

Instruction Manual

Vibration Meter

VM23

Valid from firmware ver. xxx.007



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Appendix: Warranty

Declaration of CE Conformity



Figure 1: VM23 with sensor

Thank you for choosing a Metra Vibration Measurement Instrument!

1. Purpose

The VM23 has been developed, particularly, for the measurement and monitoring of vibrations on rotating machines. In addition it is a useful tool for machines which have the purpose of generating vibration, like vibration conveyors, vibrating screens and separators.

Such measurements help to monitor the condition of the machine in order to avoid unscheduled shut-down. Furthermore vibration measurement is carried out prior to the distribution of new machinery and subsequently to repair with a view to quality control and the issuing of product guarantees.

The basis for successful machine condition monitoring is the measurement of the vibration severity over a longer period of time. Measurements are taken at regular intervals of time and recorded.

The VM23 measures and records vibration velocity, also known as vibration severity. Its specification corresponds to the ISO 2954 regulations and is suitable for, among other things, the measurement of machine vibrations on machines with a nominal speed at or above 120 min^{-1} , in accordance with ISO 10816. Additionally the VM23 can measure vibration displacement and main frequency.

The VM23 includes different band filters for acceptance measurements according to various standards, like ISO 20816 or ISO 8528.

An external piezoelectric accelerometer is used as the sensor, and is provided together with the instrument. The VM23 is fitted with an electronic measurement point detector (VMID) which enables it to take routine measurements of a large number of measurement points very effectively. A software package for transferring the measurement data to a PC is also available from Metra.

In the common hierarchy of condition monitoring the VM23 is equivalent to "Level 1". This represents the long term monitoring of parameters with low technical and personnel requirements.

For fault detection ("Level 2"), as a further step, spectral diagnostic measurements are taken, which require a large degree of expertise and sophisticated measurement technology.

In the development of the VM23 value was placed on simple operation and maintenance requirements, which enable trained personnel to operate the instrument without the need of being specially qualified.

2. Function

2.1. The Sensor

The VM23 operates with a piezoceramic shear accelerometer. Piezoelectric vibration transducers are characterized by high precision and resolution with great robustness. The accelerometer of the VM23 has an integrated electronic circuit for impedance conversion in accordance with the IEP standard. At the base of the sensor a magnet has been integrated for mounting to the measurement point. In the center of the magnet there is a contact point from which the identification number can be read. The measurement point ID is saved in the available VMID measurement points.

The coupling surface is protected by a metal cap which attaches to the sensor's magnetic base.

2.2. The Measuring Instrument

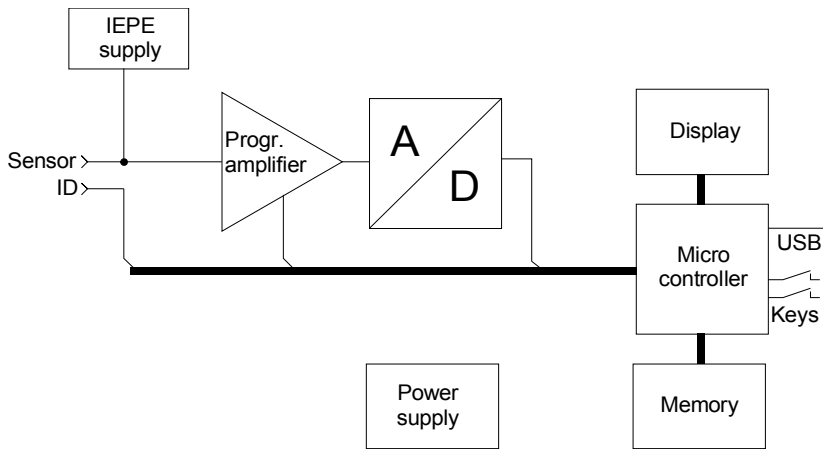


Figure 2: Block Diagram

Figure 2 shows the block diagram. The VM23 supplies the IEPE Sensor with 2 mA constant current. At the sensor output, a vibration acceleration proportional AC voltage arises, which is amplified in the instrument to produce an optimum level. The gain switch-over takes place automatically. The subsequent analog/digital converter is a Sigma-Delta converter with 24 bit resolution.

Further signal processing, such as filtering, integration (for calculating velocity and displacement from acceleration), RMS and peak-to-peak value calculation and frequency analysis for main frequency detection, is carried out in the micro controller. The micro controller also controls the graphic display, the USB communication and the storing of measurements.

3. The Measurement Procedure

Measuring vibration velocity is a common procedure for assessing the running smoothness of rotating machines. Vibration velocity, commonly known as vibration severity, is a measurement of the energy expenditure of occurring vibrations. Vibrations are caused by rotational imbalances, for example as a result of loose screws, bent parts, worn or slack bearing clearance or dirt residues on fan blades. Often several factors have a mutually reinforcing effect. Besides rotary machines, the measurement procedure is also suitable for reciprocating machines.

The specifications of vibration velocity measuring instruments are described in ISO 2954. In the ISO 2954 a band filter for the vibration velocity of 10 to 1000 Hz is defined. The VM23 has additional frequency ranges from 2 to 100 Hz and 2 to 1000 Hz. The corresponding frequency response graphs can be viewed in Figure 3.

The displayed values of the vibration severity are true RMS or true peak-peak.

For reasons of conformity with older instruments the VM23 also measures equivalent peak-peak which is calculated by multiplying RMS with $2\sqrt{2}$.

