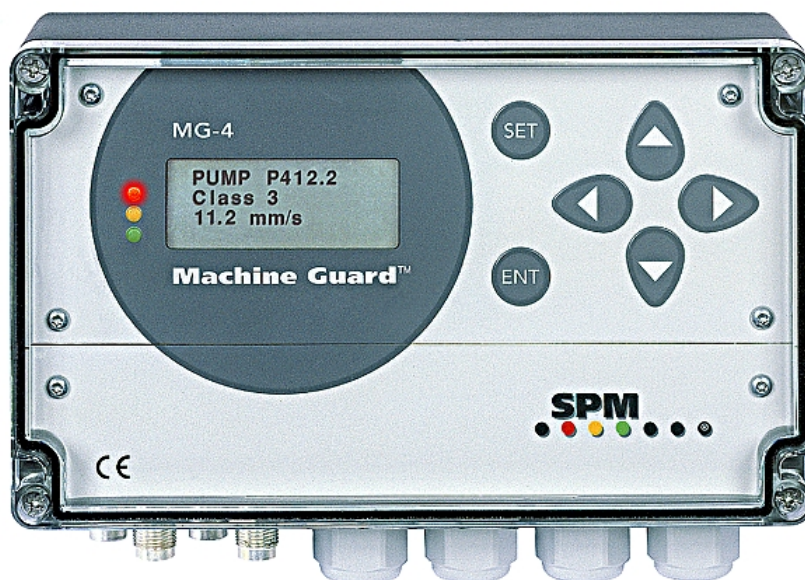




Instruction Manual

# Machine Guard™ MG-4



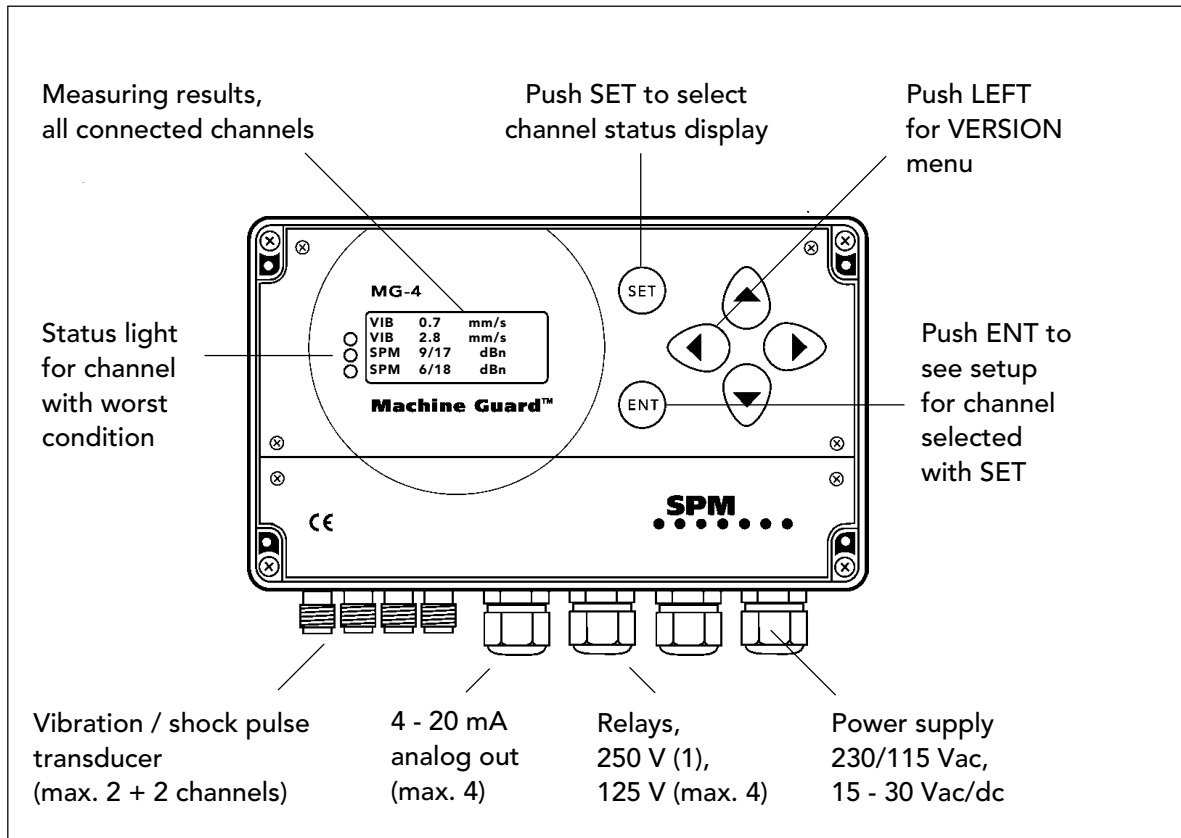


# Machine Guard MG-4

## Contents

Machine Guard MG-4 .....	1
Four basic MG-4 versions .....	2
Mechanical installation of MG-4 .....	3
Electrical installation of MG-4 .....	4
Connector configurations .....	5
Connection to PLC, principle .....	6
Measuring logic controlled by the PLC .....	7
Using the analog current in other devices .....	8
Programmed measuring parameters .....	9
Reset default parameters .....	10
The VERSION menu, version and setup .....	11
The VERSION menu, password and stand-by .....	12
Programming a vibration channel .....	13
Programming a shock pulse channel for dBm/dBc .....	15
Programming a shock pulse channel for LR/HR .....	16
The effect of alarm delay .....	17
Stand-by mode .....	18
Vibration transducers .....	19
Vibration transducer installation .....	20
Selection of SPM measuring point .....	21
Examples of SPM measuring point .....	22
Installation of shock pulse transducers .....	23
VIB – Vibration severity monitoring .....	25
Machine classes .....	26
SPM - shock pulse measurement .....	26
Normalized readings show bearing condition .....	27
Bearing condition development .....	28
Technical specifications, MG4-1 .....	29
Technical specifications, MG4-2 .....	30
Technical specifications, MG4-12 .....	31
Technical specifications, MG4-22 .....	32
VIB transducer TRV-18/19 .....	33
VIB transducer TRV-20/21 .....	34
SPM transducer 40000 .....	35
SPM transducer 42000 .....	36
Transducer matching unit TMU-12 .....	37
Programming guide .....	38





## Machine Guard MG-4

Machine Guard MG-4 is a continuous monitoring unit for vibration severity (VIB) and bearing condition (SPM). It provides, for each channel:

- Status display (green - yellow - red light)
- Display of measured value with continuous updates
- Analog output current 4 - 20 mA with programmable range
- Relay action at two programmable alarm levels (yellow and red alarm).

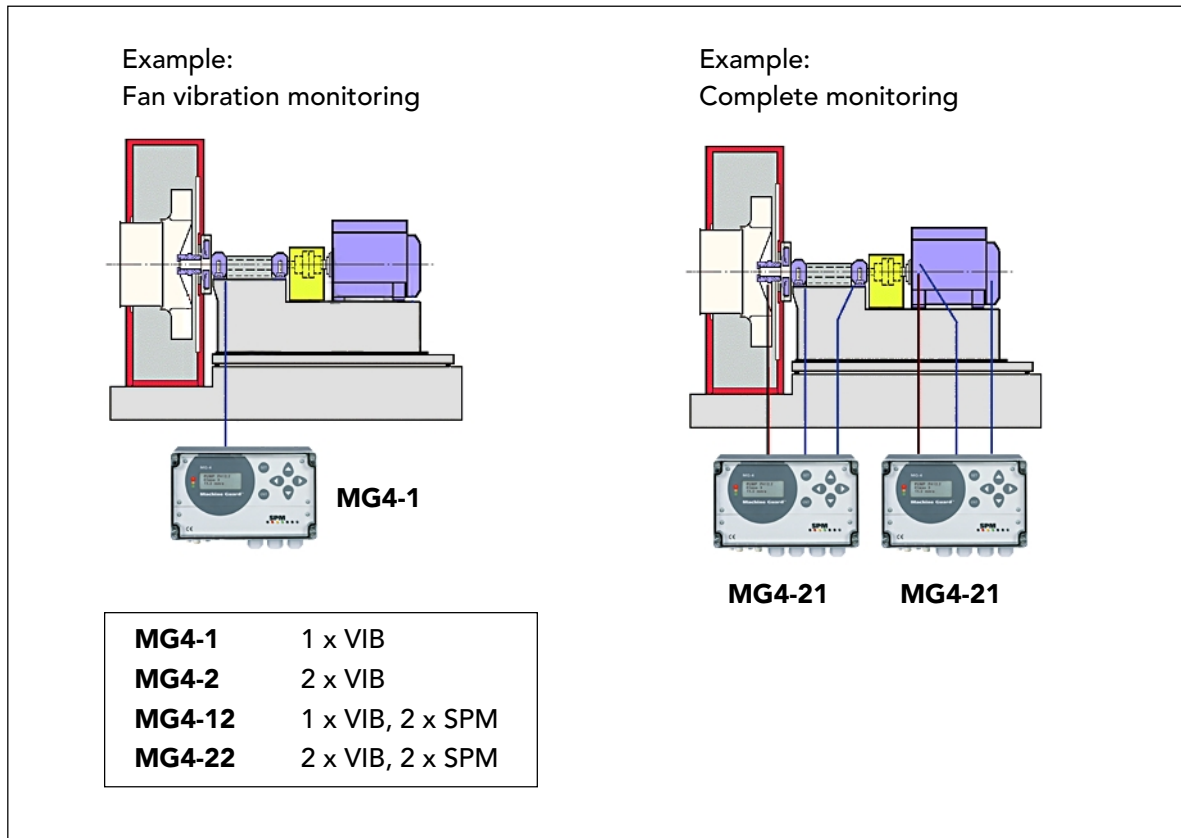
When the unit is in its normal measuring mode, the green - yellow - red status light shows the status of the channel with the worst condition. The display shows the measuring result on all connected channels.

On pressing SET, the cursor will be on channel 1 and the status light will correspond to the result on channel 1. With SET one can step through all channels.

Pressing LEFT opens a window where you can see the instrument version, set measuring unit and contrast, disable the TLT alarm and switch off the measuring function.

Pressing ENT starts the programming mode for the selected channel. This is password protected. With the password set to ON, you can see the channel configurations but are unable to make changes.





## Four basic MG-4 versions

The product family Machine Guard MG-4 consists of four basic units. They have identical polycarbonate/PVC casings with transparent lids, IP65, and the same front panel. The difference is in the number and type of monitoring channels, the number of analog output channels, and the number of relays. In addition, one can order versions for different transducer types and measuring ranges.

The basic function is vibration severity monitoring (VIB) on either one or two channels. To this, you can add two channels for bearing condition monitoring (SPM). The version numbers are:

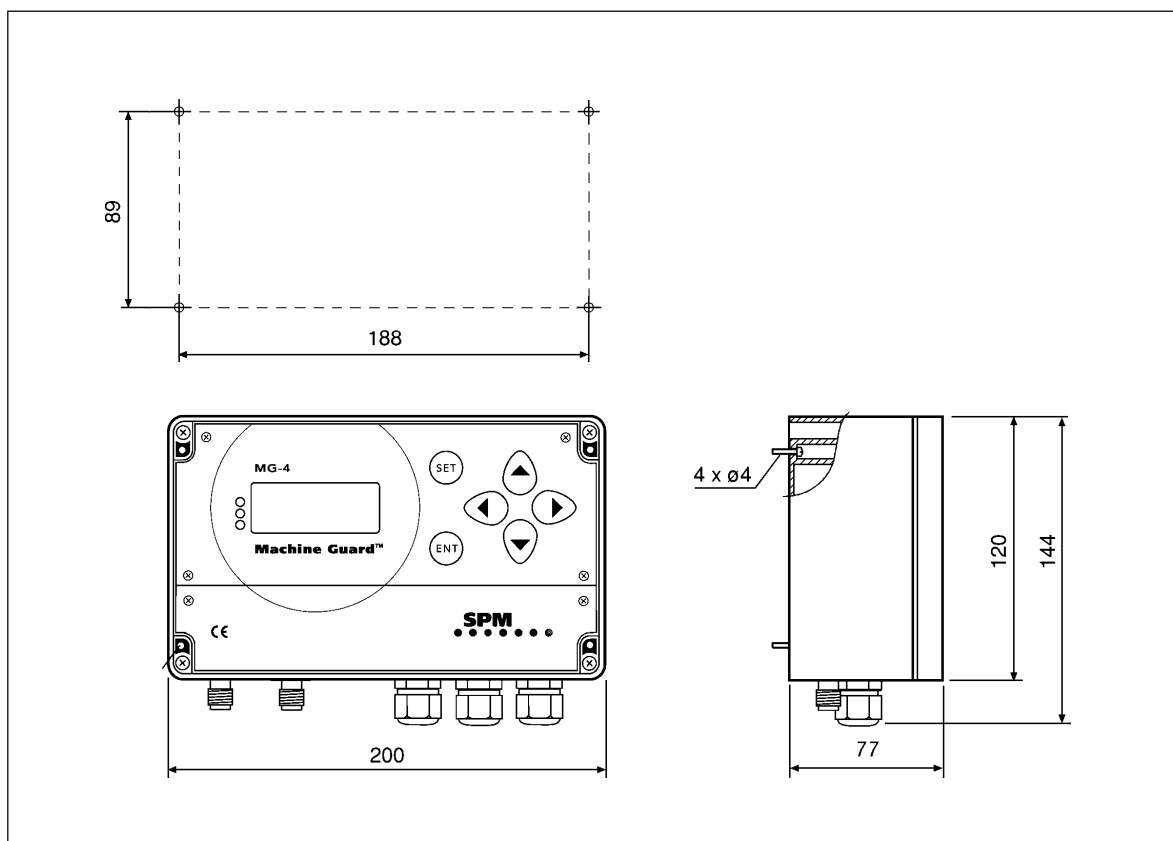
MG4-1	1 channel VIB
MG4-2	2 channels VIB
MG4-12	1 channel VIB plus 2 channels SPM
MG4-22	2 channels VIB plus 2 channels SPM.

A vibration measurement returns one value (mm/s RMS). For SPM, you can select one of two techniques: SPM dBm/dBc (returns the maximum value dBm and the carpet value dBc), or LR/HR (returns LR value, HR value, LUB number and condition codes). The measuring results can be put on any of the available analog output channels and connected with any of the relays.

The standard equipment always includes one relay 250 Vac / 5 A / 1250 VA. In addition, MG4-1 has two relays 125 Vac / 1 A / 60 VA (150 Vdc / 1 A / 30 W) while the other units have four.

An analog output channel is supplied for each measuring channel, to a maximum of four.





## Mechanical installation of MG-4

MG4 is designed for wall mounting. It is fastened with 4 screws, the screw hole diameter is 4 mm.

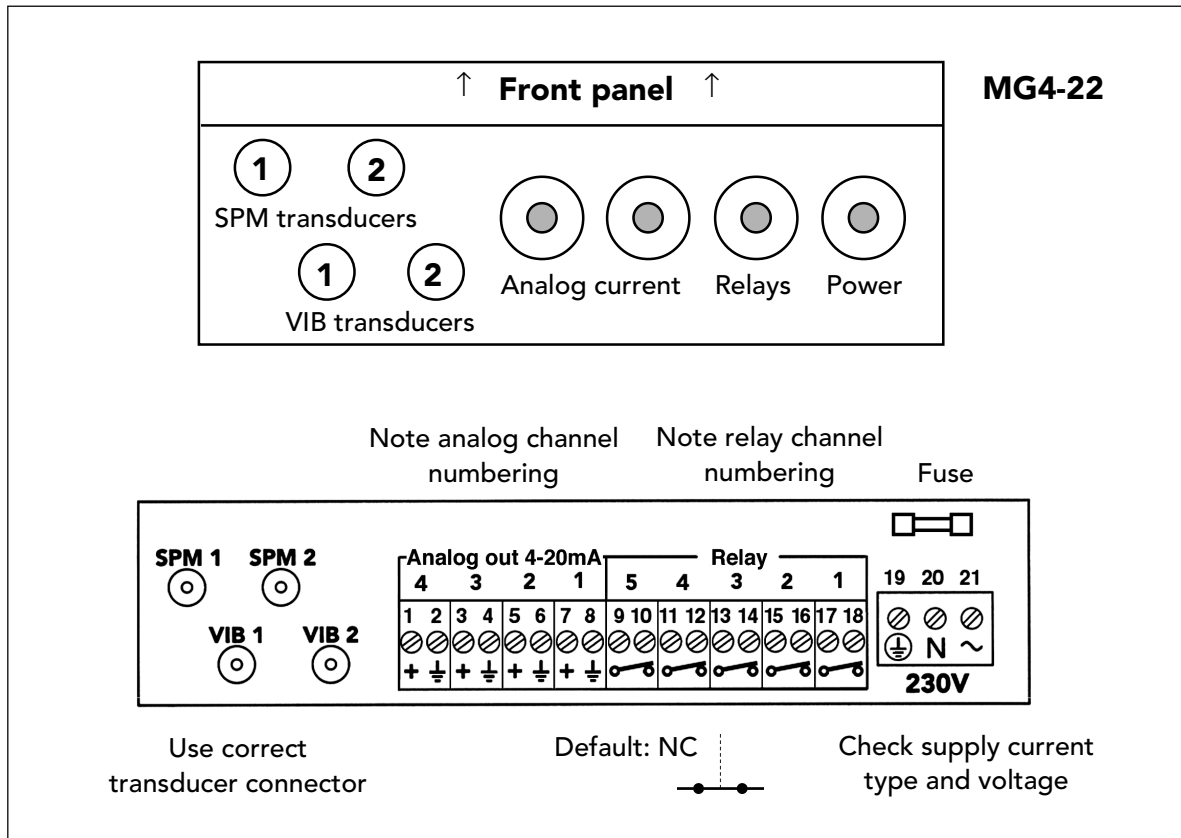
If possible, do not mount the unit against vibrating machine parts. The max. continuous vibration level should not exceed 5 mm RMS.

The casing material is polycarbonate/PVC, dimensions 200 x 144 x 77 mm. The casing is classed IP65. The cable inlets are tight for cable diameters 5.5 to 10 mm.

The temperature range of the MG-4 is 0 to 50 °C (32 to 122 °F).

The maximum length of the transducer cables is 50 m for SPM vibration transducers. For SPM shock pulse transducer 42000 and 4000 plus TMU (transducer matching unit), the maximum cable length is 100 m. For the SPM shock pulse transducer 40000 without TMU, the maximum cable length is 4 m.





