

Vibrometer CM-21

User Manual



Vibrometer CM-21 is a portable battery powered device used for condition monitoring purposes. It allows measurement of a number of parameters like vibration, temperature, rotation speed, etc.

Contents

1	Uses	5
2	Vibrometer set	5
3	Specifications	6
4	Using the CM-21	7
4.1	User interface and operation	8
4.2	Charging the CM-21	9
4.3	Switching the CM-21 on.....	10
4.4	Basic Operation of the CM-21	10
4.4.1	Measurements	10
4.4.2	Saving measurement results	11
4.4.3	View saved measurement results.....	12
4.4.4	Navigator for measurements.....	12
4.5	Setting up the CM-21	13
4.5.1	Setting the accelerometer sensitivity	13
4.5.2	Setting the bandpass filter.....	14
4.5.3	Setting the magnitude value	15
4.5.4	Alarm levels setup.	16
4.5.5	Date-time set up.....	17
4.5.6	Auto switch off setting.	17
4.5.7	User interface language setting.....	17
5	Measurements	18
5.1.1	Route measurements.....	19
5.1.2	Rotation speed measurements.	20
6	Audio monitoring	20

1 Uses

- Measurements of low frequency vibration selected by band-pass filters according to ISO 10816 and additional filters. Vibration is measured in acceleration, velocity and displacement units
- Measurement of high frequency vibration components for bearing diagnostics
- Condition monitoring and alarming using alarms levels set up by the operator.
- Rotation speed measurements using photo tacho probe
- Temperature measurements with integrated pyrometer
- Audio monitoring of the vibration signals from the vibration sensor with earphones

The functions of the Vibrometer CM-21 may be extended with further firmware updates.

2 Vibrometer set

The Vibrometer is supplied in the following set:

№	Description	Quantity
1	Vibrometer CM-21 (main unit)	1
2	Accelerometer IEPE type 608	1
3	Protective case	1
4	Magnet for accelerometer DM2	1
5	Probe for accelerometer	1
6	Mains adapter (Charger) CA-CM-21	1
7	User manual	1
8	System report	1
9	Tachoprobe FD-2 ¹	1
11	Cable for Tachoprobe KMM-21-1 ¹	1
12	Connector to earphones 3.5mm ¹	1
13	USB cable USB-CM-21 ¹	1