Note: Equivalent peak-peak measurements are only accurate for sine-wave oscillation. In spite of this limitation equivalent peak-peak may be advantageous if true peak-peak readings are very fluctuating. Higher stability is achieved by averaging over 2 seconds.

These settings are made in the main menu under “Measuring mode”.

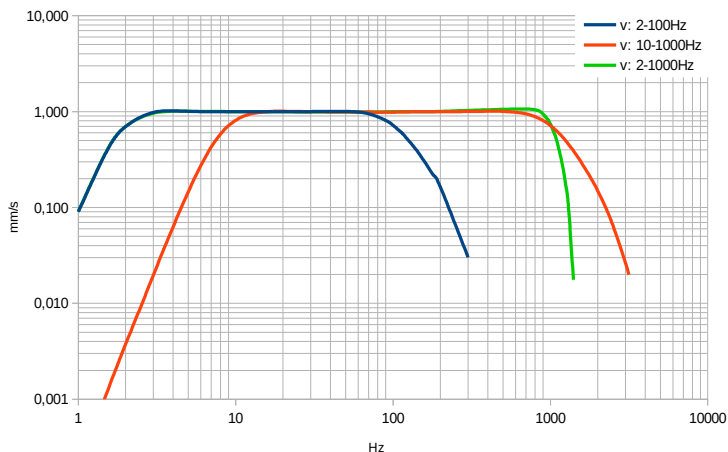


Figure 3: Frequency Response for vibration velocity

For machines with the purpose of generating vibration, like vibration conveyors, vibrating screens and separators the VM23 can display the main vibration frequency. At such machines the magnitude is usually measured as displacement.

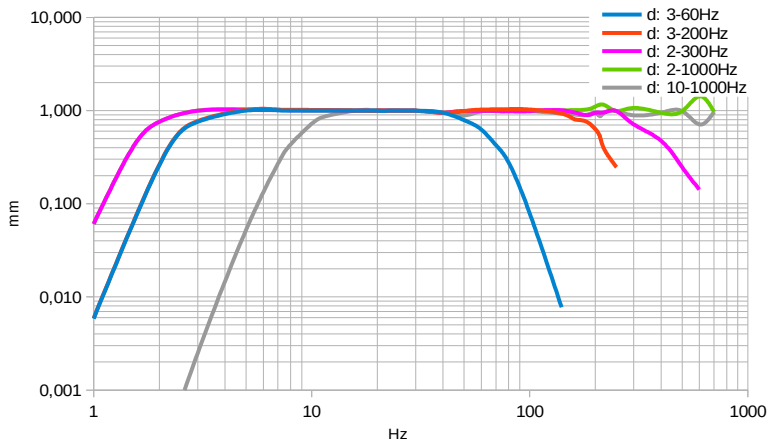


Figure 4: Frequency Response for vibration displacement

Note: Displacement amplitudes at higher frequencies are very small due to double integration of the accelerometer signal. Above approx. 300 Hz only the last digit of the display changes. Therefore the diagram in Figure 4 shows ripple at the upper end. Displacement measurements at higher frequencies should be avoided if possible since they are inaccurate. The ranges 2 to 1000 Hz and 10 to 1000 Hz are only provided for reasons of compliance with some standards demanding such limits.

4. The Batteries

4.1. Inserting the Batteries

The VM23 is supplied by three alkaline standard cell type AAA (LR03) batteries. NiMH batteries (HR03) may also be used. The minimum energy requirement of the VM23 enables maximum utilization of the batteries.

Attention: Please switch the instrument off before changing the batteries. When switched off, the contents of the memory are stored for a few minutes, without need of the batteries, and the internal clock continues to run. If the batteries are removed when the instrument is switched on or if they remain in the instrument until the batteries have been completely discharged, the device will perform a new start once the batteries have been changed. Following a 'new start' the date and time will need to be newly set. Further settings as well as the saved measurands, are stored without need of the batteries.

To insert the batteries, remove the two screws from the back cover of the device and open the battery compartment (Figure 5). When inserting the batteries, please ensure that their polarity is correct, (see the engraved markings inside the compartment).



Figure 5: Battery Compartment

Important:

- Always use three batteries of the same type and same date of manufacture.
- Remove old batteries from the instrument, and take out the batteries if the instrument will not be used for a long period of time. Otherwise leaking battery acid may cause severe damage to the instrument.



Please use your local collection point to dispose of batteries.
Batteries do not belong to the household waste.

4.2. Switching On and Off

The instrument is switched on by a short press of the ON-OFF button. A start screen will be shown on the display for 3 seconds. (Figure 6).



Figure 6: Start Screen

This displays the hardware version number (the 3 digits before the point) and the software version number (the 3 digits after the point) followed by the serial number corresponding to the type label. The month and year of the last calibration are displayed (cf. Section 10) along with the memory capacity.

By pressing the ON-OFF button again the VM23 switches itself off. In addition, the instrument has an automatic shut-off timer for saving the battery power (see cf. Chapter 4.4).

4.3. Battery Display and Battery Type

In the upper left corner of the VM23 display there is a battery level indicator (Figure 7). When the green battery symbol is full, the battery is fully charged.

