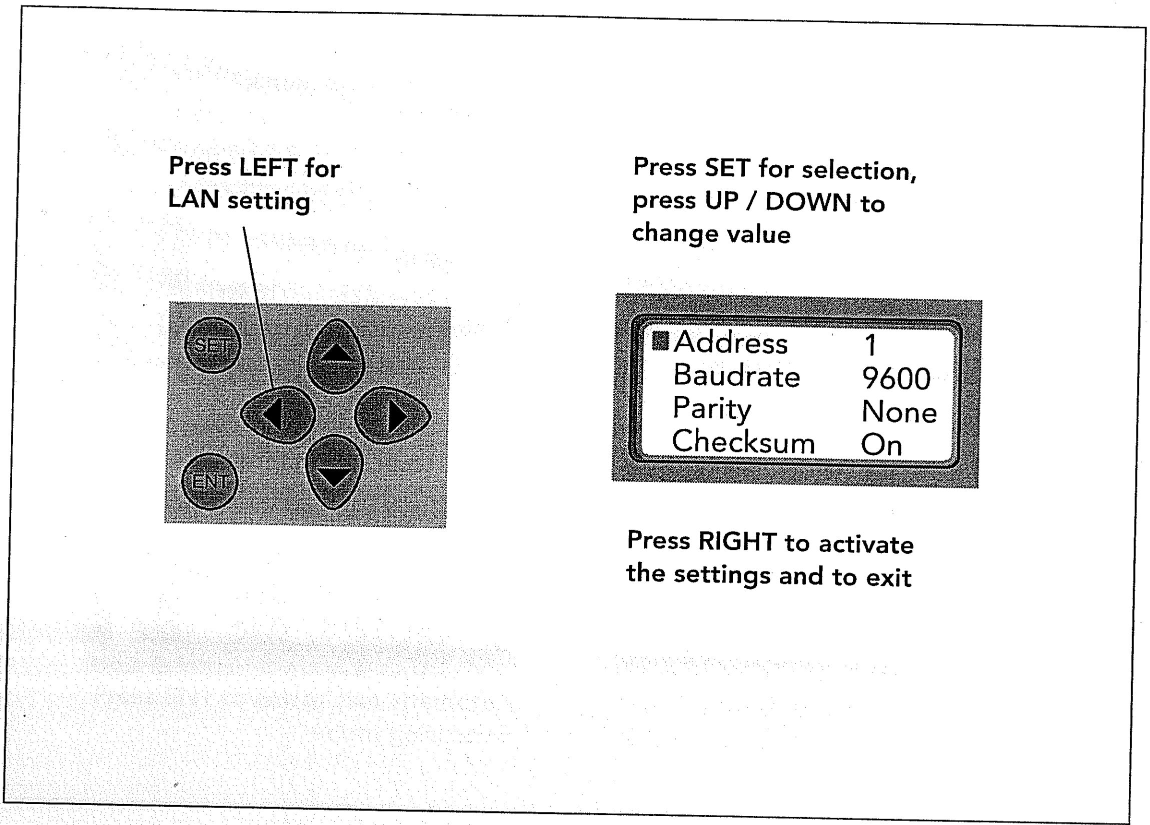


LAN settings (Modbus RTU)

MG4 units with RS-485 port for connection to network have to be programmed with LAN settings. These units have no analog outputs 4-20 mA.

To reach the LAN settings menu, press the LEFT key. Use SET to go to the setting to be changed. The UP or the DOWN key will change the setting. Press the RIGHT key to activate the new settings and to exit to the measuring mode.

MG4 has the initial factory setting:

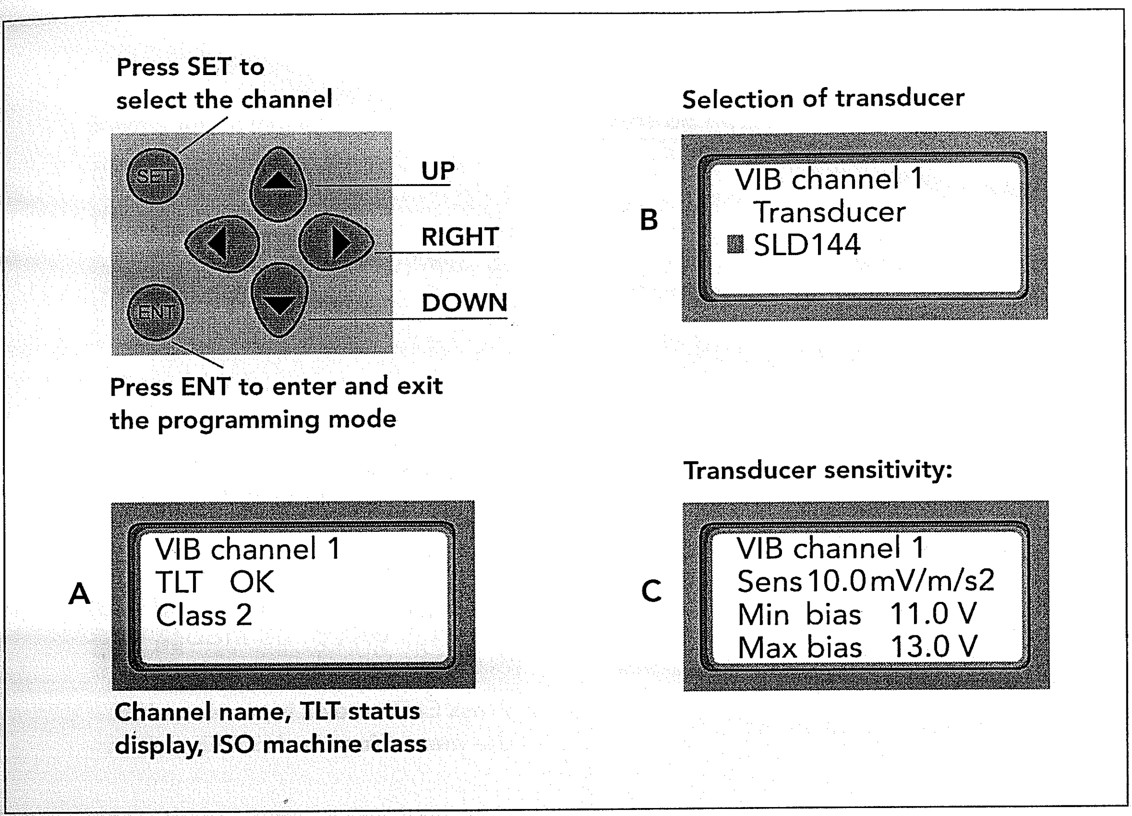
1. Adress ID: 01
2. Baudrate: 9600 bps
3. Parity: None
4. Checksum: On

Transmission rate (baudrate) can be 1200, 2400, 4800, 9600, 19200, 38400 or 57600 bps.

