and start the Instrument, the connection with the computer will close. You cannot work simultaneously with the files in the VIBER X5 MkIII™ and in the computer.
- *Can I change the SD Card name?*  
**Answer:** Yes, you can, but that's not recommended. SpectraPro® tries automatically to find the VIBER X5 MkIII™ Card, using the default name. If you change the Card name you must manually select the SD Card unit name in SpectraPro® software.
- *Can I delete some files on the SD Card?*  
**Answer:** Yes, you can. You can delete all files from the card. It is however a good practice to keep the SYSTEM folder, where the firmware files is located. You may need these files to restore the VIBER X5 MkIII™ firmware.

### 3. Help



This menu is a direct access to the context sensitive help system. The Help menu is also available in any static menu by pressing the  (MENU) key and select Help.

From **Main menu** select **Help**. Or in any static, HOLD or stopped mode press  (MENU) key and select Help.

To navigate in the help menu press:

-  (DOWN) Arrow key (or  (F2)) to go to next page
-  (UP) Arrow key (or  (F1)) to go to previous page
-  (RIGHT) Arrow key (or  (F4)) to go to next topic
-  (LEFT) Arrow key (or  (F3)) to go to previous topic
- Press  (ESC) to exit from the Help menu.

The Help menu is context sensitive, meaning that wherever you are, which application or menu are used, by pressing  (MENU) key and select Help you will access directly the help content for that particular menu/application.

The Help menu is a text file which gives you short info about the particular application and the possible settings.

### 4. Route



Route measurement is used when machines are measured and this is done on a regular basis. The

Route information is downloaded from the SpectraPro® PC-program and the measurements, notes and other information are transferred back to the SpectraPro® program. From **Main menu** select **Route**.

Route measurements and their settings are organized in the SpectraPro® software and downloaded to the instrument. It is not possible to change the route settings in the instrument.

Route measurement is easy, measure the points on the different machines indicated on the VIBER X5™ display. The measurements are automatically stored under the same name as the measuring point. When the measurements are made you simply connect the instrument to the PC and all route measurements are automatically transferred (see section transferring route) and stored in the SpectraPro® database.

#### 4.1. Route Introduction

VIBER X5™ Instrument can measure various parameters, using a predefined list of



Figure 3-1: Help Selection

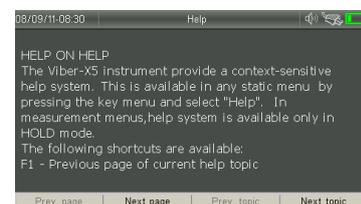


Figure 3-2: Help Menu



Figure 4-1: Route Selection

measurements, named Route.

The Route should be created in the *SpectraPro*® software.

Each type of measurement can be configured in SpectraPro®. When the instrument measures that parameter, it will automatically configure the measurement parameters.

The following measurements are supported by VIBER X5™ doing route measurements.

- Vibration, (total level, BC, Envelope, spectra)
- Temperature, with built-in IR transducer
- Speed, with external sensor (or manual input)
- Process parameter, any measurement/ signal having 1 to 5 V DC or 4 to 20 mA
- Manual Entry point; these can be any process parameter manually typed in.
- Audio, listen to the bearings using the transducer. The settings are made in the instrument only.

In addition, during the route measurements, one or several Inspection Codes can be added from a list. A notepad is also available in the instrument.

## 4.2. Transfer a Route to or from the Instrument

Before transferring a route to the instrument, the route should be created in the SpectraPro® application (for more details, read SpectraPro® User's Manual).

Transferring a route from the PC to VIBER X5 MkIII™ can be done in two ways:

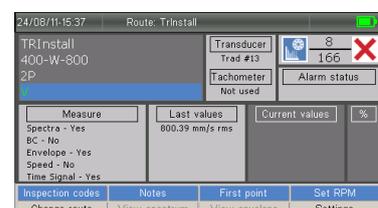
**Directly:** from the SpectraPro® program, to the VIBER X5 MkIII™ using the Connection menu.

**Indirectly:** in SpectraPro®, transfer the route to a file. Then, copy the file to the **Route folder** in the VIBER X5 MkIII™ SD Card. If you copy the Route file to another folder or to the Card root, the instrument will not show the file in the existing Route List.

The number of Route files in the micro SD Card is practically unlimited. However when the Route list menu is shown in the Route Manager, the Instrument always checks the integrity of all Route files stored, depending on how many there are and the size of the routes this process take time, therefore we recommend only to store the Routes you require.

## 4.3. Measuring in Route

When entering Route menu you enter the location of the



last point selected in the latest opened route file.

This means that when you stop the measurements in a route, you can shut down the VIBER X5 MkIII™ to save power, or make additional off route measurements. You can after that, anytime resume the route measuring where you left it, by simply selecting the Route application again.

Figure 4-2: Route Menu

The route screen displays:

- Which Route, machine, point and direction to be measured.
- Type of measurement to do in the point.

In the example Envelope  should be measured

- Record status (Collected or not)

-  Record collected
-  Not collected

- List of all measurements that should be done for that point
- Transducer type (selected in SpectraPro software)
- Speed sensor status (Tachometer, selected in SpectraPro software)
- Last values (previous values on that point stored in the machine database)
- Current values (Actual measurements)
- Gradient of change in percents
- Alarm status (Warning or Danger).

When the  (OK) key is pressed, the measurement process begins. A measurement stability diagram is shown on the right side.

Press  (OK) again, to start the data acquisition and the measurement saving process.

Depending on the number of measurements and settings, recording the measurement will differ in time.

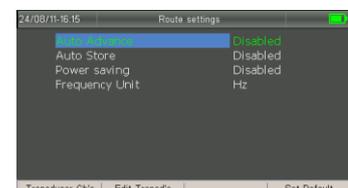
When the measurement is saved, the route will advance to the next point if Auto advance is enabled.

In the route screen, the following actions are available:

Table 4-1: Key action in Route

KEY	Action in Route
	UP/DOWN. Change the hierarchy level in the route (Plant, machine, point, direction)
	LEFT/RIGHT Go forward/backward in the route. Depending where you are in the hierarchy level you will move either forward, to plant, machine, point or direction level. When moving to plant or machine level you will go to the first point on the plant or machine.
	OK. Start measurement
	F1. Select another route from the route file list
	F2. View spectrum/time signal (only for vibration directions)
	F3. View envelope spectrum (only for vibration directions)
	F4. Change Route settings (see below)
	Ctrl + F1. Add Inspection codes from a pop-up list
	Ctrl + F2. Add notes
	Ctrl + F3. Go directly to the first record
	Ctrl + F4. Set manually the speed for current vibration point
	MENU. Opens shortcut list

## 4.4. Instrument Route Settings



To change the route setting, press **F4** (F4). The program will enter route settings menu  
In the **Route settings** menu you can change:

Figure 4-3: Route Settings

**Auto Advance** (Enabled or Disabled) - If auto advance is enabled, the instrument automatically jump to the next direction, when it completes data collected for the present direction.

**Auto store** (Enabled or Disabled) - When auto store is enabled, if the measurement is stable enough, the instrument saves data.

**Power Saving**(Enabled or Disabled) -If power saving is enabled, the instrument will turn on/off the transducer power after every measurement.

**Frequency Unit** (Hz or CPM) - Set the frequency unit preferred, when analyzing envelope or spectrum data.

**Audio** (Enabled or Disabled) -If you have a headphone connected to the instruments Audio output you will be able to listen to the frequencies transferred by the transducer during measurement.

**Audio input** (Filtered or Direct) – Filtered input will filter out all frequencies below 500 Hz.

From the **Route Settings** screen, there is a direct link to **Select Sensor** and **Edit Transducers** menus.

The transducer used can be selected during Route definition in SpectraPro®:

**Installed** – Uses the transducer determined in accordance with the **Sensor choice** menu on VIB 1 input.

**Auto** - The Instrument will measure with the auto-detection function of transducer connected to VIB1 input.

## 4.5. Instrument Route Manager

To enter Route Manager to select another route or to see the details of a Route, press **F1** (F1):

Here you can select a route loaded in the instrument. Use the Arrow keys and press **OK** (OK).

With the function keys you may also:

- **F1** (F1) – Show route details
- **F2** (F2) – Delete a route file
- **F3** (F3)– Check route file integrity
- **F4** (F4) – Delete Route data (the route definition will remain unaffected, only the measurements will be deleted).

To go back to Main menu press **ESC** (ESC) key.



Figure 4-4: Route Manager

## 4.6. Route Viewer

An easy way to check the Route content in a PC, without



using SpectraPro®, is to use the Route Viewer PC software.

With Route Viewer, you can:

- Check file integrity
- Check the Route file records measured
- See the measured values and measurements (only overall values)
- See the Route settings for a measuring point record.

Figure 4-5: Route Viewer

Route Viewers main screen is similar to the Route window you see in the Instrument. Route Viewers delivered together with VIBER X5 MkIII™ and is located on the SD Card. To install the application on your computer:

1. Copy the Route Viewer folder from the Instruments SD Card to your PC
2. Double click on the *Setup.exe* file.

The Route files can be viewed directly from the VIBER X5 MkIII™ microSD Card, if the instrument is connected to the PC and the card is shown in Windows Explorer

A convenient way to see the Route files is to “teach” the computer to recognize the Route files and to open directly the Route Viewer application, when you double-click on any Route file.

To do this, proceed as followed:

In Windows Explorer, just double-click on any Route file (The files have the extension .mvr).The window on the right will appear:

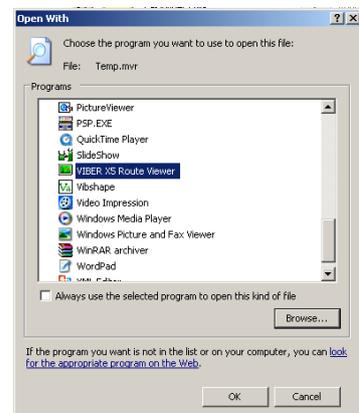


Figure 4-6: Windows Explorer list

Press Browse and locate the RouteViewer.exe (in ...\\SpectraPro® directory).

Check the “Always use the selected program to open this kind of file”.



Figure 4-7: Details window

Next time, when you double-click on a Route file, the Route Viewer will automatically be opened. If you don't use the check box, just repeat the above steps.

You can also first open the Route Viewer and select the Route file.

If you press the Details button , the window in Figure 4-7 will appear.



Figure 4-8: Details window

For Temperature, Process, Speed and Manual Entry point, the details will appear like in Figure 4-8.

You can see all the settings made in SpectraPro® for a given direction

Using the **File** menu, you can save a copy of the Route file, or you can open another Route

file.

**NOTE!** You don't have to switch on the Instrument to browse for the Route files. Just insert the USB cable between the Instrument and the PC and the Open file window will appear on the computer screen. Route files are located in the ROUTE folder on the SD Card.

If a Route file is corrupted, a warning message will appear. A corrupted file should be deleted from the VIBER X5 MkIII™ microSD Card.

## 5. Setting up Measurements

This chapter describes the different general settings that can be made in the applications and when to use them.

### 5.1. Getting started with Measurements

The general procedure for the measurements in VIBER X5™ can be divided into 4 steps:

**1<sup>st</sup> step settings:** The measurements start with a settings menu, where you set the parameters for the measurement. By pressing  (F4) the parameters will be set to default, which covers the majority of situations.

In this step you may also change transducer settings, or select transducers (with the function key shortcuts for the related menus). Once the parameters are set, attach the transducers (if applicable).

The instrument always saves the last used settings for each type of measurement.

**2<sup>nd</sup> step parameter check:** When pressing  (OK) the instrument will check if the transducers meet the required conditions and start the data acquisition for the measurement. In the mean time, the instrument may display a diagram related to the stability of the input signal and for some measurements auto ranging will ask you to confirm the stability of the signal.

The number of measured channels is automatically determined, in accordance with the installed transducers. Therefore, you should configure the instrument and attach the transducer(s) before selecting the measurement type.

**3<sup>rd</sup> step data collection:** The instrument acquires the necessary data (depending on the settings, this can take up to 30 seconds), it will also start to process and display the data. The measurement may either be automatically stopped or manually (depending on reference, setting and/or measurement) using the  (AUX) or  (F3) key

**4<sup>th</sup> step save:** When the measurement is stopped (or HOLD mode) the collected data can be saved in files when you select **Save** from the  (MENU) key menu (you may review the files using File Manager). For some measurements (example Coast Up/Down) if the measurement not is saved, a question will appear about saving before exit the measurement, for some applications the measurement may only be saved as a picture file. All screens can be saved for all type of measurements, as picture files using the  (MENU) key shortcut. To do this, the measurements needs to be temporary stopped (HOLD mode).

#### General Measurement Settings

In this section the general application settings that are common (frequently) used by different applications are described. The settings can vary from application to application but the implication of them is the same.

### **5.1.1. Measurement type**

(Acceleration, Velocity, Displacement or mV)

Depending on choice, the instrument will integer and display the units of measurement different.

### **5.1.2. Detection type**

(RMS, Peak or Peak-Peak)

How the amplitude of the frequency is calculated.

For pure sine waves, the detection types are related as followed: RMS =  $\sqrt{2}$  times zero to Peak; Peak to Peak = 2 times zero to Peak

**RMS** The RMS value of a set of values (or a continuous-time waveform) is the square root of the arithmetic mean (average) of the squares of the original values (or the square of the function that defines the continuous waveform).

**Peak**(zero to maximum) amplitude of the sine wave at the frequency of interest and is calculated from the RMS value. It can be used for detection of acceleration, velocity, and high frequency energy

**Peak-Peak**(minimum to maximum) amplitude of a sine wave at the frequency of interest and is calculated from the RMS value. Use for detection of displacement; sometimes used for high frequency energy. In the case of the sine wave, the peak-to-peak value is exactly twice the peak value because the waveform is symmetrical.

### **5.1.3. HP Filter**

(Setting is depending on type of measurement)

High pass filter. Sets the lowest level from which the frequency will be displayed and calculated. If Disabled the frequency starts from zero (0).

### **5.1.4. LP Filter**

(setting is depending on type of measurement)

Low pass filter frequency for the input signal. Sets the highest level from which the frequency will be displayed and calculated.

### **5.1.5. Max. frequency**

(400, 1600, 3200, 12800 or 25600 Hz)

These are the adjustable frequencies. The unit Hz is 1 period/second, equivalent to 60 cycles per minute.

The resolution depends on the frequency range and the number of lines selected.

### 5.1.6. No of lines

(800, 1600, 3200, 6400, 12800 or 25600)

In this setting number of lines is set and displayed in spectra.

The resolution increases when the number of lines increases, but also the time necessary for data acquisition.

Example:

If you have a Max frequency of 400 Hz and your No of lines are 6400

Then total collection time is:

$$\frac{6400 \text{ lines}}{400 \text{ Hz}} = 16 \text{ seconds}$$

From this it can be seen that high resolution spectrum, requires long time to collect the data. This has nothing to do with the speed of the calculations in the instrument; it is simply a natural law of frequency analysis.

During measurement the dynamic parameters of the machine (one example is Speed) should not change. For this reason it can be better to choose a low number of lines in situations where the parameters of the machine is not steady, or you would like to study "real time" transients.

### 5.1.7. Window(Windowing)

(Hanning, Hamming, Blackman, Kaiser-Bessel, Rectangular)

Windowing is used to shape the time portion of your measurement data, to minimize edge effects that can result in spectral leakage in the FFT spectrum. By using Window correctly the spectral resolution of your frequency result will increase.

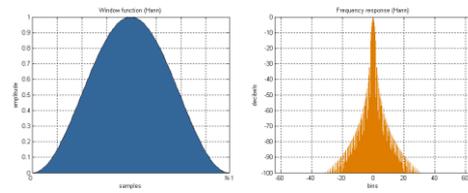
Each window function has its own advantage and suitability for different situations. To choose a window function, you should estimate the frequency content of the signal.

- If the signal contains strong interfering frequency components distant from the frequency of interest, choose a smoothing window with a high side lobe roll-off rate.
- If the signal contains strong interfering signals near the frequency of interest, choose a window function with a low maximum side lobe level.
- If the frequency of interest contains two or more signals very near to each other, spectral resolution is important. In this case, it is best to choose a smoothing window with a very narrow main lobe.
- If the amplitude accuracy of a single frequency component is more important than the exact location of the component in a given frequency bin, choose a window with a wide main lobe.
- If the signal spectrum is rather flat or broadband in frequency content, use the rectangular window.

In general, the Hanning window is satisfactory in 90% of all cases. It has a good frequency resolution and reduced spectral leakage.

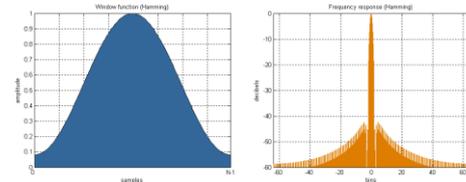
## Hanning

Is useful for measurements where better frequency resolution than some of the other windows is desired but moderate side lobes do not present a problem (resolution is more important than amplitude accuracy).



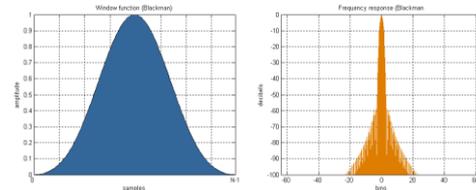
## Hamming

The window is optimized to minimize the maximum (nearest) side lobe, giving it a height of about one-fifth that of the Hanning window. Hamming has better frequency resolution but decreased amplitude accuracy than the Hanning window. It may be used to separate frequency components that are close.



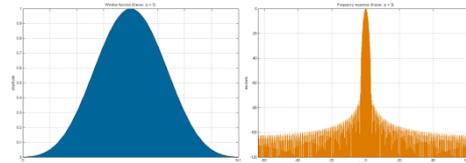
## Blackman

The Blackman window hold back the side lobes more than 92dB giving it about 11% wider bandwidth than the Kaiser-Bessel window.



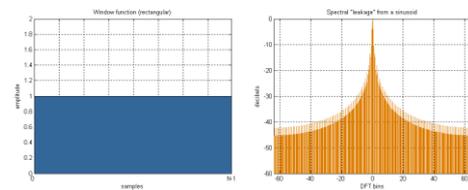
## Kaiser-Bessel

Compares roughly to the Blackman, but for the same main lobe width, the near side lobes tend to be higher, but the further-outside side lobes are lower.



## Rectangular

This is the simplest window, taking the part of the signal without any other modification, unless the signal happens to be an exact fit for the window length this leads to discontinuities at the endpoints



Because of the high side lobes, using a rectangular window function (or no window function) is normally not recommended. This window can only be used when the signal is zero from start end zero at the end of the measurement (explosion).

### 5.1.8. Averaging

(Linear, Exponential, Smart, Peak Hold)

Averaging means that the different parts are averaged together, and can be used for reducing random errors like background vibration due to a source other than the machine being measured.

**Linear** means that each part spectra/value has the same weight in the final spectra/value. If we for example select 8 as the No of Averages, every line level in the spectra will be divided by 8. When all the parts of the spectra are summed the level of each line is an average of the 8 measurements. This type of average will enhance continuous signals and reduce noise and stochastic signals. Linear averaging is well suited for trend analysis and most other frequency analysis. The measurement stops automatically when all the part spectra have been measured.

**Exponential** means that the last part spectra/value has the same weight in the final spectrum/value as the sum of all previously measured parts.

A sudden change in the vibration level is more visible than with the other averages.

Exponential is used when you want to see the variations in the vibration signal.

The measurement stops automatically when all the parts have been measured.

**Smart** averaging is similar to linear averaging with one difference:

If the value changes more than 5% percent the averaging resets.

The advantage is that when you move the transducer from one location to another, the movement of the transducer will generate a high value. On linear averaging, if the No of Averages is high, this will cause the value to slowly change to actual value during a long time. This is also the case when the measurement condition (as speed) changes.

**Peak Hold** means that the largest value of each spectrum line is stored in the final spectra.

If the level at the 50 Hz line is largest in the part spectrum 2, and the 200Hz line is largest in part spectrum 7, both will be saved in the final spectrum.

Peak hold is used at coast up/downs or when you want to measure an unexpected event.

### 5.1.9. Number of Averages

(1, 2, 4, 8, 16, 32 or 64)

To get a representative measurement of the vibrations in a machine we must measure the vibrations during a certain time. We cannot decide to stop a machine or a whole plant based on a measurement taken during less than a few seconds.

One way to extend the measuring time is to measure several spectra during a longer time and calculate an average spectrum. Each of these single spectra is called a measurement.

If you collect more averages, you will have fewer random errors. However, collecting more averages requires more time. If we for example select 8 No of Averages the instrument will measure 8 different spectra and continuously calculate an average spectrum. Usually 6 to 8 measurements are enough.

#### **5.1.10. Frequency unit**

(Hz or CPM)

With this setting you select which frequency unit to display Hertz (Hz) or Counts per Minute (CPM).

#### **5.1.11. Overlapping factor**

(0, 25, 50 or 75%)

To mitigate the "loss" that can result at the edges of the window (see window selection), the actual settings may overlap in time. With this factor you can set how much they overlap.

Most machine vibration signatures are not perfect sinus signals, if a small change occurs in the signal near the beginning or end of the time record, it will either be analyzed at a much lower level than its true level or it may be missed altogether (depending on the characteristics of the windowing function). For this reason, it is a good idea to use overlap processing.

For 50% overlap, the instrument starts to collect the 2<sup>nd</sup> set of samples when the 1<sup>st</sup> set has come to half the samples of the time record, 3<sup>rd</sup> set when 2<sup>nd</sup> has come to half samples of a time record (1<sup>st</sup> set is ended), this process continues until the set number of averages is collected.

If the overlapping is 75% then the overall time weighting of the data will be flat, and there is no advantage of using a greater overlap.

Overlapping makes the averaging process faster. The disadvantage is that the greater the overlap, there are lesser new data, and the influence of random errors will be grater.

#### **5.1.12. Save Waveform with spectra –**

If enabled, the analysis file will contain also waveform data.

#### **5.1.13. Speed Measurement –**

Measure speed along with the measurement.

#### **5.1.14. Measure BC –**

The instrument will measure the Bearing Condition value before measuring spectra (see the Bearing Condition section under Measurement for further information about this measurement)

## 6. Recommended Vibration Levels

This chapter describes the ISO standard 10816-3 and which vibration levels that is recommendable. It also describes resonance and where to place the transducers for best result.

The lists and tables in this chapter can be used, as a first consideration, when you approach a machine newly commissioned or after some time in operation. Investigate the reason for any machine that vibrates above 3 mm/s RMS. Do not leave levels above 7 mm/s without analyzing cause and consequences.

### **0 – 3 mm/s** (0 – 0, 12 in/s)

Small vibrations - None or very small bearing wear. Rather low noise level.

### **3 – 7 mm/s** (0, 12 – 0,28 in/s)

Noticeable vibration levels often concentrated to some specific part as well as direction of the machine. Noticeable bearing wear. Seal problems occur in pumps etc. Increased noise level; try to investigate the reason. Plan an action during next regular stop. Keep the machine under observation and measure at shorter time intervals than before to detect a deterioration trend if any. Compare vibrations to other operating variables.

### **7 – 11 mm/s** (0,28 – 0,43 in/s)

Large vibrations. Bearings running hot. Bearing wear-out cause frequent replacements. Seals wear out, leakage of all kinds evident. Cracks in welding and concrete foundations. Screws and bolts are loosening. High noise level. Plan action soonest. Do your best to reveal the reason. You are wearing down investments quickly.

### **11 – mm/s** (0,43 – in/s)

Very large vibrations and high noise levels. This is detrimental to the safe operation of the machine. Stop operation if technically or economically possible considering the plant stop cost. No known machine will withstand this level without internal or external damage. Reduce any further running time to an absolute minimum.