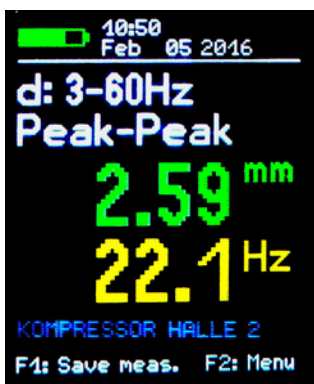


Figure 7: Battery indicator upper left



Figure 8: Select battery type

While non-rechargeable batteries have a cell voltage of 1.5 V, NiMH rechargeable batteries deliver only 1.2 V per cell. The VM23 battery indicator can be adjusted to both voltages. To adjust the voltage remove the sensor from the VMID and press F2 to open the main menu. Here the battery type can be changed by pressing F1 to scroll down to the menu option 'Instrument Settings' and then pressing OK. Within the sub-menu select "Battery type" by following the same instructions as before (Figure 8) and then by pressing F1 scroll between F1 "Alkaline" (non-rechargeable, 1.5 V) or "NiMH Accu" (rechargeable, 1.2 V). Confirm your choice by pressing OK and exit the menu by pressing F2 repeatedly.

If the power supply drops below 3.3 V when using alkaline batteries or below 3 V with rechargeable batteries, the battery indicator becomes red. Further measurements can be taken until the power supply reaches 2.8 V in keeping with the instrument specifications. At this point the battery level indicator is completely empty and the instrument switches itself off automatically.

If the VM23 is connected to a USB port, it will be supplied by the USB voltage in order to spare the batteries. In this case, "External" is displayed on the screen instead of the battery level indicator.

4.4. Shut-off Timer

The VM23 has a shut-off timer to help prolong the battery operating life. To set the shut-off timer, remove the sensor from the VMID and press F2 to open the main menu. From the main menu scroll down to the sub-menu option "Instrument Settings" by pressing F1 and OK. Here the menu option "Shut-off timer" can be selected by pressing F1 and the timer duration options of 1, 5, 15 and 60 minutes can be selected, alternatively to deactivate the switch off timer select "none". The automatic switch off timer starts to run after the last press of a button. If a button is pressed then the timer restarts and counts down again according to the duration selected.

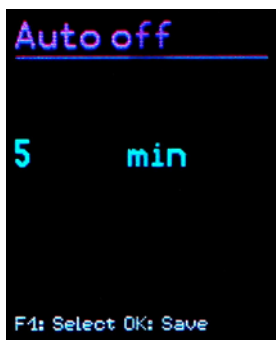


Figure 9: Shut down time

5. Preparation of Measuring Points

5.1. General Information on Measurement Point Choice

When monitoring machines it is important to take measurements under the same operating conditions, at the same measurement point. Choosing the suitable measurement point is therefore decisive.

Where possible, qualified staff experienced in machine monitoring should be called upon.

It is generally advisable to record machine vibrations near to their source. This helps to reduce distortion of the measuring signal to a minimum when it is being carried through transmission parts. Suitable measurement points include rigid machine components such as bearing housings or gearboxes.

Light or mechanically flexible machine components such as cladding and casing are unsuitable for the measurement of vibrations.

5.2. ISO 20816-1 Recommendations

The standard ISO 20816-1 recommends bearing housings or their immediate surroundings as preferred measuring location points for the measurement of machine vibrations (Figures 10, 11, 12 and 13).

For the purpose of monitoring a rotating machine it is normally sufficient to take measurements in only one direction, either vertically or horizontally.

On machines with horizontal shafts and rigid foundations the largest vibration amplitudes occur horizontally. With flexible foundations, strong vertical components also arise.

For the purpose of acceptance tests, measurement values are to be taken from all bearing point locations at the center of the bearing and in all three directions (vertical, horizontal and axial).

The following illustrations give a few examples of suitable measurement point locations.

The Standard ISO 13373-1 also gives recommendations for measurement points on various machine types.

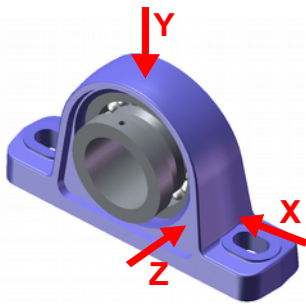


Figure 10: Measuring points on vertical bearings

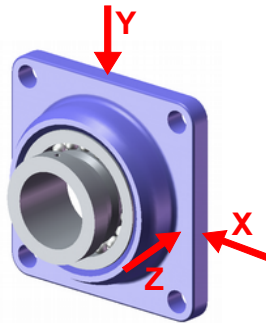


Figure 11: Measuring points on flange bearings

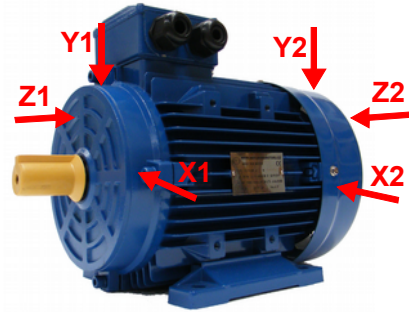


Figure 13: Measuring points on electric motors

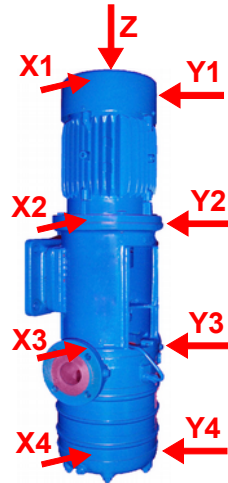


Figure 12: Measuring points on machines with vertical rotors

5.3. VMID Measurement Point

5.3.1. How the VMID Measurement Point Functions

The VM23 is equipped with an electronic measuring point detector. Metra offers a type measurement point called VMID, which is made of magnetic stainless steel and has an inbuilt memory with an individual serial number (Figure 14).



