MC5H | HD

Operational Manual

DANGER

This module is designed to connect to dangerous electric voltages. Ignoring this danger could severely harm people or generate mechanical damage.
To avoid the danger of electrical shocks and fire, the security instructions in this manual must be read and followed. The specifications must not be exceeded and the module must be applied only as follows. Before using the module, this manual must be meticulously examined. Only qualified personnel (technicians) should install this module. If the equipment is used in a different manner to the one specified by the manufacturer, the provided protection by the equipment could be damaged.

DANGER

Up until the module is fixed, no dangerous voltages must be connected. Next operations should be carried on in the disconnected modules and under ESD security connections: general montage, connection and disconnection of cables. Module failure localization.
The module repair and the change of circuits must be performed only by SEMAPI.

DANGER

Do not open the module front cover since this will damage the front DISPLAY indicator / programmer connector. This module does not have DIP switches or bridges. In order to keep the security distances, the module relays contacts must not be connected to dangerous and not dangerous electric voltages at the same time. The MC5 must be mounted on DIN rail according to DIN 46277.

Symbols Identification

Triangle with an exclamation sign: Danger / Attention
Potential lethal situations.

The CE Mark shows that the module meets the directives essentials requirements.

Double isolation symbol indicates that the module is protected by a double isolation or reinforced.

Security instructions

Definitions

Dangerous voltages have been defined as those between these spectrums:

75 to 1500 VCC and 50 to 1000 VCA. The technicians are people that are qualified or educated to mount, operate and also localize failures in a correct manner and in accordance to the regulations regarding security.
The operators, are familiarized with the content of this manual; they adjust and operate the buttons or potentiometer during normal operation.

Reception and unpacking

Unwrap the module avoiding damaging it. The wrapping should always be kept with the module until it has been installed permanently. When the module is received, check that it conforms to the requested module.

Environment

Avoid direct sun rays, dust, high temperatures, mechanic vibrations and blows, rain and heavy humidity. If it is necessary, the heat that exceeds the indicated limits for room temperature can be avoided with ventilation.

All modules are within these categories: Category 2 Installation, Level 2 Pollution and Class 2 Isolation.

Montage

Only technicians that are familiarized with the technical terms, warnings and manual instructions, and who could also fulfill the aforementioned, should connect the module.

If there was any doubt regarding the correct module connection, please contact our local distributor or, alternatively, SEMAPI www.semapi.com

The montage and connection of the module should meet with the national legislation for the montage of electrical materials, in relation to the cable section, fuse protector and localization. The descriptions for the in / out connections are shown in the blocks diagram and in the side label.

The following must be applied to the modules connected to dangerous fixed voltages:

The fuse maximum protection will be 10 A and, just like the power switch, should be easily accessible and close to the module. The power switch should be marked with a label that indicates how to disconnect the module.

UL Installation Conditions

Use only the copper conductors 60/75°C.

Use only in level 2 pollution class or better.

Maximum room temperature……..60°C.

Maximum cable size……..AWG 26-14

UL archive number…….E231911

Normal Operation

The operators are the only ones who are allowed to adjust and operate the modules that are safely installed in frames, etc., to avoid corporal damage and module deterioration. This is, to avoid dangerous electrical discharges and making the module easily accessible.

Cleaning

When disconnected, the module can be cleaned with a cloth moistened with distilled water.

Responsibility

If this manual's instructions are not strictly followed, the client cannot request SEMAPI and its distributors the conditions this normally offers in the established sales agreements.

How to disassemble the MC5H AND HD systems

First, remember to remove the connectors with dangerous voltages.

Image 1:
Separate the DIN rail module by raising the upper lock.

When the frontal LED eye turns on or the indicator shows AO .ER

The MC5 is designed as a SIL device, with a high level of security. Therefore, there is a constant measure of output 4…20mA. If the current is 0, the device goes into error mode, activating the frontal (red) LED and deactivating the relays. This option does not appear by default, we must activate it in the menu.

The error mode can only be deactivated by removing the supply voltage and putting it back.

MC5H HD Transmitter

- Input for RTD, thermocouple, Ohm, potm., mA y V
- 2 string supply > 16 V
- FM approval to install in Div. 2
- Current / Voltage output and 2 relays.
- AC or DC universal power supply.

Advanced Options

• Programmable through removable frontal display in versions: HD, relays, password protection, error diagnostic and help text.

Application

- Electronic temperature measurement, linearized, with RTD or thermocouple sensor.
- Conversion from lineal resistance variation to standard current / voltage signals e.g. from solenoid and butterfly valves or linear movements with associated potentiometer.
- Power supply and signal insulator for 2-wire transmitters.
- Processes controller with 2 couples of analog potential and output free relays contacts.
- Analog signals galvanic separation and potential free signal measurement
- The MC5 is designed according to strict security requirements and, because of that, it can be applied in SIL 2 installations.

Technical Characteristics

- When the MC5 is used in its HD version (with its display) / frontal programmer, all operational parameters can be modified to be adapted to any application.
- A green / red frontal LED indicates normal operation and bad functioning. A yellow LED is on every active output relay.
- The continuous review of the vital information is stored for security purposes.
- 2,3 kVCA galvanic isolation in all 4 ports.

MC5HD with frontal display / programmer

The simple and easily understandable MC5 menu structure and the explanatory help texts guide automatically and without effort through the configuration steps, which makes the product very easy to use.

The configuration functions and options are described in the “Programming / operate the function keys” section.

Application

- Communication interface to modify operational parameters in the MC5.
- It can be moved from one MC5HD module to another MC5H and download the configuration of the first transmitter to the followings.
- Fixed display to visualize process and status information.