Data are collected in 14 different register and are transmitted in a continuous stream. The message contains for each channel:

- Measured value (vibration value 0 – 50.0 mm/s alt. shock pulse values 0 – 99 dBsv)
- Aarm status for the channel and system error
- Alarm levels (2 per channel)
- MG4 unit type ID.

The protocol for Modbus using RTU is described on page 49.



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.

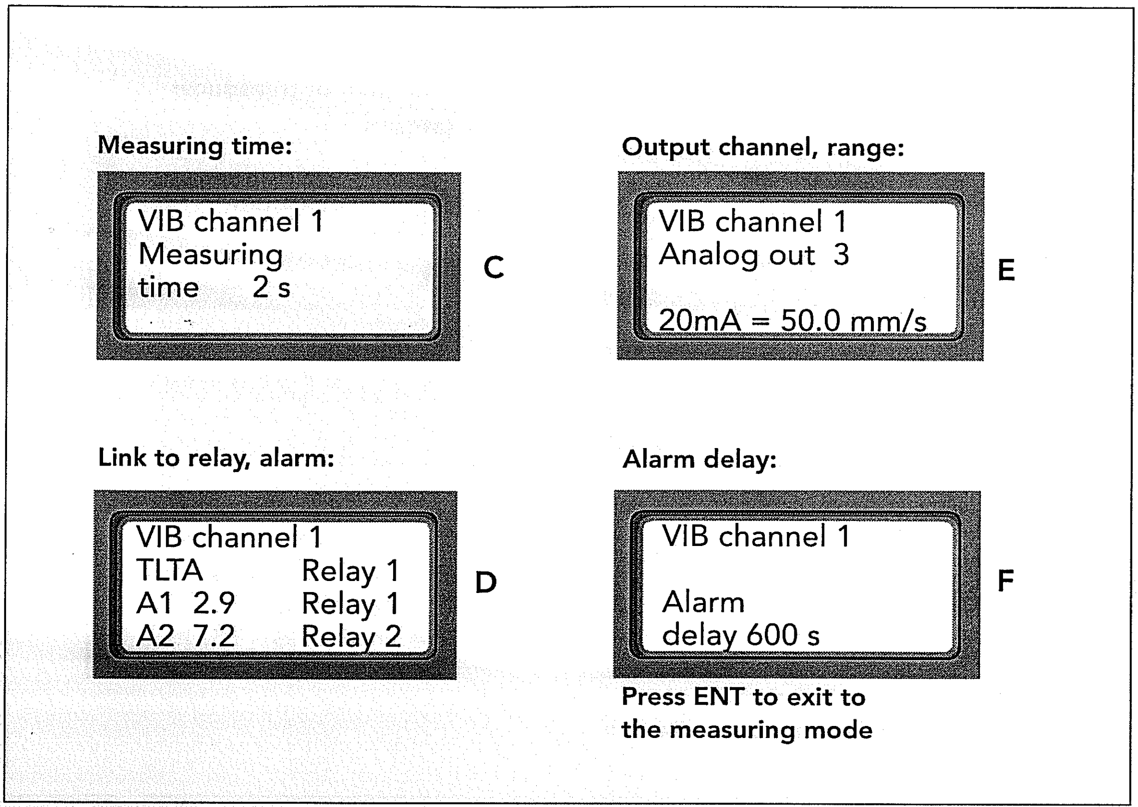
The first line contains the channel name. This can be changed, one position at a time. The new channel name is also shown on the following programming menus.

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 31. 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).

Select type of transducer on menu (B) with the keys UP and DOWN. Default values for sensitivity and min/max bias will automatically be set when a standard SPM vibration transducer is selected.

On menu (C), the variable parameters are the transducer sensitivity value (0.9–12.0 mV/m/s²) and min/max bias values (2–18 V). Enter the values from the transducer's calibration/data card.



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).

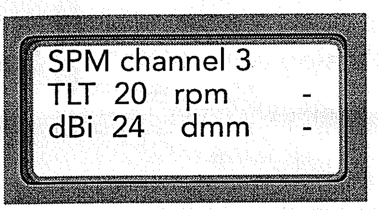
System alarm (TLTA) and the two alarm limits A1 and A2 can be linked to any of the available relays by setting the relay number 1 to max. 5. Each relay can be linked to more than one alarm cause. The setting "-" means no link to a relay.

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.

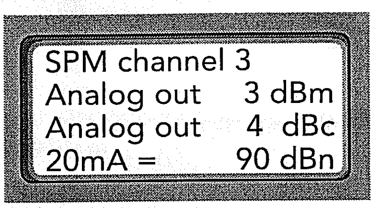
Alarm delay is set in steps of 2 seconds by stepping to a number above 0 on menu (F). The maximum is 600 seconds or 10 minutes.

Name, initial value:



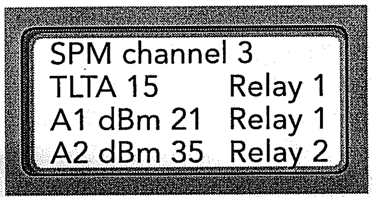
A

Analog output channel, range:



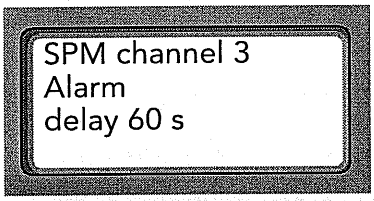
C

Alarms, links to relays:



B

Alarm delay:



D

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 (D). The maximum is 600 seconds or 10 minutes.

Name:

```
SPM channel 3
CODE A    TLT  20
LUB      6
COND  --
```

A

NORM, TYPE, and COMP:

```
SPM channel 3
NORM  29 Acc      1
TYPE     2  rpm 1480
COMP  --  dmm    32
```

B

Alarms, links to relays:

```
SPM channel 3
TLTA 15       Relay 1
A1 LR 45      Relay 1
A2 LR 51      Relay 2
```

C

Analog output channel, range:

```
SPM channel 3
Analog out   3 LR
Analog out   4 HR
20mA = 60    dBsv
```