## 6.1. ISO standard 10816-3

The ISO standard 10816-3 classifies machines differently whether the machines are considered as flexible or rigid mounted. This reflects the location of the machines stiff-body resonances related to the basic running speed of the machine.

For instance, a machine supported by rubber or spring, have resonances at low running speeds. The machine starts vibrate at certain low revolutions. When the speed is increased above these resonance frequencies, the vibration is reduced. This machine is considered flexible.

Modern machines that have high RPM's and flexible bearing supports and foundations, can be treated as flexible, even when they are not mounted on rubber or springs.

								Velocity		Velocity Threshold Values ISO 10816-3
								11.00	0.44	
								7.10	0.28	
								4.50	0.18	
								3.50	0.11	
								2.80	0.07	
								2.30	0.04	
								1.40	0.03	
								0.71	0.02	
								mm/s rms	inch/s rms	
Rigid	Flexible	Rigid	Flexible	Rigid	Flexible	Rigid	Flexible			Newly Commisioned
Pumps Over 15kW Radial, Axial & Mixed Flow				Medium Sized Machines 15-300 kW		Large Machines Over 300kW				Unrestricted Long term Operation
Intergrated Driver		External Driver		Motor Shaft Height 160 - 315mm		Motor Shaft Hieght Over 315mm				Restricted Long Term Operation
Group 4		Group 3		Group 2		Group 1				Vibration Causes Damage

## 6.2. Resonance

Existence of resonance at a frequency where the machine is running should be rectified as early as possible, since it will significantly affect the economic operation of the machine.

All machines have similar built in "tunes" with corresponding properties consisting of stiffness and a mass in the form of mechanical strings such as shafts, beams, floors and other mechanical parts. If any natural excitation (alternating force) in the machine has the same or nearly the same frequency as a resonance frequency the vibration will be amplified in this machine part, and a lot higher vibration level will occur.

A resonance can easily be found when a flexible machine is running up or down its speed. The resonance frequencies are located at the RPM's, where the vibration has a local maximum level. (The applications Coast Up and Coast Down are useful tools when looking for resonances).

To identify a resonance, measure the vibration levels in three perpendicular directions at the bearings. If you find a measurement with at least three times higher level than in the other directions you should consider resonance as a likely possibility. The resonance is amplifying the mechanical force and thus gives a high vibration in that direction. The resonance makes the machine unnecessarily sensitive to mechanical forces.

A natural excitation force is for example unbalance at the running speed, misalignment on mainly twice the speed, gear mesh forces etc.

One common resonance frequency is the critical speed of a shaft which depends on the stiffness and mass of the shaft, but resonances exist in all machine parts as well as in supporting beams and concrete floors.

THE BASIC RULE IS THAT THE RESONANCE'S OF ANY PART IN THE MACHINE SHOULD NOT COINCIDE WITH ANY NATURAL IMPULSE IN THE MACHINE.

Actions to handle a resonance are different depending on its location, operating conditions etc. It will normally require experience to alter the situation. One reason is that the modification can affect the basic mechanical design of the machine and normally require the competence of a machine designer. We recommend however to consider such modifications since the change of the resonance frequency normally is cheap compared to the high maintenance cost that will follow any attempt to run a machine in long term operation under the influence of a resonance.

A TEMPORARY AND SOMETIMES PERMANENT SOLUTION TO A RESONANCE PROBLEM IS TO CHANGE THE SHAFT SPEED OF THE MACHINE, IF POSSIBLE.

### 6.3. Recommended transducer locations:

- Measure on or as close to the bearings as possible.
- Measure vertically and horizontally in the same direction with the shaft centre.
- Measure axially at the same height as the shaft centre.

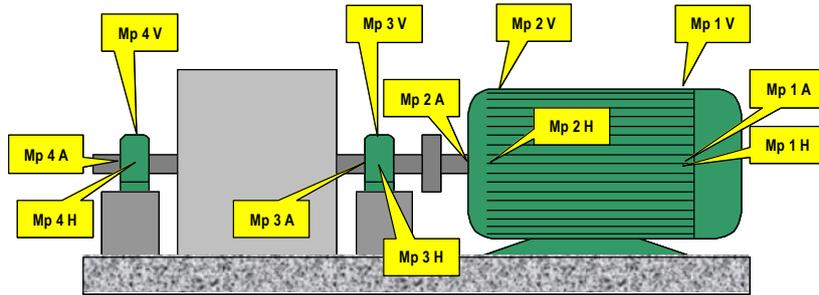


Figure 6-1: Measurement locations

Warning!

Do not measure on thin sheet metal plates, as fan covers on electrical motors!

## 7. Measure (Off-Route)



This section describes the applications in the Measurements menu. In this menu are the programs used to make analysis on site or when you need to make additional measurements during Route.

From **Main menu** select **Measure**.

The following measurement applications are included in the instrument when delivered: (for detailed description see the specified application section)



Figure 7-1: Measure Selection



### Spectra

This measurement displays a spectrum (chart) of the frequencies at which the machine component is vibrating, and the amplitude of the vibration at each of these frequencies (Page no **Fel! Bokmärket är inte definierat.**).



### Envelope

Envelope is spectra measurement that enhances the energy in the high frequency signals and is used to find early signs of bearing faults. Envelope can also be used to detect cavitations in pumps (Page no 60).



### Total value

This application is used for analyzing the effect of mechanical actions and an easy way to quickly get an overview of the vibration status of the machine (Page no 51).



### Bearing Condition

This application is used for analyzing the effect of lubrication or other actions on journal bearings. The bearing condition value is a sum average value, RMS value, of all high frequency vibrations in the set frequency interval (Page no 54).



### Temperature

With the temperature application you can measure the bearing house temperature (or any other surface temperature) with the built-in infrared temperature sensor (Page no 65).



### Speed

The speed can be measured with an external speed sensor. The application can also calculate a gear speed, if you know the gear ratio (Page no 68).



### Process

With the Process application any process parameter with the physical range of 1 to 5 V DC or 4 to 20 mA may be measured(Page no691).



### Phase

In Phase application you can measure the Amplitude and Phase of the vibration using 1 or 2 vibration sensors and a speed sensor. This tool will help you to confirm a specific machine fault or to prevent false conclusion(Page no681).



### Coast Down

Coast-down is used for analyzing mechanical resonances or critical speeds (the speeds where the vibration is amplified) as the machine speed is gradually decreasing during for example shut down. The instrument presents the measurement as two diagrams, with level and phase as function of the machine speed.(Page no724)



### Coast Up

Coast Up is used for analyzing mechanical resonances or critical speeds (the speeds where the vibration is amplified)and for monitoring excessive shaft bending in steam turbines due to uneven heating as the machine speed is gradually increasing during power up.(Page no 702)



### Orbit (XY Shape)

With this application you may see the relative orbit (displacement) of a shaft. The application displays a diagram of X value versus Y value, using two transducers mounted in perpendicular (90 degrees angle). (Page no746)



### Vibshape

This application mainly used to collect data for computer animation of machinery vibrations. Vibshape™ can also be used to measure Coast Up on RPM controlled machines like steam turbines and frequency controlled motors. Because the instrument saves the vibration, phase and speed of each measurement many transducers (one by one) can be measured at the same speed. (Page no 813)



### Data Logger

With Data Logger you may continuously measure the vibration (Total Value) for 1 or 2 channels over a specified time or record count. (Page no 79)



### Advanced

This menu contains applications with extended setting possibilities or special measurements and is intended for advanced users. (Page no 87)



Fig 7.1.1 – Advanced Measurement

**The Bump Test and Loop Power menus are included in this section.**

## 7.1. Upgrade Measurements

In addition to the above standard delivered measurements it is possible to upgrade VIBER X5 MkII™ with additional programs. VMI continuously develop analyzing programs for your instrument, check VMI download page for information on available programs.

Below are some examples of programs to upgrade your VIBER X5 MkIII™:



### Synchronous Averaging

This application is useful to reduce background noise in spectra of complex signals. When you have spectral peaks which are very close to the harmonics of the machine speed it will average out peaks that are not whole number multiples (non synchronous) of the running speed, and the signals that is synchronous with the trigger will be emphasized.



### MCSA (Motor Current Signature Analysis)

Motor Current Signature Analysis (MCSA) is used to determine the operating condition of AC induction motors without interrupting production. MCSA operates on the principle that induction motor circuits can, in essence, be viewed as a transducer. By clamping a Hall Effect Current sensor on either the primary or secondary circuit, fluctuations in motor current can be observed.

### 7.1.1. How to Upgrade

To upgrade your VIBER X5™ with additional

1<sup>st</sup> Send the serial number (SN) of your instrument (starts with X5 followed by four digits, example: X50001) to VMI.

2<sup>nd</sup> Place the file you receive in the SYSTEM folder on the VIBERX5™ SD Card

3<sup>rd</sup> Go to Update (From Main menu select Settings and Update) and press **Ctrl** + **F1** (LICENSES), the installed licenses are showed in the Update Software menu.

If you have an old Program (Firmware) file in the instrument, you may also need to update the program file.

## 7.2. Total Value



The Total Value is used to get a fast judgment of the severity of the vibration. It is also used to analyze the largest vibration on a machine or structure by moving the transducer to different positions and directions.



Figure 7-2: Total Value Selection

From **Main menu** select, **Measure** and **Total Value**.

Total Value RMS, example: If the simultaneous vibration caused by imbalance is (4 mm/s), by misalignment (2 mm/s) and by the gear mesh forces (5 mm/s) then the total vibration

will be 6.7 mm/s. Total Value =  $\sqrt{4^2 + 2^2 + 5^2} = 6,5mm / s$

Notice, if you take away the entire imbalance, total value will be = 5, 4 mm/s

## 7.2.1. Total Value Settings

When you select Total Value, the program displays the settings menu. The following parameters can be set:

- **Measurement type** (Acceleration, Velocity, Displacement or mV)
- **Show Unit** (depending on the measurement type, selected above)
- **Detection** (RMS, Peak or Peak-Peak)
- **Max. frequency** for the *Total value* calculation (400, 1000, 1600, 3200, 12800 or 25600 Hz)
- **HP Filter** (Hz) (Disabled, 2.0, 3.0, 5.0, 10.0, 20.0)
- **Averaging** (Disabled, Linear or Smart)
- **No of Averages** (1, 2, 4, 8, 16, 32 or 64)
- **Audio** output for earphones (ENABLE or DISABLE)

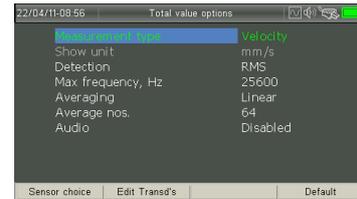


Figure 7-3: Total Value Settings

**NOTE:** Audio will be available only during measurement. Due to safety reasons, the volume will be set at a low level every time you enter the measurement

In addition, shortcuts are available to access relevant setting menus:

- **F1** (F1) - Assign channels menu
- **F2** (F2) - Edit transducers menu
- **F4** (F4) - Reset settings to default.

By pressing **F4** (F4), a default set of measurement parameters suitable for most situations will be loaded.

After measurement parameters are set, press **OK** (OK) to enter measurement menu or **ESC** (ESC) to exit.

## 7.2.2. Measure Total Value

On the right is the Total Value screen for 2-Axis vibration measurement. To the right side of the value, a bar graph

indicates the measurement stability.

On the left side of the screen are shown details regarding:

- Transducer(s) used
- Frequency range
- Averaging type
- Audio input (for total value only direct input)
- Volume (Disabled or percent of maximum volume)

During live measurements, you can press:

- **F2** (F2) - Change the measuring unit;

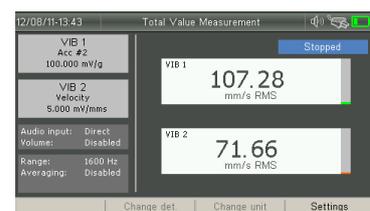


Figure 7-4: Total Value Measurement

-  (F3) - Change the detection type (RMS, Peak or p-p);
-  (F4) - Change the measurement settings.
-  (UP)/  (DOWN) Arrow – Change audio volume (if enabled)

The data collection may be temporary suspended by pressing the  (AUX) key. To resume the measurement, just press again the  (OK) key.

### **7.2.3. Listening to bearing sound**

The listening of bearing sound is an old proven method. Sound analyzes of low speed bearings and gears can sometimes be much faster and even more reliable than just BC-value. With the VIBERX5™ you can both listen and look at the vibration value at the same time. It is also a good technique for estimate lubrication volume. Only one channel can be used for listening.

## 7.3. Bearing Condition (BC)



The bearing condition value is a sum average value, RMS value, of all high frequency vibrations in the set frequency interval.



Figure 7-5: BC Selection

This value is an acceleration average with the unit “g”.

From **Main menu** select, **Measure** and **Bearing Condition**.

### 7.3.1. Interpretation of the Bearing Condition Value

The bearing condition value is an indirect method to measure the status of anti-friction bearings. A high value indicates that you need to make further frequency analysis.

When the balls or rollers rotate inside the bearing a wide-band noise and vibration arises. This noise or vibrations are increased if the bearing is poorly lubricated, overloaded or has a damaged surface. Both listening and reading the BC value is a good way to analyze bearings.

In the diagram find the machine speed. Follow this line up to the judgment lines and read the value on the left axis.

Figure 7-6: BC guide

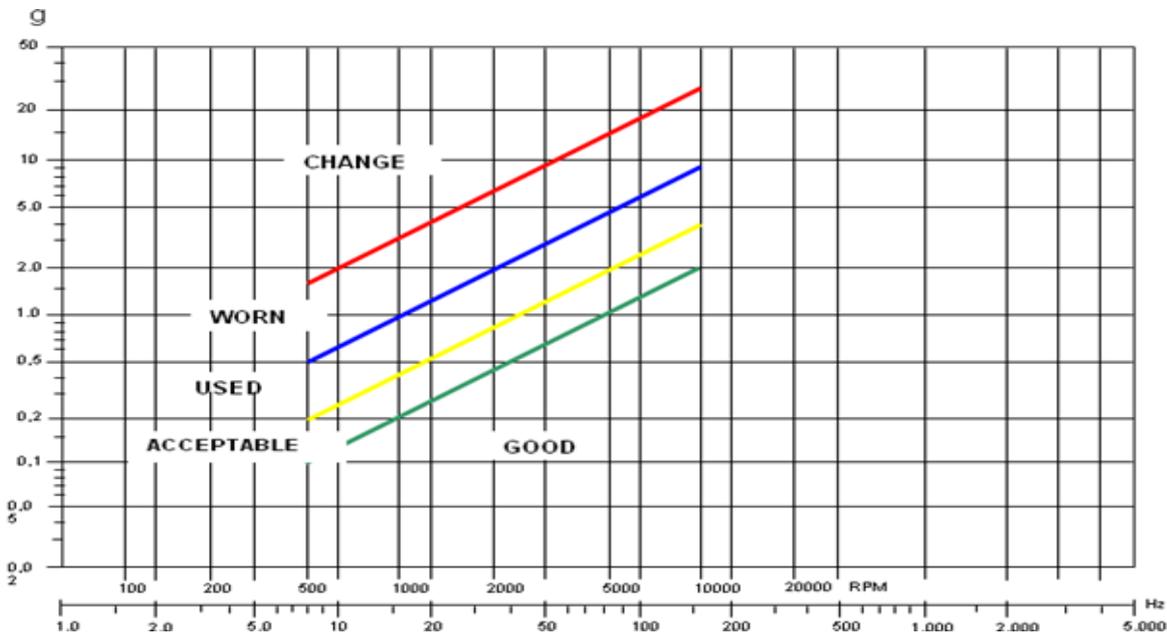


Figure 7-6 is a **guide** to interpret the bearing condition value. If vibrations of other causes (e.g. flow surge and sometimes gear mesh forces) have vibrations within the frequency range, this can indicate a high bearing condition value without the bearing being damaged.

A high bearing condition value can also be acquired if the bearing is poorly lubricated or is over-loaded due to a large misalignment or a large belt tension.

NOTE: High bearing condition values can appear at gear boxes, grinding machines, converting machines with cutters and similar machines without any bearing faults because these machines “naturally” produce high frequencies and the bearing condition value can be misinterpreted. Try to measure when the machine is unloaded.

If the selected frequency band includes low frequencies, the bearing condition value would include vibrations from unbalance, misalignment etc, and not purely from bearing vibrations and would therefore be difficult to interpret.

If the selected frequency band only includes very high frequency vibrations (above 20 kHz), we would need a special vibration transducer that it is very rigidly and closely mounted to the bearing, because the machine structure works as a mechanical filter for high frequencies.

Normal machinery vibrations from unbalances, misalignment etc., has few vibrations above 3.200 Hz.

Note: A high bearing condition value should always be used as a request to make further frequency analysis.

### 7.3.2. BC Measurement Settings

In the **Settings** menu, you can set the following parameters:

- **Detection type** (RMS, Peak, Peak-Peak)
- **Frequency Range** (Hz) (500- 6400, 500- 32000, 1000- 32000, 3000- 32000)
- **Averaging** (Disabled, Linear, Smart)
- **No of Averages** (1, 2, 4, 8, 16, 32, 64)
- **Audio** (Enabled, Disabled)

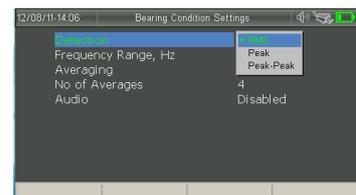


Figure 7-7: BC Settings

NOTE: Audio output will only be available during measurement. Due to safety reasons, the volume will be set at a low level every time you enter the measurement

By pressing **F4** (F4), a default set of measurement parameters suitable for most situations will be loaded.

After measurement parameters are set, press **OK** (OK) to enter measurement.

### 7.3.3. Measuring Bearing Condition

The BC screen, when using two transducers, is presented in Figure 7-8.

To the right side of the value, a bar graph indicates the measurement stability.

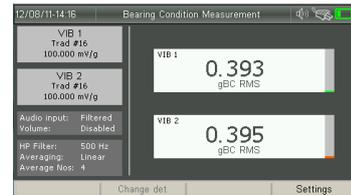


Figure 7-8: BC Measurement

On the left side of the screen are shown details regarding:

- Transducer(s) used
- Frequency range
- Averaging type
- Audio input (for BC only filtered input)
- Volume (Disabled or percent of maximum volume)

The data collection may be temporary suspended by pressing the  (AUX) key. To resume measurement, just press again the  (OK) key.

During live measurements, you can press:

-  (F2) - Change the detection type (RMS, Peak or p-p);
-  (F4) - Change the measurement settings.
-  (UP)/ (DOWN) Arrow – Change audio volume (if enabled)

### 7.3.4. Listening to bearing sound

The listening of bearing sound is an old proven method. Sound analyzes of low speed bearings and gears can sometimes be much faster and even more reliable than BC-value. With the VIBERX5™ you can both listen and look at the vibration value at the same time.

## 7.4. Spectra



This measurement displays a spectrum (chart) of the frequencies at which the machine component is vibrating, and the amplitude of the vibration at each of these frequencies.



Figure 7-9: Spectra Selection

From the **Main menu** select, **Measure** and **Spectra**.

Or From **Main menu** select, **Measure, Advanced** and **Spectra**.

The VIBER X5 MkII™ has two applications for Spectra measurement. One **regular Spectra** which is located under **Measurements**, and one **Advanced Spectra** which is located under **Advanced Measurements**.

The Advanced Spectra have more setting possibilities and is suitable for experienced user.

In Advanced Spectra the accusation time may be long due to the user settings, for this reason auto ranging is made only in the beginning of the measurements. In regular Spectra auto ranging is being made continuously.

### 7.4.1. Spectra Measurement Settings

When you select Spectra(or Advanced Spectra), the instrument will display the setting menu, where the following parameters can be set:

- **Measurement type** (Acceleration, Velocity, Displacement or mV)
- **Show Unit** (depending on the measurement type selected above)
- **Detection type** (RMS, Peak or Peak-Peak)
- **HP Filter** (Hz) (Disabled, 2.0, 3.0, 5.0, 10.0, 20.0)
- **Max. frequency**(Hz) (400, 1600, 3200, 12800, 25600 or 40000\*)
  - \*Only available in Advanced Spectra
- **No of lines** (800, 1600, 3200, 6400, 12800\* or 25600\*).\*
  - \*Only available in Advanced Spectra
- **Window** (Hanning, Hamming, Blackman, Kaiser-Bessel, Rectangular)
- **Averaging**(Disabled, Linear, Exponential, Peak Hold)
- **Number of Averages** (2, 4, 8, 16, 32 or 64)
- **Frequency unit** (Hz or CPM)
- **Overlapping** (0, 25, 50 or 75%)
- **Save Waveform with spectra** (Enabled, Disabled)

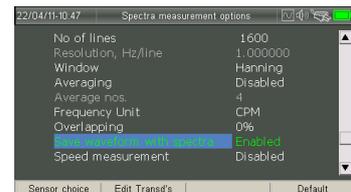


Figure 7-10: Spectra Settings

- **Speed Measurement**(Enabled, Disabled)
- **Measure BC**(Enabled, Disabled)

**NOTE:** The menu has a scroll bar on the right side indicating that it may display many items. Use  (UP)/ (DOWN) arrows to get all the items

All settings in this menu are automatically saved and will appear as preset values the next time this window is opened.

The shortcut bar is available to access directly the related menus, Sensor choice and Edit transducers.

By pressing  (F4), a default set of measurement parameters suitable for most situations will be loaded.

After measurement parameters are set, press  (OK) to enter measurement menu or  (ESC) to exit.

## 7.4.2. Measure Spectra

You can measure spectra for one or two channels simultaneously.

The frequency is displayed on the X axis and the value on the Y axis.

The scale for the value is displayed on top of the spectrum chart.

On the right side of each channel you have the cursor value and the total value for that channel.

In the middle beneath the chart is the cursor frequency.

When entering Spectra Measurements or when pressing

 (Ctrl)+  (F3), Default Zoom, the cursor will follow the highest peak in the frequency range.

**During measurements, you can do the following actions:**

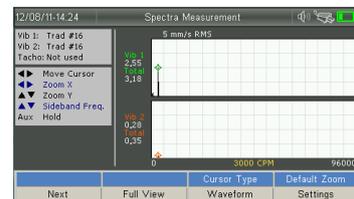
-  (F1)– Next. A single spectrum will be displayed. Order is X, Y and X + Y.

When a single channel spectrum is shown, this key has no effect (and the shortcut is disabled).

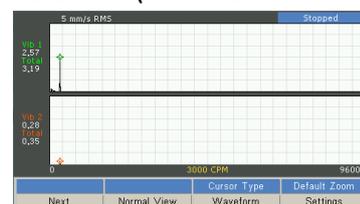
-  (F2)– Full Screen. Spectra are zoomed, to cover the whole screen (see Figure 7-12).

-  (F3)– Waveform. Instead of spectra, the waveforms are shown.

-  (F4)– Setting. Open the Settings menu for spectra measurements.



**Figure 7-11: Spectra Measurements**



**Figure 7-12: Spectra Full Screen**

- Move the cursor using the  (LEFT) and  (RIGHT) Arrow keys. When pressing the key once the cursor will move one line at a time, when keeping the key pressed the cursor will move fast 10 lines at a time.
- Zoom in or out the X-Scale, using the  (Ctrl)+  (LEFT) Arrow or  (Ctrl)+  (RIGHT) Arrow key combination. During zooming, the cursor remains visible onto the spectra.
- Zoom in or out the Y-Scale, using  (UP) or  (DOWN) Arrow keys.  
Notice that once the zoom occurs (on X or Y-Axis), the plot will not be auto-scaled. Instead, the manual settings are used. To again enable the auto-scaling mode, press  (Ctrl) +  (F4) key combination (Default Zoom).
- Change cursor type between Normal, Harmonic and Sideband by pressing  (Ctrl)+  (F3)
- While using sideband cursor, the sidebar frequency can be changed by pressing  (Ctrl)+  (UP) or  (Ctrl)+  (DOWN) key combination.