Technical Characteristics

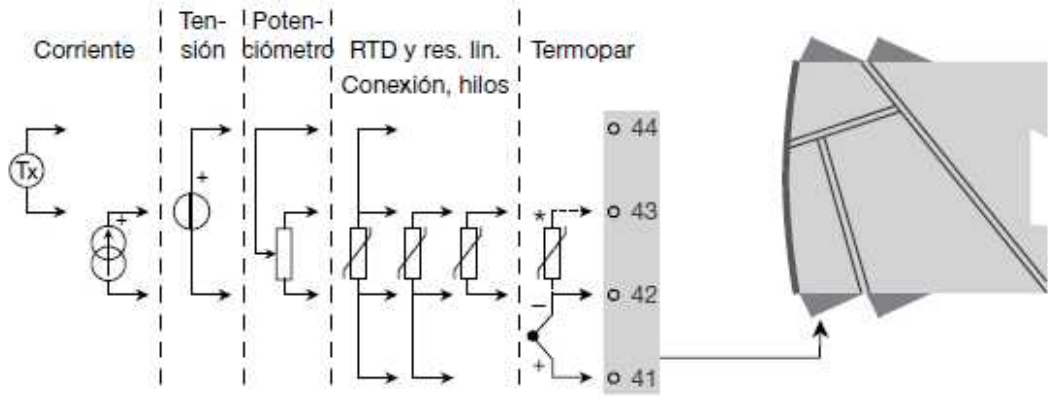
- LCD display with 4 lines; line 1 (H=5,57 mm) shows the input signal, line 2 (H=3,33mm) shows the units, line 3 (H = 3,33) shows the analog output or the TAG name and line 4 shows the communication and relays status.
- The programming access can be blocked by assigning a password. The password is stored in the transmitter to ensure a high protection level against unauthorized modifications in the configuration.

Montage / installation

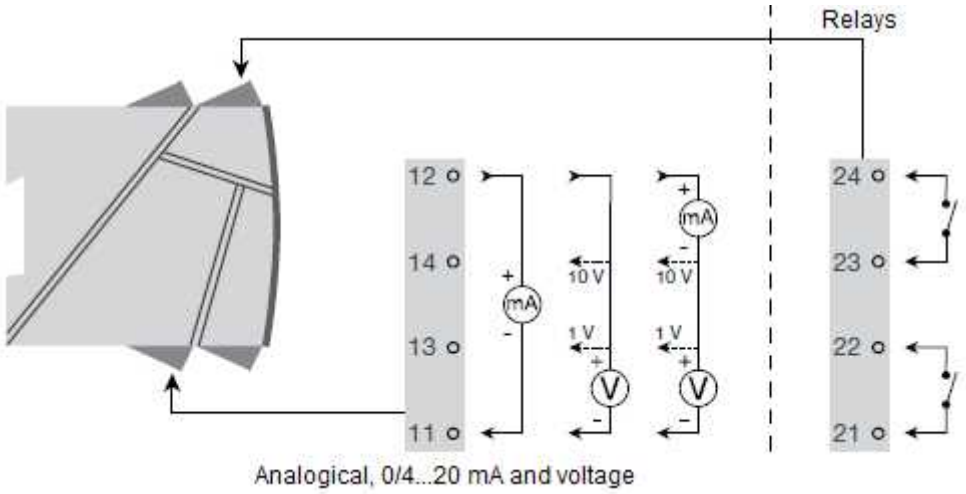
- Attach the Display in the front of the MC5H, by doing so it will turn into a MC5HD module.

Applications

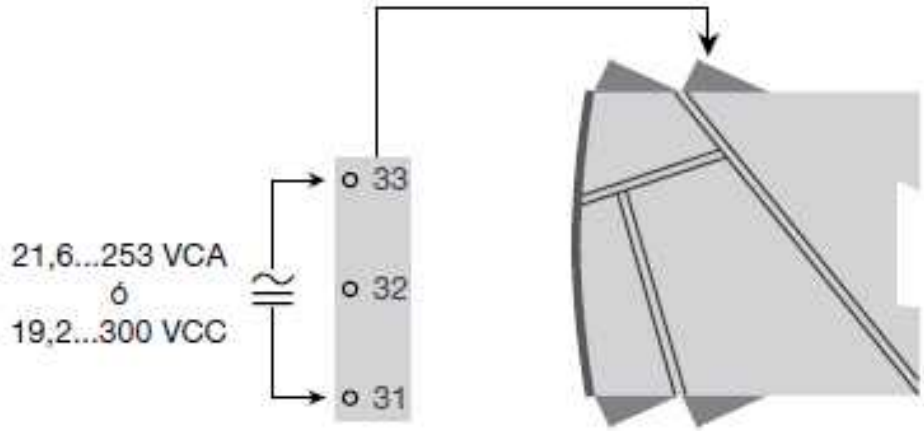
Input signals:



Output signals:



Power supply



Electrical Specifications

Range specifications..... -20°C a +60°C
Common specifications:
Universal power supply voltage..... 21,6...253 VCA, 50....60 Hz
Or 19,2...300 VCC
Maximum consumption.....≤ 2,5 W
Fuse.....400 mA SB / 250 VCA
Voltage insulation, test / opera.....2,3 kVCA / 250 VCA
Communications interface.....Frontal programmer D501
Signal / noise relation.....Minimum 60 dB (0...100 kHz)
Response time (0...90%, 100...10%):
Input temperature.....≤ 1 s
Input mA / V.....≤ 400 ms

Auxiliary voltages:

2 strings power supply (term. 44...43)..... 25...16 VCC / 0...20 mA
Maximum string size.....1 x 2,5 mm2 twisted cable
Screwed terminal twist.....0,5 Nm
Relative humidity.....≤ 95% HR (no cond.)
Dimensions, without frontal display (HxAxP)...109 x 23,5 x 104 mm
Dimensions, with frontal display (HxAxP).....109 x 23,5 x 116 mm
Degree of protection.....IP20
Weight.....170 g / 185 g with 4501

Input for RTD types:
Pt10, Pt20, Pt50, Pt100, Pt200, Pt250, Pt300, Pt400, Pt500, Pt1000
Ni50, Ni100, Ni120, Ni1000
Cable res. per string (maximum), RTD.....50 W
Sensor current, RTD.....Nom. 0,2 mA
Sensor cable
Resistance effect (3 / 4 string), RTD..... < 0,002 W / W
Error detection in the sensor, RTD..... Yes
Short-circuit detection, RTD..... < 15 W

Current input:
Measurement range.....0...20 mA
Programmable measurement ranges.....0...20 and 4...20 mA
Input resistance.....Nom. 20 W + PTC 50 W
Sensor error detection:
Loop interruption 4...20 mA.....Yes

Voltage input:

Measurement range.....0...12 VCC
Programmable measurement ranges.....0...1 / 0,2...1 / 0...5 / 1...5 / 0...10 and 2...10 V
Input resistance.....Nom. 10 MW

Current output:

Signal range (interval).....0...20 mA
Programmable signal ranges.....0...20 / 4...20 / 20...0 and 20...4 mA
Charge (maximum).....20 mA / 800 W / 16 VCC
Charge stability.....≤ 0,01% d. interv. / 100 W
Sensor error detection.....0 / 3,5 / 23 mA / none
NAMUR NE 43 Upscale / Downscale.....23 mA / 3,5 mA