## Electrical installation of MG-4

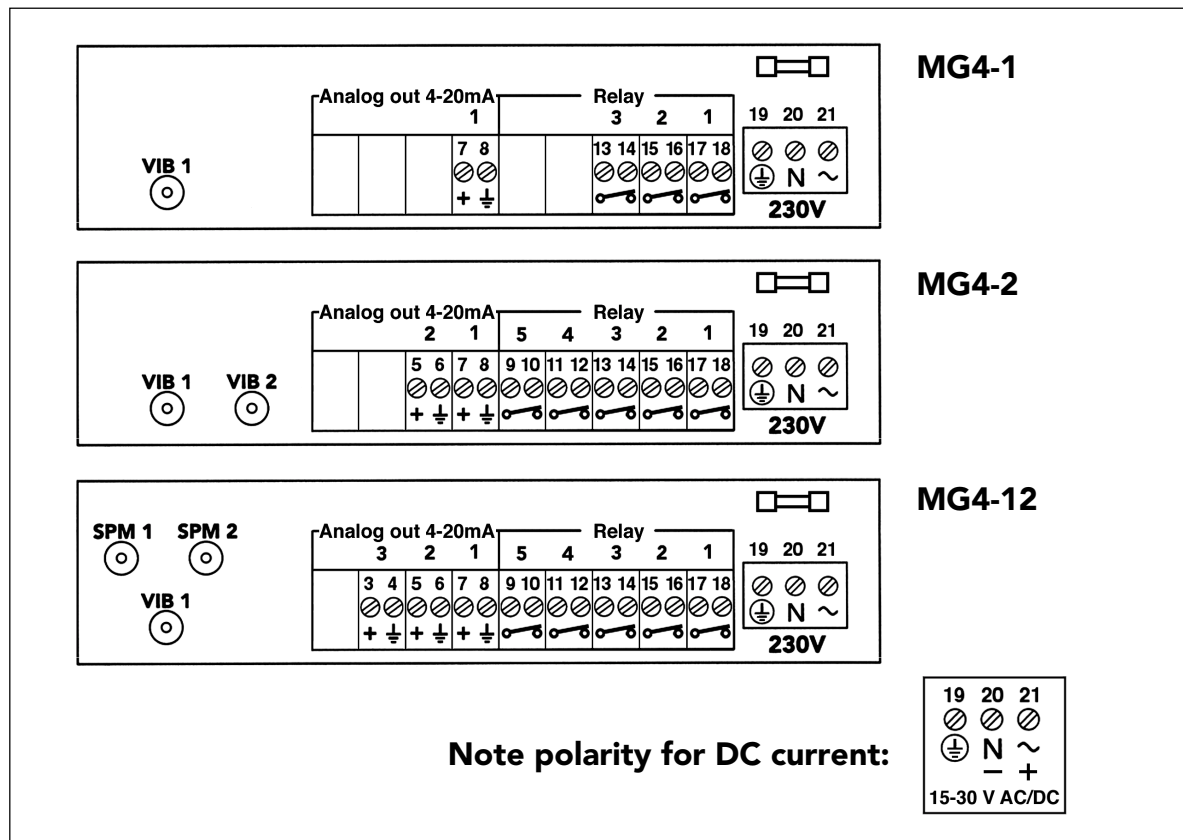
The coaxial cables from the shock pulse and vibration transducers are connected to TNC connectors on the underside of the MG-4 unit. Please note that the number of TNC connectors depends on the MG-4 version (here MG4-22, other versions see next page). The connectors for SPM are always closest to the front panel, the connectors for VIB closest to the rear side of the housing.

To connect an MG-4, remove the lower part of the front panel. The screw terminals for power supply and outgoing signals are situated beneath the lower part of the instrument panel. A label on the rear side of the cover shows the channel layout.

The supply voltage can be 230 Vac, 115 Vac, or 30 to 15 Vac/dc. Note that the power connection is labelled with the factory set supply voltage for the unit. The fuse is a slow glass tube fuse rated T50mAL250V. The cable inlets are tight for cable diameters 5.5 to 10 mm.

The relay specifications are 250 Vac / 5 A / 1250 VA for the main relay (Relay 1, connectors 17/18). The number of secondary relays, specified 125 Vac / 1 A / 60 VA (150 Vdc / 1 A / 30 W), depends on the MG-4 version. MG4-1 has two, the other versions have four such relays as standard equipment. As default, the relays are NC = normally closed and open on alarm or power failure. You can change that to NO = normally open when programming the unit, see page 11.





## Terminal configurations

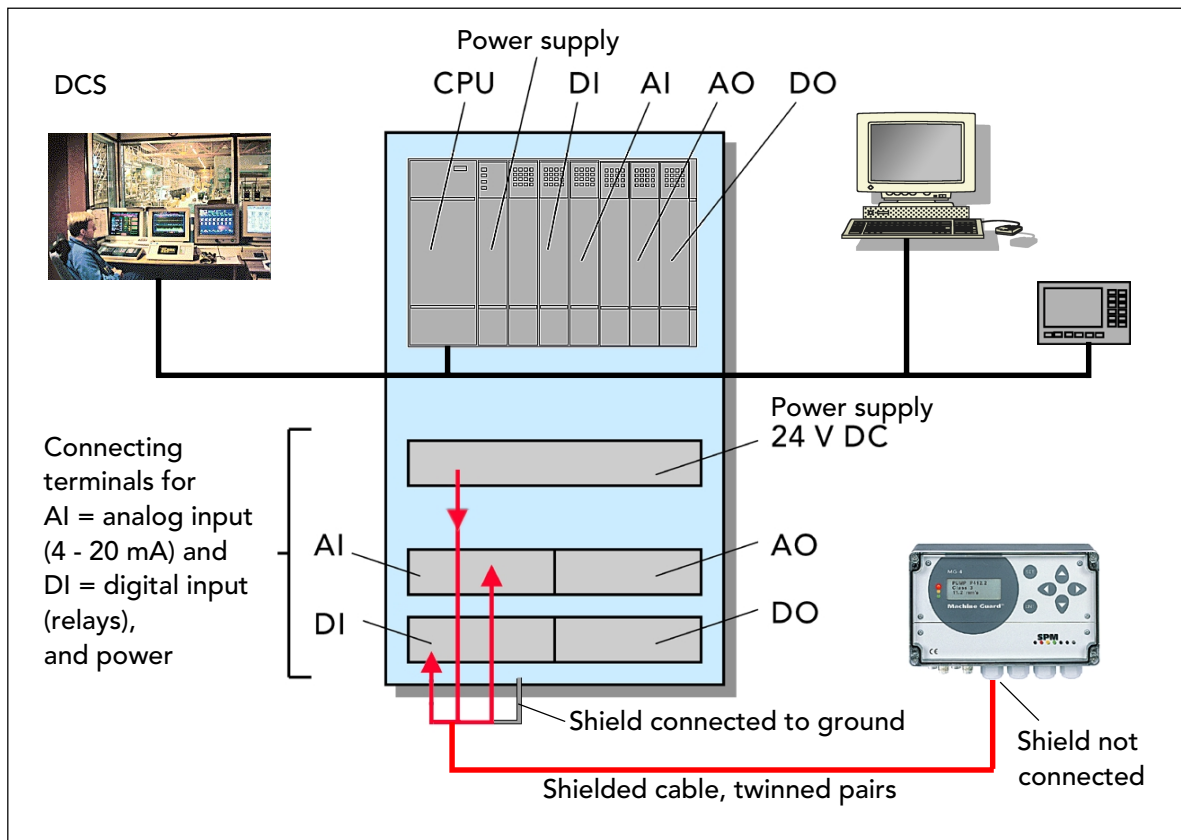
The number of input channels, analog output channels and relays depends on the MG4 version. The largest unit, MG-22, is shown on the previous page.

MG-4 units suitable for supply with 15 to 30 Vac/dc are marked as shown. The + terminal is numbered 21.

### Please note:

Regarding the outputs: analog output channels and relays can be linked to any of the input channels by programming the MG-4, see pages 14 to 16.

When TLT is set to ON (page 11), the MG-4 indicates TLT fault (fault on transducer line test) when the transducer is not connected or when the transducer line is not OK (open or short circuit for VIB, TLT value below 15 for SPM). This will cause the connected analog output to go to approx. 0 mA. When TLT = OFF, the analog output will go to 4 mA in case of TLT fault.

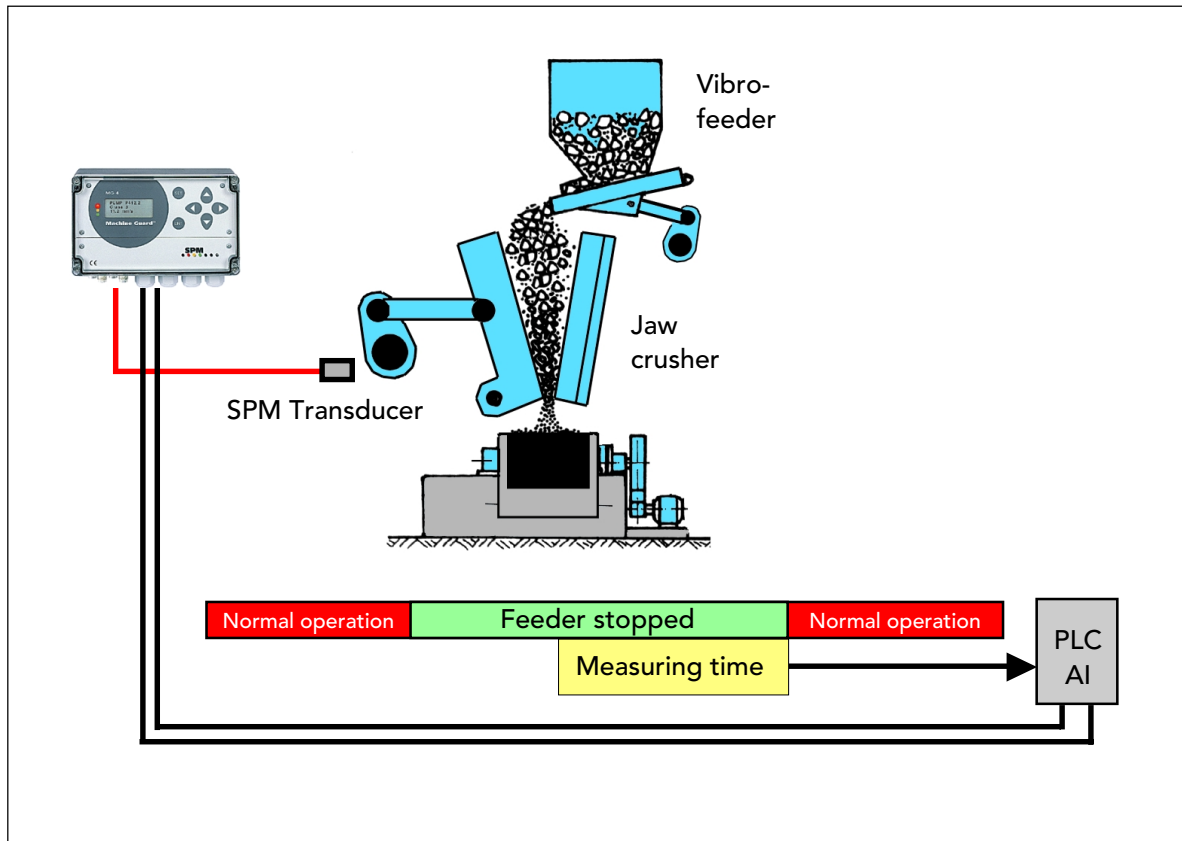


## Connection to PLC, principle

To connect an MG-4 unit to a PLC, one uses a shielded cable with twinned conductor pairs. The power supply to the MG-4, normally 24 V DC, comes from the PLC. The analog 4-20 mA outputs of the MG-4 are connected to an AI unit (analog input), the relays to a DI (digital input) unit.

The condition monitoring parameters are set up in the MG-4. Control, display and data storage are handled by the PLC.

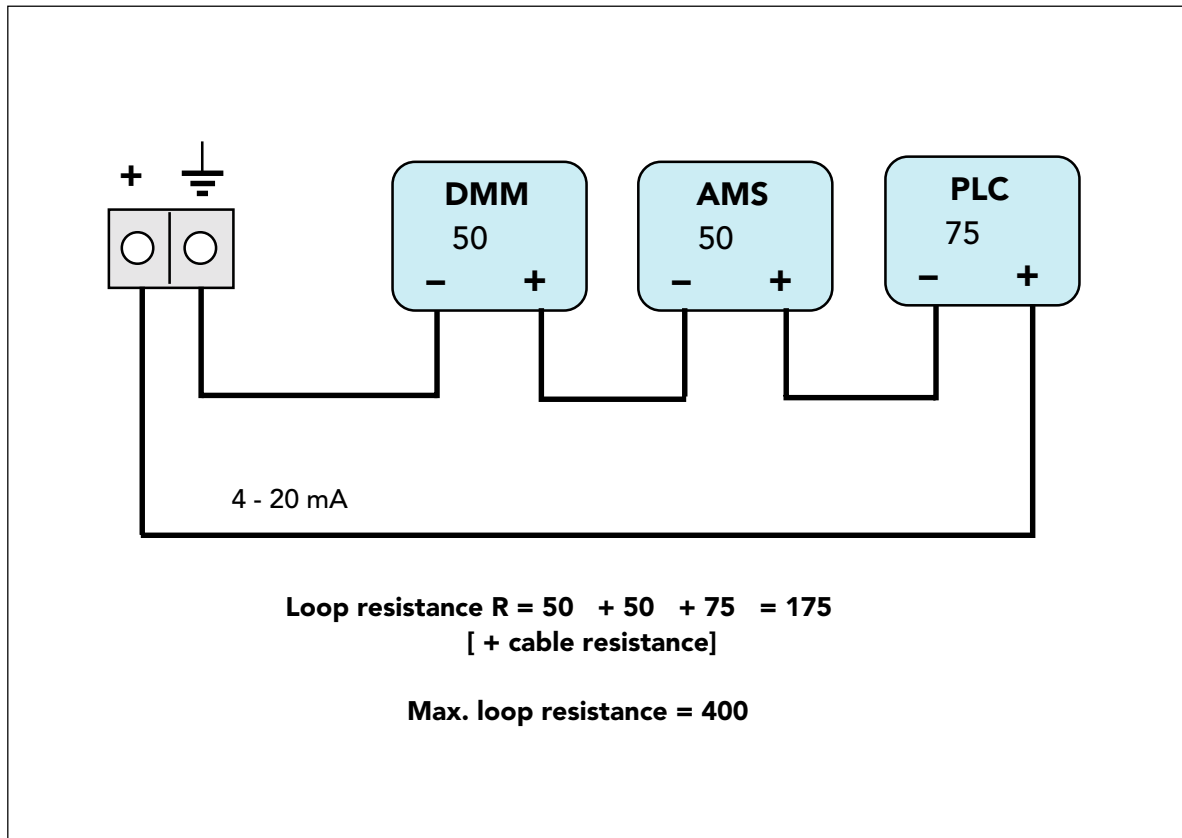
- PLC = Programmable Logic Control
- CPU = Central Processing Unit
- AI = Analog Input 4-20 mA from the MG-4
- AO = Analog Output 4-20 mA to an external display
- DI = Digital Input 0 or 24 V from a relay in the MG-4
- DO = Digital Output 0 or 24 V to an external relay
- DCS = Distributed Control System



## Measuring logic controlled by the PLC

The PLC can be used to set up a measuring logic that assures correct condition monitoring under difficult circumstances. The crusher in the example above is a 'noisy' machine. Normal operation generates interfering shock pulses which make it impossible to get correct readings from the crank shaft bearing while rock is being crushed.

After stopping the feeder and waiting until the present load is processed, the PLC reads the shock pulse values obtained while the crushers is idling. All measuring results collected by the MG-4 unit during normal crusher operation are ignored.



## Using the analog current in other devices

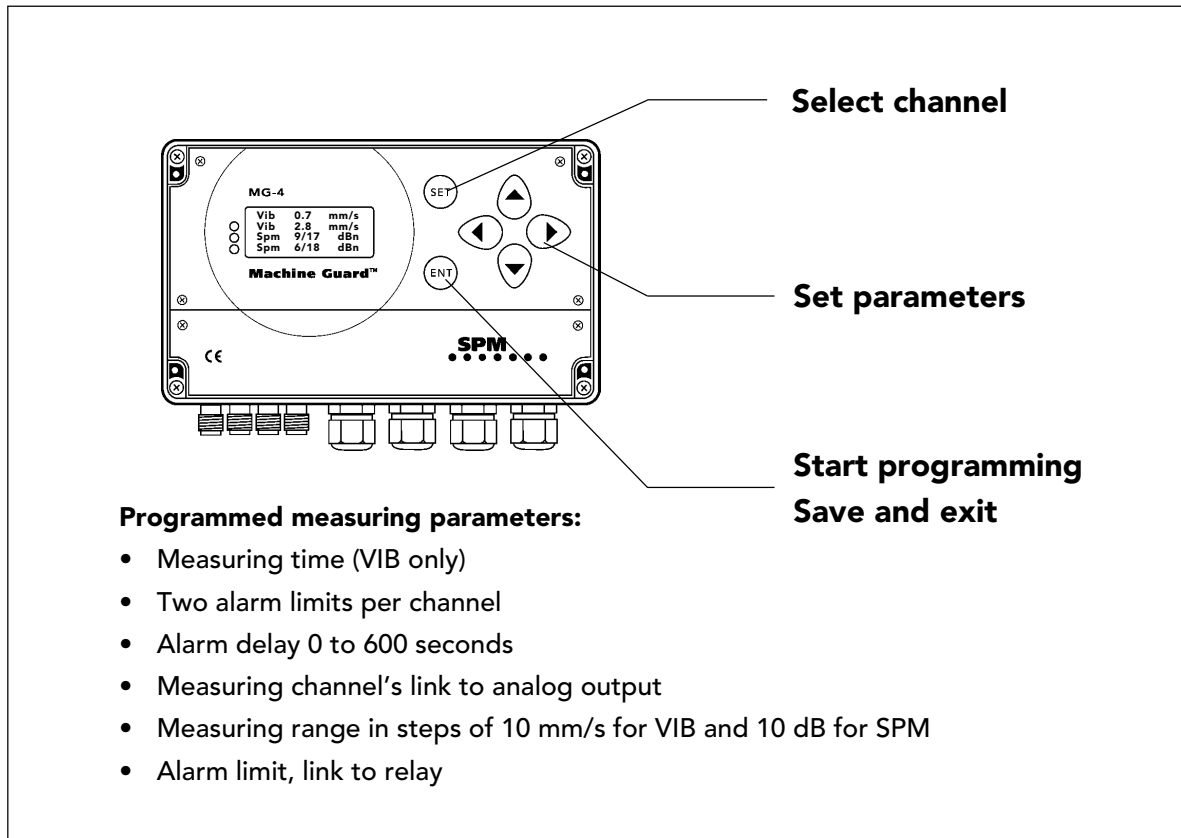
The analog output from an MG-4 can be fed to several external devices:

**DMM:** the digital display unit of the CMM System.

**AMS:** the unit for alternative measurements belonging to the CMS System. This way the measuring results can be transferred to the SPM software Condmaster®Pro.

**PLC:** Programmable Logic Control.

These devices are connected in series. The driving voltage of the analog line is about 10 V DC. This puts a limit on the number of devices and the cable length. Including cable resistance, the max. loop resistance is 400 .



## Programmed measuring parameters

The measuring and alarm parameters of an MG-4 are programmed, using the keys on the front panel. The program is password protected, which means that the password 'SPM' has to be input before any parameter can be changed.

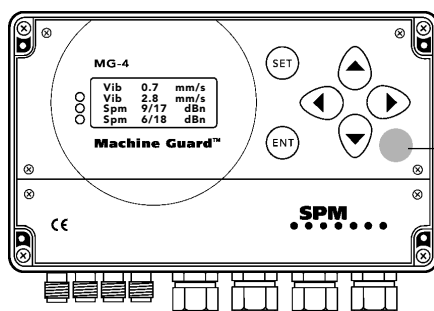
Programmed parameters are:

- Measuring time 1 to 15 seconds (VIB only)
- Two alarm limits per channel
- Alarm delay 0 to 600 seconds
- Link between the measuring channel and one of the analog output channels
- Measuring range for the analog output channel
- Link between an alarm limit and one of the relays. Several different alarms can be linked with the same relay.

The length measuring unit can be set to either mm or inch under SETUP on the VERSION menu. There you can also set TLT to OFF. TLT is the transducer line test. For VIB channels, this test checks for interruption or short circuit in the cable between vibration transducer and MG-4, or in the transducer itself.

