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VIBROCONTROL 1500

2-channel Monitoring Device for Bearing Vibrations, Rolling-element Bearing Condition and Temperature with Diagnostic Remote Monitoring

Operating Instructions

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Table of Contents

VIBROCONTROL 1500

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1 Safety advice

This operating instruction contains information and advice which must be observed during the installation and operation of the VIBROCONTROL 1500.

Please read these operating instructions carefully before installing and taking a VIBROCONTROL 1500 into operation!

Please read the general safety advice and grounding recommendations before the installation and commissioning!

The safety advice and grounding recommendations are separately included with the operating instructions!

Intended application

VIBROCONTROL 1500 is intended exclusively for measurement, display and monitoring of bearing vibrations, rolling-element bearing condition and temperature in the applications of machine protection and condition-dependent machine maintenance.

Any application beyond these is considered as invalid for the system.

Reliability

VIBROCONTROL 1500 is equipment which is reliable in service and corresponds to the state of the art technology. Every instrument leaves our works in an error-free and safe condition.

Any person who is responsible for carrying out the installation and operation of the instrument must have read and understood these operating instructions and especially the safety advice in advance of the installation and operation.

With inappropriate handling or non-observance of the operating instructions the working reliability is not guaranteed.

Warning Note!

In the operating instructions reference is made to possible risks and dangers with the installation and start-up. These references are provided with the following terms:

Caution

A caution draws attention to the fact that in case of neglect of the safety advice the possibility of material damage and personal injury exists.

Commissioning tasks

Commissioning tasks may only be carried out by authorised and trained technical personnel. The required authorisation is exclusively granted by Brüel & Kjær Vibro.

2 Overview

The VIBROCONTROL 1500 is a 2-channel, microprocessor-controlled measurement data acquisition, monitoring and diagnosis instrument. Constant-current powered (CCS) acceleration sensors are used for the vibration measurements.

In addition to the measurement of casing vibrations in the frequency ranges from 1/3/10 Hz to 1,000 Hz, a rolling-element bearing condition variable is also calculated for the assessment of rolling-element bearing condition.

For the measurement and monitoring of temperatures, of type PT-100 temperature sensors may also be applied in addition to the vibration sensors.

For operation of the instrument a power supply of 18 to 36 VDC is necessary. The power consumption of the instrument amounts to approx. 6 W.

2.1 Display and operating elements

Front view

Fig.1: VIBROCONTROL 1500 front view

Buttons and displays

▲, ▼	Buttons for switching to individual displays, making a selection within the menus and entering values
ESC	Button for return to previous display
ENTER MENU	Button for confirmation of entry and calling up menus.
OK	Green LED for display of the OK-status
L1	Amber LED for display of L1 status
L2	Red LED for display of the L2 status

The standard equipment contains:

- Two (2) relays with potential-free switch-over contacts for signaling event messages. The relays are assigned to the set limit values.
- One (1) OK relay with potential-free switch-over contacts for monitoring of the power supply, the functions of the microprocessor system and the connected sensors.
- Two (2) analogue outputs proportional to the casing vibration.
- CAN-Bus interface for data transmission between the VIBROCONTROL 1500 and a super-ordinate computer.

All setting up tasks are carried out directly at the instrument by entry or selection of parameter values. Setting up is also possible using the **VIBROCONTROL 1500 Control-Center-Software**.

The connections for the power supply, measurement sensors, analogue and contact outputs as well as the CAN-Bus interface are made through plug-in terminal blocks.

2.2 Possible measurement and monitoring tasks

2.2.1 Display values

Corresponding to the national and international prescription for evaluation of machine vibrations, the effective (RMS) value of vibration velocity is used for display and monitoring.

Display value	Abbreviation	Unit
Vibration velocity	v	mm/s in/s

There is also the possibility to display and monitor the value of rolling-element bearing condition; unit of rolling-element bearing condition: BC (Bearing Condition)

Rolling-element bearing condition	BC value	BC dimensionless

Measurement and monitoring of temperature is possible by connecting PT-100 sensors.

Temperature	T	°C °F

2.2.2 Measuring range limits

The measuring range can, according to the application, be adapted to the machine or monitored plant by a wide range.
In the table below the measuring range limits (min. max.) are given dependent upon the characteristic variable = effective (RMS) value of vibration velocity.

Sensor : Vibration acceleration sensor
Variable : Effective value (RMS)

Display and monitor value	Measurement range		Unit
	Min	Max	
Vibration velocity	0 ... 10 0 ... 0.5	0 ... 200 0 ... 10	mm/s in/s

For the selected measuring range, signals of 4 - 20 mA per sensor proportional to the characteristic variable are available at the analogue outputs.

2.2.3 Display value and bandwidth

Acquisition of the measured data is done by vibration acceleration sensors.

Display and monitor value	**Bandwidth of the characteristic value formation**
Vibration velocity	1 Hz ... 1,000 Hz
	3 Hz ... 1,000 Hz
	10 Hz ... 1,000 Hz
Rolling-element bearing condition	500 ... 5,000 Hz DFT

2.2.4 Signal detection

The output voltage of the measurement sensors is proportional to the measured magnitude of the time signal (vibration acceleration).

The following signal detection step is carried out by the VIBROCONTROL 1500:

Calculation of the effective (RMS) value of vibration velocity from an integration of the vibration acceleration signal.

2.3 General

Independently adjustable limit values are assigned to each measuring channel for the casing vibrations, the rolling-element bearing condition and the temperatures. The setting of the respective limit values is done in the unit of the measurement channel.

Two values, which are adjustable over the entire measuring range, are available for signaling a violation of the alarm limit settings. A limit value violation is displayed at the VIBROCONTROL 1500 by means of LEDs and the output of the violation respectively through potential-free relay contacts.

In order to prevent false alarms due to spurious, very short-term limit value violations, a relay response lag time can be activated for each limit value of the vibration.

The entry of the relay response lag time always take place in seconds units. If a measured value exceeding the assigned limit value is sustained for longer than the given response lag time, the appropriate event message is activated.

If the current measured value falls below the limit value during the response lag time, the event message "limit value violated" is deactivated and upon a renewed limit value violation the response lag time count begins again.

2.4 Relay functions

VIBROCONTROL 1500 is equipped with a total of three (3) relays.

The status of these relays is signaled at the front panel by LED control lamps. The relays are shared by both channels.

Note:

Short the reset contacts only for a short notice.

Caution

Voltages of a dangerous level may exist at the relay contacts at any time!

LIM 1 relay

If the current measured value exceeds the set limit value for the RMS value of vibration velocity **L1v** for longer than the period of the adjusted response lag time **T1,** the LIM1 relay is activated (closed).

The same is valid - however without consideration of a response lag time - during a violation of the limit value of the bearing condition **L1BC** and a violation of the limit value of temperature **L1temp** (with the deployment of a vibration sensor with PT-100 sensor or temperature sensor PT-100).

The **LIM 1 relay is not self-latching** and is immediately deactivated (opened) if all **L1v, L1BC** or **L1temp** limit value is no longer violated.

LIM 2 relay

If the current measured value violates the set limit value for the RMS value of vibration velocity **L2v** for longer than the period of the adjusted response lag time **T2**, the LIM2 relay is activated (closed).

The same is valid - however without consideration of a response lag time - during a violation of the limit value of the bearing condition **L2BC** and a violation of the limit value of temperature **L2temp** (with the deployment of a vibration sensor with PT-100 sensor or temperature sensor PT-100).

The **LIM 2 relay is self-latching**. To reset this condition a reset of the relay or an instrument reset must be carried out.

OK relay

Monitoring of the power supply, the functions of the microprocessor system and the connected sensors is done by an OK-monitoring function. The display of an existing OK fault is by means of an LED; the output of this signal is by means of a set of potential-free switch-over contacts.

With an error-free operation the green LED at the instrument front panel lights up (signaling operational readiness) and the contacts of the OK relay are closed.

In case of a fault the LED is extinguished and the OK relay will be deactivated.

This OK relay is active during error-free operation (closed, terminals 33 and 34 are connected). When a fault occurs these relay contacts open. This relay is **self-latching**. To reactivate this, a reset of the relay or the instrument is necessary.

Instrument Reset

Simultaneously pushing both of the buttons ▲ and **ENTER/MENU** for a period of at least 3 seconds effects a reset and a restart of the instrument.

Reset of the self-latching relay

A reset of the active (closed) condition of the self-latching relays OK and LIM2 is possible at the RESET input by connecting terminals 25 (RST REL2) and 26 (GND). This reset simultaneously also deletes all error messages.

Note:

Short the reset contacts only for a short notice.

3 Technical Data

Power supply	18 to 36 VDC
Current consumption	6 W ± 0.25 W
Protection class	IP 20
Housing	Metal
Housing dimensions	Appr. 90 x 115 x 75 mm (B x H x D)
Weight	700 g
Internal resistance	100 kΩ ± 10%
Instrument type	2-channel, switchable to 1-channel version
Measurement variable	Vibration velocity mm/s or in/s
Measurement ranges	10; 20; 40; 50; 100; 200 mm/s or 0.5, 1; 2; 2.5; 5; 10 in/s
Signal detection	Effective value (RMS)
Frequency ranges	1Hz to 1kHz, 3Hz to 1kHz, 10 Hz to 1kHz, adjustable in the menu
Filter slope	Acc. to ISO 2373 60 dB/decade with high pass 1/3/10 Hz 40 dB/decade with low pass 1 kHz
Limit values	Adjustable with push buttons in menu
Alert alarm	LIM 1 (arbitrary in selected measuring range)
Danger alarm	LIM 2 (arbitrary in selected measuring range)
Cable connections:	
Lower terminal row	Divided terminal rows with terminal blocks, plugged into the terminal sockets, max. 2.5 mm².
Upper terminal row	Divided terminal rows with terminal blocks, plugged into the terminal sockets, 0.14 mm^2 – 1.5 mm².
Power supply and distribution terminal	1 mm^2 – 2,5 mm^2
Cable glands of the Protective housing AC-211x	M12: 3.0 mm^2 – 6.5 mm^2 M16: 5.0 mm^2 – 10.0 mm^2

Sensor:

Sensor supply	5 mA ± 5%
Transmission factor	100 mV/g and OFF selectable in menu. When selecting OFF in channel B, the VIBROCONTROL 1500 operates as a 1-channel instrument and the missing sensor is then not interpreted as a fault!
Transmission factor correction value	Multiplication factor = 0.5 to 1.99; value adjustable in menu. For measurement using acceleration sensors (CCS type) whose transmission factor deviates from the standard factor of 100 mV/g.
Analogue output	4…20 mA, for the RMS value of vibration velocity of channel A and channel B, proportional to the set measuring range. Max. load at the analogue output < 500 Ω.

Limit value outputs:	Potential-free contacts
Alert alarm	Potential-free contacts LIM 1, Display: amber LED
Danger alarm	Potential-free contacts LIM 2, Display: red LED
Contact loading:	5A/24 VDC, 5A/125 VAC, 5A/230 VAC Upon violation of the limit value in channel A or B, the corresponding relays LIM1 or LIM 2 are activated.
OK monitoring	Function test of the instrument and connected sensors
Range of OK monitoring	6V $\underline{+}$ 0.5V ...18V $\underline{+}$ 0.5 V
Display	Green LED, instrument OK and operationally ready

Latching function of the relays:	
OK	= self-latching
LIM 2	= self-latching Upon violation of LIM 2 the relay is activated and remains in this condition until a RESET is carried out.
LIM 1	= not self-latching If the measured value drops below the set limit value, the LIM 1 relay activated by the limit value violation is again deactivated.
Limit value monitoring	Possible for vibration velocity, bearing condition and temperature
Relay response lag time	0 to 10 sec., adjustable in menu
Analysis:	
DFT analysis of the bearing vibrations	Frequency range: 10 ...1,000 Hz Sampling rate: 2,500 Hz No. of samples: 800 No. of lines: 320 Nominal resolution: 3.125 Hz Measurement and calculation time: appr.1.5 minutes
DFT analysis of bearing condition	Frequency range: 500 ... 5,000 Hz Sampling rate: 15,000 Hz No. of samples: 800 No. of lines: 240 Nominal resolution: 18.75 Hz Measurement and calculation time: appr. 5 seconds In the upper display line the current three highest values of vibration velocity in mm/s or BC values are indicated. In the lower display line the corresponding frequencies belonging to these three values are displayed.
Bearing condition value	Effective value of acceleration in the frequency band 500 Hz to 5 kHz. A relative value of BC is calculated from this.
Trend measurement with prognosis possibility	For the time period of 10x8, 10x24 hours or 10x30 days, a statistical assessment of the remaining time until the LIM 2 limit value will be reached. The prognosis is only a guide and is not guaranteed to be accurate.
Post-mortem	A view of the measured bearing vibrations in the time period 994 seconds before and 29 seconds after a LIM 2 violation.