You can freeze (HOLD) the measurements by pressing the  (AUX) key.

In HOLD mode, you can access the  (MENU) key menu where you can:

- Change the Main cursor:
  - Free: The cursor is positioned over a line of the screen. If screen area is less than no. of lines the cursor moves pixel by pixel on the screen and display the values for the highest line represented on the pixel. When you have zoomed enough, the cursor will move to the next line. This cursor is only available when 1 channel is on display.
  - Line: This cursor is mainly used to see line values. The cursor will move to the position of next spectrum line. This does not necessary involve a change of X position on the screen. But the Y position will change. This is the default cursor.
  - Peak locked - If the screen area is less than no. of lines the cursor moves pixel by pixel on the screen and selects the highest line represented on a new pixel. It determines if that line is a peak and if yes, calculate and display peak values as cursor values. If it is not a peak it will display the line value. When a peak is found the cursor shape is changed. The X position of the cursor is still the line position. This cursor is only available when 1 channel is on display.

In the bottom left of the screen there is a label with which main cursor type that is currently being used. If written in black user settings are respected. If in yellow, the user selected another cursor but current context does not allow this. The spectrum control automatically selected the default mode.

- Change additional cursors. This setting is the same as Ctrl + F3 during measurement
  - Harmonic - If there is enough space on the screen the harmonic index is visible.
  - Sideband
- Save the plot in a file on the microSD Card as an analysis file. The content may be

downloaded to the SpectraPro® database or it may be shown locally.

- Add notes to be saved in analysis file along with spectra.
- Enter Help menu
- Introduce manually a speed value (the value will be saved in the file)
- Save the screen into a bitmap picture file.

When waveform is selected (  (F3)), the screen will look like in Figure 7-13.

To return, press  (F2) key (Normal View).

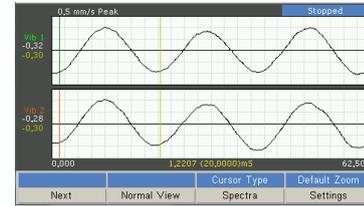


Figure 7-13: Waveform

Please notice that the distance (between the two cursors) is a period of the frequency selected by the main cursor in Spectra mode. This may be adjusted using the key combination  (Ctrl)+  (UP)Arrow and  (Ctrl)+  (DOWN)Arrow.

## 7.5. Envelope



Envelope is spectra measurement that enhances the energy in the high frequency signals and is used to find early signs of bearing faults. Envelope can also be used to detect cavitations in pumps.



Figure 7-14: Envelope Selection

From **Main menu** select, **Measure** and **Envelope**.

Or from **Main menu** select, **Measure, Advanced** and **Envelope**.

VIBER X5™ has two applications for Envelope measurement. One **regular Envelope** which is located under **Measurements**, and one **Advance Envelope** which is located under **Advanced Measurements**.

The Advanced Envelope has more setting possibilities and is suited for experienced user.

### 7.5.1. What is Envelope Spectrum?

Assume that the time signal on Figure 7-15 is coming from the vibration created by a gear mesh.

The transfer of the force from one tooth on the first wheel, to another tooth on the second wheel creates each period in this signal.

If the transfer of the force is equal for all the teeth, then the vibration level of all the periods will have the same level.

A normal vibration spectrum of this signal will have only one frequency, the gear mesh frequency, which is the same with the wheel speed (N), times the number of teeth (T).

$$F = N \times T$$

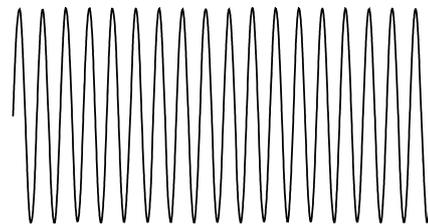
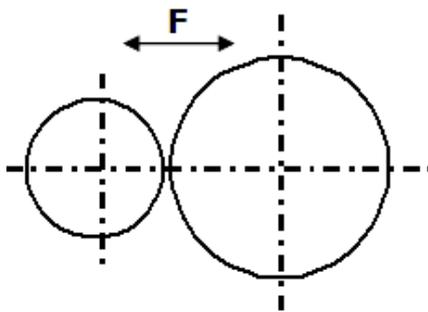


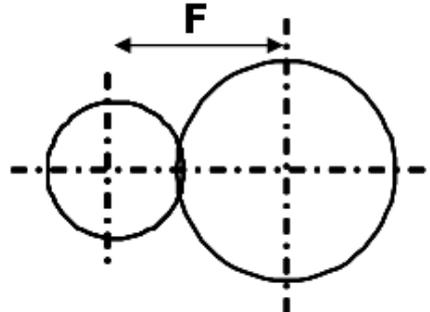
Figure 7-15: Gear mesh time signal

If the pitch diameter of the first gear wheel doesn't have the same centre as the shaft centre, the distance between the teeth on both wheels will change with a corresponding change in the transfer force.

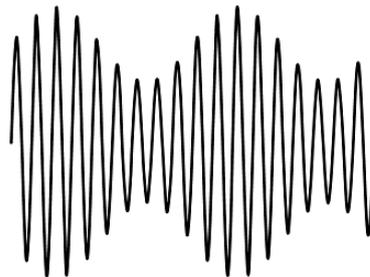
The force between the gears decreases when the distance between the gears is increased.



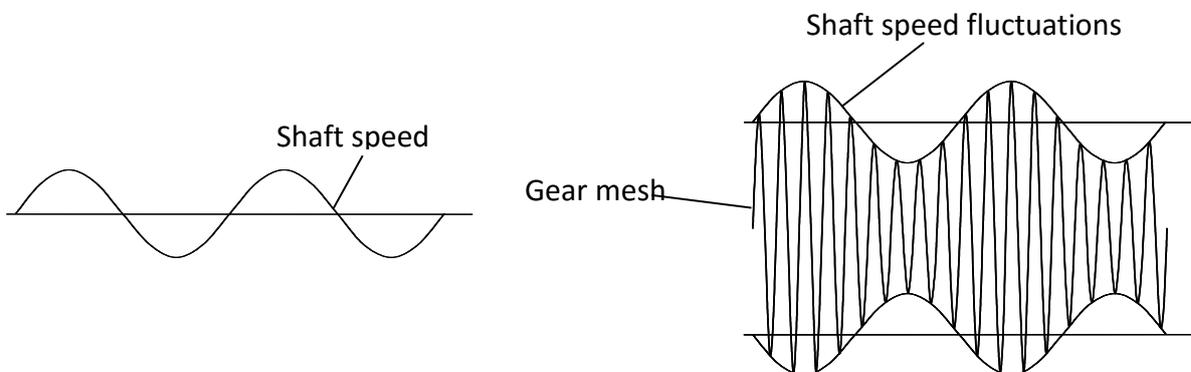
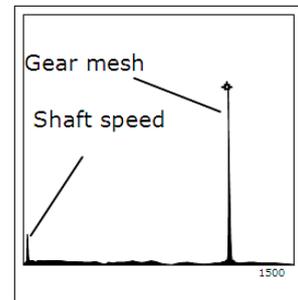
The force between the gears increases when the distance between the gears is reduced.



This will produce an amplitude fluctuation of the gear mesh frequency.



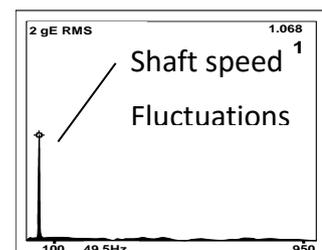
A spectrum of this signal will show two frequencies: one at the gear mesh and one at the shaft speed.



The signal contains one stable signal from the gear mesh and a fluctuating signal from the gear rotation speed.

If we instead only measure the fluctuations of the signal, the remaining signal will look like the picture below.

The resulting spectrum will be a spectrum that emphasizes the fluctuations and minimizes the influence of stable signals. In the new spectrum, the shaft fluctuations become the dominating signal instead of the gear mesh in the normal spectrum.



This is called the **ENVELOPE** spectrum.

When we want to see the fluctuations of high frequencies, it's better to use the unit "g" (acceleration), because the acceleration signal increases in signal level, when the frequency increases.

Envelope signals have their own unit "gE" (Envelope acceleration).

The level of an envelope signal depends more on how much fluctuations a certain fault can create on the original signal and not on the seriousness of the fault itself. It is therefore difficult to compare two different measuring points, but it is possible to compare two Envelope spectra of the same measuring point.

Note! An ENVELOPE spectrum is mainly useful to detect bearing and gear mesh faults in early stage.

## 7.5.2. Envelope Measurement Settings

In the **Envelope Settings** menu, the following parameters can be changed:

- **Detection type** (RMS, Peak or Peak- Peak)
- **Frequency range**(Hz) (600- 1200, 1200-2000, 2200-3200, 3200-4200 or 3200– 20000)
- **Frequency unit** (Hz or CPM)
- **Speed Measurement** (Enabled or Disabled)

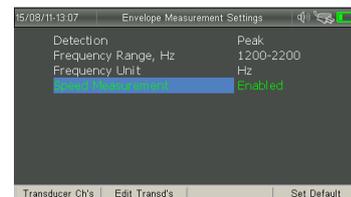


Figure 7-16: Envelope Settings

In the **Advanced Envelope Settings** menu the settings are extended and more flexible. Here you can change:

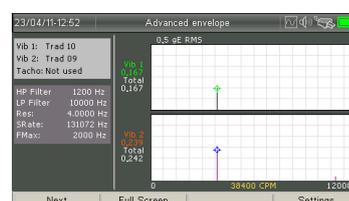
- **Detection type** (RMS, Peak or Peak- Peak)
- **HP Filter** (Hz)(150, 275, 600, 1200, 2200, 3200 or 4200)
- **LP Filter** (Hz) (500, 1200, 2200, 3200, 5000, 10000 or 20000)
- **Maximum Spectra frequency** (Hz) (Maximum frequency of spectra shown after data processing)
- **Resolution type** (low, medium, high) The resolution can be between 0.03125 and 4 Hz as function of the filter settings
- **Frequency unit** (Hz or CPM)
- **Speed Measurement** (Enabled or Disabled)
- **Save Waveform with spectra**(Enabled or Disabled)

In both regular and Advanced Spectra the shortcut bar is available to access directly the related menus, Sensor choice and Edit transducers.

By pressing **F4** (F4), a default set of measurement parameters suitable for many situations will be loaded.

After measurement parameters are set, press **OK** to enter measurement menu or **ESC** to exit.

## 7.5.3. Measure Envelope



You can measure envelope for one or two channels.

When the parameters in the settings menu are set to the desired values, attach the transducers on the measuring point. If speed is enabled, you must attach a tachometer. Press  (OK) to continue. Figure 7-17: Envelope Measurements

If you are using regular Spectra the instrument will automatically continue to take the measurements after auto ranging and stabilization.

If you are using Advanced Spectra, when auto ranging is completed, the instrument will ask you to “Press  (OK) when stable”. To start the measurement, press  (OK).

When the instrument has collected the specified number of averages, the measurement will stop automatically and the measured spectra are displayed.

The following shortcuts may be used to analyze data:

- Display a single spectrum; press  (F1) – Next. When a single channel spectrum is shown, this key doesn't have any effect.
- Full Screen, press  (F2). The spectra are zoomed, to cover the whole screen.
- Settings,  (F4). Open the Settings menu for spectra measurement.
- Move the cursor using the  (LEFT) and  (RIGHT) arrow keys.
- Zoom in or out the X-Scale, using the  (Ctrl) +  (LEFT) or  (Ctrl) +  (RIGHT) key combination. To again enable the auto-scaling mode, press the  (CTRL) +  (F4) (default zoom) key combination.
- Zoom in or out the Y-Axis scale, with  (UP) or  (DOWN) arrow key. To again enable the auto-scaling mode, press the  (Ctrl) +  (F4) (default zoom) key combination.
- Cursor Type,  (Ctrl) +  (F3).
- Side bands cursors can be added by pressing  (Ctrl) +  (UP) or  (Ctrl) +  (DOWN) key combination.
- You can freeze (Stop/HOLD) the measurements by pressing the  (Aux) key.

In HOLD mode you have access to the  (MENU) key menu:

- Save – Save the plot in a file onto the microSD Card.
- Notes – Add notes into the spectrum plot.
- Edit speed – Write manually the speed value.
- Cursor Type
- Help – Access the context sensitive help menu.
- Save screen – Save the screen in a bitmap picture file.

Figure 0-1 can be used as a guide to interpret the Envelope value gE RMS.

Envelope value gE RMS

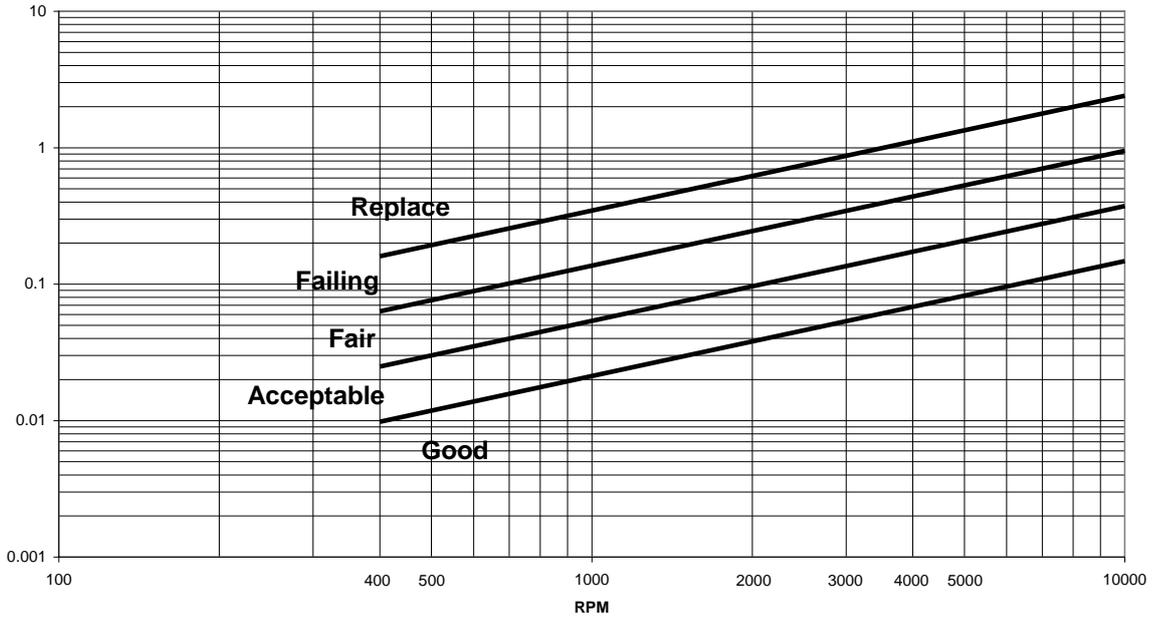


Figure 0-1: Envelope Value



## 7.6. Temperature

In the **Temperature** menu, you can as an example measure the bearing house temperature (or any other surface temperature) with the built-in infrared temperature sensor.



Figure 0-2: Temperature Selection

From **Main menu** select **Measure** and **Temperature**.

### 7.6.1. Temperature Settings

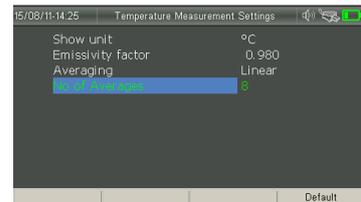


Figure 0-3: Temperature Settings

Table 0-1: Emissivity Factors

Material	Emissivity factor
Heat sink, black anodized	0.98
Paper	0.97
Black paint, matt	0.97
Ice, smooth	0.97
Wood	0.94
Glass	0.94
Rubber, hard	0.94
Transformer paint	0.94
Concrete	0.93
Brick, mortar, plaster	0.93
Porcelain	0.92
Steel, oxidized	0.79
Cooper, oxidized	0.76
Steel, heat treated surface	0.52
Copper	0.04
Aluminium, bright	0.04

When choosing Temperature measurements the instrument will display the Temperature settings menu. In the Settings menu, the following parameters might be set:

- **Show unit.** Celsius (°C) or Fahrenheit (°F).
- **Emissivity factor** (see table below for usual values function of material)
- **Averaging** (Disabled, Linear, Smart)
- **No of Averages** (1, 2, 4, 8, 16, 32 or 64)

By pressing **F4** (F4), all the parameters will be set as default values.

Press **OK** (OK) to start measurement. Press **ESC** (ESC) to exit.

#### 7.6.1.1. Emissivity

Set the **coefficient for surface reflection factor** (Emissivity factor) using, check via a contact probe (the table with emissivity factors is also implemented in the instruments context sensitive help menu).

It is very difficult to get an accurate temperature reading on untreated metals. A coating like paint, oil or emission adhesive tape applied to the object will considerably improve the accuracy of the measurement.

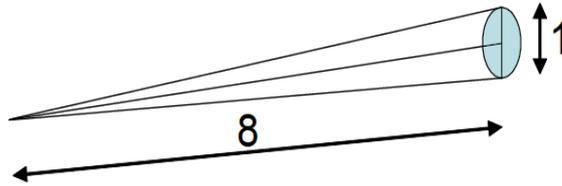
#### Warning!

Incorrect setting of the emissivity factor can lead to considerable errors of measured temperature.

## 7.6.2. Measure Temperature

Direct the IR temperature transducer towards the surface you want to measure, a red laser dot will guide you.

Keep a distance of approximately **200-500 mm (8- 20 inches) between the instrument and the object**. Reduce the distance between the object and the instrument in accordance with the surface size.



The measurement surface size related to the distance 8:1

Tip! When you find the temperature that differs most to the surroundings, then you probably have got the right direction.

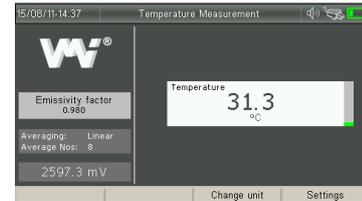


Figure 0-4: Temperature Measurement

On the right side of the temperature value, a bar graph indicates the measurement stability.

On the left side screen are shown:

- The Emissivity factor used
- The direct output from the IR sensor

During live measurements, you can:

-  (F3) - Change measuring unit (°C or °F).
-  (F4) – Access the Temperature Settings menu

The data collection may be temporary suspended (Hold) by pressing the  (AUX) key.

To resume, press the  (OK) key.

In HOLD mode you have access to the  (MENU) key menu:

- Help – Access the context sensitive help menu.
- Save screen – Save the screen in a bitmap picture file.

## 7.7. Speed



The speed (machine revolution) can be measured with an Internal or External Tachometer or by a Current Clamp.



Figure 0-5: Speed Selection

From **Main menu** select **Measure** and **Speed**.

In speed menu all system resources are used only for speed measurement to get the best performance, this means that the accuracy and limits of the speed are very high.

### 7.7.1. Speed Measurement Settings

When you select Speed from measurements menu the instrument will display the settings menu.

In the setting menu, the following parameters can be set:

- Unit (Hz or RPM)
- Number of Revolutions/Pulses – Number of shaft revolutions for each pulse of the speed transducer.
  - If you measure speed of a shaft using a reference mark on it, this is 1.0.
  - If you measure speed of a shaft using a reference mark on another shaft, this number will be the transmission factor.
  - If you have multiple reference marks, Number of Revolutions/Pulses will be set as 1.0/number of reference marks.
- Averaging (Disable, Linear, Smart)
- Averaging numbers (1, 2, 4, 8, 16, 32 or 64)

By pressing **F4** (F4), all the parameters will be set as default values.

Press **OK** (OK) to start measurement. Press **ESC** (ESC) to exit.

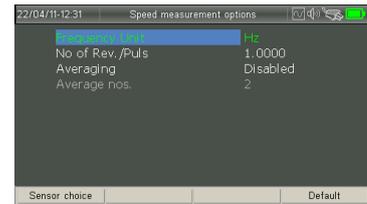


Figure 0-6: Speed Settings

### 7.7.2. Measure Speed

On the right side of the speed square, a bar graph indicates the measurement stability.

On the left side screen are shown details regarding:

- Speed transducer selected
- Multiply factor (Rev./Pulses)
- Averaging number (if it is set)

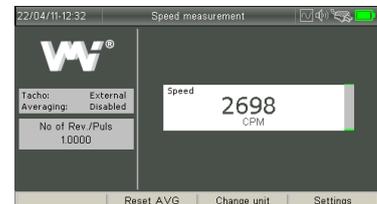


Figure 0-7: Speed Measurement

During live measurements, you can:

- F2** (F2) – Reset average buffer
- F3** (F3) – Change unit (Hz or RPM)
- F4** (F4) – Enter Speed settings menu.

The data collection may be temporary suspended (HOLD mode) by pressing the **Aux** (Aux) key. To resume, press the **OK** (OK) key.

In HOLD mode you have access to the **MENU** (MENU) key menu:

- Help – Access the context sensitive help menu.
- Save screen – Save the screen in a bitmap picture file.

## 7.8. Phase



In the Phase menu, you can measure Amplitude & Phase using 1 or 2 vibration sensors and a speed sensor.

From the **Main menu select Measure and Phase.**

The Phase application can help you diagnosing machine faults such as for example resonance, misalignment, looseness and soft foot.

The Phase application can also help you separate faults that at first look like imbalance but in reality are caused by something else (for example misalignment). Knowledge of the phase relationships of various machine faults will help you to confirm the existence of a specific machine fault and help to prevent misdiagnosis.

### 7.8.1. Phase Measurement Settings

When you select Phase from measurements menu the instrument will display the settings menu for Amplitude/Phase.

The following parameters can be set:

- Measurement type (Acceleration, Velocity, Displacement or mV)
- Show unit (depending on the above selection)
- Frequency unit (Hz or RPM)
- Multiple (X1...X10) – The frequency for amplitude/phase calculation. This may be the running speed (1X) or one of its multiplies (up to 10X)
- Averaging (SMART, ENABLE or DISABLE)
- Averaging numbers (2, 4, 8, 16, 32 or 64).
- By pressing **F4** (F4), all the parameters will be set as default values.

Press **OK** to start measurement. Press **ESC** to exit.

### 7.8.2. Measure Phase

The Amplitude/Phase screen for 2 channels vibration measurements.

On the right side of the values, a bar graph indicates the measurement stability.

On the left side screen are presented:

- Vibration sensors used
- Speed transducer selected
- Frequency range (Hz)
- Multiply (X1, X2, etc)
- Speed indication (RPM).

During live measurements, you can press:



Figure 0-8: Phase Selection



Figure 0-9: Amp./Phase Settings

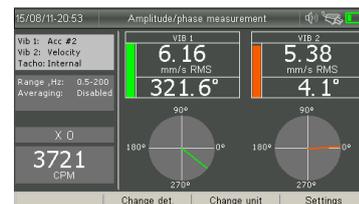


Figure 0-10: Amp./Phase Measurement

-  (F2) – Change vibration detection (RMS, Peak or Peak- Peak)
-  (F3) – Change unit for vibration measurement
-  (F4) - Access the Phase Settings menu.

The data collection may be temporary suspended (Hold) by pressing the  (AUX) key.

To resume, press the  (OK) key.