For SPM channels, the test checks the characteristics of the whole measuring circuit and returns a TLT number which should be larger or equal to 15. On TLT fault, the analog output normally goes to approx. 0 mA. Setting TLT to OFF prevents the analog output from dropping below 4 mA. Yellow system alarm will not be shown, but the relay, if linked, will still react to the system alarm.





**Invisible RESET  
button**

#### Reset to default values:

- Hold down the invisible RESET button and press SET to restore default parameters

## Reset default parameters

An unmarked button is located in the space below the RIGHT and to the right of the DOWN button. Pressing SET while holding down this invisible RESET button restores the default parameters. The message "Def. init." (default initiation) is displayed while the reset takes place. These are the default settings:

#### General:

Password ..... ON  
 Measuring ..... ON  
 TLT ..... ON  
 Relays ..... NC  
 Channel to relay ..... none  
 Channel to analog out .... none  
 Alarm delay ..... none

#### VIB channel:

Name ..... VIB channel 1 (2)  
 Machine class ..... 1  
 Transducer sensitivity ..... nominal  
 Measuring time ..... 2 seconds  
 Alarm limit A1 ..... 1.9 mm/s  
 Alarm limit A2 ..... 4.6 mm/s  
 Range for 4 - 20 mA ..... 0 to 50 mm/s

#### SPM channel:

Name ..... SPM channel 3 (4)  
 Measuring time ..... 2 seconds  
 Alarm limit A1 ..... 21 dBsv  
 Alarm limit A2 ..... 35 dBsv  
 Alarm limit TLT ..... 15  
 Range for 4 - 20 mA ..... 0 to 90 dBsv  
 Bearing speed RPM ..... --  
 Bearing diameter dmm ... --

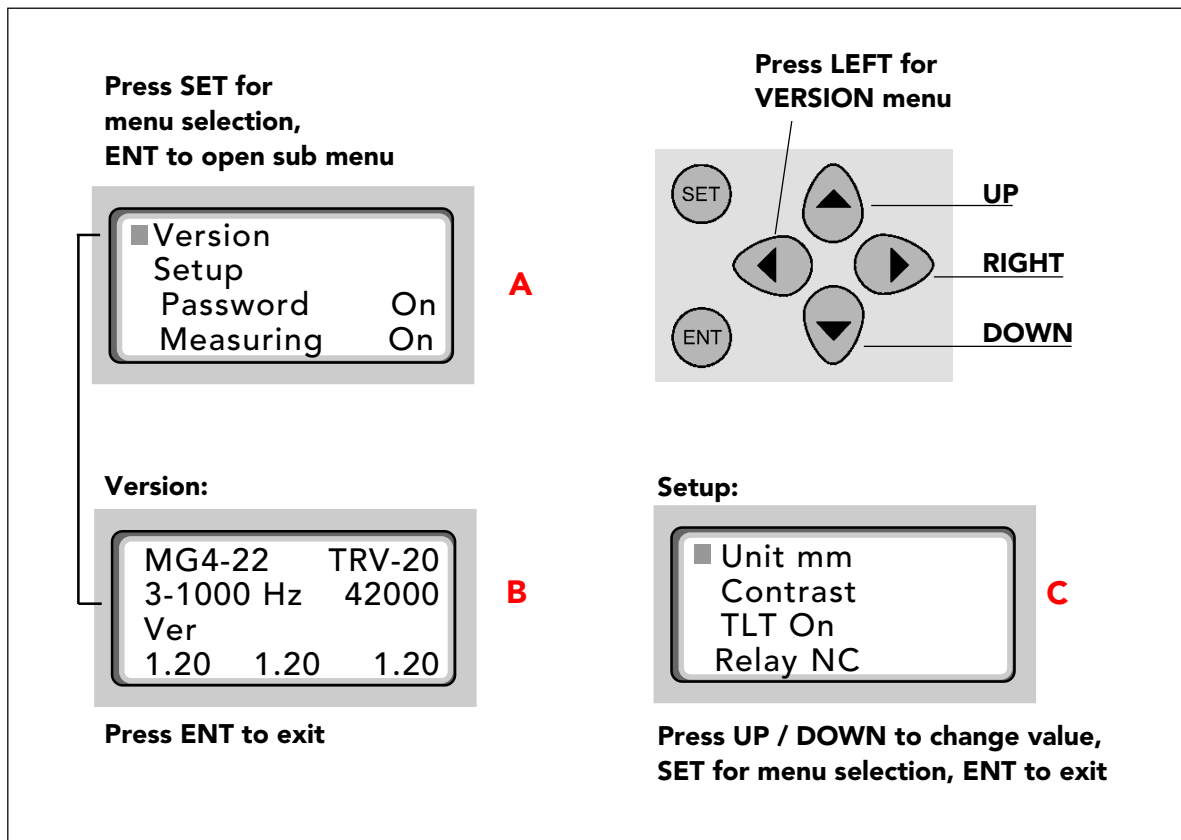
#### dBm/dBc technique

Initial value dBi ..... 0

#### LR/HR technique:

NORM number ..... --  
 TYPE number ..... 1  
 Acc (accunulation) ..... 1  
 COMP number ..... --





## The VERSION menu, version and setup

The VERSION menu shows the basic setup of the MG-4 unit, which is permanently programmed and cannot be changed, and also a number of general settings which can be changed with the function keys on the front panel.

To reach the menu (A), press the LEFT key. With SET you move the cursor to one of the four headers. Press ENT to open the first one, VERSION (B). This shows the MG-4 version, the vibration transducer type, the vibration measuring range and the shock pulse transducer type. On line 4 you see the version numbers of the three processors CPU, VIB, and SPM. None of these settings can be changed. Press ENT to exit to the VERSION menu.

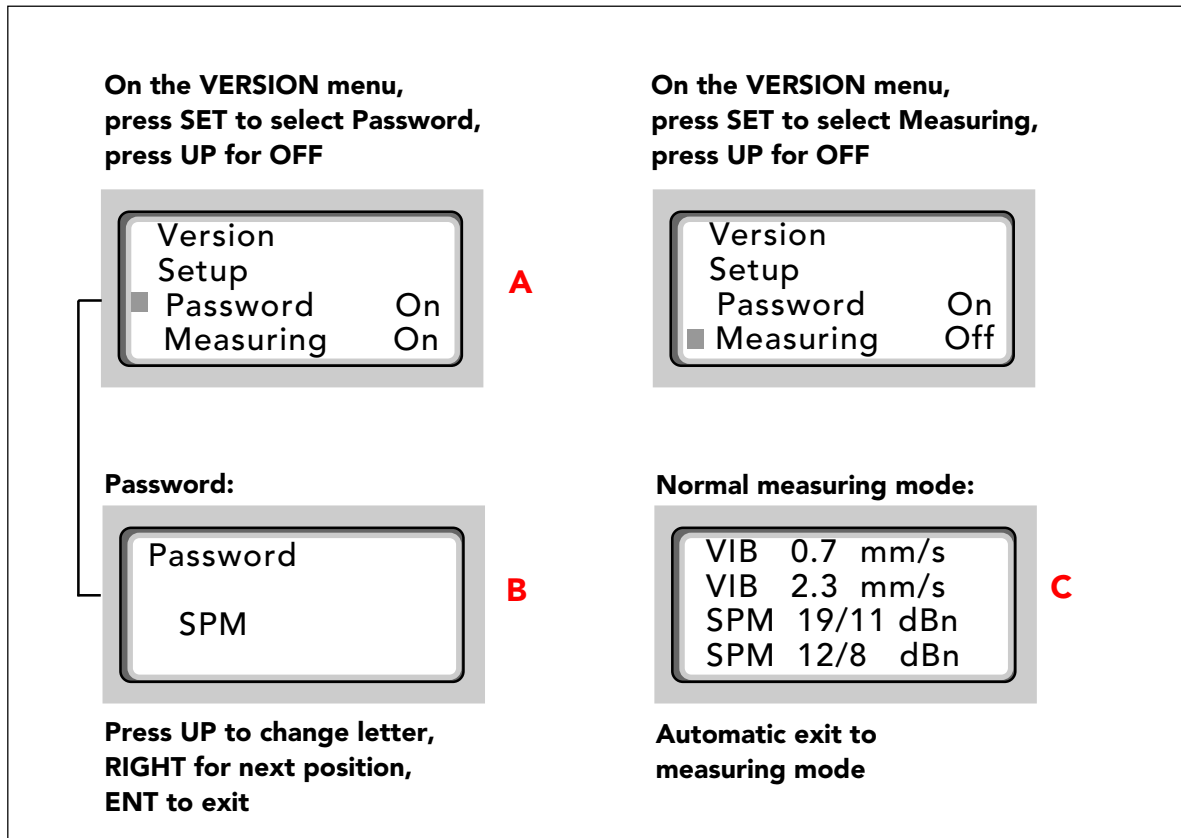
The menu under SETUP (C) allows you to make changes. Use SET to go to the setting to be changed. The UP or the DOWN key toggles between the length measuring units mm and inch. This setting affects the vibration velocity reading (mm/s or inch/s) and the input value for shaft diameter (SPM measurement). Set or measured values are automatically recalculated when the unit is changed.

Contrast means display contrast, changed with UP and DOWN. You can see the change when repeatedly pressing one of these keys.

The TLT function is toggled ON/OFF with the UP or DOWN key. TLT = OFF means that a transducer line fault will not let the output analog current drop below 4 mA. The yellow status light will not be shown, but if a relay is linked to the TLT fault, it will be triggered. You can check the nature of the TLT fault by selecting the channel with SET and pressing ENT. The TLT status is shown on the first menu.

Relay NC (normally closed) can be toggled to Relay NO (normally open). This setting affects all relays.





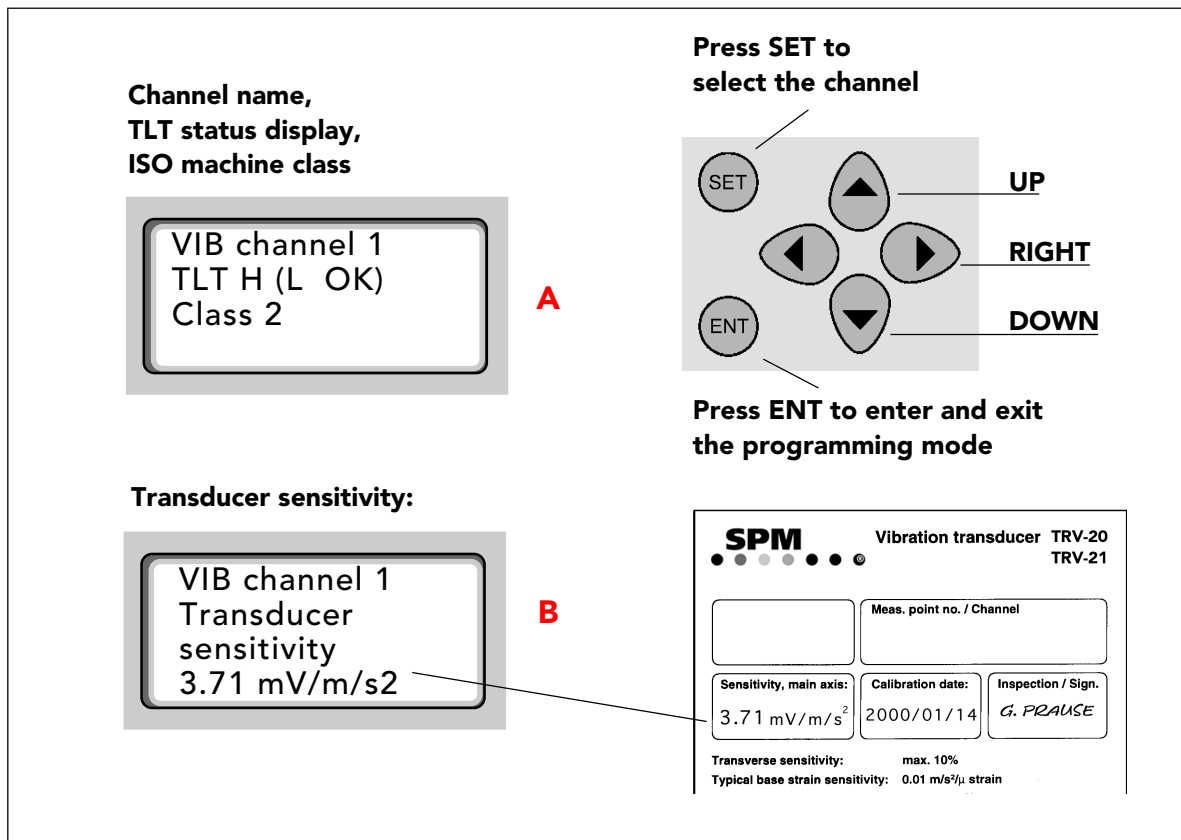
## The VERSION menu, password and stand-by

The measuring channel configuration is protected by the password 'SPM'. While Password = ON is shown on the VERSION menu (A), you can enter the channel programming mode and check all settings, but you cannot make any changes (the UP/DOWN keys are locked). On the VERSION menu, you can select PASSWORD with SET, then change to OFF with UP or DOWN. This will open the password menu (B), with the cursor on the first of three positions marked \* \* \*. Press and hold down UP until the first position reads 'S'. Step to the next position with RIGHT, use UP to set the letter 'P'. Step to the next position with RIGHT, use UP to set the letter 'M'. You can also use the DOWN key to change letters, and go to the previous position with LEFT. With ENT you exit to the VERSION menu. If you have set 'S P M', the password will now be OFF, else it is still ON and you cannot program channels. Please note: Reset the password to ON once you have finished programming.

Measuring = OFF means that the analog and relay outputs are frozen (stand-by mode). This setting is selected before disconnecting any of the VIB or SPM input channels, else disconnecting a transducer will cause a system fault alarm.

When no keys are pressed, the unit will automatically return from the VERSION menu to the normal measuring result display (C) after 30 seconds. You can also exit with LEFT or RIGHT. Please note that selecting the VERSION menu or the programming mode has the same "freezing" effect as setting the measuring mode to off, and that normal operation is resumed as soon as you return, intentionally or automatically, to the measuring result display.





## Programming a vibration channel

To enter the programming mode for a channel, select the channel with the SET key (moves the cursor at the beginning of line 1 to the next line), then press ENT. You get a sequence of programming menus.

The cursor will jump to the next position which can be changed whenever you press the SET key. In each programmable position, the keys UP and DOWN will alter the value. When a programmable parameter consists of several positions, e.g. a three digit number, you go to the next position with RIGHT, or to the previous position with LEFT.

The first line contains the channel name. This can be changed, one position at a time. The new channel name is also shown on the following programming menus.

TLT (line 2 on menu A) means transducer line test and shows the transducer line quality. For a VIB channel it can be OK (no fault), H = high (interrupted circuit) or L = low (short circuit).

Line 3 on menu (A) contains a parameter, the ISO machine class number. Setting one of the numbers 1 to 6 will automatically set the upper limit for "acceptable" vibration as alarm level A1 (yellow alarm) and lower limit for "unacceptable" vibration as alarm level A2 (red alarm). Please compare the table on page 12. The setting " - " means no machine class and requires a manual entry of the alarm limits on a later menu. Changing the alarm limits on that menu removes the machine class information on menu (A).

On menu (B), the variable parameter is the transducer sensitivity value. Enter the value from the transducer's calibration card.

<p><b>Measuring time:</b></p> <div style="border: 1px solid black; padding: 5px; width: fit-content; margin: 10px auto;"> VIB channel 1  Measuring  time 2 s </div> <p style="text-align: right; color: red; font-weight: bold;">C</p>	<p><b>Output channel, range:</b></p> <div style="border: 1px solid black; padding: 5px; width: fit-content; margin: 10px auto;"> VIB channel 1  Analog out 3    20mA = 50.0 mm/s </div> <p style="text-align: right; color: red; font-weight: bold;">E</p>
<p><b>Link to relay, alarm:</b></p> <div style="border: 1px solid black; padding: 5px; width: fit-content; margin: 10px auto;"> VIB channel 1  TLTA Relay 1  A1 2.9 Relay 1  A2 7.2 Relay 2 </div> <p style="text-align: right; color: red; font-weight: bold;">D</p>	<p><b>Alarm delay:</b></p> <div style="border: 1px solid black; padding: 5px; width: fit-content; margin: 10px auto;"> VIB channel 1  Alarm  delay 600 s </div> <p style="text-align: right; color: red; font-weight: bold;">F</p> <p><b>Press ENT to exit to the measuring mode</b></p>

## Programming a vibration channel

The default setting for the vibration measuring time (C) is 2 seconds. The time can be set to max. 15 seconds.

On the menu (D) you see the alarm limits A1 (yellow alarm) and A2 (red alarm) corresponding to the selected ISO machine class number (see previous page). Changing the alarm limits menu removes the machine class information on (A).

System alarm (TLTA) and the two alarm limits A1 and A2 can be linked to any of the available relays by setting the relay number 1 to max. 5. Each relay can be linked to more than one alarm cause. The setting " - " means no link to a relay.

On the menu (E) you set the link to an analog output channel for the 4 - 20 mA signal by setting a channel number from 1 to max. 4. The analog line can not, of course, be linked to more than one measuring channel. When stepping with UP or DOWN, only free channel numbers are displayed. Because each SPM measurement returns two values, you can have more signals than analog channels. In case all channels are occupied, you have to break the previous links before you can assign a different signal to the analog channel.

On this menu, you also set the measuring range to max. 10, 20, 30, 40, or 50 mm/s RMS. The analog current will be scaled accordingly, max. vibration value = 20 mA out.

Alarm delay is set in steps of 2 seconds by stepping to a number above 0 on menu (F). The maximum is 600 seconds or 10 minutes.

<b>Name, initial value:</b> <div style="border: 1px solid black; padding: 5px; margin: 5px;"> SPM channel 3  TLT 20 rpm -  dBi 24 dmm - </div> <b>A</b>	<b>Analog output channel, range:</b> <div style="border: 1px solid black; padding: 5px; margin: 5px;"> SPM channel 3  Analog out 3 dBm  Analog out 4 dBc  20mA = 90 dBn </div> <b>C</b>
<b>Alarms, links to relays:</b> <div style="border: 1px solid black; padding: 5px; margin: 5px;"> SPM channel 3  TLTA 15 Relay 1  A1 dBm 21 Relay 1  A2 dBm 35 Relay 2 </div> <b>B</b>	<b>Alarm delay:</b> <div style="border: 1px solid black; padding: 5px; margin: 5px;"> SPM channel 3  Alarm  delay 60 s </div> <b>D</b>

**Initial value dBi =**  
**20 (log rpm + 0.6 log diameter – log 2150)**

**Press ENT to exit to the measuring mode**

## Programming a shock pulse channel for dBm/dBc

Select the SPM channel with the SET key and press ENT to get the sequence of programming menus. As for VIB, you move the cursor with SET, alter values with UP and DOWN, and select positions with RIGHT and LEFT. The first line contains the channel name, which can be changed.