Logical inputs DC value:

Input logic, low	V_{ILmin} = 0.0 V V_{ILmax} = 1.6 V
Input logic, high	$V_{IHmi\ n}$ = 2.5 V V_{IHmax} = 24.0 V
Maximum current source	I_{smax} = 3 mA
Max. current loading for +24 VDC supply for logical inputs	40 mA
CAN-Bus	max. 40 instruments can be connected

Reset:

Reset at the instrument	Simultaneously pushing the buttons ▲ and MENU for at least 3 seconds effects a reset of the instrument.
External reset	Reset of the relays is possible by bridging terminals 25 and 26 through the VIBROCONTROL 1500 Control-Center-Software

Accuracy:

Bearing vibration measurement	at 80 Hz: ±2% ± 1digit within the filter ranges 1/3/10… 1,000 Hz: ±10% ± 1digit at the corner frequencies: +10% -20% ± 1digit
Frequency response	According to ISO 2373 60 dB/dec transition steepness 1/3/10 Hz Filter 40 dB/dec transition steepness 1 kHz Filter
Rolling-element bearing measurement BC	+10% -20% of measured value
Temperature:	± 2 °C in range 10 °C to 120 °C with sensor AS-062/T1
Analogue outputs	±1% of the displayed value ±5% at 2 mA output current

DFT analysis of bearing vibration:

Frequency display in the range 10 ... 1,000 Hz	± 2 Hz[1]
Amplitude display in the selected filter range	+5% ... -20% of measured value
Overall vibration DFT noise	+5% of measured value + 4 digits… for 10 Hz and 3 Hz highpass filter +5% of measured value + 7 digits … for 1 Hz highpass filter

[1] Typical accuracy for a single sine-wave signal

DFT analysis of rolling-element bearing condition:

Frequency display in the range 500 ... 5,000 Hz	± 18.75 Hz
Amplitude display in the range 500 ... 5,000 Hz	+10% ... -20% of measured value
BC DFT analysis noise	+10% of measured value +4 digits … for all highpass filters
BC DFT analysis channel crosstalk	-40dB

Permissible ambient conditions

Storage temperature range	-20 °C ... +70 °C
Operating temperature range without protective housing AC-211x	0 °C ... +55 °C
Operating temperature range in protective housing AC-211x with 1 x VIBROCONTROL 1500	0 °C ... +45 °C
Operating temperature range in protective housing AC-211x with 2 x VIBROCONTROL 1500	0 °C … +40 °C
Humidity	max. 95% non-condensing

Sensors for vibration and rolling-element bearing condition:

Type	Acceleration sensors with constant-current power requirement (CCS type), transmission factor 100 mV/g
Temperature type	PT-100, 3-wire or PT-100 integrated in Acceleration sensor
max. cable length between VIBROCONTROL 1500 and Sensor AS-062/T1	130 m
For monitoring the casing vibration only	600 m

Standards conformity:

2006/95/EU Low-voltage guideline	EN 61010-1 : 2002 - 08
2004/108 EU EMC guideline	EN 61326-1: 2006 - 10 Use for industrial applications to EN55011 Class A
WEEE-Reg.-Nr. DE	69572330
Product category / Application area	9

4 Installation

4.1 With the installation of the VIBROCONTROL 1500 the following are to be observed:

- Installation must not be carried with the power connected!
- Installation and connections must be carried out only by technically qualified personnel.
- The VIBROCONTROL 1500 is prepared for installation on a DIN rail.
- A minimum space of 5 cm above and below the instrument must be maintained to guarantee sufficient air circulation.
- Depending upon the ambient temperature and loading of the instrument the housing can tolerate higher temperatures!
- With establishment of the connections there is a danger of plugging the connectors into the wrong socket; with a wrong connection the instrument could be destroyed.
- Dangerous voltages may be connected at the relay contacts! - Danger of electrocution!
- Recommended installation sequence:
  - Install the instrument on the DIN rail
  - Connect the sensors
  - Connect the relays and current outputs
  - Connect the CAN-Bus, if applicable
  - Connect the power
- Power should be connected only through isolating equipment, (a switch or circuit-breaker)!
  The switch or circuit-breaker used as an isolator must fulfill the requirements according to IEC 60947-1 and IEC 60947-3 and be suitable for the application.

Note:

The assembly of the VIBROCONTROL 1500 must not be undertaken in areas with permanent vibrations. Possibly a vibration-isolated installation must be implemented.

Mounting in an AC-211x protective housing

The AC-211x protective housing offers mechanical protection as well as protection against weather influences. Up to two VIBROCONTROL 1500 instruments plus an AC-4111 power supply can be mounted in the protective housing.

Note:

Due to the limited air circulation there is a reduction in the permissible operating temperature range:

1 x VIBROCONTROL 1500 + 1 x AC-4111: 0 °C …+45 °C

2 x VIBROCONTROL 1500 + 2 x AC-4111: 0 °C … +40 °C

Do not install any other components into the protective housing!

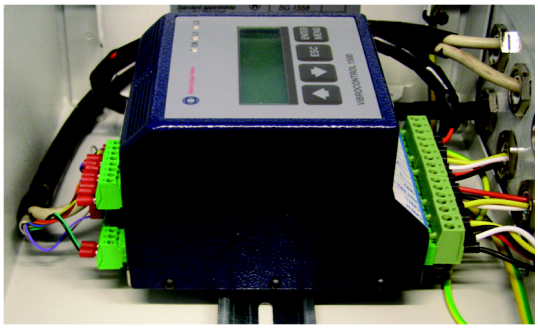
Note:

The connections between the VIBROCONTROL 1500 unit and the power supply AC-4111 is already established. Remove the VIBROCONTROL 1500 unit from the DIN Rail before mounting or connecting other parts.

- Disconnect all Phoenix plugs in the lower terminal strip.
- Pull the black lever under Port LIM 1 and remove the VIBROCONTROL 1500 unit from the DIN rail.
- Disconnect all Phoenix plugs in the upper terminal strip.
- Connect the new wiring and lay the cable screens carefully at the cable glands.

How to mount the VIBROCONTROL 1500 unit into the protective housing.

- Connect all upper Phoenix plugs at the VIBROCONTROL 1500 unit.
- Mount the VIBROCONTROL 1500 unit onto the DIN rail.
- Mount all lower Phoenix plugs at the VIBROCONTROL 1500 unit. Use a screwdriver to do this carefully.



1 2 3

Fig.2: VIBROCONTROL 1500 unit mounted on a DIN trail

1. Upper terminal strip
2. DIN rail
3. Lower terminal strip

4.1.1 Delivery specifications VIBROCONTROL 1500 unit in a protective housing AC-211x

The trim levels of the protective housing AC-211x with mounted Vibrocontrol unit.

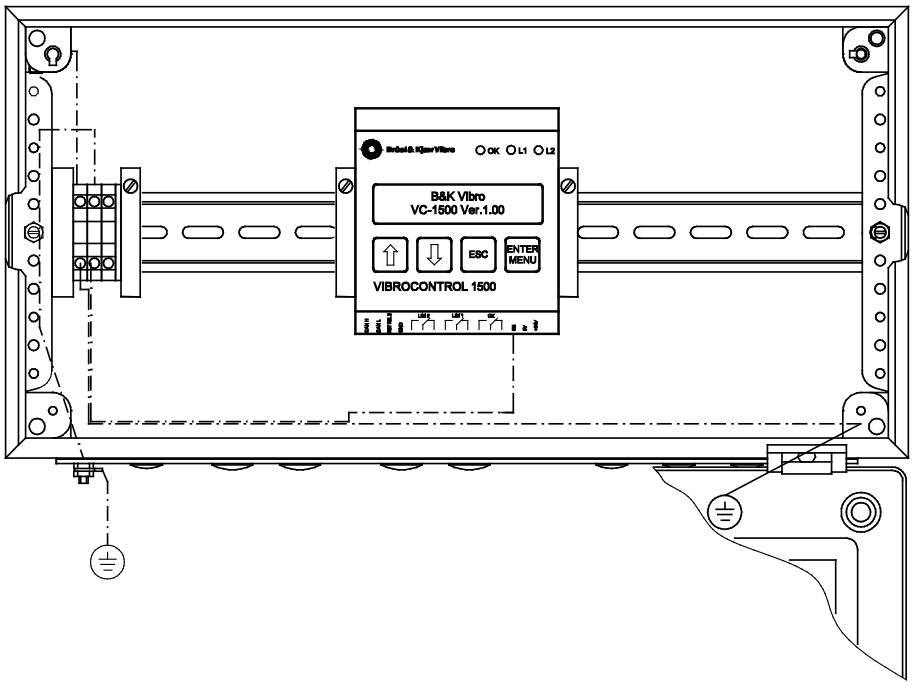


Fig.3: One VIBROCONTROL 1500 in protective housing. (Order code: VIBROCONTROL 1500/01/DC)

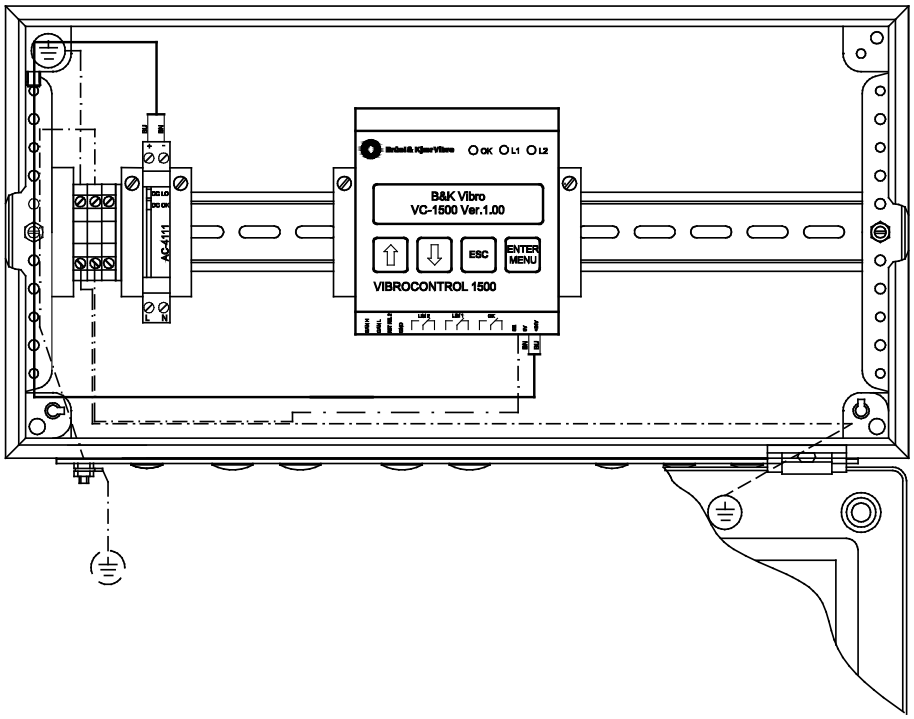


Fig.4: One VIBROCONTROL 1500 unit with power supply in. (Order code: VIBROCONTROL 1500/01/AC)