In HOLD mode you have access to the  (MENU) key menu:

- Save – Save the plot in a file onto the microSD Card.
- Notes – Add notes into the spectrum plot.
- Edit speed – Write manually the speed value.
- Help – Access the context sensitive help menu.
- Save screen – Save the screen in a bitmap picture file.

## Process

With the **Process** application, any process parameter may be measured.



From **Main menu** select **Measure** and **Process**.

### 7.8.3. Process Measurement

#### Settings

When you select Process from measurements menu the instrument will display the settings menu.

The following parameters can be set:

- Engineering unit (user defined) - This is just a description of the parameter that will be measured and does not affect the measurement itself. It may be useful if you want to save the screen for further use.
- Range Low (user defined in engineering units) - Value of the measured parameter when the input signal is 1V (or 4mA)
- Range High (user defined in engineering units) - Value of the measured parameter when the input signal is 5V (or 20mA)
- Averaging (Disabled, Linear, Smart)
- Averaging numbers (2, 4, 8, 16, 32 or 64)
- Process unit (mA or V) the measurement unit for input signals to be shown along with the value of the process parameter.

By pressing  (F4), all the parameters will be set as default values.

Press  (OK) to start measurement. Press  (ESC) to exit.



Figure 0-11: Process Selection

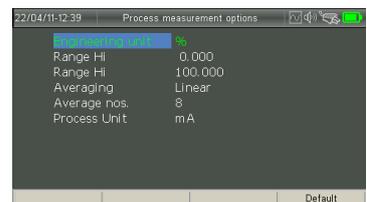


Figure 0-12: Process Settings

## 7.8.4. Measure Process

The physical range of the process measurement must be **1 to 5 V DC or 4 to 20 mA**. The process cable should be **connected to the VIB 2 input**.

If you intend to measure the current, you have to place a resistor of 250 Ohm (0.1%) in parallel with the signal input.

The instrument will display in bottom left corner of the screen the input signal value (depending of process unit setting in Volts or milliamp.).

The value for the process parameter, with measurement unit and the stability bar, is shown in the middle of the screen.

On the left side screen are shown:

- Range Low selected
- Range High selected
- Averaging number (if it is set)
- Signal unit can mA or Volts.

During live measurements, you can press:

-  (F4) - Access the Phase Settings menu.

The data collection may be temporary suspended (Hold) by pressing the  (AUX) key. To resume, just press the  (OK) key again.

In HOLD mode you have access to the  (MENU) key menu:

- Help – Access the context sensitive help menu.
- Save screen – Save the screen in a bitmap picture file.

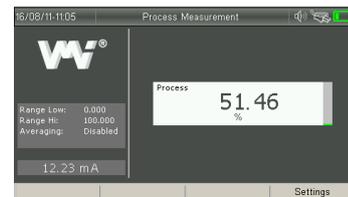


Figure 0-13: Process Measurement

## 7.9. Coast Up



Coast Up is used for analyzing mechanical resonances and for monitoring excessive shaft bending in steam turbines due to uneven heating during a machine run up procedure.

From the **Main menu** select **Measure** and **Coast UP**.



Figure 0-14: Coast Up Selection

Avoid running the machine for a longer time (more than 1 hour) on the speeds where the vibration is amplified more than 3 times.

### 7.9.1. Coast Up Measurement Settings

When you select Coast Up from measurements menu the instrument will display the settings menu.

In this menu, the following parameters can be set:

- **Measurement type** (Acceleration, Velocity, Displacement or mV)
- **Show unit** (depending on the above selection)
- **Detection** (RMS, Peak or Peak- Peak)
- **Maximum Speed**-Maximum speed when the measurement will be stopped. This may be the nominal speed of the machine. The limit is 60 000 CPM
- **Start Speed**- Minimum start speed is 90 CPM
- **Speed interval**- The minimum speed change to store a new measurement point. Disabled means as fast as possible or about 6 CPM (0,1 Hz)
- **Frequency Unit** (Hz or CPM).

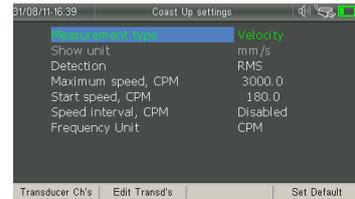


Figure 0-15: Coast Up Settings

By pressing **F4** (F4), all the parameters will be set to a default value.

The function keys have the following shortcuts:

- **F1** (F1)—enters Select Sensor menu
- **F2** (F2) – enters Transducer Settings menu

**In addition to the above settings the instrument will automatically disable the energy saving function automatic shutdown, if this is enabled.**

Press **OK** (OK) to start measurement. Press **ESC** (ESC) to exit.

### 7.9.2. Measure Coast Up

When you enter the measurement, the Instrument displays the measurement parameters and waits for a start confirmation (It displays "Press **OK** (OK) to start measurement").

The screen is divided into two panels:

On the left panel of the screen are presented:

- Vibration sensors used
- Speed transducer selected
- Start speed
- Maximum speed (when measurement will be stopped)
- End speed (when stopped)
- Speed interval
- Actual speed measured (only during measurement)
- Measured points (the number is displayed after the measurement is finished)

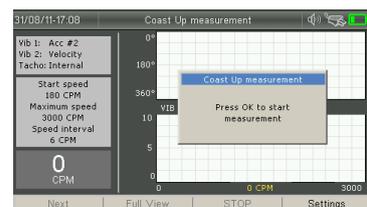


Figure 0-16: Coast Up Measurements

On the right side screen appears the current measurements for one of the measured channels in two diagrams, each of them having the speed on X-axis. The upper diagram shows the Amplitude on Y-axis, in the selected measuring unit. The bottom diagram shows

the phase in degrees, on Y-axis.

Once the measurement is started, the Instrument will automatically stop when the maximum speed is reached. You can manually stop (HOLD) the measurement by pressing  (F3).

In HOLD mode, you may:

- Change the displayed channel, by pressing  (F1).
- Use the cursor to display measured values collected at different speeds. To move the cursor, just press the  (LEFT) or  (RIGHT) arrow keys
- Have access to the  (MENU) key menu:
  - Save – Save the plot in a file onto the microSD Card.
  - Notes – Add notes into the spectrum plot.
  - Help – Access the context sensitive help menu.
  - Save screen – Save the screen in a bitmap picture file.

Exit by pressing  (ESC). If the data have not been saved in a file, the Instrument will ask you to save it.

## 7.10. Coast Down



Coast-down is used for analyzing mechanical resonances (the speeds where the vibration is amplified).

From **Main menu** select **Measure** and **Coast Down**.



Figure 0-17: Coast Down Selection

Avoid running the machine for a longer time (more than 1 hour) on the speeds where the vibration is amplified more than 3 times.

### 7.10.1. Coast Down measurement settings

When you select Coast Down from measurements menu the instrument will display the settings menu.

In this menu, the following parameters can be set:

- **Measurement type** (Acceleration, Velocity, Displacement or mV)  
Show unit (depending on the above selection)
- **Detection** (RMS, Peak or Peak- Peak)
- **End Speed**-The end speed when the measurement will be stopped.
- **Speed interval**- The minimum speed change to store a new measurement point. Disabled means as fast as possible or about 6 CPM (0,1 Hz)
- **Frequency Unit** (Hz or CPM).

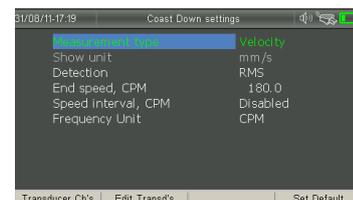


Figure 0-18: Coast Down Settings

Minimum start speed is 300 CPM

Maximum start speed is 60000CPM

By pressing **F4** (F4), all the parameters will be set to a default value.

The function keys have the following shortcuts:

- **F1** (F1) – enters Select Sensor menu
- **F2** (F2) – enters Transducer Settings menu

**In addition to the above settings the instrument will automatically disable the energy saving function automatic shutdown if this is enabled.**

Press **OK** (OK) to start measurement. Press **ESC** (ESC) to exit.

## 7.10.2. Measure Coast Down

When you enter the measurement, the Instrument displays the measurement parameters and waits for a start confirmation (It displays "Press **OK** (OK) to start measurement").

The screen is divided into two panels:

On the left panel of the screen are presented:

- Vibration sensors used
- Speed transducer selected
- Start speed (after measurement)
- End speed (when the measurement will be stopped, and actual stopped when the measurement is finished)
- Speed interval
- Actual speed measured (only during measurement)
- Measured points (the number is displayed after the measurement is finished)

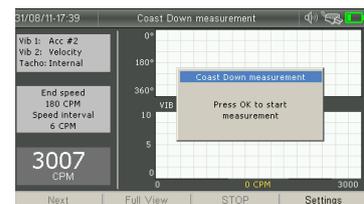
On the right side screen appears the current measurements for one of the measured channels in two diagrams, each of them having the speed on X-axis. The upper diagram shows the Amplitude on Y-axis, in the selected measuring unit. The bottom diagram shows the phase in degrees, on Y-axis.

Once the measurement is started, the Instrument will automatically stop when the maximum speed is reached. You can manually stop (HOLD) the measurement by pressing **F3** (F3).

In HOLD mode, you may:

- Change the displayed channel, by pressing **F1** (F1).
- Use the cursor to display measured values collected at different speeds. To move the cursor, just press the **LEFT** or **RIGHT** Arrow keys
- Have access to the **MENU** (MENU) key menu:
  - Save – Save the plot in a file onto the microSD Card.
  - Notes – Add notes into the spectrum plot.
  - Help – Access the context sensitive help menu.
  - Save screen – Save the screen in a bitmap picture file.

Exit by pressing **ESC** (ESC). If the data have not been saved in a file, the Instrument will ask you to save it.



**Figure 0-19: Coast Down Measurements**

## 7.11. Orbit



The **Orbit (XY Shape) Measurement** will display a diagram of X value versus Y value, using two measurement channels.

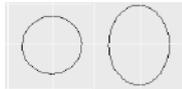
From **Main menu** select **Measure, Advanced** and **Orbit**.

The measurement requires 2 transducers of same type connected to the VIB 1 and VIB 2 inputs. The directions of the two transducers must be perpendicular (90 degrees angle).

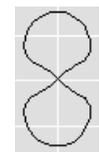
If the transducers used are displacement transducers, this diagram is the relative orbit of the shaft.

The proximity probes are installed in a sleeve bearing, one oriented vertically and one oriented horizontally. Under these conditions, vertical motion of the shaft center line will move the value vertically, and horizontal motion of the shaft will move the value horizontally. When the shaft is turning, the X and Y value will be stationary if the center of the shaft is stationary in the bearing. If the shaft is migrating around in the bearing, the value will follow, and it will trace out the motion of the shaft center on the diagram.

Under normal operating conditions, the instrument will show a circle, indicating the oil film has equal stiffness and thickness in all directions, and there is some imbalance causing the centerline to move in a circle.



The orbit plot at the left shows an ideal condition of the shaft in the bearing, while the one on the right shows that the shaft is moving more in the vertical direction than it is in the horizontal direction. This may mean that the bearing is worn in an oval pattern, with more vertical clearance than horizontal clearance.



An orbit pattern that shows shaft motion in a figure 8 pattern, indicates that it is vibrating twice as fast in one direction than in the other one. This can be caused by excessive clearance in one direction, or a bearing worn into an oval shape. A pattern like this is a danger sign, for the journal is likely to develop metal-to-metal contact with the bearing, causing extensive damage to both.

### 7.11.1. Orbit Measurement Settings

In the Settings menu you can set the following parameters:

- **Number of periods to display** (1, 2, 4, 8) related to measured or estimated speed, function of reference transducer usage.
- **Tacho** (Enabled, Disabled) Reference transducer
- **Estimated speed**. The estimated speed will be used to determine the acquisition time when a reference transducer (Tacho) is not used, or as a default value for speed.



Figure 0-20: Orbit Selection

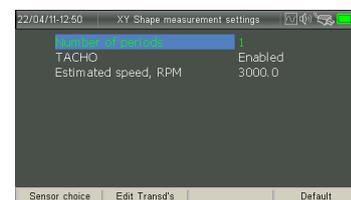


Figure 0-21: Orbit Settings

The Settings menu has also shortcuts to the following related menus:

- **F1** (F1) - Assign channels menu
- **F2** (F2) – Sensor choice menu

By pressing **F4** (F4), all the parameters will be set to a default value.

When the parameters were set to desired values check that the transducers are connected and press **OK** (OK) to continue. The instrument will do auto ranging and will display the diagram as shown on the right:

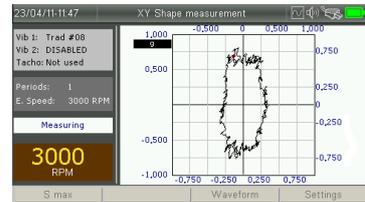


Figure 0-22: Orbit Measurements

The screen has two panels:

On the left panel the instrument displays the transducers and the speed (either measured or estimated). The XY diagram will be shown on the right panel.

The measurement can be stopped (HOLD) by pressing the **AUX** (AUX) key.

In HOLD mode, you have access to the **MENU** (MENU) key menu:

- Save the plot in a file on the microSD Card as an analysis file. The content may be downloaded to the SpectraPro® database or it may be shown locally.
- Add notes to be saved in analysis file along with spectra.
- Enter Help menu
- Save the screen into a bitmap picture file.

To view the waveform used to display the diagram, press **F3** (F3).

To calculate the maximum deviation of the diagram, press **F1** (F1). After calculation, this will be displayed on the diagram.

To resume the measurement, press **OK** (OK).

### 7.11.2. XY Shape PC Application

XY Shape Application is an accompanying tool to the SpectraPro® software, used to visualize VIBER X5 MkII™ XY Shape files. The software is free of charge when you buy a VIBER X5 MkII™.

The program is located under the PC Application folder in the VIBER X5 MkII™ SD card when the instrument is delivered.

When the instrument is connected to the PC through the USB cable select PC Application folder, copy the setup file to your preferred location on your computer and install the software, you are now ready to use it.

Using this application you can:

- View the XY File contents on the PC in a graphic mode.
- Select from the time-signal, a part to be plotted in XY Shape mode
- See the maximum machine movements (Smax).

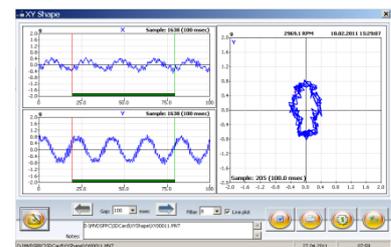


Figure 0-23: XY Shape Application

- Send the graph to a MS Word document.
- Preview/Print a graph report.

A screenshot of main window of the program is presented above.

The window has on the bottom a series of buttons, which allow the following actions:

**OPEN**



To open a XY Shape file, select from the browser any XY file and press Open. Before opening a new file, the application checks if the file is a XY Shape file and also the file integrity.

The XY Shape file is in binary format and has the extension .mv7.

If you have saved an XY measurement in your instrument the file is located under the XY Shape folder in the VIBER X5 MkIII™ SD card.



**Send graph to MS Word**

This action will send the graph plots to a MS Word document file.



**Preview/Print**

With this action you can preview or print a report containing graph plots.



**INFO**

Show information regarding application version.



**EXIT**

Close the application and all opened files.

The XY graph shows in a bi-dimensional graph, a part of the time-signal measured in two perpendicular directions. Using the combo box above the time-signal plots, you can select a time range between 50 to 2000 milliseconds.

Just click and drag the left and right cursors to establish the exact time range you want to be shown. After that, with left or right arrow keys, you can move the cursors in both X and Y time-signal plots. The XY Shape will be changing live.

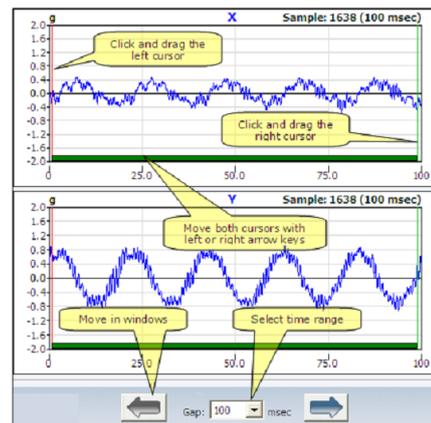


Figure 0-24: XY Graph

## 7.12. Data Logger



In the **Data logger** menu group, the Instrument continuously measures the vibration total value for 1 or 2 channels and stores the results in a file at a specified time interval.



Figure 0-25: Data Logger Selection

From **Main menu** select **Measure** and **Data Logger**.

The resulting file may be analyzed in a computer using the X5 Logging application delivered together with VIBER X5 MkII™, see X5 Logging Application section below.

### 7.12.1. Data Logger Application Menu

In the Intro menu you can select between:

**Continue** - To continue a previous logging session (using the last logging parameters) stopped for different reasons. If the file is completed, an information message will appear. When you choose “Continue” the measurement parameters cannot be changed.

**Total Value** - To Start a new Data Logging session (the logging parameters must be configured).

**Phase** – This function logs amplitude and phase data together and displays a report about each separately.

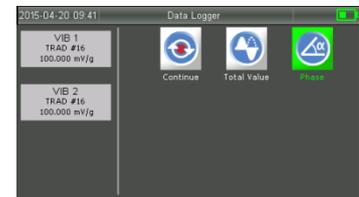


Figure 0-26: Data Logger Application Menu

### 7.12.2. Data Logger Settings

In this menu, the following parameters can be set:

- Measurement type (Acceleration, Velocity, Displacement or mV)
- Show units (depending on the above selection)
- Detection type (RMS, Peak or Peak-Peak)
- Max. frequency (Hz)
- Multiple(Only in Phase Settings) You can select to record the multiple of the machine speed.
- Log Value:
  - Current - Store the actual measured value when the time condition is reached.
  - Linear average – Store a linear mean value measured during the time interval
  - Smart average - Averaging as linear but when the value change more than 5% percent the averaging resets.
  - Peak Hold - Store the maximum value measured in the time interval.
- No of Averages - Number of averages for linear and Smart averaging.
- Interval (seconds) - time interval between log values, in seconds
- Stop condition (Time, Sample count)

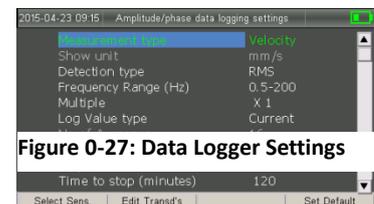


Figure 0-27: Data Logger Settings

- Time to stop (mins)
- Max. record count - Maximum number of data samples.
- Frequency Unit (Only for Phase) – Set your phase frequency unit
- Store on speed change (Only for Phase) – Enable to save data if a change of speed occurs

**F1** (F1) – Shortcut to **Sensor choice** menu

**F2** (F2) - Shortcut to **Edit transducers** menu

By pressing **F4** (F4), all parameters will be set to a default value.

After you have made the preferred settings, press **OK** (OK) to enter the measurement.

### 7.12.3. Measure Data Logger

To prevent stopping or exit the measurement by accident when you are to measure continuously over a long period, stop and exit the measurement are made by the function keys **F3** (F3) and **F4** (F4).

When you enter the measurement, the instrument displays the measurement parameters and waits for a start confirmation (It displays "Press OK to start measurement").

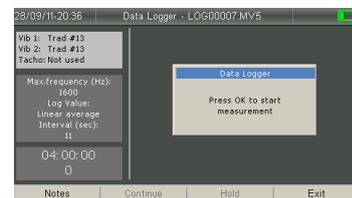


Figure 0-28: Start confirmation

On the Window header the file name of the logging session is displayed.

The screen contain two sides, on the left side are displayed:

- Transducer(s) used
- Max. frequency
- Log Value type
- No of Averaging samples
- Current sample/Maximum sample when Sample count is selected, or alternatively a time count down and number of samples logged.

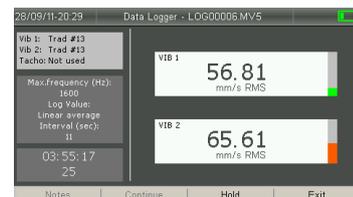


Figure 0-29: Data Logger Measurement

On the right side are the current value, the measuring unit and a bar graph indicating the measurement stability for each measured channel.

The measurement (and logging) can be stopped (HOLD) by pressing the **F3** (F3) key.

To resume, press the **F2** (F2) key.

In HOLD mode, you have access to the **MENU** (MENU) key menu:

- Enter Help menu
- Save the screen into a bitmap picture file.

You may also press **F1** (F1) to add notes.

## 7.12.4. Data Logger files Viewer

X5Logging Application is an accompanying tool of the SpectraPro® software, used to visualize or convert VIBERX5™ logging file. The software is free of charge when you buy a VIBER X5 MkII™ instrument.



Figure 0-30: X5 Logging Application

The program is located under the PC Application folder in the VIBER X5 MkII™ SD card when the instrument is delivered.

When the instrument is connected to the PC through the USB cable select PC Application folder, copy the setup file to your preferred location on your computer and install the software, you are now ready to use it.

Using this application you can:

- View the logging file contents in a simple table or formatted.
- Convert the binary logging file (.mv5) in various standard format (CSV, RTF, TXT)
- Open the logging file in the Microsoft Word or Excel.
- Open the logging file in Windows Note Pad or similar application.

The program starts with a main screen where it displays the configuration of current data logging file.

The window has on the bottom a series of buttons, which allow the following actions:



### OPEN

Open a VIBER X5 MkIII™ logging file. The logging file is in binary format and can't be viewed directly. Any logging file has the extension .mv5. File can be located anywhere, including onto VIBER X5 MkIII™ microSD Card.



### VIEW DIRECT

Using this button, you can view the logging file in a tabular format, in separate windows. From the same Windows, you can also print the file contents.



### OPTIONS

Options allow you to configure the way of converting/saving the source logging file. You can open the logging file with MS Word, MS Excel or with a simple text editor. Also you can save the file in a standard format (CSV, RTF or TXT).



### VIEW/CONVERT

Open the logging file or to convert it, according with the options settled before.



### INFO

Show information regarding application version.



**EXIT**

Close the application and all opened files.



**PRINT PREVIEW**

Display the data in print preview mode.



**EXIT**

Exits to main page

When View option is selected, the program will display all the values and the events recorded into the file in a window, from which you can print or preview the content.

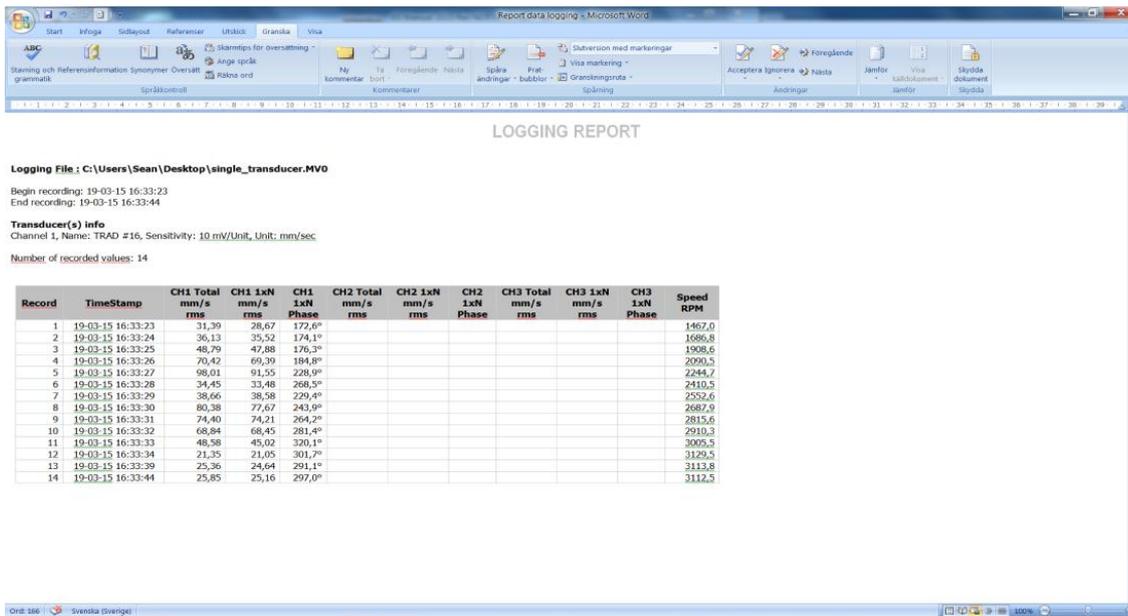


Figure 0-31: Print Preview

## 7.13. Vibshape



The Vibshape™ function is mainly used to collect data for computer animation of machinery vibrations.