D

Alarm delay:

```
SPM channel 3
Alarm
delay  60 s
```

E

Press ENT to exit to the measuring mode

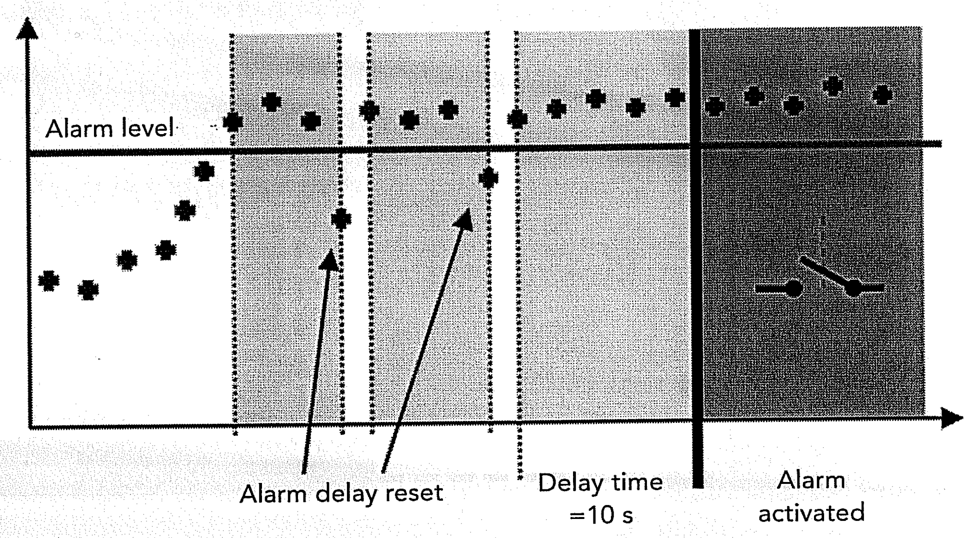
Programming a shock pulse channel for LR/HR

Select the SPM channel with the SET key, press ENT to get the programming menus. Move the cursor with SET, alter values with UP and DOWN, and select positions with RIGHT and LEFT. The menu (A) contains the channel name (can be changed), the evaluation results CODE, LUB, and COND, plus the present TLT value. For an SPM channel, TLT is a number expressing the quality of the measuring circuit. Normal values are around 20, the lowest acceptable is 15. TLT values below 15 invalidates the SPM condition evaluation because the input signal quality is poor.

NORM on line 2 of menu (B) is the NORM number of the bearing, and TYPE on line 3 its TYPE number, both needed for condition evaluation. Instead of NORM, you can input a value each for the "rpm" (shaft speed in revolutions per minute) and for "dmm" (mean bearing diameter in mm, reads "din" when inch is the selected unit). COMP is the compensation number, used in case of weak signals. Acc means accumulation and is normally 1 but should be 3 or higher on bearings with a low rpm.

On the menu (C) you can change the value for TLTA (15 = transducer line alarm) and the two standard alarm limits A1 and A2. Normally, both limits are on LR (can be changed to HR). 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. Each relay can be linked to more than one alarm cause. The setting "-" means no link to a relay.

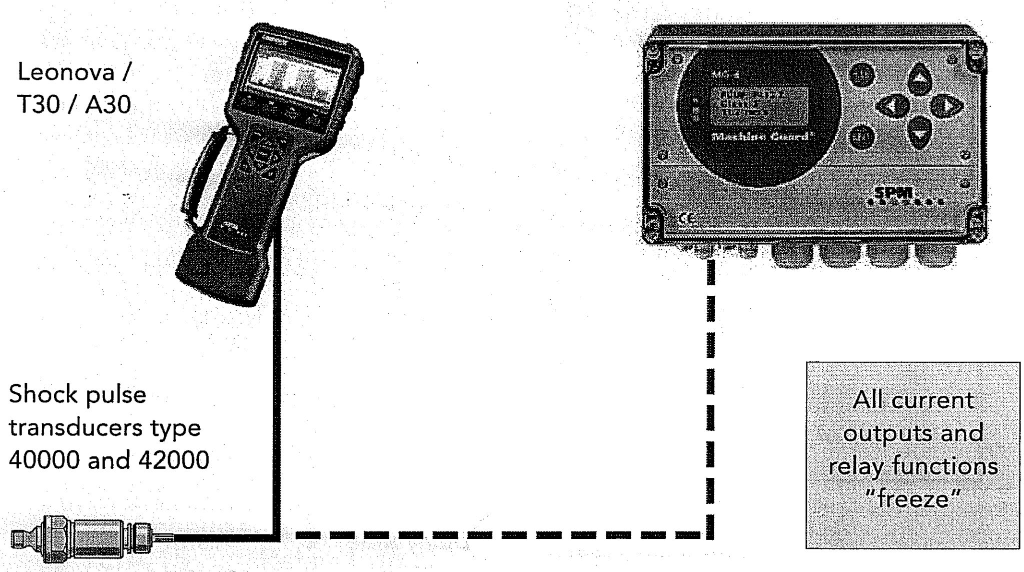
On the menu (D) you set the link to an analog output channel for the 4 - 20 mA signal by setting a channel number from 1 to max. 4. Bearing monitoring returns two values, LR for the strong shock pulses (your normal choice for the analog output) and HR for the shock carpet. The analog line can not, of course, be linked to more than one measuring channel. Only free channel numbers are displayed. The measuring range is set to between max. 10 and max. 90 dBsv. The analog current will be scaled accordingly, max. dBsv = 20 mA out. Alarm delay is set in steps of 2 seconds by stepping to a number above 0 on menu (E). 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.