¹⁾ Supplied in the advanced kit configuration

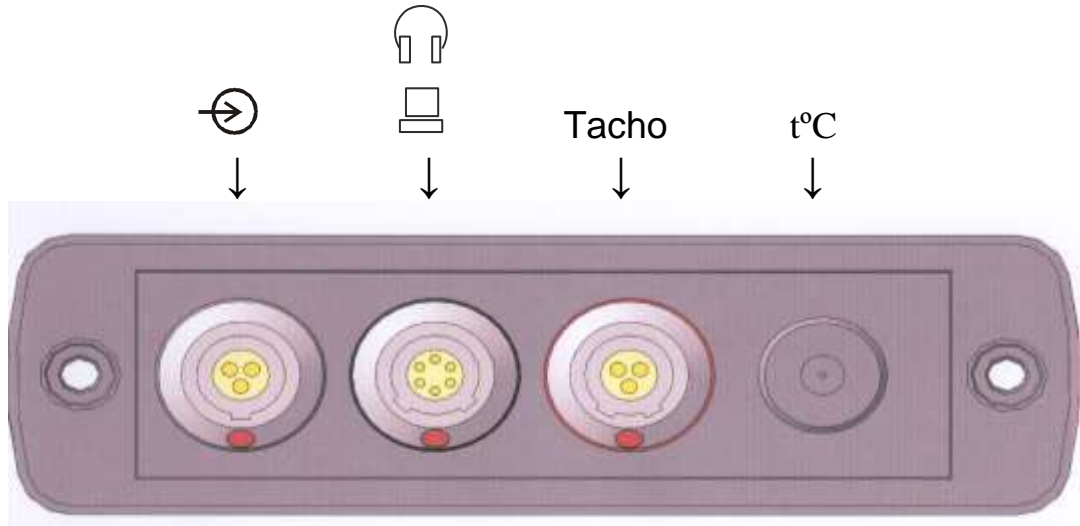
3 Specifications

Vibration measurement range:	
– acceleration, m/s ²	0,1 - 1000
– velocity, mm/s	0,1 - 1000
– displacement, um	1 - 10000
Vibration frequency range, Hz	2- 2000
Frequency bands for vibration measurements according to ISO 10816, Hz	2 - 1000, 10 - 1000, 10 - 2000
High frequency bands, kHz	6.4-25 10-25 15-25
High frequency acceleration measurements	RMS Peak Peak-factor
Bandpass filters specifications according to	ISO 2954-97
Relative error with vibration measurements in amplitude range, %	+/- 5
Relative error with vibration measurements in frequency range, %	+/- 7
Main relative error with vibration measurements, %	+/-10
Rotation speed measurements	
Rotation speed measurement range, Hz (RPM)	2 - 650 (120 - 39000)
Relative error in rotation speed measurements, %	± 1
Temperature measurements	
Temperature indication distance, m	0.1 – 1.0
Temperature range, °C	Minus 40 – plus 350
Temperature resolution, °C	0.1
Other	
Time working from batteries, not less, hours	8
Service life, not less, hours	10000
Weight, kg	0,315
Size, mm	86×138×26
Protection	IP65
Environmental conditions for operation:	
– Temperature, °C	From -20 up to +50
– Relative humidity, %	Up to 90


4 Using the CM-21

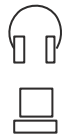
Connectors

The CM-21 has the following connectors on the top panel:



Here:

 Accelerometer input. Connect the accelerometer for vibration measurements



Connector for audio monitoring of the vibration signal – connect earphones using the earphone 3.5mm adapter from the advanced kit or special earphones. This connector is also user for communication with host computer using USB cable from the advanced kit. This connector is also used for charging the CM-21 with mains supply (charger) or host computer USB port





Tacho Tachoprobe connector. Connect FD-2 tachoprobe for rotation speed measurements






t°C Integrated temperature sensor. Point with this sensor to the area for temperature monitoring

4.1 User interface and operation

All the controls of the CM-21 are located on the front panel along with the display.



Control button	Function	Notes
	On\Off button	Press and hold button for on-off operation. Once the CM-21 is switched on it starts the measurement in the last setup.
	Calls the main menu of the CM-21 allowing choice of rpm or vibration measurements, review of the saved measurements and setting up the parameters of the CM-21	
	Cursor key in menu and display navigation.	Also used to increment the value in the accelerometer sensitivity setup before decimal point.
	Cursor key in menu and display navigation.	Also used to decrement the value in the accelerometer sensitivity setup before decimal point.

 (right)	Function button. Mostly Enter	
 (left)	Function button. Mostly cancel	This button is also used to reset the instrument in rear case it may hang up
	Recording or saving the measured vibration	When saving you can save machine and point number. Measurements are saved in numbered memory cells.
	Audio volume decrease Also used as left cursor key	Also used to increment the value in the accelerometer sensitivity setup after decimal point.
	Audio volume increase Also used as right cursor key	Also used to decrement the value in the accelerometer sensitivity setup after decimal point.

4.2 Charging the CM-21

The CM-21 operated from internal Li-Ion rechargeable battery 1700 mAh. For charging the battery you can use the dedicated charger or the USB port of the computer. Charging time from the dedicated charger is two times less that from the computer.

To charge the battery - connect the charger to the computer connector of the CM-21 and plug the charger to the mains supply. The CM-21 will switch on automatically and in the top left corner of the display you will see battery and +/- signs indicating charging, see figure below



It may take up to 4 hours to charge the empty battery from the charger or up to 8 hours from the computer USB port.

It is recommended to charge the battery at the temperature between 0 and 25 C.

4.3 Switching the CM-21 on.

Use the On button to switch on the CM-21. Press the button and hold it for a few seconds until the CM-21 will switch on. To switch off the CM-21 press the On button and hold it until the instrument will switch off.

When the instrument starts it displays the following starting screen with the version of the firmware and serial number of the instrument and control sums for the firmware:



Then the CM-21 switches to the basic operation mode.

