System Manual MMS 6000
Part 2

Direction for use

Shaft Vibration Monitor

MMS 6110

Date : 15.02.2004

Valid for

Configuration Software MMS 6910W Version 1.01, 1.03 f.f.

Firmware Version 1.20, 1.30 f.f.

Third edition

6110-00004

epro

Please note

In correspondence concerning this instrument, please quote type number and serial number as given on the type plate and software version if applicable.

Bitte beachten

Bei Schriftwechsel über dieses Gerät wird gebeten, die Typennummer und die Gerätenummer wie auf dem Typenschild aufgedruckt, sowie die Softwareversion (wenn vorhanden), anzugeben

Important

As this instrument is an electrical apparatus, it may be operated only by trained personnel. Maintenance and repairs may also be carried out by qualified personnel.

Wichtig

Da das Gerät ein elektrisches Betriebsmittel ist, darf die Inbetriebnahme und Bedienung nur durch eingewiesenes Personal erfolgen. Wartung und Reparatur dürfen nur von geschultem, fach- und sachkundigen Personal durchgeführt werden.

© epro GmbH
Jöbkesweg 3
D48599 Gronau
Germany
Telefon: (+49) 02562.709 0 Fax: (+49) 02562.709255 email: mms@epro.de

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1. PURPOSE AND APPLICATION

The MMS 6110 dual-channel shaft vibration monitor is part of the MMS 6000 machine monitoring system. In connection with two eddy current measuring chains, the microprocessor controlled module serves measurement and supervision of relative shaft vibrations at all kind of turbines, compressors, fans and gear boxes.

During configuration the two channels of the monitor may be defined for separate measurement or for the combined use. The following modes are possible:

- **Dual channel mode with two separate channels.**
  For each channel the configuration parameters (measuring range, type of transducer, limit values etc.), can be defined separately. Each channel calculates its own characteristical value (peak-peak or zero-peak value) and checks it on limit exceedings and faults of the measuring chain.
- **Calculation and output of maximum value Smax.**
  The resulting maximum value Smax of the shaft vibration for the measuring directions X and Y according to DIN 45670 (characteristical value A) is calculated by geometrical addition of the actual values S1 (channel 1) and S2 (channel 2) [$S_m(t) = \sqrt{s1^2(t) + s2^2(t)}$]. The maximum value Smax is output as characteristical value and checked on limit exceedings
- **Calculation and output of maximum vibration amplitudes S_{pp}max. according to DIN 45 670, characteristical values B or max (X, Y) according to API 670.**
  The characteristical value, output and checked on limit exceedings, is formed by the greatest of the two measuring values of channels 1 or 2 in X and Y-measuring direction.

The characteristical value is output as impressed current of either 0...20 or 4...20 mA.

Additionally, there is an analog output, providing a standardized d.c. output NGL of 0...+10V proportional to the static distance between sensor and measuring target.

For checking the signals on limit exceedings, there are two alarm channels, each of them with one warning (Alert) and one danger level. In the dual channel operating mode the characteristical value is supervised by the relevant alarm channel. The limit values for pre alarm (ALERT) and main alarm (DANGER) may be adjusted separately.

With measuring modes max. value Smax and vibration amplitude S_{pp}max resp. max(X,Y) the characteristical value, calculated from both channels, is supervised by the alarm channels of both measuring channels - but with only one "Alert" and one "Danger" limit.

During configuration the alarm outputs can be activated and the limit values defined. The alarm status is shown by two red LEDs on the front of the monitor. The module provides four relay driver outputs which can alternatively be switched to normally closed or normally open operation mode.

Input "Alarm blocking" permits blocking of the alarm outputs by means of an external signal.

During configuration, response delay and alarm blocking at fault situations can be defined.

Two green LEDs on the front and two relay driver outputs indicate the status of channel and monitor supervision. In the normal state, i.e., if neither the channel nor the module supervision have detected an error, if the channel measurement is in the settled state and the alarms are not blocked, message "Channel Clear = OK" will be indicated.

If an error occurs and the monitoring function of the module cannot be ensured, this will be indicated by flashing or switched off LEDs and by switching off the relevant alarm outputs.