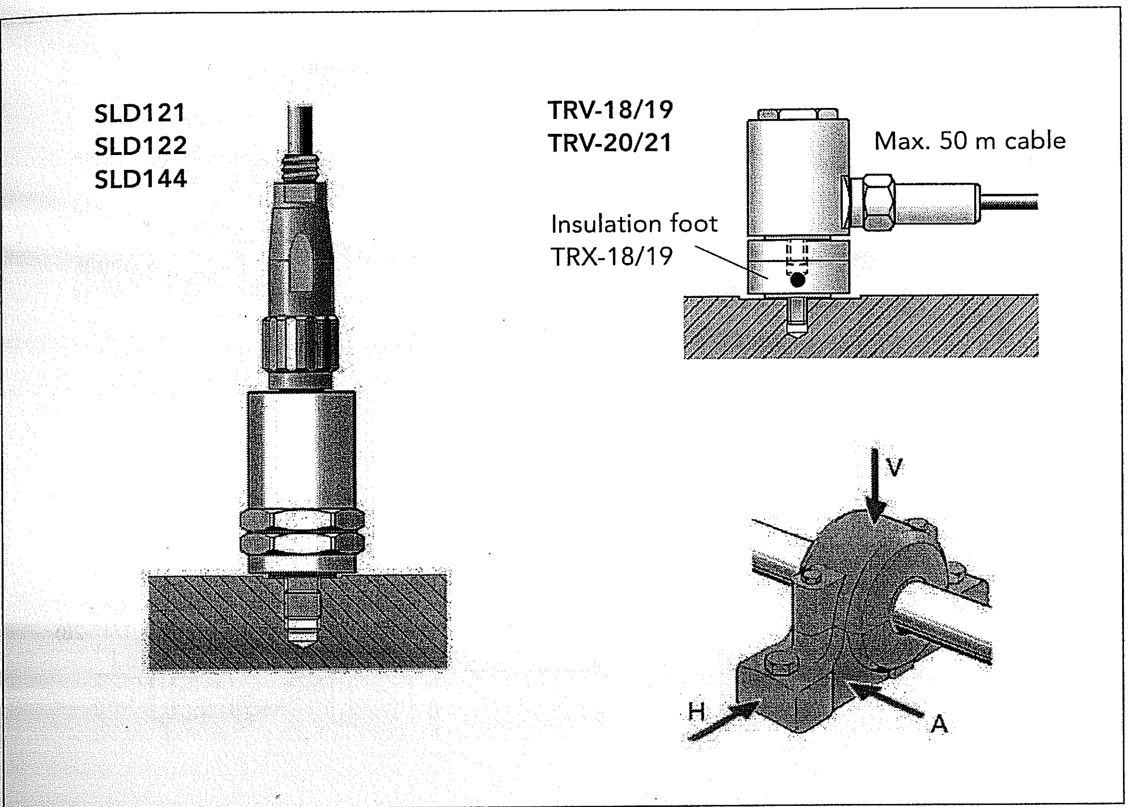


Stand-by mode

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 Leonova /T30/A30 accept both transducer types, 40000 (plus TMU) and 42000. For vibration measurement, the instrument Leonova accepts the transducer type SLD144. The vibration transducers of type SLD121/SLD122 or TRV-18/19 normally chosen with an MG4 are not compatible with the hand-held instruments.

The instruments Leonova, T30 and A30 have a recording function, allowing the recording of a programmed number of shock pulse measurements. They also download into Condmaster®, SPM's software for condition monitoring. If desired, an MG4 unit can be integrated as a "measuring terminal" into a condition monitoring system with advanced computer controlled evaluation functions.



Vibration transducers

The transducers SLD121/TRV-18/19 (linear frequency range up to 1000 Hz), SLD122/TRV-20/21 (linear frequency range up to 5000 Hz) and SLD144 (linear frequency range up to 10000 Hz) are piezoelectric accelerometers of compression type. They have built-in pre-amplifiers and are power supplied (24 Vdc) from the MG4. 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 SLD121/TRV-18/19 is 1.2 mV per m/s^2. SLD122/TRV-20/21 has 4.0 mV per m/s^2 and SLD144 has 10 $mV/m/s^2$. 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. Transducers of type SLD have thread size M8 or UNF1/4". They have SMB connector for coaxial cable or 2 pin connector for twisted pair cable.

TRV-18 and TRV-20 have thread size M8, while TRV-19 and TRV-21 have thread size UNF 1/4"-28. Transducers of type TRV 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, 15291 or 15837) 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 MG4 can cause measuring faults. Note, however, that the installation foot limits the linear range of the transducer to ≈ 2000 Hz.

Transducers of type SLD has temperature range –40° to +125° C (–40° to +260° F). TRV-18/19/20/21 has temperature range –20 to +125 °C (4 to +260 °F). The coaxial cable SPM 90005-L is specified –25 to +70 °C (–13 to +158 °F). The measuring cable SPM 90267-L is specified –55 to +150 °C (–67 to +302 °F).

SPM Instrument AB • Box 504 • SE-645 25 Strängnäs • Sweden
Tel +46 152 225 00 • Fax +46 152 15075 • info@spminstrument.se • www.spminstrument.com
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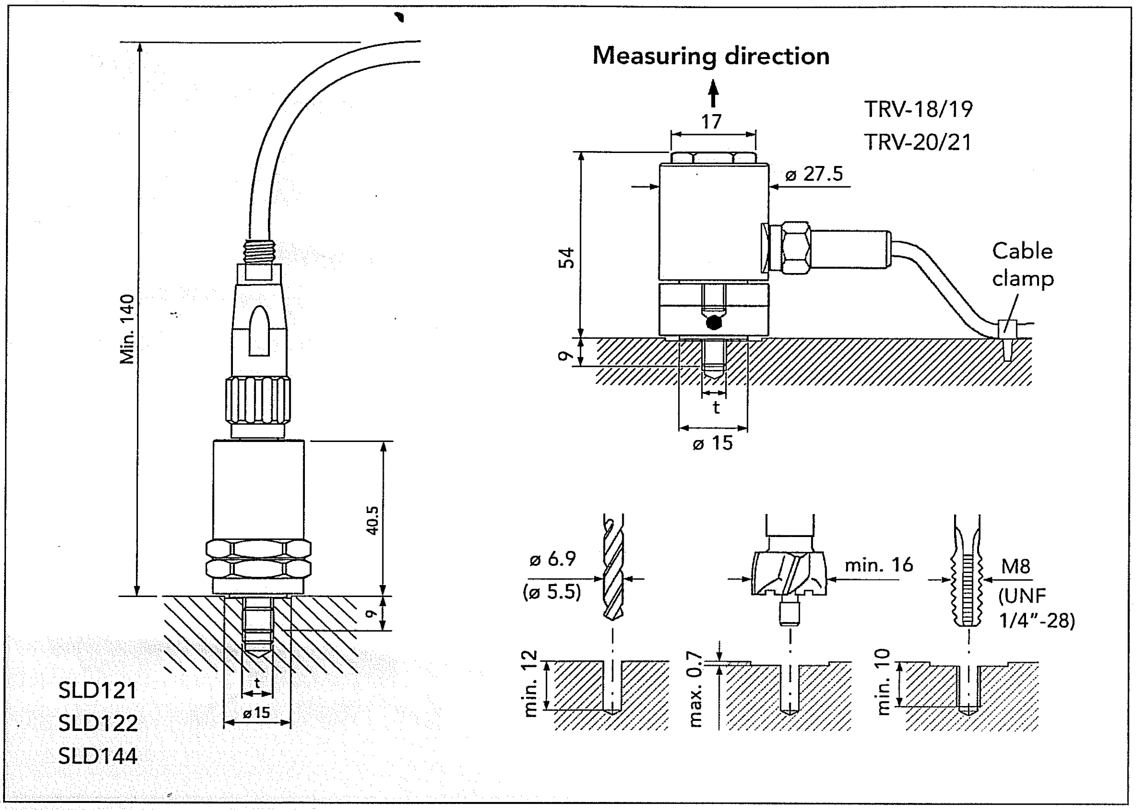
ISO 9001:2000 certified © SPM 2014-02 71945 B

