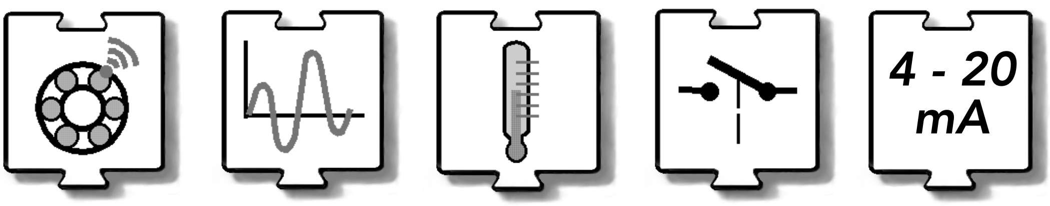
Instruction Manual
for the CMM System



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Safety Precautions

The local safety precautions of the site in question are applicable for all installation work. The manager for the installation work should be assure that all personnel, dealing with the installation, is familiar with the safety regulations before any work is commenced. In case of doubt the local management should be consulted.

Monitoring Modules

Measuring units should be located in a protected position assigned by the local contact. The modules shall be easily accessible for undisturbed measurements and service.

The cables should be marked according to the agreement with the local contact.

Work Regulations

All the personnel should be provided with the local work regulation before any work is commenced.

It is important that parts of rubber and plastics are dumped in special containers. Such parts can cause bad accidents and production disturbances if dropped on the wrong place. From environmental point of view wrapping materials should be collected for not causing any damage.

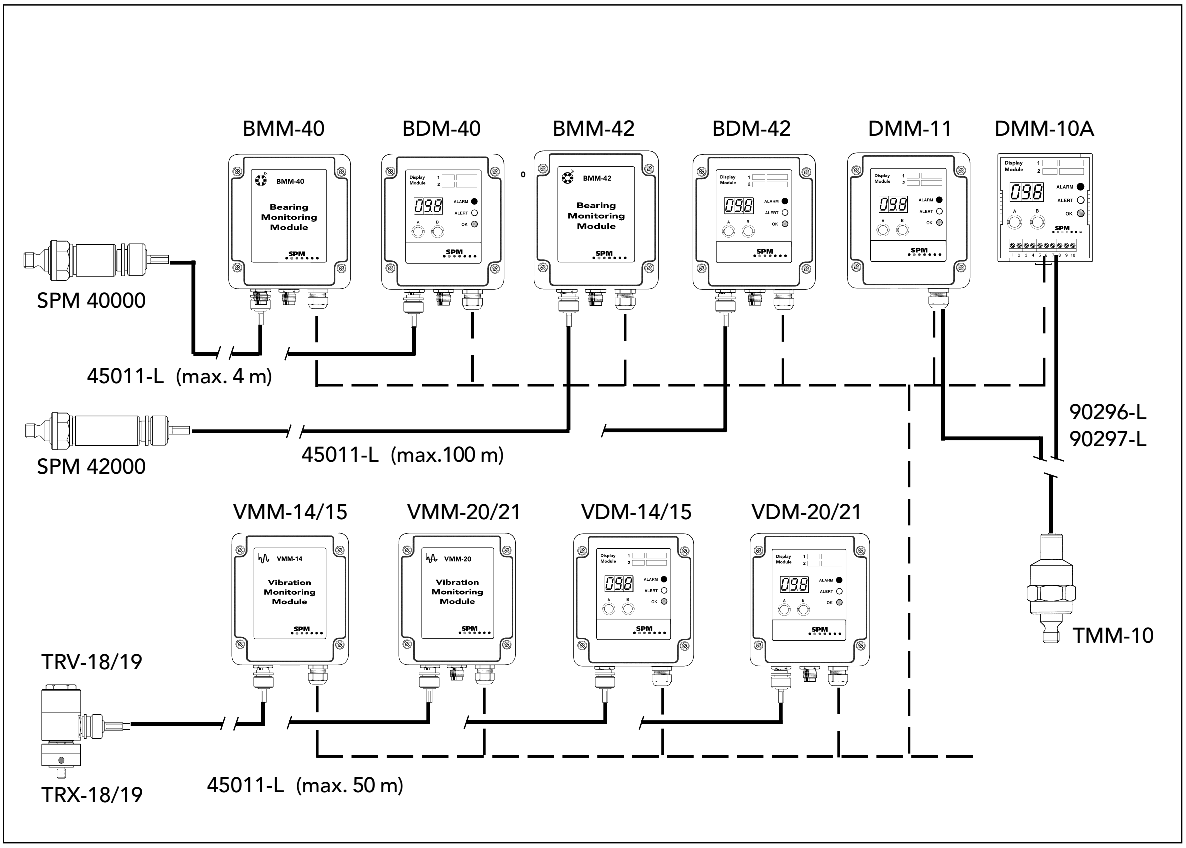
Precautions should also be taken when drilling, tapering and grinding to avoid that chips and grindings cause accidents and production disturbances.

Inspection and Acceptance

Inspection of transducer positioning, connections, cable laying, TMU installations and strapping should take place after finished installation. Inspection protocol in accordance with the local regulations, or alternatively SPM BLS 43/4, should be used.

Signal Transmission Test

A so called knock-test for checking that all transducers are working and connected to correct channel should be executed. Connect a display module or a milliamperemeter to the analog output of the unit. Then you knock on the transducer with e. g. an aluminium bar and check that you get a reaction on the corresponding analog output.



The CMM System

Introduction

The CMM Systyem from SPM Instrument AB is a family of small, cost efficient Condition Monitoring Modules - CMM - including transducers, and combined display and measuring units.

It is intended for permanent installation to monitor anything that needs monitoring, to display information locally, and to supply a universally accepted output signal.

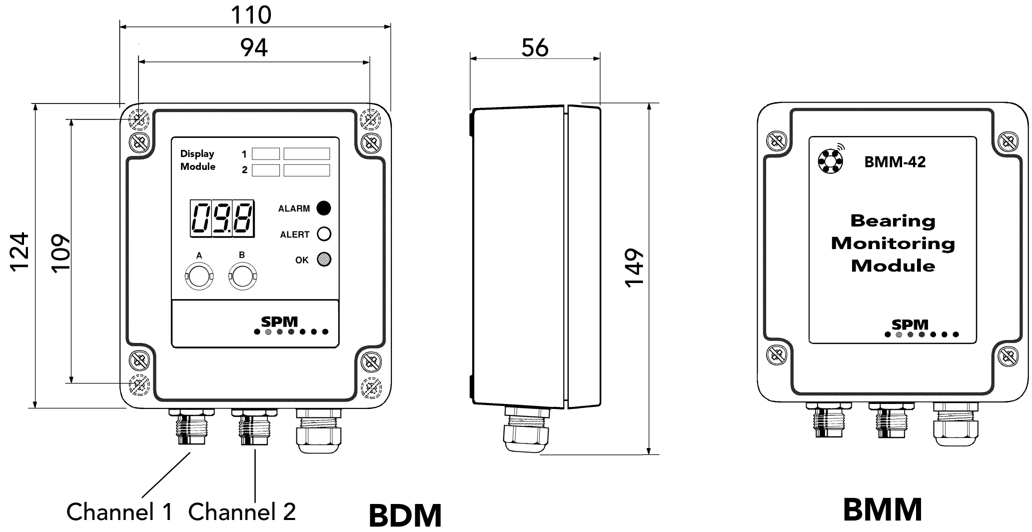
The transducers measure bearing condition according to the shock pulse method, vibration severity according to ISO 10816, and temperature.

The units transform the shock pulse and vibration transducer signals into 4 to 20 mA analog signals. The temperature transducer has an output of 4 to 20 mA. These 4-20 mA signals can represent any measured quantity and are universally used in PLC systems.

Transducer lines are automatically monitored for system faults.

Parts exposed to harsh environments are robust, non-corrosive, sealed or waterproof.

The CMM modules can be used as parts of any data collecting, analysing, and control system that accept 4-20 mA input. They can be connected to a measuring unit in SPM's CMS System, and use the software CONDMASTER®Pro for data processing in a PC based monitoring system.



Bearing modules have the same dimensions in all makes.

Bearing Monitoring Modules BMM / BDM

The Bearing Monitoring Modules are two-channel programmable converters which output 4-20 mA proportional to the unnormalized maximum value of the shock pulses measured on bearings. The measuring time is approximately 1 second per channel. The measuring range for both channels together can be jumper set to either 0 to 80 or 20 to 100 dBsv. See diagram on next page.

The task of the BMM module is to convert the transducer signal into a 4-20 mA current, which can be supplied to a display module of type DMM, or directly to a PLC or a computer controlled monitoring system (e.g. SPM's CMS System).

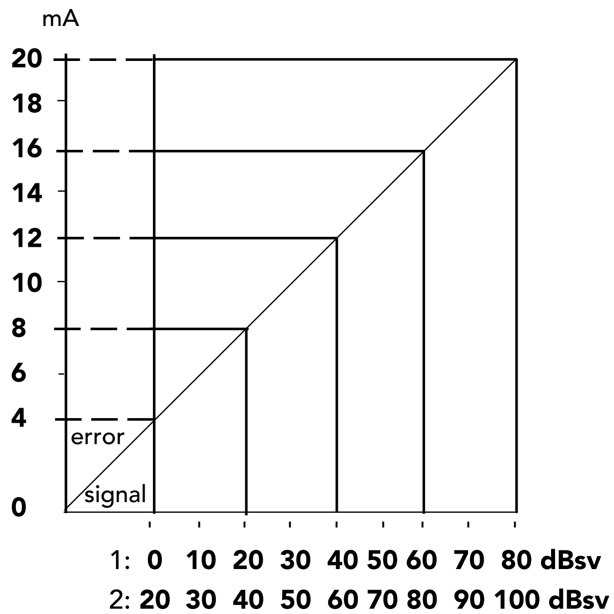
The BDM modules can in addition show the measuring value on the display and alarms can be trigged via the relay functions.

An interruption or fault in the transducer line is indicated by an output of <1 mA. This signal can be eliminated by a jumper setting for calibration, service or other reason.

The module housing has a transparent lid fixed to the box by four screws and has to be opened at installation and programming, but the display and LEDs on the BDM modules are clearly visible for inspection. The box has two TNC signal cable inlets. The input channels are connected to SPM shock pulse transducers via coaxial cables: **BMM/BDM 40 to transducers of series SPM 40000** and **BMM/BDM 42 to transducers of series SPM 42000**.

The module is wall mounted with 4 screws ø 4 mm and supplied with 12 to 24 V DC ± 10 %. The cable inlet is tight for cable diameters 5.5 to 10 mm.

Serial number indication is printed on top of the module.
The front lable has windows for the client's own designation.



Signal Conversion Diagram

Technical Data for Bearing Monitoring Modules

Measuring method:	shock pulse measurement SPM dBm, unnormalized maximum value
Channels:	2 multiplexing

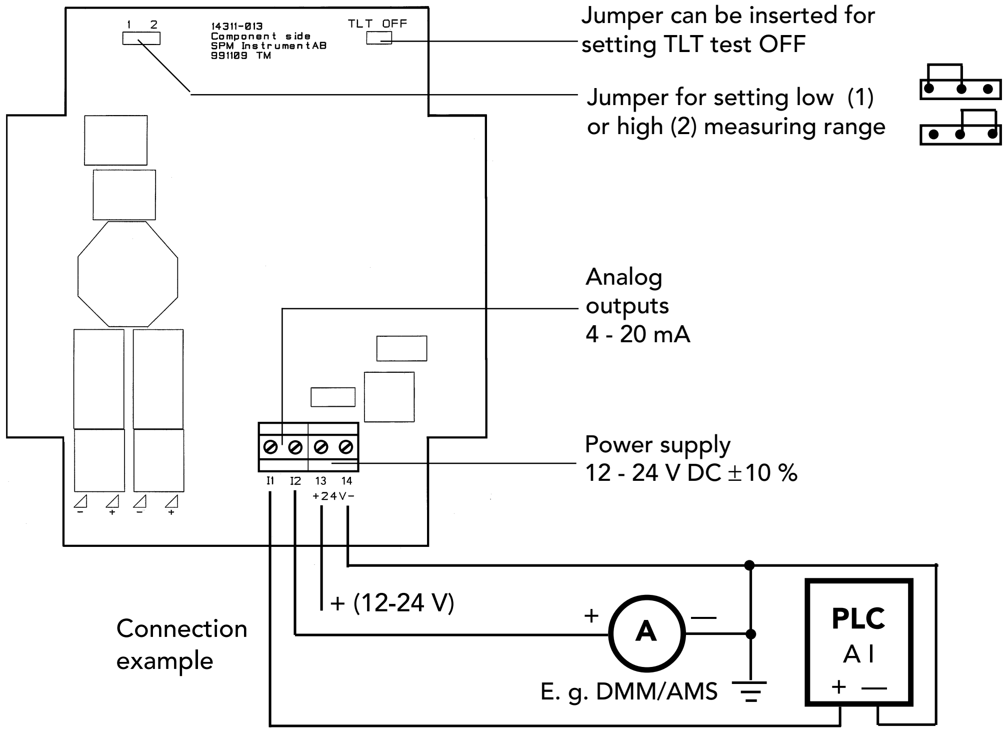
Measuring range jumper, to be set for each channel:

Measuring range 1:	SPM 0 to 80 dBsv	5 dB /mA	0.2 mA/dB
Measuring range 2:	SPM 20 to 100 dBsv	6.3 dB /mA	0.16 mA/dB

Transducer series:	series SPM 40000 (BMM/BDM 40), series SPM 42000 (BMM/BDM 42)
Transducer cable:	coaxial cable, SPM 90005-L, or 90267-L (high temperature) max. length 4 m (BMM/BDM 40), max. length 100 m (BMM/BDM 42)
Analog output:	4 to 20 mA
Relays (2):	max. 24 V/100 mA (BDM only)
TLT test:	<1 mA out = interrupted or faulty transducer line
Loop resistance:	max. 450 Ω at 12 V, 1.1 kΩ at 24 V
Power supply:	12 to 24V DC (± 10%, tested according to EN 50082-2)
Supply current:	BMM = max. 0.1 A , BDM = max. 0.15 A
Housing:	polycarbonate, IP65
Temperature range:	0° to 55° C
Vibr. severity envir.:	max 5 mm/s
Dimensions:	110 x 149 x 56 mm
Cable inlet:	5.5 - 10 mm
Mounting screws:	4 screws, ø 4 mm, spacing 109 x 94 mm
Weights:	display units, BDM = 400 g, modules without display, BMM = 300 g

Value display (BDM):	3 digits, red LED
Status display (BDM):	green, yellow, and red LED
Alarm limits (BDM):	2 per input channel, set with pushbuttons
Push-buttons (BDM):	2, for display control, alarm limit and alarm delay setting

Circuit board for BMM/BDM 40 module



Installation of Bearing Monitoring Modules

The modules of type BMM/BDM 40/42 are two-channel units for monitoring bearing condition (unnormalized maximum value in dBsv). They have analog outputs of 4 to 20 mA.

BMM/BDM 40 are intended for use together with SPM shock pulse transducer type **40000** (cable length to the module max. 4 m).

BMM/BDM 42 is used with a SPM shock pulse transducer type **42000** (cable length to the module max. 100 m).

They have a jumper sockets for setting the measuring ranges: 1 = **0 to 80** dBsv, or 2 = **20 to 100** dBsv. Jumper position is indicated on above figure.

The modules are wall mounted by means of 4 screws through the back of the casing, ø 4 mm, spacing 109 x 94 mm. Incoming power supply cable must have a diameter of 5.5 to 10 mm to maintain IP 65.

The power supply is 12 to 24 V DC ± 10 % supply voltage. Modules of type BMM can be connected to a display module of type DMM-10A/11 for local indication of measuring values and/or to the analog input AI of a PLC. See above figure.

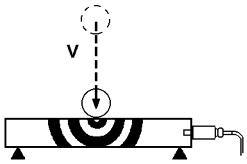
Alarm levels, set in the display module or the PLC, depend on bearing diameter and r.p.m. In the diagrams on page 11, the alarm level in mA corresponds to a normalized shock value of 35 dBn, i. e. the lower limit of the red "bad condition" zone.

Between every 5th measurement (approx once per 10 sec.) the unit checks the condition of the transducer connections. In case of bad - open or short circuit - the unit indicates it with < 1 mA on the corresponding analog output.

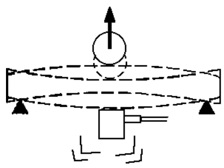
TLT is factory set ON. A jumper can be installed for setting TLT OFF = signal out min. 4 mA.

Connection of display module is described on page 19, and programming on page 20.

