These installation and operating instructions apply to: ***Vibro****Scanner*

Important Note:

Before use of the Netter ***Vibro****Scanner* read this operating instruction carefully and store afterwards.

Netter GmbH does not assume liability for damage or injury resulting from technical modifications to the product, or failure to observe the instructions and warnings in this operating manual.

Serving industry with vibration

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Contents

Scope of delivery

Check the packaging for possible signs of transport damages.
In the event of damage to the packaging, check that the contents are complete and undamaged. If there is any damage, inform the shipping agent. Compare the scope of the delivery with the delivery note.

1 General Notes

Applications

The ***Vibro**Scanner* is used to measure the acceleration and dominant frequency of mechanical vibrations by means of an acceleration sensor.

Possible applications are the measurement of the operational parameters of vibration systems, e.g. frequencies and effective accelerations in vibration feeders and conveyors, vibration compactors or vibration test systems. Thereby, the ***Vibro**Scanner* permits a quantitative process control on a regular basis, thus contributing essentially to a long successful operation of the vibration system. Moreover, it makes it possible for plant manufacturers to perform batch controls in vibration drives, thus ensuring a consistent product quality.

The dimensions in millimetres can be measured only if the Sorftware version 0.1 is installed.
The dimensions in inches can be measured only if the Sorftware version 0.1A is installed.

The device complies with the following generic standards:

EN 61000-6-4: 2007, Emission standard for industrial environments

EN 61000-6-1: 2007, Immunity for light-industrial environments

	Note on important procedures		Warning of a danger spot
	Environmentally friendly disposal		No disposal with domestic waste

2 Technical Data

Power supply:

Two 1.5 Volt Mignon AA size batteries, LR6

Acceleration measurement:

Root mean square (RMS)

displayed as multiple of the acceleration due to gravity (1 g_e = 9.81 m/s²)

Measuring range: -15 ... 15 g_e (-147... 147 m/s²)

Resolution: +/- 0.1 g_e (+/- 1 m/s²)

Measuring accuracy: 3%

Damping: -2dB at 800 Hz

Frequency measurement

Measuring range: 5 ... 800 Hz

Resolution: +/- 0.1 Hz

Measuring accuracy: 3%

Stroke measurement

Resolution: +/- 0.1 mm, special version: +/- 0.01 inch

Measuring accuracy: 10%

Temperature:

-10°C to 40°C

The ambient temperature must not be exceeded or fallen short of.

Max. permissible shock acceleration: 1000 g_e for 1 ms

Protection type

Measuring device: IP 54 with plugged-in and screwed cable

Sensor: IP 65 with plugged-in and screwed cable

3 Design and Function

The sensor used is a capacitive micromechanical (MEMS) sensor, characterized by high mechanical strength. The signal processing takes place directly in the sensor housing, thus reducing considerably the sensitivity to electrical interference. In addition, the sensor is connected via robust stranded wire instead of the bend-sensitive coaxial cable normally used with piezoelectrical sensors.

The measuring range of the sensor is +/- 150 m/s^2 (+/- 15.3 g_e), the measuring accuracy 3% with a repeatability of 0.5%. The maximum permissible shock acceleration is 1.000 g_e. At the maximum measuring frequency of 800 Hz the amplitude damping is 2 dB.

Operating elements

1 On/off key
and display mode selector

2 Key to turn on the display backlight

3 Hold key
freezes all current measured values

Fig. 1: Top of the ***Vibro****Scanner* measuring device with touch keys and LC display

4 Safety

Warnings

The measuring device and the sensor must not come into contact with units or components carrying voltages above 60 V.

When inserting the batteries, pay attention to the correct polarity. Batteries must not be short circuited; battery fluid may leak.

Do not try to recharge non-rechargeable batteries. These batteries might explode.

Do not dissemble batteries. The contact with its components can result in injuries or fire. Do not heat up batteries or throw them into fire; the heat might result in an explosion.

Remove used batteries immediately, because batteries may leak fluid. If you do not use the measuring device for a longer time, take the batteries out of its compartment. Leaking electrolytes may result in injuries and damage to the device.

Power supply:
Two 1.5 Volt Mignon AA size batteries, LR6

Temperature:
-10°C to 40°C
The ambient temperatures must not be exceeded or fallen short of.