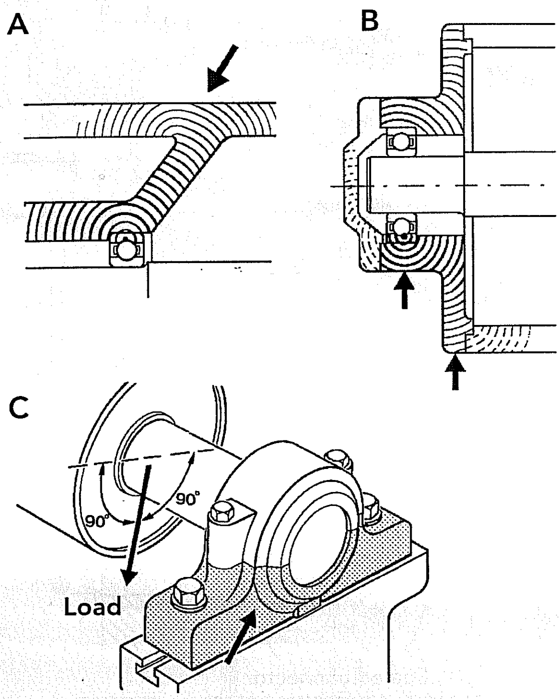


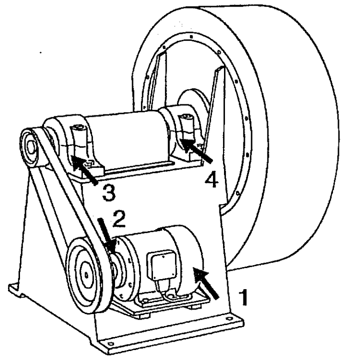
Vibration transducer installation

The transducer is mounted on the machine against a smooth, flat surface. M8 and UNF 1/4"-28 are the threads on the transducers. The transducer type TRV is supplied with three washers, each of which changes the output direction 90°. The coaxial cable must be clamped close to the transducer. A sealed cable plug 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 when using transducers of type TRV. The reason is that differences in earth potential between transducer and MG4 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 17 mm torque wrench. The torque is 10 Nm.





Load direction is mostly determined by the weight of the machine, but also by the pull of belts and the direction of the active forces

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.

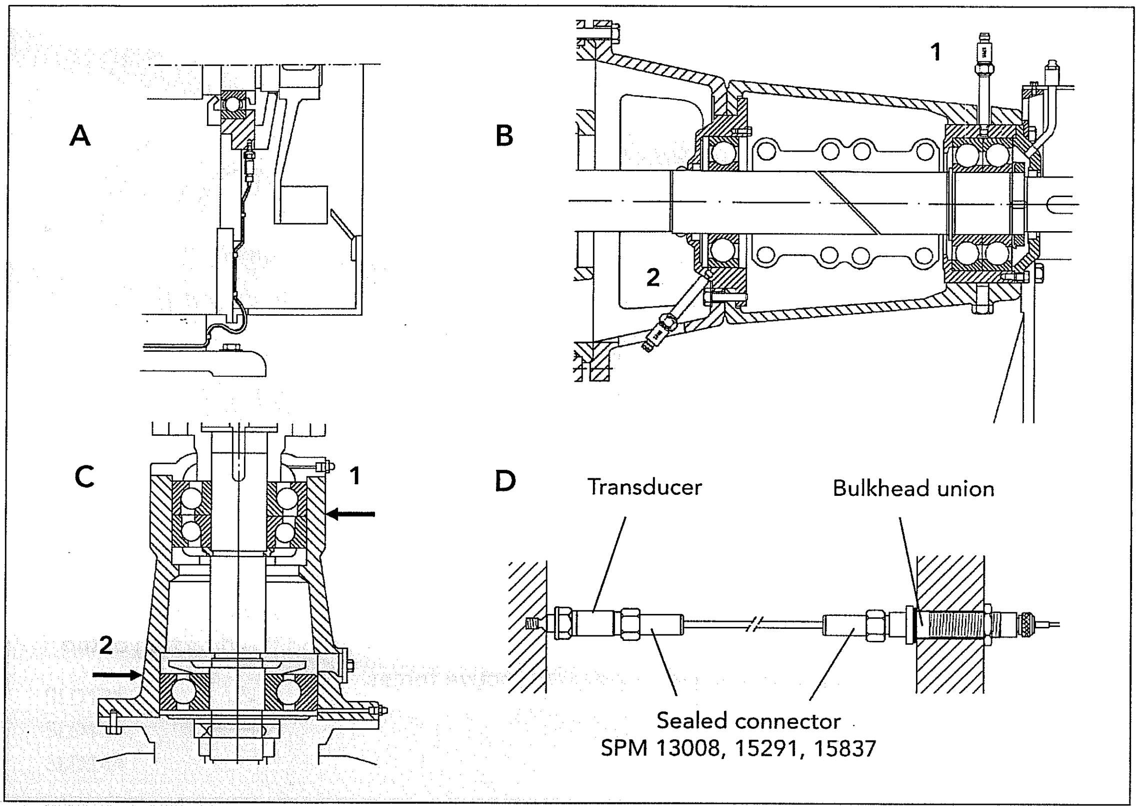
B The signal path must contain only one mechanical interface, that between the bearing and the bearing housing.

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

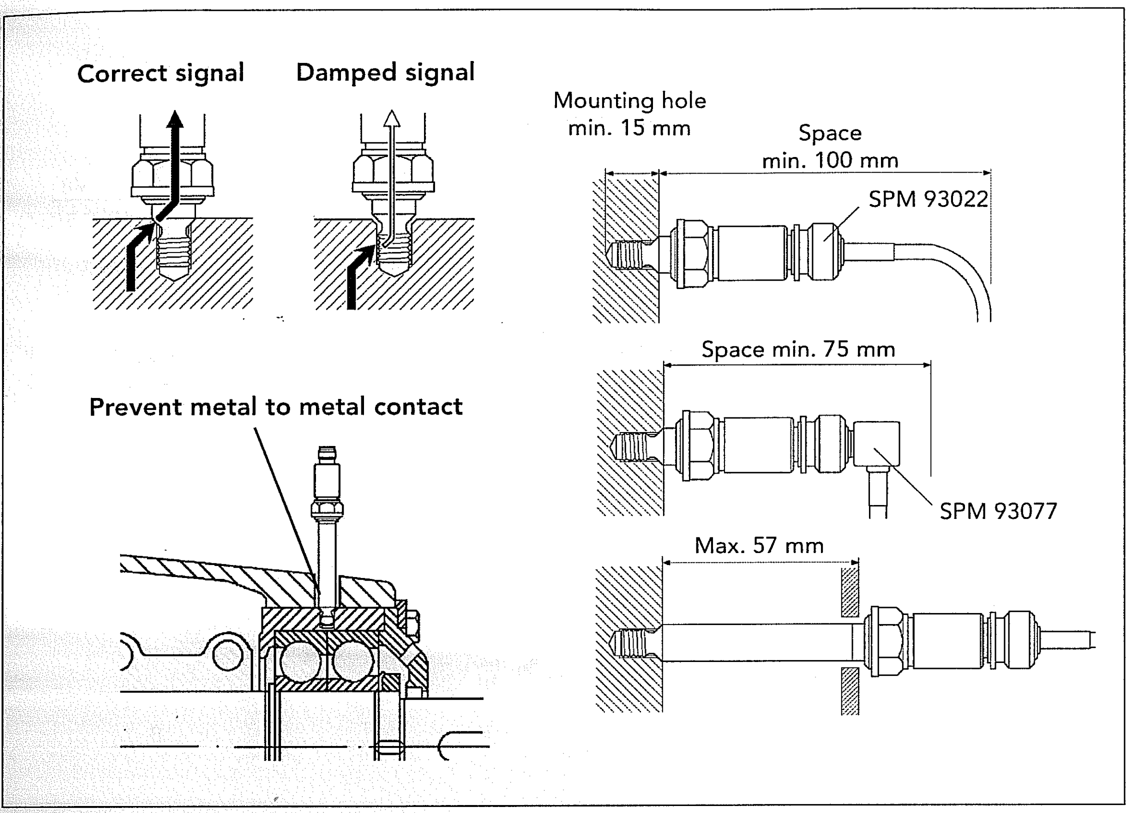
It is extremely important to mount the transducer on the bearing housing, because each interface dampens the shock signal. The damping effect, and thus its result on the condition evaluation of the bearing, cannot be measured. A correct selection of the measuring point and a correct transducer installation 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 is influences the strength of the shock signal and thus the evaluation of bearing condition.