Results of an impact:

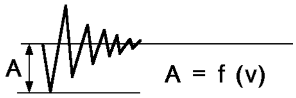


Event 1: a shock wave spreds through the material

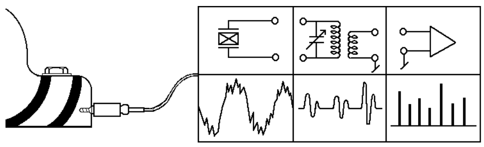


Event 2: the body vibrates

Shock pulse measurement:



1. Shock waves converted to electric pulses

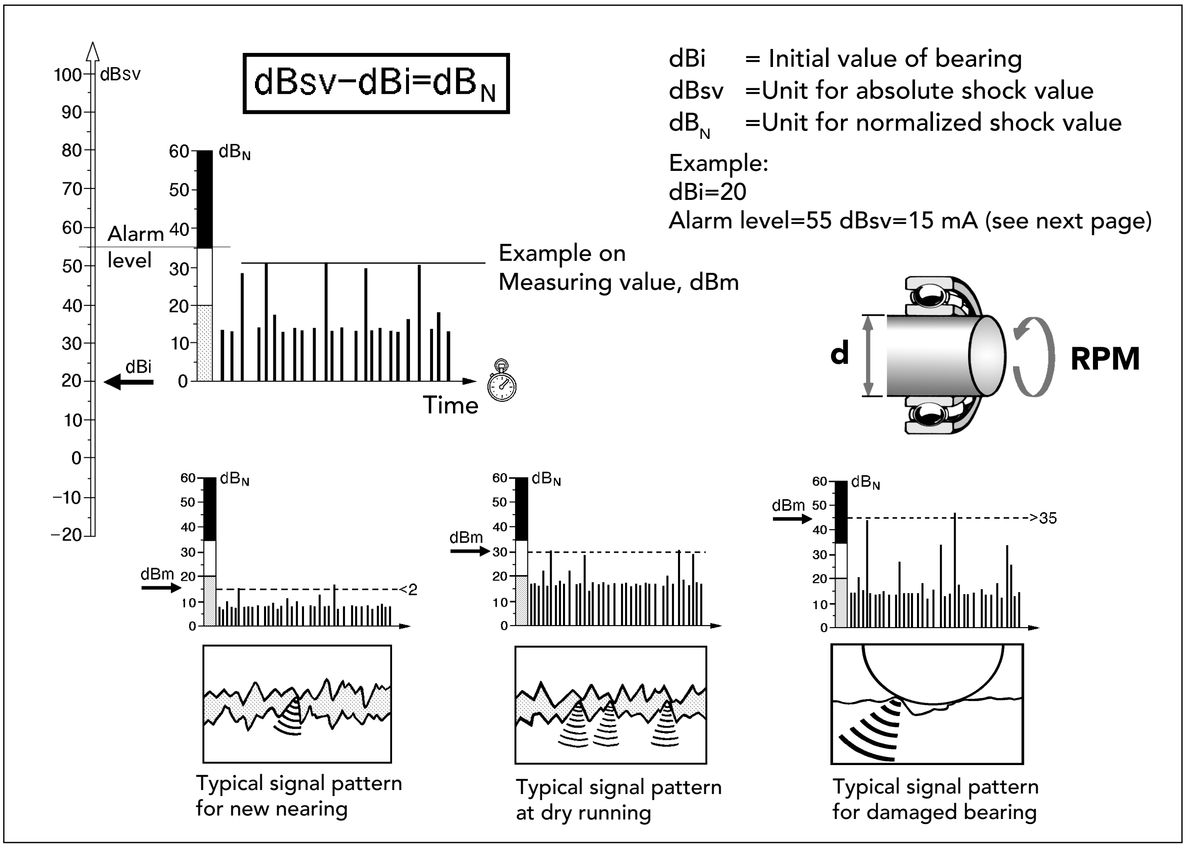


2. Pulse magnitude is measured, vibration filtered out

The Principle of the Shock Pulse Method

The Shock Pulse Method for bearing condition monitoring (SPM) is briefly described here. 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.



Alarm Setting and Evaluation of Shock Pulse Measurements

Shock pulses are generated in the loaded contact area between the rolling elements and the raceways in a rolling bearing. All bearing surfaces have a certain degree of roughness. Shock pulses of different magnitudes are the result of:

- pressure variations in the contact area and impacts between colliding peaks in undamaged bearing surfaces which are partly separated by an oil film.
- severe impacts caused by rolling elements hitting damaged areas in the raceway or other obstacles, such as contaminations in the lubricant.

In new bearings, the magnitude and distribution pattern of the shock pulses depend mainly on the thickness of the oil film in the contact area. During the service life of a bearing, its general shock level tends to increase slowly. A marked rise is a sign of increasing stress in the material and minor damage. This should be the shock level monitored by the CMM System. Once damage has started it will increase, but there should be enough time (several months, unless shock values rapidly increase) to prepare for the bearing replacement.

Shock Pulse Level is Speed Related

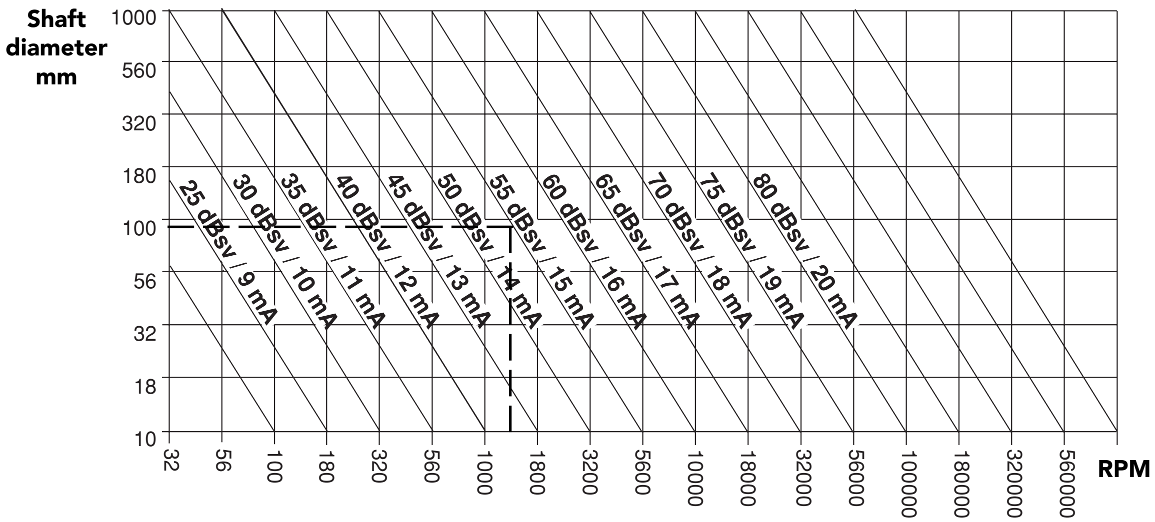
Because the shock level is a function of the rolling velocity as well as of bearing condition, it is necessary to define normal shock levels for good bearings, and the range between good and bad condition.

Above is shown two measuring scales, an absolute "unnormalized" scale graded in dBsv (decibel shock value), and a "normalized" scale graded in dB_N (normalized shock value). The normalized scale starts at the initial value dBi of the bearing, which is calculated from the shaft diameter and rpm. The dBn scale is divided into three condition zones, indicating good (0 - 20 dB_N), reduced (21 - 35 dB_N), and bad condition (>35 dB_N).

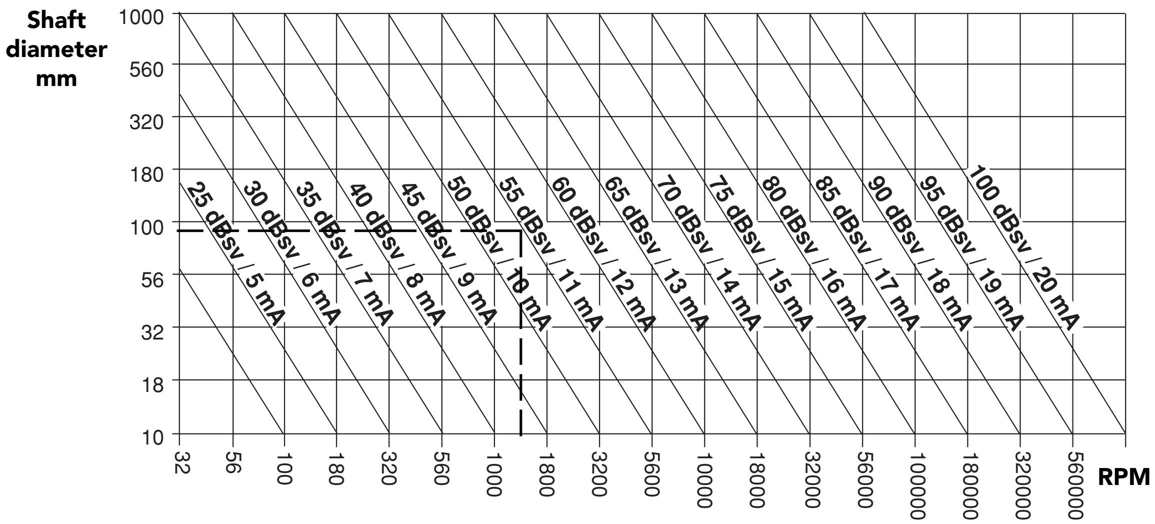
Adjusting the Alarm Level

The alarm level is programmed on the display module or PLC according to the diagrams on next page. A trend can be achieved by starting to monitor at a low level (e.g. 25-30 dB_N) and then state intervals where the alarm level had to be increased. The best way to find the correct dBi is to use an instrument of type SPM Tester T30.

Measuring range 0 to 80 dBsv, alarm level at 35 dBn



Measuring range 20 to 100 dBsv, alarm level at 35 dBn



The initial shock pulse level (dBi = decibel initial) of rolling bearings in good condition depends on bearing size and rotational speed. The beginning of the red "bad condition" zone is normally dBi + 35 dB (35 dB_N on the normalized scale). In the diagrams, this level is shown in dBsv (unnormalized shock value) and in mA.

Example:
A bearing with shaft diameter d = 90 mm and rotational speed = 1485 r.p.m. has a dBi of 20. 35 dBn thus corresponds to 55 dBsv, that is 15 mA for measuring range 0 to 80 dBsv, and 11 mA for measuring range 20 to 100 dBsv.

As signal strength also depends on the quality of the measuring point, it may be necessary to adjust the alarm level to the individual bearing, normally downwards, as e.g. at low speed etc.

Whenever possible, the bearing should be measured with a Shock Pulse Tester before setting alarm levels. This instrument will also show the exact initial value dBi of a bearing when shaft diameter and r.p.m. are input.

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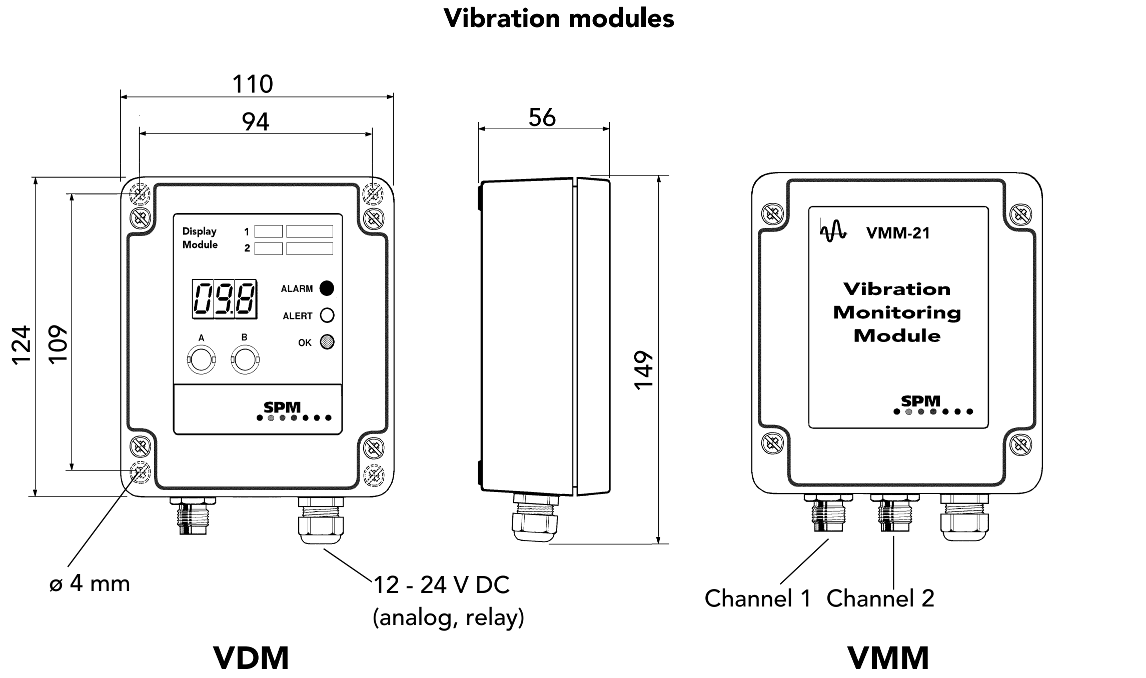


Vibration Modules VMM / VDM

Vibration Monitoring Modules are programmable converters which supply a 4-20 mA signal proportional to the RMS-value of the vibration velocity measured in two frequency ranges. **10 to 1000 Hz** (VDM/VMM-14/20) and **3 to 1000 Hz** (VDM/VMM-15/21). This later range is suitable for machines with rotational speed down to 180 r.p.m.

The measuring range can be set by means of a DIP switch to either 0 to 5, 0 to 10, 0 to 20 or 0 to 40 mm/s.

The task of the VMM module is to convert the transducer signal into a 4-20 mA current, which can be supplied to a module with display of type DMM, or directly to a PLC or SPM's monitoring system CMS.

The VDM modules can in addition show the measuring value on the display and alarms can be trigged via the relay functions.

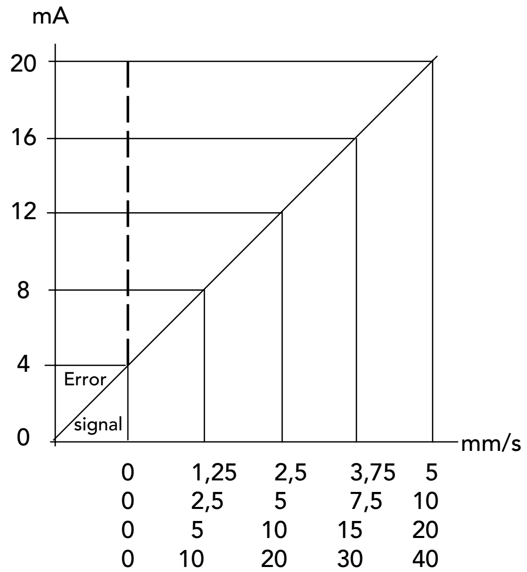
An interruption or fault in the transducer line is indicated by an output of <1 mA. This error signal can be eliminated to min. 4 mA by a jumper setting, separate for each channel. See page 13.

The module is wall mounted with 4 screws ø 4 mm with a spacing of 109 x 94 mm. The module housing has a transparent lid fixed to the box by four screws and has to be opened at installation and programming, but the display and LEDs on the VDM modules are clearly visible for inspection.

The module is supplied with 12 to 24 V DC ± 10 %. The cable inlet is tight for cable diameters 5.5 to 10 mm.

The box has one (VMM/VDM-14/15) or two (VMM/VDM-20/21) TNC signal cable inlets. The input channel is connected to a SPM vibration transducer TRV-18/19 + TRX-18/19 via a suitable coaxial cable selected from the System Component List.

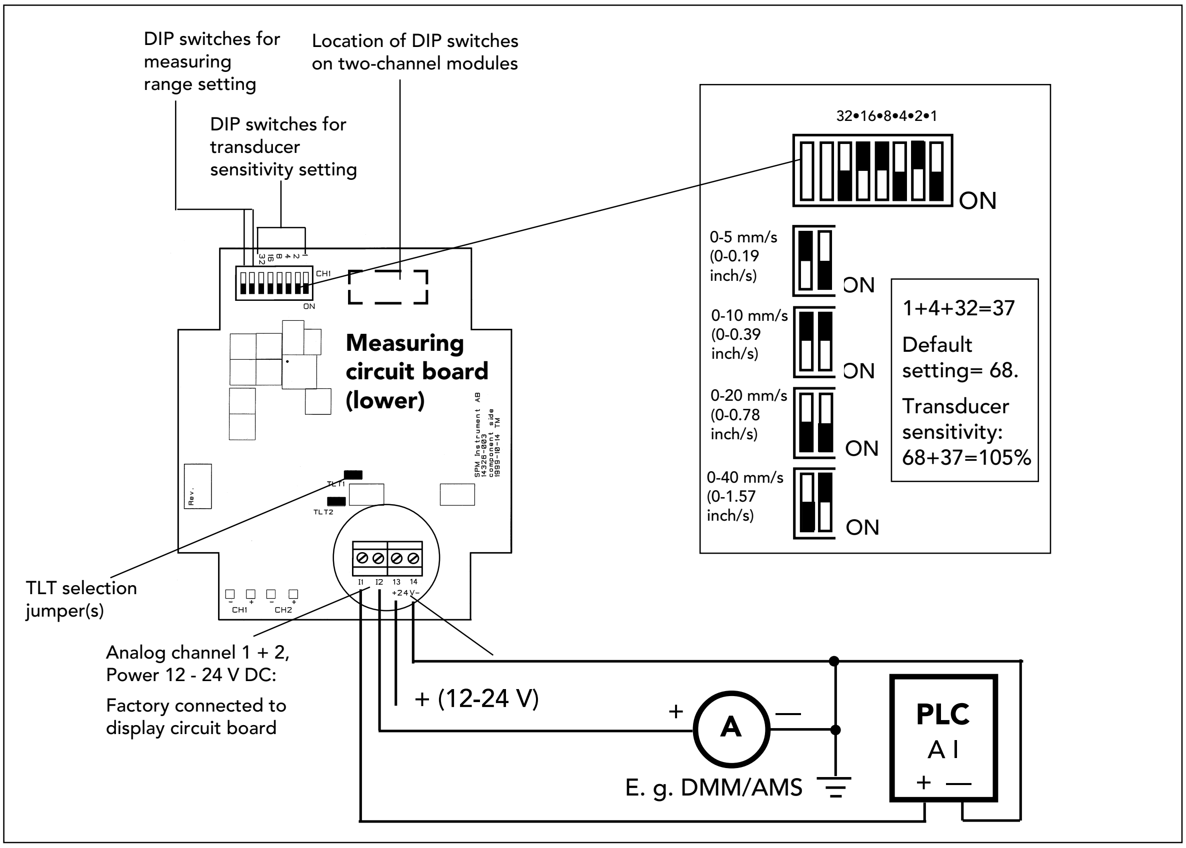
Serial number indication is printed on top of the module.
The front lable has windows for the client's own designation.



