Instruction Manual

Machine Guard™ MG4 A

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

Machine Guard MG4

Contents

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

1. Safety Arrangements

1:1. General

All persons performing installation or service on rotating machines and electrical equipment should be authorised and familiar with general safety rules and IEC symbols as well as local requirements, rules and regulations. In case of doubt the local management should be consulted.

SPM will not be responsible for any accident caused by persons not observing this Safety Precautions.

When performing installation or service on machines in potentially explosive atmosphere, the requirements according to ATEX EN 60079 should be followed.

1:2. Disconnection

Before starting installation work on machines, make sure that main power is off and will stay off until the work is done. Do not simply pull the switch - remove the fuses, lock the fuse box, put up warning signs. Check all terminals to ensure that the equipment is voltage free by using a voltage tester.

1:3. Electrical Installation

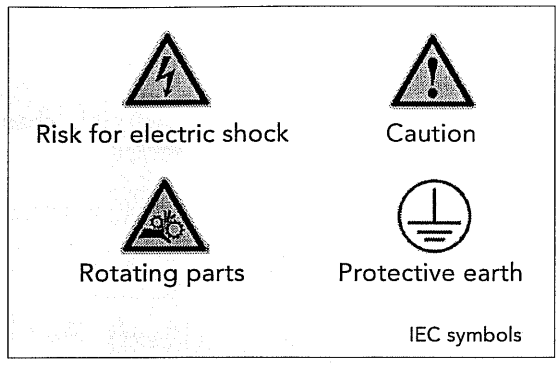
Always read the instructions delivered with the equipment before performing installation or service on electric equipment. If you are in doubt, please contact your local SPM representative before installing the equipment. Damage of the equipment caused by incorrect installation is not covered by product warranty. Before starting installation work, make sure that the main power switch is in off position and will stay off until the work is done. Check that all terminals, marked with protective earth IEC symbol, are properly connected to the protective earthing conductor of the building installation wiring. In some countries, the term "protective grounding" is used instead of "protective earthing". Earth and ground are used synonymous in this installation instruction. Choose installation tools that are safe and suitable for its working environment. Electrical risks can sometimes be eliminated by using air, hydraulic or handpowered tools. These are especially useful in harsh conditions.

1:4. System Components

To ensure optimum safety for user and environment, only original system components available from SPM should be used. When using non-original components, the compliance with EU directive with respect to electric safety, EMC and machine safety is not guaranteed by SPM.

1:5. Reapplying Power

For human safety, ensure the electrical equipment or installation is electrically safe. Before starting the machine, make sure that all protection covers on the machine are mounted and secured.



IEC symbols

2. Installation Precautions

2:1 Installation of Measuring Units and Measuring Terminals

Measuring units and terminals should be located in a protected position assigned by the local management. The units shall be easily accessible for undisturbed measurements and service. Signal cables should not be located close to power supply cables. The measuring equipment should be intended and specified for use in existing environment.

It is important that you read the operating instructions completely and follow all safety precautions before operating the measuring units. Electrical connections and wiring should be performed only by suitably trained personnel.

2:2 Work Regulations

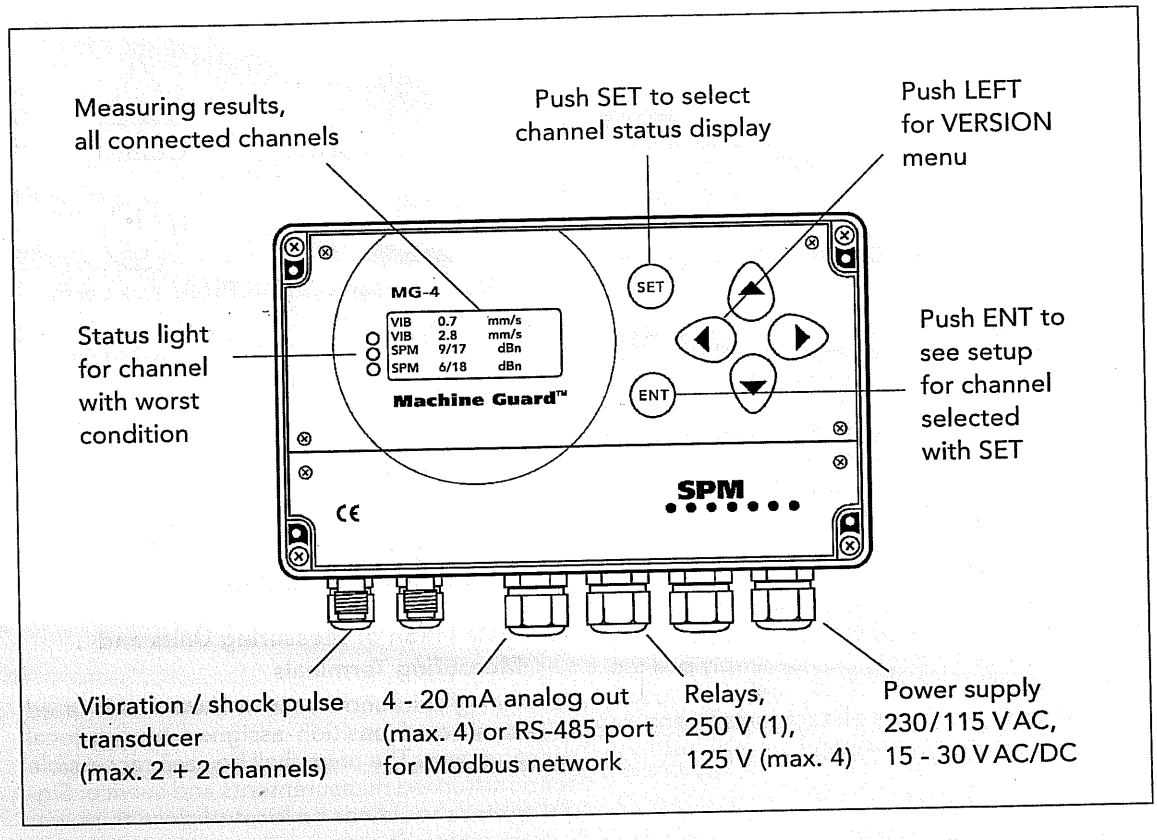
All personnel should be provided with the local work regulation before any work is commenced.