The shock pulse transducers 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 MG4. In moist environments, a sealing TNC connector SPM 13008 must be used. An angle connector used in narrow spaces. With the extended transducer one can reach bearing housings below protecting covers, etc.

Operations

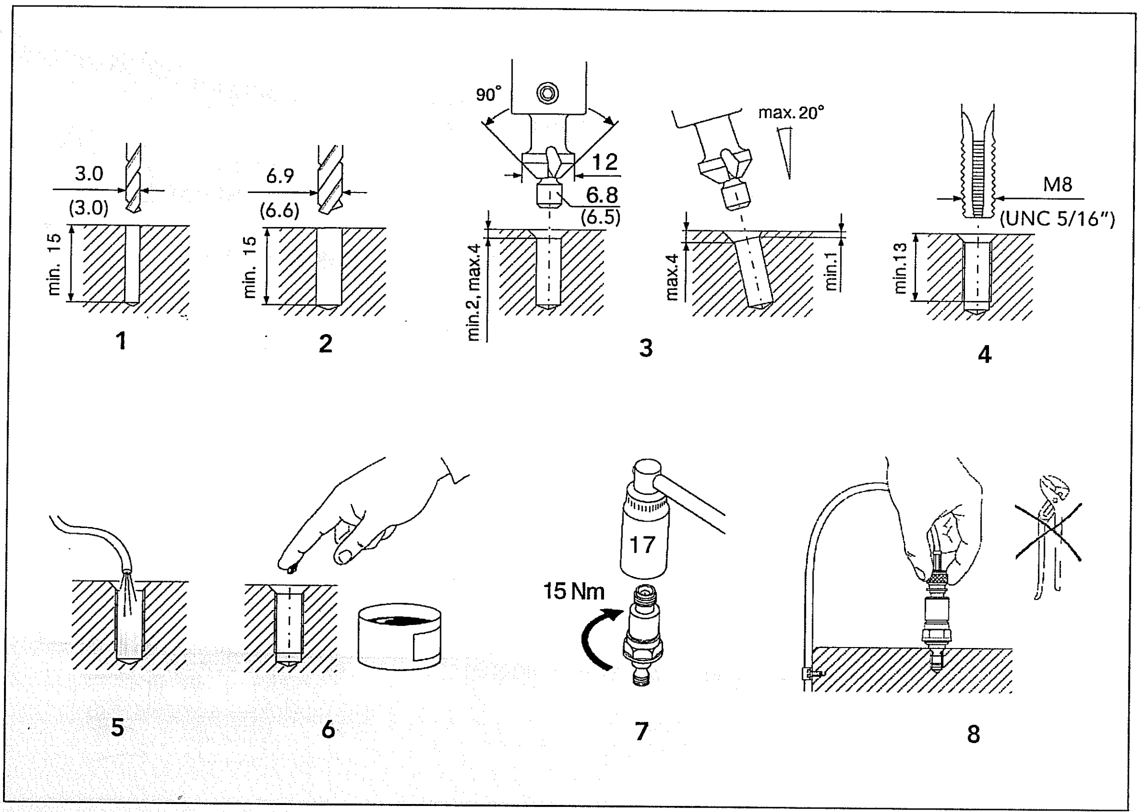
- Selection of measuring point
- Drilling, countersinking, threading and clearing of the mounting hole
- Torquing with torque wrench
- Connection of cable.

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).

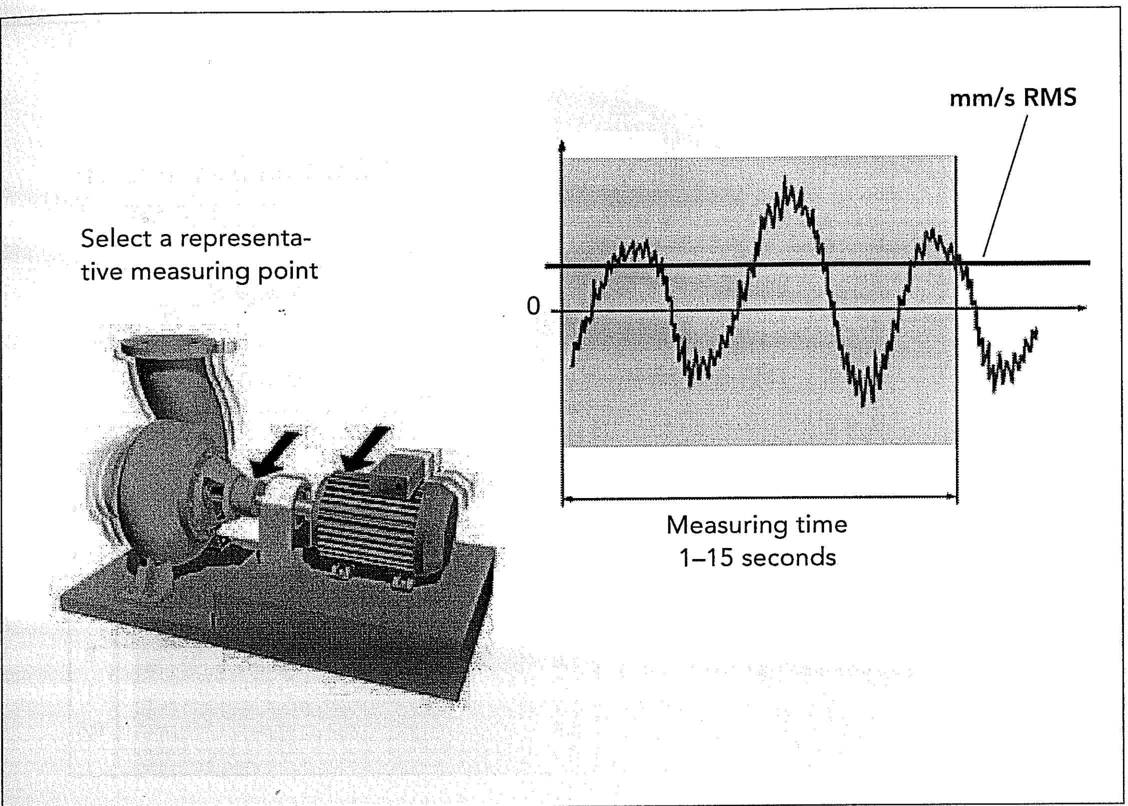
4 Thread the hole for M8 (UNC 5/16"), to a depth of min. 13 mm.