Scale conversion diagram.
Signal output/measuring range

Technical Data for Vibration Modules VMM / VDM

Measuring method:	vibration severity similar to ISO 10816 (modified frequency range, VMM/VDM-15/21)		
Channels:	1 (VMM-14/15, VDM-14/15)		
	2 (VMM-20/21, VDM-20/21)		
Measuring range switch, adjustable for each channel		**mm/s/mA**	**mA/mm/s**
Measuring range 1:	0 to 5 mm/s (0 to 0.19 inch/s),	0.313	3.2
Measuring range 2:	0 to 10 mm/s (0 to 0.39 inch/s),	0.625	1.6
Measuring range 3:	0 to 20 mm/s (0 to 0.78 inch/s),	1.25	0.8
Measuring range 4:	0 to 40 mm/s (0 to 1.57 inch/s),	2.5	0.4
Frequency range:	10 to 1000 Hz (VMM-14/20, VDM-14/15		
	3 to 1000 Hz (VMM-15/21, VDM-15/21)		
Transducer type:	SPM TRV-18/19 with insulation foot TRX-18/19		
Transducer cable:	coaxial cable, SPM 90005-L , 90267-L, max length 50 m		
Analog output:	4 to 20 mA		
Relay output (2):	max. 24 V/100 mA (VDM only)		
TLT test:	<1 mA out = interrupted or faulty transducer line		
Loop resistance:	max. 400 Ω at 12 V, 1 kΩ at 24 V		
Power supply:	12 to 24V DC (± 10%, tested according to EN 50082-2)		
Supply current:	max 0.1 A (max. 0.15 A, VDM)		
Housing:	polycarbonate, IP65		
Temperature range:	0° to 55° C		
Dimensions:	110 x 124 x 56 mm		
Cable inlet:	5.5 - 10 mm		
Mounting screws:	4 screws, ø 4 mm, spacing 109 x 94 mm		
Weights:	display units, VDM = 400 g, modules without display, VMM = 300 g		
Value display (VDM):	3 digits, red LED		
Status display (VDM):	green, yellow, and red LED		
Alarm limits (VDM):	2 per display channel		
Push-buttons (VDM):	2, for display control, alarm limit and alarm delay setting		



Installation of Vibration Modules

DIP-switch settings

The modules have four measuring ranges, set by DIP-switches as shown above. On the two-channel modules each channel has its own DIP-switch capsule.

The sensitivity of the connected transducers of type TRV-18/19 are also set by DIP-switches according to the instruction printed on the circuit board. The default setting of the DIP-switches is measuring range 0 - 40 mm/s, transducer sensitivity 100 %. See above example.

The DIP-switch capsule has 8 positions of which the rightmost six are used to set the transducer sensitivity. The two to the left are used to set the measuring range.

Setting the transducer sensitivity

The nominal sensitivity of the transducer TRV-18/19 is 1.2 mV/m/s^2 = 100 %. The actual sensitivity is printed on the transducer's calibration card in both mV/m/s^2 and % of the nominal sensitivity.

The vibration module is factory set to 68 % (all six right hand switches in OFF position). To set the actual transducer sensitivity, set the required number of switches to the ON position. The value is marked above each switch. The total range is from min. 68 % to max. 131 % of the nominal sensitivity.

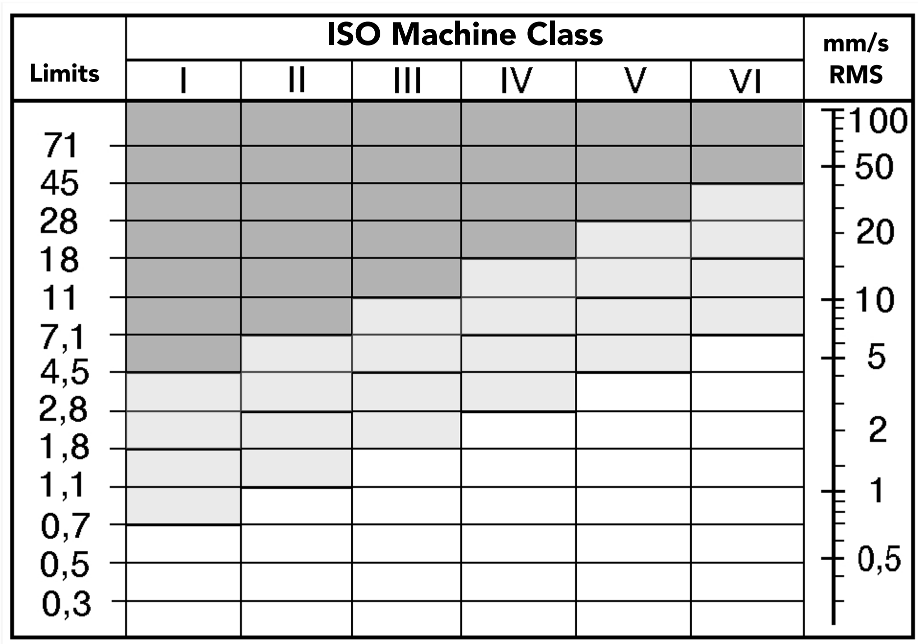
The above example shows the setting 105 %. If the transducer is replaced, the sensitivity has to be reset to match the new transducer.

Measuring range setting

Each measuring channel in a VDM module has four measuring ranges:

1. 0 - 5 mm/s (0 - 0,19 inch/s)
2. 0 - 10 mm/s (0 - 0,39 inch/s),
3. 0 - 20 mm/s (0 - 0,78 inch/s)
4. 0 - 40 mm/s (0 - 1,57 inch/s)

One of these ranges must be set with the leftmost two switches as shown above. The factory setting of the channel(s) is 0 - 40 mm/s. The range can be changed at any time. Note that the range settings of the display module or PLC must be changed accordingly. Programming of display modules is described on page 20.



The Principle for Vibration Measurements

For general monitoring of machine condition, ISO recommends wide frequency band measurements. The vibration transducer output is converted into a reading of vibration severity. This is defined as the root mean square of the vibration velocity, measured in mm/s RMS.

Wide frequency band measurement registers the combined vibration of the different machine parts. The velocity reading is directly related to the energy level of machine vibration, and thus a good indicator of the destructive forces acting on the machine.

Excessive vibration has basically three causes: something is loose, misaligned, or out of balance. An experienced maintenance crew will normally find the cause without any complex analysis, if it is noticed that something is wrong.

Selecting Suitable Alarm Levels

The ISO Recommendation 10816 define vibration classes for various types of machines listed overleaf. The above table shows the most common of the six classes and their limit values.

For setting the suitable alarm levels you have to define the normal vibration level of the machine, either according to its vibration classing, the manufacturer's recommendations, or on the basis of measurements when the machine is in good condition. As an example, a 100 kW ventilation fan on a concrete base would belong to class III.

Vibration increase is measured in steps, where each step is a 1.6 times increase over the previous level. Two steps up from the normal value is a 2.5 times increase and should alert maintenance. Three steps up - a fourfold increase - is regarded as an alarming change demanding immediate action.

The correct setting for the chosen alarm level is then done during a channel configuration of a DMM module or in a PLC. See scale conversion diagram on page 13.

Definition of Machine Classes According to ISO 10816

The following text is an extract from ISO 10816.

In order to show how the recommended method of classification may be applied, examples of specific classes of machines are given below. It should be emphasized, however, that they are simply examples and it is recognized that other classifications are possible and may be substituted in accordance with the circumstances concerned. As and when circumstances permit, recommendations for acceptable levels of vibration severity for particular types of machines will be prepared. At present, experience suggests that the following classes are appropriate for most applications.

Class I

Individual parts of engines and machines, integrally connected with the complete machine in its normal operating condition. (Production electrical motors of up to 15 kW are typical examples of machines in this category.)

Class II

Medium-sized machines, (typically electrical motors with 15 to 75 kW output) without special foundations, rigidly mounted engines or machines (up to 300 kW) on special foundations.

Class III

Large prime movers and other large machines with rotating masses on rigid and heavy foundations which are relatively stiff in the direction of vibration measurement.

Class IV

Large prime movers and other large machines with rotating masses on foundations which are relatively soft in the direction of vibration measurement (for example turbogenerator sets, especially those with lightweight substructures).

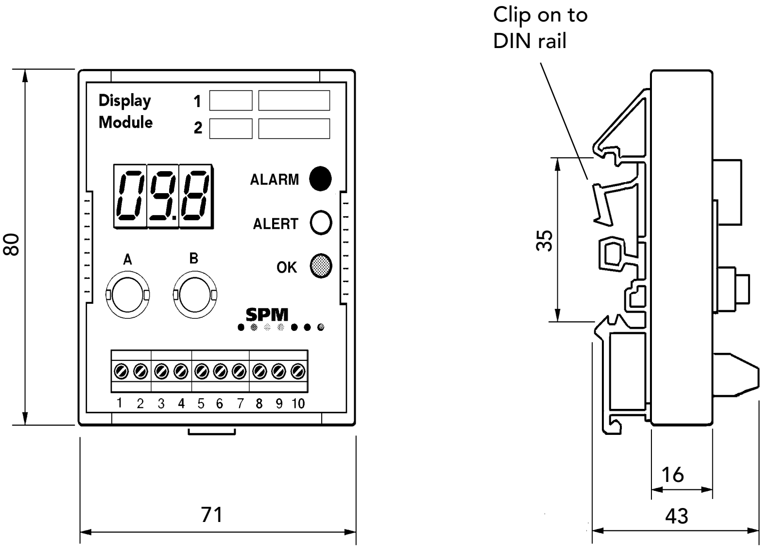
Class V

Machines and mechanical drive systems with unbalanceable inertia effects (due to reciprocating parts), mounted on foundations which are relatively stiff in the direction of vibration measurement.

Class VI

Machines and mechanical drive systems with unbalanceable inertia effects (due to reciprocating parts), mounted on foundations which are relatively soft in the direction of vibration measurements; machines with rotating slackcoupled masses such as beater shafts in grinding mills; machines, like centrifugal machines, with varying unbalances capable of operating as selfcontained units without connecting components; vibrating screens, dynamic fatigue-testing machines and vibration exciters used in processing plants.

Display module DMM-10A



Display Modules

There are two versions of display modules in the CMM family. The only differens is the housing.

The DMM-11 module is installed in a polycarbonate housing which makes it suitable for wall mounting. The housing is of the same type as the VDM and BDM modules.

The display module DMM-10A is clipped onto a standard mounting rail in a control cabinet or similar.

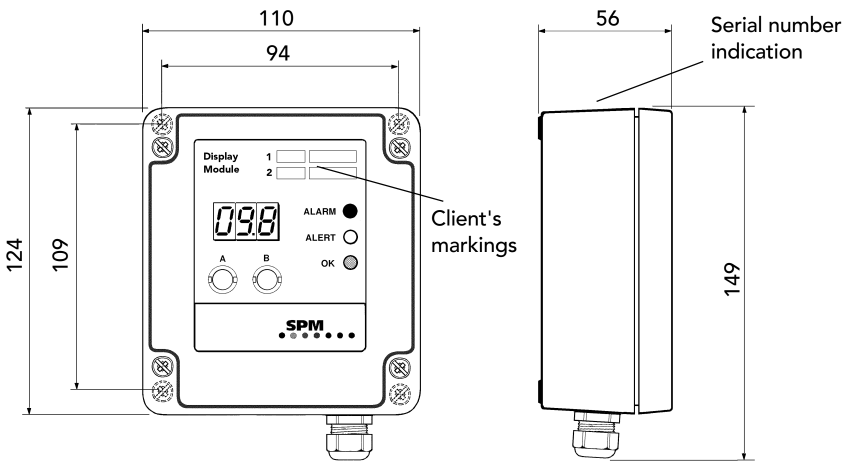
The display module has two input channels and two relay outputs. The relays can be controlled by either input channel. In one channel mode, both relays are slaved to a single input channel and provide relay switching at two levels (ALERT and ALARM). In two channel mode, each input channel uses one relay which switches at a preset ALARM level.

Programmable parameters for each input channel are the measuring range,the two alarm levels ALERT and ALARM, and alarm delay. These are input using two push buttons. Power failure will not erase the program.

Condition display is provided by three coloured LEDs. The green LED is on while measured values are below the ALERT level. Measured values between ALERT and ALARM on either channel trigger a yellow LED, and a red LED lights up when a measured value exceeds an ALARM level. A blinking yellow LED indicates a system fault (incoming signal below 4 mA).

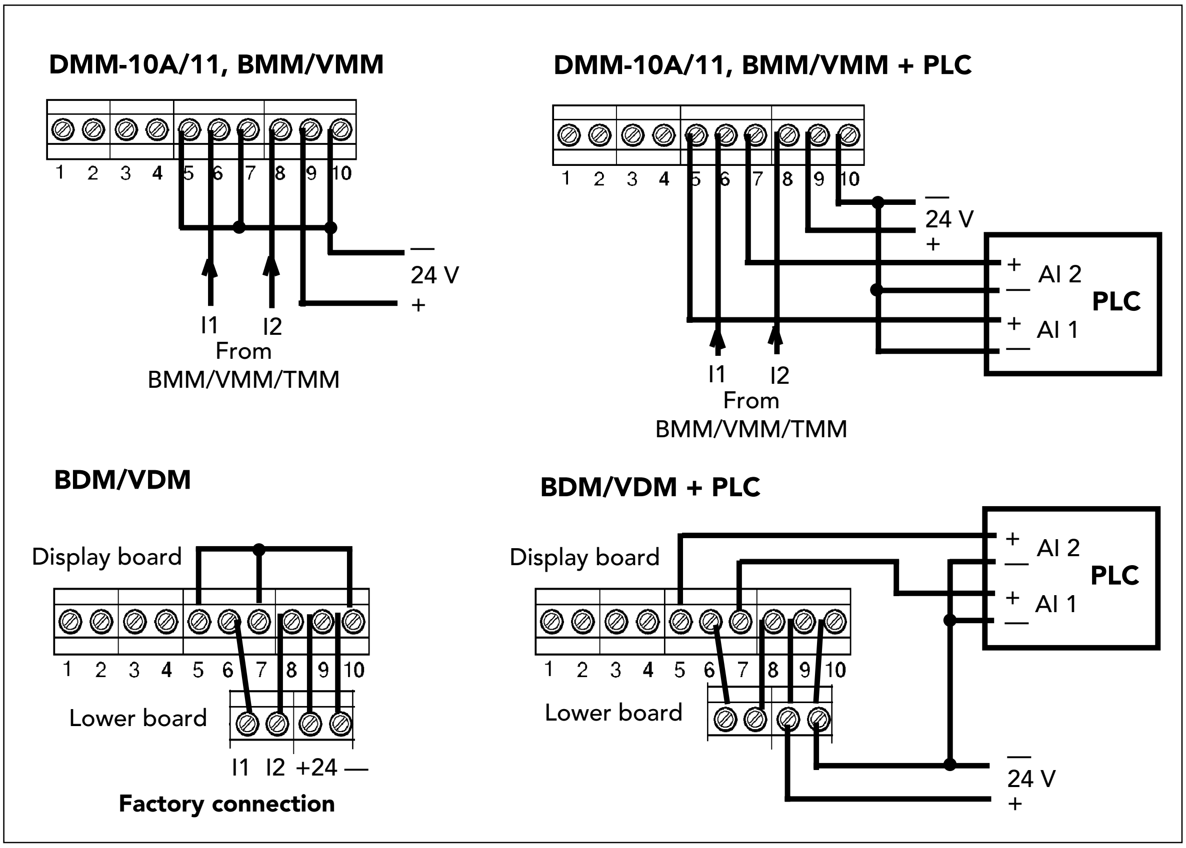
The measured value is displayed in red LED (three digits). In two channel mode the display alternates between the two channels and shows the channel number followed by the measured value on this channel.

Display module DMM-11



Technical Data for Display Modules

Input channels:	2, for 4 - 20 mA
Output channels:	2, relays, max. 24V / 100 mA
Measuring range:	selected to match the signal source.
Measuring time:	approx. 1 second
Value display:	3 digits, red LED
Condition display:	green, yellow, red LED
Alarm limits:	2 per input channel, set with push-buttons
Alarm delay:	programmable 0 - 100 seconds per alarm level
Push-buttons:	2, for display control, alarm limit and alarm delay setting
Line continuity:	blinking yellow LED = signal below 4 mA (faulty or interrupted input circuit).
Measuring resistance:	50 Ω
Power supply:	12 to 24V (± 10%, tested according to EN 50082-2)
Supply current:	max. 0.05 A
Temperature range:	0° to 55° C
DMM-10A housing:	polyamide, not protected
Mounting:	clip on to 35 mm DIN rail
Dimensions:	80 x 71 x 43 mm
Weight:	100 g
DMM-11 housing:	housing: polycarbonate, IP65
Dimensions:	110 x 124 x 56 mm
Cable inlet:	5.5 to 10 mm
Mounting screws:	4 screws, ø 4 mm, spacing 109 x 94 mm
Weight:	400 g



Connection Examples for Display Modules

BDM and VDM modules are delivered with jumpers that connect the connect the 4 - 20 mA output of the lower measuring circuit to the upper display circuit.