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

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

2:3 Inspection and Acceptance

Inspection of transducer positioning, connections, cable laying, TMU installations and strapping should take place after finished installation. The cables should be marked in accordance with agreement with the local contact. Inspection protocol in accordance with the local regulations should be used.



Machine Guard MG4

Machine Guard MG4 is a continuous monitoring unit for vibration severity (VIB) and bearing condition (SPM). It provides, for each channel:

- Status display (green - yellow - red light)
- Display of measured value with continuous updates
- Analog output current 4 - 20 mA with programmable range or complete data on LAN (Modbus network using RTU)
- Relay action at two programmable alarm levels (yellow and red alarm).

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

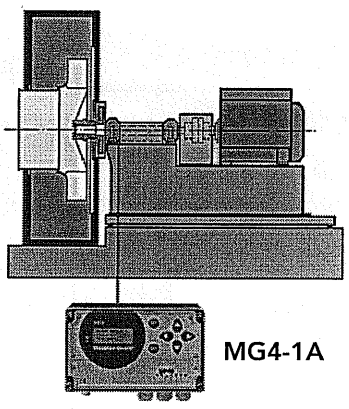
On pressing SET, the cursor will be on channel 1 and the status light will correspond to the result on channel 1. With SET one can step through all channels.

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

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

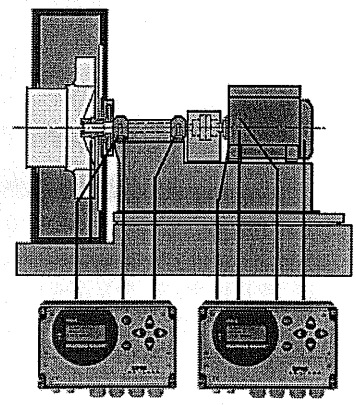
SPM Instrument AB • Box 504 • SE-645 25 Strängnäs • Sweden
Tel +46 152 225 00 • Fax +46 152 15075 • info@spminstrument.se • www.spminstrument.com

Example:
Fan vibration monitoring



MG4-1A

Example:
Complete monitoring



MG4-12A MG4-22A

MG4- 02A	2 x SPM
MG4-1A	1 x VIB
MG4-2A	2 x VIB
MG4-12A	1 x VIB, 2 x SPM
MG4-22A	2 x VIB, 2 x SPM

Five basic MG4 versions

The product family Machine Guard MG4 consists of five basic units. They have identical polycarbonate/PVC casings with transparent lids, IP65, and the same front panel. The difference is in the number and type of monitoring channels, measuring ranges, the number of analog output channels, and the number of relays.

The basic functions are vibration severity monitoring (VIB) and bearing condition monitoring (SPM). The version numbers are:

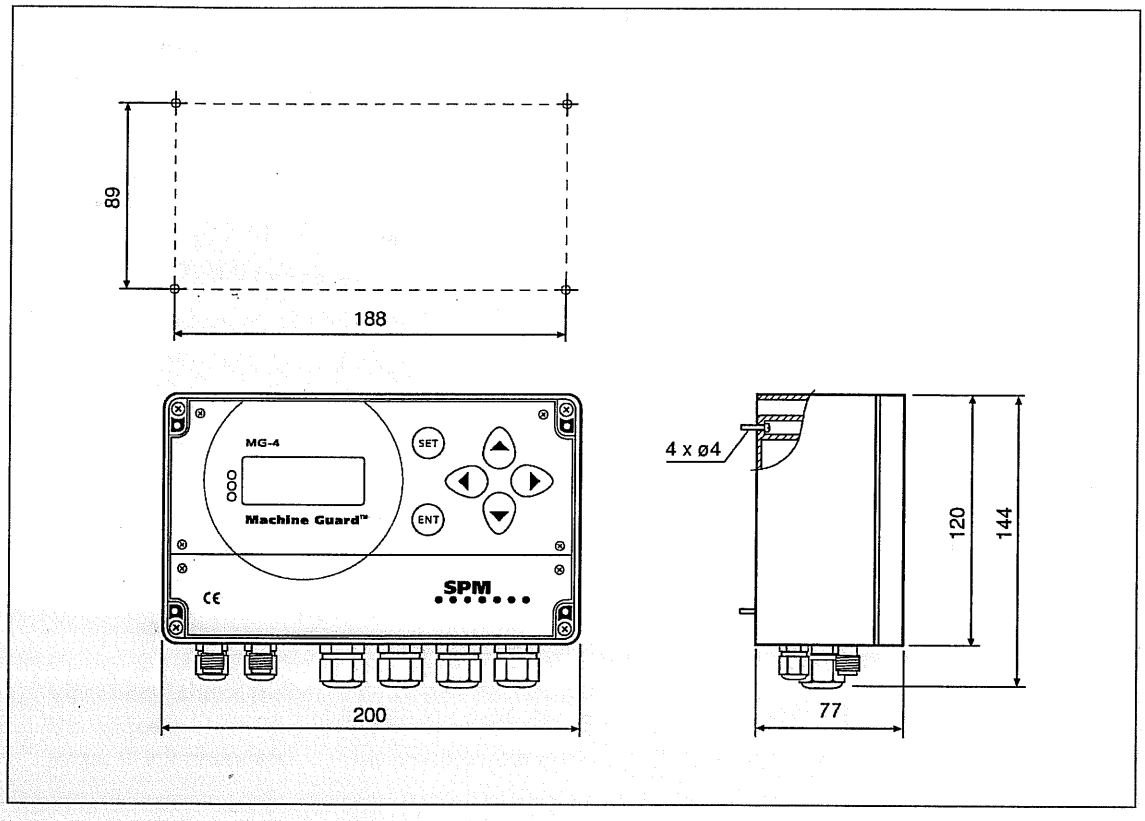
MG4-02A 2 channels SPM
MG4-1A 1 channel VIB
MG4-2A 2 channels VIB
MG4-12A 1 channel VIB plus 2 channels SPM
MG4-22A 2 channels VIB plus 2 channels SPM.