Configuration of the monitor MMS 6110 is made by means of a laptop computer or a personal computer connected to the RS 232 interface socket on the front of the monitor. The software required for configuration and visualization of measuring results and states, as well as the connection cable between computer and monitor are part of the MMS 6910 W configuration kit. Moreover, this kit comprises the system manual on the CD-ROM with all necessary information for testing and visualization of measuring results and the states of the monitor. The configuration of the monitor is exclusively made by means of the configuration software, there are no hardware settings necessary.

Three different levels permit definition of the access authorization for operation, configuration and for installation and test of the monitor.

- Access authorization "Factory" includes all adjustments and is intended for installation purposes by the **epro** staff.
- Access authorization "Service" is intended for specialists who specifies and configures the monitor for the actual application.
- Access authorization „Operation“ permits changing settings required for the normal operation.

By means of laptop/PC and the operating kit, the parameters of the selected monitor and the measuring results (including order analysis, FFT etc.) as well as the status of the monitor can be watched on the computer screen.

The Operating Kit also contains two measuring cables for measuring the sensor signals at the mini coax sockets on the monitor front. By means of these cables the coaxial sockets for the sensor signals 1 and 2 can be connected to an oscilloscope.

An RS 485 interface (at the device connector) serves the connection of the monitor to the **epro** MMS 6850 Analysis and Diagnosis system for acquiring and analysing measuring data.

The monitor is designed as printed board in the standard euro format (100 mm of x 60 mm) with 6 TE width (approx. 30 mm) and an eloxadized front plate.

The supply of the monitor requires +24 V, two supply inputs, decoupled via diodes, permit redundant supply of the monitor.

2. CONFIGURATION, MENU `FILE`

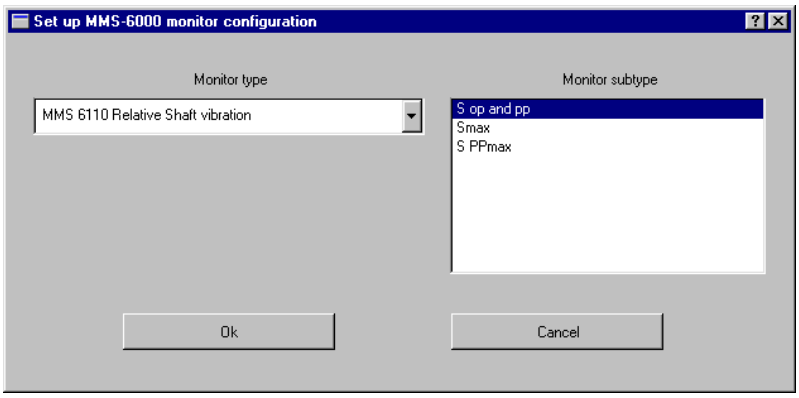
This chapter describes the configuration especially of the MMS 6110 module by using the MMS 6000W configuration program. The installation software for the configuration program MMS 6910 W and the MMS 6000 system manual are part of the MMS 6910 Operating kit and stored on a CD-ROM. The description of the handling of the configuration software and descriptions of the parameters common to all of the MMS 6000 monitors, are described in part 1 - CONFIGURATION AND VISUALIZATION - of the MMS 6000 W System manual.

There are two different ways how to configure a new monitor:

1. Select menu "`New`" in main menu "`File`", select parameters monitor type and operation mode and set all relevant parameters in menu "`Edit`".
2. Call up menu "`PreDefined`" in menu "`File`" and select a monitor with an operating mode which definitions suits best to the application. At least channel names must be entered and parameters can then be corrected in menu `Edit`.

2.1 Monitor Configuration `New`

Menupoint `File > New` opens dialog window `Set up MMS-6000 Monitor-configuration`.



The left part of the menu shows a list where the monitor to be configured is selected. The right part of the menu shows a list with all operating modes possible for this monitor, one of them must be chosen with a mouse click.

Possible modes for the MMS 6110:

S_{0P} and **S_{PP}** — Dual channel mode with two separate channels. The configuration (measurement range, sensor type, limit value etc.) can be selected for each of the channels, each channel calculates its own characteristical value (peak-peak or zero-peak value) and checks it on limit exceedings and faults of the measuring chain.