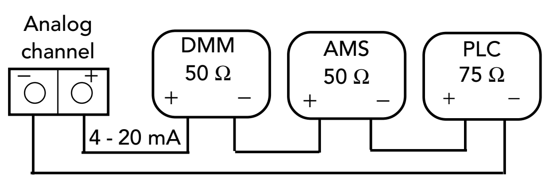
Connect to power

When used as a stand-alone measuring and display unit, the module is connected to a 12 - 24 V DC power source and the jumpers connecting the analog signals are left in place.

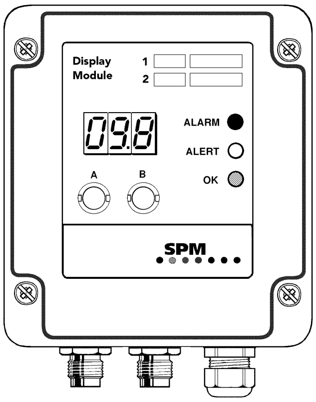
When connected to a PLC the modules can use its power supply, as shown above. The jumpers to ground connection from the analog channels are then removed. The analog channels are connected to the PLC's AI (analog in) unit, the relays to the DI (digital in) unit.

The action of the relays is described on page 22. The analog signal 4 - 20 mA can also be used in the AMS unit for on-line condition monitoring in connection with the SPM Condmaster®Pro software.

Note that the total loop resistance of a 4-20 mA circuit depends on the output circuit of the current source (Please see the specifications for the module in question) and the supply voltage. Here is an example of loop resistance calculation. The cable resistance should be included.



Loop resistance R = 50 + 50 + 75 = 175 Ω + cable resistance.



Programming sequence:

Chx Channel number (2 chan. mode)
AL1 Level 1 alarm (lower)
dL1 Alarm delay for AL1
AL2 Level 2 alarm (higher)
dL2 Alarm delay for AL2

Measuring programs

Measured quantity	Measuring unit	from	to	Program no.
Test 0-20 mA	mA	0.0	20.0	00
Vibration severity	mm/s	0.0	5.0	01
" "	"	0.0	10.0	02
" "	"	0.0	20.0	03
" "	"	0.0	40.0	04
Shock pulse	dBsv	0	80	05
" "	"	20	100	06
Temperature	°C	-16	120	07
Vibration severity	inch/s	0.00	0.19	08
" "	"	0.0	0.39	09
" "	"	0.0	0.78	10
" "	"	0.0	1.57	11
Temperature	°F	3	248	12
Percentage	%	0	100	13

				99

Channel Configuration

Programming

After connecting power and signal leads, the module is programmed with the operating parameters.

The 1 channel mode can be set for channel 1 even when both channels are receiving input signals. It is not possible to measure on channel 2 only. If channel 1 is disconnected while the module is active, there will be a continuous "interrupted circuit" status (flashing yellow LED, analog signal = 0 mA).

There is no manual reset for alarms and relays. The status of the LEDs and the relays is exclusively controlled by the incoming signal and the program.

If an alarm delay cycle is interrupted by a measured value below the alarm limit, it starts again from 0 when the next value above the alarm limit is received.

Operation

In one-channel mode, the number display shows the value on channel 1. The LEDs show the status:

OK	green
Signal < 4 mA	flashing yellow
Level 1 alarm	yellow
Level 2 alarm	red

In two-channel mode**,** the display alternates between the channels, showing Ch1 - value, then Ch2 - value. Alarm status is shown by the LEDs as in one-channel mode.

To check the active program, hold down A+B until all LEDs light up. The number display shows one firm digit for measuring mode/channel followed by two flashing digits for the active program:

0 x x 1 channel mode, program no. xx
1 x x 2 channel mode, program no. xx on chan. 1
2 x x 2 channel mode, program no. xx on chan. 2.

The module returns to the measuring mode after 30 sec.

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mA	mm/s	mm/s	mm/s	mm/s	inch/s	inch/s	inch/s	inch/s
20	5.0	10.0	20.0	40.0	0.19	0.39	0.78	1.57
16	3.7	7.5	15.0	30.0	0.14	0.29	0.59	1.18
12	2.5	5.0	10.0	20.0	0.09	0.19	0.39	0.78
8	1.2	2.5	5.0	10.0	0.05	0.09	0.19	0.39
4	0	0	0	0	0	0	0	0
Prog.:	**01**	**02**	**03**	**04**	**08**	**09**	**10**	**11**

Vibrating measurement, value – mA

mA	dBsv	dBsv	°C	°F	%
20	80	100	120	248	100
16	60	80	86	183	75
12	40	60	52	122	50
8	20	40	18	61	25
4	0	0	-16	30	0
Prog.:	**05**	**06**	**07**	**12**	**13**

Other measurements, value – mA

Channel Configuration (contd)

Channel mode and program selection

1. Hold down A+B until all LEDs light up, then press A+B once more to start mode selection.
2. Press either A or B.
   A is for 1 channel mode. The display shows "0 0 0", 2nd and 3rd digit flashing.
   B is for 2 channel mode. The display shows "1 0 0", 2nd and 3rd digit flashing.
3. Press B repeatedly until the desired program number is shown (2nd and 3rd digit).
4. Press A. If you are in 1 channel mode, this starts the measuring mode. If you are in 2 channel mode, the display will show "2 0 0", 2nd and 3rd digit flashing, and you select the program for channel 2 as above. Finish with button A.

Setting alarm levels and delay

1. For channel 1, hold down button A until "AL1" or "Ch1" is displayed. For channel 2, hold down button B until "Ch2" is displayed. From there, the steps are the same for both channels:
2. Keep pressing A until you reach the parameter you want to change.
3. Change the (flashing) parameter value with button B, then confirm and continue with A.

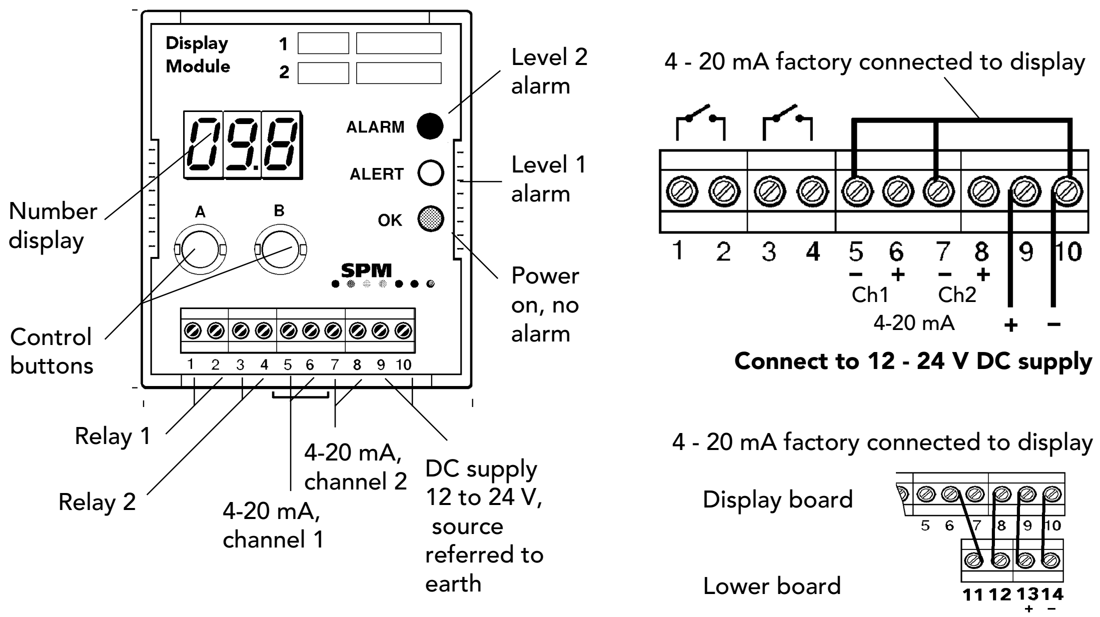
If you overstep the desired number setting with button B, you have to start over again from the beginning. Pressing A while you hold down B takes you straight to the max. value. The unit is back in measuring mode when you finish programming.

By selecting a display program from the list, you automatically adjust the display of the module to the selected range. The measuring unit is not shown, so it should be written on the channel label.

Programs 1 to 4 for mm/s RMS and 8 to 11 for inch/s RMS correspond to the vibration measuring ranges set by the DIP switches on the lower measuring circuit board.

In VDM-14/15, you have a free display channel. You can, for instance, connect it to a temperature transducer TMM-10 (program 07 or 12) or to a BMM signal converter for bearing condition monitoring (program 05 or 06).

After disconnecting the analog output channel(s) of the lower measuring circuit board (see page 2) from the analog inputs of the display circuit board, you can connect any 4 - 20 mA input from external sources to the display circuit board.



VDM display circuit
Stand alone

Channel Configuration, contd.

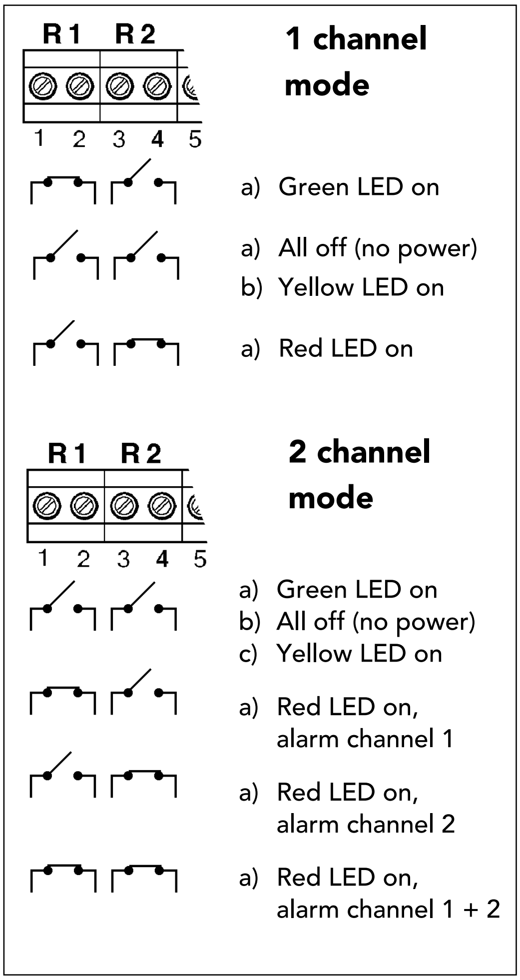
Relay action

The relays are specified 24 V/100 mA. The relay action differs, depending on the **programmed** display mode.

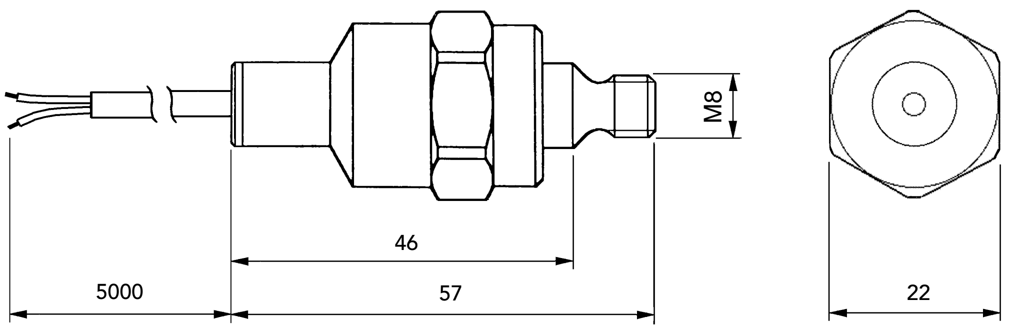
In **one channel display mode**, the module displays the analog signal on channel 1. Two alarm levels can be programmed. Level 1 = ALERT = yellow LED is connected to Relay 1. Relay 1 is NC = normally closed. It opens on power failure and on alarm (value above the lower or ALERT alarm level). Thus, it will be open when the yellow or the red status LED is on.

The alarm level 2 = ALARM = red LED is connected to Relay 2. Relay 2 is NO = normally open. It closes on ALARM = red status LED is on.

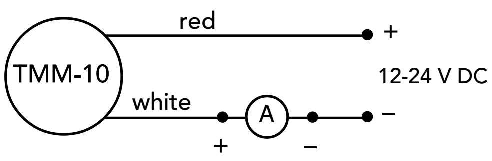
In **two channel display mode**, Relay 1 is connected with Channel 1 and Relay 2 is connected with Channel 2. Both relays are NO = normally open. They close on ALARM = red status LED is on. Thus there is no relay action on power failure or yellow alert.



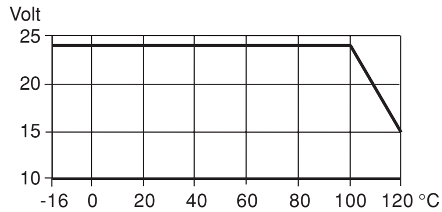
Temperature monitoring module



Electrical connection



E. g. BDM/DMM/VDM/PLC AI



Derating curve

Temperature Monitoring Module

TMM-10 is a temperature transducer with a measuring range from –16° to 120 °C and an analog output of 4 to 20 mA. The transducer is mounted in a countersunk M8 hole. It is supplied with 12 to 24 V DC (see derating curve).

Because of the analog 4 to 20 output TMM-10 transducers can directly be adapted as temperature measuring modules in the CMM system or be connected to a BDM, DMM, VDM module or to a PLC AI which has display and relay functions. **Please note:** The maximum supply voltage is 15 V if used above 100° C.

Technical data

Measuring range:	–16° to 120 °C
Output:	4 to 20 mA, 8.5° C/mA, 0.12 mA/° C
Inaccuracy:	typical 1° C, max. 3° C at 25° C
Linearity deviation:	2% +0.5 °C
Long time stability:	0.4 °C
Temperature range:	–30° to 125° C
Power supply:	12 to 24 V DC, see derating curve and text note above
Loop resistance:	max. 50 (U-7) Ω for U=12 to 24 V DC e.g. 400 Ω at 15 V
Housing:	acid proof steel AISI 316 (SS2382), Viton sealing, IP67
Mounting hole:	M8 threads, 90° countersunk
Torque:	max. 15 Nm
Cable type:	twinned two leader TPC, area 0.24 mm², covering FEP, max. temperature, 125 °C, SPM 90296-L (L = length in meters)
Cable length:	5 m (other lengths on request)
Weight:	55 g (excl cable), 120 g (with standard cable)

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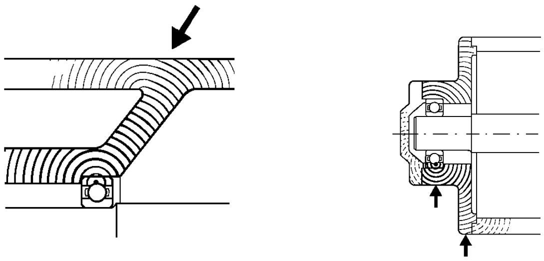
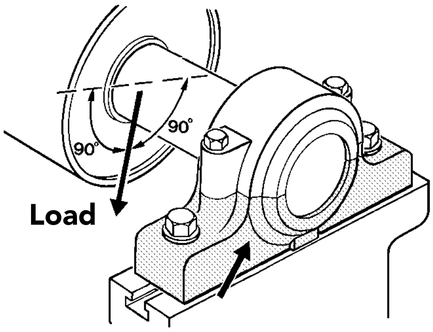
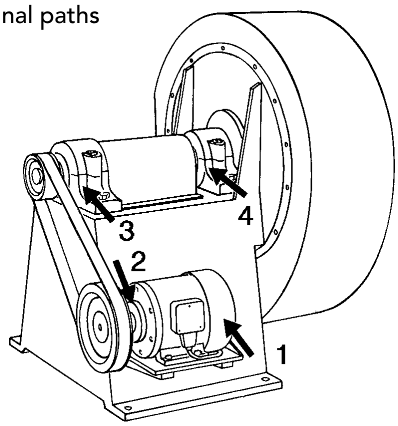


Look for straight and short signal paths





Typical load zones on a fan installation

Selection of Measuring Points for Shock Pulse Measurement

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

1 **The signal path between bearing and measuring point shall be as straight and short as possible.**

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

3 **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. When a measuring point cannot conform to the rules, because the ideal spot cannot be reached, make allowance for a weaker signal. 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.

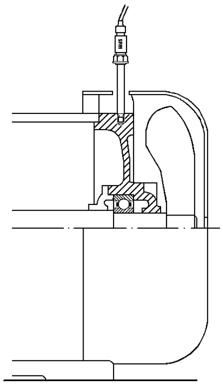
Load Zone

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.