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

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

An analog output channel is supplied for each measuring channel, to a maximum of four. MG4 units equipped for LAN network have no analog outputs.

Please note! The following functions must be selected on ordering: Vibration frequency range, SPM measuring technique, Type of power supply, Analog outputs or Modbus network. They are factory set and cannot be changed by the user.



Mechanical installation of MG4

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

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

The casing material is polycarbonate/PVC, dimensions 200 x 144 x 77 mm. The casing is classed IP65. The cable inlets M12 for measuring cables are tight for cable diameters 3 to 6.5 mm. The cable inlets Pg11 are tight for cable diameters 5.5 to 10 mm.

The operating temperature range of the MG4 is 0 to 50 °C (32 to 122 °F) and maximum relative humidity 80% for temperatures up to 31 °C decreasing linearly to 50% relative humidity at 40 °C.

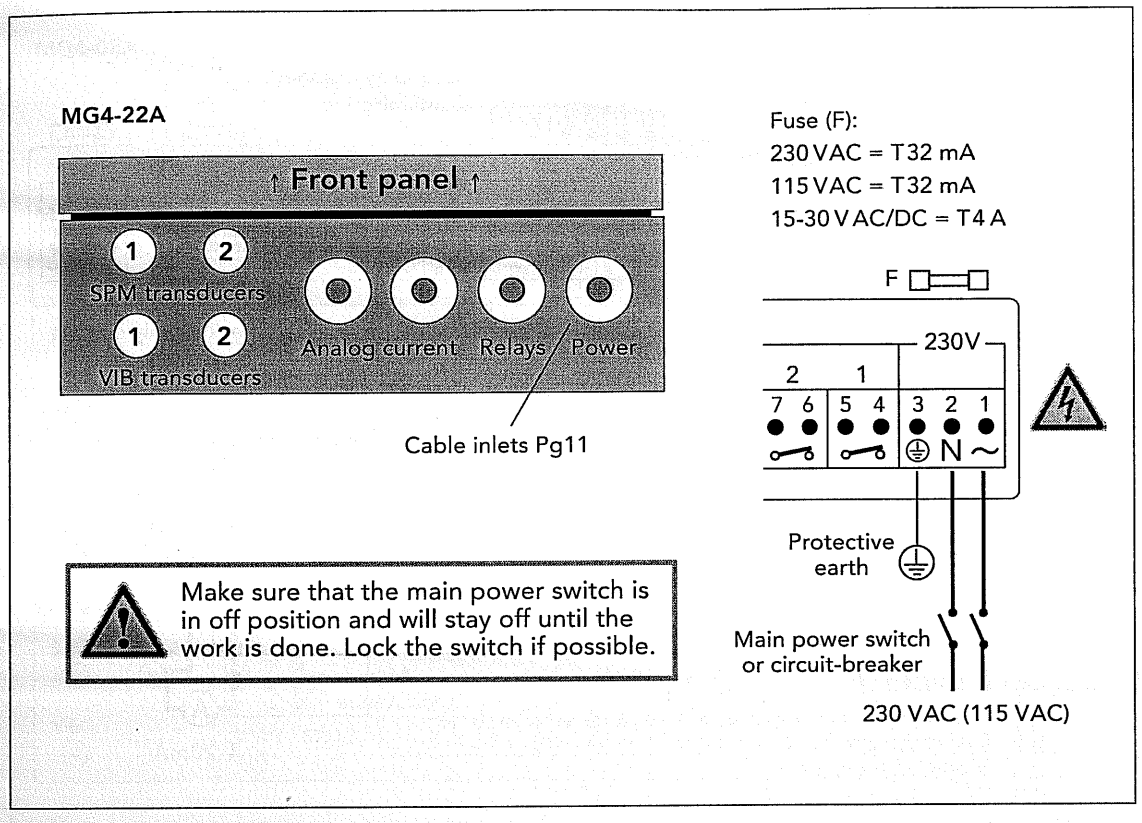
For SPM shock pulse transducer 42000 and 40000 plus TMU (transducer matching unit), the maximum cable length is 100 m. For the SPM shock pulse transducer 40000 without TMU, the maximum cable length is 4 m.

Important things to consider at installation of MG4

For good performance it is of great importance that MG4 is installed on a plane, robust and stable structure and always with the front cover mounted.

If not properly installed we have found that low frequent torque and bending forces on the MG4 casing can be transferred to the circuit board and affect the readings particularly if the front cover is not mounted.

Caution should be taken when mounting MG4s casings as great forces might even damage the circuit board or its components.