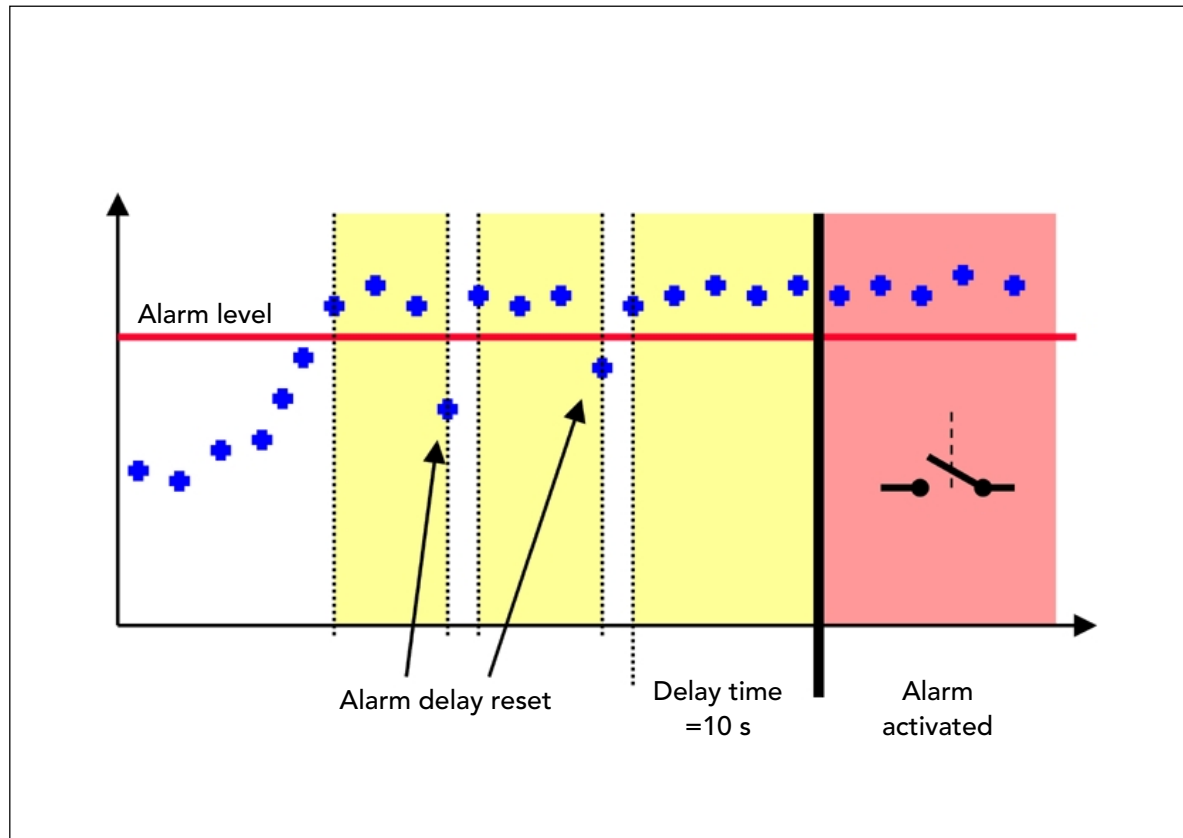
"TLT" on line 2 of menu (A) shows the transducer line status. For an SPM channel it is a number expressing the quality of the measuring circuit. Normal values are around 20, the lowest acceptable value is 15. TLT values below 15 invalidates the SPM condition evaluation because the input signal quality is poor.

"dBi" on line 3 of menu (A) is the initial value of the bearing, needed for the condition evaluation. You either input a value for dBi or you input a value each for the "rpm" (shaft speed in revolutions per minute) and for "dmm" (shaft diameter in mm, reads "din" when inch is the selected unit).

On the menu (B) you can change the value for TLTA (15 = transducer line alarm) and the two standard alarm limits A1 (21) and A2 (35). Normally, both limits are on the maximum value dBm (can be changed to carpet value dBc). A1 and A2 trigger the relays but do not change the evaluation in green, yellow and red indicated by the status LED display. System alarm (TLTA) and the two alarm limits A1 and A2 can be linked to any of the available relays by setting the relay number 1 to max. 5. A relay can be linked to more than one alarm cause. The setting " - " means no link to a relay.

On the menu (C) you set the link to an analog output channel for the 4 - 20 mA signal by setting a channel number from 1 to max. 4. Bearing monitoring returns two values, maximum value dBm (your normal choice for the analog output) and carpet value dBc. The analog line can not, of course, be linked to more than one measuring channel. Only free channel numbers are displayed. You also set the measuring range to between max. 10 and max. 90 dB. The analog current will be scaled accordingly, max. dBn value = 20 mA out.

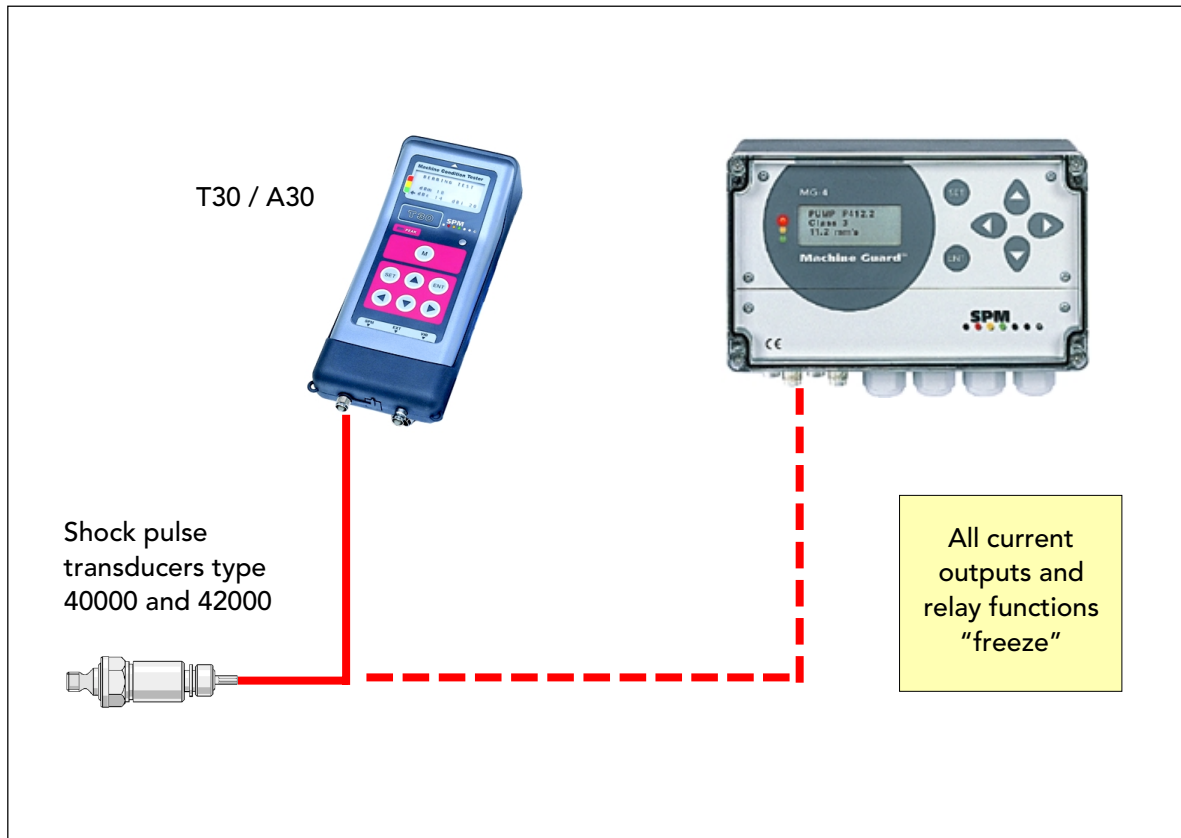
Alarm delay is set in steps of 2 seconds by stepping to a number above 0 on menu (F). The maximum is 600 seconds or 10 minutes.



## The effect of alarm delay

Alarm delay is set in steps of 2 seconds, to max. 600 seconds = 10 minutes. During the delay time, the measured value has to be constantly above the alarm level, else the delay is interrupted and measurement continued without triggering a relay or changing the status light. First after a full delay period the relay is triggered.

Alarm is reset automatically when the alarm condition (high measured value) is terminated. There is no manual reset.



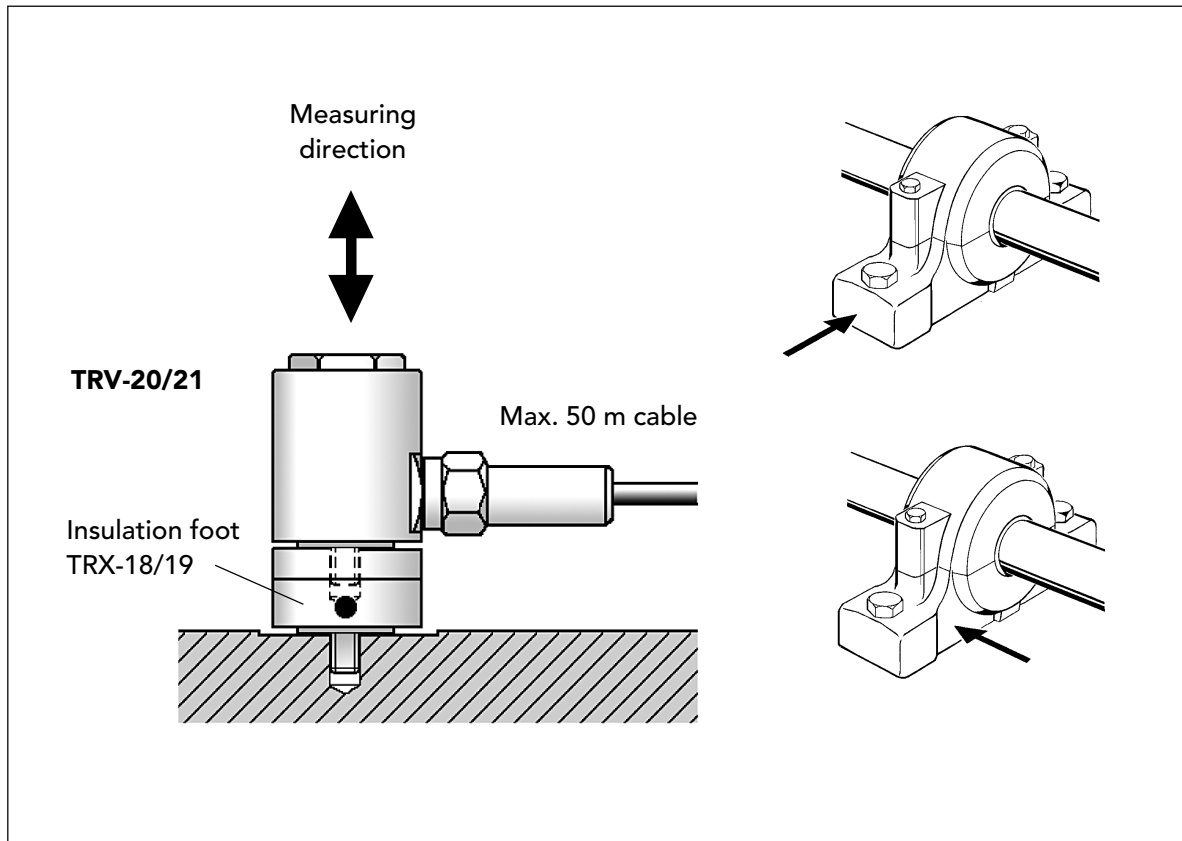
## Stand-by mode

On the setup menu, one can select MEASURING OFF, a mode which freezes analog and relay outputs. Thus, there is no TLT alarm when an incoming signal line is disconnected. The transducer cable can then be connected to a hand-held instrument.

For the SPM measurement, the instruments T30/A30 accept both transducer types, 40000 (plus TMU) and 42000. The vibration transducers of type TRV-20/21 or TRV-18/19 normally chosen with an MG-4 are not compatible with the hand-held instruments.

The instruments T30/A30 have a recording function, allowing the recording of a programmed number of shock pulse measurements. They also download into Condmaster®Pro, SPM's software for condition monitoring. If desired, an MG-4 unit can be integrated as a "measuring terminal" into a condition monitoring system with advanced computer controlled evaluation functions.





## Vibration transducers

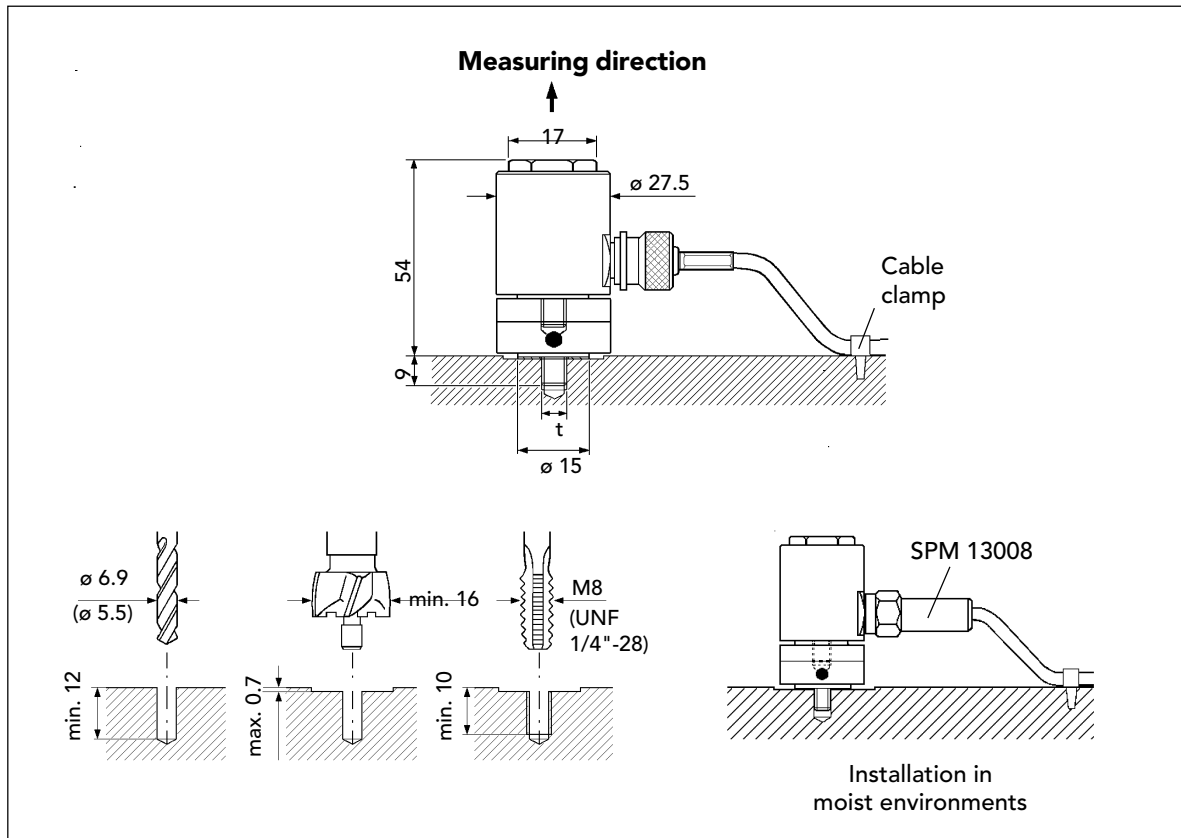
The transducer TRV-20/21 (linear frequency range 2 to 5000 Hz) is a piezoelectric accelerometer of compression type. It has a built-in pre-amplifier and is power supplied (10 Vdc) from the measuring unit. This allows the detection of a short or open circuit in the transducer line. The cable length between transducer and measuring unit is max. 50 m (165 ft.).

The nominal transducer output for TRV-20/21 is 4.0 mV per  $\text{m/s}^2$ . The MG-4 unit is factory adapted for this transducer type, so in case of a transducer replacement, the same type must be used. The actual transducer output is printed on the transducer's calibration card. This value is input as part of the measuring channel configuration.

The transducer is mounted against a smooth, flat surface on the machine. TRV-20 has thread size M8, while TRV-21 has thread size UNF 1/4"-28. The transducers are delivered with three washers for adjusting the connector angle. Each washer turns the transducer 90°. The coaxial cable (SPM 90005-L or 90267-L) with TNC connector must be secured with a clamp close to the transducer. In moist environments, use sealing TNC cable connectors SPM 13008 to prevent cable corrosion.

As a rule, an insulation foot, either TRX-18 for M8 or TRX-19 for UNF 1/4"-28, should be used to provide electric insulation. The reason is that differences in earth potential between transducer and MG-4 can cause measuring faults. Note, however, that the installation foot limits the linear range of the transducer to 2000 Hz.

The temperature range for TRV-20/21 is -20 to +125 °C (4 to +260 °F). The coaxial cable SPM 90005-L is specified -20 to +70 °C (-4 to +158 °F). The cable SPM 90267-L is specified -40 to +125 °C (-40 to +260 °F).

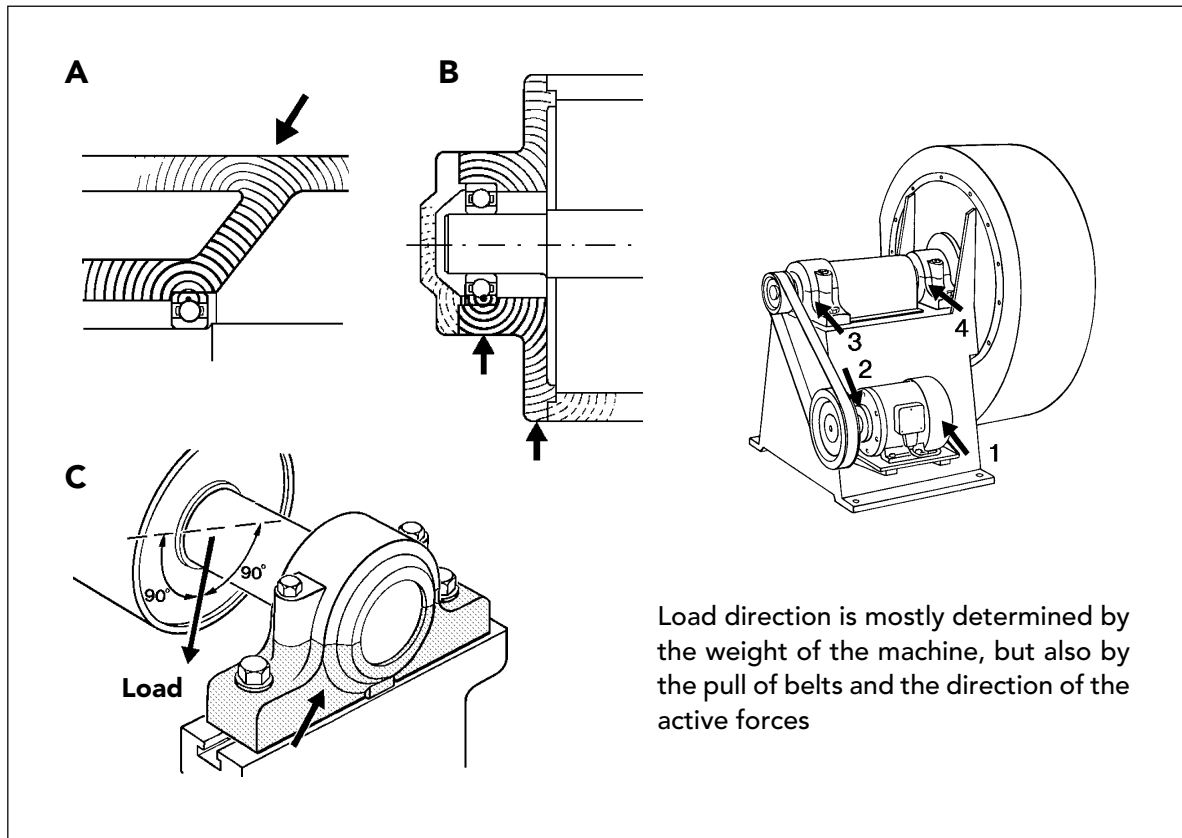


## Vibration transducer installation

The transducer is mounted on the machine against a smooth, flat surface. M8 and UNF 1/4"-28 are the threads on the TRV transducers. The transducer is supplied with three washers, each of which changes the output direction 90°. The coaxial cable must be clamped close to the transducer. Cable plug SPM 13008 should be used for installations in moist environments.