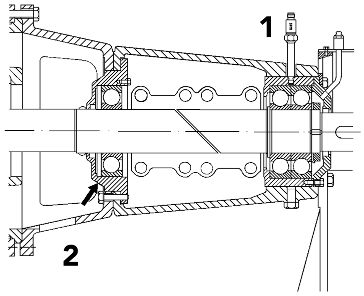
Consider also the direction of the force acting on the shaft when the machine is running. In the above fan installation is shown how belt tension determines the load on the bearings. The fan shaft in point 3 is pulled down towards the motor. The drive end of the motor shaft is pulled up towards the fan (2), the non-drive end is pressed down and away from the fan. The arrows in the above figure show the measuring points.

Find the Strongest Signal

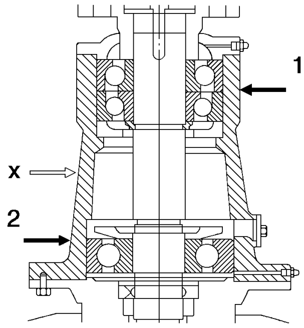
Use the probe to find the spot on the bearing housing where the signal is strongest. If there are several points yielding the same signal, select the point where it is easiest to take readings.



A. Use of extended transducers



B. Bearing housings beneath brackets



C. Multiple bearing housing

Measuring Points, Examples

The following two pages show measuring points and possible transducer installations.

Through Hole for Long Adapter or Extended Transducer

Above at A. is shown how a measuring point beneath a fan cover can be reached with an extended transducer, through a hole in the cover.

Bearing Housings Beneath Brackets

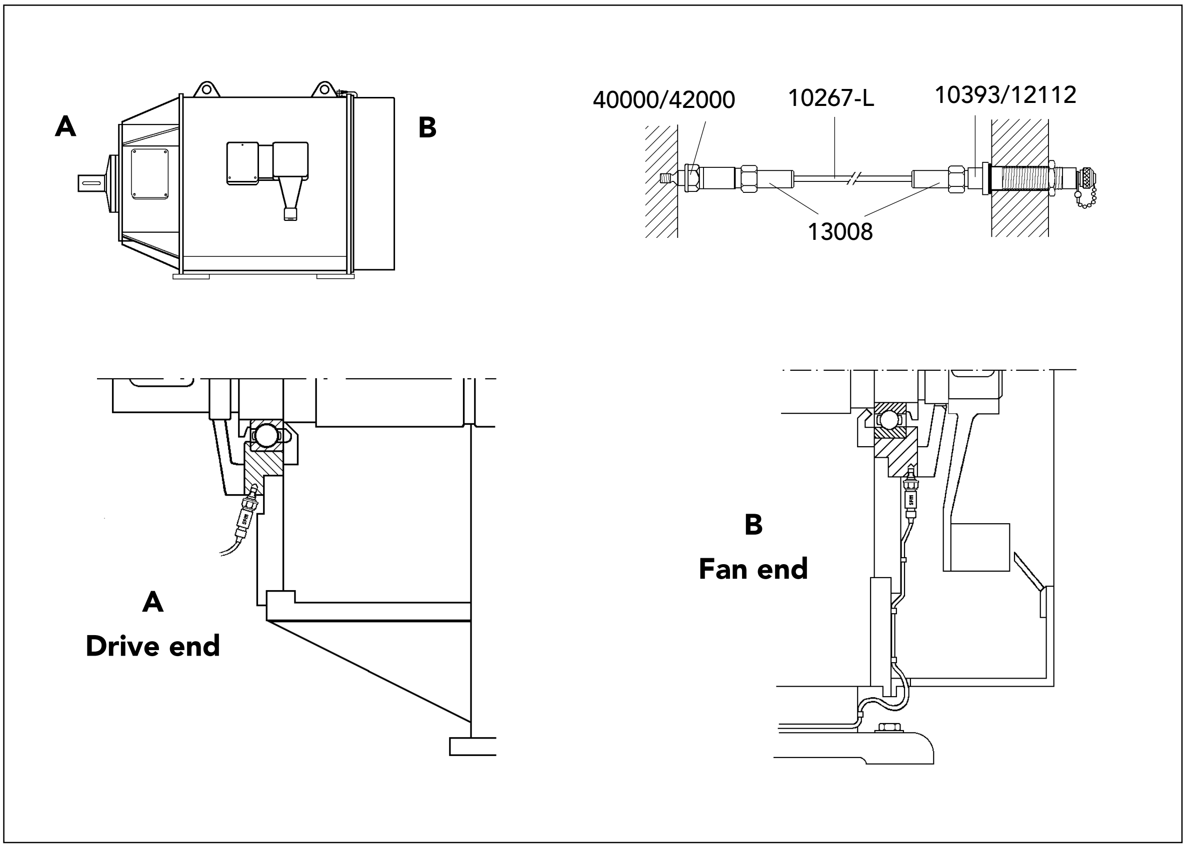
Consult machine drawings and identify the bearing housing before selecting a measuring point. In figure B, showing a pump, the bearings are placed in two separate housings inside the bearing bracket. Measuring point 2, placed below and opposite to the pump outlet (load direction!) can be reached with an extended transducer through an opening in the pump shield.

The bearing pair at measuring point 1 can be reached with an extended 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.

Multiple Bearings in One Housing

If there are several bearings in the same housing, they are normally treated as a single bearing. The shock pulse value in dB from 2 similar bearings mounted in pair is only slightly higher than from 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. Check signal strength with the probe. Use one measuring point only if readings are identical in both points. This point (x) can be placed halfway between points 1 and 2.



Measuring Points, Examples /contd./

On large electric motors (above left), the bearings are often mounted in bushings which are welded or bolted to the motor shields. Because of the damping in the interface between the bushing and the shield, the measuring point should be on the bushing. The bearing bushing at the drive end can usually be reached with a transducer or a long adapter. The transducer is installed at an angle to the shield, so that there is enough space for connecting the transducer (above at A).

Installed Transducer

The bearing at the fan end requires a permanent transducer installation (above at B). The transducer is installed in the bushing. The coaxial cable is run through a slit in the fan cover to a measuring terminal on the stator frame.

Check Installed Equipment

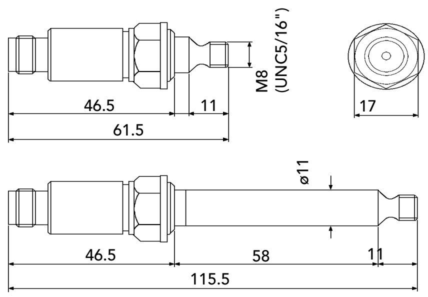
Incorrectly installed transducers can cause a significant damping of the shock pulse signal. Check all installations. Make sure that mounting holes are correctly countersunk and that the seat surfaces of transducers have good contact with the material of the bearing housings.

Use high temperature cables and moisture proof equipment where required, and protect installations against damage.

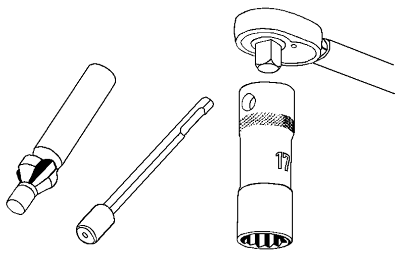
Sealed Installation

Measuring points on suction cylinders in paper machines, inside gear boxes, turbo chargers etc. require sealed, moisture proof cable installation between the transducer inside the machine and a measuring terminal or interface outside the machine. The principle is shown in upper right corner of the figure. If there is danger of mechanical damage, the coaxial cable must be protected by a stainless steel pipe, rubber tube or similar.

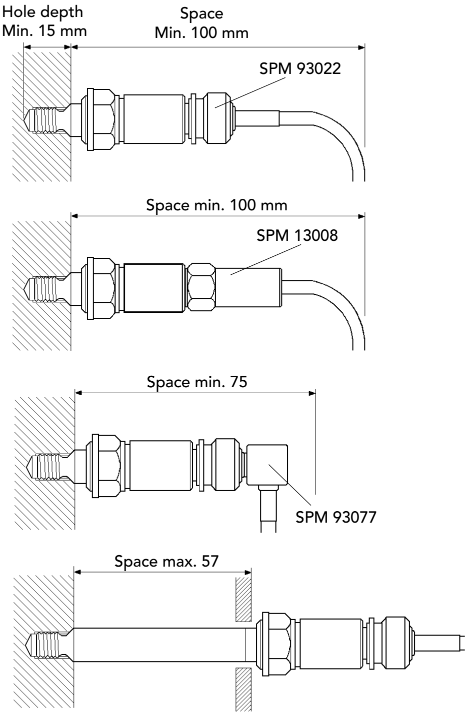
Standard Shock Pulse Transducers series 40000



Set of installation tools



Different types of transducer installation



Installation of Standard Shock Pulse Transducers

Transducers and measuring cables should be installed in such a way that they don't prevent the normal operation or the general activities around the machine. The local contact should therefore be consulted about the location of transducers and cables before installation. The standard 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. Tool and hole dimensions for the UNC threads are given in brackets (). Via a coaxial cable with TNC connector (A), the transducer is connected to a bearing damage detector or a measuring terminal for a portable shock pulse meter.

In moist environments, a sealing TNC connector SPM 13008 must be used (B). An angle connector (C) is used in narrow spaces. With the extended transducer (D) one can reach bearing housings below protecting covers, etc. The transducer SPM 40010, which is glued into position, can be used for thin-walled bearing housings.

Operations

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

Special Tools

82053 Countersink with 90° angle, diameter 12 mm, and pilot 6.8 (6.5) mm
81085 Torque wrench
81086 17 mm socket, long
Drill bits 2.75, 3.0, and 6.9 (6.6) mm

Installation Material

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

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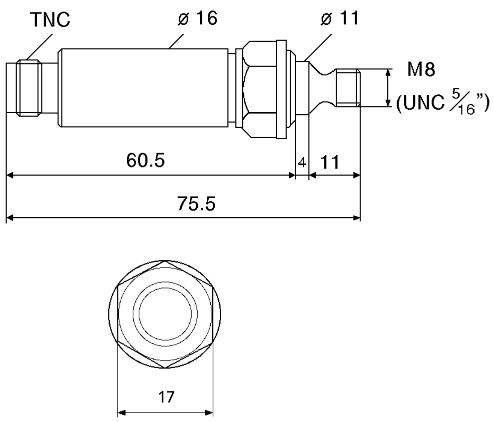
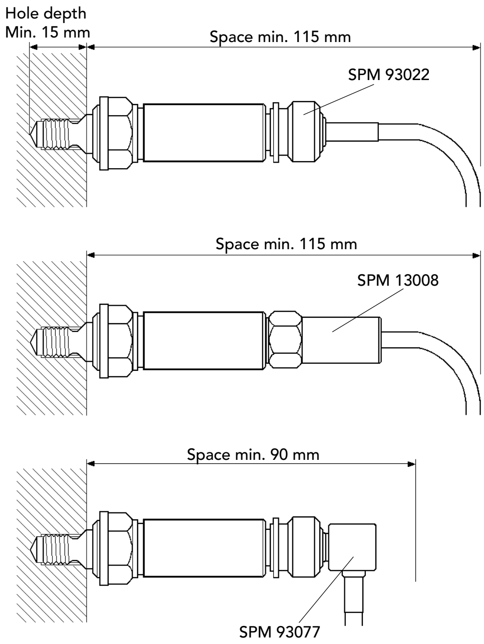
Transducer with TMU series 42000



Different types of transducer installation



Installation of Shock Pulse Transducer with TMU

The shock pulse transducer with TMU is used in SPM installations where the cable length between transducer and measuring device exceeds 4 m. With this transducer, the maximum cable length is 100 m.

The transducer with TMU is 14 mm longer than the standard shock pulse transducer, and is made of stainless, acid proof steel to resist aggressive environment. Standard thread is M8 with UNC 5/16" as alternative.

Except for space requirements, all installation instructions for the standard transducer apply to the transducer with TMU (see previous pages). The same tools are used for both.

Via a coaxial cable with TNC connector SPM 93022 (A), the transducer is connected to the measuring device of type BMM or BDM. In moist environments, a sealing TNC connector SPM 13008 must be used (B). An angle connector, SPM 93077 (C) is used in narrow spaces.

Operations

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

Mounting Tools

82053	Countersink with fixed pilot for M8
81027	Holder for countersink
81028	Countersink, angle 90°, ø 12 mm
81031	Pilot for M8
81032	Pilot for UNC 5/16"

To drill the mounting hole, use drill bits 6.9 mm for M8, 6.6 mm for UNC 5/16".

Torque and unscrew the transducer with a torque wrench and a long 17 mm socket (SPM 81092). Ordering numbers are listed in the end of this manual.

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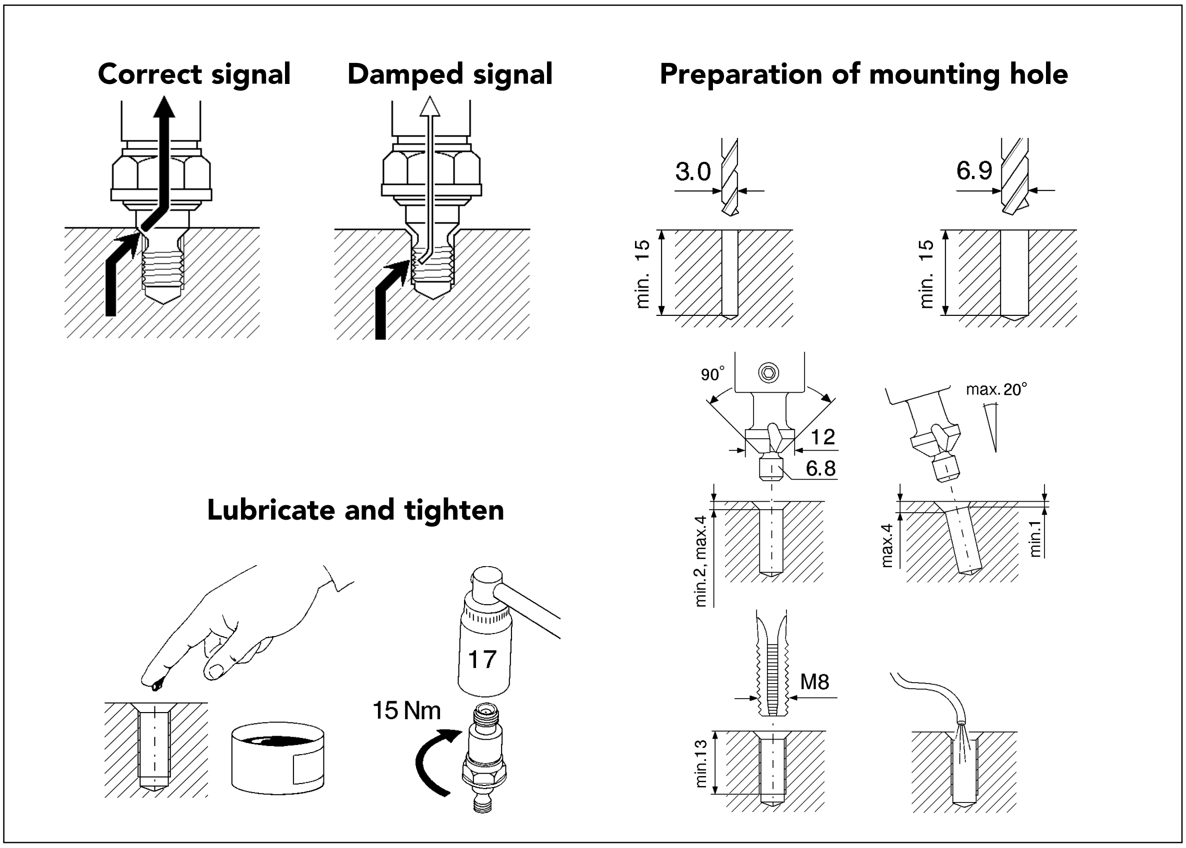

Correct Installation is Essential

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 Mounting Hole

The mounting hole 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.

Note: 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.

Transducer Mounting

1 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.

2 Torque the transducer with a torque wrench. The torque is 15 Nm (11 lbf./ft.).

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.This is not applicable for connector of type SPM 13008.