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.



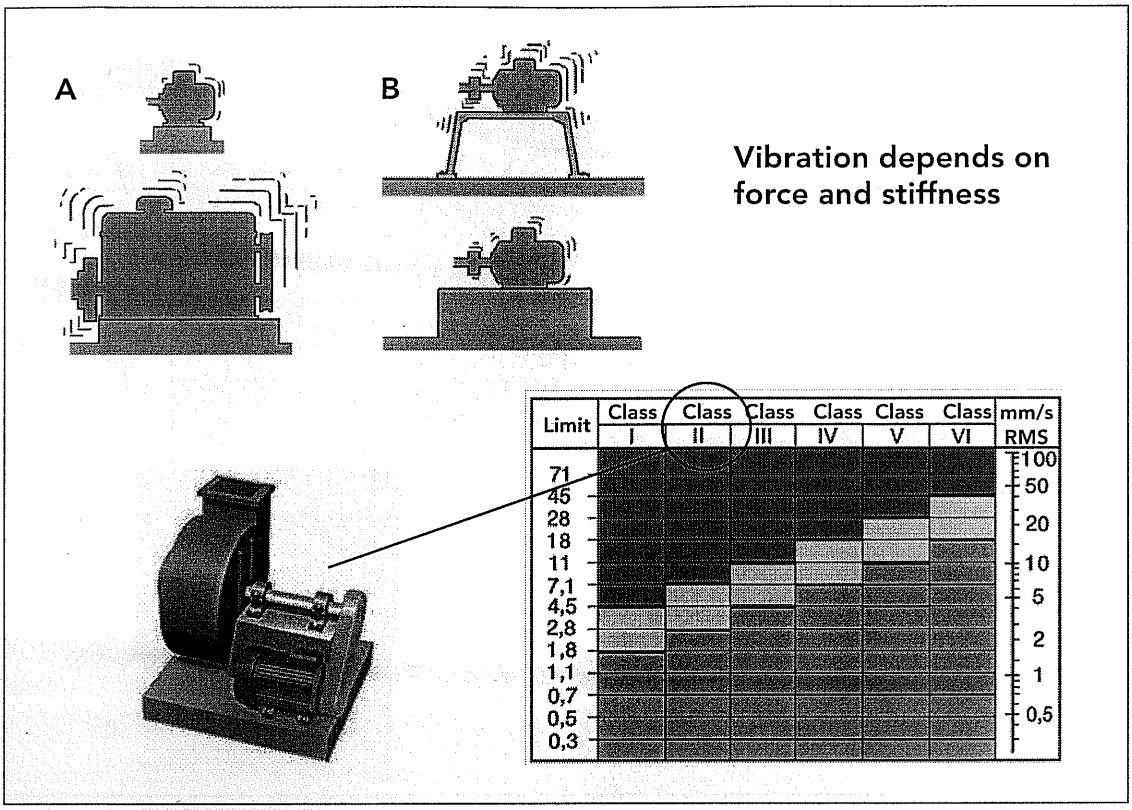
VIB – Vibration severity monitoring

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 MG4 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. MG4 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).



Vibration depends on force and stiffness

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).

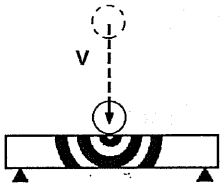
The international standards group industrial machinery into six different vibration classes, depending on machine size and function plus the stiffness of the foundation:

- 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.

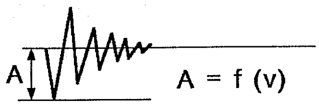
The diagram shows the limit values for all six ISO vibration classes. For each class, the standards give vibration severity levels ranging from very good condition through average and poor to bad. From one limit value to the next value above, vibration severity increases 1.6 times (1 step). From one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

Results of an impact:

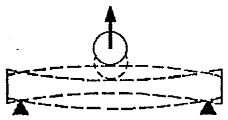


Event 1: a shock wave spreads through the material

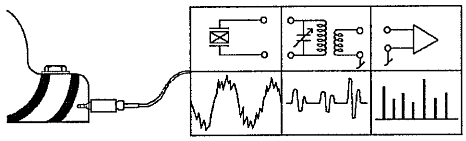
Shock pulse measurement:



1. Shock waves converted to electric pulses



Event 2: the body vibrates



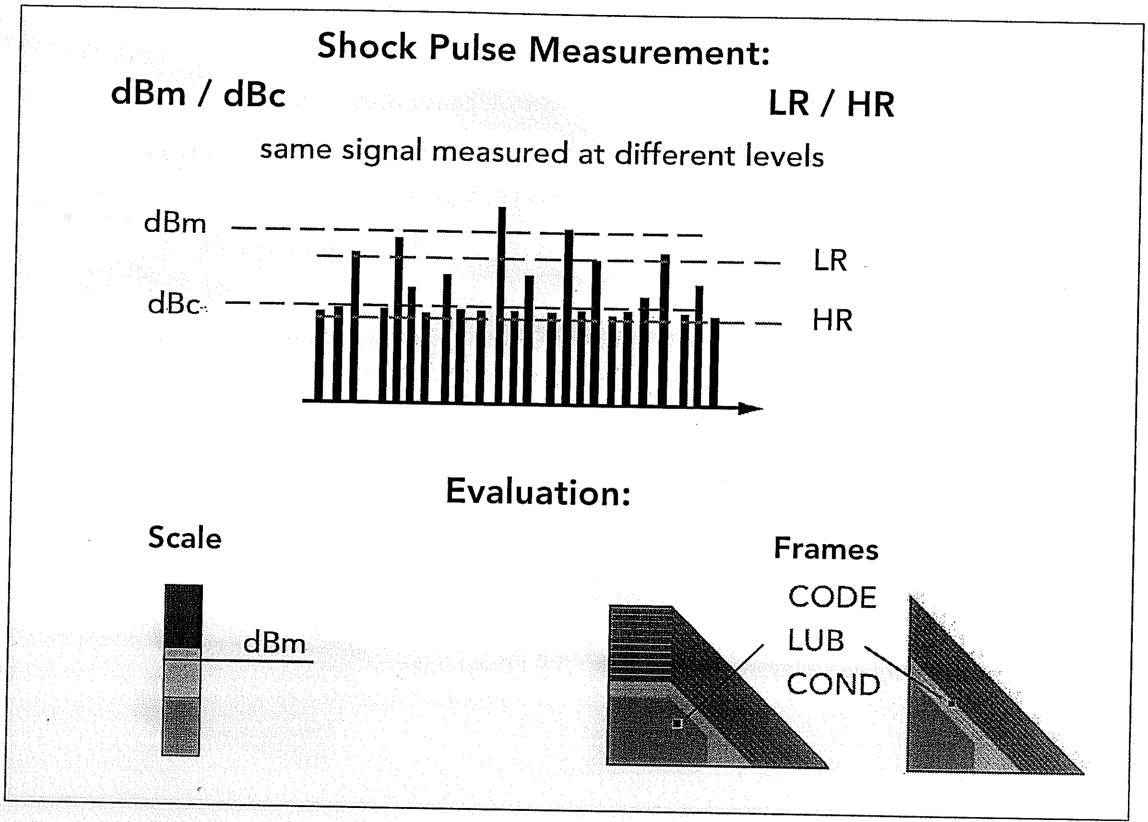
2. Pulse magnitude is measured, vibration filtered out

SPM - shock pulse measurement, dBm/dBc

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.