As a rule, an insulation foot, either TRX-18 for M8 or TRX-19 for UNF 1/4"-28, should be used to provide electric insulation. The reason is that differences in earth potential between transducer and MG-4 can cause measuring faults. Note, however, that the installation foot limits the linear range of the transducer to 2000 Hz.

Flat-face mill the surface to a depth of max. 0.7 mm. To drill the mounting hole, use drill bit 6.9 mm for M8 and 5.5 mm for UNF 1/4". Torque and unscrew the transducer with a torque wrench and a 17 mm socket (SPM 81092). The torque is 10 Nm.



## Selection of SPM measuring point

To assure a correct signal transmission, measuring points must be selected according to the following rules:

- A The signal path between bearing and measuring point shall be as straight and short as possible.**
- B The signal path must contain only one mechanical interface, that between the bearing and the bearing housing.**
- C The measuring point shall be located within the load zone of the bearing.**

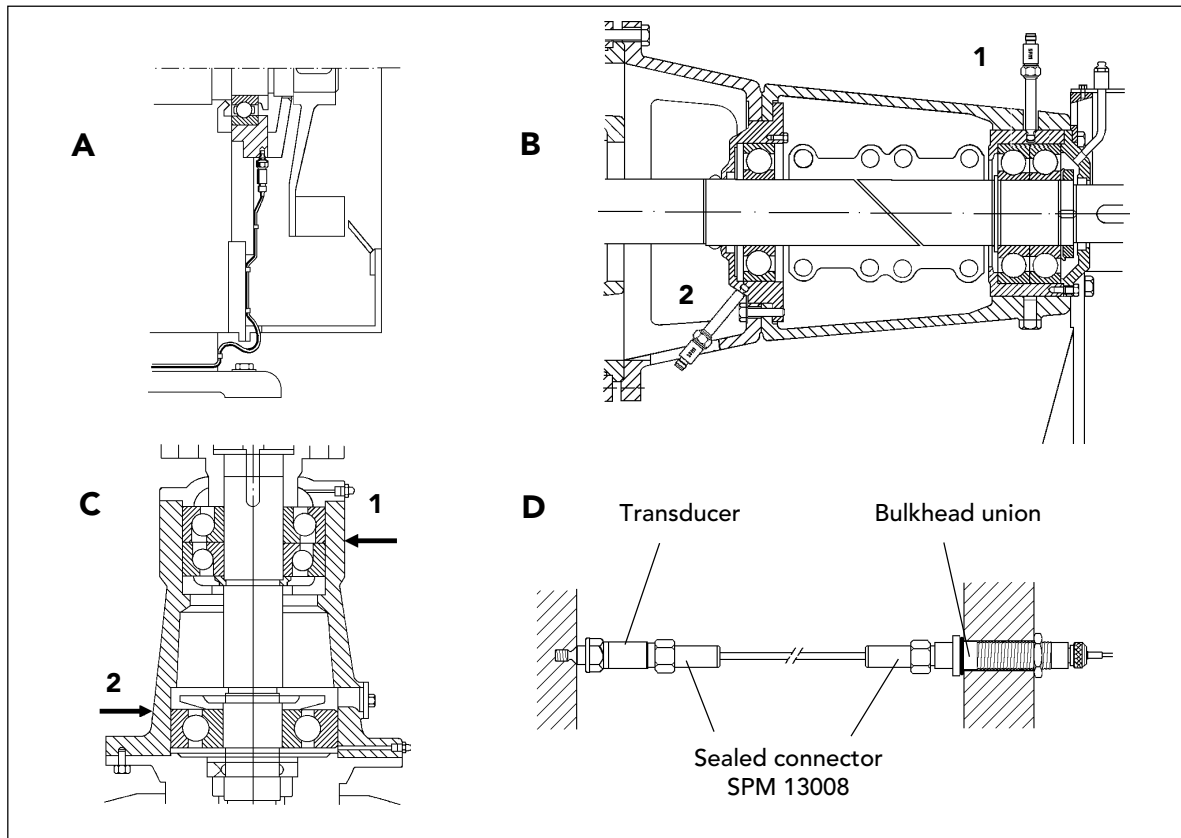
SPM's evaluation rules and the condition scale are not valid if a measuring point does not conform with these rules. However, a measuring point that comes at least close to the requirements will yield consistent if somewhat low readings. One can compensate for this by setting lower limit values for bad condition, and by following the development trend of the readings. The signal losses in the two unavoidable interfaces (bearing – bearing housing and housing – adapter) have been taken into account in SPM's evaluation of bearing condition.

The load zone is defined as the load carrying part of the bearing housing. It is normally determined by the weight of the supported machine part, i.e. the load is mostly on the lower half of the bearing housing. Consider also the direction of the force acting on the shaft when the machine is running. Thus, on the fan shown here, the belt tension determines the load on three of the bearings. The fan shaft in point 3 is pulled down towards the motor. The drive end of the motor shaft is pulled up towards the fan (2), the non-drive end is pressed down and away from the fan. The arrows show the correct measuring points.

Whenever possible, use a hand-held shock pulse meter with a probe to find the spot on the bearing housing where the signal is strongest. If there are several points yielding the same signal, select the point where it is easiest to install the transducer.







## Examples of SPM measuring point

It is extremely important to mount the transducer on the bearing housing, because each interface dampens the shock signal. The damping effect, and thus its result on the condition evaluation of the bearing, cannot be measured. A correct selection of the measuring point and a correct transducer installation is the only way to assure accurate results. Consult machine drawings and identify the bearing housing before selecting a measuring point. Use sealed connectors in moist environments, because cable corrosion results in signal loss.

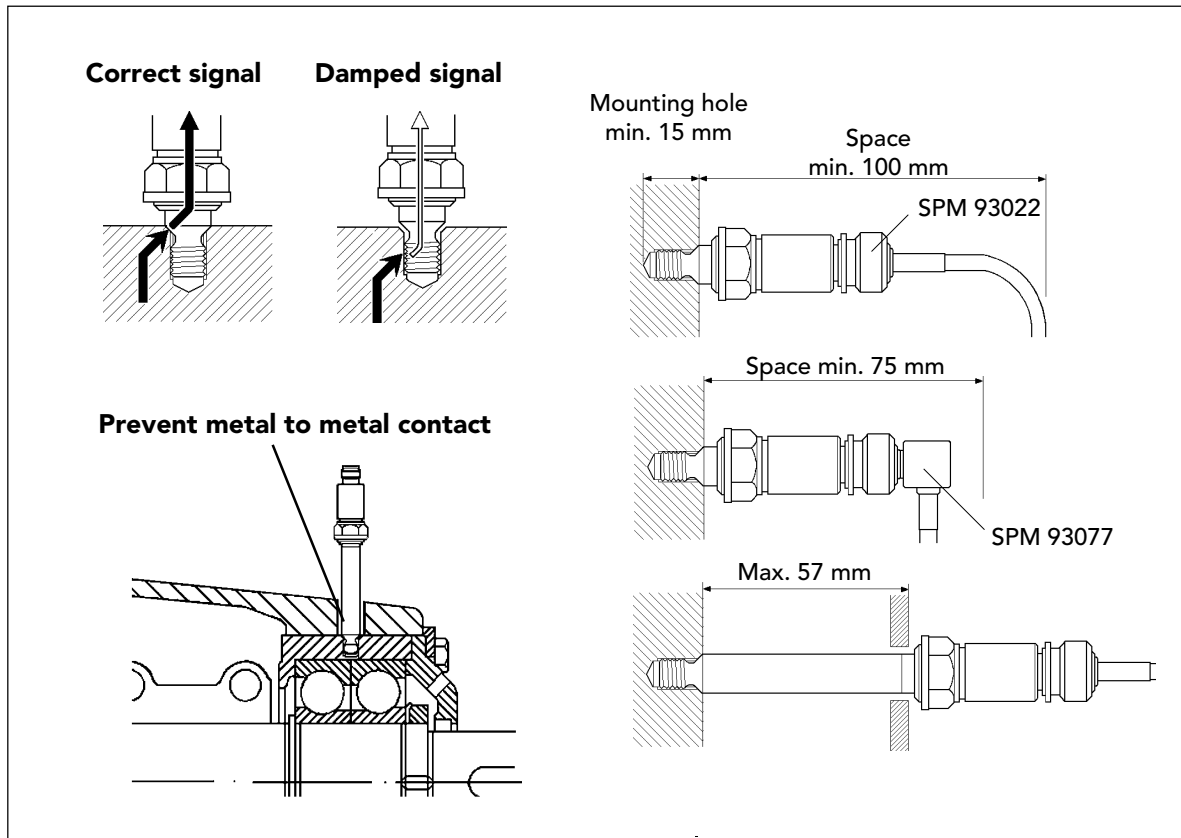
In figure A, showing part of a large electric motor, the load direction makes it necessary to install the transducer below the shaft. On many electric motors, the bearing housing is behind a fan cover. It can be reached with an extended transducer, through a hole in the cover. Only the transducer seat surface (and the threads, of course) must have metallic contact with the machine. Prevent any other transducer part from knocking against hard objects by using damping material.

In figure B, the bearings are placed in two separate housings inside the bearing bracket. Measuring point 2, placed below and opposite to the pump outlet (load direction!) can be reached with a long transducer through an opening in the pump shield. The bearing pair at point 1 can be reached with a long transducer through a clearance hole in the bracket. The hole must be large enough to allow bearing adjustment and still prevent metallic contact between bracket and transducer.

If there are several bearings in the same housing, they are normally treated as a single bearing. Figure C shows the bearing arrangement for a vertical pump. It is not possible to distinguish between the shock pulses from the paired bearings in point 1. There is also a risk for cross talk between point 1 and point 2, which means that the shock pulses from the bearing in worst condition are picked up in both points. If possible, check signal strength with a shock pulse meter. Use one measuring point only if readings are identical in both points.

In moist environments, use cables with sealed connectors (D).





## Installation of shock pulse transducers

Transducers and measuring cables should be installed in such a way that they do not hinder the normal operation or the general activities around the machine. Correct installation is very important because it influences the strength of the shock signal and thus the evaluation of bearing condition.

The shock pulse transducer is installed on the bearing housing, in a threaded, countersunk mounting hole. Standard thread size is M8, with UNC 5/16" as an alternative. Via a coaxial cable with TNC connector, the transducer is connected to the MG-4. In moist environments, a sealing TNC connector SPM 13008 must be used. An angle connector is used in narrow spaces. With the extended transducer one can reach bearing housings below protecting covers, etc.

### Operations

- Selection of measuring point
- Drilling, countersinking, threading and clearing of the mounting hole
- Torquing with torque wrench
- Connection of cable.

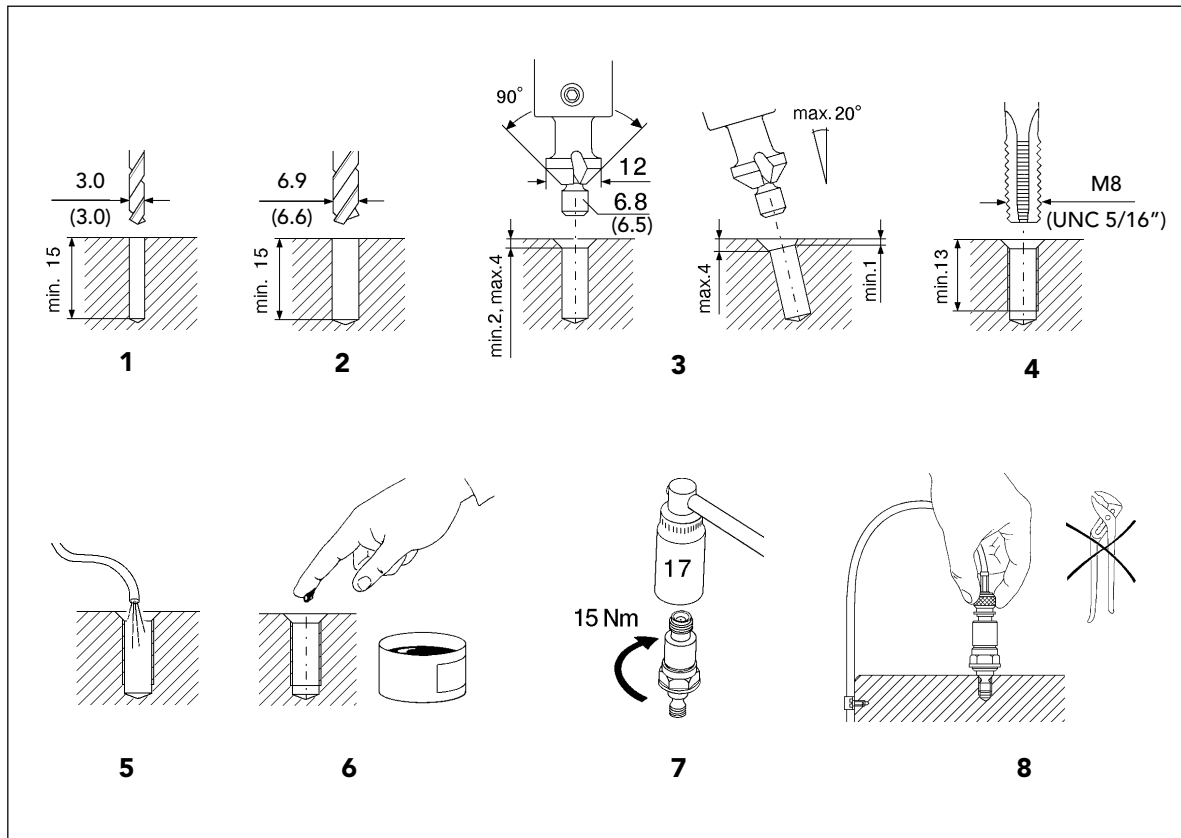
### Special tools

- Countersink with 90° angle, diameter 12 mm, and pilot 6.8 (6.5) mm
- Drill bits 2.75, 3.0, and 6.9 (6.6) mm
- Torque wrench with a long 17 mm socket.

### Installation material

- Clean grease
- Cable clamps for 5 mm cable
- Self-threading screws M3
- As needed, elastic sealing material for through holes.





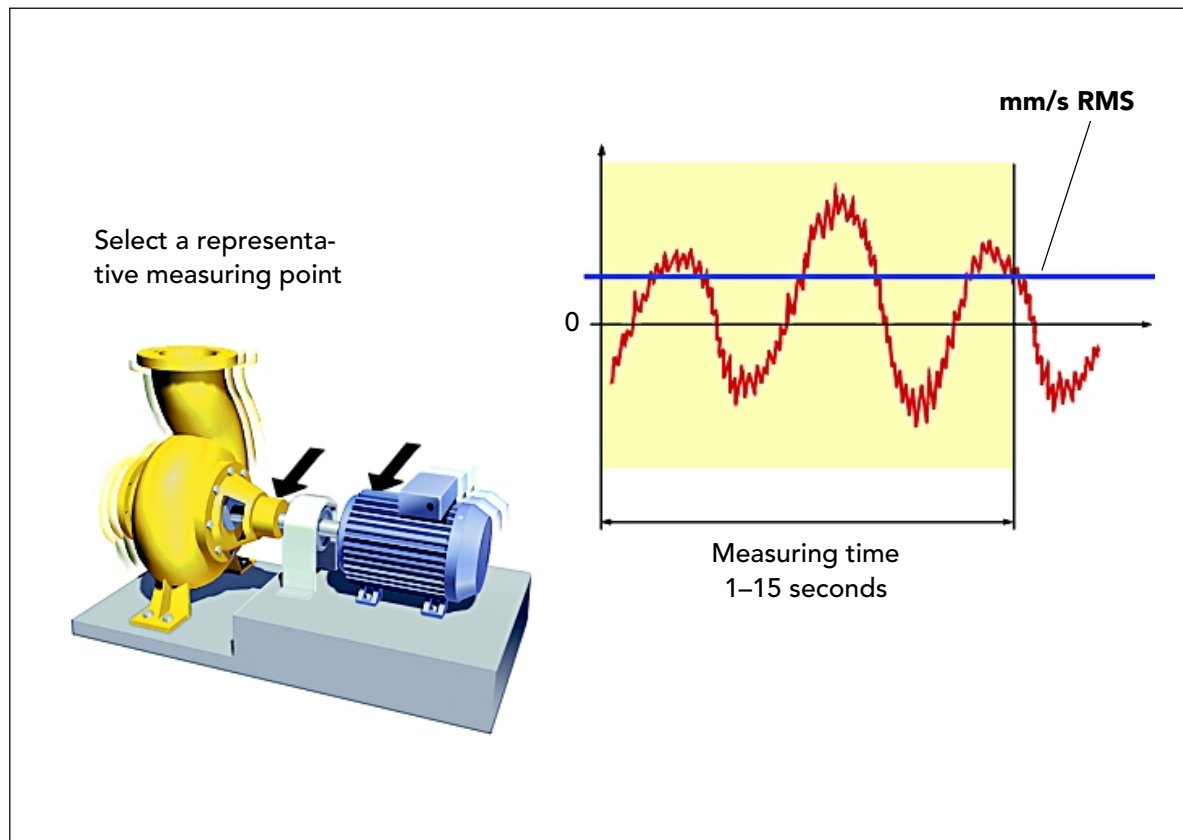
## Installation of shock pulse transducers

An SPM installation is useless if signal strength is lost through incorrect transducer installation. The transducer's conical seat surface must have firm contact with the material of the bearing housing. Drill and thread to the required depth, and torque correctly. Try to point the transducer straight at the bearing.

The installation is made as follows:

- 1 Drill a pilot hole with a 3.0 mm drill bit, depth 15 mm. With a 15 mm hole, you will stay within tolerances if you countersink and thread as deep as the tools will go.
- 2 Enlarge the hole with a 6.9 mm bit for M8, a 6.6 mm bit for UNC 5/16". These recommended drill bits are 0.1 mm above standard size, to prevent the pilots from jamming and breaking.
- 3 Countersink the hole, using a 90° countersink with pilot 6.8 (6.5) mm. Countersinking depth is min. 2 mm ,max. 4 mm (min. 1 mm at the shallowest point when the transducer is mounted at an angle to the surface of the bearing housing).
- 4 Thread the hole for M8 (UNC 5/16"), to a depth of min. 13 mm.
- 5 Blow the chips out of the hole, using compressed air or a small tube. Chips left in the mounting hole can knock against the transducer when the machine vibrates and produce an interfering shock signal. The hole must be clean.
- 6 Put some clean grease on the seat surfaces to improve signal transmission. Loctite or a similar adhesive may be used to secure the transducer on vibrating machines.
- 7 Torque the transducer with a torque wrench. The torque is 15 Nm (11 lbf./ft.).
- 8 Make sure that the seat surface has firm connection with the material of the bearing housing. Connect the transducer cable by hand. Do not use pliers on a standard TNC connector.