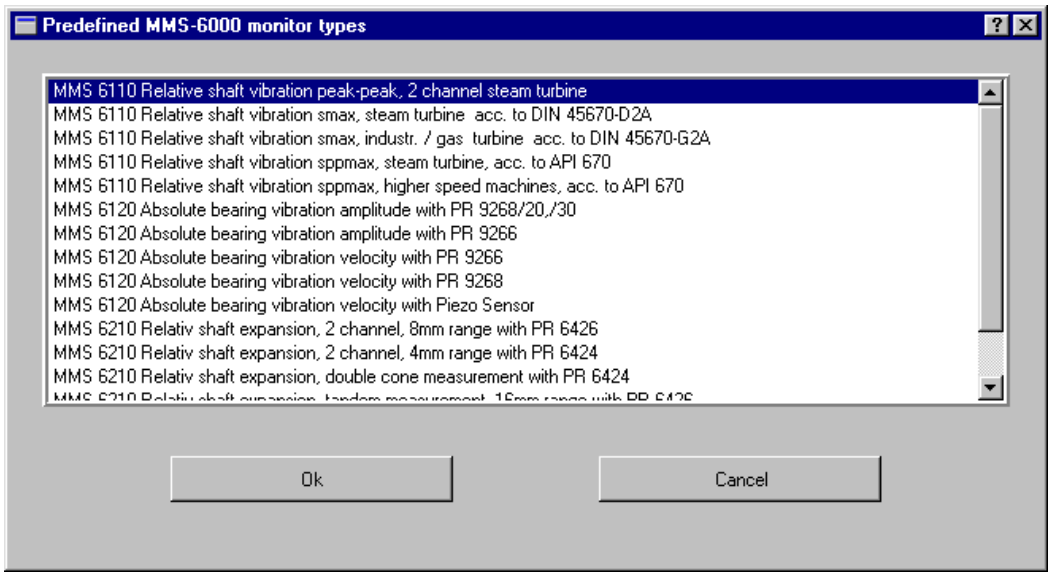
S_{max} — The resulting maximum value of the shaft vibration for the measuring directions X and Y is calculated according to DIN 45670 characteristical value A by geometrical addition of the actual values S1 (channel 1) and S2 (channel 2) [$S_m(t) = \sqrt{s1^2(t) + s2^2(t)}$]. The maximum value S_{max} is output as characteristical value and checked on limit exceedings.

S_{PP}max Calculation and output of the greater vibration amplitude S_{pp}max according to DIN 45670, characteristical value B or max (x, y) according to API 670. The characteristical value, output and checked on limit exceedings, is formed by the greatest of the two measuring values of channels 1 or 2 in X and Y-measuring direction.

Having confirmed the choice by clicking the OK- button, the program returns to the main menu. The newly defined monitor must then be configured in menu "`File > Edit`".

2.2 Monitor type `PreDefined`

Menu point `File > PreDefined` opens dialog window `PreDefined MMS 6000 Monitor Types`.



This window shows predefined configurations for different monitor types and their operating modes for various applications. After selection of the monitor type and confirmation by clicking the OK button, the configuration is stored in the memory.

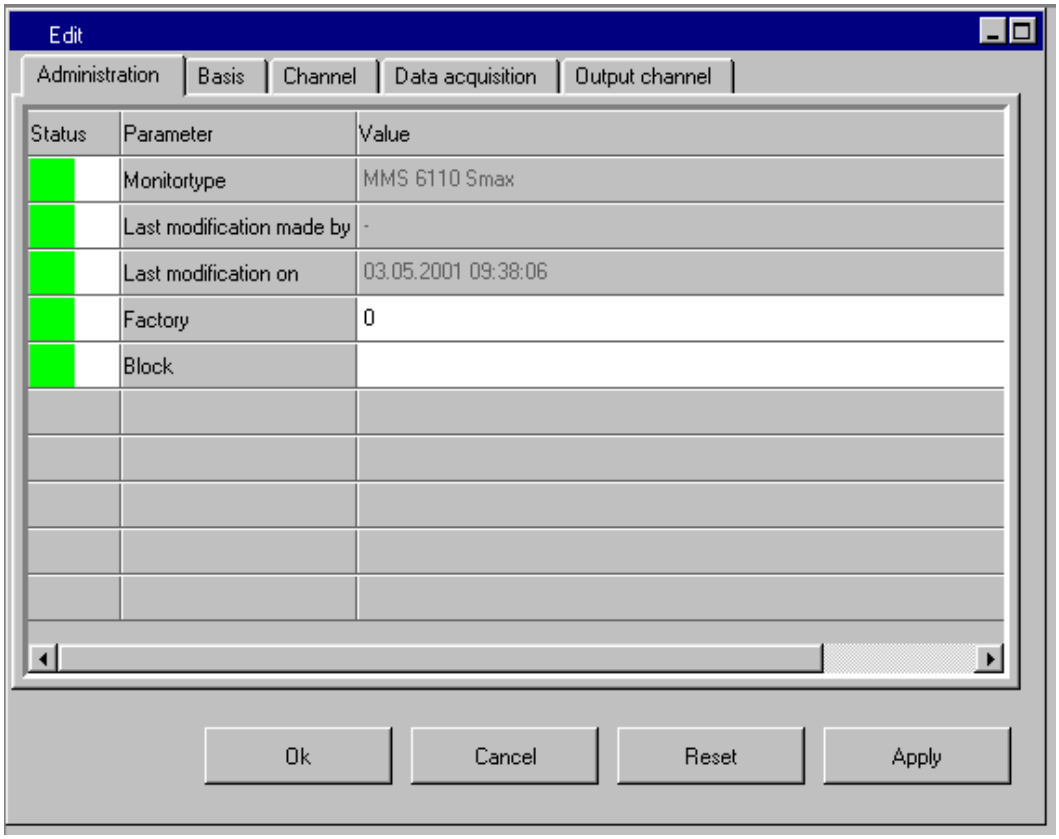
In any case the device parameters must be adapted to the actual application in menu `File > Edit` and the channel designations entered.