Electrical installation of MG4

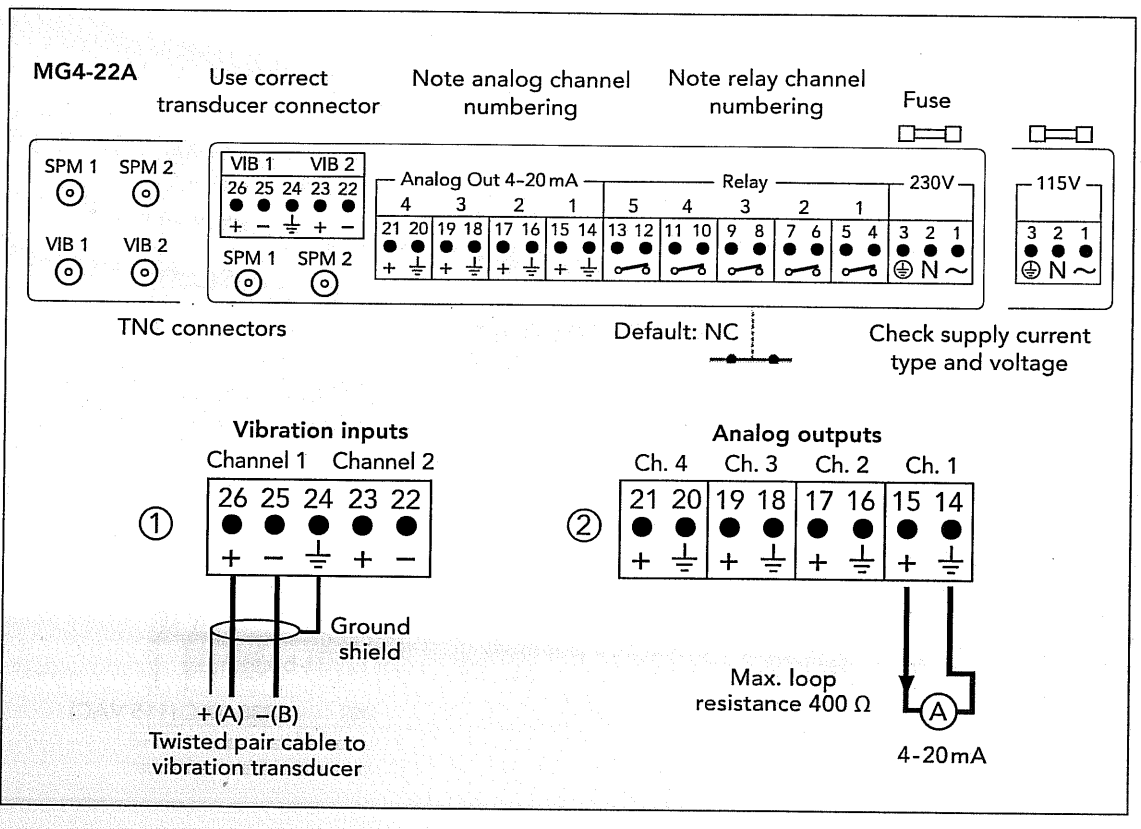
To connect an MG4, remove the lower part of the front panel. The terminals of type push-in for power supply and outgoing signals are situated beneath the lower part of the instrument panel. Switch off the main power switch before removing the panel. A label on the rear side of the cover shows the channel layout.

Power supply

The supply voltage can be 230 V AC, 115 V AC, or 15 to 30 V AC/DC. Note that the power connection is labelled with the factory set supply voltage for the unit. The fuse is a slow glass tube fuse rated T32mA for 250V and 115 V versions and T4A for the 15 to 30 V version. The cable inlets (Pg11) are tight for cable diameters 5.5 to 10 mm. An adequately rated power cord should be used.

The supply power should come via an external main power switch or a circuit-breaker, from a power source with an even load (nominal voltage ± 10%, no excessive transients). The switch or circuit-breaker must be suitably located and easily reached. It must be marked as the disconnecting device for the equipment. See the figure above for connection to mains power terminals. Check that the unit is connected to protective earth, marked with IEC symbol, and that protective earth is properly connected to the protective earthing conductor of the building.

Read the Safety Precautions on page 2 before performing electrical installation. If you are in doubt, please contact your local SPM representative before installing the equipment.



Transducer inputs

The coaxial cables from the shock pulse transducers are connected to TNC connectors on the underside of the MG4 unit. The vibration transducers are connected via shielded twisted pair cables to the input terminals on the circuit board inside the unit (fig.1) or to TNC connectors (option) underside of the unit. The TNC connectors for SPM are always closest to the front panel, the connectors for VIB closest to the rear side of the housing. Please note that the number of TNC connectors depends on the MG4 version (here MG4-22A, other versions see next page).

Recommended transducers are SPM type SLD or IEPE (ICP®) type transducers with bias 2 to 18 VDC and sensitivity 0.9 to 12.0 mV/m/s². Vibration transducers of type SLD are isolated from machine ground. The cable shield shall be connected in one end only, preferably to the earth terminal. The cable shield shall not be connected to the earth terminal in cases where the shield already is connected at the transducer end. The cable inlets (M12) are intended for measuring cables with diameter 5 mm (IP65).