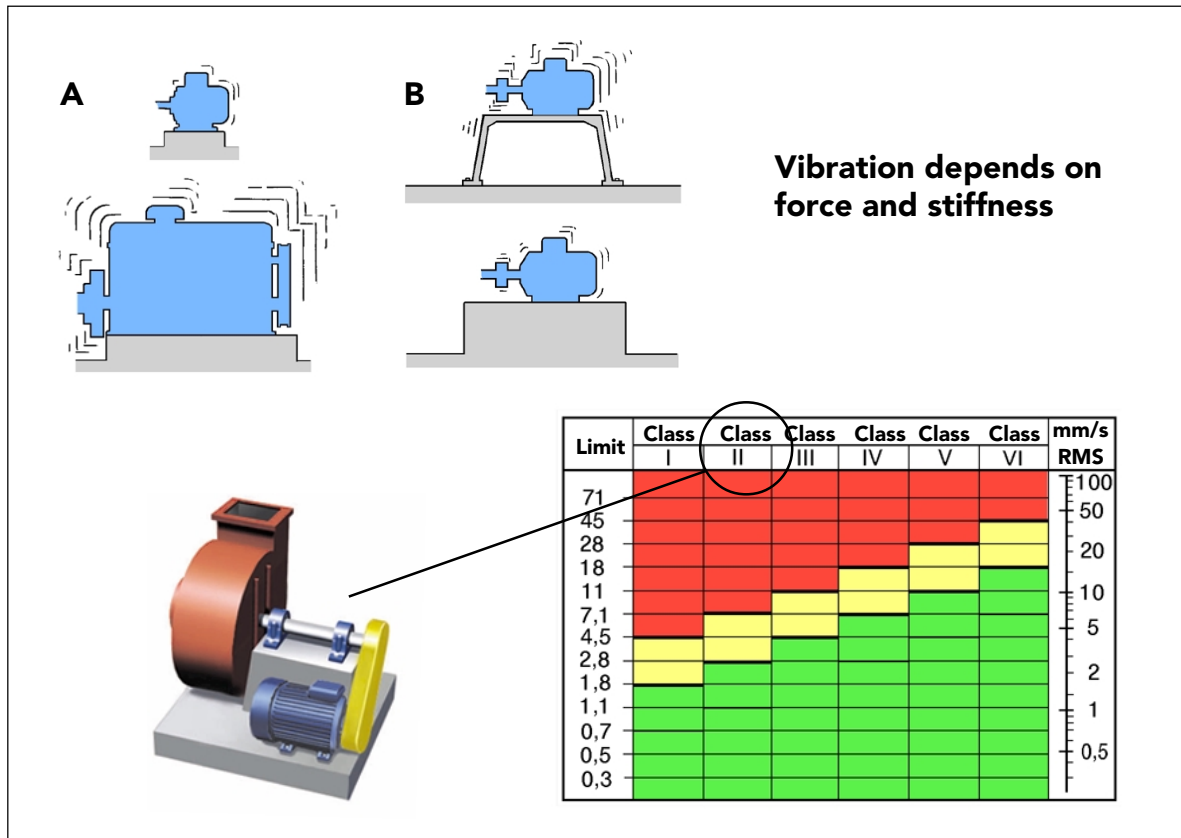
## VIB – Vibration severity monitoring

Machine vibration is a complex oscillating movement which can be measured as displacement, acceleration, or as velocity. The original ISO standard 2372 concerning machine condition monitoring by means of vibration measurement defines **vibration severity** as the RMS (root mean square) value of vibration velocity, measured over a frequency range of 10 to 1000 Hz. The revised ISO standard 10816 basically recommends the same type of measurement but allows variations of the frequency range.

Vibration severity is the best indicator of the energy contents of machine vibrations and thus of the destructive forces acting on the machine structure. The measuring unit is mm/s (inch/s). The RMS value displayed by the MG-4 is a good general indicator of machine condition, but it does not allow conclusions as to the causes of excessive machine vibration. The cause can be unbalance, misalignment, structural weakness or a combination of these.

The measuring point has to be selected so that the transducer delivers a representative signal. Normally the transducer is mounted on a bearing housing. In most rotating machines, the radial forces are dominant and are measured in horizontal direction. Some machine structures are weaker in the axial direction, so a measurement in axial direction will yield a more representative signal.

The ISO standard also contains a table of limit values for different machine classes which allow an evaluation of the vibration severity measured on a particular machine. MG-4 uses the ISO limit values as alarm levels and for status indication when an ISO machine class number is set as a measuring parameter (else it uses the input alarm levels). Please note that the default limits are the upper limit of the 'acceptable' range (yellow alarm) and the lower limit of the 'unacceptable' range (red alarm, see next page).



## Machine classes

Generally, a large machine with much power is allowed to vibrate more than a smaller machine with less power (A). Given two identical machines, there will be a considerable difference in their vibration depending on the foundation: a comparatively weak metal frame allows more movement than a stiff concrete foundation (B).

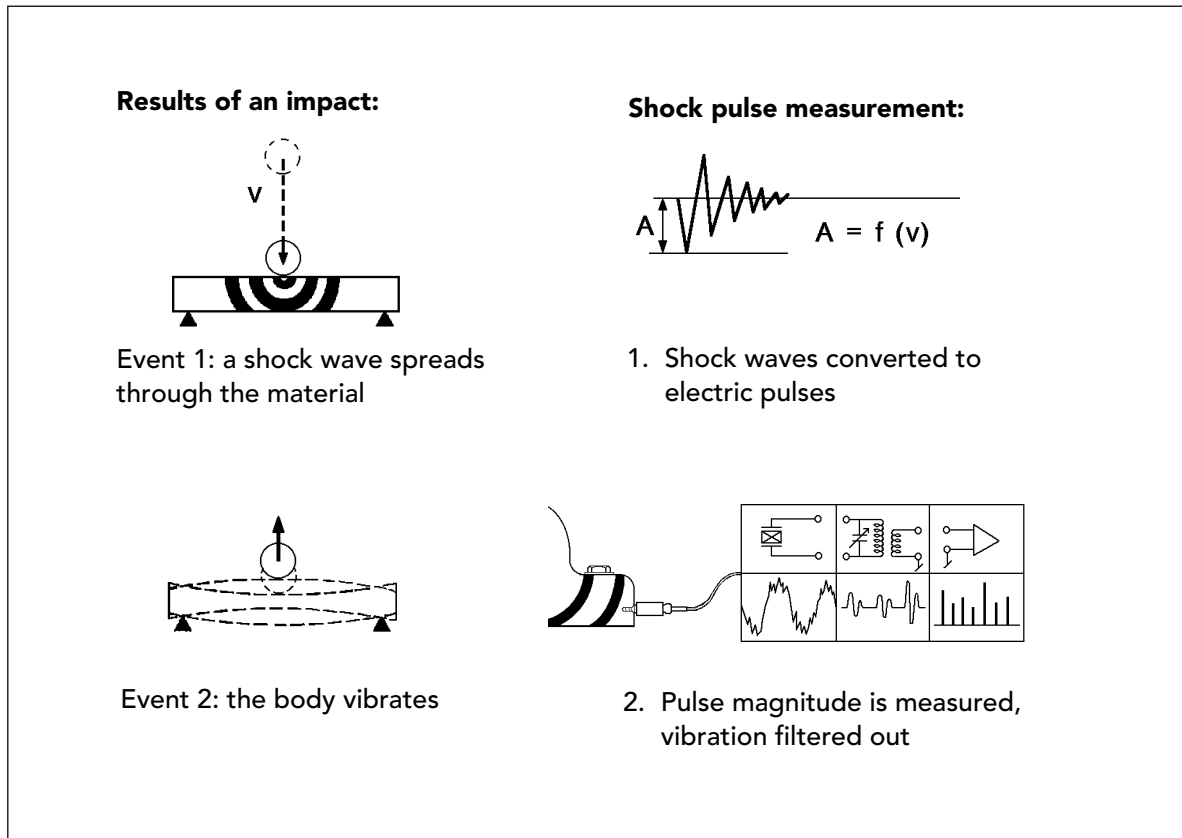
The international standards group industrial machinery into six different vibration classes, depending on machine size and function plus the stiffness of the foundation:

- I Parts of engines and machines, e.g. electrical motors up to 15 kW.
- II Medium size machines without special foundations, 15 to 75 kW.  
Rigidly mounted machine up to 300 kW.
- III Large prime movers and machines on rigid and heavy foundations.
- IV Large prime movers and machines on soft foundations.
- VI Machines and mechanical drive systems with reciprocating masses, machines with rotating slack coupled masses (beater shafts), vibrating screens and vibration inciters.

Motor power and types (electric, turbine, diesel), machine size and foundation stiffness (concrete base, metal frame, etc.) will give a first indication of machine class. Most smaller process pumps in a chemical plant would be Class II. A 100 kW ventilation fan on a concrete base would be Class III. However, the same fan fastened to the metal deck of a ship could be considered as Class IV.

The diagram shows the limit values for all six ISO vibration classes. For each class, the standards give vibration severity levels ranging from very good condition through average and poor to bad. From one limit value to the next value above, vibration severity increases 1.6 times (1 step). From one condition zone to the next above, vibration severity increases by a factor of 2.6 (2 steps). 3 steps up is a fourfold increase.

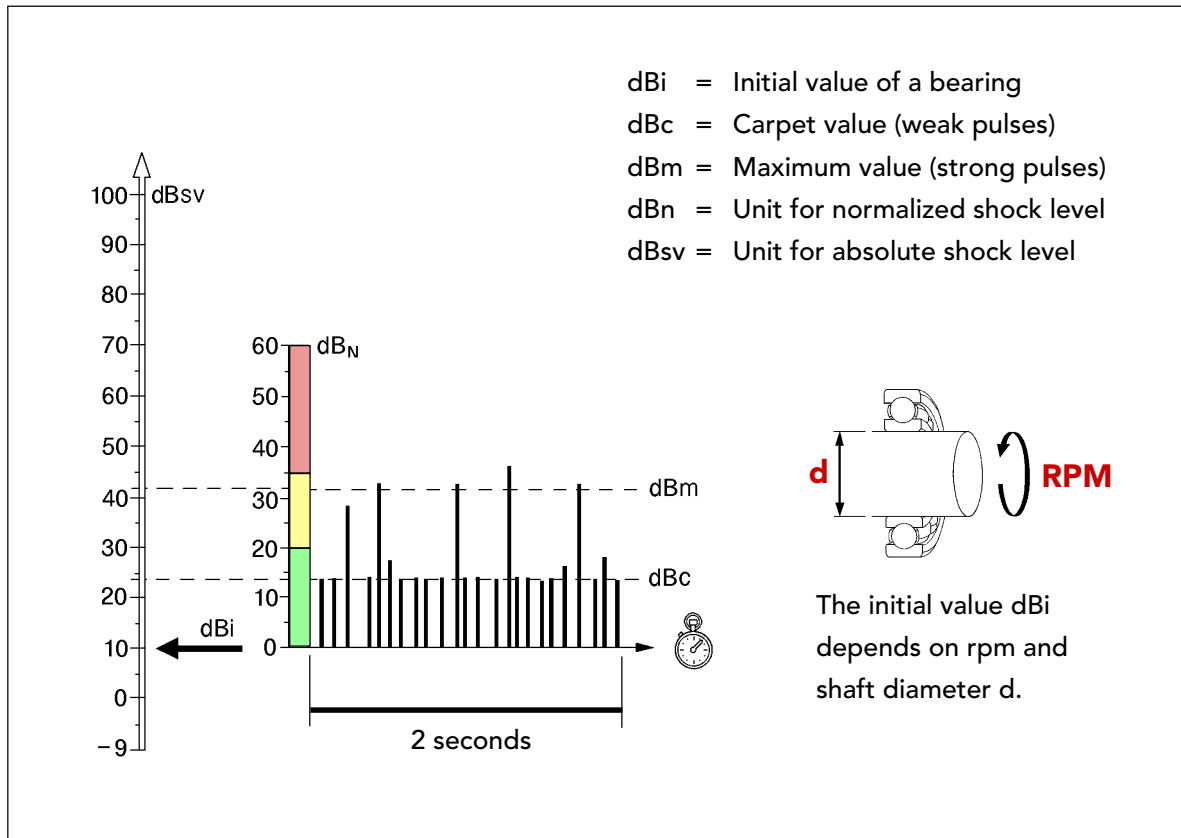




## SPM - shock pulse measurement

The Shock Pulse Method for bearing condition monitoring (SPM) differs from vibration monitoring. Vibration monitoring records a continuous complex motion (which even contains shocks), while the SPM method targets the shocks and filters out the vibration. This is a short and simplified summary of some important facts needed to understand the basic input data for bearing monitoring as well as the nature and use of the shock pulse transducers.

- Shock pulses are caused by impacts. An impact is a single event: one body hitting another body once. It is not a constant force. It can be repeated at regular intervals in time, but is often not. In a bearing, typically the impacts occur at random (and extremely short) intervals.
- The impact sends a shock wave through the material of both bodies. Vibration comes as a second stage. In the SPM transducer, vibration is filtered out.
- The shock pulse transducer reacts to the amplitude of the wave front at its own resonance frequency. This magnifies the low energy signal. Only the wave front is measured, causing one shock pulse from the transducer.
- The amplitude of the wave front is a function of impact velocity. This means, bearing and operating condition being equal, the higher the rpm, the higher the shock level. Because the rotational speed of the bearing depends on both its size and the rpm, both are needed as input data.
- Shock pulses are transient signals. They lose their energy on the way through the material of the machine. Also, they are reflected from surfaces and severely dampened by interfaces in the material. That is why we need defined measuring points.
- All impacts cause shock pulses. You must make sure that you are measuring a signal from the bearing.



## Normalized readings show bearing condition

The signal you measure consists of a train of stronger and weaker electric pulses, analog to the shock pulses emitted by the source. Here, the  $dBm/dBc$  technique is used to quantify the signal.

The absolute shock pulse level of a bearing, measured in  $dBsv$  (decibel shock value), is both a function of rolling velocity and of bearing condition. To neutralize the effect of rolling velocity on the measured value, the MG-4 has to be programmed with shaft diameter (in millimetre or inch) and rotational speed (in rpm).

The MG-4 will then calculate the **initial value  $dBi$** , the starting point of the condition scale for a particular bearing. You can also input the  $dBi$  directly. The condition scale is graded in **normalized** shock values,  $dBn$ .

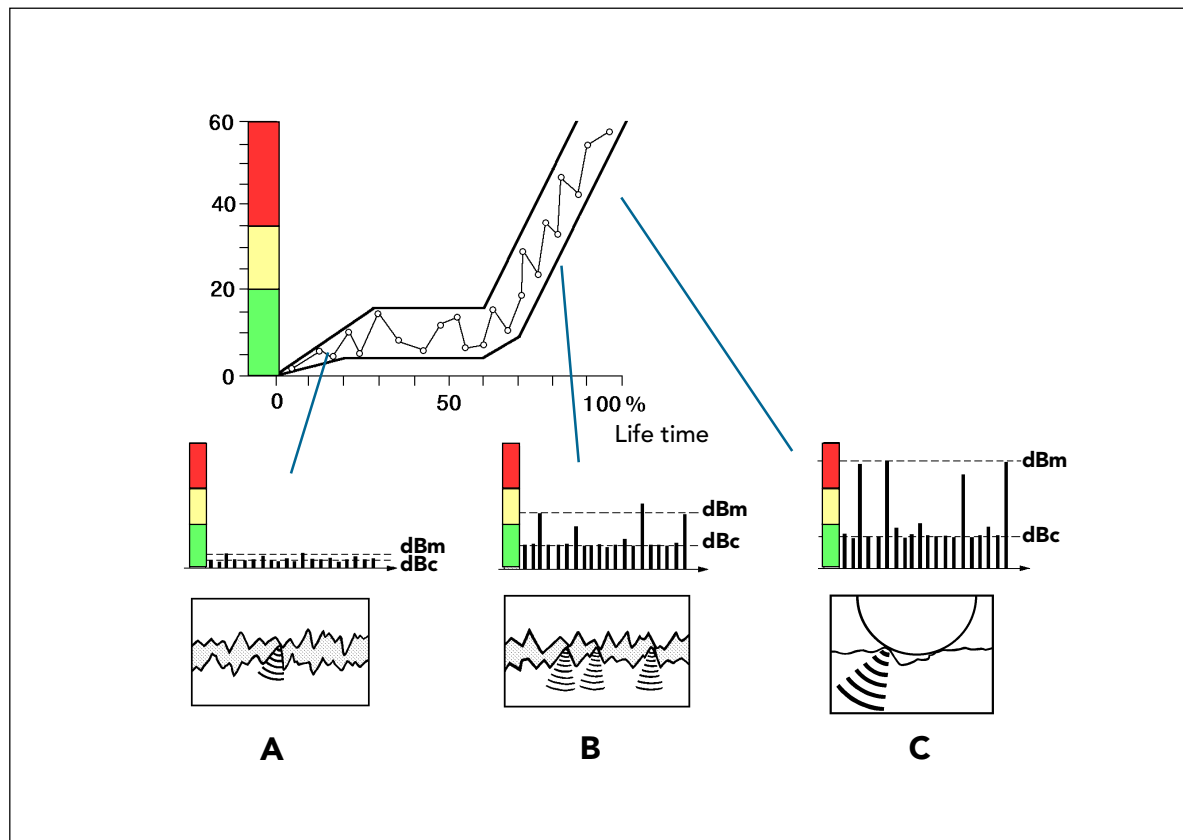
The MG-4 takes a sample count of the shock pulses occurring over a period of time and displays:

- the **maximum value  $dBm$**  for the small number of strong shock pulses in the measuring time window (2 seconds for the MG-4).
- the **carpet value  $dBc$**  for the large number of weaker shock pulses.

The maximum value  $dBm$  defines the bearing's position on the condition scale:

- green for  $dBm$  up to 20  $dBn$  = good condition
- yellow for 21-34  $dBn$  = caution,
- red for 35  $dBn$  and more = bad condition.

21 and 35 are the recommended alarm limits for the maximum value  $dBm$ .



## Bearing condition development

The dBm/dBc technique is well suited for industrial condition monitoring, because it works with few, easy to understand in- and output data and with "reasonable accuracy".

Even on a logarithmic scale, there is normally a large, distinct difference between the maximum values from good and bad bearings. Thus, minor inaccuracies in the input data (rpm and shaft diameter) have little effect on the evaluated measuring result.

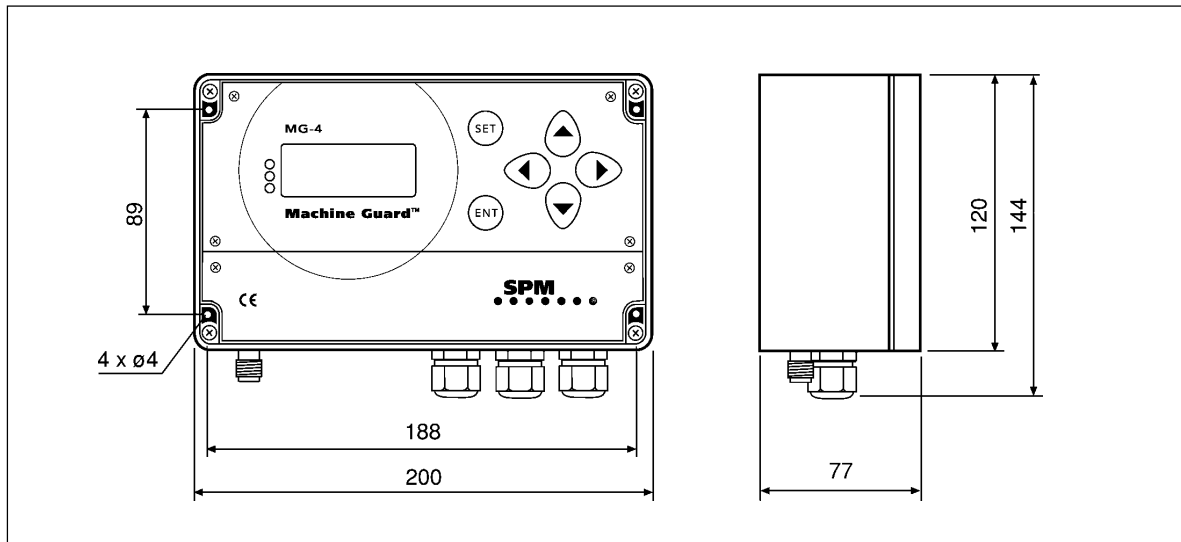
Typically, a new and correctly install rolling bearing will have low shock values in the green zone (A). If that is not the case, suspect damage on installation or an excessive pre-load. There is always some fluctuation in the shock values, because the measuring time window will not always coincide with the moment the largest shock occurs, especially on machines with a low rpm.