Air humidity: max. 85 %

Max. permissible shock acceleration: 1000 g_e for 1 ms

Protection type:
Measuring device: IP 54 with plugged-in and screwed cable
Sensor: IP 65 with plugged-in and screwed cable

5 Transport and Storage

Check the packaging for possible signs of transport damages. In the event of damage to the packaging, check that the contents are complete and undamaged. If there is any damage, inform the shipping agent. Compare the scope of the delivery with the delivery note.

Transport the ***Vibro****Scanner* only in the original packaging to protect the device from damage.

The device should be stored in a dry and clean environment.
Keep the batteries at a cool, dry place, without exposure to direct sunlight.

The ***Vibro****Scanner* is maintenance-free. Clean the device with a slightly damp cloth.

If you have to store the ***Vibro****Scanner* for a longer period (up to a maximum of 2 years), the temperature in the storage room must not drop below 10°C and not exceed 60°C.

Remove the batteries if you do not use the ***Vibro****Scanner* for a longer period.

6 Startup/Operation

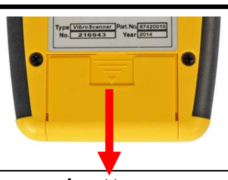
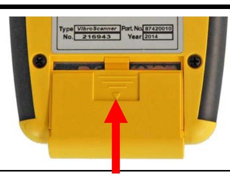
This chapter provides a brief overview of the most important functions of the ***Vibro****Scanner*.
It is a shortcut for advanced users already familiar with acceleration measuring devices and measurements at vibration systems.

Basics of vibration measurement can be found in chapter 7.

For a detailed description of all functions see chapter 8.

Inserting / replacing batteries

For the operation of ***Vibro****Scanner* you need two 1.5 Volt Mignon AA size batteries (LR 6, included in the scope of delivery).

			
Open battery compartment lid by pushing it in the direction of the arrow	Observe the correct polarity shown on the bottom of the battery compartment	Insert batteries observing the correct polarity direction	Close battery compartment lid by pushing it in the direction of the arrow

Connecting the sensor

		
Connect sensor cable with sensor. The connector is protected against polarity reversal. Tighten screws manually, <u>do not use tools!</u>	Connect sensor cable to the measuring device. The connector is protected against polarity reversal. Tighten screws manually, <u>do not use tools!</u>	The ***Vibro****Scanner* is ready for operation. The device is switched on automatically as soon as the sensor cable is connected.

Sensor fasteners

				
Sensor	Magnetic mount	Sensor with magnetic mount	Metal-/ plastic-probe	Sensor with probe

Screw magnetic mount into the sensor thread and tighten manually, <u>do not use any tools!</u> The magnetic mount has a maximum holding force of 140 N to ferromagnetic surfaces.	Screw probe into the sensor thread and tighten it manually, <u>do not use any tools!</u> During the measurement the sensor must not detach from the surface (press down firmly!). Use the plastic probe for sensitive surfaces.

Users have to be informed about actual or potential risks to their health and safety resulting from exposure to vibration.

Turning the device on

To turn on the measuring device push and hold the On/Off key (1) for at least 3 seconds. You will hear three beeps in a row and the device is ready for operation.

The ***Vibro**Scanner* also starts automatically as soon as the sensor cable is connected. We therefore recommend to always leave the sensor connected with the cable, and if you want to store the ***Vibro**Scanner* only to disconnect the cable from the handheld unit. The device is then ready for operation as soon as you reinsert the cable.

If the sensor cable is not plugged in, the ***Vibro**Scanner* cannot be started. If only the cable without sensor is connected to the device, or if the sensor or cable is defective, the error message “no sensor signal” will appear in the display, and you will hear 8 beeps at intervals of one second. Subsequently, the device is automatically turned off.

Error message if no sensor has been connected.

Display modes

The display mode can be changed by *briefly* pressing the On/Off key repeatedly.

There are two display modes:
→ Measuring mode
→ Info mode

In the measuring mode the following values are displayed:
→ acceleration RMS
→ dominant frequency
→ stroke (peak-to-peak value of the displacement)

Stroke in mm

Stroke in inch

The info mode shows
→ the length of the measuring interval (default: 1 s)
→ the hardware / software version

Turning the device off

Push and hold the On/Off key (1) for at least *3 seconds* to turn the device off. You will hear 5 high-pitched beeps in a row (countdown) while the key is pressed. After the 5th beep the device is turned off automatically.