4.4 Basic Operation of the CM-21

4.4.1 Measurements

The basic mode the CM-21 is continuous measurement of the vibration parameters and temperature as well as audio monitoring of the vibration signal with earphones.

The display in the basic operation mode includes the following information:



Here the first line indicates the battery charge, time, measured temperature. The next three lines indicate the vibration level in acceleration, velocity and displacement.

The 5th line indicates the measurement point location.

Here M01 – means machine#1, T02 – measurement point #2, Axial direction of measurement.

You can use the navigator function to set the measurement point identification

The last line shows the values of the function keys.

In the basic mode you can choose only one vibration parameter for display using the Up and Down cursor keys and press the Enter button (right function key). The display will change to the following:



To leave this mode use the Cancel button.

4.4.2 Saving measurement results

To save measurement result use the Rec button on the CM-21. The instrument will display the following screen



Here the first line contains date, time and temperature, next three lines measurement results to be saved. If some alarm level is exceeded the signs will present warning left from the magnitudes – arrow down – low level alarm, “!” – alert, and bold “!” – danger.

The next line displays the memory cell or measurement point Id where the results will be saved.

You can change:

- Machine number with Up and Down cursor keys
- Point number with “Volume +” and “Volume –“ keys
- Direction of measurements with the Menu and Rec keys.

To save the results in the selected measurement point Id use the Yes function key, to cancel saving use No function key.

If you save the results the CM-21 will return to the basic measurement mode.

Note – the measurement results in the basic mode cannot be unloaded to the computer – they can be reviewed on the screen of the CM-21 only. To be able to unload measurement results for trending use the route map measurements – data collector mode.

4.4.3 View saved measurement results

To review measurement results use the Menu key and select the “View results” command. The following screen will be displayed:

```

16-06 14:02:03 25.5%
Acc.rms  0.02 m/s²
Vel.rms  0.02 mm/s
Dis.rms  1.04 um
M03T05Axial 000001
|Delete|  |Exit|

```

Here you can consequently display all measured vibration values and delete them.

4.4.4 Navigator for measurements

To simplify the measurements results recording and identification you can use the navigator function – it allows saving results for the specific machine, measurement point and direction of measurements,

Use the Navi function key to enter the navigation mode.

```

16-06 14:03:08 26.0%
 60.9 MM/S
M Vert. 000■000000000T
0 Hor.  0!00000000000
3 Axial 0000■00000002
| 4 | | ▶ |

```

Here the first line contains date and time of measurement and measured temperature, then you have the current measured vibration value. Next the navigation table is presented.

On the left you see the Machine number e.g. M03 – machine #3. On the right you see the measurement point number T02 – Point #2

The squares indicate the memory cells for the selected Machine – rows are for the measurement direction – Vertical, Horizontal, Axial, columns are for measurement points for the Machine.

You can have up to 99 Machines in the CM-21 navi system, up to 12 Measurement points for each machine and 3 measurement Direction for each Point .

To change use

Volume keys to change machine

Left-right function keys to change point

Up-Down kes – to change direction

Empty square indicates empty memory cell, solid square indicates saved results in the memory, “!” indicates the current cell to where the results will be saved by the Rec button.

When you select the cell with measured results the saved value is displayed on the screen.

To leave the Navi mode use the Menu button and then Cancel function key.

4.5 Setting up the CM-21

Before taking measurements the CM-21 can be set up to work according to your tasks. You can set the following parameters:

- Sensitivity of the accelerometer
- Bandpass filter used for vibration measurements
- Magnitude values detector (rms, peak, peak-peak)
- Alarm levels
- Date-time
- Auto switch off
- Language for the interface

To enter the setup functions use the Menu button on the CM-21 in the basic operation mode, select by the Up and Down cursor keys the Setup menu and press Enter function key.