2.3 Edit monitor configuration

Menu point `Edit` opens a dialog window with several property pages for setting device parameters.

2.3.1 Property page `Administration`

In property page `Administration` the general data, valid for the actual monitor type are shown.



Display field `Monitor type`

This field shows the predefined monitor type (indicated parameters in this menu cannot be changed !)

Display field `Last modification made by`

This line shows the names of that user who last made changes of parameters to this monitor (cannot be changed in this menu !)

Display field `Last modification on`

Date and time of this line indicates the moment when changes to this monitor configuration were made last (cannot be changed in this menu !).

Entry field `Factory`

At this point of the menu, the designation for the plant where the machine monitoring system is installed, can be entered (max. 41 characters).

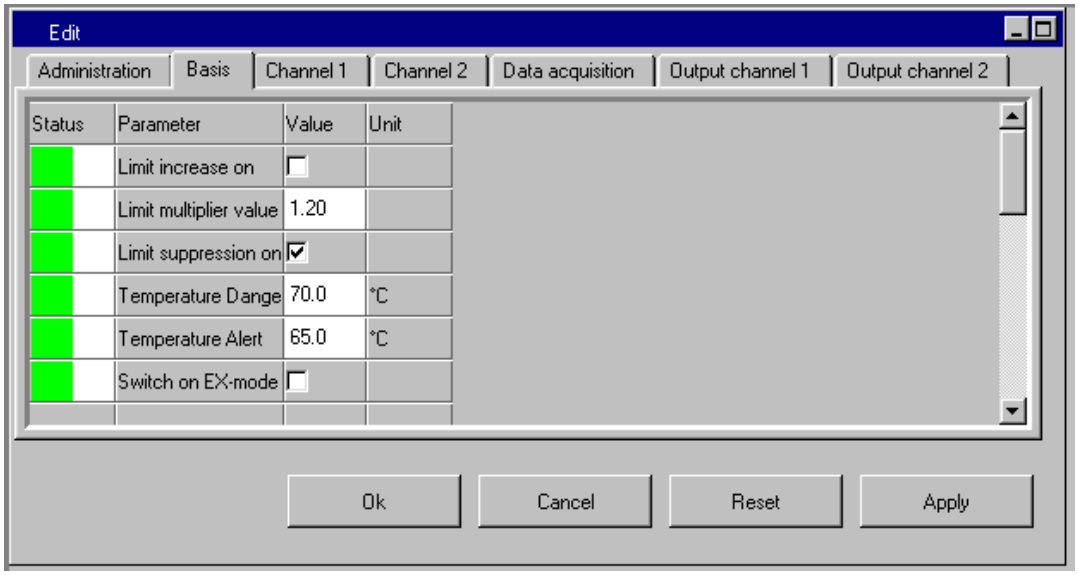
Entry field `Block`

In this field the designation for the machine block where the monitoring system is installed can be typed in (max. 41 characters).

The entries will be saved with a mouse click on button `Apply`.