Output limit

4...20 and 20...3 mA signals.....3,8...20,5 mA
0...20 and 20...0 mA signals.....0...20,5 mA
Current limit.....≤ 28 mA
Voltage output:
Signal range.....0...10 VCC
Programmable signal ranges.....0...1 / 0,2...1 / 0...5 / 1...5 / 0…10 / 2…10 / 1…0 / 1…0,2 / 5…0 / 5…1 / 10…0 and 10…2 V

Charge (min.)……..500 kW
Relay outputs:
Relay functions…….. Consignment, Window, Error in the sensor, Latch, Power and Off
Hysteresis, in % / counting units……..0,1…25% / 1…2999
Delay ON / OFF…….0…3600 s
Sensor error detection……Open / Close / Maintain
Max. Voltage……250 VRMS
Max. Current……2A / AC or 1A / DC
AC max. power……500 VA

Ex. / I.S. approval:
FM, applicable in……. Class I, Div. 2, Group A, B, C, D
Class I, Div. 2, Group IIC Zone 2
Max. Room temperature for T5…….. 60º C

Marine approval:
Det Norske Veritas, Ships & Offshore..... Standard for Certification #2.4
GOST R Approval:
VNIIM, Cert. #.....See www.prelectronics.es

Observed requirements: Standard:
EMC 2004/108/CE……EN 61326-1
LVD 2006/95/EC……EN 61010-1
FM……360, 3611, 3810 and ISA 82.02.01
UL, Standard for Safety……UL 508
d. interval = from the selected range in person

Out of range reading (IN.LO, IN,HI): If the valid range of the polynomial or A/D conversor is exceeded			
Input	Range	Reading	Limit
VOLT	0...1 V / 0,2...1 V	IN.LO	< -25 mV
		IN.HI	> 1,2 V
	0...10 V / 2...10 V	IN.LO	< -25 mV
		IN.HI	> 12 V
CURR	0...20 mA / 4...20 mA	IN.LO	< -1,05 mA
		IN.HI	> 25,05 mA
LIN.R	0...800 Ω	IN.LO	< 0 Ω
		IN.HI	> 1075 Ω
	0...10 kΩ	IN.LO	< 0 Ω
		IN.HI	< 110 kΩ
POTM	-	IN.LO	< -0,5 %
		IN.HI	> 100,5 %
TEMP	TC / RTD	IN.LO	< temp. range -2°C
		IN.HI	> temp. range +2°C

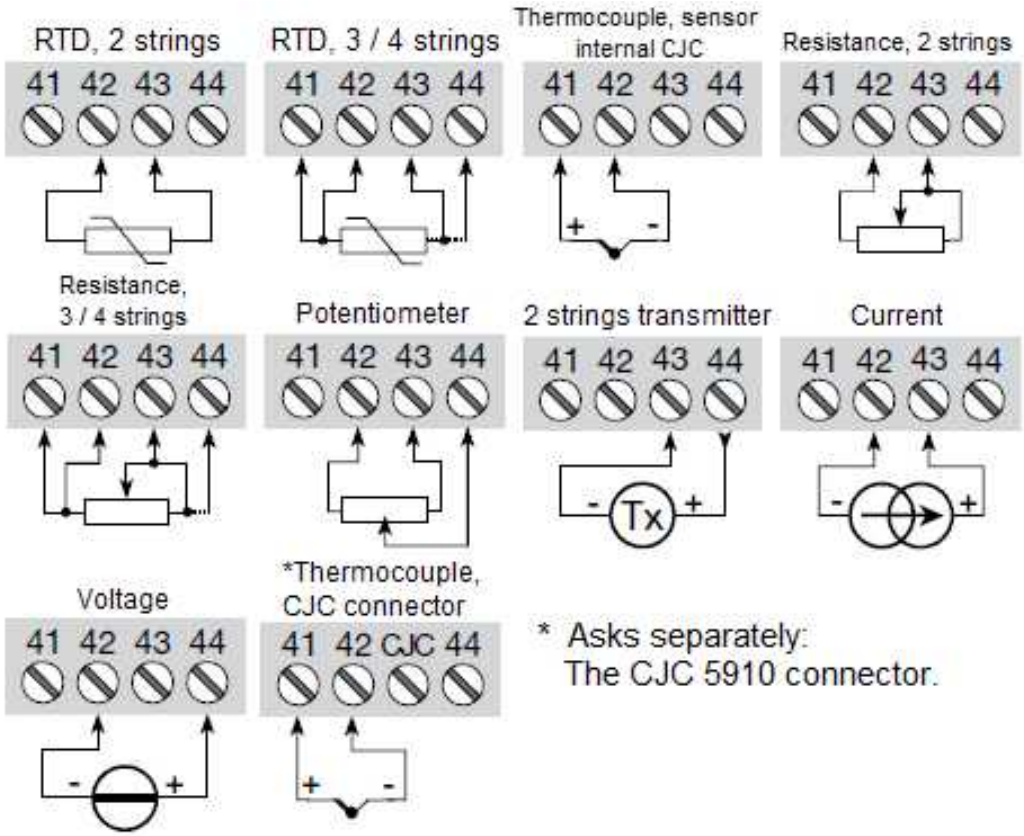
Display reading under min. - / over max. (-1999, 9999):			
Input	Range	Reading	Limit
All	All	-1999	Display reading <-1999
		9999	Display reading >9999

Error readings

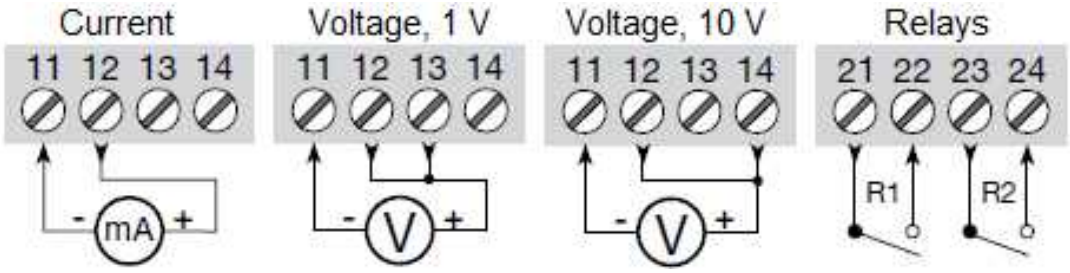
Error reading with hardware		
Error search	Reading	Cause of the error
Sensor internal CJC test	CJ.ER	Defect in the CJC sensor or temp. out of range
Configuration sum test in the FLASH	FL.ER	Error in the FLASH
Analog output current measurement test	AO.ER	1) No charge in current output (only S4...20/20...4 mA)
4501 / 4116 communication test	NO.CO	Connection error
Verify that the input signal shows the input config.	IN.ER	1) Error level in input
Verify that the saved config. in 4501 correponds to the module	TY.ER	The configuration is not 4116

Error indications sparkle in the display once per second. The help text explains the error!
The error can only be cancelled by disconnecting and connecting the power suppy to the module

Inputs



Outputs



Programming / operate with the function keys

In general:
When the MC5 is configured, the user is guided through all the parameters, so that the values can be chosen with which the module will adapt to the application. For each menu there is a drop down help text that is shown automatically in the display.