Figure 0-32: Vibshape Selection

From **Main menu** select **Measure** and **Vibshape**.

The Vibshape™ function can also be used to measure coast-up on RPM controlled machines like steam turbines and frequency controlled motors. Because the instrument saves the vibration, phase and speed of each measurement many transducers (one by one) can be measured at the same speed

To use the Vibshape™ function the instrument must have a signal on the RPM input. This signal is usually coming from the RPM transducer in the same way as with balancing, but can also come from another source like a signal generator

driving a vibrator.

- Ongoing: Continue on the last list you were working on
- New: Create a new Vibshape list
- From file: Open a previously stored list



Figure 0-33: Vibshape Application Menu

### 7.13.1. Vibshape Settings

When you select New the program displays the settings menu. The following parameters can be set:

- **Measurement type:** mV, Acceleration, Velocity or Displacement
- **Detection type:** How the amplitude of the frequency is calculated. RMS, Peak or Peak- Peak.
- **Frequency unit:** Hz or CPM
- **Multiple 1 value:** Number of times to multiply vibration and angle to the reference signal (Ext. Tacho)
- **Multiple 2** (Enabled, Disabled) If disabled you will create a list with only Multiple 1 values.
- **Multiple 2 value:** The instrument can measure two values from the same transducer at the same time. By entering for example 1 after **Multiple 1 value** and 3 after **Multiple 2 value** the instrument will measure the vibration and angle (phase) of one and three times the shaft speed or reference input.

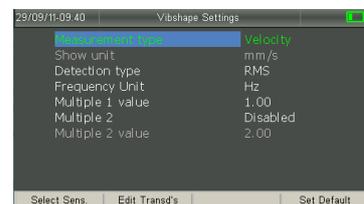


Figure 0-34: Vibshape Settings

**Note!** If you are entering a multiple value, for example  $1/3 = 0.33$ , this is not an exact multiple or division of the speed and the phase reading will slowly change (rotate). This will occur because the internal instrument speed is not exactly the same as the rotation speed. The change is increasing with time and the different measurements will not be comparable.

- F1** (F1) = Shortcut to Select Sensor menu, to select which transducer to work with. If you select a sensor for both Vib1 and Vib2 the instrument will measure 2 points each time you press **OK** to measure. If you disable Vib2 a list with only 1 point per measurement will be created.
- F2** (F2) = Shortcut to Transducer Settings menu, to make the settings for the transducers.
- F4** (F4) = All parameters will be set to default value.

After you have made the preferred settings, press **OK** to enter the measurement.

### 7.13.2. Measure Vibshape

To use Vibshape function the instrument must have a signal from a Tacho input. This signal is usually coming from the RPM transducer in the same way as with balancing, it can also come from another source like a signal generator driving a vibrator.

Press **OK** to measure a new point. After each measurement the instrument will automatically jump to the next point to be measured.

If you have selected a transducer for Vib1 only (Vib2 input is disabled), you will add to the measurement list 1 (one) point each time you press **OK** to measure.

If you have selected a transducer for Vib1 and Vib2, you will add to the measurement list 2 (two) points each time you press **OK** to measure. The first point will be from Vib1 and the second from Vib2. Next measurement will add another 2 (two)

points having Vib1 as number 3 and Vib2 as number 4 and so on.

If you have Enabled Multiple 2 you will have a list with 2 values for each measurement point.

In measurements menu when pressing **MENU** key you can:

- **Enter Vibshape settings:** To recreate as true shape vibration as possible the settings menu should be seen as information only during measurement. For this reason the settings for Multiple 1 and Multiple 2 are disabled.

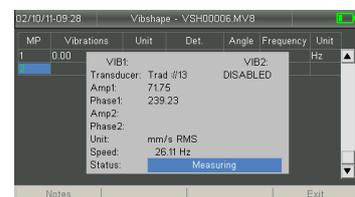


Figure 0-35: Add one point

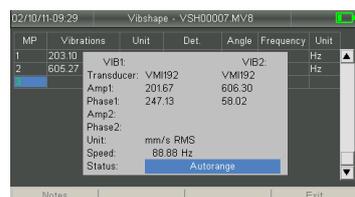


Figure 0-36: Add two points



Figure 0-37: Multiples

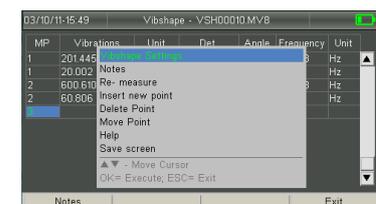


Figure 0-38: Vibshape Menu

- **Add notes**
- **Re- measure a point:** Select the point you would like to re-measure with the  (UP) or  (DOWN) arrow key. You may put the cursor on either multiple 1 or 2, the program will select both multiplies, there after enter  (MENU) key menu and select Re- measure. Only 1 point will be measured using the Vib1 transducer.
- **Insert a new point:** Select the point/row where you would like to insert a new point with the  (UP) or  (DOWN) arrow key. You may put the cursor on either multiple 1 or 2, the program will select both multiplies, there after enter  (MENU) key menu and select Insert new point. Press  (OK) to measure the new point. Only 1 point will be measured using the Vib1 transducer.
- **Delete a point**
- **Move Point:** Select the point you would like to move with the  (UP) or  (DOWN) arrow key. You may put the cursor on either multiple 1 or 2, the program will select both multiplies, there after enter  (MENU) key menu and select Move Point.
- **Enter Help menu**
- **Save the screen in a picture file**

The Vibshape file name is displayed on the window header.

You exit the Vibshape application by pressing  (F4), Exit.



## 7.14. Advanced Measurements

This menu contains applications with extended setting possibilities or special measurements and is intended for advanced users. It is found in the Measurement Menu. The following Advanced Functions and settings are designed to allow in-depth analysis of a machines vibration spectrum:



**Spectra** – (extra settings) Shown Unit, Resolution Hz/Line, No of Averages. **Refer 7.4**



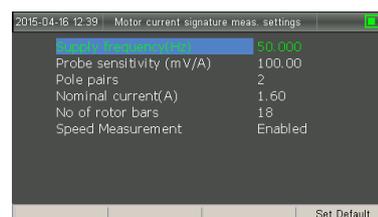
**Envelope** – (extra settings) Resolution Type, Resolution Hz/line, Save Waveform with Spectra. **Refer 7.5**



**Orbit** - Number of Periods, Tachometer, and Estimated Speed rpm. **Refer 7.11**



**MCSA** - The Motor Current Signature Analyser function is useful for inspection of electrical motor windings to determine whether faults maybe present. It is also useful for measuring the machine shaft speed if access to the shaft is not possible. In this menu you can choose your **Supply Power Frequency (Hz)**, **Probe Sensitivity (mV/A)**, **Pole Pairs**, **The Nominal Current(A)** of the motor, **The Number of Rotor Bars** and whether **Speed Measurement** is Enabled or Disabled.



If using the *Fluke i2000 Flex AC Current Probe* we recommend using the 20A (100mV/A) setting to ensure a correct reading. Becoming familiar with the current probes instructions before use is also recommended.

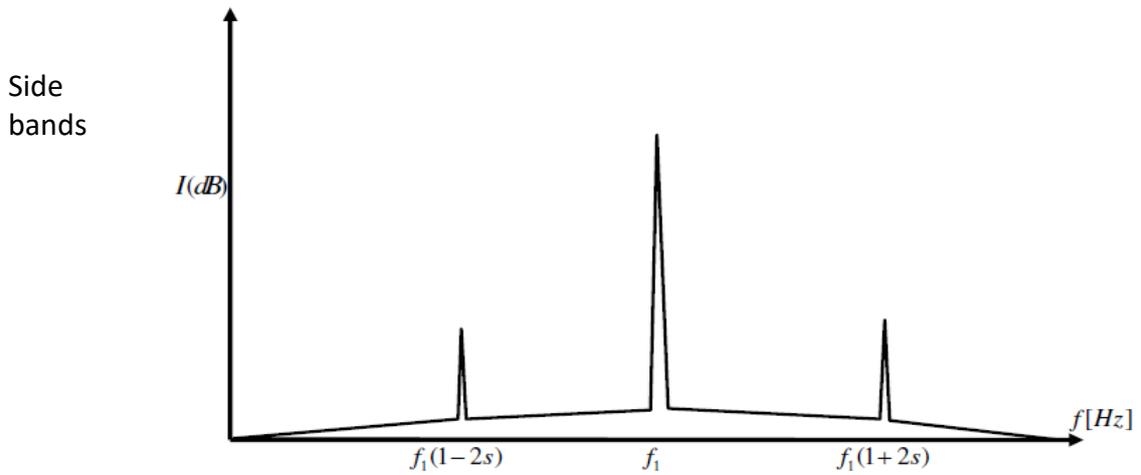
After you have selected your required settings Press (OK) to enter the measurement window. Watch the reading and when it becomes stable Press (OK). The device will start processing the data being received; this may take a few seconds.

Once the data is processed by pressing (F1) you can change between 4 different views which give you different representations of the probes signals for analyzing different motor faults. The 4 views are **Broken Rotor Bars**, **Shorten Turns**, **Full Range** and **Demodulated**.

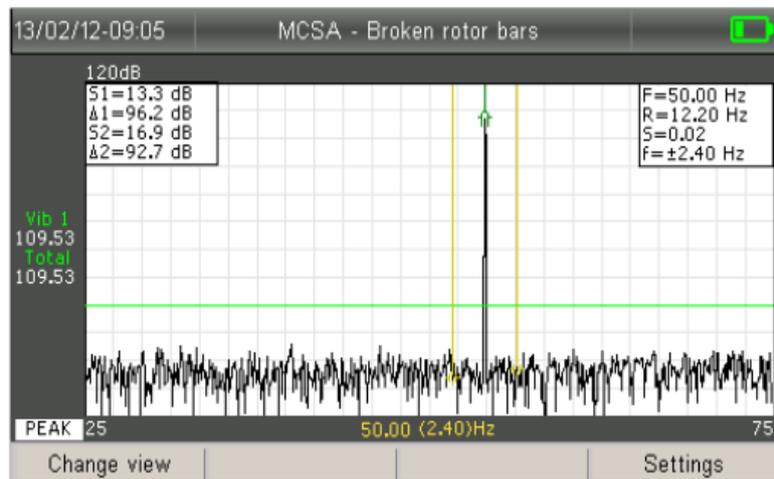
The first view(default) will make **Broken Rotor Bars** easy to identify. The rotor currents in a cage winding produce an effective 3-phase magnetic field with the same number of poles as the stator field but rotating at slip frequency, this frequency is the actual rotation of the rotor which lags slightly behind the stator's current field.

With symmetrical cage windings, only a forward rotating field exists. If rotor asymmetry occurs then there will also be a resultant backward rotating field at -2x slip frequency with

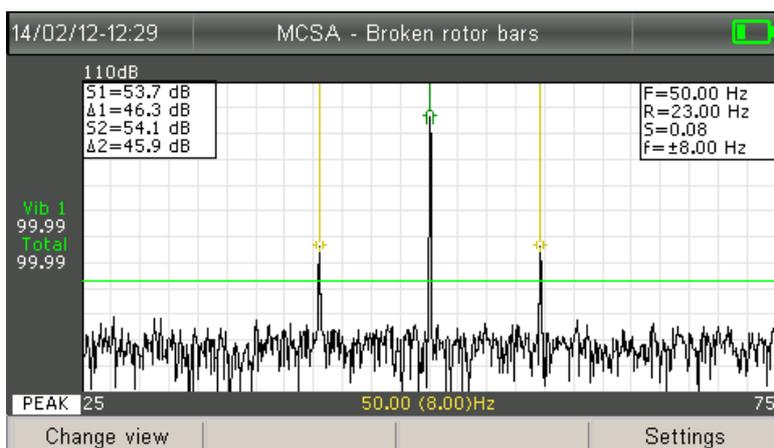
respect to the forward rotating rotor. As a result, the backward field induces an electromagnetic field and current in the stator winding. This can be seen as the lower sideband of slip frequency. The Upper side band is created by torque pulsation at twice slip frequency due to current variations in the stator windings caused by the lower sideband.



A healthy motor under full load (Power freq. 50Hz)

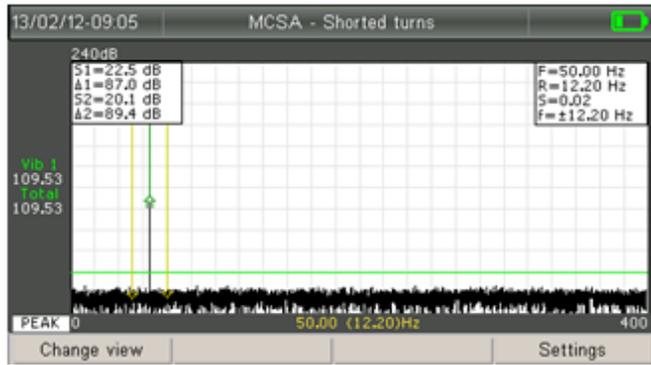


A faulty motor under full load (Current =100A, Power freq.=50Hz, Speed=1380 RPM, with sidebands at  $\pm 8$  Hz)

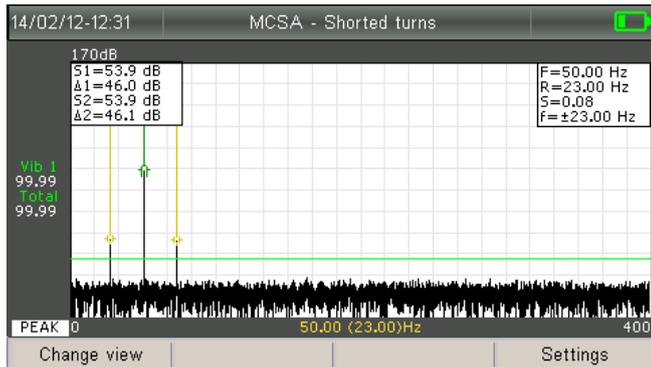


In the **Shorten Turns** view sidebands created by insulation failure in the stator windings will be prominent, at a frequency dependant of the air gap and axial flux variation this is also effected by load and speed.

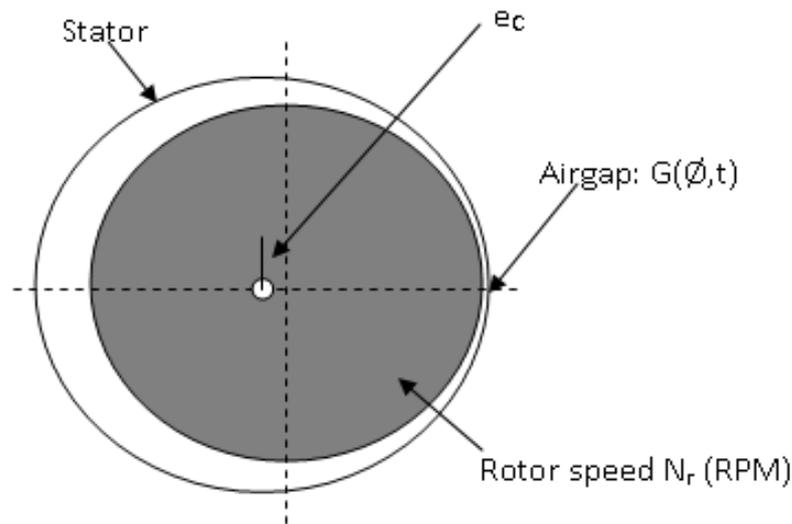
As you can see in the example the upper and lower sidebands present in the bottom picture at 23hz from the motors frequency are have an amplitude of 53.9dB. They are caused by shorten turns in the stator which produce magnetic variations in the rotating field similar to the effect on the rotor when it has broken bars.



As the breakdown of insulation increases these sidebands will increase in amplitude more and decrease the amplitude of the motors running frequency, reducing torque eventually to a point where the motor will be unable to run. By detecting this breakdown of insulation early we are able to take corrective measures at an opportune time to repair or replace the motor.

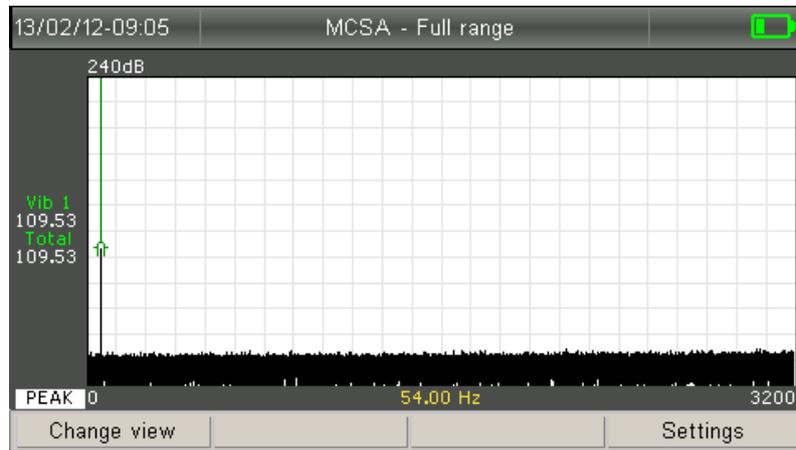


**Full Range** view is used to detect frequency components that are a function of airgap eccentricity. There are two types of simultaneously occurring eccentricity, Static and Dynamic. Static eccentricity is where the radial position of the minimal airgap length is fixed. This is caused by manufacturing and part tolerances. Dynamic eccentricity is caused by the rotation of the minimal airgap with the rotor and can be caused by non concentric outer rotor diameters or thermal bowing of the shaft. The airgap eccentricity specified by a manufacturer is the radial airgap eccentricity (static plus dynamic) and is normally given as a percentage ( $e\%$ ) of the nominal radial airgap length ( $g$ ).

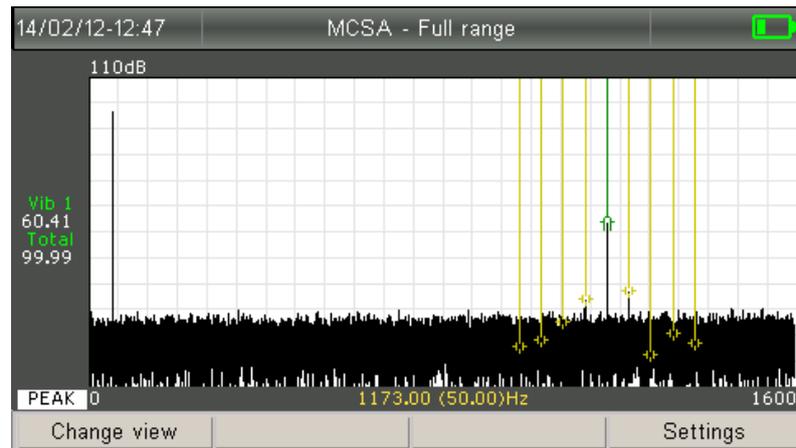


as a  
of the

The 2 pictures demonstrate how **Full Range** can be useful when analyzing a wide range of motor faults. It is always beneficial to observe the entire spectrum of a motors current signature when considering possible causes of malfunction.

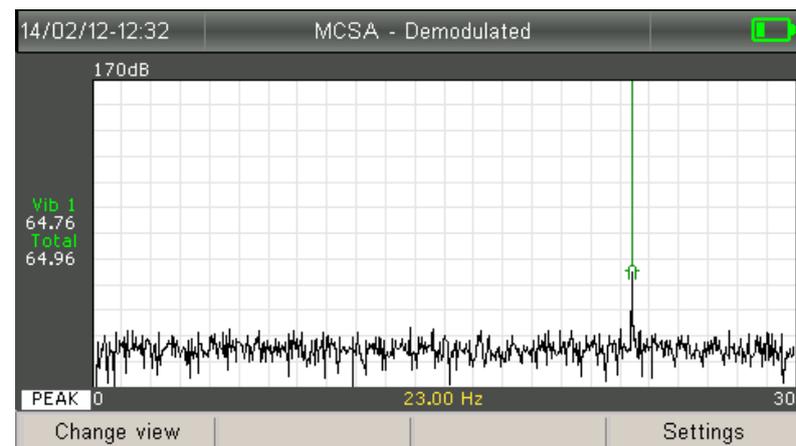


The bottom display is showing a fault condition at a frequency far from the operating frequency. We may miss this if we concentrated only on analyzing sidebands of the operating frequency. This fault is representative of a typical airgap eccentricity fault.



In **Demodulated** view you can observe a much cleaner spectrum, modulation is when lower frequencies are merged on top of a higher frequency. In other words, lower frequencies ride on the higher frequency signal. This makes the carrier frequency the dominant peak in the FFT spectrum, and most of the information is lost in the noise floor of the spectrum. The repetitive load variation frequencies have always been present but difficult to identify and trend in the current spectrum.

Demodulation is simply the process of taking the carrier frequency out of the spectrum. In **Demodulated** view the frequencies related to repetitive load variations are left behind and shown on the demodulated current spectrum.



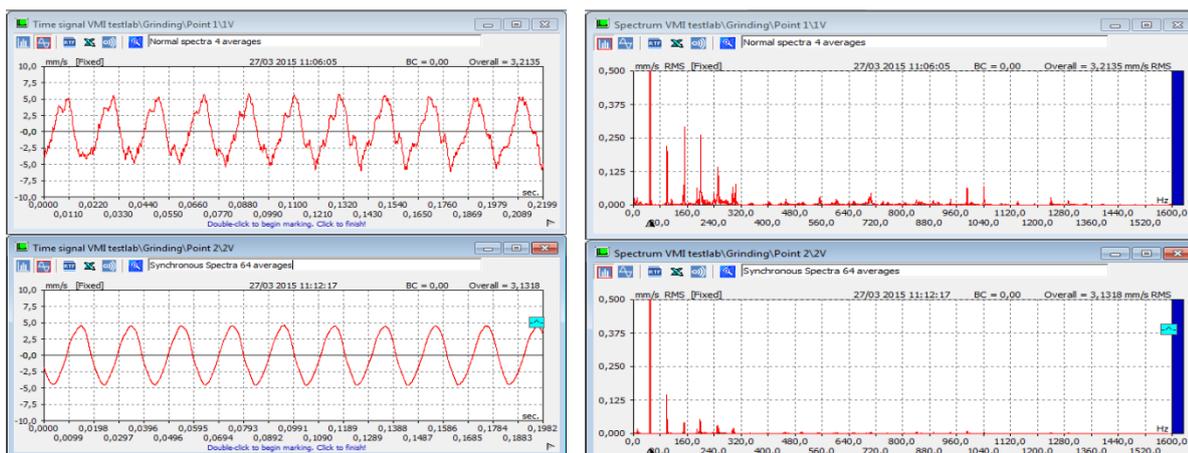
Fault frequencies can be identified and trended in the demodulated current spectrum. The ability to have baseline data when the machine is in good health is ideal, while comparing data to similar machines is also very effective.