2.3.2 Property page `Basis`

Selection of property page `Basis` opens the menu concerning the device parameters. Access authorization SERVICE permits activation of all functions. Authorization OPERATION only permits access to functions limit increase and limit suppression.



Parameter switch `Limit increase on`

To activate function `limit multiplier`, the parameter switch must be activated by clicking the parameter switch with the mouse and then by entering a multiplication factor into the field below. .

This function is useful for increasing the alarm limits e.g. for run-up or run-down of the turbine.

Entry field `Limit multiplier value`

The limit value multiplier increases the values of the alarm limits by a freely selectable factor provided, binary input "Factor X" (d18) is activated (i.e. set to LOW).

In this field a multiplication factor must be entered (a decimal point must be used instead of a comma) within the range of 1.00 to 5.00.

Parameter switch `Limit suppression on`

On activation of this function the watching of limit values is disabled as long as status "Channel Clear" is not OK. This could happen, if the input signal of a channel exceeds the upper limit of the defined operating range plus 0.5V (refer to section 2.3.3 property page "channel") or falls below the lower limit minus 0.5V. All other conditions (monitor not OK, delay time etc.) which could lead to the deactivation of alarms remain untouched of this button. (refer to section 4.5 *Function description – condition monitoring).*

"Limit values suppressed“ means that the alarm outputs are set to their initial state (i.e. no alarm).

For single channel measurement and calculation of characteristical values, the activation of the alarm suppression depends on the status of the relevant channel. If the characteristical

value is calculated by combination of the results of both channels, and watched on limit exceedings, the alarm function will be disabled only, if both channels indicate the message "Channel Clear not OK".

Entry fields `Temperature Danger` and `Temperature Alert`

The input fields for temperature alert alarm and danger alarm show the default factory settings of the alarm values. If the environmental temperature of the monitor exceeds the Alert limit measured by a built-in temperature sensor, the Channel Clear LED on the monitor front starts flashing quickly. On exceeding the Danger alarm, this is considered to be a module fault, as a consequence the Channel Clear LEDs will distinguish and the alarm outputs be suppressed (refer to detailed *function description -- condition monitoring* in section 4.5).

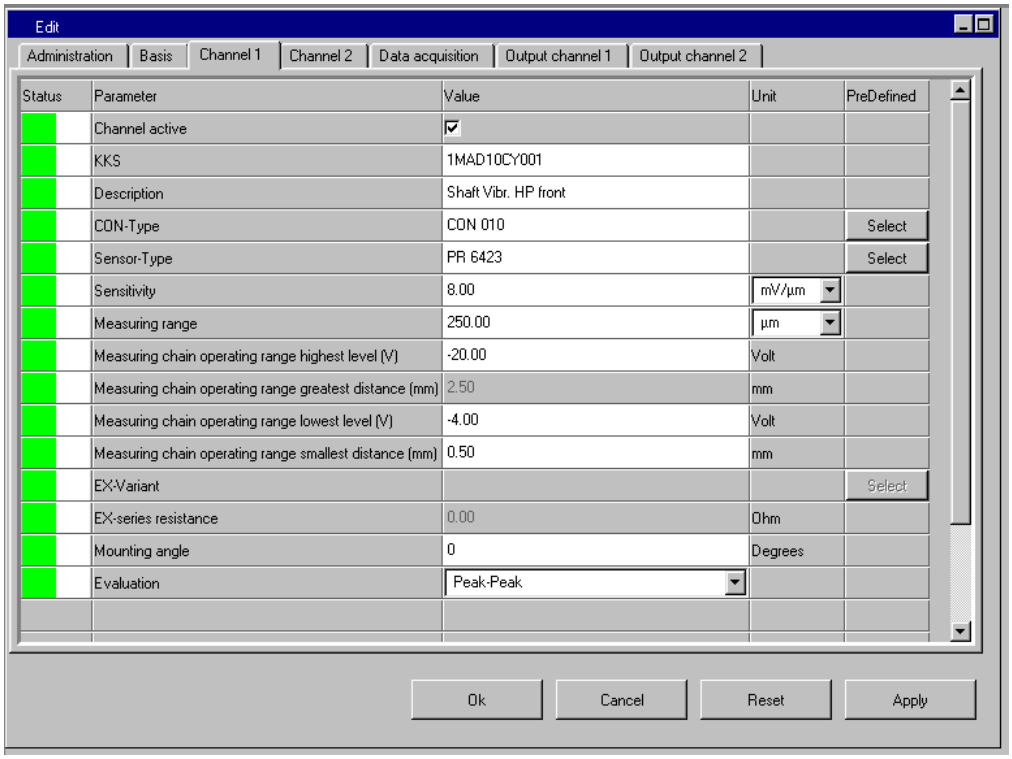
The predefined limit values of 65 °C and 70 °C may be modified with access authorization "Service". However, it has to be taken into account that the danger of measuring faults or failures of components increases with higher temperatures.