The configuration is carried out through the 3 function keys:

 will increase the numeric value or will choose the next parameter.

 will decrease the numeric value or will choose the previous parameter

 will accept the chosen value and will finish the menu.

Once the configuration is entered, the display will go back to the default 1.0 state.
By pressing and holding down step 3 it will go back to the previous menu or it will go back to the default (1.0) state without saving the changed values or the parameters.
If no key is pressed during 1 minute, the display will go back to the default 1.0 state without saving the configuration changes.

More explanations:

Quick configuration adjustments and relay test: These menus allow quickly changing the configuration and reviewing the relay operability when the Quick Configuration menu is activated. This function can only be activated when the relays are configured for the consignment function and controlled by this consignment.

By pressing  and  simultaneously we'll activate a relays test and we'll change the relay state. By pressing 3 the configuration change will be saved.

By holding down the  for more than 1 second, we'll go back to the default state unit without changing the configuration.

Sensor and signal error information through the frontal D501 indicator

The sensor error (look for limits in the chart) is shown as SE.BR (sensor break) or SE.SH (sensor short-circuit).

The signals out of the selected range (not error in sensor, look chart for limits) are shown as IN.LO indicating low input signal or IN.HI indicating high input signal.
The error indication is shown in line 3 as text and, at the same time, the contrast blinks.
Display's line 4 is a state line that shows the state of the following: relay 1 and 2, COM mode (regular flash) that indicates the correct DISPLAY D501 functioning and ascending / descending arrows that indicate the input signal reading trend.

If figure 1 or 2 blinks, the unit has detected that the consignment has been exceeded and that the relay is in the "delay" mode. When the delay time has been surpassed and the relay open and closes, the relay symbol is shown or disappears.

Sensor and signal error indication without frontal indicator.

The unit state can be read from the red/green LED in the module frontal.
The blinking green LED at 13 Hz indicates normal operation.
The blinking green LED at 1 Hz indicates sensor error
The fixed red LED indicates internal error.

Relay functions

6 different relay functions configurations can be selected.
Consignment: The unit functions as a simple amplifier with relay output.
Window: The relay has a window that is defined through a low and a high consignment. At both ends of the window the relay has the same state.
Error function: The relay is activated through the error in the sensor.
Power supply: The relay is activated all the time the module is powered.
Disconnected: The relay is deactivated.
Latch: The relay is blocked. Only valid for the setpoint and window functions.
Increase/decrease: The relays can be configured to be activated by the increase or decrease of the input signal.
Delay: Both the connection and disconnection delay can be configured in both relays within the 0…3600 s range.
Hysteresis: A hysteresis can be configured within the 0.1…25% input range or within 1…2999 accounts.

Latch

When the setpoint value is surpassed, the relay inputs go to alarm mode. The MC5 latch function will keep the relays in that state until we manually deactivate the function. The latch function can be applied once we've selected the setpoint or window functions.
The latch function can be selected separately for each relay. If the configuration is copied from one device to another through the D501, the latch function must be re-configured.
The latch function activates and keeps closed the relays when the input signal increases above and decreases beneath the selected setpoints and the relays function has been selected as increasing or decreasing. The window function is selected by choosing in the menu the "window" option and redefining a setpoint above and another one beneath.

You can select so that each relay contact is open or close inside the window. This selection is made in the R1.cont and R2.cont menu.
The setpoint function is selected by choosing "setpoint" in the limits election menu. The device then works as a single relay. An activated relay means that the contact is closed if in the contact function we've selected "normally open", and the contact is open if we've selected "normally closed".

The delay time for the activation or deactivation can be different between the relays, in the ON.DEL and OFF.DEL menus respectively.

If the "Error" function is deactivated, the relay will activate when the sensor error occurs, and will not deactivate automatically when the sensor error has been solved.

The relay can only be deactivated by an operator and when the deactivation rules are known. If the input signal has a value that activates the relay, once is deactivated it will activate back.

Look at the setpoint and window function graphic representation in this manual

Latch function manual deactivation

If the relay outputs are blocked and active, this will be indicated in the display.

The screen backlight blinks and the help text moves showing how to deactivate the output. The manual deactivation is accessed with the DISPLAY D501 frontal buttons.

Using  and  to navigate in the menu and 20 pressing 3 to validate your selection. If the password is activated, you must enter it to be able to enter the deactivation menu. Look at the configuration tree in page 29.

Advanced functions
The unit provides access to a certain number of advanced functions that can be obtained by answering “Yes” in the “adv.set” point.
Display configuration: Here you can adjust: the brightness and backlight contrast, the TAG number configuration with 6 alphanumeric characters, functional reading selection in the display’s third line (choose between the analog output reading and the tag number).

Process simulation function: If you accept the “EN.SIM” point it’s possible to simulate an input signal through the ascending and descending arrow keys and, thus, control the output signal. When the step 3 finishes, the unit goes back to the normal mode. The next step allows activating the relays 1 and 2 through the ascending and descending arrow keys.

You must exit the menu by pressing 

(without exceeding the time).

Password: Here you can choose a password between 0000 and 9999 to protect the unit against unauthorized configuration modifications.

The unit, by default, is supplied without password. If you have blocked, by mistake, the unit with password, you can always access the menu using the master password 2008.