7 Basics of Vibration

A vibration is the periodic variation of a parameter (e.g. displacement of a plate) caused by the fact that a system is displaced from its stable equilibrium due to a disturbance and forced back towards its original state by a restoring force. A well-known example from everyday life is a pendulum which after displacement by an external force is drawn back into the equilibrium position by gravity.

A harmonic vibration, where displacement, velocity and acceleration in relation to time show the shape of a sinusoidal wave, represents an idealized special case. In this case only few parameters are needed to describe the shape of the vibration and mathematical principles can be derived very easily.

In practice, the acceleration in relation to time in vibration systems mostly deviates from this ideal sinusoidal wave; either because the vibration drive itself does not generate a harmonic vibration (e.g. special pneumatic linear vibrators) or because interfering factors like vibrating or hitting components or natural vibrations of an excited product overlay the excited vibration.

Harmonic vibrations

To describe a harmonic vibration, three parameters are needed: Frequency (unit of measurement: 1 Hz = 1/s), amplitude and phase. The frequency determines how many vibration cycles per second occur, the amplitude determines the maximum value of the vibration and the phase indicates in how far the zero position of the vibration is shifted in relation to the zero point on the time scale. The time required for one cycle of vibration (reciprocal of the frequency) is called period.

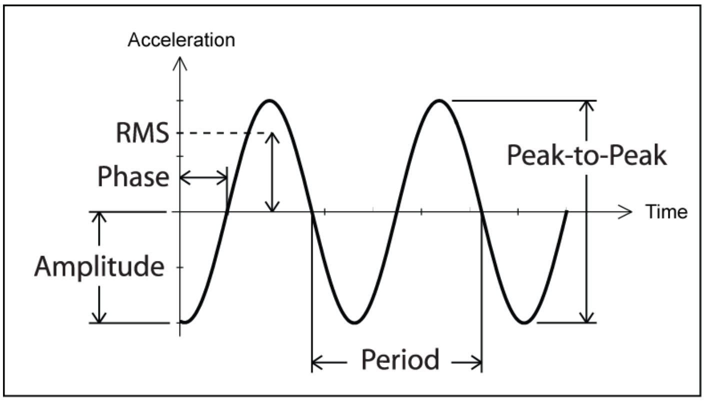


Fig. 2: Acceleration of a harmonic (sinusoidal) vibration

Peak-to-Peak Value

As the zero position and thus the amplitude often are difficult to access for measuring purposes, sometimes the difference between maximum and minimum value, the so-called peak-to-peak value, is indicated instead. The peak-to-peak value of the displacement is also called stroke.

Root Mean Square / RMS

A further important parameter is the Root Mean Square (RMS) or effective value. The RMS value of a time-dependent parameter a (t) in a time interval T is defined as the root of the sum of the squared measured values which has been divided by the time interval before:

$$a_{RMS} = \sqrt{\frac{1}{T}\int_0^T a(t)^2 \cdot dt}$$

In case of a harmonic vibration the RMS is about 71% of the amplitude (exactly $1/\sqrt{2}$). The advantage as compared to amplitude or peak-to-peak value is that small variations of the minimum or maximum acceleration have only little effect on the RMS, as an average value is ascertained over a time interval instead of only considering peak values at a time. This is the reason why it is better suited to ascertain the actual effect a vibration is having on a machine part or product over a longer period of time.

Random vibrations

Random vibration wave forms can be described mathematically as superposition of several harmonic vibrations varying in frequency, amplitude and phase. The more complex and “sharp-edged“ the shape of a vibration is, the more harmonic vibration components are needed to describe it with sufficient accuracy. Usually random vibrations are characterized by means of the frequency spectrum which indicates the portion each harmonic vibration component with fixed frequency contributes to the overall vibration.