SPM Instrument AB • Box 504 • SE-645 25 Strängnäs • Sweden
Tel +46 152 225 00 • Fax +46 152 15075 • info@spminstrument.se • www.spminstrument.com



The difference between dBm/dBc and LR/HR

The signal from a shock pulse transducer consists of a train of stronger and weaker electric pulses, analog to the shock pulses emitted by the source. SPM has developed two quantifying techniques for this shock pulse pattern: dBm/dBc and LR/HR. MG4 can handle either, depending on the setting.

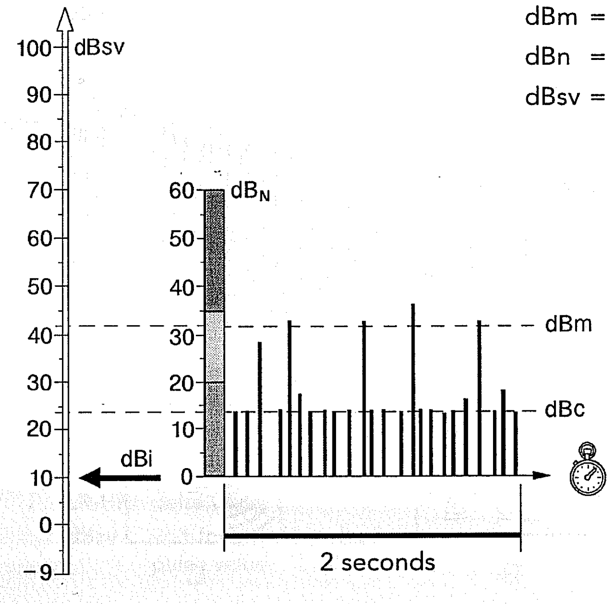
The dBm is a maximum value defining the strongest pulse in the time window. It is the indicator for bearing damage. The dBc or carpet value is read at the level where about 200 pulses/second are registered. It is the indicator for lubrication condition. To evaluate these values, they are measured on a normalized decibel scale. Normalized means that the scale is adjusted with regard to the basic bearing data: shaft diameter and rpm. The MG4 displays normalized values for dBm/dBc and indicates bearing condition with green - yellow -red LEDs.

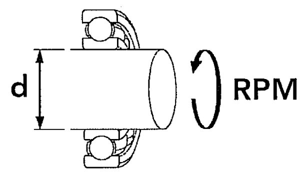
When using the LR/HR technique, the MG4 displays the values LR and HR. LR (from "Low Rate of occurrence") is an average value of the stronger pulse in the measuring window. It corresponds to but is not equal with the maximum value. HR (from "High Rate of occurrence") is read at the level where about 1000 pulses/second are registered. It corresponds to but is not equal with the carpet value. Both are "raw data", measured on an unnormalized decibel scale. The evaluation produces three results:

CODE A to D (describing condition), the LUB no. (for lubrication condition), and the COND no. (indicating damage severity). You can also get different error codes. The LR/HR technique requires more input data for the evaluation: the mean diameter of the bearing (which described bearing size more accurately than the shaft diameter), the rpm, and the TYPE number of the bearing (which describes the bearing geometry, e. g. single row ball bearing or double row cylindrical roller bearing). This data determines the bearing's evaluation frame. The frame is more complex than the normalized scale, but also has the green-yellow-red evaluation zones. It allows a finer distinction of "poor bearing condition", which can be due to lubrication or to mechanical damage.

dBm/dBc

dBi = Initial value of a bearing
dBc = Carpet value (weak pulses)
dBm = Maximum value (strong pulses)
dBn = Unit for normalized shock level
dBsv = Unit for absolute shock level





The initial value dBi depends on rpm and shaft diameter d.

The dBm/dBc technique

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 MG4 has to be programmed with shaft diameter (in millimetre or inch) and rotational speed (in rpm).

The MG4 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.

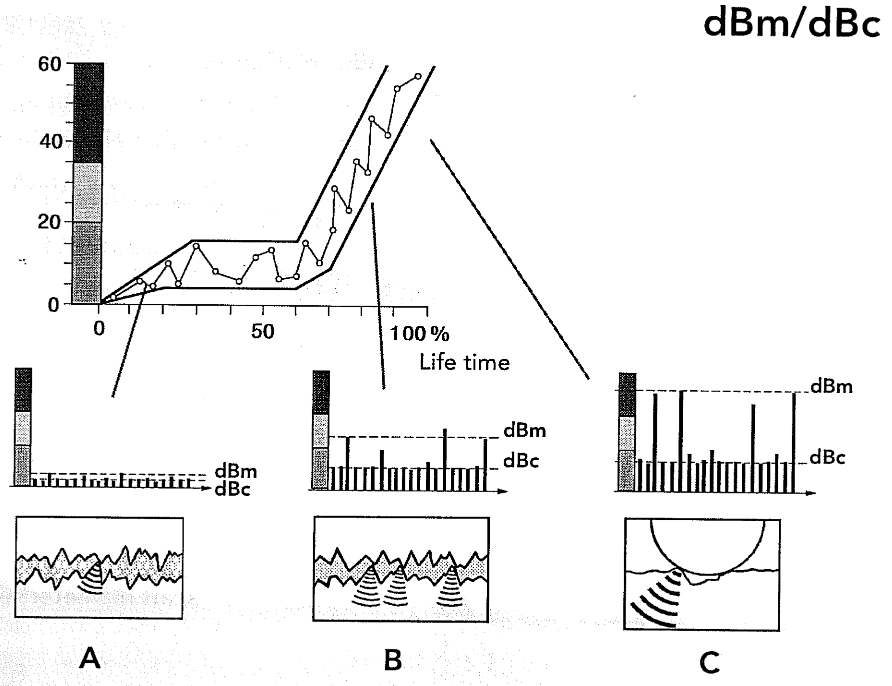
The MG4 takes a sample count of the shock pulses occurring over a period of time and displays:

- the **maximum value dBm** for the small number of strong shock pulses in the measuring time window (2 seconds for the MG4).
- 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.