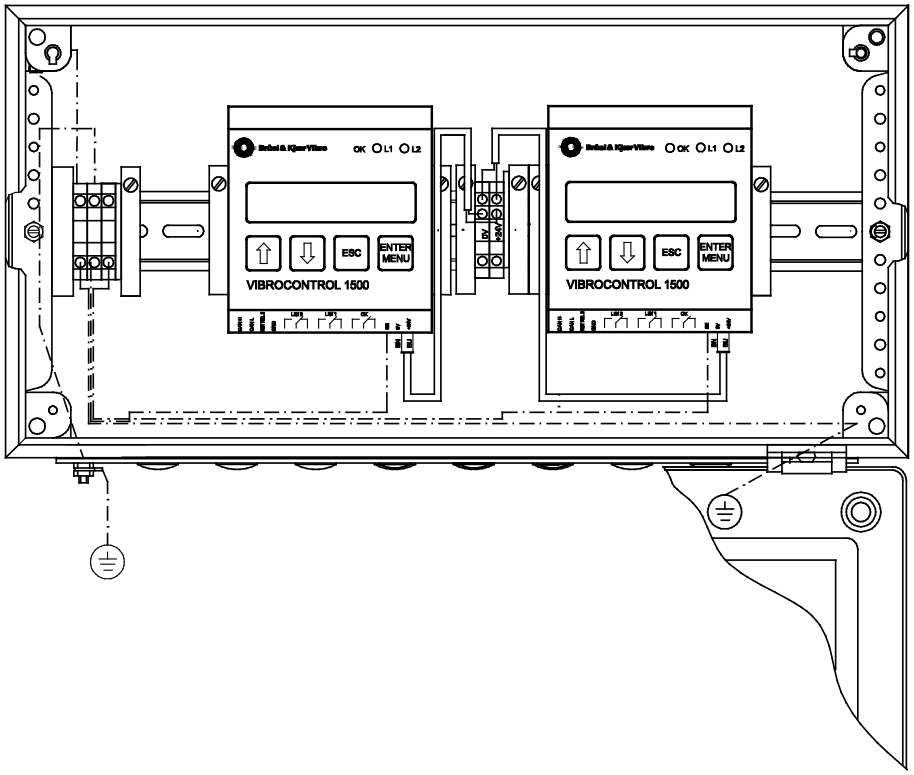


Fig.5: Two VIBROCONTROL 1500 units in protective housing. (Order code: VIBROCONTROL 1500/02/DC)

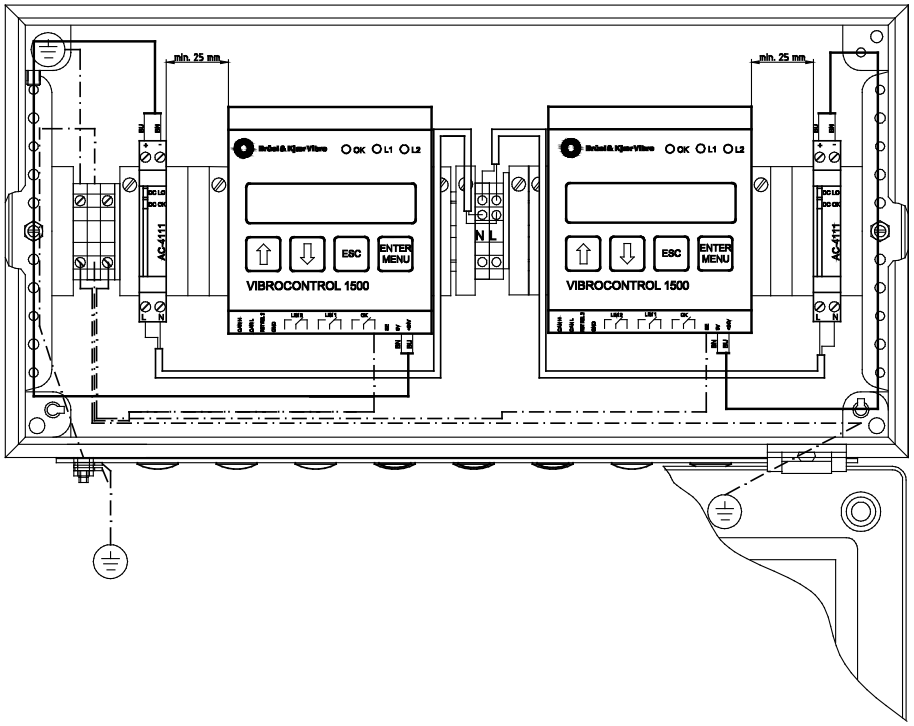


Fig.6: Two VIBROCONTROL 1500 units with power supply in protectiv housing. (Order code: VIBROCONTROL 1500/02/AC)

5 Connections

Upper terminal strip

1st row

2nd row

Lower terminal strip

Fig. 7: VIBROCONTROL 1500 connection terminals

5.1 Connection terminal layout - upper terminal strip, 1st row

Channel A – Sensor connections (acceleration sensor – CCS)

1	**SE**	Shield
2	**GND**	0 VA
3	**SIG+**	Positive signal input
4	**SIG-**	Negative signal input
5	**POWER**	Sensor power
6	**NC**	Not used
7	**NC**	Not used

Channel B – Sensor connections (acceleration sensor – CCS)

8	**SE**	Shield
9	**GND**	0 VA
10	**SIG+**	Positive signal input
11	**SIG-**	Negative signal input
12	**POWER**	Sensor power
13	**NC**	Not used
14	**NC**	Not used

DC current output 4-20mA, maximum load 500 Ω

15	**OUT A**	Output channel A
16	**GND**	0 VA Current output common
17	**OUT B**	Output channel B

Logical inputs

18	**LOG IN 1**	Logical input - not used
19	**LOG IN 2**	Logical input - channel B trip multiplier
20	**LOG IN 3**	Logical input - channel A trip multiplier
21	**GND**	0 VA Logical ground
22	**+24V**	+24 V

5.2 Connection terminal layout - upper terminal strip, 2nd row

PT-100 A

39	**SUP**	PT-100 positive power
40	**IN**	PT-100 signal input
41	**COM**	PT-100 negative power
42	**SE**	Shield

PT100 B

43	**SUP**	PT-100 positive power
44	**IN**	PT-100 signal input
45	**COM**	PT-100 negative power
46	**SE**	Shield

5.3 Connection terminal layout - lower terminal strip

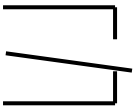
CAN-Bus

23	**CAN H**	CAN-Bus signal, positive connection
24	**CAN L**	CAN-Bus signal, negative connection

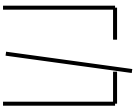
Reset

25	**RST REL 2**	Logical input - self-latching relay RESET, occurs if logical input low (0 V)
26	**GND**	0 VA Ground of logical input

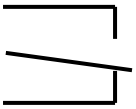
Limit 2 relay

27	**LIM 2-1**	
28	**LIM 2-2**	
29	**LIM 2-3**	

Limit 1 relay

30	**LIM 1-1**	
31	**LIM 1-2**	
32	**LIM 1-3**	

OK relay

33	**OK 1**	
34	**OK 2**	
35	**OK 3**	

The connections of the relays are done through three-pole Phoenix plugs. There is a danger of incorrectly connecting these plugs to adjacent sockets! If the relay contacts are connected to dangerous voltage, and the plug is connected incorrectly, the dangerous voltage could be connected on the ground connection (Pin 26) of the reset input.

Take care of using the right connection for the relay plugs!

Shield

36	**SE**	Shield

Power supply

37	**0 V**	0V for power supply
38	**+24V**	Positive of 24 VDC power supply

Connection of the power and the shield is done through a three-pole Phoenix plug. There is a danger of incorrectly connecting this plug to an adjacent socket! Power must only be connected through the provided terminals (37 and 38) – otherwise the instrument may be destroyed!

5.4 Connection terminal layout - power supply AC-4111

L	mains L
N	mains N
+	+24 V power supply for VIBROCONTROL 1500
-	0 V power supply for VIBROCONTROL 1500

Refere chapter 10.1. for more details.

5.5 Sensor connection and sensor monitoring

VIBROCONTROL 1500 is prepared for connection of two acceleration sensors with constant-current power requirement (CCS type) and an output sensitivity of 100 mV/g.

When connecting the sensors it must be noted that a connection between SIG- and GND as well as between SIG+ and POWER must be made.

For testing the error-free function of the sensor a test voltage is measured between SIG+ and SIG-. The permissible voltage range lies between 8 – 16 V $\pm$ 0.5 V.

If the test voltage at both channels lies outside of this range the OK relay switches and error-message 10 ”Both ch sensors“ appears in the display.

In a case where the test voltage at only one channel lies outside the permissible range, the OK relay will switch and the message "Sensor error" appears (sensor fault) with a display of the relevant channel. Other functions of the instrument are normal.

In an error case the current output of the channel will go back to 2mA output current.

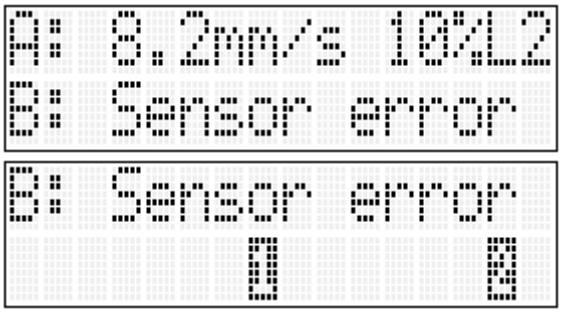


Fig. 8: Display of sensor fault in channel B

5.6 Connection of sensors

VIBROCONTROL 1500 is prepared for connection of a max. of two acceleration sensors with constant-current power (CCS type) as well as two PT-100 sensors with three-conductor cable As an example the connections for the sensor AS-062/T1 are shown below. For further details about this sensor please consult the technical description.

Example: AS-062/T1

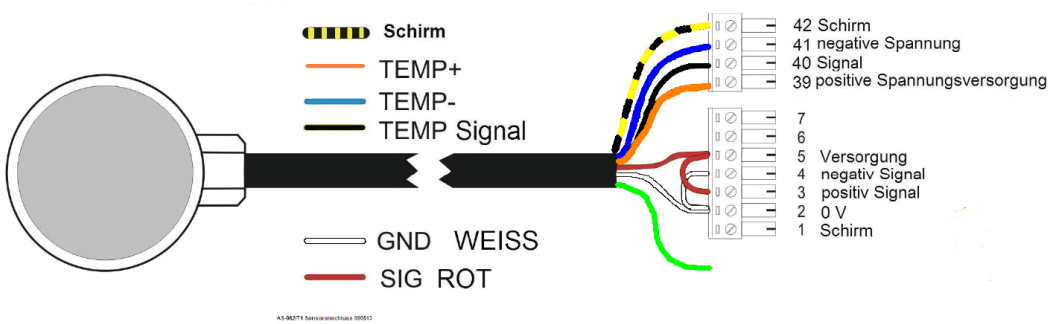


Fig. 9: Connection between VIBROCONTROL 1500 and sensor AS-062/T1

clamp	Color of wire	Signal
42	yellow-black **(GN/YE)**	**SE** : Schield
3 & 5	red **(RD)**	**SIG**: Sensor-Signal
2 & 4	white **(WH)**	**COM/0 VA**: Sensor Signal Ground
39	orange **(OR)**	**PT-100 +**
41	blue **(BU)**	**PT-100 -**
40	black **(BK)**	**PT-100 -**
	green **(GN)**	**PT-100 +** :for 4-wire connection of PT-100 ***Attention!*** ***Will not be used with the VIBROCONTROL 1500! Please take care that there is no contact in any case with this green wire!***

Note:

For connection of other sensors please observe the respective sensor data sheet!

Advice!