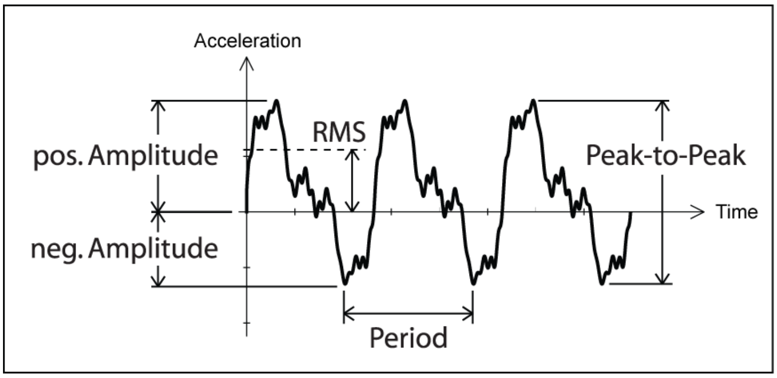


Fig. 3: Acceleration of a non-sinusoidal periodic vibration

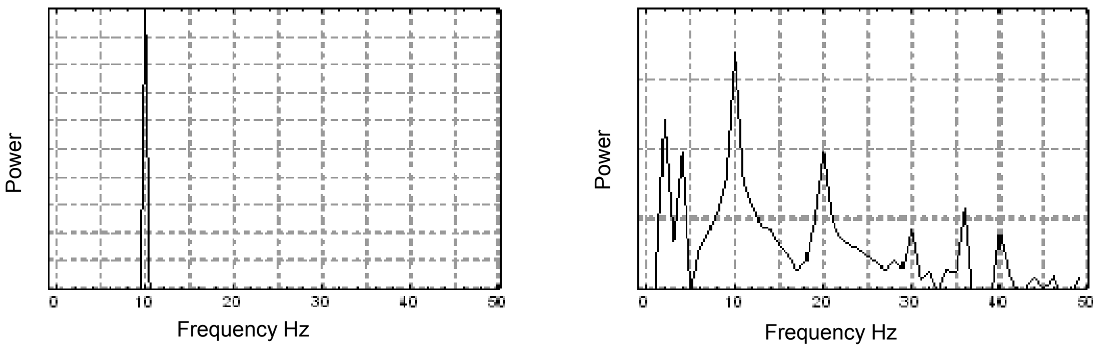


Fig. 4: Spectra of a sinusoidal vibration (on the left)) with a frequency of 10 Hz and of a random vibration (on the right) with a dominant frequency of 10 Hz

Also for more complex types of vibration it is common use in vibration technology to indicate only one frequency which dominates the system to be measured. The relevant period is ascertained between two points of time in a row where the value of the oscillating quantity reaches its maximum (or minimum).

The ***Vibro**Scanner* shows the frequency which contributes at least 50% to the power of the overall vibration. Thus it is possible, for instance, to read out the exact value of the excitation frequency of a vibration drive without any affect on the measurement by low- or high-frequency interference.

8 Functional Description

8.1 Sensor design and function

Attachment of the sensor

The sensor is supplied with a magnetic mount and two probes, which are connected to the sensor via an M6x10 thread. It is important to ensure that the sensor is fully screwed into the thread and the magnetic mount / probe firmly tightened. The tight fit of the fastening elements has to be checked before each measurement, as the screws can loosen over time due to strong vibrations.

The supplied plastic probe is suitable for attaching the sensor to scratch-sensitive surfaces. Moreover, the plastic probe should be used for high-frequency vibrations, as the metal probe is far more susceptible to wear under these circumstances.

The angle of the sensor with respect to the direction of the vibration is decisive for the measuring result. If the full amplitude of a vibration is to be measured, it has to be ensured that in case of linear vibrations the longitudinal axis of the sensor is to be aligned parallel to the direction of vibration and radially in case of circular vibrations.

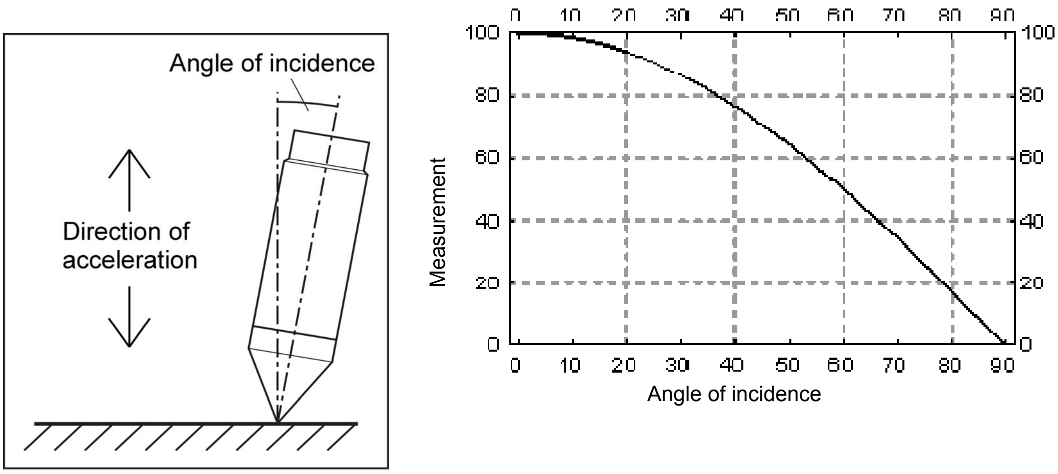


Fig 5: Percentage displayed when measuring the actual acceleration as a function of the angle of incidence.