4.5.1 Setting the accelerometer sensitivity

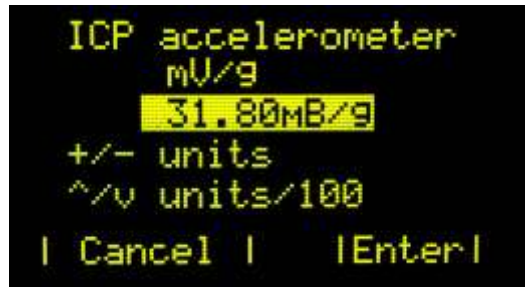
The instrument comes with the sensor and sensitivity is already set up, but if you replace the accelerometer or recalibrate it you may need to adjust the sensitivity coefficient. To do this you need to:

1. Use the Menu button on the CM-21 in the basic operation mode, select by the Up and Down cursor keys the Setup menu and press Enter function key
2. In the Setup menu select the Sensitivity function and press Enter key



3. Enter the password for your instrument that you can find in the System report supplied with the instrument. It is done so that unauthorized personnel will not occasionally change the sensitivity of the measurement system causing wrong measurements results. To enter the password use Up and Down cursor keys to select a number at the position and Volume+, Volume- keys to advance in position. If you do not know the password you can view the sensitivity, but can not change it. To view the sensitivity press the Enter (right function key).

4. The following Screen will be displayed



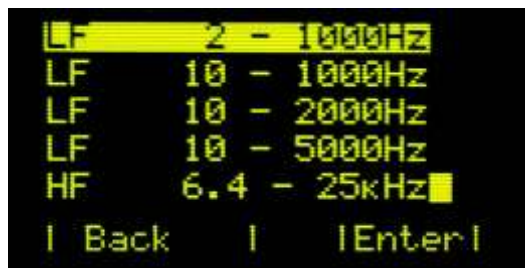
Use the cursor and volume keys to adjust the value and press Enter to save sensitivity or Cancel to exit without saving

4.5.2 Setting the bandpass filter

You can conduct vibration measurements with different bandpass filters according to the task. The basic vibration standard requires measurements of vibration in the range of 10-1000Hz for the machines rotating above 600rpm and 2-1000Hz for the slow rotating machines – operating under 600rpm, also there is a possibility to measure high frequency vibration for bearing analysis and friction forces monitoring. Note that in High frequency domain only the acceleration can be measured.

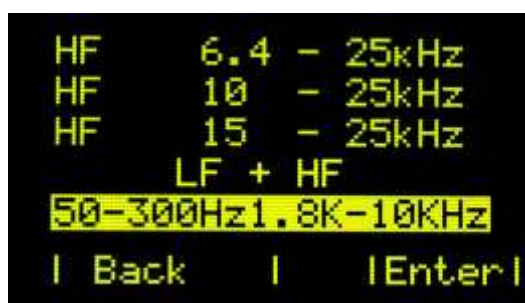
To set up the appropriate filter:

1. Use the Menu button on the CM-21 in the basic operation mode, select by the Up and Down cursor keys the Setup menu and press Enter function key
2. In the Setup menu select the Bandpass filter function and press Enter key
3. The following screen will be displayed

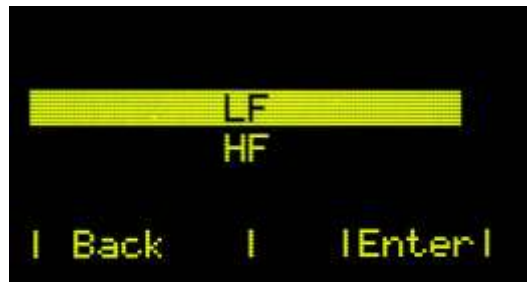


Here you can use Up and Down keys to select low or high frequency filter and make choice by Enter button.

There are two special measurement setups – one for measurements of High and Low frequency simultaneously LF + HF and another for measurements acceleration in 3 bands – low, medium and high frequency:



When you choose LF + HF you will need to set both High- and Low- frequency bands simultaneously.



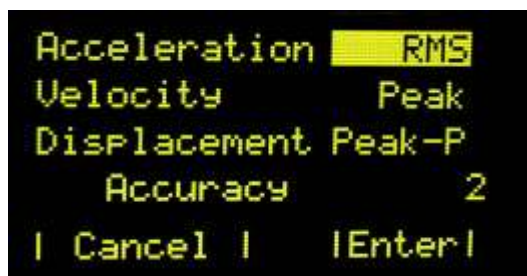
This mode is recommended for general condition monitoring and bearing condition monitoring. The high frequency vibration starts to increase with bearing defects development while low frequency vibration increases with general machine degradation.