## Sync Spectra

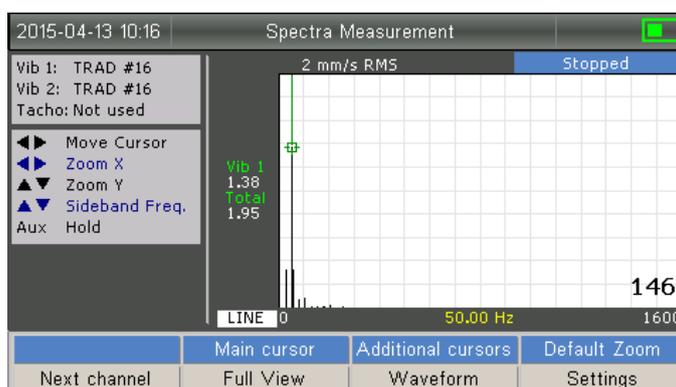
This function synchronizes spectra readings, to the machine speed, so these vibrations will be prominent. **Refer to 7.4 for more information on setting up the Viber X5 MkII for Spectra readings.**

A synchronous spectrum means that the digital sampling of the measured signal starts each time the tachometer sends a signal to the device. The final time signal will be an average of each individual time signal. Non synchronous samples will sometimes be positive and sometimes negative and the average of these samples will be close to zero. With a sufficient number of averages the resulting time signal will be a signal synchronous with the tachometer reading. This function is particularly useful when analyzing a machine where several shafts and speeds are involved.

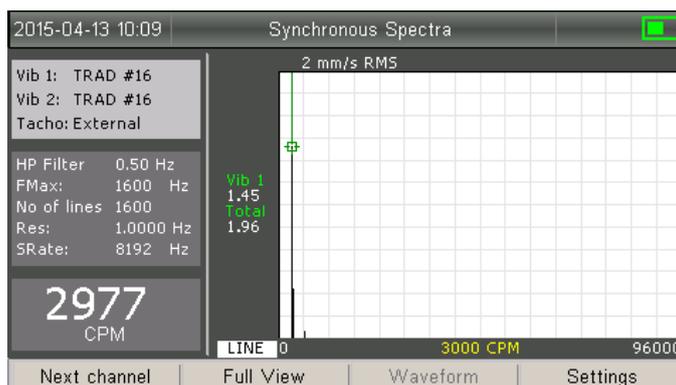


In the **two pictures above (provided using Spectra Pro software)** you can see the top windows display a normal sampling while the bottom windows display the same sample with sync spectra applied. The signal is much cleaner due to the removal of vibrations which do not relate to machines shaft speed.

You can see the same here displayed by the Spectra and Sync Spectra displays of the Viber X5 MkII. The top picture is a normal Spectra reading while the one below is the cleaner Synchronous Spectra.



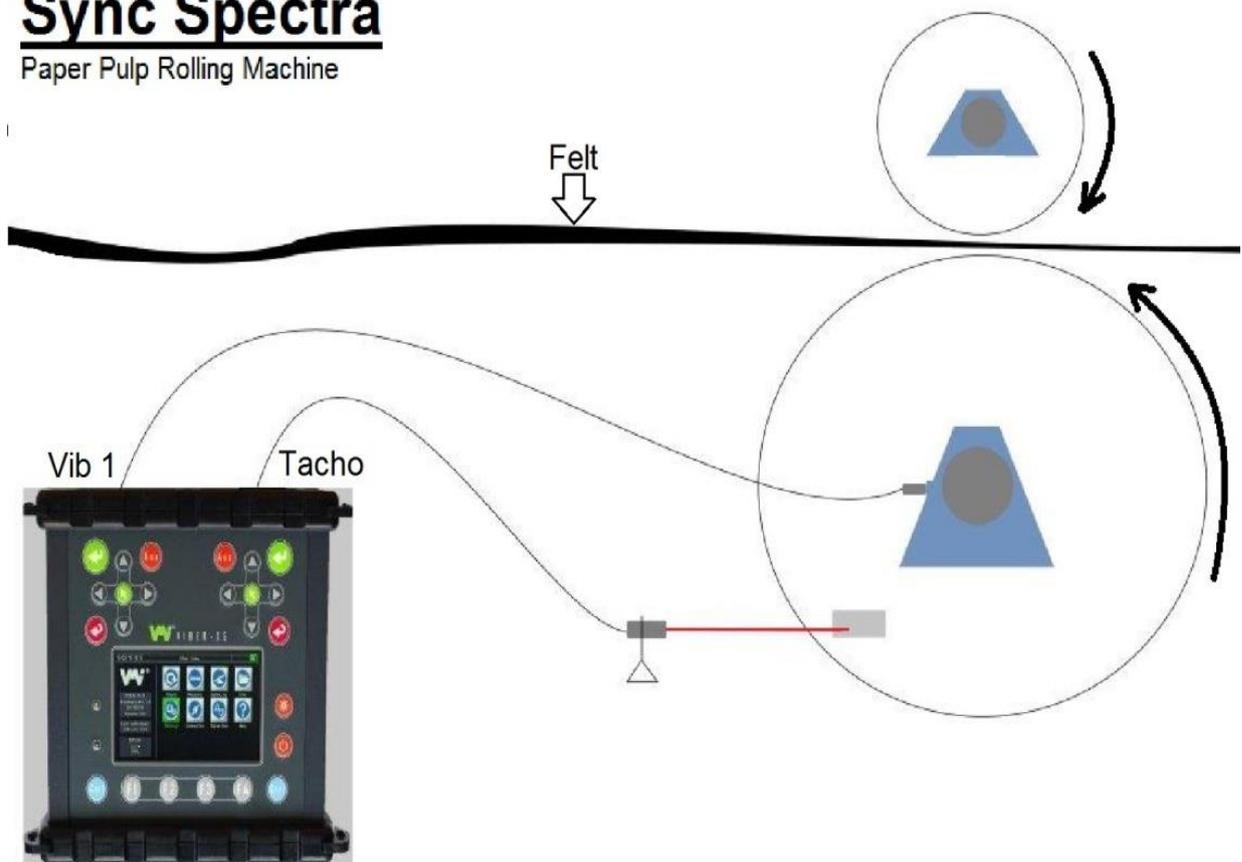
The measurement shows only vibrations which relate to shaft speed.



The pressure section in a paper machine involves the suction roll, the pressure roll and the felt. By measuring three separate synchronous spectrum with the tachometer placed on the three parts, the two rollers and the felt, you can find the source of the vibration and also measure when patterns occur in the felt, because each of the three spectra will only show vibrations synchronous with their own speed.

## Sync Spectra

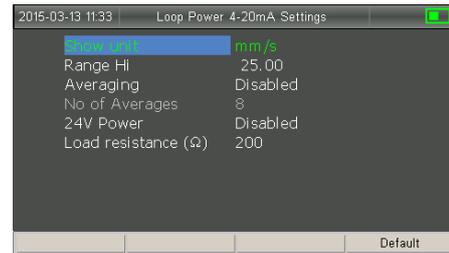
Paper Pulp Rolling Machine



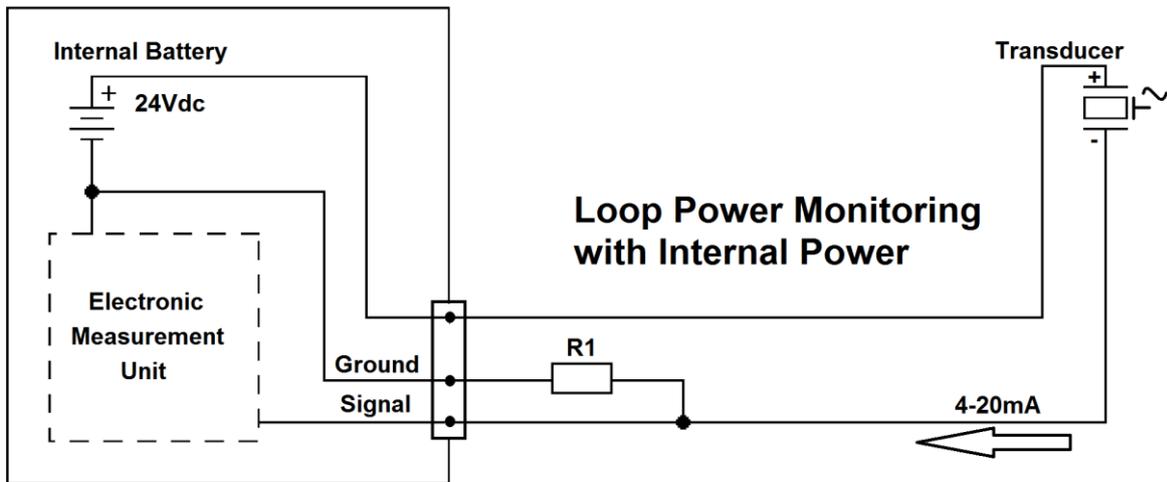


## Loop Power

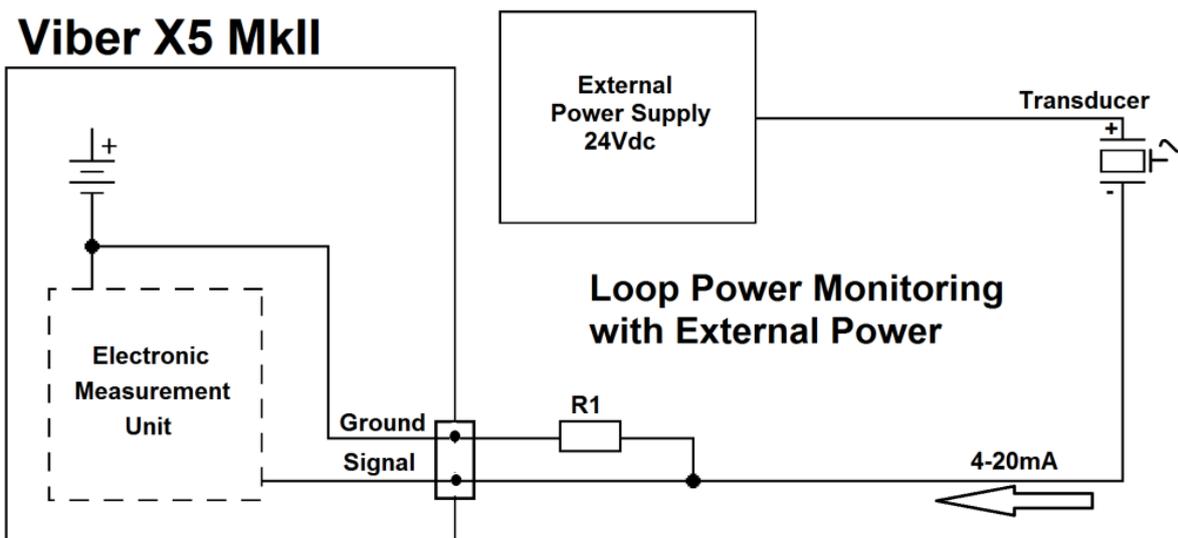
The Loop Power function gives the VIBER X5 MkII™ compatibility with installed 4-20mA Loop Power Monitoring systems. In this menu you can adjust the settings to meet your requirements by changing the **Shown Units**, **Range Hi**, **Averaging**, **No of Averages**, **24V Power** and the **Load Resistance  $\Omega$**  of Resistor 1 in the following diagrams.



### Viber X5 MkII



### Viber X5 MkII





## Bump Test

In this menu you can change the **Measurement Type**, **Shown Units** and the **Detection Type**, how the “Bump” is detected.

When conducting a Bump Test we strike the machine to cause an amplification of the resonant vibrations, by measuring these oscillations we can gain an understanding of the machines resonance.

Use a “hammer” proportional to the weight of the analyzed object. A timber log can be used for heavy objects while a rubber hammer can be used for smaller objects. Let the “hammer” bounce on to the object and never let it rest on the object. The intension is the same as hitting a guitar string. The string will resonate a while after the “bump” and the same will the mechanical structure even if it is unnoticeable to the naked eye. Do not use a hard hammer it will only produce high frequencies with low “bump” energy at low frequencies (below 100Hz).

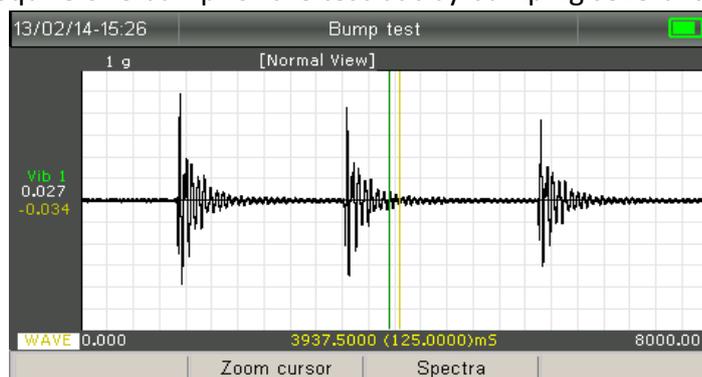
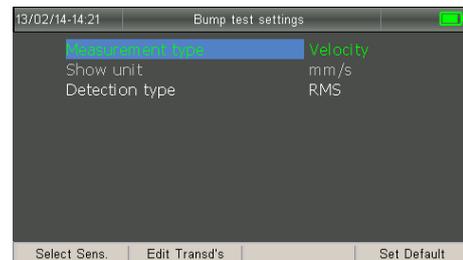
Mount the vibration transducer in the same, horizontal, vertical or axial direction, as the bump direction.

1. Select **Measure** in the main menu.
2. Select **Advanced** in the Measurement menu.
3. Select **Bump test** in the Advanced Measurement menu.
4. Adjust your settings
5. Press the **ENTER** button.

The message **Start Bumping** will appear, press the **ENTER** button to begin.

**Bump** several times within the next 8 seconds, while the instrument is auto scaling.

**Bump** again several times while the instrument is collecting the time signal. Try to use approximately the same bump force and position for both the auto scaling and collection. You only require one bump for the test but by bumping several times you have the choice



to select the best bump.

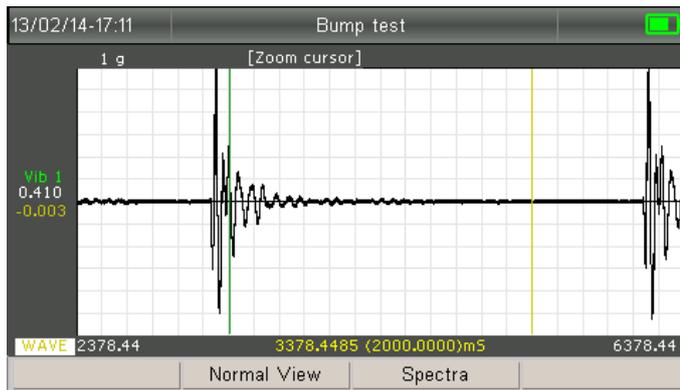
Move the cursors to the beginning of the bump or to one of the bumps with the **left** or **right** buttons.

Increase or decrease the time (distance) between the cursors with the **Ctrl+up** or **Ctrl+down** buttons. You are now actually selecting the number of samples within the cursors.

The larger the time distance, the larger the number of samples and the higher the resolution you will get in the spectra.

The time between the cursors is inverted to the frequency resolution according to the formula:

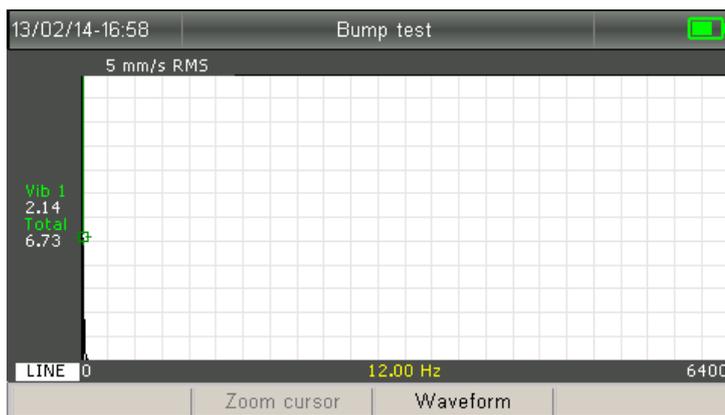
$$F_{Hz} = 1/T_{sec}$$



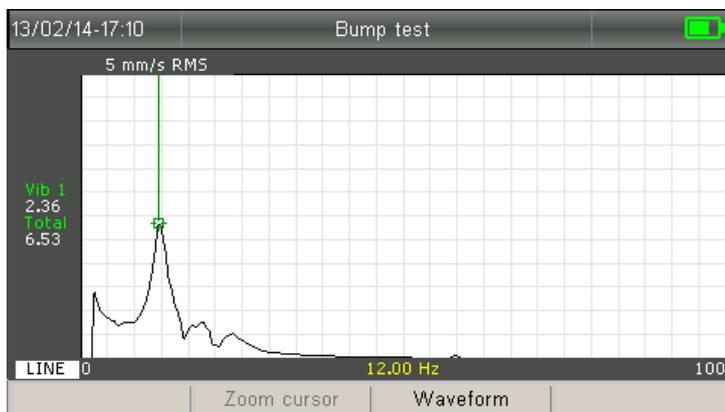
In our example above the time is 2000ms or 2 s. According to the formula it will give a frequency resolution of  $\frac{1}{2}=0,5\text{Hz}$ .

**Zoom cursor (F2)** will show the time signal zoomed around the cursors and will give you a possibility to fine adjust the time area. You cannot change the resolution in zoom mode.

Note: Move the area to a position where it doesn't include the part containing the actual bump.



Press **Spectra (F3)** and the instrument will show the spectra of the time signal within the cursors. The display shows the full spectra up to 6400Hz which in this case is too much.



The Spectra shown above is set to 100Hz which in this case is a better selection.

Press Ctrl+left or Ctrl+right to change the displayed frequency range.

Use left or right buttons to move the cursor.

Use up or down buttons to change the amplitude scale

Use the waveform button to go back and change resolution and time area.

Press the Menu button (the small green button) to save, add cursors, add notes to this measurement or get help.

The amplitude with the highest peak will show you the resonance frequencies.

## 8. Balancing



Balancing is a procedure by which the mass distribution of a rotor is adjusted to ensure that the vibration and/or forces at the bearings at a frequency corresponding to service speed are within specified limits.

From **Main menu** select **Balancing**.

With the Balancing application in VIBER X5 MkIII™ you can perform 1 or 2 plane balancing. This application is optional.

Rotor unbalance can be caused by design, material, manufacturing and assembly. Every rotor has an individual unbalance distribution along its length, even in a series production.



Figure 8-1: Balancing Selection

### Balancing section contents

<b>HEADING</b>	<b>Page no.</b>
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ISO 1940-1 Settings	97
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## 8.1. Balancing Theory

When we want to balance a new machine we do not know the relationship between the vibrations and weight e.g. how much vibration a certain weight is creating.

To solve this problem we measure the vibrations before and after we have mounted a trial weight. If the difference in vibration between the initial run (before weight mounting) and the trial run (after weight mounting) is 12 mm/s due to a trial weight of 43 grams then we can calculate how many grams that are needed to change the vibration 1 mm/s.

$$\frac{43 \text{ grams}}{12 \text{ mm/s}} = 3.58 \text{ grams / mm/s}$$

This is called the **unbalance sensitivity** of the machine and depends on the stiffness of the machine and on the shaft speed. The VIBER X5 MkIII™ stores this unbalance sensitivity with the name **Response matrix**.

To balance a vibration of 7 mm/s we only have to multiply the vibration with the unbalance sensitivity:

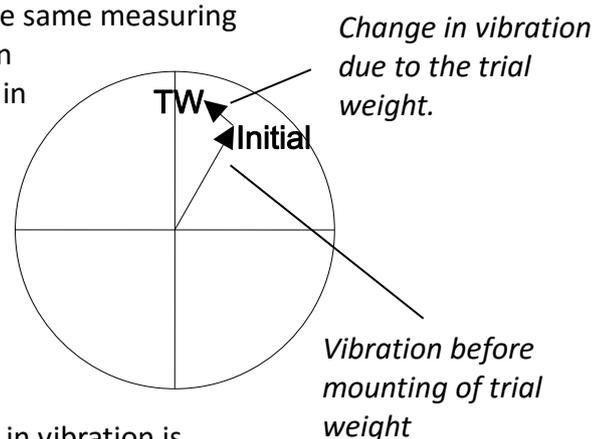
$$7 \text{ mm/s} \times 3.58 \text{ grams / mm/s} = 25 \text{ grams}$$

When we want to balance a machine where the unbalance sensitivity is unknown we must use trial weights and trial runs.

No vibrations are completely stable. If we measure the same measuring point twice, with a small time difference, the vibration readings usually differ a little due to normal variation in the vibrations, even if we are averaging the measurement. This difference is increased if we stop the machine between the measurements.

To minimize the effect of this “natural” variation at balancing we must put in such a large trial weight that the change in vibration due to the trial weight is much larger than the natural variations.

During a trial run the instrument checks if the change in vibration is sufficient.



## 8.2. Balancing Application menu

In the Balancing application menu you choose:

**Ongoing** = to continue the last balancing session

**1 Plane** = to perform a new one plane balancing

**2 Plane** = to perform a new two plane balancing

**From File** = to work with, or view, a previous balancing session from a balancing file.

**Response matrix** – To perform a balancing session with the unbalance sensitivity of an existing balancing file.



Figure 8-2: Balancing Application Menu

### 8.3. Balancing Settings

Balancing settings are the same for both 1 plane and 2 plane balancing. The settings made in this menu will apply to any balancing session (New or Ongoing) there after regardless if it is 1 or 2 plane until you change the settings.

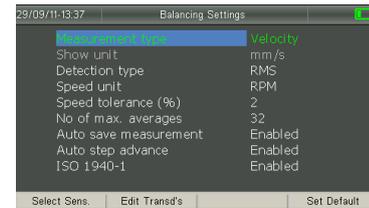


Figure 8-3: Balancing Settings

In Balancing Settings you can set the following:

- **Measurement type:** mV, Acceleration, Velocity or Displacement  
Show unit is depending on this setting.
- **Speed unit:** RPM or Hz
- **Speed tolerance (%):** The tolerance of the current balancing speed compared with the saved balancing speed to consider that the measurement is suitable for the balancing procedure. When the measured speed is outside of this tolerance the speed value will be colored yellow. This is also used in **Auto save measurement** to determine if the rotor is running on balancing speed after a stop.  
It is important to measure the vibrations at the same RPM during the whole balancing session.
- **No of max. averages:** The maximum number of measurements used to save the data if **Auto save measurement** is enabled. If the measurements are not stable enough (the speed is out of tolerance), the instrument will save the data when this number of measurement is reached.
- **Auto save measurement:** If Enabled, the instrument will save the measurement automatically if the Speed is in tolerance or if maximum number of averaging samples is reached.
- **Auto step advance:** If Enabled, the instrument will automatically go to the next balancing step after the measurement for the current step is saved.
- **ISO 1940-1 (Balance quality):** If Enabled, you will enter into the settings for ISO Quality before the measurement starts. Here you select the balancing quality grade. Enter the maximum rotor speed, weight and dimensions. The instrument then calculates maximum allowable residual unbalance and compares this value with the remaining unbalance in the rotor.

**F1** (F1) = Shortcut to Select Sensor menu, to select which transducer to work with.

**F2** (F2) = Shortcut to Transducer Settings menu, to make the settings for the transducers.

**F4** (F4) = All parameters will be set to default value.

After you have made the preferred settings, press **OK** (OK) to enter the measurement.

## 8.4. ISO 1940-1 Settings

In this menu you enter:

- The applicable ISO Quality Grade. See Grades for information about the different grades.