Adhesive attachment of the sensor

If the sensor is to be fixed by means of adhesive, its damping behaviour must be taken into account. Elastic adhesives may dampen high-frequency vibrations (mechanical low-pass filter), which means it is possible that the displayed acceleration value is too low with high-frequency vibrations. You can buy special adhesives or impact-resistant super glues which are suitable for attaching acceleration sensors. The spot to which the sensor has been glued must be checked for cracks or fissures before each measurement.

In cases where a dampening effect at the point of connection is negligible (vibrations with a frequency below 200 Hz) or even wanted, you can use the adhesive putty included with the delivery to attach the sensor. The adhesive putty can be shaped by hand and be removed from smooth surfaces without residues. As the adhesive force of the putty will suffer from dirt or grease, the measuring surface should be wiped clean before attaching the sensor. If the adhesive putty is kept clean in the supplied storage pot at room temperature, it can be reused for several years.

Permanent attachment of the sensor

If you want to fix the sensor permanently to a measuring surface, we recommend to use a clamp support (part no. 61703219).

8.2 Measurement

In the measuring mode the ***Vibro****Scanner* shows three measuring values:

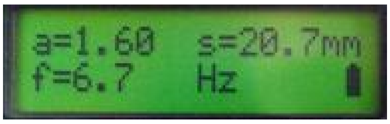
→ acceleration RMS in multiples of the gravitational acceleration (1 g_e = 9.81 m/s²)

→ dominant frequency in Hertz

→ stroke (peak-to-peak value of the displacement) in millimetres, spezial version in inches

The display is always updated at the end of the measuring interval which by default is one second. The measured values shown are the average values over this interval.

The length of the measuring interval is displayed in the info mode (see chapter 8.2.38.3.4) and can be extended to maximally 8 seconds by ***Netter****Vibration* if required.



Display in the measuring mode (mm)

Display in the measuring mode (inch)

8.2.1 Acceleration

In the upper left corner of the display the Root Mean Square (RMS) of the acceleration is displayed as a multiple of the gravitational acceleration (1 g_e = 9.81 m/s²).

Averaging starts with every update of the display and is completed with the display of a new measured value.

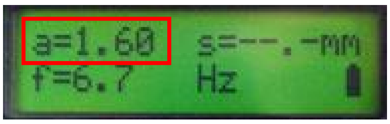
Small changes of the minimum or maximum acceleration have only little effect on the measured value due to averaging.

The RMS value of the acceleration a (t) in the time interval T is defined as the root of the sum of the squared values which has been divided before by the time interval:

$$a_{RMS} = \sqrt{\frac{1}{T}\int_0^T a(t)^2 \cdot dt} \ .$$

In case of a harmonic (sinusoidal) vibration the RMS value is about 71% of the amplitude (exactly $1/\sqrt{2}$).

If the acceleration at the sensor is outside the measuring range (+/- 15 g_e), the message **”-aovr-“** appears in the display instead of a measuring value.



Display of the RMS acceleration

8.2.2 Frequency

In the lower left corner of the display the frequency of the measured acceleration signal is displayed, which is always the main component of the frequency spectrum; i.e. the dominant frequency containing at least 50% of the spectral power. This, for instance, makes it possible to ascertain the excitation frequency of a vibration drive without the measurement being affected by low-frequency or high-frequency interferences.

For an accurate frequency measurement it has to be ensured that the acceleration is at least 0.5 g_e.

If, however, the acceleration is very close to the lower measuring range limit (< +/- 0.5 g_e), it may happen that the displayed frequency changes between different values, e.g. between the correct value and its double (second harmonic frequency) or half value.

If immediately after turning on the measuring device the measured frequency value changes by more than 30% within less than 1 s, you should wait until the readout has stabilized in order to obtain a reliable measuring result.