4.5.3 Setting the magnitude value

You can choose between RMS (root mean square), peak and peak-peak values to be displayed for the vibration reading. The ISO standards require mostly RMS readings nowadays, though some regulations may require different values representation.

To set up the appropriate readings:

1. Use the Menu button on the CM-21 in the basic operation mode, by Up and Down cursor keys chose the Setup menu and press Enter function key
2. In the Setup menu select the Magnitude value and press Enter key
3. The following Screen will be displayed



Here you can use Up and Down cursor keys to select the magnitude and Volume+, Volume- keys to make a choice of the magnitude representation.

Accuracy means how many decimal digits will be displayed during measurements, The choice is between 2 and 3 digits. The CM-21 allows two decimal digits accuracy, but for the calibration purposes 3 digits can be measured.

Use enter function key to confirm the choice.

4.5.4 Alarm levels setup.

You can set up alarms to all the measurements done with the CM-21 i.e.

- Acceleration low frequency
- Acceleration high frequency
- Acceleration peak factor (Peak value divided by RMS value)
- Velocity
- Displacement
- Rotation Speed
- Temperature

Choice of the alarm levels can be done with the ISO standards for your equipment, other regulations, or the general knowledge and experience. Only one set of alarm levels can be set for the CM-21. Each of the measurements can have three thresholds:

- Normal
- Alarm
- Danger

When the measured value exceeds the threshold the alarm will be displayed on the screen

To set up the appropriate alarms:

1. Use the Menu button on the CM-21 in the basic operation mode, select by the Up and Down cursor keys the Setup menu and press Enter function key
2. In the Setup menu select the Alarm levels and press Enter key
3. The list of measurements and alarms will be displayed. Use the cursor Up and Down keys to select the measurement and Volume+, Volume- keys to set alarm on/off for this measurement
4. Once you set the alarm ON use the Enter key to set up levels for alarms
5. Use the cursor keys to select between Normal, alert and danger alarms and press Enter to set the levels
6. The following Screen will be displayed



Here you can use Up, Down cursor keys and Volume+, Volume- keys to set the alarm level. Use the Enter function key to confirm the choice.

4.5.5 Date-time set up.

For correct date-time stamp for saved measurements we recommend to set the entire clock of the CM-21.

To set up date and time:

1. Use the Menu button on the CM-21 in the basic operation mode, select by the Up and Down cursor keys the Setup menu and press Enter function key
2. In the Setup menu select the Date/time setup and press Enter key
3. Use Up, Down cursor keys and Volume+, Volume- keys to set the date and time Use the Enter (right) function key to confirm the settings

4.5.6 Auto switch off setting.

You can set the CM-21 to switch off automatically if no buttons are pressed for a certain time (about 20 minutes). It may save battery from the occasional discharge.

To set up auto switch off:

1. Use the Menu button on the CM-21 in the basic operation mode, select by the Up and Down cursor keys the Setup menu and press Enter function key
2. In the Setup menu select the Auto switch and press Enter key
3. Use Volume+, Volume- keys to set the function. Use the Enter function key to confirm the settings

4.5.7 User interface language setting.

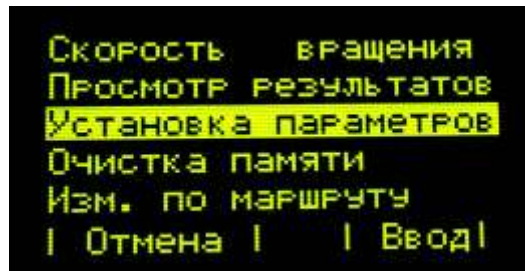
You can set the CM-21 to work in several Languages.

To select the language:

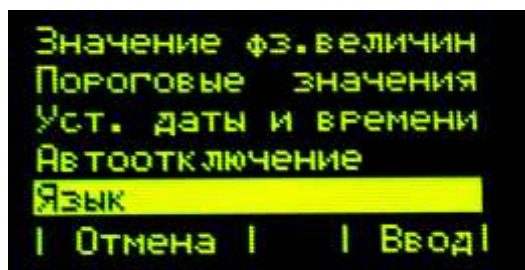
1. Use the Menu button on the CM-21 in the basic operation mode, select by the Up and Down cursor keys the Setup menu and press Enter function key
2. In the setup menu use up\down keys to select the Language menu and press enter function key
3. Select the desired language and press Enter to confirm changes
4. Switch off the instrument to save this global setting an switch it on back.