When the AS-062/T1 is used the cable length between the VIBROCONTROL 1500 and the sensor may not exceed a maximum length of 130 m (for monitoring the casing vibration only 600 m) Values valid at 25 °C ambient temperature and 120 pF/m cable capacitance.

Note:

In the case where some other cable is used, the cable specification must allow that with full rejection, signals up to 5 kHz can be transferred (dependent upon cable capacitance, temperature and supply current). This is the only way reliable monitoring of rolling-element bearing condition is possible.

For an estimation of the cable length the following formula can be used:

$$l = \frac{I_B - I_L}{2\pi \cdot f \cdot C_K \cdot \hat{U}_{max}}$$

l = Cable length [m]

I_B = Constant - current power [A]

I_L = Charge amplifier power consumption [A]

f = Frequency [Hz]

C_K = Specific cable capacitance A/S [F/m]

$\hat{U}_{max}$ = max. peak voltage [V]

Note:

If a PT-100 input is connected after the instrument has been switched on, this could lead to an activation of the limits L1temp, resp. L2temp if these have been activated in the setup. Because of this the connection of sensors should only be carried out with the VIBROCONTROL 1500 switched off.

6 Switching the instrument ON

6.1 Single-channel operation

After the VIBROCONTROL 1500 is switched on by applying the supply voltage, a test of the attached sensors, an internal test of the instrument and an initialization of the selected instrument settings takes place. This initial procedure lasts for approx. 10 seconds and is signaled by a simultaneous flashing of the LEDs for OK, LIM 1 and LIM 2.

During this time it is possible to interrupt the initialization procedure and reach the menu, without producing an error message, by pushing the **MENU** pushbutton. The Setup menu is called up and the sub-menu "Channel setup" is selected. After confirming with the pushbutton **ENTER**, the selected channel settings can be edited.

If the sensitivity for the sensor in channel B is set to "OFF" in the "SENS."-setting and stored, after a return to the menu and further initialization the instrument can be operated as a single-channel instrument with only one sensor connected to channel A.

Note:

If only one sensor in connected, e.g. in channel A, and the instrument has not been configured to operate as a single-channel instrument, a message ”Sensor ERROR“ will appear for the unused channel. The OK-relay will switch. Measurement on the other channel is possible.

6.2 Two-channel (acceleration-temperature) operation:

The single-channel operation described above is associated only with the connection of acceleration sensors. This means if the "SENS." setting, e.g. for channel B, has been set to "OFF", no acceleration measurement can be acquired at this channel. **However it is possible to use the channel B that is switched off for temperature monitoring.** To do this a 3-conductor PT-100 sensor has simply to be connected to the corresponding terminals. The LIM 1 and LIM 2 limit value monitoring and the activation of relays for the used temperature channel remain active.

Advice!

The VIBROCONTROL 1500 can also be used in a two-channel (temperature-temperature) operation.

6.3 Hardware / Firmware version

After the instrument switched on, and during the display of the type description and version number, it is possible to determine the complete hardware and firmware description of the VIBROCONTROL 1500 instrument by simultaneously pushing the ▲ and ▼ pushbuttons.

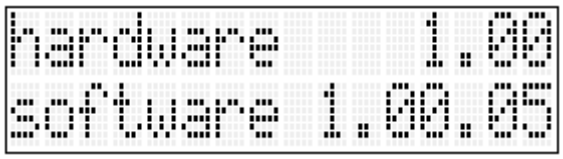


Fig. 10: Display of the hardware and software version numbers
(The version numbers are only examples)

If subsequently an error message (see chapter about error messages) is indicated in the display, eventual necessary changes can be made in the menu. After saving the settings a RESET and a restart of the equipment takes place. Only with a “sensor error” and the appropriate correction no complete RESET and restart takes place.

7 Operating the VIBROCONTROL 1500

7.1 Commissioning the instrument

After power is applied the instrument automatically switches ON.

The instrument name and software version are displayed. The instrument requires approx. 10 seconds for initialization of the measuring and monitoring electronics. The procedure is signaled by a flashing of the three LEDs. After initialization the instrument is ready for operation and this condition is signaled by the green OK lamp being on.

During this initialization time it is possible to call up the setting menu by pushing the **MENU** pushbutton to carry out changes to the settings that deviate from the standard settings made at the works. This interrupts the initialization procedure. This is indicated by all three LEDs being permanently on. After the changes to the settings have been saved, or the setting menu is exited, a new initialization procedure starts.

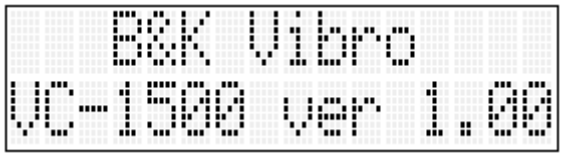


Fig. 11: Display at the instrument after switching on

7.2 Base display

After initialization of the instrument the base display appears on the front panel of the VIBROCONTROL 1500:

The current measured effective (RMS) value of vibration velocity in mm/s (or in/s) from both sensors.

In addition the measured value as a percentage (with reference to the set **L2v** limit value per channel) is displayed.

Using the pushbuttons ▲ and ▼ further displays can be called.

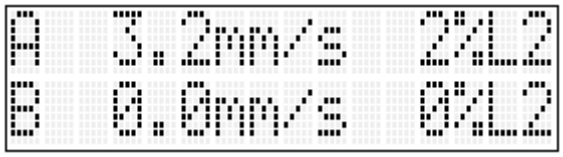


Fig. 12: Base display

7.3 Bargraph with limit value display

The base display can be switched over to a bargraph display of the measured value at channel A by pushing the button ▲ .

In the following figure the bargraph scale in relation to the set limit values (1 = L1v and 2 = L2v) and the up-to-date measured value with reference to the set measuring range are displayed.

Further switching to display the values from channel B is effected by pushing the button ▲.

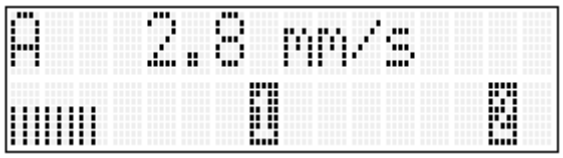


Fig. 13: Bargraph display of the measured value at channel A as well as both set limit values.

7.4 Measuring the temperatures

Note:

The VIBROCONTROL allows temperature measurement in the range 10 °C - 120 °C.

By pushing the button ▲ again the temperature display can be called.

When temperature sensors have been connected, the temperature from the PT-100 elements for channel A (**A:**) and channel B (**B:**) at the installation locations are displayed.

The temperature in the VIBROCONTROL 1500 instrument is shown at **I:.**

The display N/A in the lower line signifies that no temperature signal is available (e.g. when no temperature sensor is connected).

The measured temperatures are displayed in °C or in °F according to the selection made in the Setup menu (Device setup).

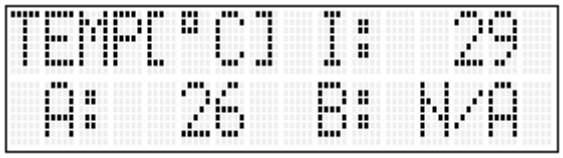


Fig. 14: Temperature display

7.5 Limit value violation - Display

If the pushbutton ▲ is again pushed the instrument displays information about the last limit value violation by the measured value which has taken place.

If the measured value has not violated the limit values **L1v**, **L2v**, **L1temp**, **L2temp**, **L1BC**, **L2BC** the following information is displayed.

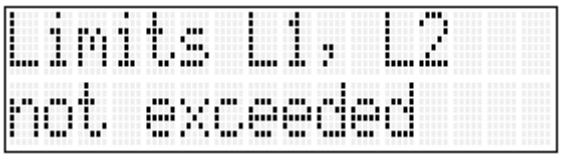


Fig.15: Display of limit value violation; in this case no limits have been violated

If any of the limit values **L1v**, **L2v**, **L1temp**, **L2temp**, **L1BC** or **L2BC** have been violated the display indicates the last violation with the associated channel description.

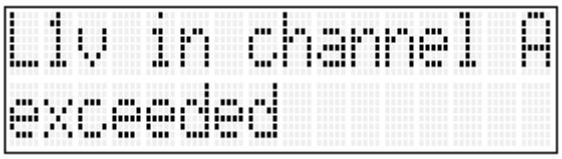


Fig.16: Display of limit value violation; L1v in channel violated

If the **ESC** button is pushed while this is being displayed the current information about the limit value violation is deleted from the display. Only the next arbitrary violation of a limit value leads to a new display of a limit value violation.

Note: By pushing the **ESC** button the self-latching relay LIM2 is not reset. This only occurs with the help of terminals 25 and 26 or a new restart of the VIBROCONTROL 1500 instrument.

Pushing the ▲ button again leads to a return to the base display.

Note:

When the reset channel is closed, the display does not show the state of the LIMs correctly. In this case only the LEDs indicates the correct state of the LIM channels.

7.6 Menu-guided instrument dialogue

By pushing the button **ENTER/MENU** the menu programme of the instrument is called and displayed.

With the buttons ▲ and ▼ one can page backward and forward through the individual points of the menus.

To return to the previous display, push the **ESC** button.

7.7 Measuring the rolling-element bearing condition

The rolling-element bearing measurement is described by the BC measurement and the rolling-element bearing condition as the BC value **(BC = Bearing Condition)**.

For the acquisition of the rolling-element bearing condition VIBROCONTROL 1500 performs quasi continuous a DFT analysis in the frequency range 500 to 5,000 cycles per second and forms from the 20 largest frequency lines of this frequency range the geometrical sum ($\sum f^n$)of the RMS of vibration acceleration [m/s ² eff.] and displays this as the current value **Im**.

From 4 **Im**-Sum values, i.e. after 4 x 4 min = 16 min., a sliding average value is formed and this value is displayed as **Avg** (“average value”) without a unit and stored. After 120 x 4 min. = 8 h the instrument forms a “Reference Value” **Ref**.

Here only the values measured **at a running machine** enter the computation. For the recognition of a stationary machine VIBROCONTROL 1500 has a “**Vibration limit value machine on**“, value which e.g. can be set at 3% of the bearing vibration measuring range. The presence of a significant value for the bearing vibration points to the fact that the machine is not stationary. Only when this value is exceeded are the measurements accepted. Thus it is avoided that downtimes enter the Avg computation. The actual length of time for the formation of the Ref value can thereby be more than 8 hours.

As soon as a reference value is formed and indicated, an additional third display with the designation **BC** (“Bearing condition“) appears in the display, which is formed as follows:

BC = Avg / Ref

This quotient is the bearing condition characteristic value and exhibits at the beginning the value 1.0. Generally the BC-value will increase with the actual operating time and will reach values >1.0.

During the BC-value increases with the actual operating time and values >1.0 are reached, the reference value keeps its validity for further computations.

Investigations have shown that with new rolling-element bearings, vibrations related to the condition of the roller bearing decrease during the initial life span phase and the BC-value can become <1.0, since roughness and burrs at the running surfaces and the rolling elements resulting from the manufacturing process wear away and thereby the operating behaviour improves. Subsequently, then the second life span phase of the camp begins with increasing wear, pitting effects and material fatigue, which usually leads to a constant vibration increase and thus to an increase in the BC-value.

In order to allow this behavior in the parameter setting **Autoref = <auto>** the reference value will be automatically updated as soon as the quotient of the average value and reference value – the BC-value – is less than 0.9.

Starting from this time the previous reference value is replaced by the last measured 8-hour average value Avg which is then active as the new reference value.

This procedure can repeat itself during the life span of the bearing several times. In this case the update cycle of the BC display amounts to at least 8 hours.

In the setup menu the reference value can be reset by a return to zero in the channel setup, which e.g. becomes necessary after a bearing exchange, and the entire procedure repeats itself as described above.

VIBROCONTROL 1500 monitors the BC value with the help of two adjustable limit values designated as L1BC and L2BC. Beyond that it stores and visualizes the BC trend as averaging of Avg-Values and provides the frequencies and amplitudes of the three dominant vibration components within the range of 500 to 5,000 cycles per second for damage identification.