Display of frequency

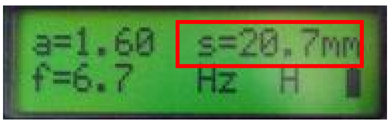
8.2.3 Stroke

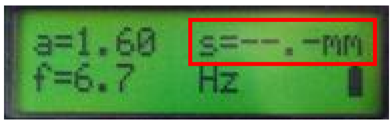
The stroke is the peak-to-peak value of the displacement.

With the ***Vibro****Scanner* the stroke can only be accurately determined for sinusoidal vibrations. So if the measured ratio of stroke and RMS value deviates by more than 15% from $\sqrt{2}$ (the value for a sinusoidal signal), no stroke will be displayed. Instead you will see s=--,-mm, spezial version: s=-,--in, in the display.

Note that this criterion is only an indicator whether there is a sinusoidal vibration or not, a clear answer can only be obtained by using a recording instrument or an oscilloscope. Even non-sinusoidal vibration can have the same stroke/RMS ratio as a sinusoidal vibration. Such cases, however, are very rare in practice.

If the acceleration at the sensor is outside the measuring range (+/- 15 g_e), the stroke cannot be ascertained, and you will see **”-ovr-“** instead of a measured value in the display.





mm Stroke exactly determinable (sufficiently sinusoidal vibration) inch

Non-determinable stroke (no sinusoidal vibration)

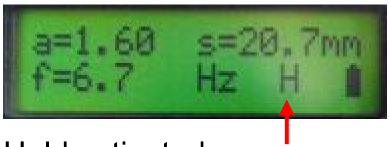
8.3 Additional functions

8.3.1 Hold function

By pressing the Hold key (No. 3 in Fig. 1, page 5) the currently measured values are frozen and permanently displayed (when pressing the key, you will hear a medium-pitched signal tone). As long as the Hold function is activated, a flashing “H“ is shown in the right lower corner of the display.

By pressing again the Hold key the continuous measurement process is restarted.

If no further entries are made, the ***Vibro****Scanner* turns off automatically after 5 minutes.



Hold activated

8.3.2 Display backlight

By turning on the measuring device, the display backlight is activated temporarily for 10 seconds. A short pressing of the lighting key (No. 2 in Fig. 1, p. 5) activates the display backlight for 10 seconds at a time. When pressing the lighting key, you will hear a high-pitched signal tone. The display backlight has the highest power consumption of all device functions, and if frequently used, considerably reduces the battery life span.

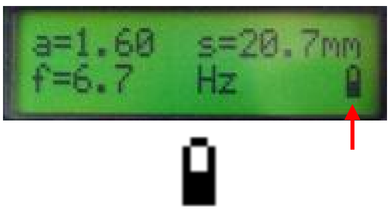
In order to ensure that the measuring device can be used as long as possible with partially discharged batteries, the time during which the backlight remains activated depends on the battery charge status (see 8.2.38.3.3).

8.3.3 Battery status indicator

The battery icon in the right corner of the lower display line shows the battery charge status in three stages. If the battery charge has sunk so low that measurement is no longer possible, the message **“low bat“** will appear in the display when the device is turned on, and it will automatically turn off again.

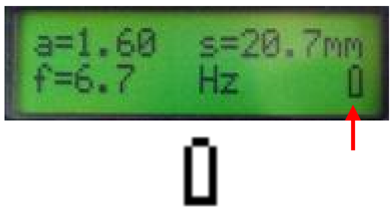
Batteries fully charged

Display backlight:
Possible for 20 s at a time



Partially discharged batteries

Display backlight:
Possible for 10 s at a time



Replacement of batteries recommended

Display backlight:
Possible for 5 s at a time

8.3.4 Display mode Info

By briefly pressing the On/Off key you can switch between measuring mode and info mode. If the info mode is enabled, the length of the measuring interval in seconds appears in the upper left corner.

Length of the measuring interval

If the info mode is enabled, the status of the input high-pass filter in the upper right corner of the display.

High-pass filter status

The lower line of the display shows the hardware and software version of the ***Vibro****Scanner*.

Hard-/software version (mm)

Hard-/software version A (inch)

8.3.5 Automatic off feature

If no keys have been pressed for more than 5 minutes, the device is turned off automatically.

The same is true for the enabled hold mode; i.e. the device shuts down automatically after 5 minutes.