If in some case the instrument will switch to the language you do not understand, for example Russian language here is the menu you have to select to get to Language settings:

The main menu in Russian with the setup selection:



The setup menu with the selected language menu in Russian:



When you get to the Language menu, the languages will change with menu items selection.

5 Measurements

The CM-21 has three measurement modes^

- Basic measurements
- Route measurements
- RPM measurements

The CM-21 once in the basic operation mode makes continuous measurements of set up vibration parameters and temperature. Note that for low frequency vibration measurements it will measure acceleration, velocity and displacement values for the selected band. In the high frequency domain it will measure only acceleration, but in rms, peak and peak factor values. In bearing condition monitoring when initial defects occur first will grow the peak factor value when the defect becomes severe the peak factor value may decrease and RMS value starts to grow in high frequency domain.

Vibration is measured with the external accelerometer that should be connected to the input connector. The temperature is measured with the integrated pyrometer. To make temperature measurements point with the pyrometer window to the object. The measurement distance should be within the range on 0.1-1 meters. The shorter the distance, the more precise are the measurements.

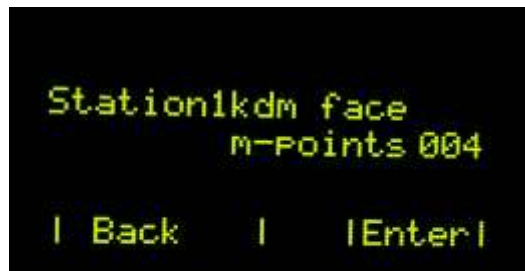
The basic measurements can be saved to CM-21, but currently can not be unloaded to computer. The basic measurements are described in Chapter 4.4 above

5.1.1 Route measurements.

Route measurements are designed for the periodical condition monitoring of the equipment. The measurements are done according to the route map created in the VibroLevel or other compatible software. The measurement setup and alarms are stored in the route map for each point individually. The measurement results are saved for each point and can be unloaded to computer for storage and trending.

Each point is identified by corresponding Station, Machine, Measurement point and direction of measurement. The route can contain machines and points only from one station.

Once the routes are loaded to the CM-21 you can go to the main Menu and use the Choose Route command to select route for measurements:



Here in the first line you see the Station name and the route name. The second line shows the number of measurement points in the route.

You can choose a route by Up/Down buttons and confirm your choice by the Enter key.

The route measurement display contains the following information:



Here you see

- What is measured (velocity peak value),
- Low level alarm
- Measured value
- Machine Id from the route
- Measurement point Id from the route and measurement direction set in the route
- Date/time of measurement if it was measured already and saved.

The CM-21 makes continuous measurements and once you see the result you can save measurements with the Rec button,

When the measurement is saved, the CM-21 advances in the route to the next measurement point. You can scroll measurement points in the route with Up/Down keys.

You can overwrite previous measurements with the new ones just saving the new one on top of the previous data. Previous data will be lost in this case, Only one measurement result can be stored for the point.

Once the Danger or Alert alarm level will be exceeded the CM-21 will present alarm with color and beep sound:



To leave the route you go to Menu, Choose route and use the back function key. The CM-2 will return to the basic mode.

5.1.2 Rotation speed measurements.

Rotation speed measurements are done with the external FD-2 tachoprobe. Connect it to the CM-21, Use the Menu button and select the Rotation speed measurement in the menu.



Use the Up/Down keys to change measurement units from Hz to RPM

The tachoprobe requires some blister mark to be attached to the shaft. In most cases you can use chock mark or it may work without the mark as the sensor has auto gain and in many cases can find some uneven mark on the shaft itself. The working distance to the shaft is 1-20 cm. When the probe senses the mark it blinks with led indicator.

6 Audio monitoring

The CM-21 provides output to the earphones for audio monitoring of the vibration signal. To listen to the vibration signal simply connect earphones to the audio connector. The volume of the signal can be adjusted using +/- volume buttons