Figure 14: VMID Measurement Point

The serial number stored inside the measurement point is a unique 16-digit hexadecimal number, e.g. “000000FBC52B”.

Each measurand can be easily and reliably allocated to a specific measuring point. To read the serial number, contact is made through the sensor's magnetic base.

The maximum permissible operating temperature for the VMID is 80 °C.

5.3.2. Mounting the VMID Measurement Point

A VMID measurement point is mounted onto the machine using two component epoxy adhesive. For an accurate vibration transmission, Metra recommends the following adhesive:

- LOCTITE Hysol 3430 without filler for even surfaces
- LOCTITE Hysol 3450 with filler for uneven surfaces

Before applying the adhesive ensure that all residues of grease have been thoroughly removed from both contact surfaces. The two component adhesive can be applied directly onto the chosen surface. The adhesive takes 5 minutes to harden and after 15 minutes the first measurement can be taken.

For protection against dust and humidity according to IP67 please put the supplied protective plastic cap on the VMID measurement points when no measurements are taken.

6. Measurement

6.1. Measurement Value Display

In the top margin of the screen (Figure 15) the battery power is displayed. Next to this the date and time are also indicated.



Figure 15: Measurand display

Below the measurand (d: 3-60Hz Peak-Peak) the currently measured vibration displacement is displayed green in mm (or velocity in mm/s).

The blue line below shows the measurement point name if a VMID was detected.

6.2. Measurement Point Detection

6.2.1. Reading the VMID Data with the VM23

The VMID measurement points are designed, so that the magnetic sensor base centers itself. To avoid mechanical shock do not let the sensor snap onto the measurement point, instead, roll it slowly over the edge. To improve the vibration transmission the measuring point can be lightly lubricated.



Figure 16: Newly recognized VMID

When the Sensor base comes into contact with the measurement point for the first time, the VM23 displays the VMID measurement point number (Figure 16).

6.2.2. Entering the Measurement Point Text

If a measurement point has not yet been assigned a text, press F1 to reach the text-edit menu (Figure 17).



Figure 17: ID-Text Entry

A space of two rows consisting of 10 characters each is assigned for the measurement point text. The text can be entered by pressing F1 and F2, F1 selects the character for editing and F2 the character position. Both capital letters (A to Z) and numbers (0 to 9) can be used. To reach the second row press OK and then to exit the menu press OK again. After entering the ID text you can set filtering and integration and choose between RMS and peak-peak detection.

Once you have assigned the VMID serial number a text, the VM23 will display the text continually upon identification of the measurement point. (Figure 18).



Figure 18: ID Text Display

The measurement point text can also be changed later by following the instruction for the initial entry. Remove the sensor from the measurement point, open the main menu by pressing F2, scroll down to the sub menu “Point ID Memory” by pressing F1 and OK to select. From within the Point ID Menu select “Edit Point ID”. Select your chosen measurement point by pressing F1 and then OK to edit. The editing of the ID text is achieved by following the instruction given for the initial entry.

Note: Changing the measuring point data also effects the display of saved measurements (cf. Chapter 7). The current saved text of the respective VMID series number is always displayed in the measurement data.

The measurement point data is saved in the instrument. If several instruments are used at the same measurement point location, the measurement point data will need to be saved within each instrument.

6.2.3. Deleting Measurement Point Data

Remove the sensor from the measurement point and open the main menu by pressing F2 and select the sub menu “Point ID memory” by pressing F1 and OK.

Within the menu option “Erase Point ID”, measurement point data records, each consisting of a VMID serial number, text and operational mode, can be deleted one by one. In the subsequent menu “Erase Point ID”, press or hold down F1 until the record you wish to delete is shown, then press OK and confirm the warning by pressing F1 once again. (Figure 19).

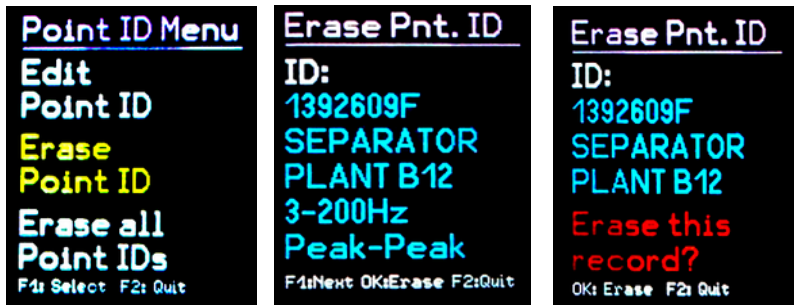


Figure 19: Deleting measurement Point Records

In the same way, the entire measurement point data can be deleted as a whole by selecting “Erase all Point IDs” in the “ID Menu”.

The VM23 memory can store data for a maximum of 1600 measurement points.

Note: Deleting measurement point data effects the display of saved measurements. Instead of the measurement point series number and the measurement point text being shown, “none” is displayed. The measurement point data records can always be newly generated, as described in 6.2.2

6.3. Saving Measurands

The currently displayed measurands and their measurement point numbers (if available), as well as the date and time can be saved by pressing the F1 key.

Note: If the sensor locates a measurement point which has not yet been assigned a text (cf. Chapter 6.2.2), the F1 key can be used to enter the new measurement point text.