With the help of the visualization software **VIBROCONTROL 1500 Control-Center**-**Software** the trend and frequency analysis of rolling-element bearing condition can be displayed with a higher resolution and in a greater extent.

Course of the measurement of the rolling-element bearing condition.

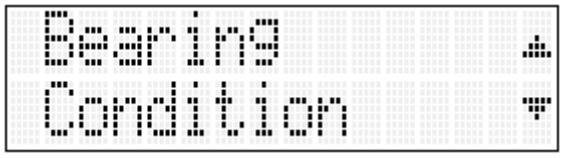


Fig.17: Menu for rolling-element bearing condition

After confirming the button **ENTER/MENU,** the display for selection of the channel appears, with the calculation/analysis is to done. The channel is selected using the pushbuttons ▲ and ▼.

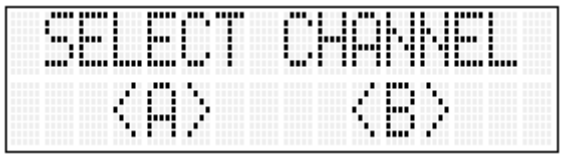


Fig.18: Channel selection

The calculation / analysis is started by pushing the button **ENTER**.

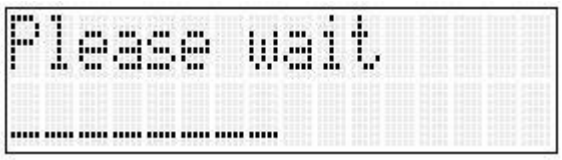


Fig.19: Display during the analysis

After the bearing condition analysis is completed the result is displayed.

During the first 8 hours after a reset of the trend measurement, the following value will be displayed: Bearing condition reference value **Ref** (displays the value 0 because only after at least 8 hours can the first reference value be calculated).

The instantaneous RMS value of acceleration **Im** and the average RMS value of acceleration **Avg**.

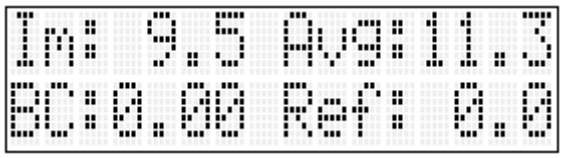


Fig.20: Result of the bearing condition analysis before the establishment of the reference variable Ref.

*After the determination of the magnitude of the bearing condition reference **Ref** (at the earliest after a running time of min. 8 h) the instantaneous RMS value of acceleration **Im** and the average value **Avg** are displayed. In addition the bearing condition variable*

BC = Avg/Ref

can now also be calculated and displayed.

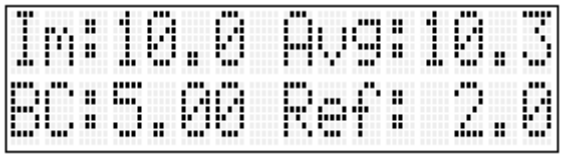


Fig. 21: Result of the bearing condition analysis after establishment of the reference variable Ref and calculation of the BC value.

When the button **ENTER** is pushed (and held) the three largest RMS values of acceleration (**a:**) and their associated frequencies (**F:**) in the frequency range between 500 Hz and 5 kHz are displayed.

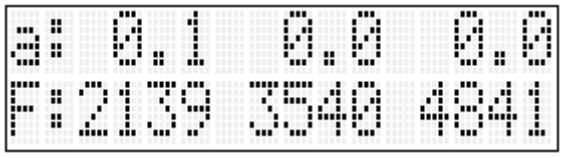


Fig.22: Result of the DFT analysis of bearing condition with the three largest values and their frequencies.

7.7.1 Switching off the automatic reference value determination

Using the parameter setting **Autoref = <auto>** can be set on the VIBROCONTROL 1500, if the reference value is to be updated automatically as soon as the BC-value - the ratio of Avg-Value and the Reference value - falls below the value of 0.9.

The advantage of this setting is that with decreasing BC-Value, the reference value is automatically re-calculated when the last calculated BC-Value more than 10% less than the current reference value.

If this behavior of the automatic Reference value re-calculation is not desired, it can be switched off by changing the parameter **AutoRef** to **<non-auto>**. But with this parameter setting, the reference value can only be re-calculated by resetting the parameter **Reset BC ref? = <Yes>** within Channel Setup menu.

In the Control Center software the parameter **Autoref** can be found in the tab **Setup** with the parameter name **Automatic BC reference**.

Note:

In automatic reference value determination can be observed in the BC value trend of the Control Center software in the case of re-calculations of reference values jumps or transient phenomena.

This is not an error of the instrument or the Control Center software. The reason for this is due to the recalculation of the reference value.

7.7.2 General advice for bearing condition analysis

The executed DFT (discrete Fourier transformation) analysis determines the 20 largest amplitude values of the RMS value of acceleration in the frequency range 500 Hz to 5,000 Hz. At the display of the VIBROCONTROL 1500 instrument the three largest amplitude values of these with the corresponding frequencies are displayed.

Using the VIBROCONTROL 1500 Control-Center-Software all 20 values can be displayed.

However the DFT analysis supplies a much higher resolution than the simplified display on the instrument permits. For the improvement of the frequency resolution and display, with VIBROCONTROL 1500 the following algorithm is carried out:

1. By means of the DFT a frequency analysis is executed and the corresponding lines (amplitudes) in the spectrum are stored.
2. From the consideration of a max. of 3 adjacent lines, if the middle line exhibits the largest value, only one line is formed. The frequency of this one line is the evaluated average value of the three considered frequency lines. As the weighting for the calculation of average values the respective RMS values of the vibration acceleration of these 3 considered frequency lines is used.
3. This computed single frequency line is stored as one of a maximum of 20 dominating lines. Lines which are smaller than the smallest of these 20 lines are not indicated.
   By this optimization procedure it can happen however that 2 closely adjacent frequency lines, with different vibration excitations, may merge into one line. Typical cases are decanters, separators, hydraulic couplings, etc. where 2 rotating machine components have almost exactly the same rotational speed and thus they create very closely adjacent, rotational-frequency vibrations. The difference in rotational speed is so small that the resolution is not sufficient with the DFT analysis to create 2 separated frequency lines and thus assign each of the frequency components to its respective cause. An accurate frequency analysis with high resolution can be reached in this case by the deployment of a portable frequency analyzer.

To reach the menu again, push the **ESC** button.

7.8 Trend display and prognosis

The VIBROCONTROL 1500 instrument stores the measured data. Similarly to a bearing condition measurement, here a measured value is stored only when recognition of the machine's running condition has determined that the machine is not stationary. Based on the available trend values and using the connotation of future probability, it is in the position to calculate, in advance, the time it will take to reach the LIM 2 limit value.

The display shown in the figure below is selected by pushing the buttons ▲ and ▼ and the selection is confirmed with **ENTER**.

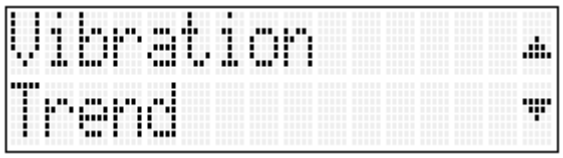


Fig.23: Trend display with bearing vibrations

A display with the channel selection appears. The desired channel is selected using the buttons ▲ and ▼ and confirmed with **ENTER**.

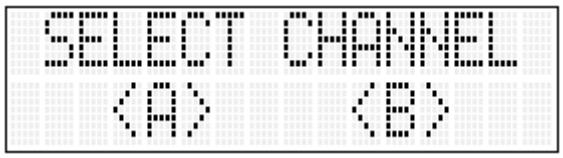


Fig.24: Channel selection

It is possible to display the trend over a time period of 10x8 hours, 10x24 hours or 10x30 days. Selection of the desired time period is done using the buttons ▲ and ▼. The maximum measured value (upper value) and the minimum measured value (lower value) within the time period are also displayed.

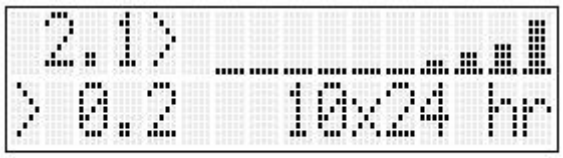


Fig.25: Trend display; largest value within 10 x 24 hours was 2.1

If the **ENTER** button is pushed and held, the prognosis display appears:

The prospective time until LIM2 will be violated by the measured value will be displayed.

In addition a probability statement for the reliability of the prognosis is displayed: N/A (calculation not possible), LOW (low probability), HIGH (high probability).

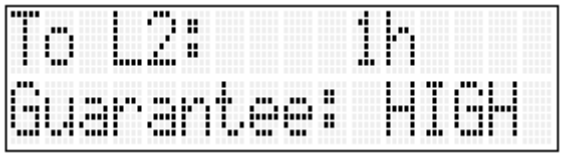


Fig.26: Predicted time period until the LIM 2 value is violated.

If no clear calculation is possible the following display appears.

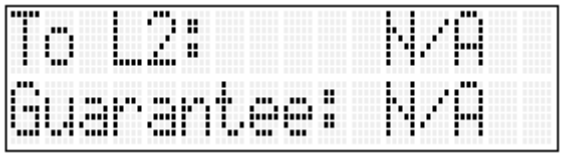


Fig. 27: Indeterminate prognosis, a prediction is not possible.

Please note!

This predetermination involves a statistical procedure, which supplies exclusively a reference to the possible period to a violation of the LIM 2 limit value. An absolute guarantee for this statement cannot be given.

A return to the menu is reached by pushing the button **ESC.**

The course of the data reduction for a trend representation.

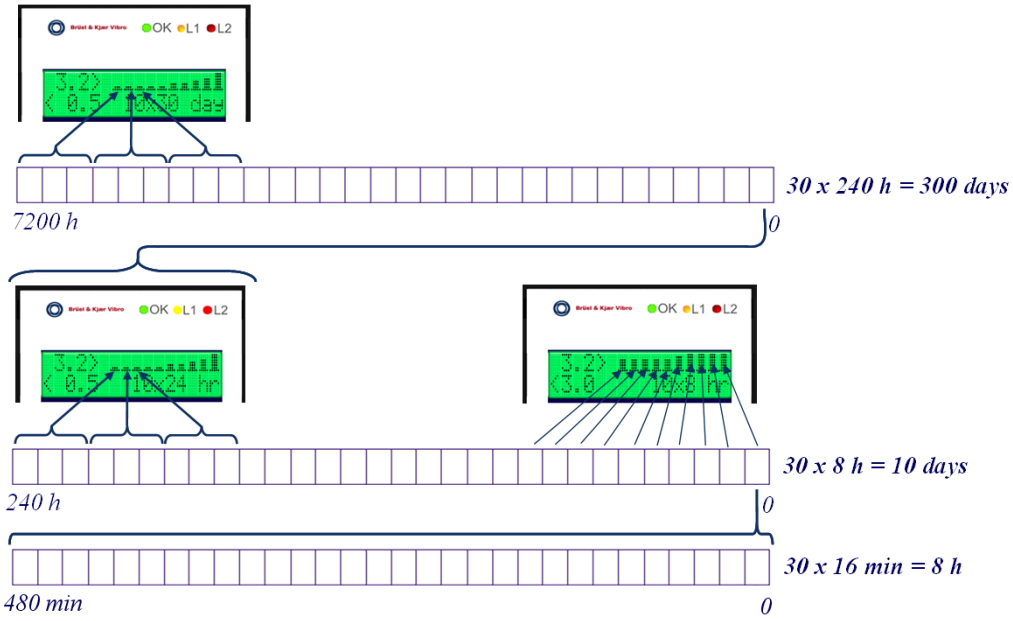


Fig. 28: Structure of the trend representation (AVG = average value)

The instrument contains 3 internal memory areas with values for the trend measurement. In each memory area 30 averaged measurement values are stored:

- An area for the trend from 30 x 16 minutes,
- an area for the trend from 30 x 8 hours and
- an area for the trend from 30 x 240 hours.