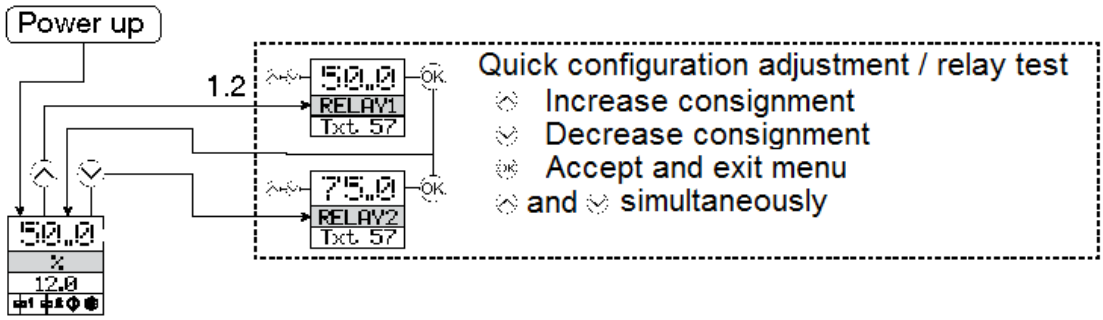
Language: In the “lang.setup” menu you can choose between 7 different languages in the help text that will appear in the menu. You can choose between UK, DE, FR, IT, ES, SE, and DK.

Self diagnosis

The unit performs an internal circuit’s advanced self diagnosis.
The following possible errors can be shown in the DISPLAY D501 frontal unit.

FL.ER – Error in the Flash
AO.ER – No charge in the current output (only in S4…20 mA / S20…4 mA)
NO.CO – Error in the connection
IN.ER – Error levels in the input

Set 1 and Set 2 level setting



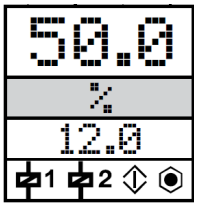
Set point 1

Press ^ to change the set point 1, it will show the R1.SETP menu, change the value with ^ and v, once you find it press OK.

Set point 2

Press v to change the set point 1, it will show the R1.SETP, change the value with ^ and v, once you find it press OK.

Indicators in the DISPLAY



Surpassed Set points indicator

When the first setpoint is surpassed by the input level the equipment will begin to blink the display light, in the same one it will be indicated the presence of the activated relay: 1 2

Verify equipment measurement:

Once the equipment receives signal from the sensor, the display will indicate

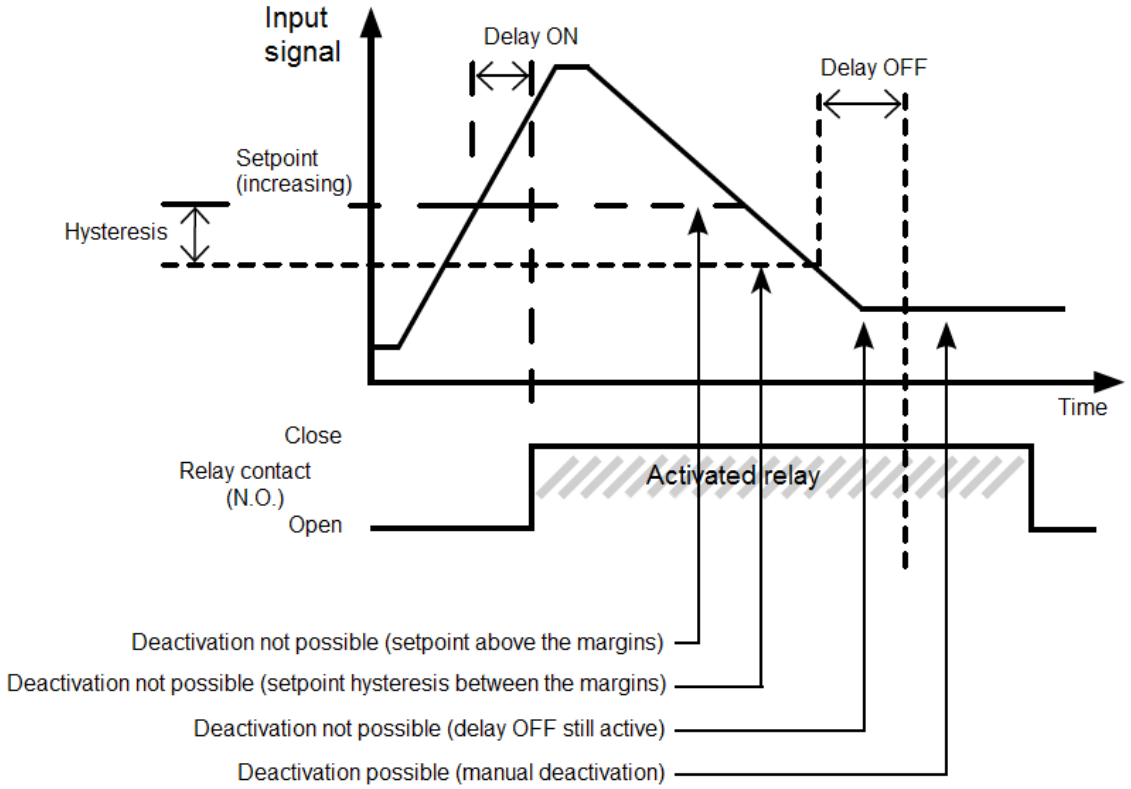
The measurement increasing and decreasing values will be indicated in the display with:

RELAYS RESET

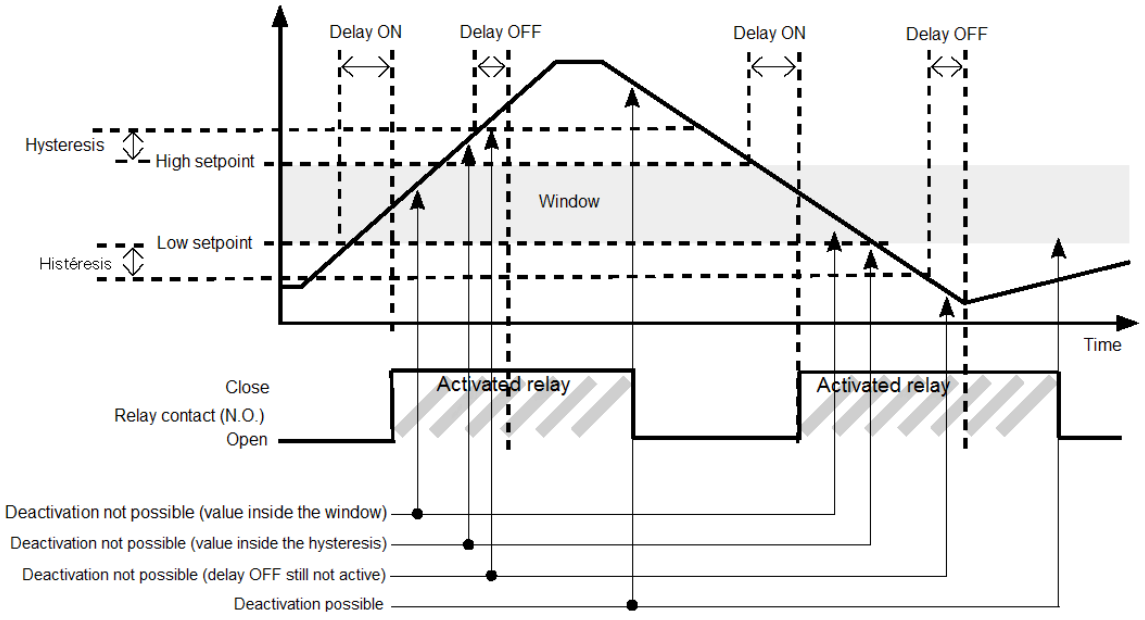
IMPORTANT:

For security of the monitored machines, the only way to deactivate the activated relays, is cutting the MC5 monitor energy and turning it back on.

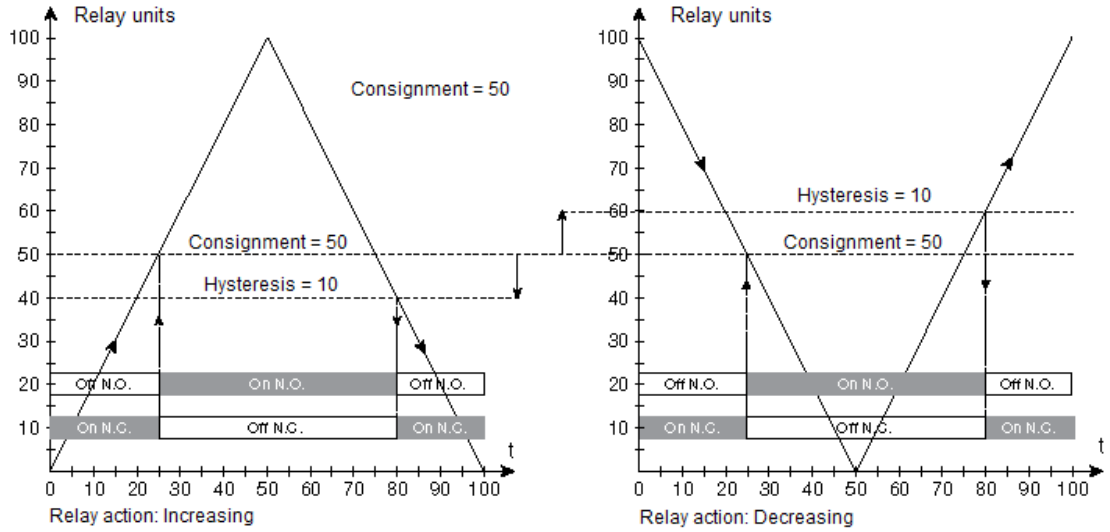
Setpoint activation function graphic representation



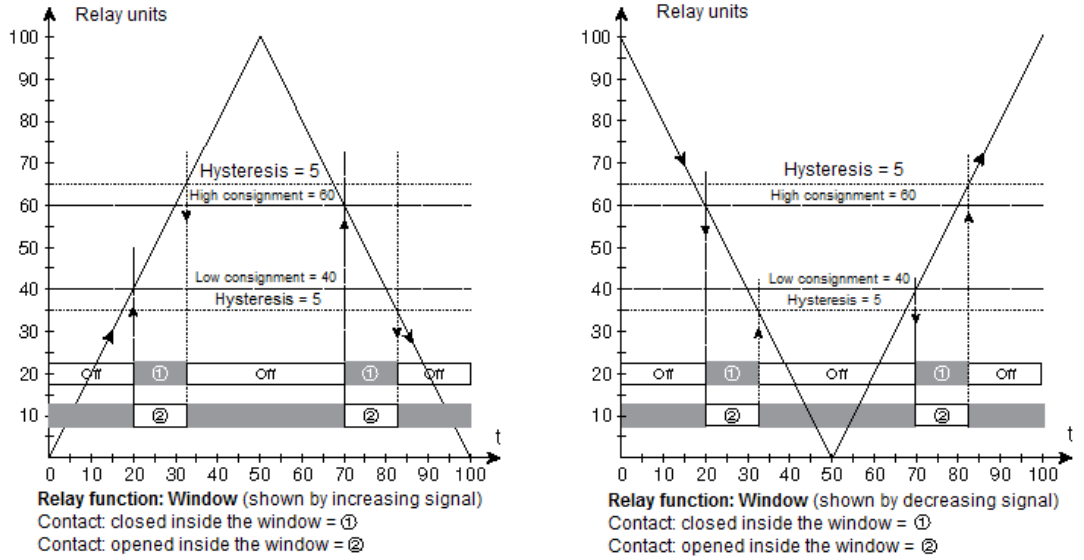
Window activation function graphic representation



Relay Consignment action graphic illustration



Window relay action graphic illustration



Vibrations monitoring with the MC5

The continuous mechanic vibrations monitoring, both in a dynamic equipment as in a structure, protects the unit against the emergence of excessive vibrations.
There is a big correspondence between the vibrations and the mechanic problems that generates them, which is why it is necessary to know the reasons behind a positive variation.

On the other side, the excess of vibrations generates variable efforts provoking material fatigue alongside the well known consequences.

It is our intention that the continuous monitoring equipment is used in the best possible way. Therefore we make some commentaries that we consider useful:

A.- The choice of the variable to be controlled depends upon the expected vibration frequency: for low frequency phenomena you must choose SPEED (structural blows, montage conditions, increasing light of the white metal bearings, rotors unbalancing and equipments misalignment); and for high frequency , ACCELERATION (ball bearing status, friction, gear wear, lubrication problems).

B.- Maximum vibration speed: (V=W x Xo, mm/seg)
This parameter tells us about the functioning from the montage point of view: alignment, balancing, twisted axis, defective pulleys, etc.
In general, it is very unlikely that these vibrations have a significant positive evolution in time. Its follow up is only recommended in those cases in which rotor soiling is expected (progressive unbalancing), or in cases where there is white metal bearings, in which the increase of light generates an increasing imbalance component.