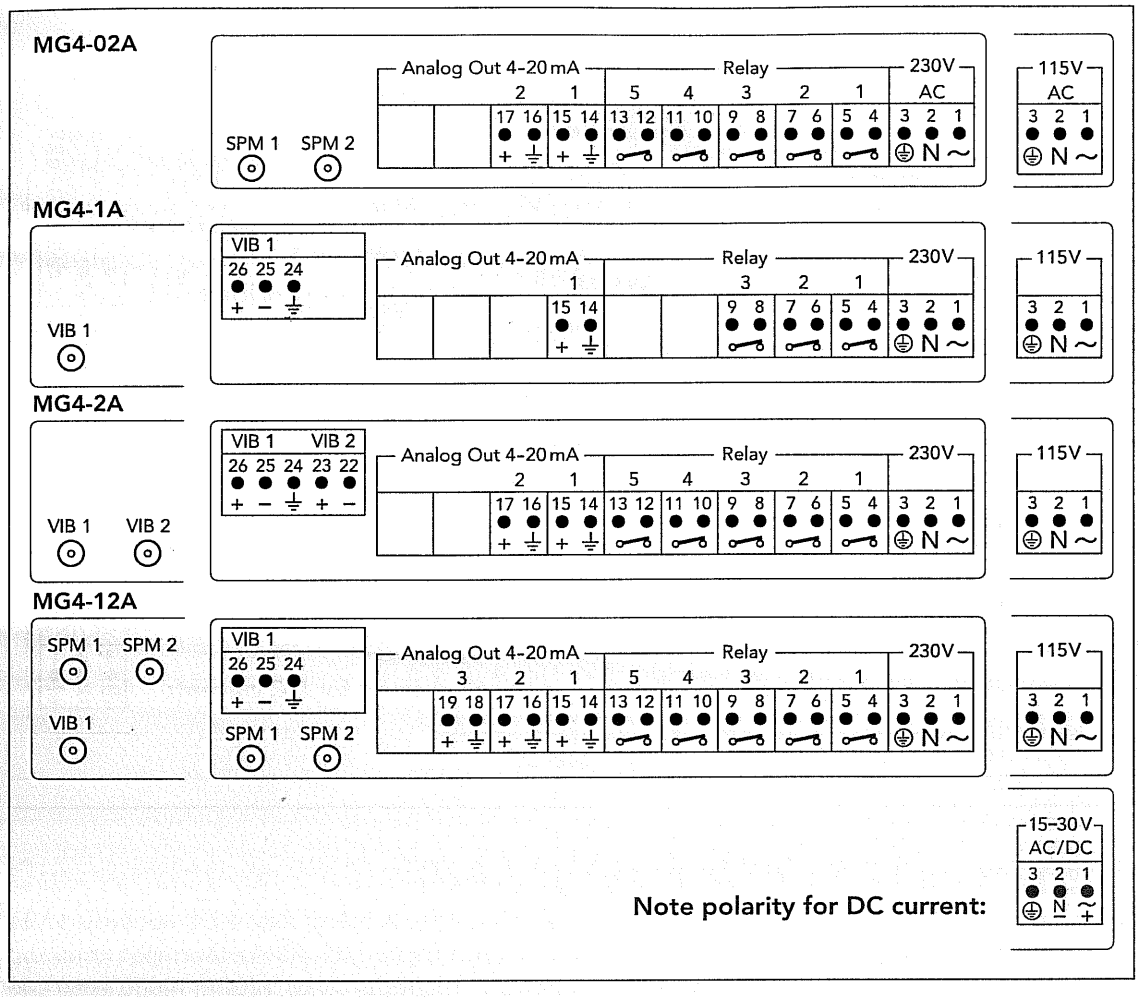
Relays

The relay specifications are 250 V AC / 5 A /1250 VA for the main relay (Relay 1, connectors 4-5). The number of secondary relays, specified 125 V AC / 1 A / 60 VA (150 V DC / 1 A / 30 W), depends on the MG4 version. MG4-1A has two, the other versions have four such relays as standard equipment. As default, the relays are NC = normally closed and open on alarm or power failure. You can change that to NO = normally open when programming the unit, see page 15.

Analog outputs

The up to four 4-20 mA analog outputs (fig.2) have no galvanic separation, but a common earth connection. In case galvanic separation is required, the user must supply a suitable insulation module.

NB: The MG4 is the active unit in the 4-20 mA loop and is feeding about 10 V DC to the PLC or the devices in the loop. Including cable resistance, the max. loop resistance is 400 Ω.



Terminal configurations

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

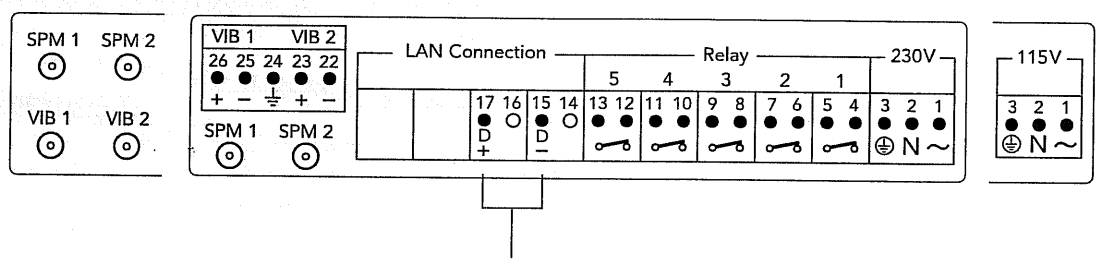
MG4 units suitable for supply with 15 to 30 VAC/DC are marked as shown. The + terminal is numbered 1.

Please note:

Regarding the outputs: analog output channels and relays can be linked to any of the input channels by programming the MG4, see pages 19 to 21.

When TLT is set to ON, the MG4 indicates TLT fault (fault on transducer line test) when the transducer is not connected or when the transducer line is not OK (open or short circuit for VIB, TLT value below 15 for SPM). This will cause the connected analog output to go to approx. 0 mA. When TLT = OFF, the analog output will go to 4 mA in case of TLT fault.

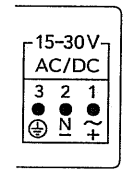
MG4-22A with RS-485 port



17. D+ = DATA+, in- and outgoing conductors, RS-485

15. D– = DATA–, in- and outgoing conductors, RS-485

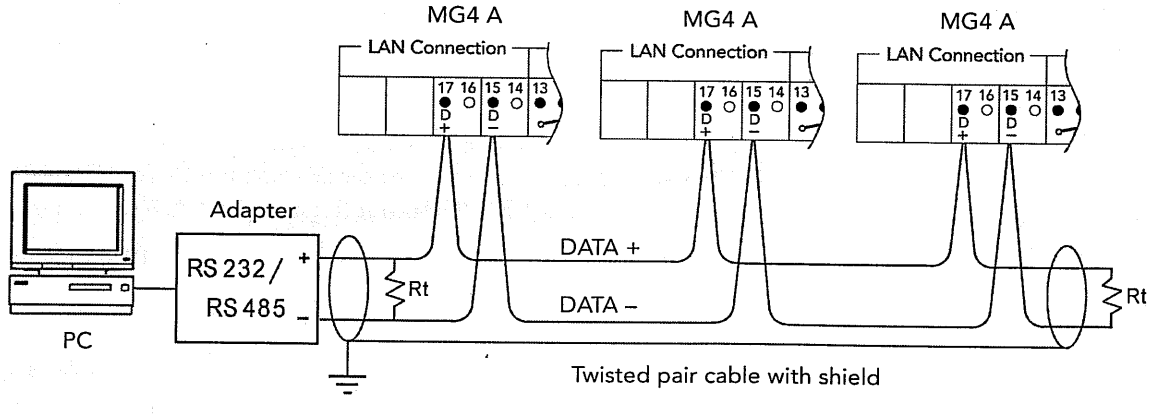
Note polarity for DC current:



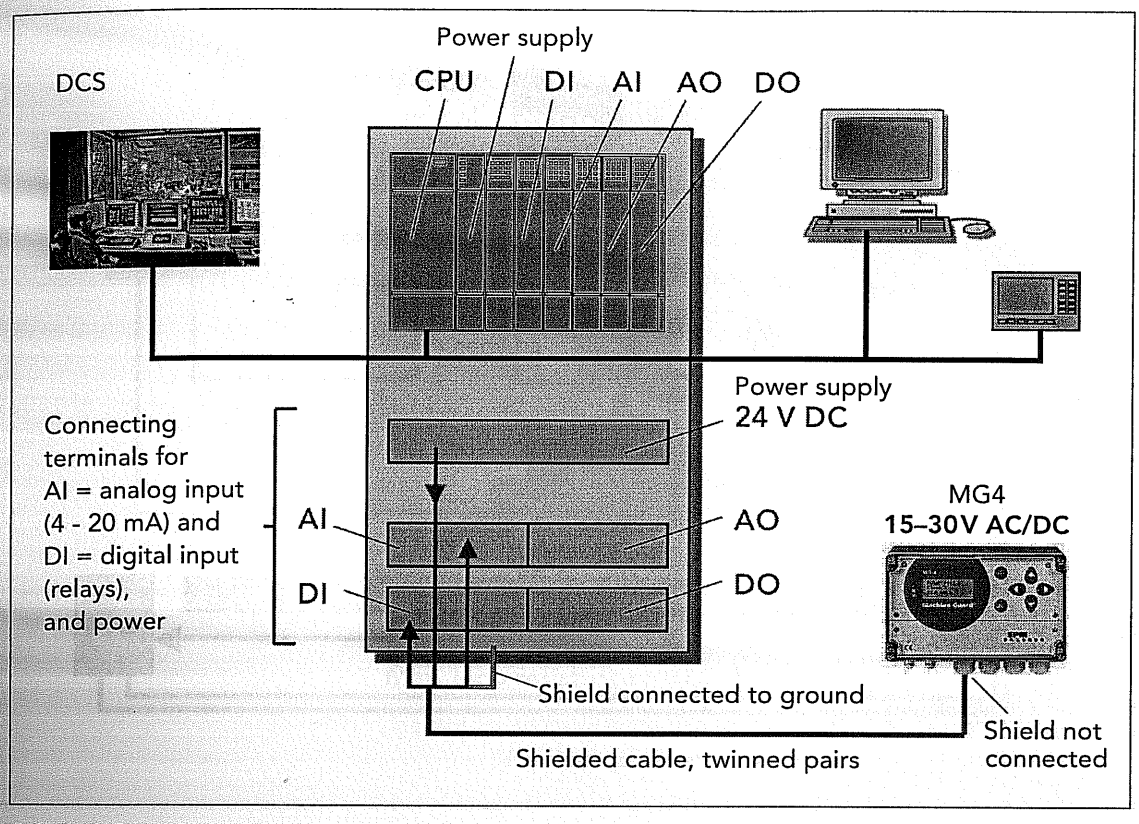
Connection to RS-485 network (LAN)

As an option the MG4 can be equipped with a RS-485 port for sending data via a network. MG4 units with network connection have no 4-20 mA analog outputs. RS-485 is the most common type of local network (LAN) in the industry. It allows cable lengths up to 1200 m (4000 feet) per segment and baudrates up to 57600 bps. Up to 32 (255) MG4 units can be parallel connected in one segment. The number of units depends on how they are mixed with other equipment. The network has differential transmission (balanced lines) with high resistance against noise. A twisted pair cable with shield is used to connect the units, see the figure below. The cable shields should not be connected to the MG4. These are joined together outside the terminals.

The protocol is Modbus RTU (Remote Terminal Unit). Each message must be transmitted in a continuous stream. The protocol is described in the end of this manual.



Rt = Termination resistor (120 ohm)

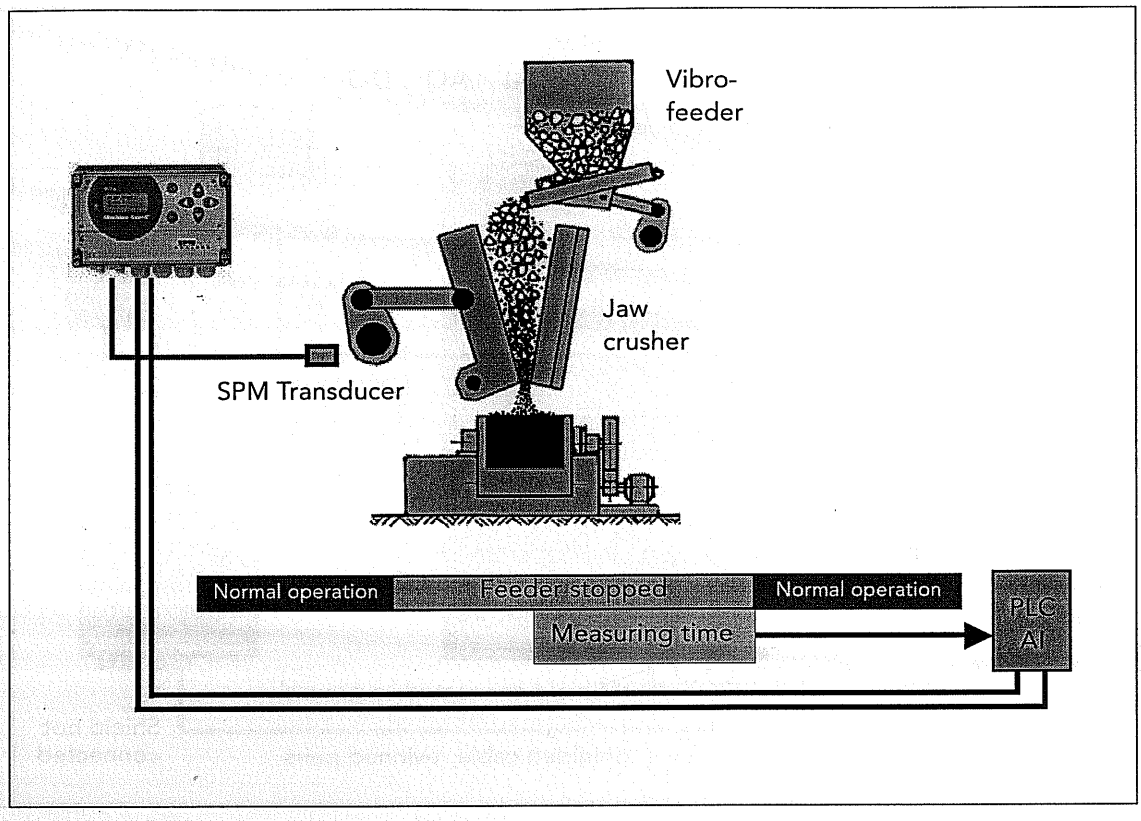


Connection to PLC via analog output

To connect an MG4 unit to a PLC, one uses a shielded cable with twisted conductor pairs. The power supply to the MG4, normally 24 V DC, comes from the PLC. The analog 4-20 mA outputs of the MG4 are connected to an AI unit (analog input), the relays to a DI (digital input) unit.