For reasons of a simplified recording the time axis is reversed - on the left the oldest and on the right the most current measured value is registered.

Due to the dimensions of the display, not all values, but only the average value from three sequential measurement values are indicated, with a column in the display. This is valid for the trend course which will be formed from the area of 30 x 8 hours (called in the instrument 10 x 24 hours), and from the area of 30 x 240 hours (called in the instrument 10 x 30 days).

The trend course from the storage area 30 x 16 minutes cannot be displayed at the equipment. This trend can be displayed only by the PC software **VIBROCONTROL 1500 Control-Center-software**. The trend 10 x 8 hours is only present in the VIBROCONTROL 1500 instrument, and is in principle differently formed than all other trends. Therefore it is not possible to find any connection between this and other trends. This trend represents only 10 temporally last recorded measured values from the storage area 30 x 8 hours (see fig. 23).

The contents of all storage areas can be selected in unchanged form only over the optionally available **VIBROCONTROL 1500 Control-Center-Software**. Here the trends are actually displayed as trends over 30x16 minutes, 30 x 8 hours and 30 x 240 hours.

7.9 Rolling-element bearing condition and temperature - Trend

The equipment also stores the trend of the rolling-element bearing condition out of averaging of Avg-values as well as the temperature.

The operation is identical to the trend measurement with bearing vibration. Select the following display from the menu and confirm the selection with **ENTER**.

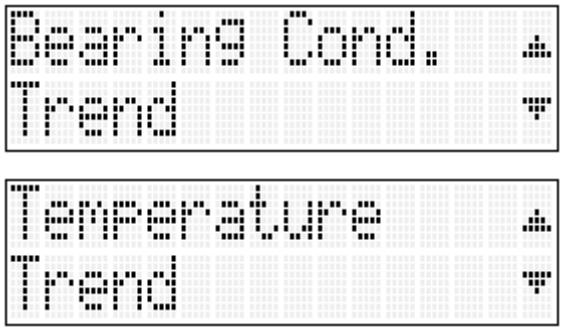


Fig. 29: Rolling-element bearing condition and temperature trend.

A forecast computation is not possible for these measured values.

7.10 Frequency Analysis

VIBROCONTROL 1500 is in the position to perform a frequency analysis of the bearing vibrations. The following display is selected in the menu and confirmed by pushing **ENTER**.

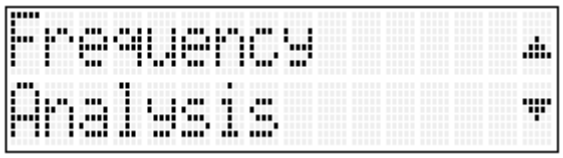


Fig. 30: Menu – Frequency analysis

In the display the selection of the channel which is to be evaluated appears. The desired channel is selected with the help of the buttons ▲ and ▼ and the analysis is started with the button **ENTER**.

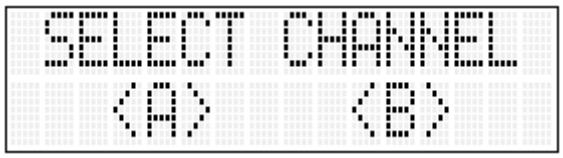


Fig. 31: Channel selection

During execution of the frequency analysis the following message appears in the display.

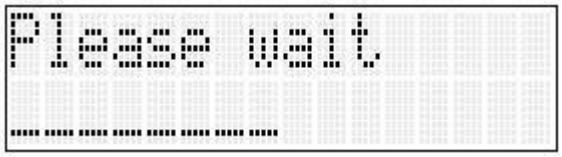


Fig. 32: Execution of the frequency analysis.

The result shows the 3 largest RMS values of vibration velocity **V:** in the frequency range from 10 to 1000 Hz and the three associated frequencies **F:**.

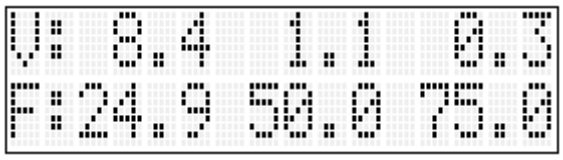


Fig. 33: Result of the frequency analysis.

The frequency analysis will be continuously executed and the determined new measured values continually displayed.

7.11 Post-mortem display after a LIM2 violation

The instrument permits examination of the recorded measured data from both sensors in the time period of 994 seconds before the LIM 2 violation and up to 29 seconds after the LIM 2 violation.

In the menu the following display is selected and confirmed with **ENTER** .

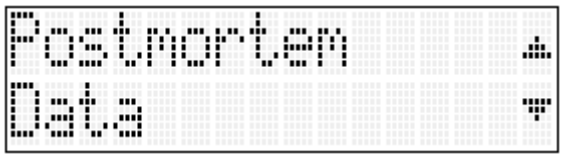


Fig. 34: Post-mortem menu.

In the display the selection of the channel from which you would like to examine the measured data appears. The desired channel is selected using the buttons ▲ and ▼ and confirmed with the button **ENTER**.

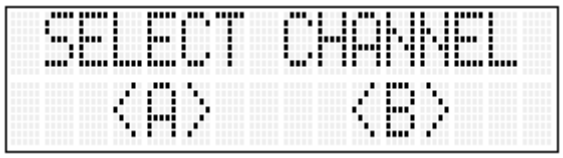


Fig. 35: Channel selection.

In the upper line of the display the measured value of bearing vibration and in the lower line the course of time are displayed. The time value ‘0’ is the exact time of the LIM 2 violation. On the left the measured value preceding the violation and on the right the measured values after the violation are displayed. The buttons ▲ and ▼ are used to page backward and forward in the history of the event. Return to the menu using the button **ESC**.

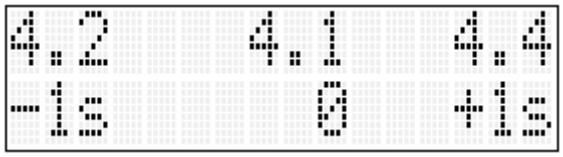


Fig. 36: Post-mortem display

Note:

After switching the instrument off by removing the power all stored post-mortem data will be deleted!

7.12 Setting/Editing measurement channel functions - Channel

In this menu the parameters of the VIBROCONTROL 1500 instrument can be edited separately for channel A and channel B.

The settings for both limit values, the relay response lag times, measuring ranges, input filters frequencies and the values for recognition of the machine running status for rolling-element bearing condition and trend measurements are carried out in this menu.

Select the following display using the buttons ▲ and ▼ and confirm with the button **ENTER**.

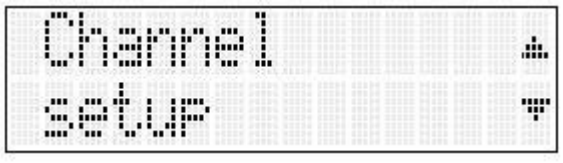


Fig. 37: Setup menu for channel settings

In the display the selection of the channel which is to be edited appears. The desired channel is selected using the buttons ▲ and ▼ and the selection is confirmed with the button **ENTER**.

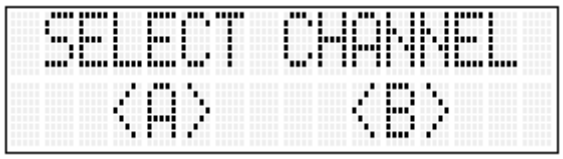


Fig. 38: Channel selection

The following display appears. A distinction is made between:

MONITOR : Measurement channel-specific settings

SENS. : Sensors-specific settings

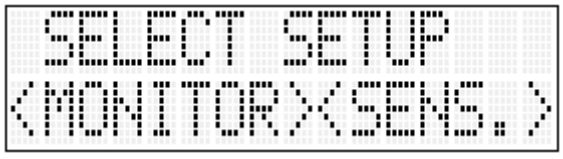


Fig. 39: Selection of the setting.

7.12.1 Channel setup - (MONITOR)

Using the buttons ▲ and ▼ **MONITOR** is selected and confirmed with the button **ENTER**.

A password entry is then required. The password for measurement channel-specific settings is **1500** and be changed with the master password. The individual password numbers are entered one at a time using the buttons ▲ and ▼ and each number is confirmed with the button **ENTER**.

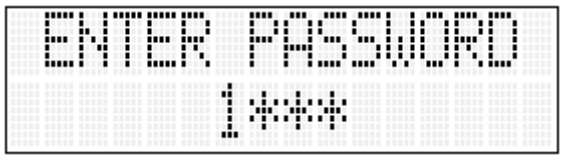


Fig. 40: Password entry

After correct entry of the password the following display appears where the limit values and relay response lag times can be seen. Using the buttons ▲ and ▼ the value which is to be edited is selected and confirmed with ENTER. Subsequently, the value can be increased or decreased with the buttons ▲ and ▼. If the arrow keys are held down when modifying the limit values **L1 v** and **L2 v**, the parameter is changed in increments of 0.1 mm/ s. After 5 modifications the step size jumps from 0.1 mm/s to 2.0 mm/s. By pressing **ENTER** the modified value will be accepted.

Using the button **ESC** it is always possible to go back without having edited a value. The values **L1 v**, **L2 v** are the limit values for bearing vibration in mm/s or in/s. **T1** and **T2** are the relay response lag times in seconds after which the alarm takes place at the instrument.

The values **L1BC**, **L2BC** are the limit values for rolling-element bearing condition and can be switched off. **L1temp**, **L2temp** are the limit values for temperature measurement. These 4 limit values can be entered as numeric values or can also be switched [OFF]. On selection of OFF instead of a numeric value no monitoring of the values takes place.

With **L1BC, L2BC, L1temp** and **L2temp** no relay response lag time for the limit value violation is preselectable. Signaling of these events takes place immediately after violation of the set limit values.

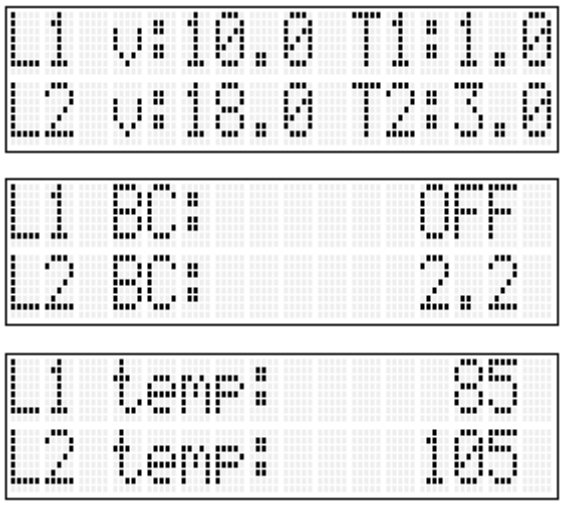


Fig. 41: Limit settings

With further paging through the menu points using the buttons ▲ and ▼ the display with setting options for the measuring range and input filter frequency are reached.

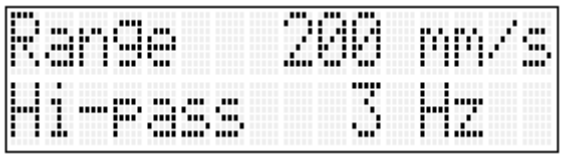


Fig. 42: Setting for the measuring range and highpass corner frequency

Possible measuring range:
10; 20; 40; 50; 100; 200 *mm/s* (0.5; 1,0; 2; 2.5; 5.0; 10.0 *in/s*)

A plausibility check when changing the measurement range with respect to the pre-set limit values is not performed. This means, for example, it is possible to set the measuring range smaller than the limit values. The correct configuration is the sole responsibility of the user.

Possible high pass corner frequency:
1, 3, 10 Hz. Please note that through selection of the corner frequency all vibrations with frequencies lower than the selected corner frequency will be suppressed.