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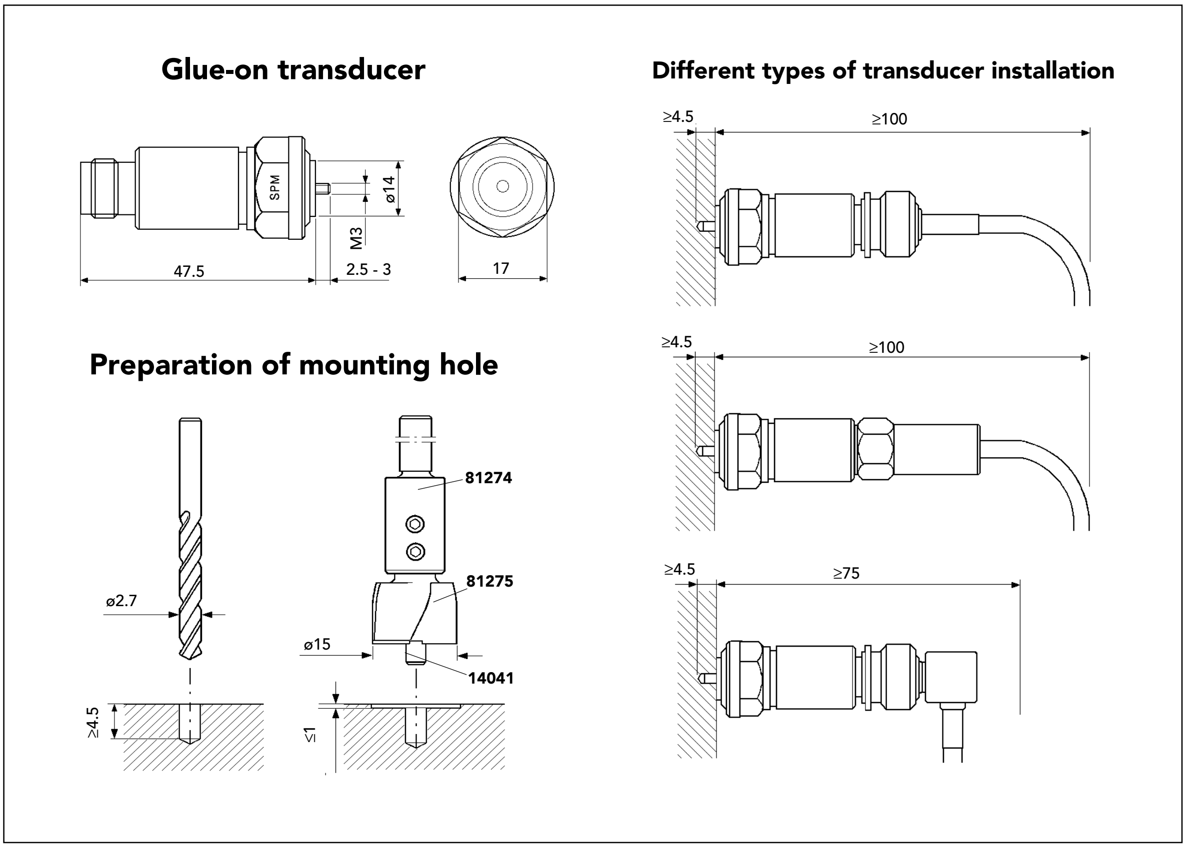


Glue-on Shock Pulse Transducer SPM 40010

Glue-on transducers 40010 can replace standard transducers on thinwalled bearing housings and on machines where the drilling of standard mounting holes would affect equipment warranties. They have the same measuring characteristics as standard transducers, but a flat, circular base which is glued to the measuring point, and an M3 screw for unloading and fixing.

Mounting

The transducer is mounted against a smooth, flat surface on the machine. Use a 2.7 mm drill for the mounting hole and make it 4.5 mm deep. Always plane the surface with a counterbore, min. diameter 15 mm.

The recommended adhesive is Loctite 638 or similar. Please read the instructions for use and follow them carefully. Screw the transducer by hand into the mounting hole. The screw is self-threading. In narrow spaces a 17 mm socket (SPM 81086) may be used. The torque should not be more than 1 Nm. Wait until the adhesive has hardened before connecting the cable.

Operations

- Selection of measuring point
- Drilling and planing
- Careful cleaning of the contact surface to make the glue stick
- Apply glue according to the manufacturer's instructions
- Fix the transducer
- Connect the cable.

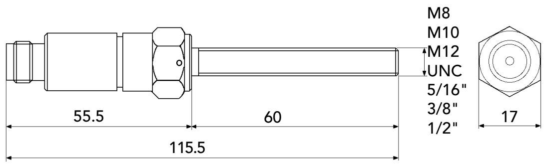
Mounting Tools

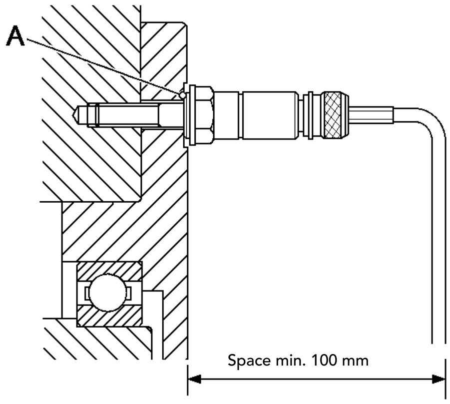
14042	Counterbore, complete
81274	Holder for counterbore
81275	Counterbore, diameter 15 mm
14041	Pilot, diameter 2.7 mm
81086	Socket, 17 mm

Installation Material

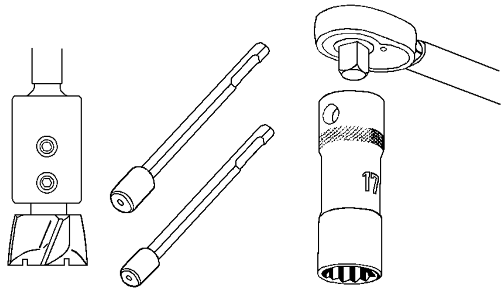
- Cable clamps for 5 mm cable
- Glue Loctite 638 or equal
- Self-threading screws M3
- As needed, elastic sealing material for through holes.

Shock pulse transducer in bolt design





Set of installation tools



Shock Pulse Transducers in Bolt Design

A shock pulse transducer in bolt design is intended to replace one of the holding bolts of the bearing housing. It can be used under two conditions:

- There must be an uninterrupted signal path between the bearing and the transducer's seat surface (A).
- The actual torque is 20 Nm (15 lbf.-ft.) for M10 and 25 Nm (18.5 lbf.-ft) for M12 transducers.

Uninterrupted signal path means that the material of the bearing housing contains no interface between the outer bearing ring and the seat surface (A) of the transducer. Shock pulses from the bearing are transmitted via that surface, not via the threads.

The transducer cannot replace bolts with a high torque. It contains a piezo-electric crystal which can be damag-ed if the torque exceeds 15 Nm (11 lbf.-ft.).

The transducer is mounted against a flat surface, milled and unpainted, within the load zone of the bearing. Washers must not be used. The transducer is pierced for a locking wire, hole diameter 1.5 mm.

Via a coaxial cable with TNC connector, the transducer is connected to a bearing damage detector or a measur-ing terminal for a portable shock pulse meter. In moist environments, a sealing TNC connector SPM 13008 must be used. An angle connector SPM 93077 is used in narrow spaces (min. space requirement 75 mm).

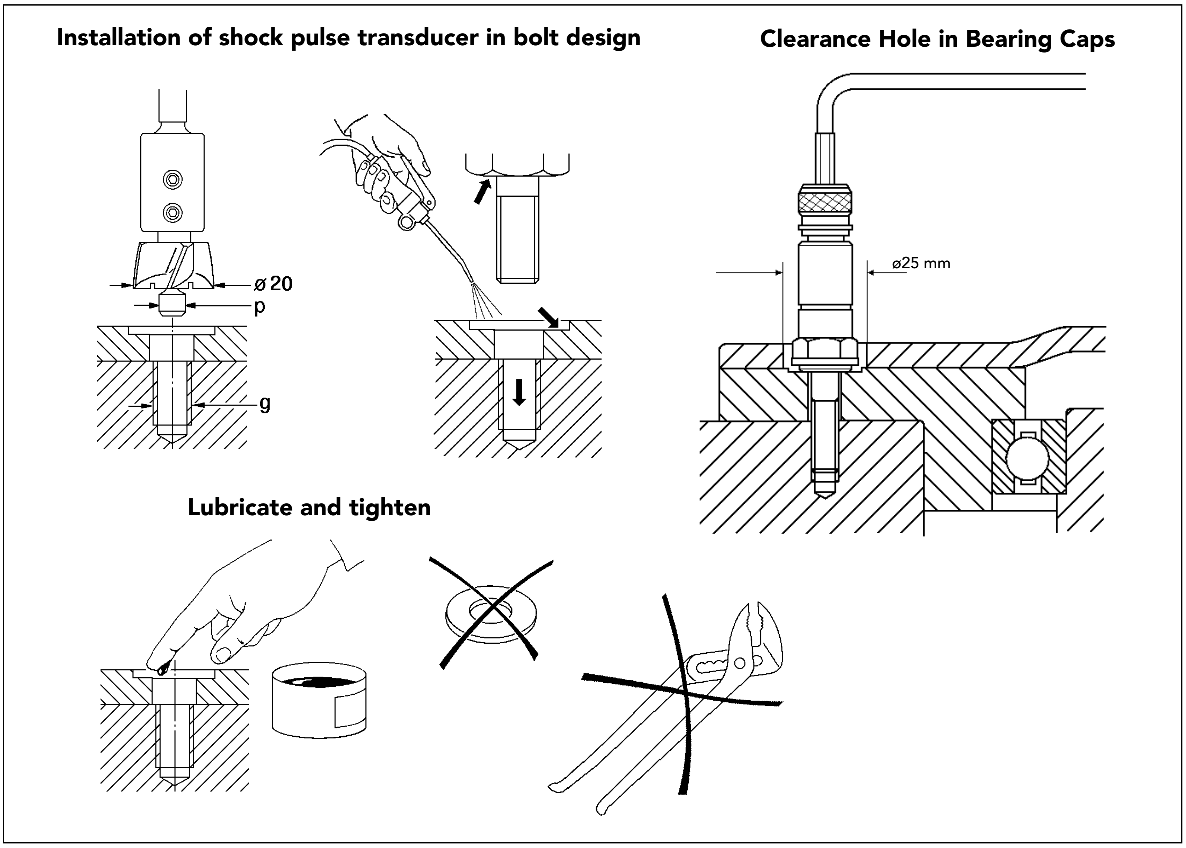
Operations

- Selection of measuring point
- Flat face milling, cleaning of seat surface and mounting hole
- Torquing with torque wrench
- Connection of cable.

Special Tools

81027 Holder for counterbore
81057 Counterbore, diameter 20 mm
81033 Pilot 8.5 mm (M10)
81035 Pilot 10.2 mm (M12)

Torque the transducer with a torque wrench and a long 17 mm socket (SPM 81092)



Flat Face Milling

Uneven or painted surfaces must be flat face milled before the transducer can be mounted. Use a counterbore with a 20 mm diameter (Holder SPM 81027 plus Counterbore SPM 81057).

The correct pilot size for M10 is 8.5 mm (SPM 81033). For M12 it is 10.2 mm (SPM 81035).

Mounting

Seat surfaces and mounting hole must be free from dirt and chips.

Some clean grease on the seat surfaces improves the signal transmission. Washers must not be used.

If required, cut the threads to fit the mounting hole.

Torque the transducer with a torque wrench and a long 17 mm socket. Applicable torque is 20 Nm (15 lbf.-ft.) for 10 mm and 25 Nm (18.5 lbf.-ft.). Spanner wrenches or pliers must not be used, because they can damage the piezo-electric crystal inside the transducer.

If required, lock the transducer with wire.

Clearance Hole in Bearing Caps

The transducer must not be used as a holding bolt for bearing caps or other parts which are separated from the bearing housing by an interface.

If the bearing cap is not too thick, one of the existing bolt holes can be enlarged (diameter 25 mm), so that the transducer can be mounted directly against the material of the bearing housing. Make sure that the remaining holding bolts can keep the bearing cap securely in place.

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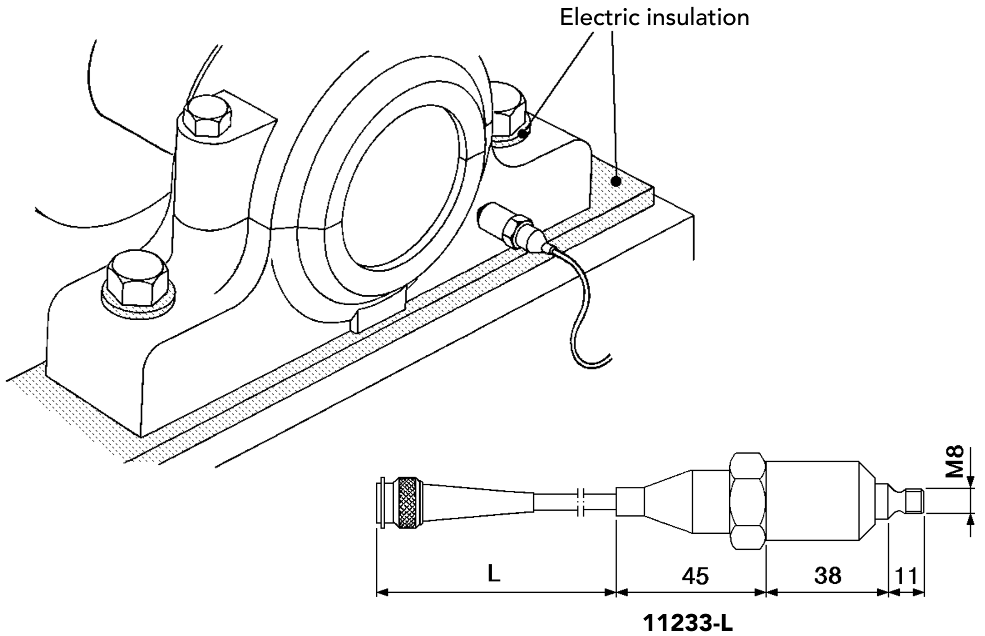


Installation of Isolated Shock Pulse Transducers

Isolated shock pulse transducers are used for electrically isolated bearing housings, for instance on high voltage electric motors.

This type of transducer has a factory mounted cable of PVC type (temperature range –10° to +70° C). Cable length L is max. 4 m. Thread size is M8.

Transducer Mounting

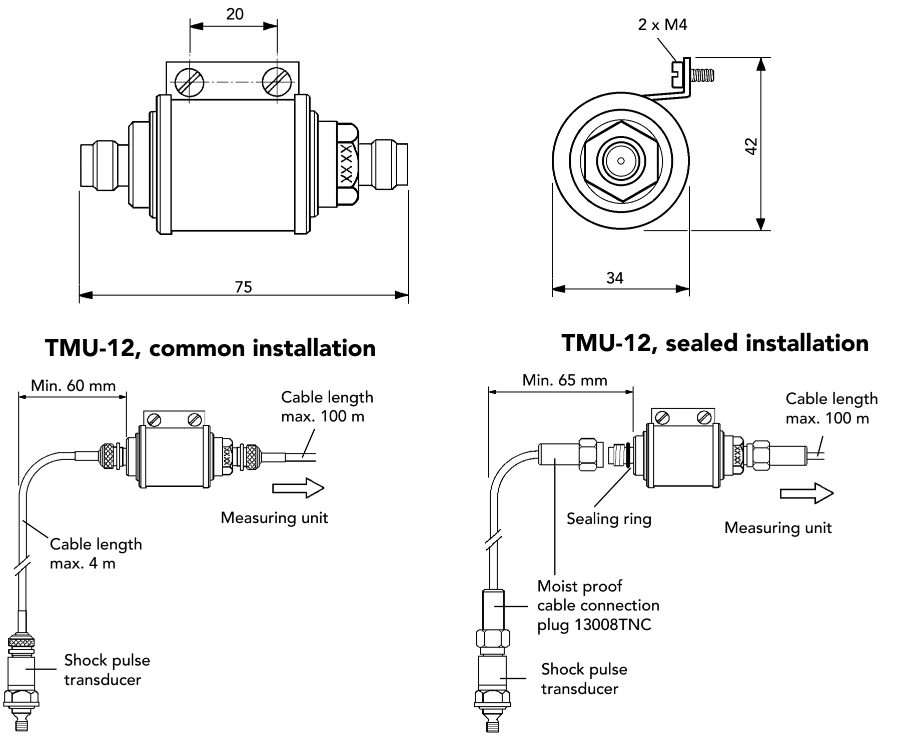
Follow the installation instructions for a standard shock pulse transducer with M8 threads.

The only difference is in torquing. An open spanner, width 26 mm, has to be used for this transducer. Recommended torque is approximately 15 Nm (9–11 lbf.-ft.).

Dismounting

Avoid twisting the cable when the transducer has to be dismounted. Start at the BMM/BDM end and loosen the whole cable before unscrewing the transducer. Do not use pliers to unscrew the TNC connector.

Transducer matching unit TMU-12



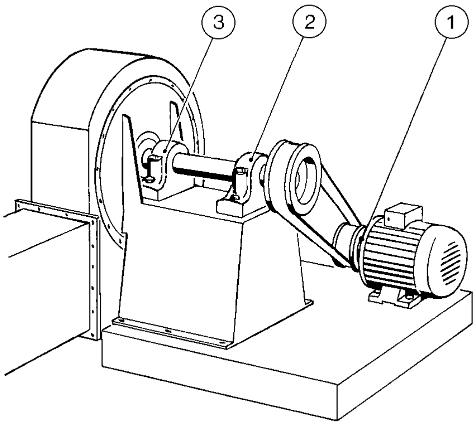
Transducer Matching Unit TMU-12

Transducer Matching Unit TMU-12 is an impedance converter. It is used to extend the length of the coaxial cable between transducer series 40000 and measuring device from max. 4 m to max 100 m and is used particularly in cases of high temperature and/or narrow spaces. The distance between the TMU and the transducer is always max. 4 m. It is placed between the shock pulse transducer and the measuring device or measuring terminal. 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.

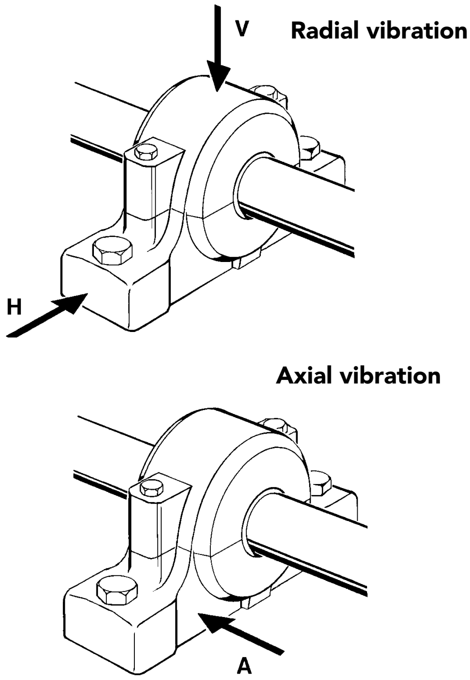
TMU-12 is suitable for both chemically basic and acid environments. For installations in moist environments, it is necessary to use sealing TNC cable plugs SPM 13008 to prevent cable corrosion.