7. Viewing Saved Measurement Data

7.1. Graphical Trend Display

The purpose of measuring vibration according to ISO 10816 and ISO 13373 is as follows; To make assessments concerning the operating condition of a machine based on changes in its vibration behavior. To achieve this it is imperative, that measurements are taken at regular time intervals, from the same points and under the same conditions.

To deliver the service staff on site a report about the periodic changes in vibration severity and consequently the previous history of the measurement point concerned, the VM23 provides a graphical trend display. The prerequisite for retrieving graphical trends is placing the sensor on the relevant VMID. The trend display is obtained by pressing the F2 key. (Figure 20).

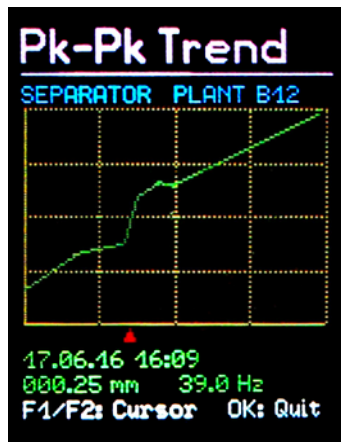


Figure 20: Trend Display

The vibration magnitude (RMS or peak-peak) is shown on the vertical axis and the time on the horizontal axis. Both are scaled to their respective maximum value. The time axis shows the interval between the first and last saved measurement. Below the diagram there is a red marker. This can be moved horizontally to read the magnitude, with the F1 and F2 keys. The marker only skips forward to time points which have a measurand. At each data point the date and time of the measurement as well as the measured RMS are displayed. Above the diagram the text assigned to the measurement point is displayed. In order to be able to display trends, the points are joined together by a line.

Press the OK key to exit the trend display.

If only one or zero measurands for a selected measurement point can be located in the memory, the error message "Too few data for trending" will appear instead of the trend graphic.

7.2. Viewing Saved Measurement Values

In addition to the graphical trend readings for current measurement points, saved measurement data can be viewed in text format. Remove the sensor from the measurement point, open the main menu by pressing F2, select the sub-menu “Measurement data memory” by pressing OK and within the sub-menu press OK to select “View measurement data memory”. The first data record will now be displayed. At the top, a consecutive number and the number of the data record within the memory will be shown. Below these, the measuring point serial number and its assigned text are displayed. The saved measurand is displayed underneath the date, time and filter type in use (Figure 21).

With F1 you can scroll to the next measurand. The currently displayed measurands can be deleted by pressing OK. Press F2 to exit the menu.

The VM23 memory can hold 16000 measurement values.

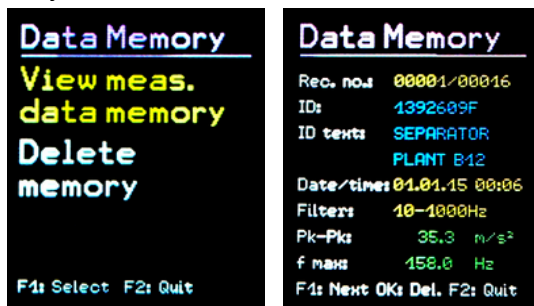


Figure 21: Viewing Saved Measurement Values

7.3. Deleting all Measurement Data

Select in the sub-menu “Measurement data memory” “Erase meas. data memory” in order to delete all measuring data. After pressing OK a warning message will appear showing the total number of records.

8. Measurement Evaluation

To be able to derive statements from the measured vibration velocity values about the condition of a machine, experience is necessary. If experienced personnel are not available, in many cases one can refer to the ISO 10816 recommendations. In this standard, the vibration severity zone limits for various machine types are defined, which can provide an initial evaluation of a machine's maintenance condition. The four zone boundary limits characterize the machine in categories according to vibration severity.

A: New condition

B: Good condition for unrestricted continuous operation

C: Poor condition - allows restricted continued operation only

D: Critical condition - Danger of damage to the machine

In the appendix of part 1, extended in 2009, general zone restrictions for machines which are not separately dealt with in other parts of the standard are specified.

| | | | | |
|-------------------------------|---------------------------------|-----------------------------------|----------------------------------|-----------------------------------|
| V _{eff} 10 – 1000 Hz | 45 mm/s | | | |
| | 28 mm/s | | | |
| | 18 mm/s | | | |
| | 14.7 mm/s | | | |
| | 11.2 mm/s | | | |
| | 9.3 mm/s | | | |
| | 7.1 mm/s | | | |
| | 4.5 mm/s | Zone A/B 0.71 – 4.5 mm/s | Zone B/C 1.8 – 9.3 mm/s | Zone C/D 4.5 – 14.7 mm/s |
| | 2.8 mm/s | | | |
| | 1.8 mm/s | | | |
| | 1.12 mm/s | | | |
| | 0.71 mm/s | | | |
| | 0.45 mm/s | | | |
| | 0.28 mm/s | | | |
| D | Risk of machine damage | | | |
| C | Restricted continued operation | | | |
| B | Unrestricted operation possible | | | |
| A | Newly operating machine | | | |

Table 1: Typical zone limit values for vibration severity according to ISO 10816-1.

In the standard it is pointed out that small machines, for example electric motors with a power rating of up to 15 kW, tend to lie around the lower zone limits, whereas large machines, for example motors with flexible foundations, lie around the upper zone limits.