Note:
When a high pass corner frequency is edited it is necessary to carry out a reset of the instrument. This happens automatically when the selected changes to the settings are stored.

DC current output

The selected measuring range has an influence on the attitude of the limit values and also on the current output of 4 - 20mA, whereby a value of 20mA corresponds to a value of 100% of the selected measuring range.

At the analogue output a 4 - 20 mA signal proportional to the selected measuring range is available for channel A and channel B.

When an OK fault occurs the analogue output falls to 2 mA. The analogue output exhibits the same behavior when the measuring range is exceeded or the error "OVERFLOW" is displayed.

Machine On – Recognition of the machine's running status

With the help of the buttons ▲ and ▼ the following data are successively displayed.

Machine On is a threshold value, starting from which the trend values are stored and on which determination of the rolling-element bearing condition characteristic of BC takes place. For this the current measured value of bearing vibration is considered. The **Machine On** value is entered as a percentage of the selected measuring range. As long as the actual measured value is lower than the set threshold value, no value is stored in the trend memory because the VIBROCONTROL 1500 assumes that the machine is stationary. Also no rolling-element bearing condition measurement takes place.

The setting range is from 1% to 50% of the selected measuring range.

Trip Multiplier

During the run up or coast down of the machine being monitored it is possible, with the help of the logical inputs, to temporarily increase the value of the limit **L2v** by the factor of the **Trip mul**. The setting range for the Trip mul factor is from 1 to 20.

When an low level is fed to input **LOG IN 2** (terminal 19) the limit value **L2v** for channel A is increased by the preselected factor.

When an low level is fed to input **LOG IN 3** (terminal 20) the limit value **L2v** for channel B is increased by the preselected factor.

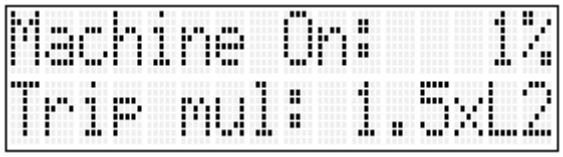


Fig. 43: Setting of 1% for the machine running status recognition and an entry of 1.5 as the factor for the Trip multiplier

Deleting the trend data

In a case where the trend values are to be deleted push the button **ENTER** at the query display below and change **No** to **Yes**. The actual deletion takes place after confirmation of the new settings is made (see further below).

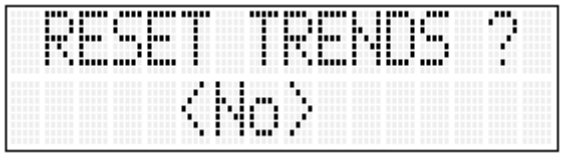


Fig. 44: Query for trend deletion

Deleting the rolling-element bearing condition reference value

When a bearing is exchanged it is necessary to delete the data determined for the old bearing and to determine new data. Therefore a reset of the BC reference value is necessary.

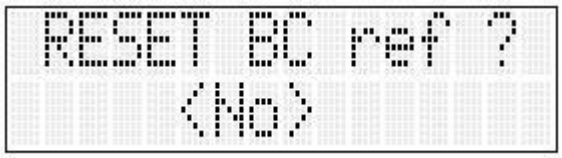


Fig. 45: Query for deletion of the BC reference value

After pushing with the **ESC** button, you will return to the main menu. If any changes have been made a query will appear asking whether the edited values should be saved.

Using the buttons ▲ and ▼ select either **No** or **Yes** and confirm with the button **ENTER**.

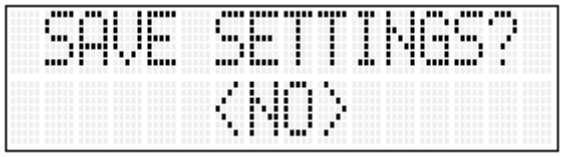


Fig. 46: Confirmation for storing the new settings

Channel setup – (SENS)

Here the sensitivity (transmission factor) settings for both sensors are carried out. The entry of sensor-specific date is carried out separately for each channel. The display for selecting the setups is reached through the display "Channel setup" und "Select channel". The desired channel A or B is selected and confirmed with **ENTER.**

With the help of buttons ▲ and ▼ the option **SENS** is selected in the Setup menu and confirmed with **ENTER**.

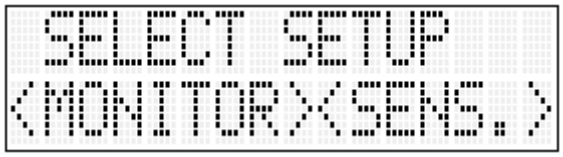


Fig. 47: Selection of the settings

You are then required to enter a password. The password for the sensor-specific setting is **1500**. The individual password numbers are entered one after the other with the help of the buttons ▲ and ▼ and each number is confirmed with the button **ENTER** after it is entered.

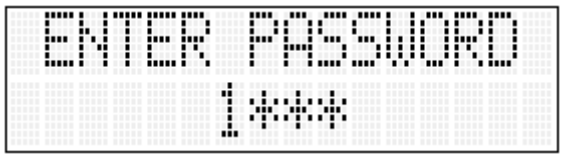


Fig. 48: Password entry

After entry of the correct password the display for setting the sensor sensitivity appears. Using the buttons ▲ and ▼ select between 100 mV/g or OFF and confirm with **ENTER**.

With the help of the button **ESC** it is possible to exit the menu without having carried out a change to the setting.

On selection of 100 mV/g the VIBROCONTROL 1500 assumes that the sensor being connected has a transmission factor of 100 mV/g. In order to consider a deviating transmission factor, the instrument can be adjusted by a **Trim** factor to the actual transmission factor of the sensor to be used. The calibration of the VIBROCONTROL 1500 to the sensor that will be used then takes place with the help of the Trim factor, which can be set within the range of 0.50 to 1.99.

The **Trim** value is calculated according to the following formula:

$$\text{Trim} = \text{Sens}_{\text{nominal}} / \text{Sens}_{\text{real}}$$

Sens$_{nominal}$ nominal value of the transmission factor 100 mV/g.

Sens$_{real}$ actual value of the transmission factor xxx mV/g of the sensor

If the sensitivity is set to **OFF**, the channel is switched off and no measurement takes place at this channel.

Note:
As long as no sensor is connected to the sensor connection terminals and the sensitivity is not set to OFF, the instrument will signal a fault.

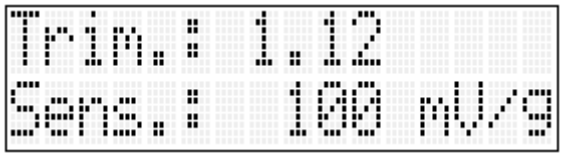


Fig. 49: Setting for sensor sensitivity

After pushing the **ESC** button to return to the main menu, the query asking whether the changed values should be saved will appear if any changes have been made.

Using the buttons ▲ and ▼ select either **No** or **Yes** and confirm by pushing the button **ENTER**.

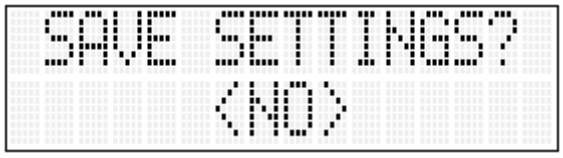


Fig. 50: Saving the new settings per measurement channel

7.13 Setting up/Editing the basic functions - Device Setup

Here the basic setting up of the instrument is carried out.

Settings carried out here will affect the entire instrument, i.e. channel A as well as channel B..

In the menu select the following display and push **ENTER**.

Fig. 51: Menu – Basic settings

With the help of buttons ▲ and ▼ the value to be changed is selected and confirmed with **ENTER**. Using the buttons ▲ and ▼ the values can be changed. The new settings are confirmed with the button **ENTER**. With the **ESC** button one can return to the menu without accepting any changes.

Setting up the CAN-Bus

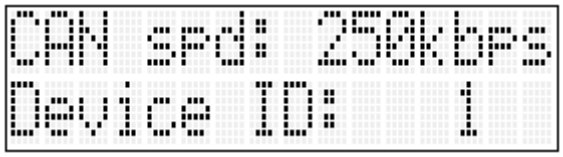


Fig. 52: Setting the transmission speed and CAN-Bus address

In this menu an individual CAN-Bus address (device ID) can also be entered for each VIBROCONTROL 1500. Here it must be noted that this address for each CAN-Bus connection (i.e. each VIBROCONTROL 1500 instrument) can be assigned only once.

Selecting the units

With the help of the buttons ▲ and ▼ the units can be changed from metric (mm/s, °C) to Imperial (in/s, °F).

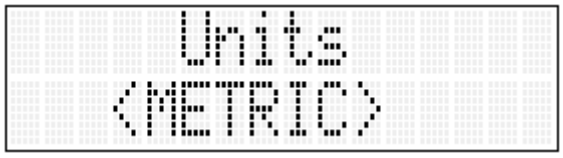


Fig. 53: Changing the units

Setting the automatic reference value determination

With the help of the buttons ▲ and ▼ can be switched between automatic **AutoRef** = **<auto>** and manuel **AutoRef** = **<non-auto>** reference value determination.

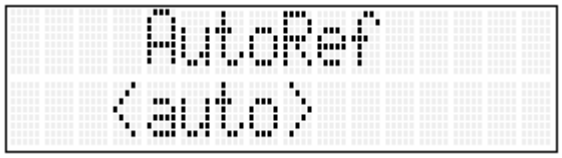


Fig. 54: Switching on the automatic reference value determination

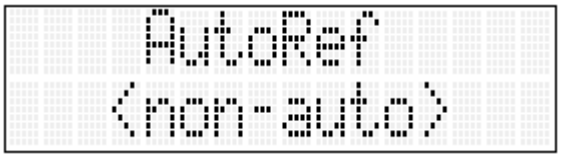


Fig. 55: Switching off the automatic reference value determination

Changing the password

By further use of the buttons ▲ and ▼ the menu option “Change password” can be reached. Here it is possible to replace the instrument password “1500“ with any other password (excluding “0000“). In order to accomplish this change, it is necessary to enter the special master password “7327” which provides protection against an inadvertent change of the password.

If the general password “1500” is to be changed, select “Yes" in the display and confirm by pushing **ENTER**.

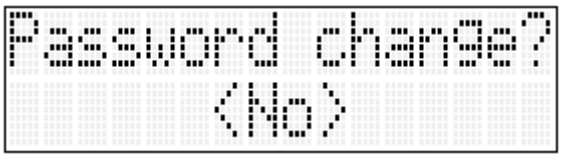


Fig. 56: Password change

Now enter the master password **7327** and confirm with **ENTER.**

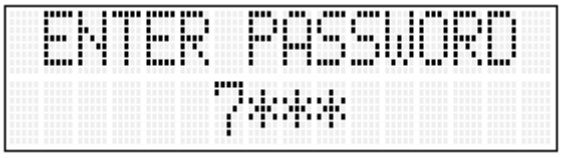


Fig. 57: Enter the master password

Now a query appears asking whether you would like to return to the original password; "Reset password" to the original value (1500). If "Yes" is selected using the button ▲ the original password "1500" will be reactivated. If "No" is selected with the button ▼ a new password (excluding "0000") can be entered.

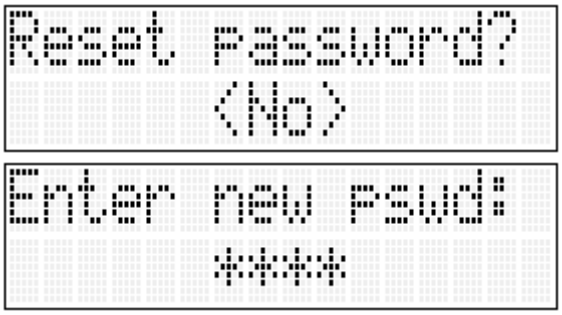


Fig. 58: The upper illustration shows the query for returning the password to the original value "1500"; the lower illustration shows the display for entering a new password

After entering the new password, exit the entry window by pushing **ESC**. A query appears asking whether the new password should be saved.