A marked increase in the dBm value (B) shows surface stresses or beginning damage. An increase of both dBm and dBc and a small difference between them indicates poor lubrication or dry running. Both conditions normally put the measuring results in the yellow (caution) zone.

High dBm values above 35 are a sign of surface damage, often visible. The values will increase with the extent of damage. They also tend to fluctuate as new, sharp spallings are rolled out. A temporary drop in the readings at this stage does not reflect an improvement of the bearing condition.

Above 45 dB, the failure risk is very high. If the bearing cannot be replaced at once, carefully monitor the trend of the readings: the steeper the curve, the greater the failure risk.



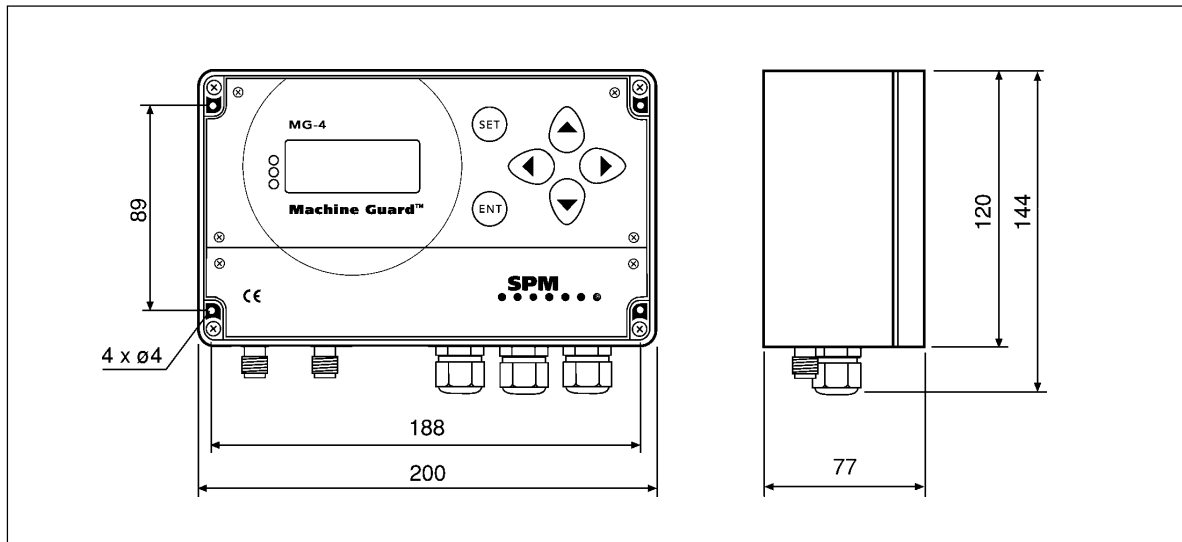


## Technical specifications, MG4-1

Vibration channels:	1
Analog output (1):	4 - 20 mA, selective range
Main relay (1):	250 Vac, 5 A, 1250 VA
Secondary relays (4):	125 Vac, 1 A, 60 VA / 150 Vdc, 1 A, 30 W
Power supply:	230 Vac, 115 Vac or 15 to 30 Vac/Vdc
Power consumption:	max. 6 VA
Temperature range:	0 to 50 °C (32 to 122 °F)
Casing:	Polycarbonate/PVC, IP65
Display screen:	LCD, 4 x 16 characters, back-lighted
Status display:	Green, yellow, red LED
Dimensions:	200 x 144 x 77 mm
Weight:	1060 grams

### Vibration channel (VIB)

Measuring range:	0.5 to 49.9 mm/s RMS (0 to 1.9 inch/s RMS)
Resolution:	0.1 mm/s (0.01 inch/s)
Frequency, lower limit:	3, 10, or 100 Hz
Frequency, upper limit:	1000 or 2000 Hz
Measuring time:	Programmable 1 to 15 s
Alarm limits:	2, programmable
Alarm delay:	0 to 600 seconds, steps of 2 s
Fault indication:	Transducer line test for short and open circuit
Transducer type:	TRV-18/19 or TRV-20/2, with isolated installation foot TRX-18/19

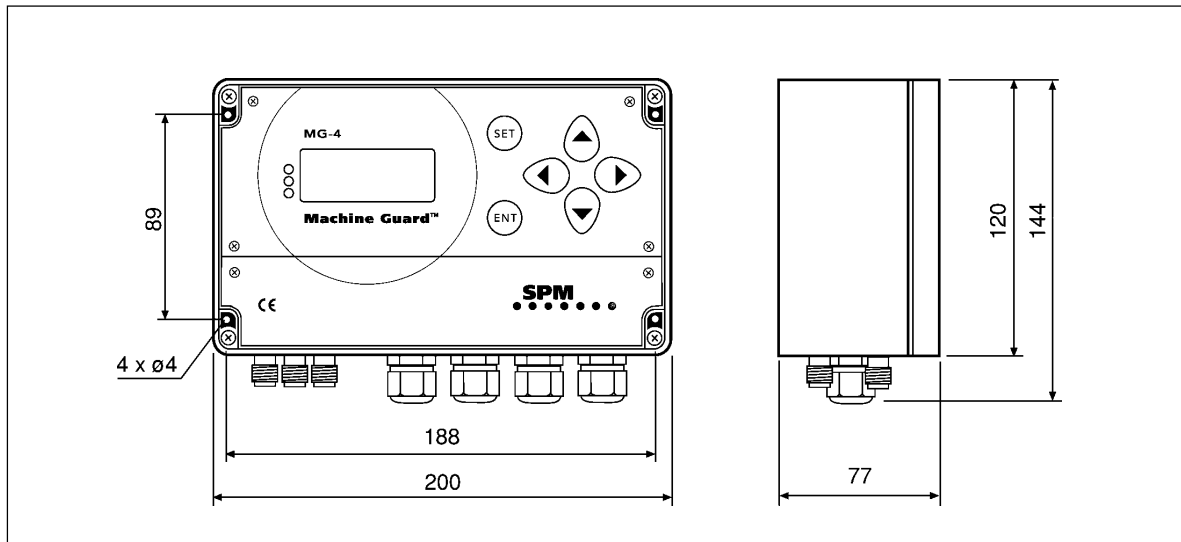


## Technical specifications, MG4-2

Vibration channels:	2
Analog outputs (2):	4 - 20 mA, selective range
Main relay (1):	250 Vac, 5 A, 1250 VA
Secondary relays (4):	125 Vac, 1 A, 60 VA / 150 Vdc, 1 A, 30 W
Power supply:	230 Vac, 115 Vac or 15 to 30 Vac/Vdc
Power consumption:	max. 6 VA
Temperature range:	0 to 50 °C (32 to 122 °F)
Casing:	Polycarbonate/PVC, IP65
Display screen:	LCD, 4 x 16 characters, back-lighted
Status display:	Green, yellow, red LED
Dimensions:	200 x 144 x 77 mm
Weight:	1070 grams

### Vibration channel (VIB)

Measuring range:	0.5 to 49.9 mm/s RMS (0 to 1.9 inch/s RMS)
Resolution:	0.1 mm/s (0.01 inch/s)
Frequency, lower limit:	3, 10, or 100 Hz
Frequency, upper limit:	1000 or 2000 Hz
Measuring time:	Programmable 1 to 15 s
Alarm limits:	2, programmable
Alarm delay:	0 to 600 seconds, steps of 2 s
Fault indication:	Transducer line test for short and open circuit
Transducer type:	TRV-18/19 or TRV-20/21 with isolated installation foot TRX-18/19



## Technical specifications, MG4-12

Vibration channels:	1
SPM channels:	2, multiplexing
Analog outputs (3):	4 - 20 mA, selective range
Main relay (1):	250 Vac, 5 A, 1250 VA
Secondary relays (4):	125 Vac, 1 A, 60 VA / 150 Vdc, 1 A, 30 W
Power supply:	230 Vac, 115 Vac or 15 to 30 Vac/Vdc
Power consumption:	max. 6 VA
Temperature range:	0 to 50 °C (32 to 122 °F)
Casing:	Polycarbonate/PVC, IP65
Display screen:	LCD, 4 x 16 characters, back-lighted
Status display:	Green, yellow, red LED
Dimensions:	200 x 144 x 77 mm
Weight:	1140 grams

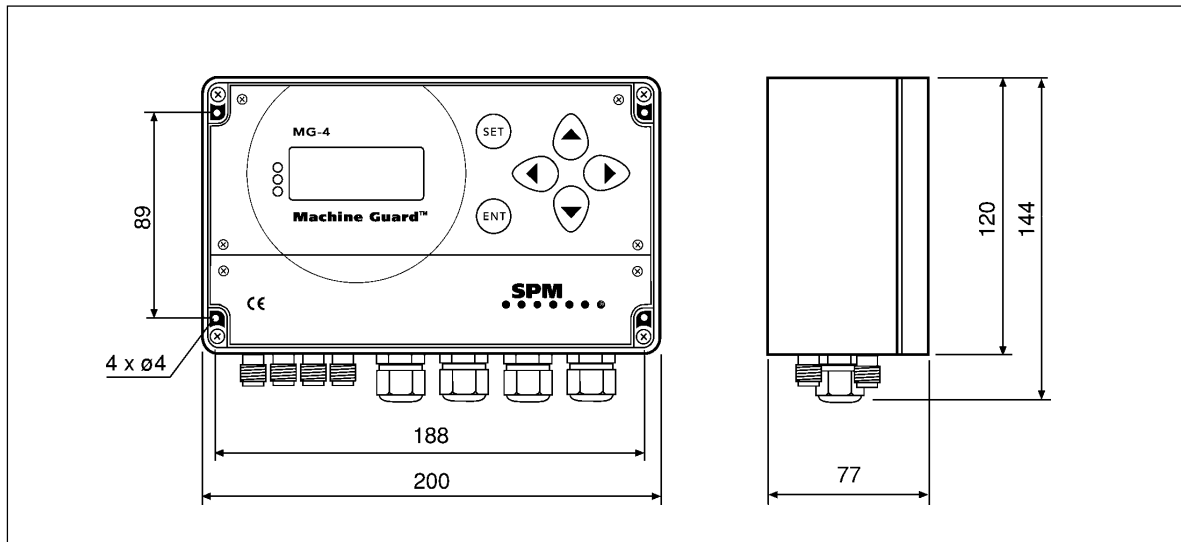
### Vibration channel (VIB)

Measuring range:	0.5 to 49.9 mm/s RMS (0 to 1.9 inch/s RMS)
Resolution:	0.1 mm/s (0.01 inch/s)
Frequency, lower limit:	3, 10, or 100 Hz
Frequency, upper limit:	1000 or 2000 Hz
Measuring time:	Programmable 1 to 15 s
Alarm limits:	2, programmable
Alarm delay:	0 to 600 seconds, steps of 2 s
Fault indication:	Transducer line test for short and open circuit
Transducer type:	TRV-18/19 or TRV-20/21 with isolated installation foot TRX-18/19

### Bearing channel (SPM)

SPM method:	dBm/dBc or LR/HR, evaluated
Measuring range:	0 to 99 dBsv
Resolution:	1 dBsv
Alarm limits:	2, programmable (dBm)
Alarm delay:	0 to 600 seconds, steps of 2 s
Fault indication:	Transducer line test of measuring circuit quality
Transducer type:	SPM 40000 or 42000





## Technical specifications, MG4-22

Vibration channels:	2, multiplexing
SPM channels:	2, multiplexing
Analog outputs (4):	4 - 20 mA, selective range
Main relay (1):	250 Vac, 5 A, 1250 VA
Secondary relays (4):	125 Vac, 1 A, 60 VA / 150 Vdc, 1 A, 30 W
Power supply:	230 Vac, 115 Vac or 15 to 30 Vac/Vdc
Power consumption:	max. 6 VA
Temperature range:	0 to 50 °C (32 to 122 °F)
Casing:	Polycarbonate/PVC, IP65
Display screen:	LCD, 4 x 16 characters, back-lighted
Status display:	Green, yellow, red LED
Dimensions:	200 x 144 x 77 mm
Weight:	1150 grams

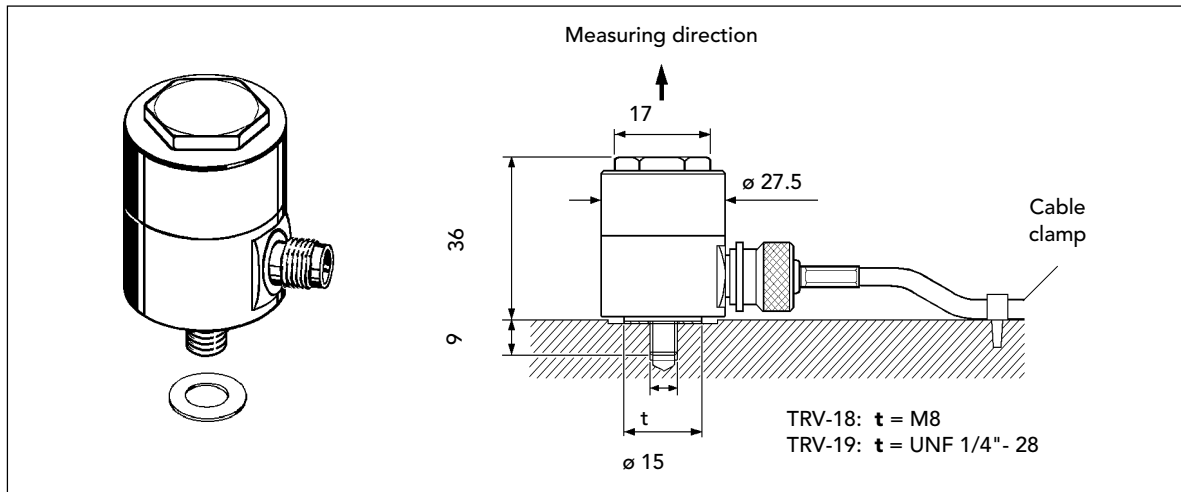
### Vibration channel (VIB)

Measuring range:	0.5 to 49.9 mm/s RMS (0 to 1.9 inch/s RMS)
Resolution:	0.1 mm/s (0.01 inch/s)
Frequency, lower limit:	3, 10, or 100 Hz
Frequency, upper limit:	1000 or 2000 Hz
Measuring time:	Programmable 1 to 15 s
Alarm limits:	2, programmable
Alarm delay:	0 to 600 seconds, steps of 2 s
Fault indication:	Transducer line test for short and open circuit
Transducer type:	TRV-18/19 or TRV-20/21 with isolated installation foot TRX-18/19

### Bearing channel (SPM)

SPM method:	dBm/dBc or LR/HR, evaluated
Measuring range:	0 to 99 dBsv
Resolution:	1 dBsv
Alarm limits:	2, programmable (dBm)
Alarm delay:	0 to 600 seconds, steps of 2 s
Fault indication:	Transducer line test of measuring circuit quality
Transducer type:	SPM 40000 or 42000



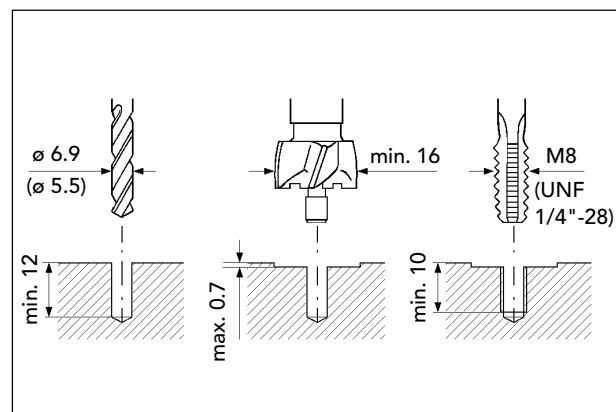
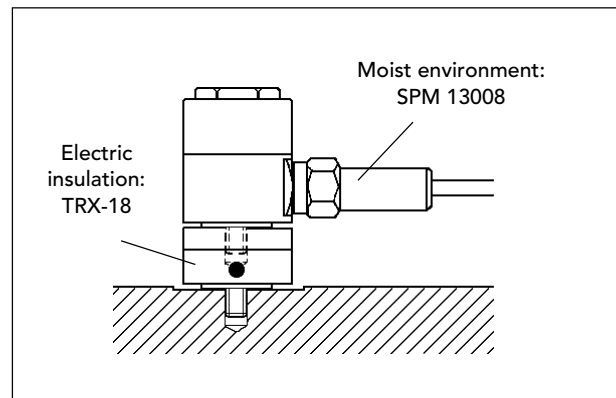


## VIB transducer TRV-18/19

The transducers TRV-18 and TRV-19 are piezo-electric accelerometers of compression type with built-in preamplifier, designed for vibration monitoring of industrial machinery. They are used in permanent installations with the CMM System (condition monitoring modules VMM). The cable length between transducer and measuring unit is max. 50m (165 ft).

The transducer is mounted against a smooth, flat surface on the machine. TRV-18 has thread size M8 and TRV-19 has UNF 1/4"-28. The transducers are delivered with three washers for adjusting the connector angle. Each washer turns the transducer 90°. The coaxial cable (SPM 90005-L or 90267-L) with TNC connector must be secured with a clamp close to the transducer.

In moist environments, use sealing TNC cable plugs SPM 13008 to prevent cable corrosion. For electric insulation, use insulation foot TRX-18.



## Technical data

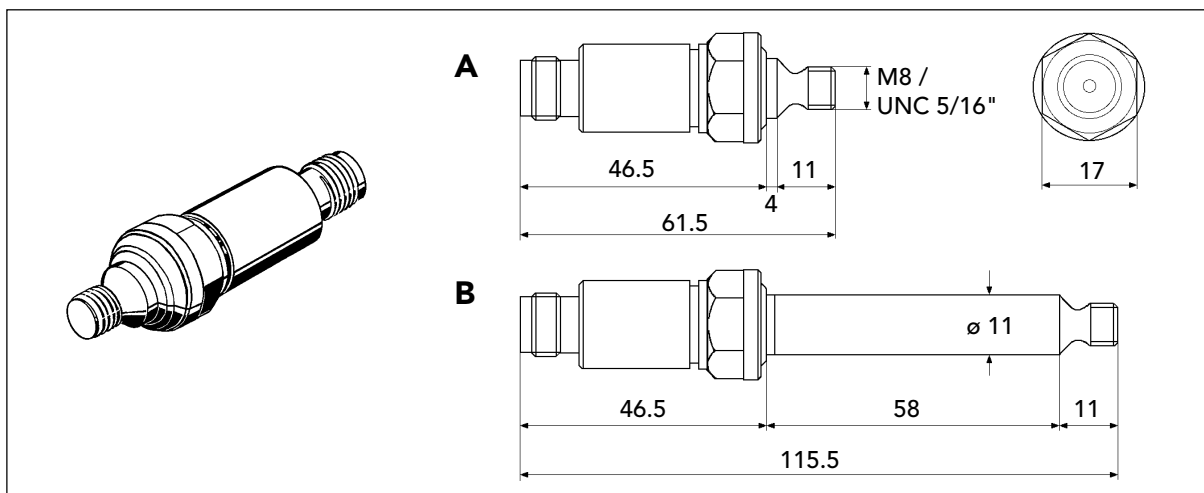
Nom. sensitivity, main axis:	1.2 mV/m/s <sup>2</sup> *
Transverse sensitivity:	max. 10%
Typical basestrain sensitivity:	0.01 m/s <sup>2</sup> /m strain
Linear frequency range:	3 to 1000 Hz
Max. peak acceleration:	600 m/s <sup>2</sup>
Temperature range:	-20 to +70 °C (-4 to +158 °F)
Typical temperature drift:	0.25% / °C

Casing:	Stainless steel, acid proof, AISI 316 (SS 2382)
Design:	Sealed
Weight:	135 grams (5 oz)
Connector type:	TNC
Torque limit:	10 Nm (7.4 lbf/ft)

\* Individual value given on the calibration chart.