C.- Maximum vibration acceleration: ($A=W^2$ x Xo, g)

The deterioration of the lubricating film and the ball bearings will have a significant incidence in this parameter, which is why it is recommended to control this variable.

D.- If the speed is measured, it is best to choose the less rigidity direction, normally the horizontal.

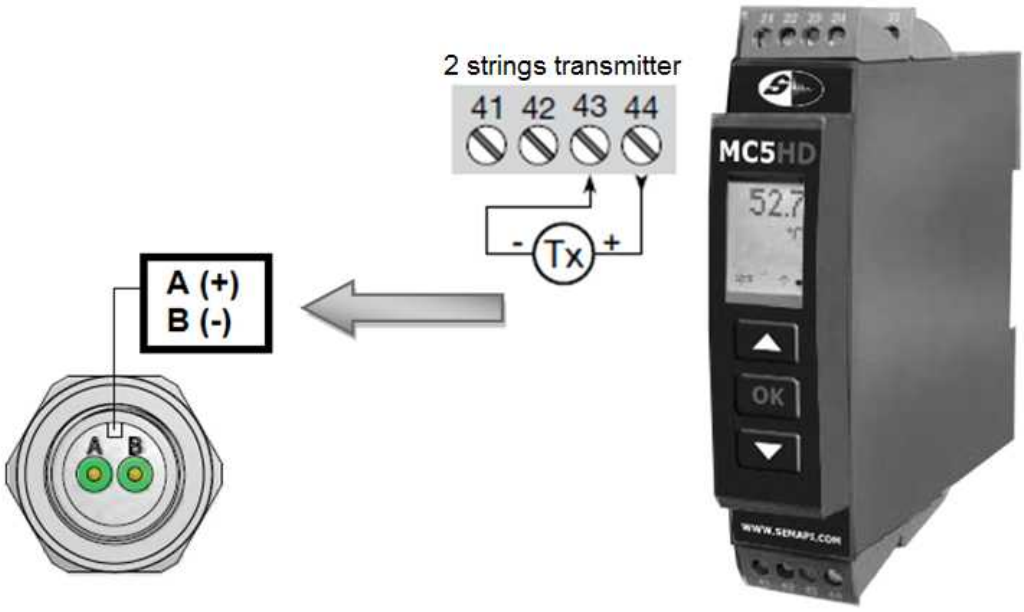
E.- In case of measuring acceleration in ball bearings, it is advisable to measure it vertically, because in this direction the track is more requested. It is necessary to fix the Sensor to the same piece in which the ball bearing in radial direction is located.

Installation

The MC-5 equipment must be mounted inside an electrical board and cabinet with din rail montage. This board must be protected against possible humidity entrances, since the equipment wouldn’t resist an excessive humidity condition.

The power supply connection must comply in all cases the earthing of the system.

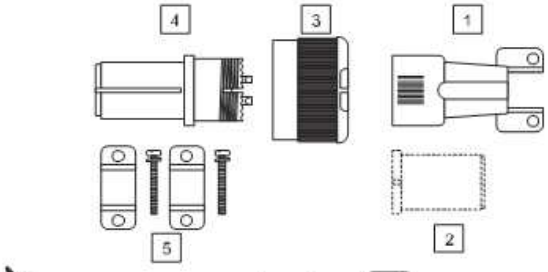
Sensor connection



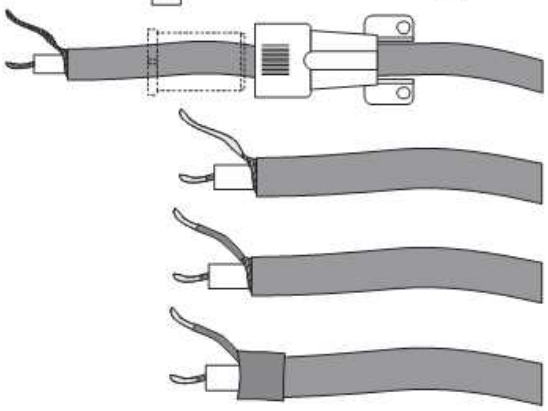
Recommendations

- Use twisted, meshed cable with screen.
- For lengths superior to 7 meters, place 1.5mm section per conductor.
- PLC side earthing is recommended to avoid noise loop.

Construction of cable with connector:



CONNECTOR PIECES

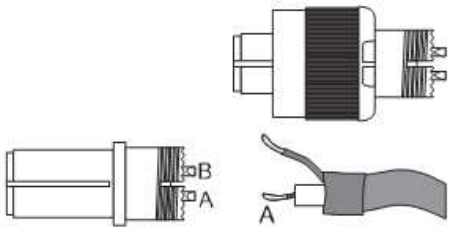


Step 1
Place piece 1 and 2

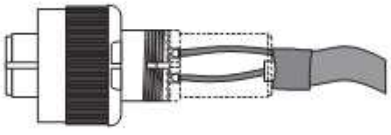
Strain tin in both terminals

Place 4 mm heat shrinkable in the cable mesh

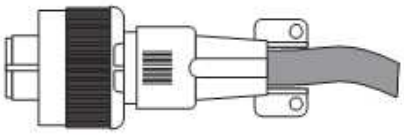
Place 15 mm heat shrinkable in the exterior cable



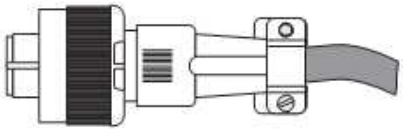
Screw the pieces 3 and 4 until the first one turns freely.
Weld the cable respecting the polarity and the letters indications
according to the connector.
A (+) B (-)



Slide piece 2 according to the figure



Screw in piece 1
Note: to adjust piece one hold the connector end firmly, piece 4, to avoid damagin the cable.