In part 3 of the ISO 10816, revised in 2009, the zone borders for the vibration velocity of machines with a power of 15 kW to 50 MW are specified (2).

| | Machine type | Large machines with 300 kW to 50 MW | | Medium sized machines with 15 to 300 kW | |
|-------------------------------|--------------|--|---|--|-------|
| | | Electric motors with a shaft height above 315 mm | | Electric motors with a shaft height between 160 and 315 mm | |
| | Foundation | flexible | rigid | flexible | rigid |
| V _{eff} 10 – 1000 Hz | > 11 mm/s | D | D | D | D |
| | > 7.1 mm/s | C | D | D | D |
| | > 4.5 mm/s | B | C | C | D |
| | > 3.5 mm/s | B | B | B | C |
| | > 2.8 mm/s | A | B | B | C |
| | > 2.3 mm/s | A | B | B | B |
| | > 1.4 mm/s | A | A | A | B |
| | < 1.4 mm/s | A | A | A | A |
| | | D | Risk of machine damage | | |
| | | C | Restricted operation | | |
| | | B | Unrestricted long-term operation possible | | |
| | | A | Newly commissioned | | |

Table 2: Vibration velocity classification in accordance with ISO 10816-3

Part 7 of the ISO 10816 deals specifically with rotodynamic pumps (3).

| | | Category 1 | | | Category 2 | |
|-------------------------------|------------|--|----------|------------|---|----------|
| Type | | Pumps with high safety and reliability demands | | | Pumps for general and less critical use | |
| Performance | | < 200 kW | > 200 kW | | < 200 kW | > 200 kW |
| V _{eff} 10 – 1000 Hz | > 7.6 mm/s | D | D | > 9.5 mm/s | D | D |
| | > 6.5 mm/s | D | C | > 8.5 mm/s | D | C |
| | > 5.0 mm/s | C | C | > 6.1 mm/s | C | C |
| | > 4.0 mm/s | C | B | > 5.1 mm/s | C | B |
| | > 3.5 mm/s | B | B | > 4.2 mm/s | B | B |
| | > 2.5 mm/s | B | A | > 3.2 mm/s | B | A |
| | < 2.5 mm/s | A | A | < 3.2 mm/s | A | A |
| | | <div style="display: flex; flex-direction: column; align-items: flex-start;"> <div>D Risk of damage to the machine</div> <div>C Restricted operation</div> <div>B Lasting operation in safe working operating range without restrictions possible</div> <div>A Newly commissioned pumps in preferred operating range</div> </div> | | | | |

Table 3: Classification of the vibration severity of rotodynamic pumps in accordance with ISO 10816-7

9. Setting the Date and Time

When saving measurement values the date and time need to be correctly recorded. To set the date and time remove the sensor from the VMID and open the main menu by pressing F2. From within the main menu press F1 repeatedly to scroll down to the menu option “Instrument Settings” and then press OK. Within this sub-menu select “Time and Date” by following the same procedure.

By pressing F1 the selected value can be increased. Upon reaching the maximum value, e.g. in the 23rd hour, the counter starts again from the beginning. With F2 you can move to hour, minute, month, day and year.

The date takes the leap year into consideration. It is, however, important to ensure that no invalid day-month combinations are entered.



Figure 22: Time and Date

Additionally, clock inaccuracy can be corrected. This can be done using the setting at “Cal.” in ppm (parts per million). The clock frequency can be increased with positive values and decreased with negative. The sign changes to minus at +254 ppm. Example: The clock is 5 seconds slow. There are $24 * 60 * 60 \text{ s} = 86400 \text{ seconds}$ in a day. The difference amounts to $5 \text{ s} / 86400 \text{ s} = 58 * 10^{-6} = 58 \text{ ppm}$. The adjustable value is -58 ppm.

To exit the menu press OK followed by F2 repeatedly.

10. Calibration

The VM23 comes with with a factory calibration, which is traceable to the reference standard of the Physikalisch-Technischen Bundesanstalt (PTB). The calibration is only valid with the supplied vibration transducer. The serial number of the instrument and the transducer are stated on the calibration certificate. The month and year of the factory calibration are displayed when the instrument is switched on (cf. Figure 6 on page 7).

The value set upon calibration is the transducer sensitivity in mV/ms^{-2} .

This can be viewed in the calibration menu. Remove the sensor from the VMID and open the main menu by pressing F2. From the main menu scroll down using F1 until you reach the menu option “Sensor calibration” and select OK. Within this sub-menu select “By entering sensitivity”. The displayed value is the sensor's calibrated sensitivity. (Figure 23). It should not be changed, unless a new calibration is being carried out. Press OK followed by F2 repeatedly to exit the menu.

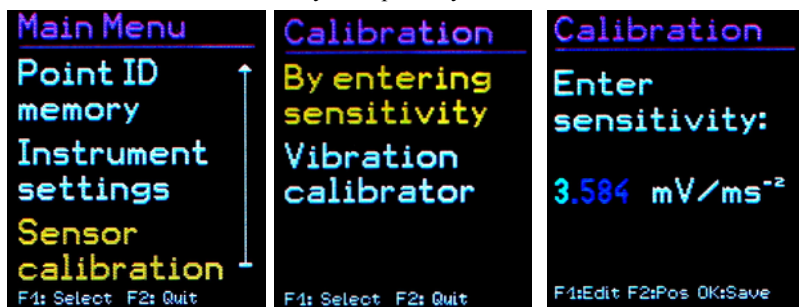


Figure 23: Transducer sensitivity

Apart from the factory calibration an accuracy test or re-calibration can be carried out by the user. For this a vibration calibrator is required. Metra offers the instruments VC20 and VC21 (Figure 24). They can generate one or more vibration amplitudes and frequencies with defined accuracy. For the calibration of the VM23 a sufficient acceleration would be 10 m/s^2 at 159.2 Hz (radian frequency 1000 s^{-1}).