## SPM transducer 40000

Standard shock pulse transducers are used in all permanent SPM installations for bearing monitoring. They are installed in countersunk mounting holes on the bearing housings.

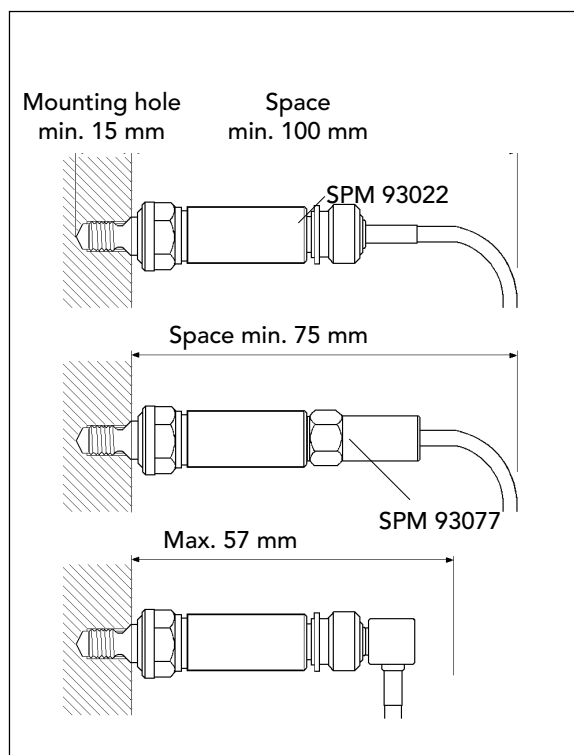
A shock pulse transducer converts the shock pulses emitted by the bearing into electric signals. A coaxial cable connects the transducer with a measuring terminal or measuring device. Max. cable length is 4 m.

Transducer housing and base are made of stainless acid proof steel, suitable for aggressive environments. Standard thread size is M8, with UNC 5/16" as an alternative. Standard length (A) is 61.5 mm. A long transducer (B), length 115.5 mm, is used to reach bearing housings beneath protective covers.

The transducer is normally connected with a TNC plug, SPM 93022. A TNC angle plug, SPM 93077, can be used in narrow spaces. To prevent cable corrosion in moist environments, the coaxial cable must be connected with a sealing TNC plug, SPM 13008.

### Ordering numbers

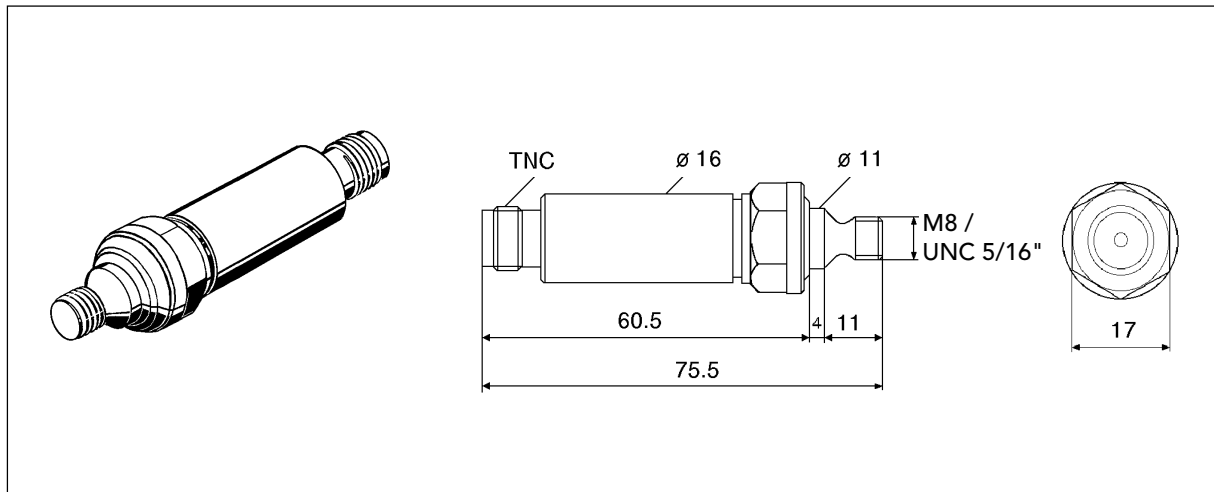
- 40000 Standard shock pulse transducer, M8
- 40100 Standard shock pulse transducer, UNC 5/16"
- 40001 Standard shock pulse transducer, M8, extended
- 40101 Standard shock pulse transducer, UNC 5/16", extended



### Technical data

Measuring range:	Max. 100 dBsv
Housing, base:	Stainless steel, SS 2382
Design:	Sealed
Temperature range:	-30 to +150 °C
External overpressure:	Max. 1 MPa (10 bar)
Torque:	15 Nm, max. 20 Nm
Connector:	TNC jack





## SPM transducer 42000

The shock pulse transducer with TMU is used in permanent SPM installations for bearing monitoring, in cases where the cable length between transducer and measuring unit exceeds 4 m. This allows a cable length of max. 100 m. The transducer with TMU is installed in a countersunk mounting hole on the bearing housing, in the same way as a standard transducer.

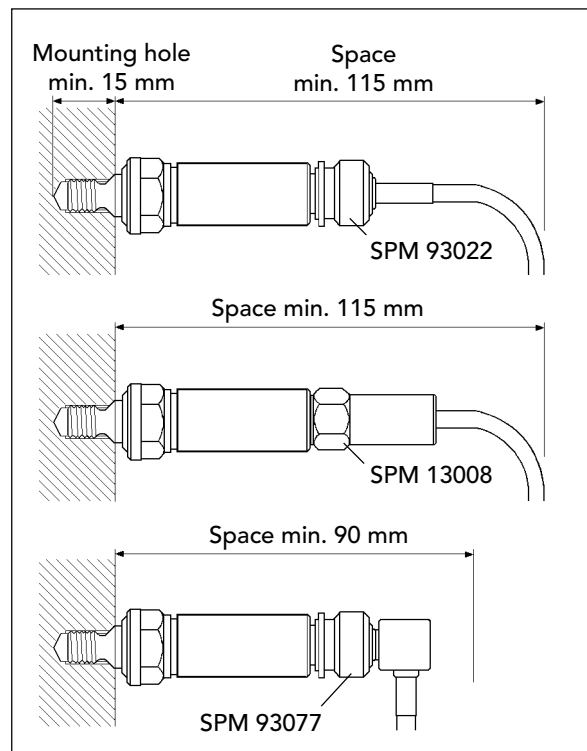
A shock pulse transducer with TMU (TMU = Transducer Matching Unit) converts the shock pulses emitted by the bearing into an electric signal, and stabilizes the signal for transmission via a long cable. A coaxial cable connects the transducer with a measuring terminal or measuring device.

Transducer housing and base are made of stainless, acid proof steel (SS 2382), suitable for aggressive environments. Thread size is M8, with UNC 5/16" as an alternative.

The transducer is normally connected with a TNC plug, SPM 93022. In moist environments, the coaxial cable must be connected with a sealing TNC plug, SPM 13008. A TNC angle plug, SPM 93077, can be used in narrow spaces.

## Ordering numbers

- 42000 Shock pulse transducer with TMU, M8
- 42100 Shock pulse transducer with TMU, UNC 5/16"

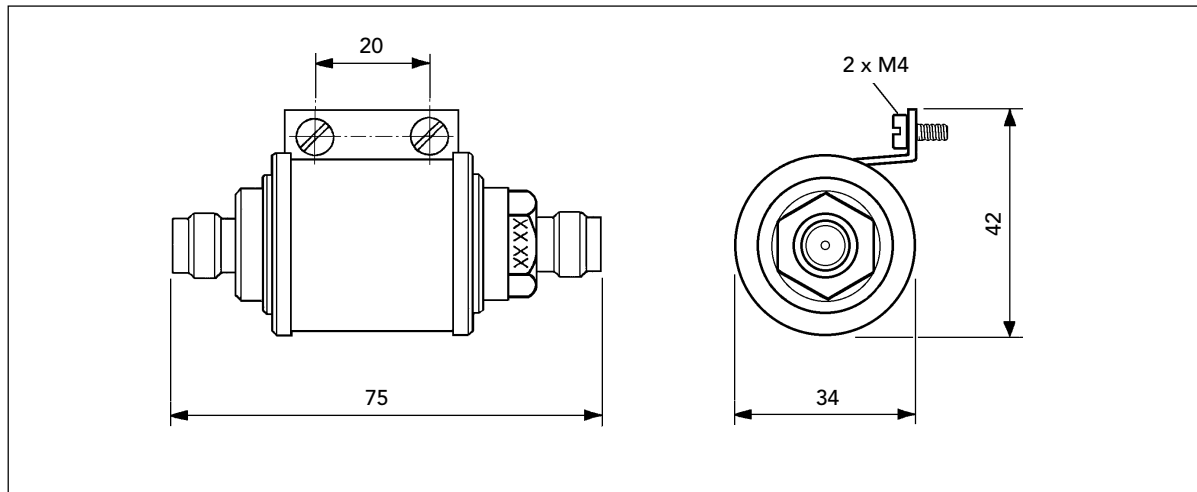


## Technical data

Measuring range:	Max. 100 dBsv
Housing, base:	Stainless steel, SS 2382
Design:	Sealed
Temperature range:	-30 to +100 °C
External overpressure:	Max. 0.7 MPa (7 bar)
Torque:	15 Nm, max. 20 Nm
Connector:	TNC jack







## Transducer matching unit TMU-12

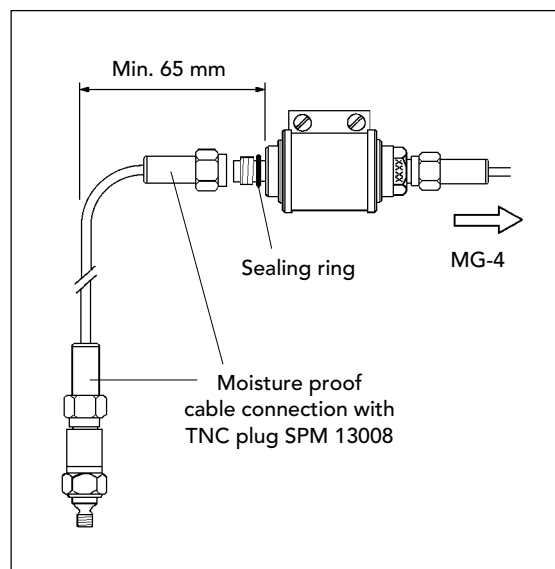
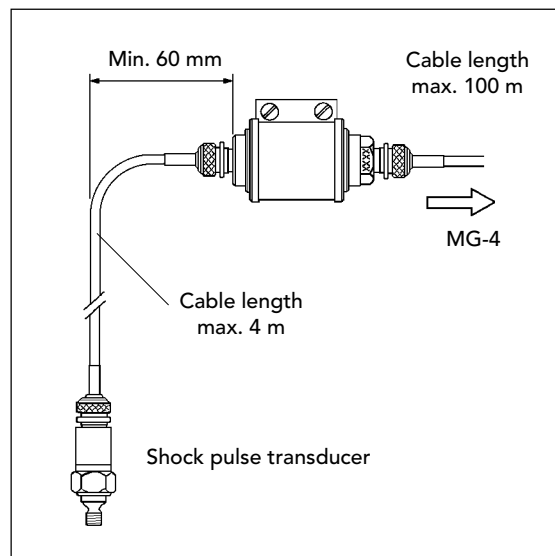
Transducer Matching Unit TMU-12 is an impedance converter for all permanently installed SPM bearing monitoring systems. It is placed between the shock pulse transducer and the measuring device. The bracket on the TMU is fastened with two mounting screws to the machine or machine foundation. The round connector base faces towards the transducer.

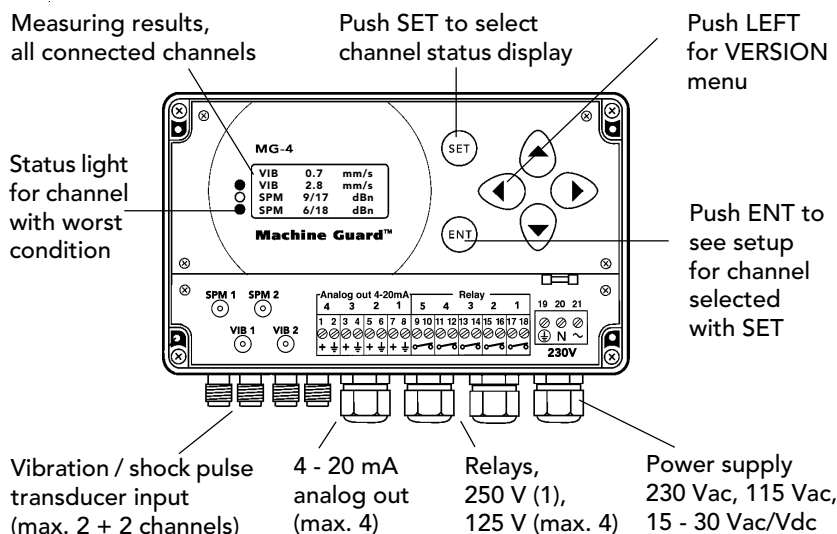
A TMU is used to extend the length of the coaxial cable between transducer and measuring device from max. 4 m to max. 100 m. The distance between the TMU and the transducer is always max. 4 m.

TMU-12 is suitable for both chemically basic and acid environments. For installations in moist environments, it is necessary to use sealing TNC cable plugs SPM 13008 to prevent cable corrosion.

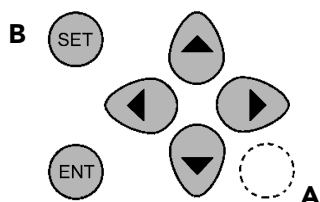
### Technical data

Casing	Stainless steel AISI 316, and fluor rubber
Sealing	IP 65 with TNC connector IP 67 with connector SPM 13008
Temperature range	-30 to +100 °C
Dimensions	75 x ø 34 mm
Weight	140 grams
Connectors	TNC jacks
Cable length	Max. 100 m
Fastening screws	2 x M4, stainless steel





### Default initiation



Hold down the invisible reset button (A) and press SET (B) to restore default parameters.

Copy and use to record the settings and program of your MG-4 unit.

### Version menu

- ◀ Start
- SET Select
- ENT Open
- ▲ Change
- ENT Close/Save
- ◀ Finish

### Channel programming

On the VERSION menu, set password OFF, then set 'SPM'

- SET Select channel
- ENT Start programming
- ▲ ▼ Change value
- ◀ ▶ Change position
- SET Next item
- ENT Close / Save

### General setting

Item	Default	Choice	Setting, comment
Password	on	on / off	Set OFF to program, then set password 'SPM'
Measuring	on	on / off	OFF freezes all outputs
TLT	on	on / off	OFF blocks yellow LED (not relay), min. current 4 mA
Unit	mm	mm / inch	
Relays	NC	NC / NO	

### VIB channel programming

Item	Default	Range	VIB channel 1	VIB channel 2
Name	VIB channel 1/2	16 characters		
Machine class	1	1 to 6		
Transducer sensitivity	nominal	see data card		
Measuring time	2 seconds	2 to 15 s		
TLT alarm, on relay no.	--	-- to max. 5		
Alarm limit A1	1.9 mm/s	-- to 49.9		
Alarm A1, on relay no.	--	-- to max. 5		
Alarm limit A2	4.6 mm/s	-- to 49.9		
Alarm A2, on relay no.	--	-- to max. 5		
Analog out channel no.	--	-- to max. 4		
20 mA out =	50 mm/s	10 to 50 mm/s		
Alarm delay	--	-- to 600 s		

## SPM channel programming, dBm/dBc technique

Item	Default	Min./max.	SPM channel 3	SPM channel 4
Name	SPM channel 3/4	16 characters		
Initial value dBi	0	-9 to 40		
Bearing speed RPM	--	max. 19999		
Shaft diameter d	--	max. 1999 mm		
Alarm limit TLT	15	5 to 25		
TLT alarm, on relay no.	--	1 to max. 5		
Alarm limit A1 on	dBm	dBm / dBc		
Alarm limit A1	21 dBn	-- to 99 dBn		
Alarm limit A1 on relay	--	-- to max. 5		
Alarm limit A2 on	dBm	dBm / dBc		
Alarm limit A2	35 dBn	-- to 99 dBn		
Alarm limit A2 on relay	--	-- to max. 5		
Analog out , channel no.	--	-- to max. 4		
Analog out , value	dBm	dBm / dBc		
Analog out , channel no.	--	-- to max. 4		
Analog out , value	dBc	dBm / dBc		
20 mA out =	90 dBsv	10 to 90 dBsv		
Alarm delay	--	-- to 600 s		

Location .....

MG4- ..... Serial no. .... Date ..... Sign. ....

SPM Instrument AB • Box 4 • S-645 21 Strängnäs • Sweden

Tel +46 152 22500 • Fax +46 152 15075 • info@spminstrument.se • www.spminstrument.se

Technical data subject to change without notice.

ISO 9001 certified. © SPM 2000-12. 71612.B

CUSTOMER COPY

PRODUCT \_\_\_\_\_ SERIAL NO. \_\_\_\_\_  
PURCHASE DATE \_\_\_\_\_ VERSION NO. \_\_\_\_\_  
COMPANY \_\_\_\_\_  
ADDRESS \_\_\_\_\_  
CITY \_\_\_\_\_ POSTAL CODE \_\_\_\_\_  
COUNTRY \_\_\_\_\_ PHONE \_\_\_\_\_  
USER NAME(S) \_\_\_\_\_ FAX \_\_\_\_\_  
AUTHORIZED DISTRIBUTOR \_\_\_\_\_ CUSTOMER NO. \_\_\_\_\_



REGISTERED LIMITED WARRANTY

One (1) year limited warranty from date of purchase against defects in workmanship or materials. Warranty is void if instrument is altered or repaired by unauthorized service center. Warranty does not apply on any instrument subjected to misuse or damaged by leaking batteries. Warranty is for instrument only and does not cover batteries or cables. SPM reserves the right to determine disposition as to repair or replacement of goods.

Warranty form MUST be completed and returned to SPM Instrument to validate warranty.

Should the instrument require any service whether under warranty or not, you should contact SPM Instrument or your local distributor for instructions before returning the goods.

SPM Instrument AB  
Box 4  
S-645 21 STRÄNGNÄS  
Sweden



RETURN TO VALIDATE WARRANTY

PRODUCT \_\_\_\_\_ SERIAL NO. \_\_\_\_\_  
PURCHASE DATE \_\_\_\_\_ VERSION NO. \_\_\_\_\_  
COMPANY \_\_\_\_\_ CHECKED BY \_\_\_\_\_  
ADDRESS \_\_\_\_\_  
CITY \_\_\_\_\_ POSTAL CODE \_\_\_\_\_  
COUNTRY \_\_\_\_\_ PHONE \_\_\_\_\_  
USER NAME(S) \_\_\_\_\_ FAX \_\_\_\_\_  
AUTHORIZED DISTRIBUTOR \_\_\_\_\_ CUSTOMER NO. \_\_\_\_\_



PLACE  
STAMP  
HERE

SPM Instrument AB  
Box 4  
S-645 21 STRÄNGNÄS  
Sweden