8.3.6 Signal tones

Tone sequences and pitch	**Meaning**
1x low-pitched, 1x medium-pitched, 1x high-pitched	Device has been turned on and is ready for operation
5x low-pitched	Device has been turned off (Turn-off countdown)
1x low-pitched	Change of display mode
1x medium-pitched	Hold function enabled / disabled
1x high-pitched	Display backlight enabled
8x very high-pitched	No sensor found after device has been turned on → automatic shut-down

9 Troubleshooting

Fault	Possible cause(s)	Remedy
The measured frequency changes continuously between two or more values which differ considerably (more than 10%) from each other.	The measured vibration is composed of two or more harmonic vibrations which contribute nearly equally to the overall vibration.	If only the lowest frequency of a system with several excitation/resonance frequencies is to be measured, a mechanical damping (e.g. a rubber pad placed below the sensor) can be used in order to hide higher frequencies during the measurement (mechanical low-pass filter).
	The sensor is not firmly fixed to the system to be measured and detaches repeatedly from the measuring surface during the measurement.	The sensor must be firmly attached to the measuring surface; or when using the probe, it must be pressed down to the surface with sufficient force.
	The stroke of the acceleration is too small.	The frequency measurement is reliable if the acceleration is greater than 0,5 g_e.
The measured stroke differs distinctively from a reference value which has been ascertained through a different measuring method.	The vibration deviates considerably from a sinusoidal wave.	The measurement of the amplitude will only be reliable if the measured acceleration is sinusoidal.
	The sensor is not aligned parallel to the vibration direction.	The longitudinal axis of the sensor must be aligned parallel to the vibration direction or radially in case of circular vibrations.
The acceleration displayed is always zero, although the sensor is attached to a vibrating system.	The sensor is aligned at a 90 degree angle to the vibration direction.	The longitudinal axis of the sensor must be aligned parallel to the vibration direction or radially in case of circular vibrations.
	The sensor is defective. The measuring device is defective.	Send the measuring device including sensor and connecting cable to ***Netter****Vibration* for checking and repair.
After the measuring device has been turned on, the message "no sensor signal" appears in the display and the device shuts down automatically, although the sensor is connected to the measuring device.	The sensor cable is not correctly plugged into the sensor.	The cable connector must be fully inserted into the sensor socket and the cap nut firmly tightened.
	The sensor cable is defective. The sensor socket is defective The sensor is defective. The measuring device is defective.	If no spare cable or sensor is available for checking purposes, send the measuring device including sensor and connecting cable to ***Netter****Vibration* for checking and repair.

10 Spare Parts

If you order spare parts, please give us the following information:

1. **Type of device (*Vibro*Scanner)**
2. **Description of the spare part / Part no.**
3. **Requested quantity**

Pos.	Description	Part No.
1	***Vibro**Scanner* gauge (incl. 1.5V battery)	87420014
2	Acceleration sensor	87420012
3	Probe tip (metal)	97420011
4	Sensor connecting cable	87420013
5	Probe tip (plastic)	87420016
6	Magnetic mount	87420015
7	Adhesive putty in storage pot	97420017
8	1.5 Volt Mignon AA size batterie, LR6	61703755
9	Carrying case	61703244

11 Appendix

11.1 Accessories

Further products for continuous use in production environments

For the constant monitoring of vibration systems in a production environment ***Netter****Vibration* offers the system ***Vibro****Monitor*. It serves as vibration switch with pre-adjusted measuring threshold and transmits the sensor status to a control display or programmable logic controller (PLC) via NPN or relay outputs. The sensor in this system can be located in a distance of up to 250 m from the control unit. In addition the system is monitored for cable break and short circuit.

11.2 Disposal

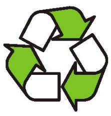
At the end of their life span electrical and electronic products have to be disposed of separately from household trash at authorized collection and disposal points in accordance with the electronic waste regulations.

The parts have to be disposed of appropriately depending on the material used.

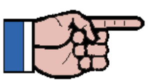
Batteries must not be disposed of with domestic waste but have to be delivered at the designated collection points. Packaging material are resources. Dispose of them in an environmentally conscious manner for the sake of environmental protection. Deliver unserviceable equipment to collection points for electronic waste. Your local authorities will inform you accordingly.

For customers from the European Union

Please contact ***Netter****Vibration* for more information if you want to dispose of electrical and electronic units.



All units can be disposed of through Netter GmbH.
The applicable disposal prices are available upon request.



Additional information available upon request:
Leaflet No. 39, mounting sketches and much more