Figure 24: Vibration Calibrator VC20

To calibrate the instrument, open the “Calibration” menu and select „Vibration calibrator”. You will be requested to mount the sensor on to the vibration exciter. (Figure 25). This is done using the magnetic base. Press OK.

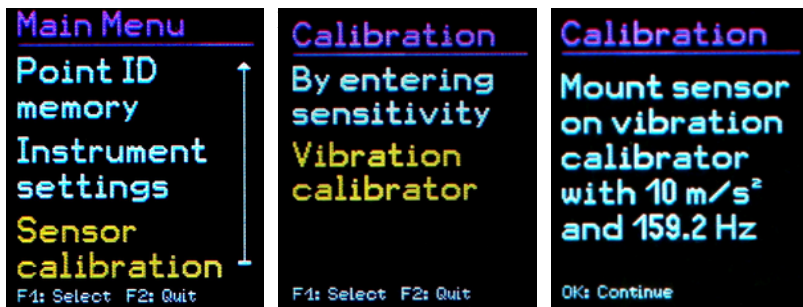


Figure 25: Calibration Menu

The VM23 is now ready for the reference vibration signal. It displays the measured acceleration (Figure 26). By using F1 and F2 the displayed value can be increased or decreased, until it amounts to 10.00 m/s^2 . To save the setting press OK and exit the menu. By adjusting the sensor sensitivity the instrument has now been calibrated. Check the calibration in the measuring mode. A vibration acceleration of 10.00 m/s^2 at 159.2 Hz corresponds to a vibration speed of 10.00 mm/s .



Figure 26: Calibration

11. Sensor Check

The VM23 input is designed for use with a low power IEPE accelerometer. These sensors are supplied by constant current, which produces a positive DC voltage potential at the output. Due to this DC voltage an assessment can be made of the sensor's operating condition. The VM23 detects three operational conditions:

| | |
|-------------|-------------------------------|
| < 0.1 V: | short circuit |
| 0.1 – 11 V: | in working order |
| > 11 V: | open input, e.g. broken cable |

If a short circuit occurs or the input is open the instrument will display “SENSOR ERROR” instead of the measurand.

12. Reset Key

If it occurs that the VM23 does not respond to the press of any button, press the reset key to restart the instrument. The reset key is reached with a thin object through the aperture next to the type label (Figure 27).



Figure 27: Reset Key

Saved data and settings are not lost when the instrument is reset.

13. Connection to a PC

13.1. Device Driver

The VM23 has a USB interface. For connection to a PC the supplied VM2x-USB cable can be used (Figure 28), which is connected to the 8 pin socket on the VM23. Please switch the instrument off before connecting it to the PC.



Figure 28: USB Cable VM2x-USB

Connect the other end of the cable to a USB port of the computer and switch the VM23 on again. If the instrument is being connected with a particular computer for the first time, a driver installation will be necessary. The driver MMF_VCP.zip can be found on our website: http://mmf.de/software_download.htm

Unpack and save both data files in a directory on your computer.

When Windows requests details of the source of the device driver, this directory should be entered.

The device driver is digitally signed and runs with Windows XP, Vista, 7, 8 and 10.

13.2. Firmware Update

The instrument software (firmware) can be updated via the USB port. First of all, check whether a more up-to-date version than that which is currently installed is available. To view the latest version visit our “Software Download” site.

http://www.mmf.de/software_download.htm

Here you will see the most recent firmware version available. The version number is composed of three digits for the hardware and three for the software (hhh.sss). Only the last three digits are relevant for the firmware.



Figure 29: Firmware version

The version currently installed on your instrument is displayed on the start screen (Figure 29). If a Firmware version with a higher number is available on the website, proceed as follows:

1. Download the firmware file vm23.hex from the above named internet address.
2. Also download the program “Firmware Updater” from the above named internet address and install it on your PC.
3. Connect the VM23 to the PC using the USB cable and switch it on so that Windows detects it as USB device.
4. Start the “Firmware Updater” (Figure 30), then select the instrument type “VM23” and set up the virtual COM port assigned by the PC. If you are not sure which of the available COM ports is correct, you can check in the Windows system control manager located within the instrument manager.

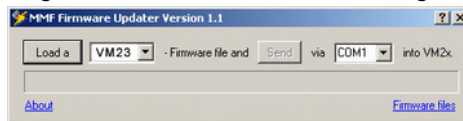


Figure 30: Firmware Updater software

5. Click on “Load” in the “Firmware Updater” and enter the path to the file where the downloaded firmware vm2x.hex is located.
6. Within the VM23 “Instrument Settings” select the option “Update Firmware” and confirm the warning and subsequent message by pressing OK. By carrying out this step the old firmware is deleted. The VM23 will then indicate that it awaits new firmware data from the USB port (Figure 31).