Technical Data

Casing	Stainless steel AISI 316, SS 2382, 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 to measuring module, max 4 m to transducer
Fastening screws	2 x M4, stainless steel AISI 316, SS 2382



Measuring points for vibration monitoring



Installation of Vibration Transducers

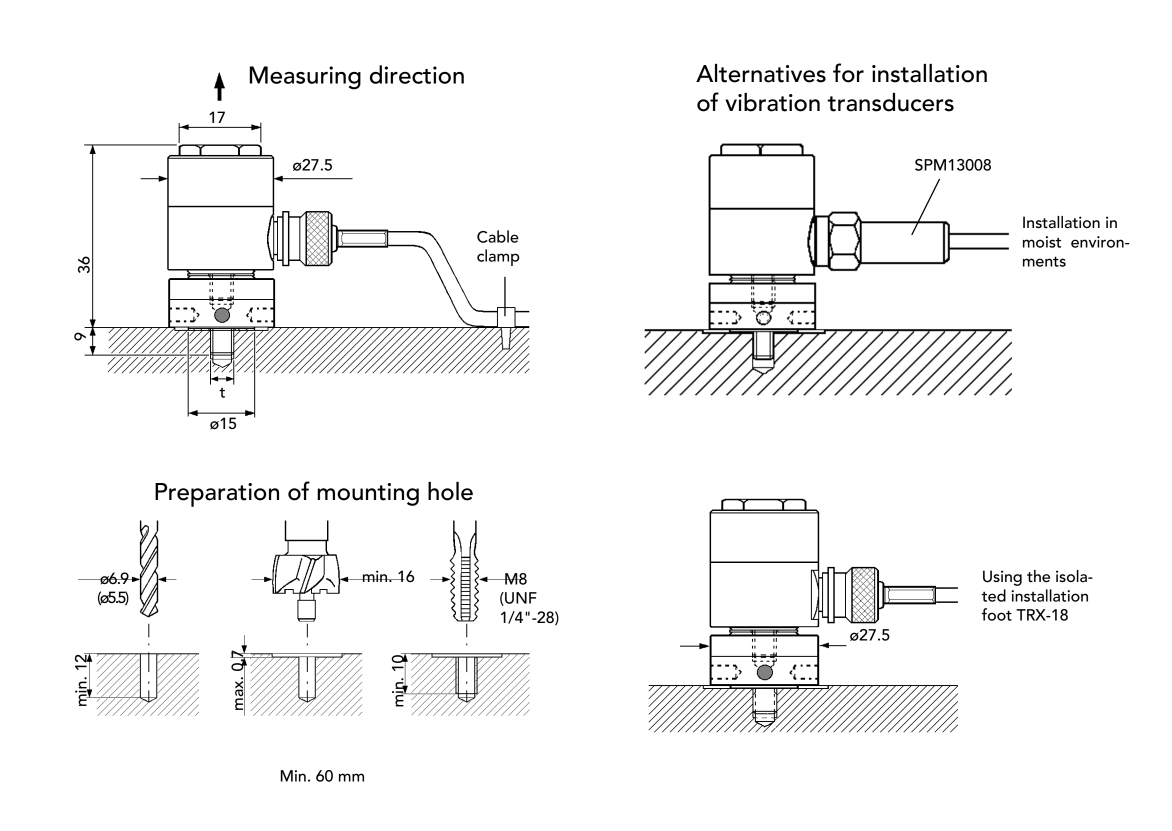
Measuring Points for Vibration Monitoring

Vibration at the measuring point should be representative of the overall vibration pattern of the machine. The forces involved are usually transmitted through the bearings and their housings to the machine foundation. Consequently, measuring points should be located on or near the bearing housings. Machine guards, cover panels and other parts which are considerably less stiff than the main structure are not suitable as measuring points.

Generally speaking, the more measuring points chosen, the easier it is to locate a specific mechanical problem. Consider a fan belt driven from an electric motor. Measurements taken on the fan bearing (3) will primarily give information on fan balance. If out-of-balance is the main problem, measuring on that bearing will be sufficient. To be able to make an adequate assessment of the mechanical state of the whole machine, one should also measure on the drive end bearing (2) and on the motor (1).

Direction of Measurement

Out-of-balance forces rotate with the shaft and cause radial vibration acting in all directions within the plane of rotation. Normal practice is to take readings in three directions at each measuring point: vertical (V), horizontal (H) and axial (A). Of the two radial measurements, a reading in the vertical direction tends to give information about structural weakness. The horizontal reading is most representative of balance conditions. Axial vibration, along with the line of the shaft, is normally caused by faulty alignment, i.e. badly assembled couplings or bent shafts.



Vibration Transducers

The SPM transducers of type TRV are piezo-electric accelerometers of compression type, designed for vibration monitoring of industrial machinery. TRV transducers intended for use together with the CMM System have built-in pre-amplifiers. Cable length between transducer and measuring unit can be up to 50 m (165 ft).

The transducer is mounted on the machine against a smooth, flat surface. M8 and UNF 1/4"-28 are the common threds on the TRV transducers. The transducer is supplied with three washers, each of which change the output direction 90°. Coaxial cable with TNC connector should be clamped close to the transducer. For threads and properties, see the parts list in the end of this manual.

Cable plug SPM 13008 should be used for installations in moist atmosphere for preventing humidity to penetrate into the cable and cause corrosion and signal error.

The individual transducer sensitivity value is specified on the calibration card. The various types of vibration transducers are listed in the end of this manual. **It is recommended to always install vibration transducers together with isolated installation foot TRX-18/19 as shown above.**

Mounting Tools

81027	Holder for counterbore
81057	Counterbore, diam. 20 mm
81030	Pilot for UNF 1/4" (TRV-19)
81031	Pilot for M8 (TRV-18)

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).

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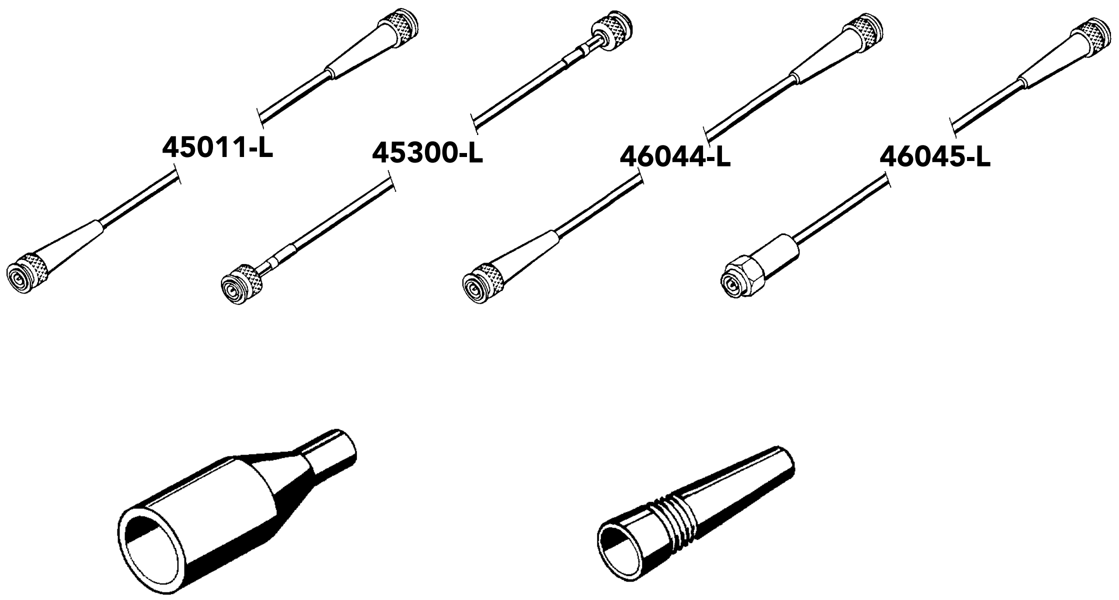

Selection of Cable Type for SPM and VIB

The table in fig. 50 shows the available coaxial cables for shock pulse monitoring. The main difference is the temperature range. Mechanical and chemical properties are good for all cables, with the stated exceptions. Cable diameter is 5 mm for SPM 90005, SPM 90176, and 4 mm for SPM 90267. For ø4 mm cables a rubber tube SPM 82166 is needed to assure a proper connector fit. Break protectors SPM 81018 are used with cable 90005-L. Only use calibrated and marked crimping tool.

Cables for shock pulse transducers and vibration transducer TRV-18/19

45011-L	Cable with connectors, -10° C to 70° C
45300-L	Cable with connectors, -40° C to 125° C

Coaxial cables without connectors

90005-L	PVC, -10° C to 70° C, ø 5 mm
90267-L	PVF, -40° C to 125° C, ø 4 mm,

Accessories

10473	Sealing cover for TNC/BNC connector
81018	PVC sleeve for TNC/BNC crimp connector

Note:
When ordering cables, please state the desired length (L) in meters.

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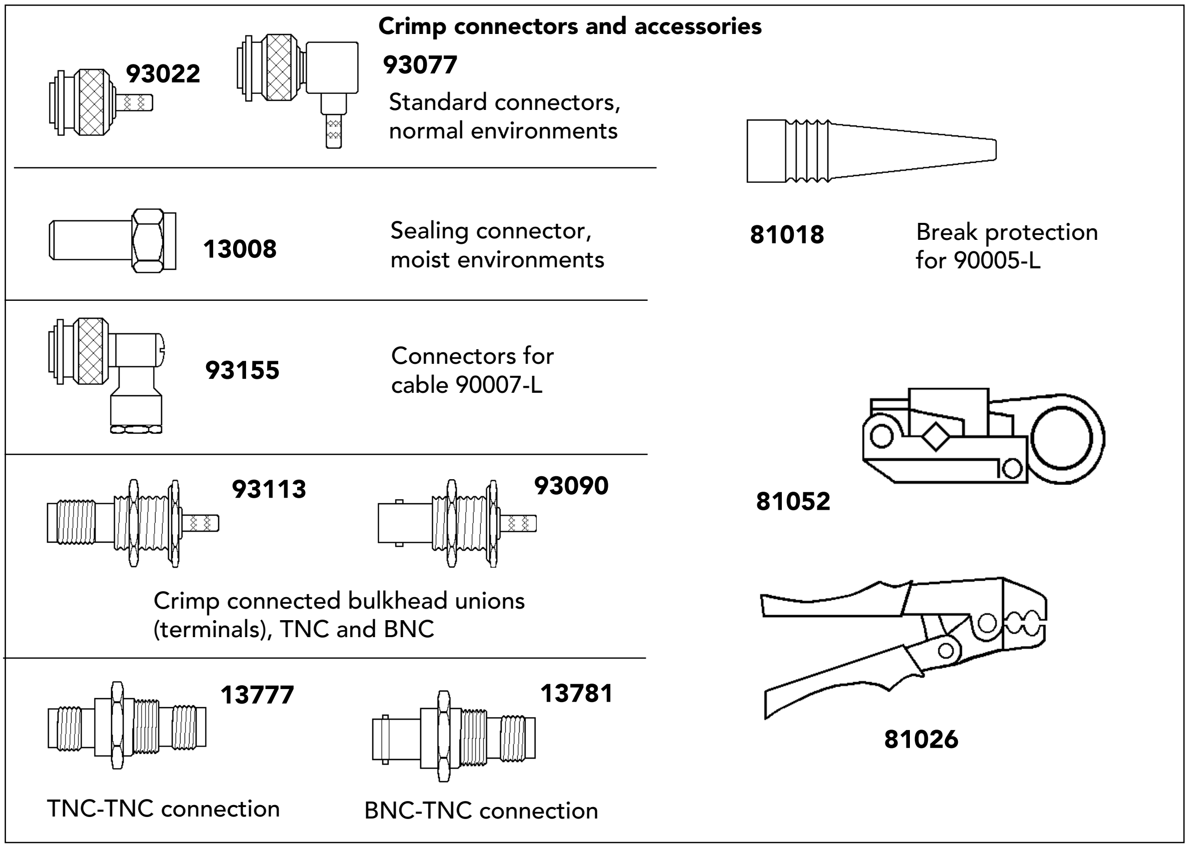

Cable Installation

Cables should be laid in such a way that normal operation or common work within or around the machine isn't prevented or disturbed or cause damage on them. Cables should never be laid against sharp edges or similar things that may damage them. Draw the cable, if possible, behind lubricant pipes. Use existing cable ducts if possible. The cable should follow the lubricant pipe to the bearing housing where it should be connected. Short cuts and crossing the lubricant pipes should be avoided. Signal cables shouldn't be laid close to high voltage cables (>110 V). Damaged cables should be exchanged. Only as an exception a cable should be jointed. Jointing is described on page 40. There are two ways of mounting a connector on a coaxial cable for shock pulse and vibration monitoring:

- solder/screw connection, only for cable SPM 90267 and angle connectors SPM 93077 + rubber tube 82166.
- crimp connection, used for all other connectors and cables.

The crimp connectors for normal environments are SPM 93022 and 93077 (angle connector). In moist environments connector SPM 13008 for sealed installation must be used.

Bulkhead Unions and Terminals

SPM 93113 and 93090 are crimp connected to the cable and used as bulkhead unions or measuring terminals with TNC and BNC connectors respectively. SPM 13777 is a terminal contact with TNC/TNC connector and 13781 is a corresponding unit with TNC/BNC connectors. All these connectors should be mounted completely electrically insulated if the earth connection is unsatisfactory. See page 42.

Operations

- Select cable type and connectors
- Measure required cable length
- Strip the cable end and fit the connectors
- Install and secure the cable.

Long cables are normally installed from one end before they are cut to length and fitted with the second connector.

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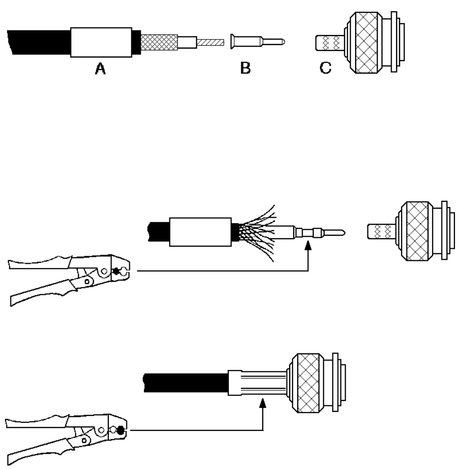
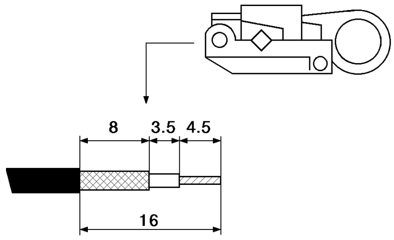
Connectors for normal environment



Cutting tool SPM 81052



Special Tools, Materials

- Cutting tool SPM 81052
- Fitting tool SPM 81127 for 93155 and 93156
- Expansion pliers SPM 81130 for rubber tube
- Cable clamps for ø 5 mm (4 mm), self-threading screws M3
- Cable straps, protecting tubes as required.

Installation of Crimp Connectors

The cutting tool SPM 81052 shown above is used for all crimp connectors shown on this and the opposite page. If the cutting depth is properly adjusted, neither inner conductor nor braid will be damaged. The cut through the insulation should not quite reach the braid. If two or more strands are cut off the inner conductor, the pin will not hold when crimped on. A cable is stripped as follows:

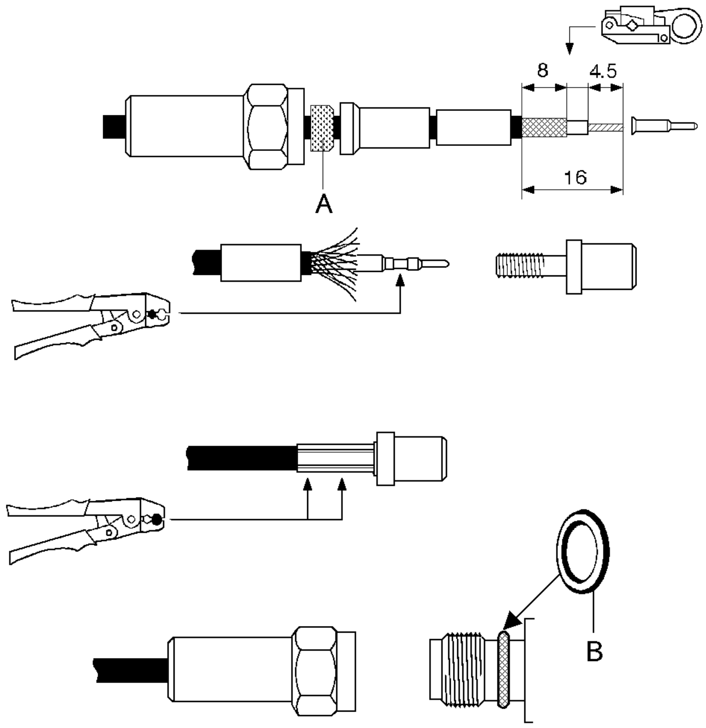
- Cut the cable end with a sharp knife. Push the cutting tool slide to **5**. Put the cable into the tool, with the end towards the SPM label, level with the center of the outer groove.
- Close the tool. Push the slide one step at a time to **1**, rotating the tool several turns for each step. Push the slide to 5, open the tool, take out the cable.
- Remove the cut-off parts. The two outer bits should come off easily, exposing 4.5 mm of the inner conductor and 3.5 mm of the dielectric.
- Slice lengthwise through the remaining bit of insulation, peel it off. Do not damage the braid.