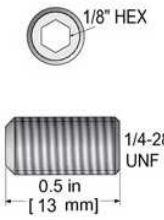


Place the two clamps, pieces 5

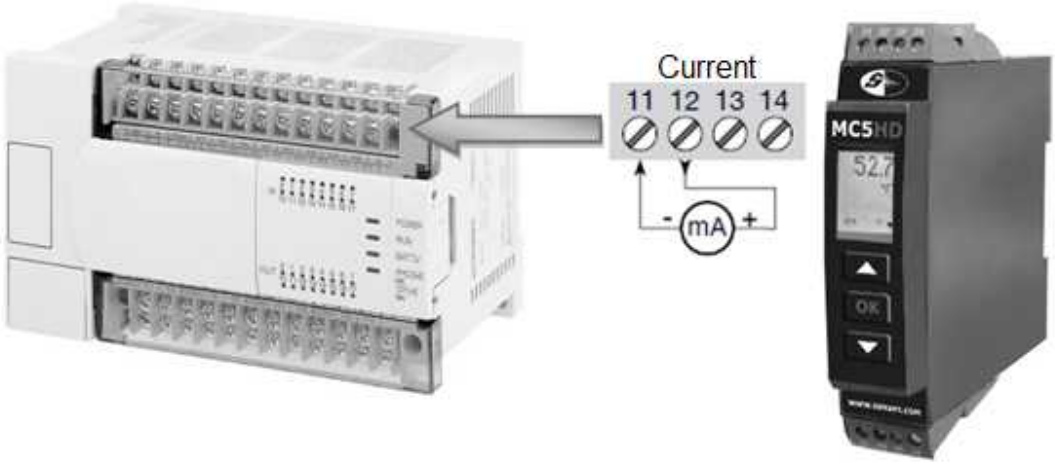
Sensor montage:

The Sensor has a threaded stud montage accessory that must be placed previously in the location selected for the vibrations measurement. The Sensor must place its entire base in the selected place; this must be clean for a better measurement. It is recommended in addition to the cleaning, that the surface be flat or that it rectifies so that the entire sensor base make contact with the equipment to be measured.

Prepare for the prisoner montage, a 6 mm deep orifice in the middle of the defined point as measurement.
Pass a threaded male of ¼ x 28 strings, the three times that it is recommended for the complete set.



Transmitter Connection



Recommendations

- Use threaded meshed cable with screen.
- For lengths longer than 7 meters, place 1.5 mm of section per conductor.
- It is recommended PLC side earthing to avoid noise loop.

Vibrations measurement operation

The MC-5 equipment, allows monitoring the vibrations of a rotating equipment of any power.

Its 4-20mA output is ideal to connect to PLC analog inputs, which allows visualizing the ON LINE measured values and managing monitoring with alarms.

Where and why to measure Acceleration and Speed?

Speed measurement:

This variable allows detecting low frequency phenomena (normally until 500Hz) or 5/6 times the machine RPM (harmonics).

Phenomena description: unbalancing, misalignment, loose parts, excessive movement, twisted axis, problems with pulleys or belts, blows, excessive bearing movement, etc.

Acceleration measurement:

There are low amplitude and high frequency phenomena that can’t be detected in the speed measurement.

Since the acceleration vibration frequency is squared, this allows phenomena, like lubrication failure (5 Khz) or bearings between 1 or 2 Khz, to be easily detectable.

White metal bearings: generate only low frequency phenomena, thus the speed measurement is sufficient (high frequency phenomena is generated by the friction of two metals of similar hardness).

On line continuous monitoring

Goals

The predictive maintenance goal is to determine the machine functioning state changes caused by early flaws, to ultimately be able to program the reparation, avoiding surprising machine standstills alongside its consequences.

The continuous monitoring is the ideal mechanism to comply with this goal, for which it is necessary to install fixed sensors that supply the necessary information for it to be permanently evaluated and so be able to determine the functioning state changes as soon as the first symptoms of the possible failures are generated.

The mechanic vibrations measurement provides a lot of information about a machine functioning state, since it is an indirect measurement of the efforts to which it is subject.

The ideal continuous monitoring system

The ideal continuous monitoring system is the one that complies with the following conditions:

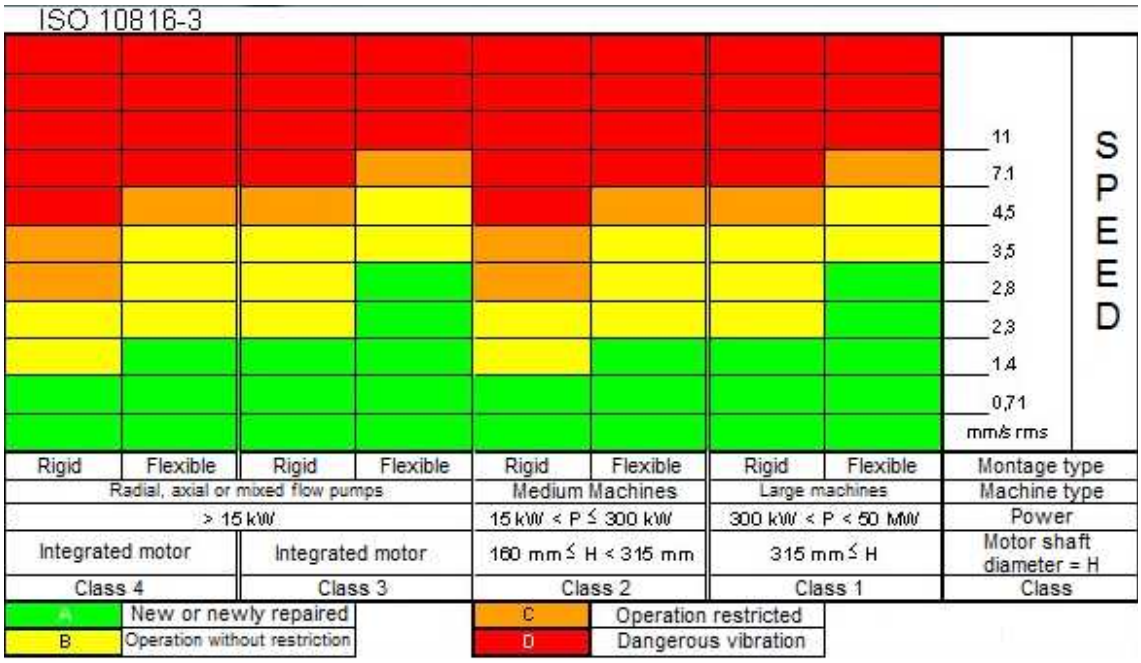
Detects any functioning condition change caused by flaws from the moment they occur, offering as consequence the most time possible to be able to program the reparation.

Verifies that the machine operation conditions are within the normal functioning ranges and consequently the conditions that could cause flaws are avoided.

Notifies or decides when it is necessary to stop the machine in the face of imminent catastrophic failures conditions.

The system reliability is 100%, or, the system reports that it's not working properly (self checking).

Vibration norms:



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