The condition monitoring parameters are set up in the MG4. Control, display and data storage are handled by the PLC.

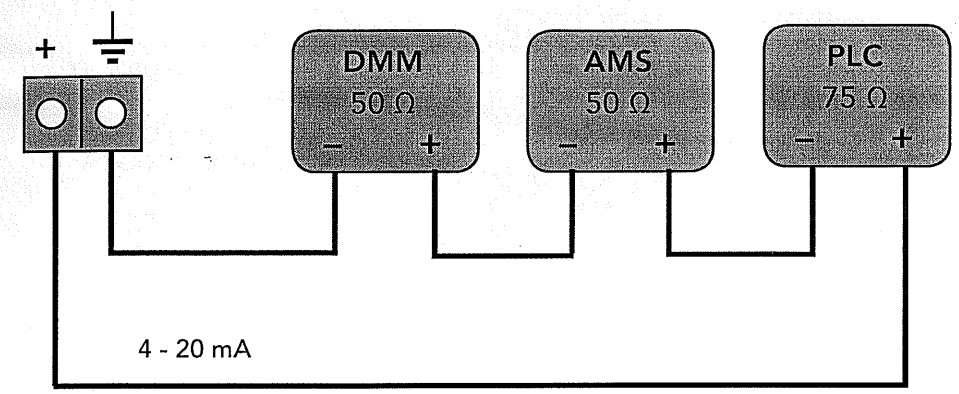
PLC = Programmable Logic Control
CPU = Central Processing Unit
AI = Analog Input 4-20 mA from the MG4
AO = Analog Output 4-20 mA to an external display
DI = Digital Input 0 or 24 V from a relay in the MG4
DO = Digital Output 0 or 24 V to an external relay
DCS = Distributed Control System



Measuring logic controlled by the PLC

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

After stopping the feeder and waiting until the present load is processed, the PLC reads the shock pulse values obtained while the crushers is idling. All measuring results collected by the MG4 unit during normal crusher operation are ignored.



Loop resistance R = 50 Ω + 50 Ω + 75 Ω = 175 Ω
[+ cable resistance]

Max. loop resistance = 400 Ω

Using the analog current in other devices

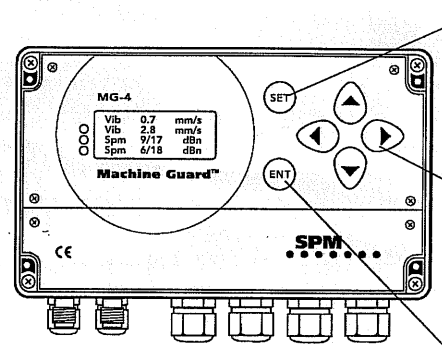
The analog output from an MG4 can be fed to several external devices:

DMM: the digital display unit of the CMM System.

AMS: the unit for alternative measurements belonging to the Intellinova online system. This way the measuring results can be transferred to the SPM software Condmaster®.

PLC: Programmable Logic Control.

These devices are connected in series. The MG4 is the active unit in the loop and is feeding about 10 V DC to the devices in the loop. This puts a limit on the number of devices and the cable length. Including cable resistance, the max. loop resistance is 400 Ω.



Programmed measuring parameters:

- Measuring time (VIB only)
- Two alarm limits per channel
- Alarm delay 0 to 600 seconds
- Measuring channel's link to analog output
- Measuring range in steps of 10 mm/s for VIB and 10 dB for SPM
- Alarm limit, link to relay

Programmed measuring parameters

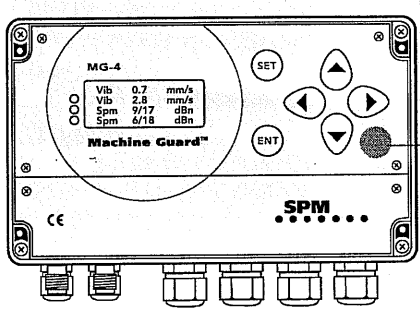
The measuring and alarm parameters of an MG4 are programmed, using the keys on the front panel. The program is password protected, which means that a the password 'SPM' has to be input before any parameter can be changed.

Programmed parameters are:

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

The length measuring unit can be set to either mm or inch under SETUP on the VERSION menu. There you can also set TLT to OFF. TLT is the transducer line test. For VIB channels, this test checks for interruption or short circuit in the cable between vibration transducer and MG4, or in the transducer itself.

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



Invisible RESET button

Reset to default values:

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

Reset default parameters

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

General:

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

VIB channel:

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

SPM channel:

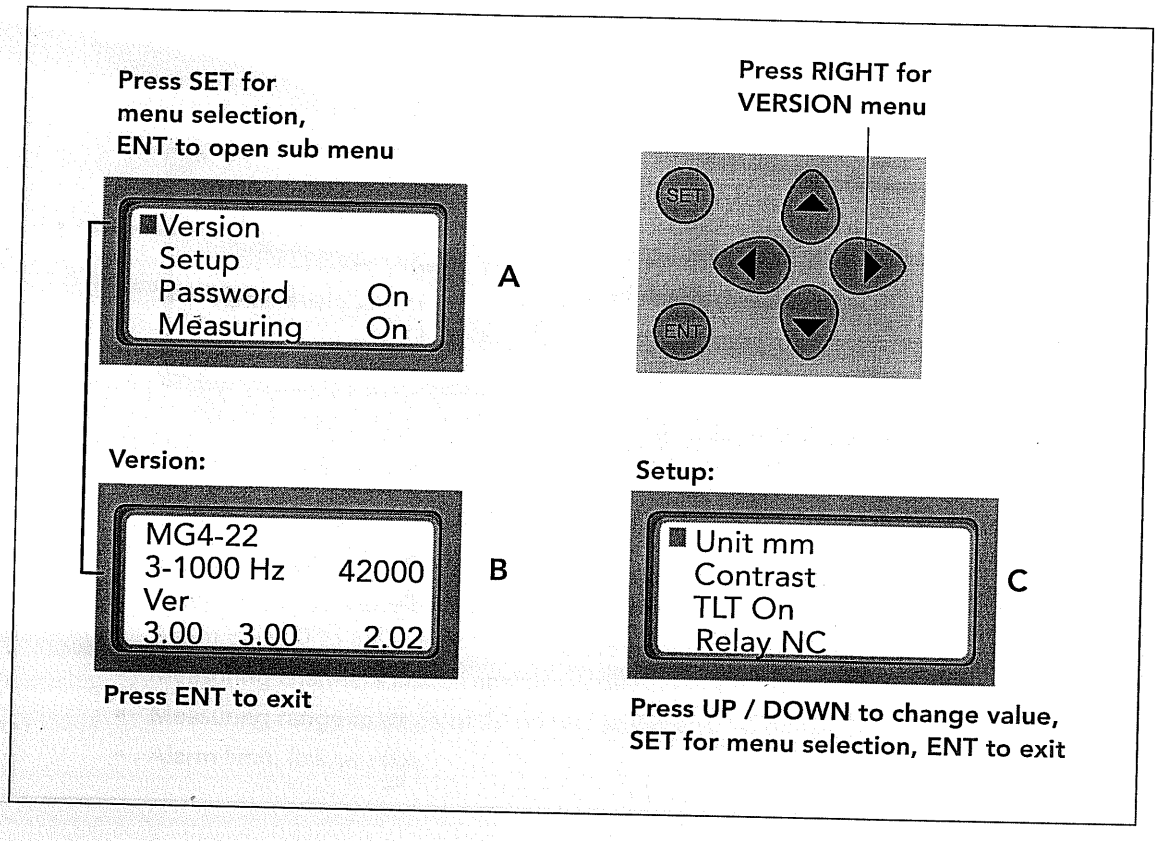
Name	SPM channel 3 (4)
Alarm limit TLT	15
Range for 4 - 20 mA	0 to 90 dBsv
Bearing speed RPM	--
Bearing diameter dmm	--

dBm/dBc technique:

Initial value dBi	0
Alarm limit A1	21 dBsv
Alarm limit A2	35 dBsv

LR/HR technique:

NORM number	--
TYPE number	1
Acc (accunulation)	1
COMP number	--
Alarm limit A1	-- dBsv
Alarm limit A2	-- dBsv



The VERSION menu, version and setup

The VERSION menu shows the basic setup of the MG4 unit, which is permanently programmed and cannot be changed, and also a number of general settings which can be changed with the function keys on the front panel.

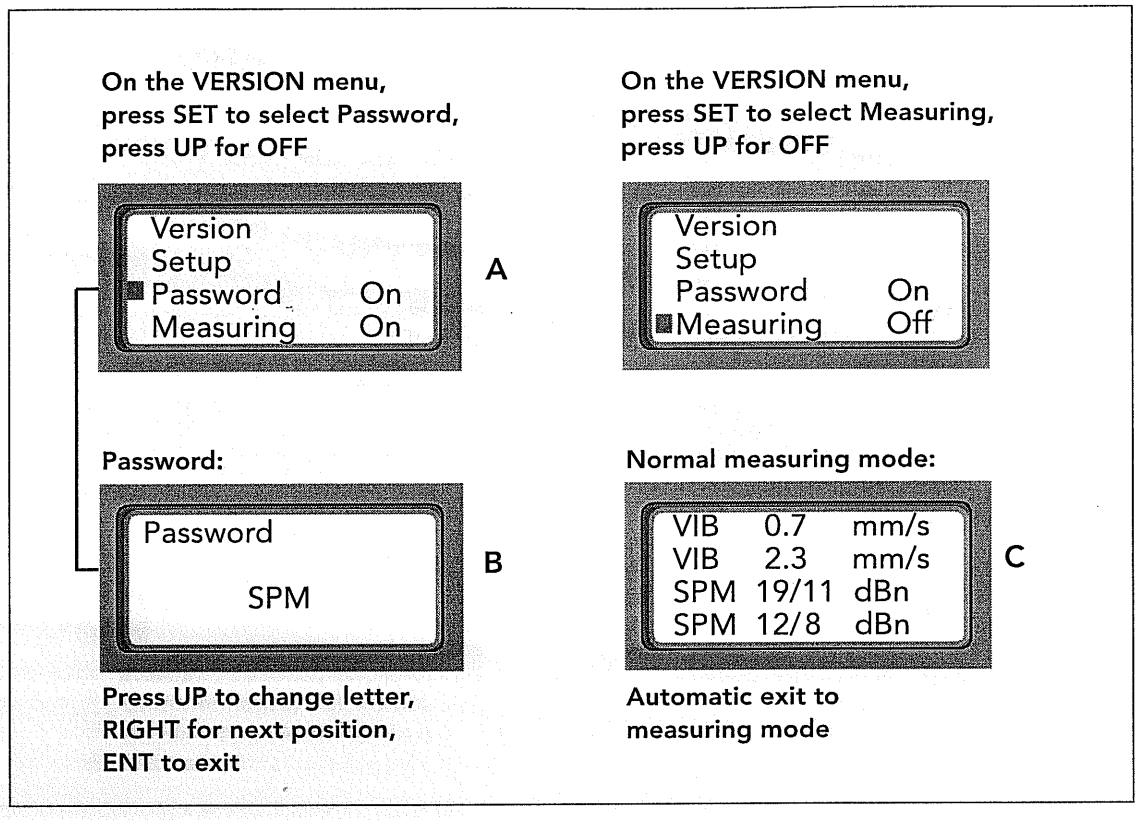
To reach the menu (A), press the RIGHT key. With SET you move the cursor to one of the four headers. Press ENT to open the first one, VERSION (B). This shows the MG4 version, the vibration measuring range and the shock pulse transducer type. On line 4 you see the version numbers of the three processors CPU, VIB, and SPM. None of these settings can be changed. Press ENT to exit to the VERSION menu.

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

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

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

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



The VERSION menu, password and stand-by

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

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

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