**Note!** The Operating speed is the maximum speed the rotor will ever reach in normal operation and not the balancing speed you have selected for the moment.

- Operating speed in RPM
- Rotor Mass in Kg
- Rotor dimensions. If you are balancing in 1 (one) plane you only need to enter R1. For balancing in 2 (two) planes you will also enter radius for the second plane (R2), and the rotor dimensions (H, H1 and L).

To guide you how to measure/set the values for H, H1 and L, there is a picture representing the rotor type on the right side of the window.

For 1 (one) plane this picture is only a representative outboard rotor for the radius R1.

For 2 (two) plane the picture can be changed between outboard and inboard rotor type by pressing **F2** (F2) Rotor type.

When you press **F4** (F4), Symmetrical, the length dimensions will automatically be symmetrical, depending on **H** value for inboard and **L** value for outboard rotor type. The instrument calculates maximum allowable residual unbalance and compares this value with the remaining unbalance in the rotor.

During Balancing Run If the remaining unbalance is lower than the allowable the instrument displays an **OK**, otherwise **Not OK**. The phase circles will also change color to indicate allowable unbalance according to the set quality grade. The Balancing Quality Grade selected is displayed in the middle of the screen.

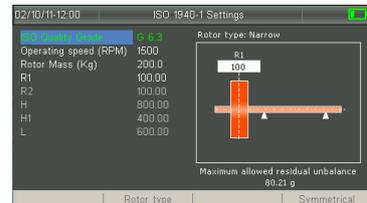


Figure 8-4: ISO 1940 Settings

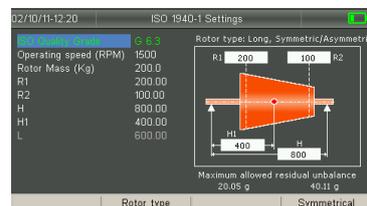


Figure 8-5: Inboard Rotor

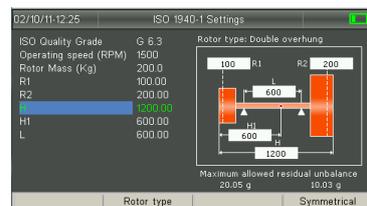


Figure 8-6: Outboard Rotor



Figure 8-7: ISPO Quality in Balancing run

**Note!** It is impossible to balance to zero (0). There will always be some small remaining unbalance in the machine when we are finished with the balancing.

The ISO1940 standard gives us a help when we can stop balance. If the remaining unbalance is less than the allowable unbalance according to the standard then the machine is considered to be in good balance and we can stop the balancing procedure.

When you enable ISO 1940, VIBER X5™ will also suggest a suitable trial weight depending on the rotor weight and radius you enter. You must however still write the weight and position of the “real” trial weight you have mounted in the machine.

The calculated trial weight can have large errors and gives only a hint of the size of the weight. There is no need to make and place the trial weight exactly as the calculated values, because it is only a trial weight.

**Note!** The suggested trial weight is calculated for machines with normal bearing support stiffness. It might be too large if the balancing speed is close to a mechanical resonance or if the initial vibration is very small. To prevent you from making grave errors the maximum suggested trial weight by the program is 500g (even though a larger weight might be needed)

### 8.4.1. ISO 1940 Balance Quality Grades

In ISO1940 the machines are divided into different grades called **Quality Grade**.

Table 8-1: ISO 1940 Quality Grades is only an overview and not an extraction from the standard.

Table 8-1: ISO 1940 Quality Grades

Grade	Rotor Types
<b>G 0.4</b>	Gyroscopes, Spindles, discs and armatures of precision grinders
<b>G 1</b>	Record players, Grinding-machine drives, Small electric armatures with special requirements
<b>G 2.5</b>	Turbo compressors, Rigid turbo-generator rotors, Gas and steam turbines, including marine main turbines (merchant service) computer hard disks, Machine-tool drives, Turbine-driven pumps, small electric armatures not qualifying for one or both of the conditions specified for small electric armatures of balance quality grade G 6.3, Medium and large electric armatures with special requirements
<b>G 6.3</b>	Normal process machinery, Parts of process plant machines, Marine main turbine gears (merchant service), Centrifuge drums, Paper machinery rolls, Print rolls, Fans, Assembled aircraft gas turbine rotors, Pump impellers, Flywheels, Machine-tool and general machinery parts, Medium and large electric armatures without special requirements, Small electric armatures, Individual components of engines under special requirements
<b>G 16</b>	Parts of agricultural machinery, Drive shafts (propeller shafts, cardan shafts) with special requirements, Parts of crushing machines, Individual components of engines (gasoline or diesel) for cars, trucks and locomotives, Crankshaft/drives of engines with six or more cylinders under special requirements
<b>G 40</b>	Car wheels, wheel rims, wheel sets, drive shafts, Crankshaft/drives of elastically mounted fast four-cycle engines with six or more cylinders, Crankshaft/drives of engines of cars, trucks and locomotives
<b>G 100</b>	Crankshaft/drives of fast diesel engines with six or more cylinders, Complete engines

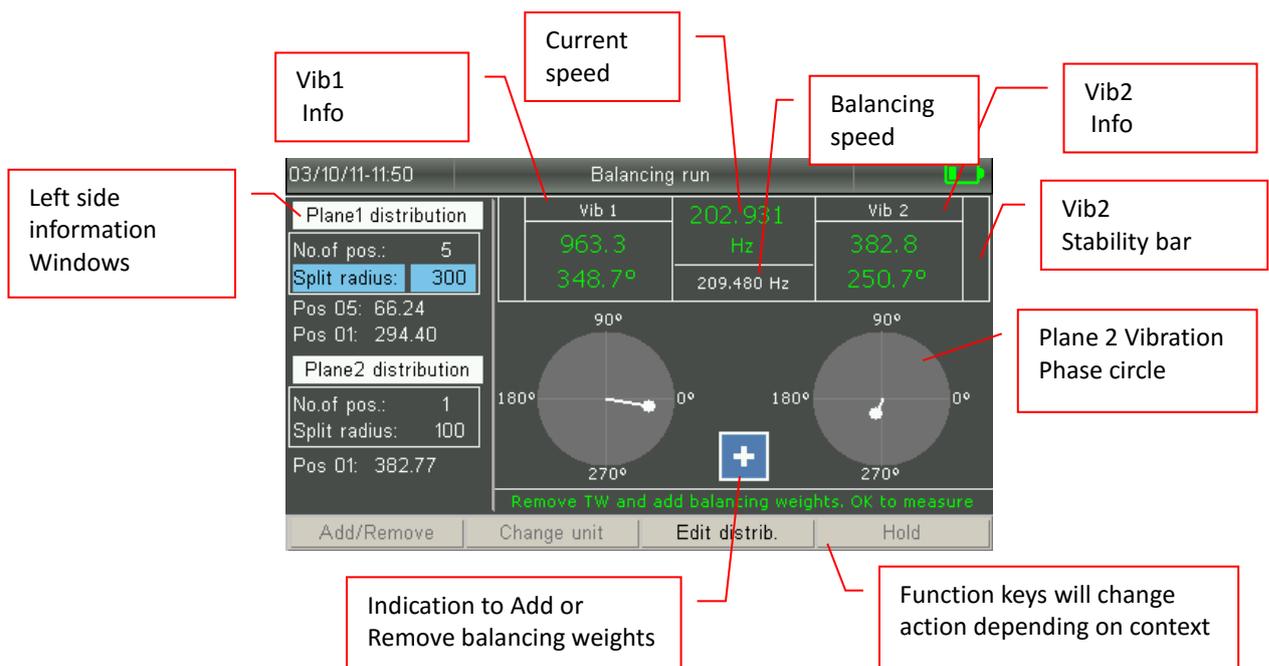
(gasoline or diesel) for cars, trucks and locomotives.

**G 250** Crankshaft/drives of rigidly mounted fast four-cylinder diesel engines.

Parts of a machine are normally balanced to one quality class lower than the whole machine.

*Example:* A complete fan is normally balanced to Q6.3 but if we balance only the fan wheel we have to balance down to Q2.5.

## 8.5. Balancing Window Description



## 8.6. 1- and 2-Plane Balancing

The steps to perform balancing with VIBER X5™ are in general the same for both 1 and 2 plane balancing. The only difference is that we have to mount a trial weight first in plane 1 and then in plane 2 and that we have to mount two balancing weights.

**1 (one) plane balancing** is used when the heavy rotor part is narrow axially, for example a brake disk, a narrow fan wheel, or when the normal rotor speed is low. For 1-plane balancing we need to connect one transducer to **VIB1** and use a tachometer.

**2 (two) plane balancing** is used when the heavy part of the rotor is wide axially and when one-plane balancing is not enough.

In the bottom of the window a message will guide you on the actions to do.

In each step there are different actions available for the function keys **F1** **F2** **F3** **F4**.



**Figure 8-8: Balancing window**

Press the  (MENU) key when you want to:

- Add notes to the balancing file
- Save the session
- View the balancing report
- Access Help for balancing
- Save the screen in a picture file

If you enabled **Auto save measurement** in the settings menu, the instrument will save the measurement automatically if the Speed is in tolerance or if maximum number of averaging samples is reached, otherwise you press  (AUX) key to save the measurement in each step.

If you enabled **Auto step advance** in the settings menu, the instrument will automatically go to the step after the measurement for the current step is saved, otherwise you press  (RIGHT) Arrow key to advance.

You can in each step press  (LEFT) to go back to previous step, to either see the measurement or settings you made or re do the measurement or change the settings.

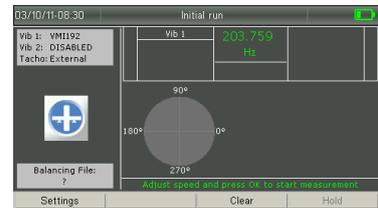


Figure 8-9: 1 Plane speed adjustment

**There are 3 basic steps to perform a new balancing session.**

### 1. Initial run.

After you have made the settings for the balancing session, the rotor must be run to balancing speed. After it stabilize, press

 (OK) to start initial measurement. This is the step when balancing speed is saved in rotor data. After this step, the speed is compared with this to calculate if it is within set tolerance. To clear previously measured data (and also balancing speed), press  (F3) key. To save, depending of the setting you made, press  (AUX) key when measurements are stable (or it will automatically be saved).



Figure 8-11: 2 Plane Initial run

To get to next step press  (RIGHT) Arrow.

### 2. Trial weight run

First you edit the weight you will place in Edit Trial Weight menu (see section Edit Trial Weight). Then you attach the trial

weight to the specified location and run the rotor to balancing speed. When the rotor speed has stabilized press  (OK) to start trial weight measurement.

To save, depending of the setting you made, press  (AUX) key when measurements are stable (or it will automatically be saved). If the speed is not within set limits a warning message will appear when you try to save the measurement, you can still decide to continue (forcing the instrument to save).



Figure 8-10: Plane 1 Trial run

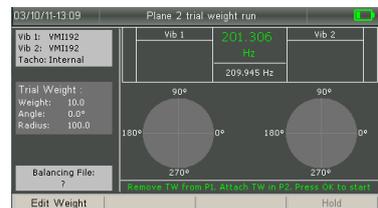


Figure 8-12: 2 Plane Initial run

## Warning!

Forcing the instrument to save means that you are accepting very unstable measurements. This can later cause errors in the calculated balancing weights.

The purpose of mounting a trial weight in plane 1 is to measure how much this weight is changing the vibration vector in measuring point 1 but also to measure how much the vibration is changing in measuring point 2. This is called the influence from plane 1 to plane 2.

The purpose of mounting a trial weight in plane 2 is to measure how much this weight is changing the vibration vector in measuring point 2 but also to measure how much the vibration is changing in measuring point 1. This is called the influence from plane 2 to plane 1. If we mount both trial weights at the same time we do not know the cause and effect and the instrument cannot calculate a correct response matrix.

To get to next step press  (RIGHT) Arrow.

If you are making a 2 plane balancing you will have to make the Trial weight run for first the 1<sup>st</sup> Plane and then the 2<sup>nd</sup> Plane.

### 3. Balancing run

Using the data from previous steps, the instrument calculates the weight to compensate residual unbalance and compare it with tolerances.

The options available are:

 (F1) Add/remove: To calculate the weight switching between adds (+) or remove (-) at specified angle

 (F2) Change unit: Switch the indication between weight and vibration units

 (F3) Edit weight distribution. Use  (UP) or  (DOWN) Arrows to move the marker to edit **No of positions** and/or **weight radius**, then press  (F3) key to edit.

You can also use the  (MENU) key context menu where you can:

- Add notes to be added in balancing file (Notes).
- Save rotor to card in a balancing file (Save rotor).
- View balancing report with balancing data (View report).
- Display context help (HELP)

- Save the screen in a bitmap picture file (Save screen).

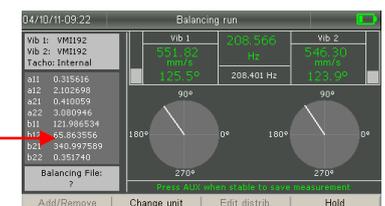


Figure 8-13: Balancing Measurement

During balancing measurement the response matrix values are shown on the left side of the screen.

The vibration values for the Vib 1 and Vib 2 are displayed in Vib 1 and Vib 2 info window. If you instead would like to see the balancing weight press  (F2) Change unit.



Figure 8-14: Balancing weight distribution

When the measurement are stable and you press  (AUX) key to save the left side info window is changed to display the number of split positions, weight radius and balancing weight needed at each position in both 1<sup>st</sup> and 2<sup>nd</sup> plane. You can edit the number of positions available to

place the weight and the radius (for both 1<sup>st</sup> and 2<sup>nd</sup> plane) by selecting the value to be edited with  (UP) or  (DOWN) Arrow key pressing  (F3), the weight (and position) will be recalculated for the new values.

If you edit the balancing weight radius for either 1<sup>st</sup> or 2<sup>nd</sup> plane the weight for the angle position displayed in the Vib 1 and Vib 2 info window be recalculated for the new values.

If you press  (F2) Change unit the window will display the response matrix and vibration value as during the measurement.

When you have mounted the balancing weights sometimes a small unbalance will remain. You can then select to continue with fine balancing and the instrument calculates new **Fine balancing weights** in the same way as the instrument calculated the balancing weights. The number of Fine Balancing steps you can make is limited to 64.

The **Fine balancing weights** are calculated so that they only will balance the remaining unbalance and we must therefore keep the first balancing weights in the balancing planes. If the radius is changed the weight will be recalculated to correspond to the new radius.

*There are several reasons why we have to add Fine balancing weights:*

- *It is often difficult to place the balancing weight exactly in the angle that the instrument had calculated.*
- *It is often difficult to place the balancing weight on exactly the radius we have written in the instrument.*
- *The stiffness of the bearing support is nonlinear and depends on the vibration level.*

After the balancing weights are in place you should to start the machine and measure at least one more time to check the result. You may have made a mistake when you mounted the balancing weights or another fault may have a risen in the machine.

## 8.7. Edit Trial Weight

After you have made Initial run you will enter into Edit trial weight menu.

Here you enter the parameters for the Trial Weight (TW)

**Radius:** Enter the radius on where you are placing the trial weight

**Weight:** Mass of the trial weight. If you press  (F3) the Instrument will calculate an estimated weight.

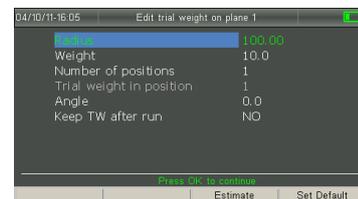


Figure 8-15: Edit Trial weight

NOTE! The calculated trial weight can have large errors and gives only a hint of the weight and angle. There is no need to make and place the trial weight exactly as the calculated values, because it is only a trial weight. The calculated trial weight is only a proposed trial weight. You do not need to mount exactly the calculated weight. The proposed trial weight gives you a hint of the size of the weight.

If the shaft speed is close to a structural resonance in the machine we might have a large amplification of the vibration. In this case the proposed trial weight might be too large.

You must write the weight and position of the “real” trial weight you have mounted in the machine.

**Number of positions (Weight distribution):** With this function the instrument distributes the balancing weight to evenly distributed positions. This eliminates the need of angle measurements in the rotor. For example if a fan has 12 blades then number the blades from 1 to 12, and write the number 12 in the setting for Number of positions. The instrument distributes the balancing weight to the blades nearest on each side of the correct angle. The vector sum of these two weights is equal to the calculated balancing weight.

**Trial weight in position:** Here you enter the position you have placed the trial weight.

**NOTE!** The program works for any unit for the Radius or Weight, as long as the same units are used during the whole balancing procedure.

Default is position 1 which is angle 0.

**Angle:** Angle where the weight should be attached measured from reference mark of the balancing plane against direction of rotation of the shaft.

**Keep trial weight after run:** In this case the instrument will calculate a balancing weight that will balance both the trial weight and the original unbalance at the same time.

*Why do I want to keep the trial weight in the machine?*

- *If the trial weight is impossible or very difficult to remove*
- *If I have drilled or grinded away material as a trial weight.*
- *If the trial weight substantially improved the balance status.*

You can always step back and change this setting if the trial weight was unsuitable to keep. If you step back to change the resulting balancing weight will automatically be recalculated to not balance the trial weight.

By pressing  (F4)-Default, the parameters will be set as default.

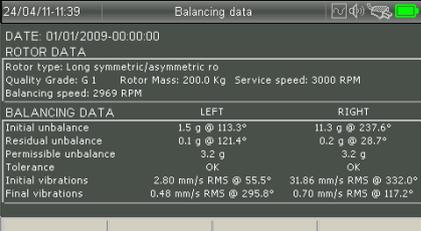
## 8.8. Balancing report

Press  (MENU) key and select View report.

In this window you can see the data that will be used in the balancing report. The Displayed data depends on the settings you made.

You will see the:

- Type of rotor
- ISO Quality Grade used
- Rotor mass
- Service speed
- Balancing speed
- Initial unbalance for each plane
- Residual unbalance (unbalance we have for the moment)
- Permissible unbalance (allowable by the ISO standard)
- initial vibrations
- Final vibrations (the vibrations we have now)



Balancing data			
DATE: 01/01/2009-00:00:00			
ROTOR DATA			
Rotor type: Long symmetric/asymmetric ro			
Quality grade: G 1 Rotor Mass: 200.0 Kg Service speed: 3000 RPM			
Balancing speed: 2969 RPM			
BALANCING DATA		LEFT	RIGHT
Initial unbalance	1.5 g @ 113.3°	11.3 g @ 237.6°	
Residual unbalance	0.1 g @ 121.4°	0.2 g @ 28.7°	
Permissible unbalance	3.2 g	3.2 g	
Tolerance	OK	OK	
Initial vibrations	2.80 mm/s RMS @ 55.5°	31.86 mm/s RMS @ 332.0°	
Final vibrations	0.48 mm/s RMS @ 295.8°	0.70 mm/s RMS @ 117.2°	

**Figure 8-16: Balancing report**

## 8.9. Residual unbalance

### What is a residual unbalance?

If we place a large weight in the shaft centre we do not get an unbalance. The radius from the shaft centre is also important.

The residual unbalance in VIBER X5 MkII™ is always the product of the unbalance weight times the radius and has often the unit gram/mm = gram millimeter.

That is why the numbers in the residual and allowable unbalance seems so large.

A residual unbalance of 100 grams corresponds to an unbalance weight of:

1 gram at the radius 100 mm or 10 grams at the radius 10mm or 100 grams at the radius 1mm.

They all produce the same centrifugal force and unbalance vibration.

## 8.10. Response matrix

VIBER X5 MkII™ calculates and stores the unbalance sensitivity (*Response Matrix*) while you are balancing. Next time you want to balance the same machine you can use the response matrix and the instrument calculates the balancing weights directly after the first trial run, or if all transducers are already mounted, even while the machine is still in production. No trial weights are needed to be mounted.

When you use the *Response Matrix* all transducers including the RPM transducer must be placed in the same directions and locations as when the *Response Matrix* was first calculated.

### What is a response matrix?

When we mount a trial weight in the machine and make a new start the vibrations have changed. (If they have not changed the trial weight is too small). We can calculate this change by (vectors) subtracting the vibrations without the trial weight from the vibrations with the trial weight.

If we divide this change in vibration with the weight of the trial weight we will get the normalised unbalance sensitivity or the response matrix.

For example:

The change in vibration is 8 mm/s caused by a trial weight of 50 grams on the radius 400 mm. Then the unbalance sensitivity will be  $8/(50 \times 400) = 0.0004$  or  $4.0E-4$  (mm/s) / (gram millimeter). This value is called  $a_{11}=0.004$  in the response matrix.

The unbalance sensitivity can be explained in other words. First, we assume that the machine in our example has no unbalance what so ever thus the vibration is zero (0).

If we mount a weight of 1 gram on the radius 1 mm = 1 gram millimeter, then the vibration would be 0.0004 mm/s.

If we mount this weight in the direction we call zero (0) degree in the machine and the

vibration angle is 38 degrees then the value  $b_{11} = 38$  in the response matrix.

The values  $a_{11}$  and  $b_{11}$  goes together as all previous readings with vibration and angle.

The response matrix is saved together with all other information when the balancing session is saved.

**Table 8-2: Response Matrix Table1 Plane balancing**

### **1 Plane balancing**

**a<sub>11</sub>** is the normalized vibration in Mp1 for 1gram millimeter unbalance.

**b<sub>11</sub>** is the angle of the vibration in Mp1 if the trial weight is mounted in the zero (0) direction.

### **2 Plane balancing**

**a<sub>11</sub>** is the normalized vibration in Mp1 for 1gram millimeter unbalance in plane 1.

**b<sub>11</sub>** is the angle of the vibration in Mp1 if the trial weight in plan 1 is mounted in the zero (0) direction in plane 1.

**a<sub>12</sub>** is the normalized vibration in Mp1 for 1gram millimeter unbalance in plane 2.

**b<sub>12</sub>** is the angle of the vibration in Mp1 if the trial weight in plan 2 is mounted in the zero (0) direction in plane 2.

**a<sub>21</sub>** is the normalized vibration in Mp2 for 1gram millimeter unbalance in plane 1.

**b<sub>21</sub>** is the angle of the vibration in Mp2 if the trial weight in plan 1 is mounted in the zero (0) direction in plane 1.

**a<sub>22</sub>** is the normalized vibration in Mp2 for 1gram millimeter unbalance in plane 2.

**b<sub>22</sub>** is the angle of the vibration in Mp2 if the trial weight in plan 2 is mounted in the zero (0) direction in plane 2.

The response matrix for one-plane contains only 2 elements while the response matrix for 2-planes contains 8 elements.

Use balancing with Response matrix when you want to

- balance the same machine again,
- balance identical machines or
- balance identical rotors in the same (balancing) machine.

**Note! You cannot use balancing with Response matrix, if the bearing stiffness has been changed. For example:**

- The machine has been moved from a stiff support to a support with springs or rubber feet.
- The machine has been moved from a support with springs or rubber feet to a stiff support
- The weight of the machine has been changed more than +/- 10%

## 8.11. Balancing Files viewer

X5 Balancing Viewer Application is one of the accompanying PC software to the VIBER X5 MkIII™ Analyzer, used to visualize VIBER X5 MkIII™ Balancing files on a computer.

The program is located under the PC Application folder in the VIBER X5 MkIII™ SD card when the instrument is delivered. When the instrument is connected to the PC through the USB cable select PC Application folder, copy the setup file to your preferred location on your computer and install the software, you are now ready to use it.

Using this application you can:

- Edit the Balancing Report header.
- Choose the contents of the Balancing Report File
- Preview and Balancing Report.
- Copy the report file into MS Word.