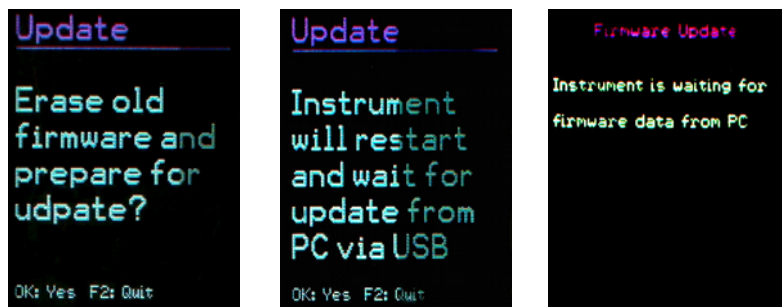


Figure 31: Firmware update

7. Click on “Send” in the “Firmware Updater”. Transfer of the Firmware data has now begun. The transfer progress is displayed as a time bar on the PC and also on the VM23. When the update is finished the VM23 will start up and the “Firmware Updater” will close. Please do not interrupt the update process. Following transfer failures the update can be restarted at point 3.

Important: Before starting an update please ensure that the batteries are sufficiently charged. Otherwise the update may fail and can only be restored by the manufacturer.

14. Technical Data

| | |
|--|--|
| Displayed measurand | true RMS of vibration velocity true peak-peak of vibration velocity equivalent peak-peak of vibration velocity true RMS of vibration displacement true peak-peak of vibration displacement equivalent peak-peak of vibration displacement |
| Measuring range | 0.1 – 1000 mm/s for specified measurement accuracy 0.01 – 60 mm for specified measurement accuracy |
| Display resolution for RMS and peak-peak | 0.01 mm/s 0.001 mm |
| Measurement accuracy | $\pm 5\% \pm 2$ digits |
| Frequency ranges (3dB limits) | 2 – 1000 Hz for vibration velocity 10 – 1000 Hz for vibration velocity (ISO 2954) 2 – 100 Hz for vibration velocity 3 – 60 Hz for vibration displacement 2 – 300 Hz for vibration displacement 3 – 200 Hz for vibration displacement 2 – 1000 Hz for vibration displacement 10 – 1000 Hz for vibration displacement |
| Main frequency detection | 512 lines FFT |
| Display resolution of main frequency | at 2 – 1000 Hz: 1 Hz at 10 – 1000 Hz: 2 Hz at 2 – 100 Hz: 0,2 Hz at 3 – 60 Hz: 0.12 Hz at 3 – 200 Hz: 0.4 Hz |
| Overload indication | at $> 240 \text{ m/s}^2$ vibration acceleration on the sensor |
| Measurand memory | Flash, 16000 data records |
| Sensor input | low power IEPE, 2 mA / 12 V, socket Binder 711, 3 pins |
| Analog/digital converter | 24 Bit |
| Display | OLED, colored, 128 x 160 pixels |
| USB serial interface cable | USB 2.0, full-speed, CDC-mode, with cable VM2x-USB |
| Batteries | 3 cells type AAA Alkaline (LR03) or NiMH accumulators (HR03) |
| Battery operating life | 8 – 12 hours, depending on battery capacity |
| Automatic shut down | 1 / 5 / 15 / 60 minutes or off |
| Menu languages | German / English / French / Spanish / Italian / Dutch |
| Operating Temperature | - 20 – 60 °C |

| | |
|------------|--|
| Range | |
| Dimensions | 125 mm x 65 mm x 27 mm |
| Weight | 140 g (with batteries, without sensor) |

Vibration Transducer:

| | |
|-----------------------------|-------------------------------------|
| Type | KS82L |
| Measuring principle | Piezo electric shear accelerometer |
| Output | Low power IEPE |
| Sensitivity | 3.5 mV/ms ⁻² (typical) |
| Operating temperature range | - 20 – 80 °C |
| Dimensions | Ø = 21 mm, h = 34 mm |
| Weight | 53 g |
| Sensor cable | spiral cable, extended length 1.6 m |

Measurement Point detection:

| | |
|----------------------------------|--|
| Principle | digitally stored in VMID measuring point, read through sensor base |
| Coding | 16 digit unique hexadecimal number |
| Measuring point ID memory (VM23) | 1600 measuring points with serial number and text |
| Mounting the VMID | Mount with two part adhesive, e.g. LOCTITE Hysol 3430 or 3450 |
| Maximum temperature | 80 °C |

Limited Warranty

Metra warrants for a period of
24 months

that its products will be free from defects in material or workmanship and shall conform to the specifications current at the time of shipment.

The warranty period starts with the date of invoice.

The customer must provide the dated bill of sale as evidence.

The warranty period ends after 24 months.

Repairs do not extend the warranty period.

This limited warranty covers only defects which arise as a result of normal use according to the instruction manual.

Metra's responsibility under this warranty does not apply to any improper or inadequate maintenance or modification and operation outside the product's specifications.

Shipment to Metra will be paid by the customer.

The repaired or replaced product will be sent back at Metra's expense.

Declaration of Conformity

According to EMC Directive 2014/30/EC

Product: Vibration Meter
Type: VM23 (from Ser. no. 160000)

It is hereby certified that the above mentioned product complies with the demands pursuant to the following standards:

DIN EN 61326-1: 2013
DIN EN 61010-1: 2011
DIN 45669-1: 2010

The producer is responsible for this declaration

Metra Mess- und Frequenztechnik
in Radebeul e.K.

Meißner Str. 58, D-01445 Radebeul

declared by



Michael Weber
Radebeul, April 22, 2016