Using the buttons ▲ and ▼ select either "NO" or "YES" and confirm your selection by pushing **ENTER**. If YES is confirmed the new password overwrites the default password "1500" supplied with the VIBROCONTROL 1500. This new password should then be exclusively used with future requests in the instrument dialogue to enter the password.

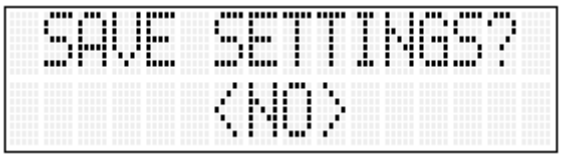


Fig. 59: Confirmation for saving a new password

8 Error messages

#1	Internal fault in the input amplifier of channel A.
#2	Internal fault in the input amplifier of channel B.
#3	*Not assigned*
#4	*Not assigned*
#5	*Not assigned*
#6	*Not assigned*
#7	Internal error – supply voltage of the analogue part out of range.
#8	Overheating of the instrument; the temperature inside the instrument is higher than 90 °C.
#9	Internal fault; the FLASH memory test sum is faulty.
#10	Fault in both sensor channel; test voltage is outside the specified range in both channels.

9 Function checks and self-diagnosis

VIBROCONTROL 1500 has the following internal self-diagnoses:

- **Watchdog** –
  The Watchdog counter is reset every 200ms by the interrupt routine, which computes the RMS value of the vibration velocity. If the Watchdog is not reset (by the occurrence of an error), the Watchdog counter overflows and an instrument RESET follows.
- **RAM test** –
  The RAM memory test takes place in an interrupt at 15kHz (approx. 66µs). In each interrupt a memory cell is examined. If an error arises the RAM/FLASH memory error flag is set active.
- **FLASH test** –
  The program memory is tested every hour, while the machine runs. In case of an error the RAM/FLASH memory error flag is set active.

The RAM/FLASH memory error flag is tested every hour according to the program memory (FLASH) test.

10 Accessories

10.1 Power supply AC-4111

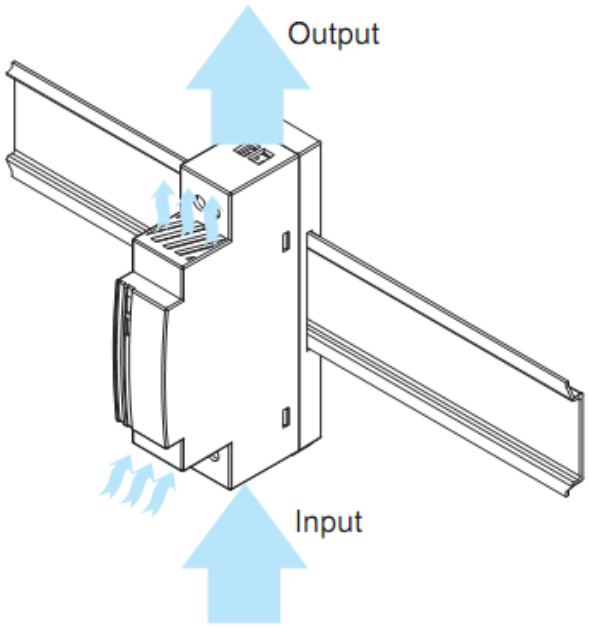


Fig. 60: AC-4111 power supply

The AC-4111 power supply is a 230 VAC / 24 VDC power supply with 10 W output power. This unit can provide power for **one** VIBROCONTROL 1500 instrument and it is intended for mounting on a DIN rail.

AC-4111 description:

Input data	
Input voltage	100 VAC – 240 VAC
Frequency	47-63 Hz
Current consumption	300 mA
Output data	
Nominal output voltage	24 VDC
Output power	10 W
General	
Temperature range	Storage: -25 °C to +85 °C, Operation: -25 °C to +71 °C
Housing	Plastic
MAX. necessary space	25 mm on all sides
Dimensions H x B x D (mm)	91 x 18 x 55,6
Weight	60 g

10.2 AC-4601 power supply

Fig. 61: AC-4601 power supply

The AC-4601 power supply is a 230 VAC / 24 VDC power supply with 600 W output power. Up to **8** VIBROCONTROL 1500 instruments can be provided with power by the unit and it is intended for mounting on a DIN rail.

AC-4601 description:

Input data	
Input voltage	100 VAC – 240 VAC
Frequency	45 - 65 Hz
Current consumption	Appr. 0.86 A (at 120 VAC (nominal load)) appr. 0.47 A (at 230 VAC (nominal load))
Output data	
Nominal output voltage	24 VDC
Output current	2.5 A (-25 °C … +60 °C)
General	
Temperature	Storage: -25 °C to +85 °C, Operation: -25 °C to +60 °C
Housing	Plastic
Minimum necessary space	25 mm on all sides
Dimensions H x B x D (mm)	130 x 55 x 125
Weight	850 g

10.3 USB/CAN interfaceconverter AC-4201

The converter serves the connection and regulation of up to 40 VIBROCONTROL 1500 units to a PC.

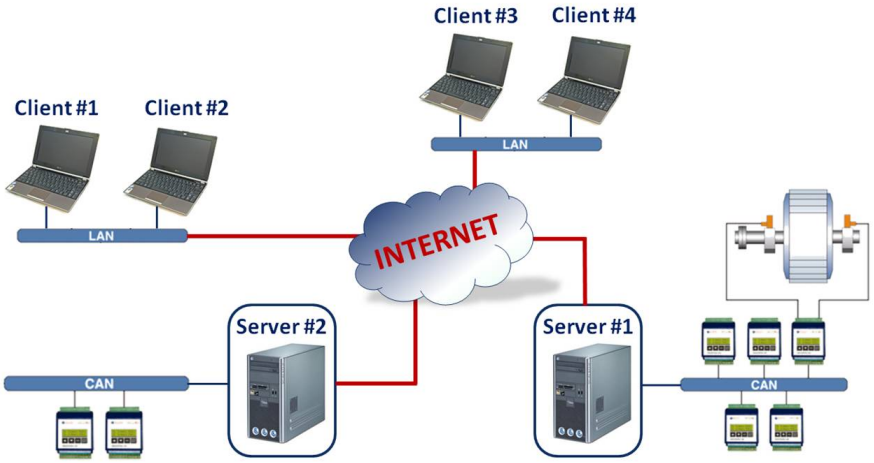


Fig. 62: Example of use AC-4201

11 User dialogue - Overview

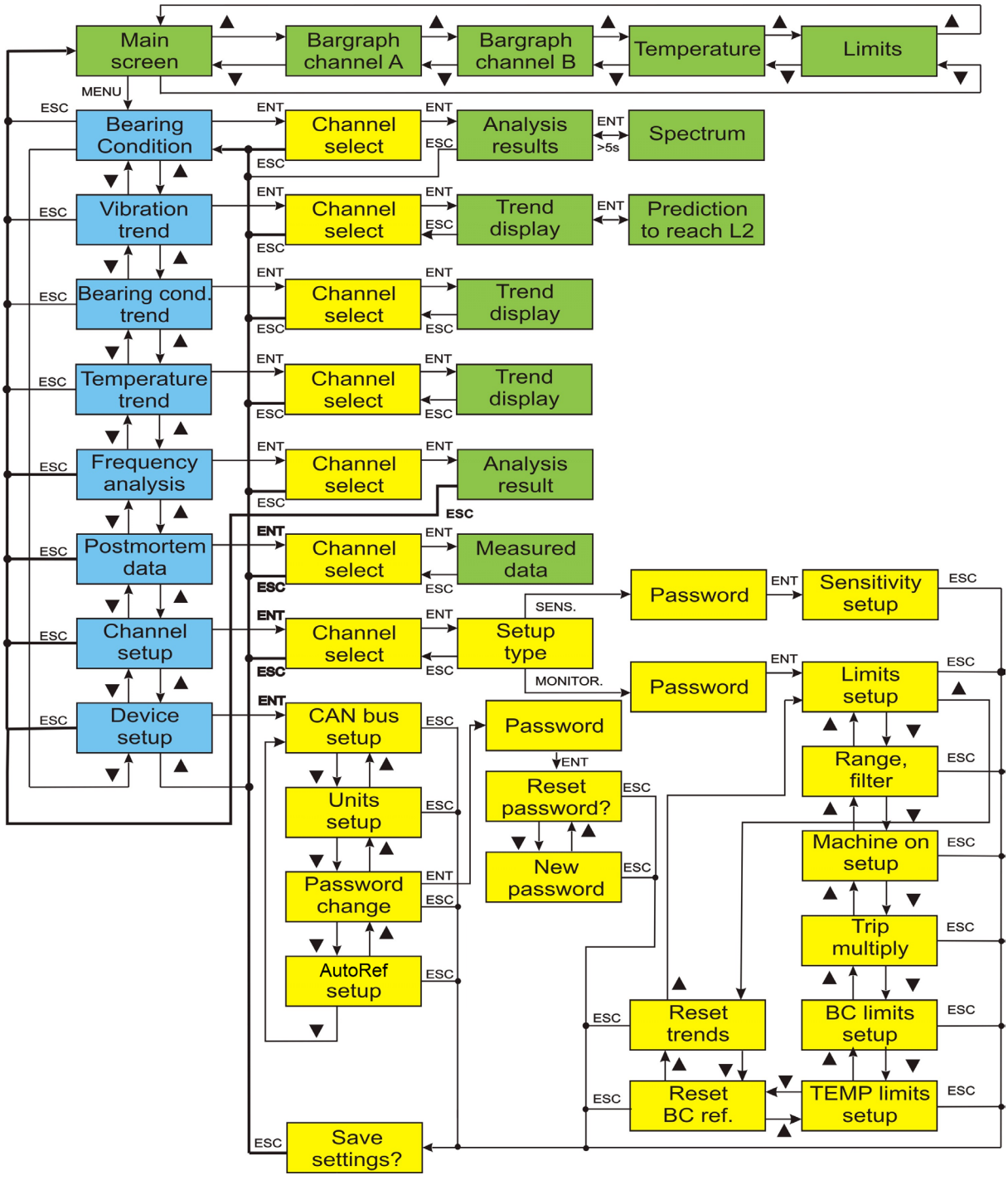


Fig. 63: Structure of the menu-controlled user-dialogue

12 Calibration

We recommend that the VIBROCONTROL 1500 be calibrated every 5 years. This will ensure that the correct functionality of the system is checked, and that the certification according to the quality standard is maintained.

13 Disposal

The equipment is to be disposed of through the local valuable material acceptance location.

14 CE Decleration and C-Tick

Brüel & Kjær Vibro

EG-Konformitäts-Erklärung
Declaration of conformity

Hiermit bescheinigt das Unternehmen / *The company*

Brüel & Kjær Vibro GmbH
Leydheckerstraße 10
D-64293 Darmstadt

CE

die Konformität des Produkts / *herewith declares conformity of the product*

Mess – und Überwachungsgerät / Measuring and Monitoring equipment

VIBROCONTROL 1500

mit folgenden einschlägigen Bestimmungen / *with applicable regulations below*
EG-Richtlinie / *EC directive*

2004/108/EG	**EMV-Richtlinie / EMC-Directive**
2006/95/EG	**Niederspannungsrichtlinie / Low Voltage Directive**

Angewendete harmonisierte Normen / *Harmonized standards applied*

DIN EN 61326-1: 2006 - 10
DIN EN 61010-1: 2002 - 08

Angewendete nationale technische Spezifikationen / *National technical specifications applied*

Bereich / Division
Brüel & Kjær Vibro GmbH

Unterschrift / Signature
CE-Beauftragter

Ort/*Place* **Darmstadt**
Datum / *Date* **10.08.2010**

(N. Kang)

We declare the conformity with the EMV requirement of the australian Government authority (AMCA) accordance with C-Tick.