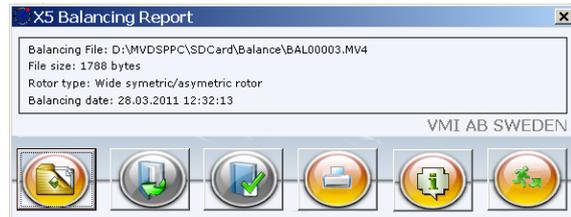


Figure 8-17: Balancing files viewer

The program starts with a main screen where it displays the configuration of current balancing file.

The window has on the bottom a series of buttons, which allow the following actions:



### OPEN

Open a VIBER X5 MkIII™ Balancing file. The Balancing file is in binary format and cannot be viewed directly. A Balancing file has the extension .mv4. File



### EDIT REPORT HEADER

Allow you to Edit the Balancing Report Header.



### OPTIONS

Options allow you to configure the contents of the Balancing Report file.



### View/Convert

Options allow you to preview and print the Balancing Report and optionally to copy the report into the MS Word.



### INFO

Show information regarding application version.



### EXIT

Close the application and all opened files.

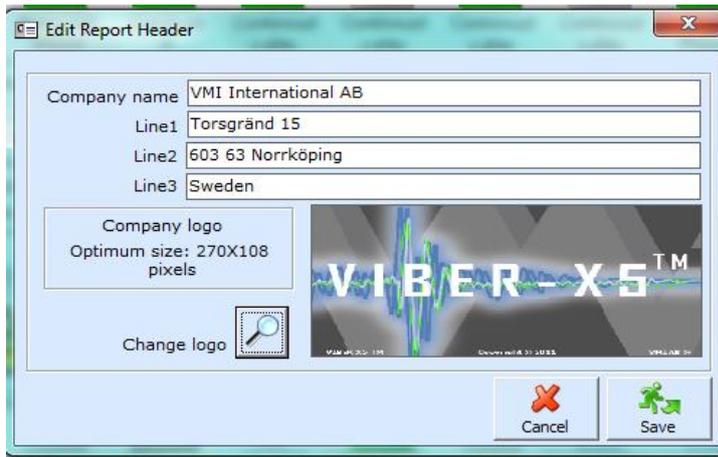


Figure 8-18: Edit Header Window

When you select Edit Header, a dialog window will appear allowing you to edit it.

The following items may be edited:

- **Company name**
- **Company details**-Line 1,2 and 3
- **Company logo** - You can add any picture file in the dedicated area.

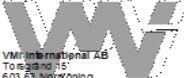
The following part of the Balancing Report can be added or excluded:

- **Rotor picture**
- **Vibration** – Final vibrations readings
- **Balancing Matrix.**
- **Measurement List** – All the result after Fine Balancing run will be shown in a list.
- **Trial Runs Results**
- **User Notes**– If you added some notes in time of balancing session, this information will be also included in the Balancing report



Figure 8-19: Balancing Report items

Example of a balancing report first page.

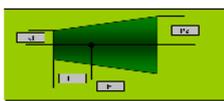


VMI International AB  
Torsgränd 15  
603 63 Norrköping  
Sweden

Balancing date: 2011-03-28 12:32:13

**BALANCING REPORT**

Rotor data			
Rotor type: Wide s/metric/asymmetric rotor	Balancing speed: 2969 RPM		
Rotor mass: 200.0 Kg	Service speed: 1500 RPM		
Correction radius R1: 100 mm	Correction radius R2: 100 mm		



H = 900 mm  
H1 = 400 mm

Initial unbalance			
Parameter	LEFT	RIGHT	
Initial unbalance	14.6 gmm	1.1 Kgmm	
Initial mass	1.45 gr		

Final unbalance			
Parameter	LEFT	RIGHT	
Residual unbalance	11.1 gmm	16.6 gmm	
Residual mass	0.111 gr	0.166 gr	

Final Vibration (x IRPM)			
	Vibration LEFT	Initial	Vibration RIGHT
Initial	2.80 mm/s RMS @ 55.5°	Initial	31.86 mm/s RMS @ 332.0°
Final	0.48 mm/s RMS @ 295.8°	Final	0.70 mm/s RMS @ 117.2°

Balancing Matrix	
Matrix element	Value
B11	3.711206
B12	8.010882
B13	0.629903
B14	40.266060
B21	1.937433
B22	170.006200
B23	2.980623

## 9. Instrument Maintenance

In this chapter are presented maintenance guidelines to keep your instrument in good condition, so that you have a reliable companion for many years to come.

For the batteries to last as long as possible charge them fully at least once every 3<sup>rd</sup> month, even though you have not used the instrument. Normal battery life is 2 years after that the instrument operation time will start being gradually reduced.

Store the instrument in a cool place away from direct sunlight (the instrument case delivered with the instrument is an ideal storing place). The storing temperature should not exceed 80 degrees Celsius or go below -30 degrees Celsius.

Clean the instrument with a mild detergent and a clean cloth.

It is good practice to always wipe the transducers and Tachometer holding magnets clean before using them and when placing them in the case after use.

The connectors and cables for the VIBER X5 MkIII™ have been selected to be as robust and reliable as possible, even so it is good practice not to bend the cables or pull them when loosening the transducer magnet.

To make sure your instrument continues to show accurate readings it should be regularly calibrated.

### 9.1. Battery Management

The instrument has two battery packs built-in:

- Backup battery. A small 3V battery for the Real Time Clock; the expected life of this battery is 10 years. If Date and Time are always reset to the default values when you stop/start the Instrument means that the backup battery should be replaced.
- Main battery pack

The main battery pack capacity and type may be variable depending on instrument version; standard is 66.6 Wh, Li-Ion.

In each menu, the window header displays graphically the battery status (by the color of the battery symbol) and remaining capacity (by the filling grade of battery symbol). Also it displays the charging status if the charger is connected (see Status Bar section on Instrument description).

Whenever the symbol is yellow or red the battery should be charged as soon as possible.

The Instrument can work with a very weak battery without the risk to corrupt the measurements. The built-in battery controller keep watch on the available power and automatically stops the Instrument, when the power is too weak to assure the measurement integrity.

When you work with a weak battery, the battery life can drop dramatically.

A full charge process may take 3 to 5 hours, depending on the battery's total capacity.

The charger icon can be:

Green (the battery is normally charged)

Red - The battery temperature is too high and the charger has stopped the charging process. The charger still supplies the Instrument. Normally when the battery temperature decreases, the charging process continues. There is no need to remove the charger.

The charging process should be allowed to continue until the battery is fully charged (100%). If the charging process frequently is not finished, the total battery life will decrease.

The Battery Charger LED will change colour depending on the charge current being supplied:

Orange – current being supplied is at maximum

Yellow- current is under maximum, usually the battery is >80% charged

Green-current is 0, charging has stopped

## 9.2. Power Saving Good Practice

To save the battery power, do the following actions:

Adjust LCD backlight to the minimum value required for a normal visibility. Keep in mind that the LCD backlight consumes up to 30 % of the total power. You can adjust the backlight fast, use  (Light) +  (DOWN) Arrow key to decrease the backlight intensity or  (Light)+  (UP) Arrow key to increase it.

Adjust the property of the **Backlight off time** (in the **General Settings** menu). The Instrument automatically enters into power saving mode (backlight to minimum), if you do not press a key during the time you have set. To resume your backlight setting press the  (Light) key.

Use **Auto Off time**. This will stop the Instrument after a while, if no key is pressed. The software switches off the backlight for 10 seconds, before stopping the Instrument. If you observe this, just press any key and the Instrument will continue to work normally. The backlight will be set to the last set value.

Switch off the Instrument when you move from one location to another. When you start the Instrument again, the last screen will become active. The Instrument always remembers the last position you where when you shut down the instrument and restores it on power on. If the battery pack is weak, you will succeed to extend a little the battery life by temporary stopping the Instrument.

When you use the microSD Card with Windows Explorer, we recommend switching off the Instrument. The Card controller will use computer power, instead to consume the battery power.

NOTE: If the battery capacity is incorrectly displayed (this happens when the charging/discharging cycle is not over):

- Leave the Instrument ON without charger, until the Instrument automatically stops.
- Completely charge the battery, up to the full capacity.

The normal lifetime for a battery pack in everyday use is 2 years. After this time the battery will start to gradually loose capacity. We recommend replacing the battery every 2 years to ensure optimal performance from your device.

## 10. Trouble Shooting

If your instrument does not work correctly, follow the symptom list below. If the fault is lasting or reoccurring contact your instrument distributor.

Start-up		
Symptom	Action	Cause
After pressing ON key, the display is dark (nothing shown and no backlight)	Attach the charger.	If the instrument starts, look at the window header for the charger symbol. If the symbol is green, the batteries were empty and they are beeing charged. Empty batteries may be due to a long period when the instrument was not used. If still the instrument does not start please contact a VMI serivce center.
After pressing ON key, the display is white(nothing shown but backlight is ON)	Restart the instrument. Watch the keyboard LEDS	On normal start-up, the red and blue LED will be ON for about 1 second. After this, they will blink for about 3 seconds and they will go OFF. By pressing any key, the green LED should blink. If the LED does not go off, means the microprocessor board did not start properly. This may be either caused by a power supply fault or by the board itself. If the LED sequence is normal but still the display is empty it may be a display fault. Please contact a VMI serivce center.
The instrument attempts to start but shut down quickly	Attach the charger.	The instrument has a power management system which automatically shut down the system if battery voltage is below 5.0V. If start is successful, there is a battery problem. Look at the display header for the charger symbol. If green, the batteries were empty and they will be charged. Also you can see the actual battery voltage in main menu. For normal operation, this must be between 9 and 11 Volts. Also a power supply problem may be the cause for this problem.
The instrument start displaying the bootloader screen	Press  (F3)-Load program from SD card and follow the steps described in <i>Failsafe Update Procedure</i> section in chapter <i>Instrument overview</i>	This occurs when the program file stored in internal memory is not valid or when an upgrade procedure fails or there is an internal memory problem.

<b>Boot loader</b>		
<b>Symptom</b>	<b>Action</b>	<b>Cause</b>
After selecting  (F1)- <i>Retry to load application</i> the message <i>Error Bad program file</i> appears	Press  (F3)-Load program from SD card and follow the steps described in <i>Failsafe Update Procedure</i> section in chapter <i>Instrument overview</i>	This occurs when the program file stored in the internal memory is not valid. If the procedure fails, there is an internal storage memory problem.
After selecting  (F3)- <i>Load from SD Card</i> the message <i>Error Cannot mount SD card</i> appears	Put the instrument OFF and connect it to a PC.	This message is generic for the SD card controller and appears when either: - The controller is defective - The card is defective - The card is not properly formatted.  The instrument should behave as a standard mass storage device when connected to the PC. If the device is not published or appears as an unknown device, there is an SD card controller error. Please contact a VMI service center.  If the device is published (appears in Control panel) but cannot be handled as a disk, it is a problem with the SD card, which is either not formatted or defective. Regarding format parameters, read <i>Format</i> section in chapter <i>Instrument overview</i> .
Message: <i>"Error: Cannot find SYSTEM folder"</i>	The problem is due to a bad format of the card or a card error.	If it is no hardware fault you should use the operating system utilities to determine and solve the problem.
Message: <i>"Error: Cannot find any program file"</i>	The problem can also be due to reason that the required file or folder may not be present on the card.	The messages are self explaining and will guide you to solve the problem.  Regarding format, please read <i>Format</i> section in chapter <i>Instrument overview</i> .
Message: <i>"Error: Cannot open file"</i>	Put the instrument OFF and connect it to a PC.	Regarding files, please read <i>Files</i> section in chapter <i>Instrument overview</i>
Message: <i>"Error: Bad header CRC"</i>		
Message: <i>"Error: Incompatible program file"</i>		

<b>Battery charger</b>		
<b>Symptom</b>	<b>Action</b>	<b>Cause</b>
<p>The charging is stopped before the battery is fully charged.</p> <p>Charger symbol on the status bar is red.</p>	<p>Disconnect battery charger. Wait 5 seconds. Reconnect the battery charger.</p>	<p>Look at the charger symbol on the status bar. If it is red one of the following problems caused the charging system to stop charging:</p> <ul style="list-style-type: none"> <li>-Battery pack temperature is above 60 °C</li> <li>-Charging time is longer than 4 hours</li> <li>-Battery pack voltage during charging is beyond expected limit. This may happen if one of the cells in the battery pack is defective or when there is a connector problem.</li> <li>- Battery charger voltage cannot supply desired charging current</li> <li>- Voltage change ratio on battery pack signals that the battery is fully charged.</li> </ul>
<p>The charging process does not start.</p>	<p>Check the battery connectors and the fuses.</p>	<p>If the battery pack voltage before charging is almost nothing the charging system assume that a battery pack is not connected and will not start charging. This may happen when the instrument has not been used for a long time (2-3 months).</p>
<p>The battery charge ratio shown on display is incorrect</p>	<p>Discharge the instruments battery (a suggestion is to use Data logger). Perform a full battery charge after this.</p>	<p>The instrument integrates the current to and from the battery pack and display the remaining capacity.</p> <p>This appears typically when the battery pack is worn and the internal power loss is significant. Also when the instrument have been OFF for long time.</p> <p>Also when you disconnect the battery pack, the remaining capacity is shown as 0.</p> <p>The battery voltage displayed in the Main menu is a direct measurement of the battery voltage, disregarding calculated remaining capacity, this may be used to evaluate the battery pack status.</p>

Transducer		
Non volatile storage & settings		
Symptom	Action	Cause
The instrument display at every start the message "Invalid factory data! The system will load defaults. A new configuration is required!"	You should contact your VMI distributor to solve this problem.	Factory data is a set of parameters which describe the hardware revision of the instrument, serial number, battery pack capacity and other essential data. This can appear when an incompatible program is loaded into the instrument (see <i>Updates</i> section in chapter <i>Instrument overview</i> ) or when there is a problem with the internal non-volatile storage.
The instrument displays at start-up the message "Calibration Lost! The system will load defaults. A new calibration is required!"	Press  (OK). You can reload original calibration data from the file delivered with the instrument.	This can appear when an incompatible program is loaded into the instrument, see <i>Updates</i> section in chapter <i>Instrument overview</i> , or when there is a problem with internal non-volatile storage. See also <i>Files</i> section in chapter <i>Instrument overview</i>
In some of the settings menus the items are wrongfully disabled or they have unusual values	Press  (F4)-Default settings and after this configure the parameter as you wish.	This can appear when an incompatible program is loaded into the instrument, see <i>Updates</i> section in chapter <i>Instrument overview</i> , or when there is a problem with internal non-volatile storage.
The program displays the text using a small font.	Update the font file.	The font resource used by the program is either corrupted or invalid. see <i>Updates</i> section in chapter <i>Instrument overview</i>
Some of the characters are replaced with "?"		
In selection menus, some of the pictures are "generic"	Update the picture file	If all pictures are the same, the picture resource used by the program is either corrupted or invalid, see <i>Updates</i> section in chapter <i>Instrument overview</i> . If just some of the pictures are wrong, the picture file is old and should be updated to the latest available (or suitable for the current program version running).
Some of the messages appear not to be translated.	Update Language files.	There is a gap in time between the release of a new program and translation of different languages. Default resources for the program are included with the program file. Update the language pack if a new translation file is available.
Some of help topics are missing		

Symptom	Action	Cause
When try to measure vibration, the message : <i>"In auto detect mode, a standard transducer must be connected to Vib 1. Retry?"</i> appears	Try to connect another transducer on VIB1 connector.	The instrument autodetects the connected transducer using settings made inside the transducer cable. If something is defective, the system will not work properly.
The instrument displays another transducer than the transducer connected.		
Message: <i>Transducer bias beyond limits. Please check connection. Retry?</i>	Check if the instrument displays the connected transducer. Check in settings if the configuration is correct (limits) and if the transducer is powered.	Go to Bias menu to see actual values and compare them with limit values configured on transducer settings for specific transducer.

SD card		
Symptom	Action	Cause
When attempt to access SD card a message <i>"Error – Cannot mount SD card"</i> appears.	Restart the instrument by using ON/OFF key.	This error is generic for SD card controller and appears when either: - The controller is defective - The card is defective - The card is not properly formatted. - The controller is hang-up If the problem is not solved by restarting, put the instrument OFF and connect to a PC. The instrument should behave as a standard mass storage device. If the device is not published or appears as an unknown device, it is an SD card controller error. If the device is published (appears in Control panel) but cannot be handled as a disk, it is a problem with the SD card, which is either not formatted or defective. You should use the operating system utilities to solve the problem(if no hardware). Regarding format parameters, please read <i>Format</i> section in chapter <i>Instrument overview</i> .
Other card access errors (most of the messages are self explaining)	Close the work session by pressing  (ESC). Thereafter enter again into the application	The file corresponding to the current work session may be corrupted. By exiting the work session, the instrument will close it. When again entering the application, the instrument will check the file and try to fix it.  If you still have the same problem, you may put the instrument OFF and try to use PC operation system utilities to fix the file or contact a VMI service center.

## 11. Technical Specification

<b><u>Digital</u></b>	<b>DSP Processor</b>	Texas TMS320C6713B	
	<b>Memory</b>	Storage: 4GB micro SD 128MB Ram 2x 16 MB fast flash RAM	<i>Actual Spec is dependent on hardware revision.</i>
	<b>ADC</b>	16 bit, max 192 KSPS simultaneous sampling	
<b><u>Display</u></b>	<b>Size &amp; Resolution</b>	4.3" Amorphous TFT-LCD 480x272 pixels	
	<b>Colours</b>	65536	
<b><u>Signals In/Out</u></b>	<b>AC Inputs</b>	All standard ICP accelerometers (4mA/24V), velocimeters or general purpose AC transducers in range 0-8V RMS. Auxiliary inputs with range 0-30V RMS.	<i>VMI default transducers are automatically detected</i>
	<b>DC Inputs</b>	0 to 5V	
	<b>External Reference</b>	0.8 to 24V	
	<b>Signal Generator Function</b>	Amplitude: 0 to 4.7Vp-p Frequency: 4 to 1kHz	<i>Sweep and step Generation software dependent</i>
<b><u>Built-in Transducers</u></b>	<b>Temperature</b>	-10 to 120°C	<i>Infrared</i>
	<b>Tachometer</b>	Up to 60000rpm	<i>0.1 to 2m range</i>
<b><u>Measurements</u></b>	<b>Processing</b>	Direct, single or double integrated or deviated (configured in software upon used transducer and user request). Up to 3 channels simultaneous sampling	
	<b>Frequency Range</b>	0.5 to 32kHz	<i>Transducer dependent</i>
	<b>Amplitude Range</b>	0 to 80g	<i>Transducer dependent</i>
	<b>Accuracy</b>	0.001g ± 1% for non integrated 0.1mm/s ± 2% for single integrated 2µm ± 3% for double integrated	
	<b>FFT Lines</b>	25600	
	<b>Sampling Rate</b>	Up to 131072Hz dependent on selected frequency range	<i>3 channels simultaneous sampling</i>
	<b>Windowing</b>	Selectable: Hanning, Hamming, Blackman, Kaiser-Bessel	
<b><u>Power</u></b>	<b>Accumulators</b>	6.2 Ah Li-ion fule gauge smart battery pack	
	<b>Autonomy</b>	12 hours continuous use	
	<b>Charging</b>	4 hours for full charge	
<b><u>Temperature</u></b>	<b>Operating</b>	-20 to 70°C(-4 to 158°F)	
	<b>Storage</b>	-30 to 80°C(-22 to 176°F)	

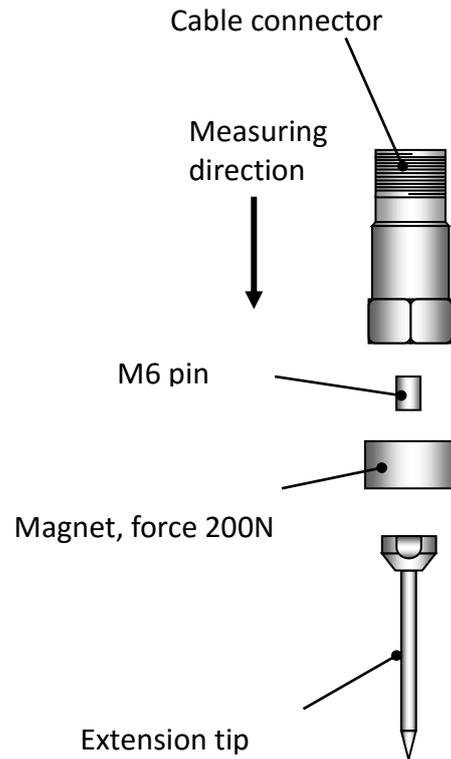
## 11.1 Accelerometers

Vibration transducer, with built in amplifier

Internally shielded and case isolated.

### Technical specifications for VMI192

Sensitivity (+/-10%)	100mV/g
Frequency response	(±3dB) 0.4–13000Hz (±10%) 1.0-9000Hz
Dynamic Range	±80 g, peak
Sensing Structure	Shear Mode
Internal resonance	26000Hz
Settling time	<2 Seconds
Bias Voltage	10-14VDC
Electrical Case Isolation	>10 <sup>8</sup> ohm
Temperature range	-50 to 121 °C
Maximum Shock Protection	5000 g, peak
Electromagnetic Sensitivity	CE-Certified
Sealing	Hermetic Welded
Weight (without magnet)	51 grams
Case Material	316L Stainless steel
Mounting	¼-28 Tapped Hole
Mounting stud	M6 Adapter stud
Mounting Torque	2.7-6.8 Nm



Note! Use of the Magnet will reduce the linear frequency response to 2000-4000Hz depending on the surface structure of the measuring point.

Use of the Extension tip will reduce the linear frequency response to 1200-2000Hz depending on the surface structure of the measuring point.

Only use the extension tip at otherwise inaccessible points.

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# Declaration of Conformity

VMI declares that the VIBER X5™ is manufactured in conformity with national and international regulations.

The system complies with, and is tested according to, following requirements:

EMC Directive: **2004/108/EC**

Low Voltage Directive: **2006/95/EC**



8 August 2011

Vibration Measurement Instrument International AB(VMI)

## Warranty disclaimer

VMI warrants the products to be free from defects in material and workmanship under normal use and service within two years from the date of purchase and which from our examination shall disclose to our reasonable satisfaction to be defective. Warranty claimed products shall be returned prepaid to VMI for service. We reserve the right to repair or to replace defective products. Always try to explain the nature of any service problem; by e-mail or telephone. Check first all natural problems, like empty batteries, broken cables, etc. When returning the product, be sure to indicate that the purpose is to make repairs and indicate the original invoice number and date of shipment to you, if possible.

## Warranty exclusions

Damage not resulting from a defect in material or workmanship or by other than normal use. Damage resulting from repairs performed other than by an authorized service centre. The limited two year warranty and remedies contained herein are in lieu of all other warranties, expressed or implied including any warranty of merchantability and any warranty of fitness for a particular purpose, and all other remedies, obligations or liabilities on our part. In addition, we hereby disclaim liability for consequential damages for breach of any expressed or implied warranty, including any implied warranty of merchantability and any implied warranty of fitness for a particular purpose. The duration of any implied warranty which might exist by operation of law shall be limited to one year from the date of original retail purchase.

NOTE: Some countries do not allow the exclusion or limitation of consequential damages, and some countries do not allow limitation on how long an implied warranty lasts, so the above exclusions or limitations may not apply to you. This warranty gives you specific legal rights and you may also have other rights that vary from country to country. If you have problems with your instrument during or after the warranty period, first contact the distributor you purchased the unit from.



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