Connectors for Normal Environment

Above shown example applies to all crimp connectors for normal environment shown on the previous page, and to the co-axial cable SPM 90005-L.

- Cut the cable end. Slide the metal ferrule A onto the cable. Strip the cable as shown above
- Push the contact pin B over the inner conductor and against the dielectric, with all strands of the inner conductor inside the contact pin. Crimp on the contact pin.
- Splay out the braid with a conical movement of the cable end. Push the crimp spigot C under the braid until the contact pin engages. All strands of the braid must be on the outside of the spigot.
- Slide the ferrule over the braid and against the connector bodys and crimp close to the connector body.

Connection of cables for moist environment



Connectors for Moist Environment

Above figure shows the sealing connector for moist environments, SPM 13008. The connector package contains two cable seals **A** of different inner diameters. **Green** seal for **4** mm, and **grey** for **5** mm cables. Use the appropriate seal and discard the other. The cable is cut and stripped with cutting tool SPM 81052, as shown on the previous page.

- Cut the cable end. Slide locking nut, seal, spacing tube and crimping ferrule onto the cable, as shown above. Strip the cable.
- Push the contact pin over the inner conductor and against the dielectric, with all strands of the inner conductor inside the contact pin. Crimp on the contact pin.
- Splay out the braid with a conical movement of the cable end. Push the crimp spigot under the braid until the contact pin engages. All strands of the braid must be on the outside of the spigot.
- Slide the ferrule over the braid and against the connector body. Crimp twice, first close to the connector body, then again at the end of the ferrule.
- Push the spacing tube over the ferrule against the connector body, and the seal into the tube.

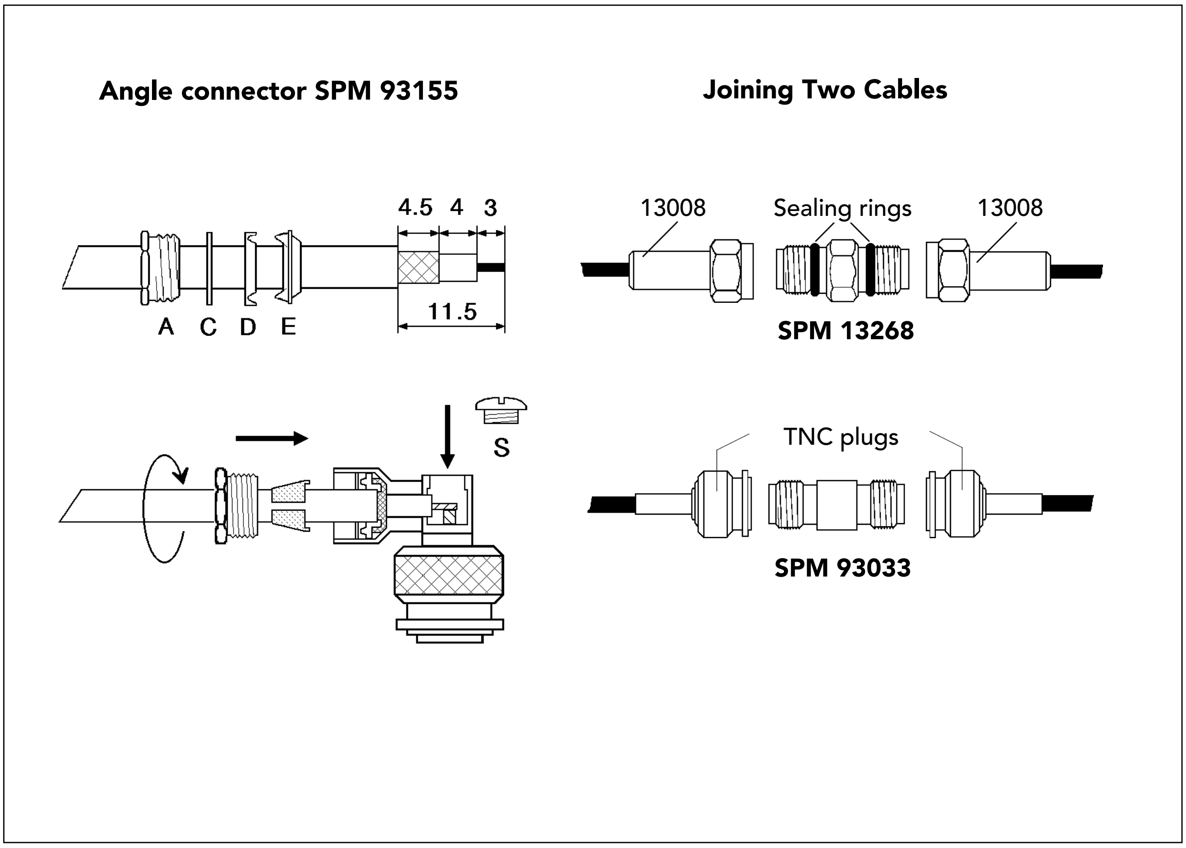
The sealing ring **B** must to be placed on the receiving TNC jack. Lubricate the taper with oil or grease. Tighten the locking nut with a 14 mm open wrench.

Cable Installation

Except for the sealing connector SPM 13008, all TNC connectors are screwed on and off by hand. Do not use tools or excessive force.

Avoid bending the cable with a small radius and don't twist it. Smallest bending radius is usually15 mm when in normal conditions and 25 mm when exposed to more than 50° C permanently. Harder bends may result in short circuits between the core leader and the screen. Use an angle crimp connector in narrow spaces, and a break protection SPM 81018 when required, especially with cable SPM 90267-L.

Secure the coaxial cable with cable clamps or straps. Use nylon straps SPM 82092 in moist atmosphere. For temperatures above 50° C tefzel straps SPM 82143 should be used. Maximum distance between straps is 25 cm (10"). The cables must not be loose. Cut the straps close to avoid injuries. All straps on the same section should be turned in the same direction.



Angle Connector SPM 93155

Angle connector SPM 93155 is used in narrow spaces for the high temperature cable SPM 90267-L.

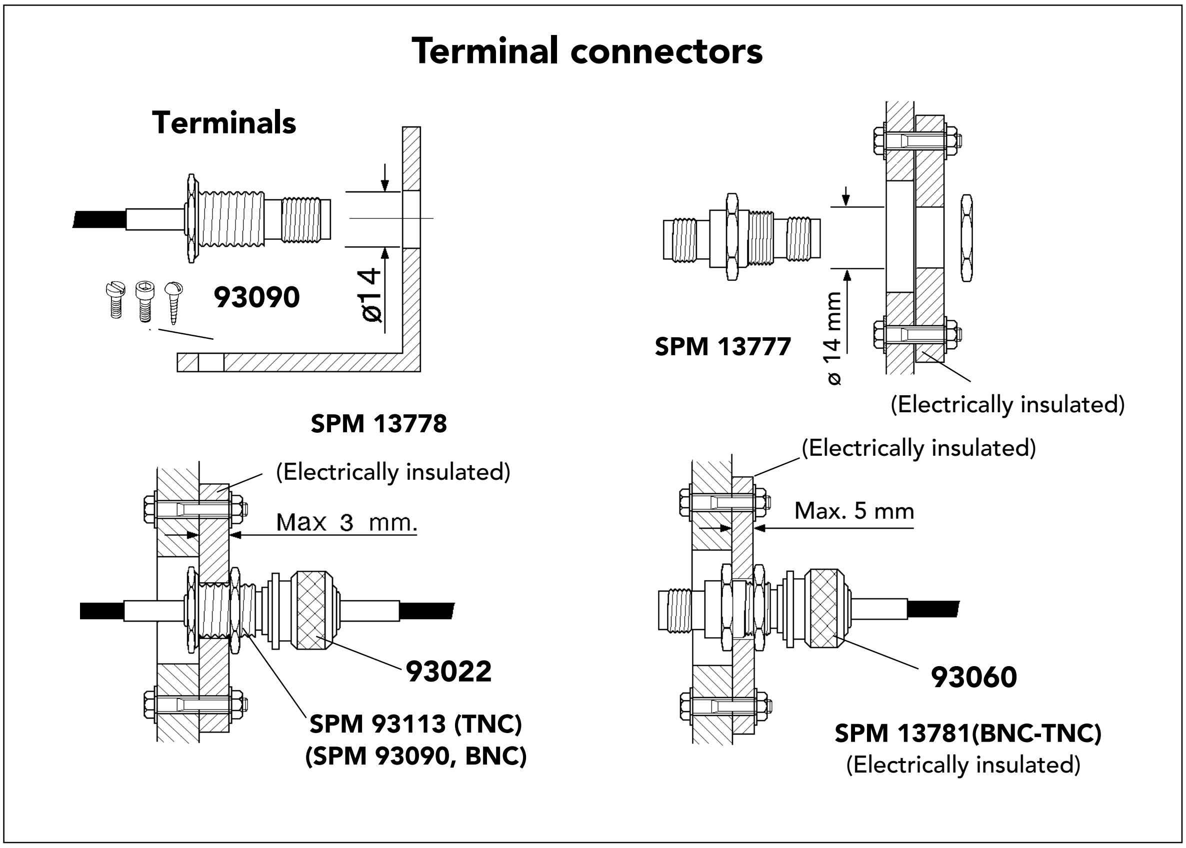
- The nut **B** is not used.
- The cable is stripped as shown above to the left. Splay out and fold back the braid, then push the cable into the connector body.
- The contact pin is part of the connector body. Remove the screw **S** and solder the inner conductor of the cable to the contact pin. Replace the screw. Push parts **E**, **D**, and **C** into the connector body. Fit the strain relief cones and tighten the locking nut.

The connector 93156, without angle, is mounted in a similar way with the exception that the nut B is mounted between the parts A and C:

Joining Two Cables

In moist environments, the cables are fitted with sealing connectors SPM13008 and joined with the TNC adapter SPM 13268 for sealed installation. The sealing rings delivered with the connectors are placed onto the adapter as shown above to the right. Lubricate the taper with oil or grease. The TNC adapter SPM 93033 is used for environments which do not require a sealed cable installation.

The joint always has to be insulated from earth by means of shrinking tubing. It should enter the record as specified by the local contact.



Terminals

The parts SPM 93090 (BNC, above) and 93113 (TNC) are normally used as measuring terminals, mounted on a terminal bracket SPM 13778. The connectors are crimp connected to the cable as described on page 38, and mounted with locking nuts.

These types of terminal connectors form sealed connections when combined with connector SPM 13008.

The connectors should always be protected by dust caps when not in use. Use dust cap SPM 93035 for TNC connections and SPM 93061 for BNC connections.

Bulkhead Unions

The terminal connectors are used as bulkhead unions for walls with thickness up to 5 mm.
Part 93113 (TNC) can be also be used as a bulkhead union, joining two cables fitted with TNC plugs. The maximum wall thickness is 5 mm, the through hole diameter is 14 mm.

The bulkhead union is sealed in connection with sealed cable connection.

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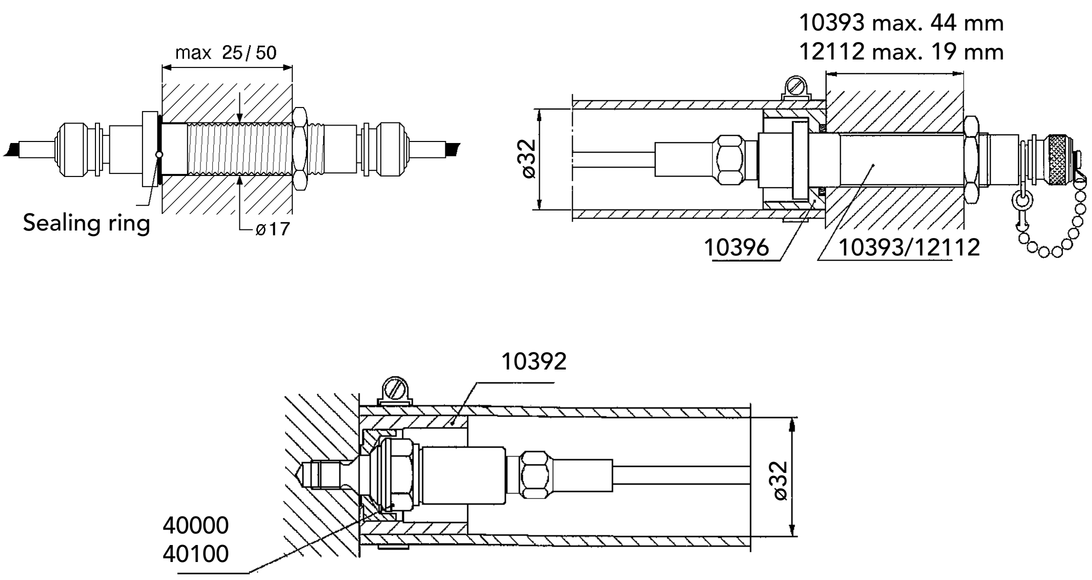
Use of bulkhead unions



Bulkhead Unions for Thicker Walls

The parts SPM 12112 and 10393 are bulkhead unions (measuring terminals) for thicker walls or partitions (max. thickness 25 mm and 50 mm respectively). They have TNC jacks at both ends and are supplied with sealing ring and dust cap. The connectors fastened with a lock nut, as shown above.

Tubes and Through Holes for Cables

The adjacent table gives the minimum inner diameters of protecting tubes and through holes for ø 5 mm coaxial cables and, in brackets, for the 4 mm cables SPM 90267.

A larger diameter should be selected for long and bent tubes. The cables are pushed through before they are stripped and fitted with connectors.

Accessories for Remote Monitoring

The sealing sleeves, SPM 10392 and 10396, are used to attach a flexible protection tube with ø 32 mm inner diameter. The sleeves can only be used together with standard transducers and bulkhead unions SPM 10393 and 12112.

No. of cables	Min. through hole ø, mm	No. of cables	Min. through hole ø, mm
1	6 (5)	8	16 (14)
2, 3	11 (9)	9	18 (16)
4	13 (11)	10	20 (17)
5	14 (12)	11,12	21 (18)
6, 7	15 (13)	13 - 16	23 (20)

CMM System Components

Bearing monitoring

BMM 40 2-channel module, for 40000 series transducers
BDM 40 2-channel module with display, for 40000 series transducers
BMM 42 2-channel module, for 42000 series transducers
BDM 42 2-channel module with display, for 42000 series transducers

Shock pulse transducers

40000 Shock pulse transducer, M8
40100 Shock pulse transducer, UNC 5/16"
40001 Shock pulse transducer, M8 extended
40101 Shock pulse transducer, UNC 5/16" extended

41225 Transducer in bolt design, M10
41435 Transducer in bolt design, M12.
40010 Glue-on transducer

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

42011 Shock pulse transducer with TMU, M8, Ex
42100 Shock pulse transducer with TMU, UNC 5/16", Ex

TMU-12 Transducer matching unit

Vibration monitoring

VMM 14 1-channel module, no display, 10-1000 Hz
VMM 15 1-channel module, no display, 3-1000 Hz
VDM 14 1-channel module, with display, 10-1000 Hz
VDM 15 1-channel module, with display, 3-1000 Hz
VMM 20 2-channel module, no display, 10-1000 Hz
VMM 21 2-channel module, no display, 3-1000 Hz
VDM 20 2-channel module, with display, 10-1000 Hz
VDM 21 2-channel module, with display, 3-1000 Hz

Vibration transducers

TRV-18 Vibration transducer, M8
TRV-19 Vibration transducer, UNF 1/4-28
TRX-18 Isolated base, M8
TRX-19 Isolated base, UNF 1/4-28
45011-L Cable with connectors -10 to +70°C, max. l=50 m

Temperature monitoring

TMM-10 Temperature transducer. -16 to +120°C
90296-L Twinned cable for TMM-10, no shield

Display module

DMM-10A 2 channels for 35 mm DIN rail
DMM-11 2 channels, in cabinet IP 65
14141 Cabinet for display modules
14142 Mounting rail, 35 mm DIN

Coaxial cables without connectors

90005-L PVC, -10 to +70° C 5 mm
90267-L PVF, -40 to +125° C, 4 mm

Cable connectors

10393 Bulkhead union, 50 mm
12112 Bulkhead union, 25 mm
10392 Sealing sleeve (for bulkhead union)
10396 Sealing sleeve (for bulkhead union)
13008 TNC cable connector, plug, crimp
13268 TNC adapter, jack-jack, for sealed conn.
93033 TNC adapter, jack-jack
13777 TNC-TNC terminal connector
13781 BNC-TNC connector
93022 TNC cable connector, plug, crimp
93077 TNC crimp connector, angle
93060 BNC cable connector, plug, crimp
93090 BNC terminal connector, crimp
93113 TNC terminal connector, crimp
93155 TNC angle connector, screw type with strain relief, solder/screw type
93156 TNC cable connector, screw type with strain relief, solder/screw type
81018 Break protection
82166 Rubber tube
82092 Nylon straps, moist atmosphere
82143 Tefzel straps, >50° C

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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.

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