Parameter switch `Switch on EX-mode`

This function has to be activated, if the connected sensors are installed in explosion hazardous areas and must be operated with safety barriers. The activation of this function effects that on property page "channel" (channel configuration) the series resistance of the safety barriers must be entered into field "series resistance".

2.3.3 Property page `Channel`

The channel configuration is made in property page "Channel".



For the dual channel mode with two characteristical values, both channels have to be configured separately. If an operating mode has been selected with only one characteristical variable calculated from the results of both channels, there is only one property page for both channels.

With access authorization "OPERATION" the channels may only be activated / deactivated, with authorization "SERVICE" all parameters can be edited.

Parameter switch `Channel`

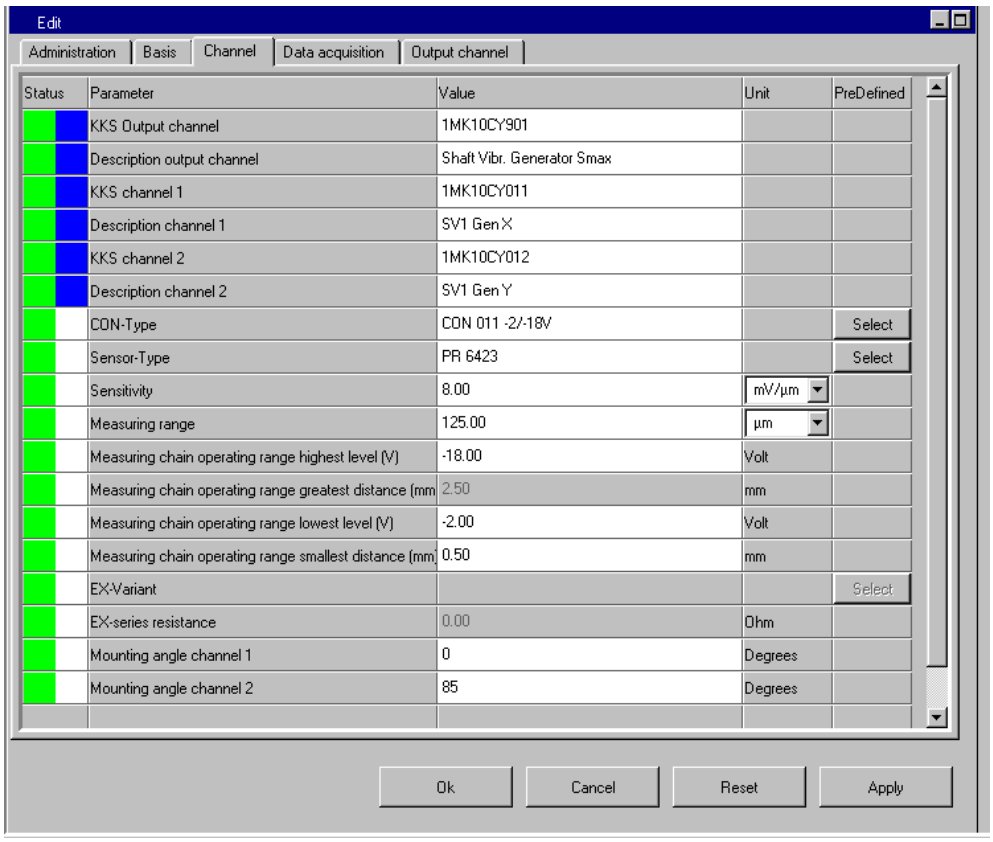
By clicking parameter switch "channel" with the mouse, the relevant channel can be activated / deactivated. If the channel is deactivated, calculation of characteristical values, limit watching and channel supervision are switched off.

Entry fields `KKS` and `Description`

These fields can be filled in according to the user's requirements. Both fields require inputs of parameters. As long as no entries were made in the fields, the fields are indicated red.

Preferably the KKS number is entered here according to the power plant identification system under which sensor or measuring chain are documented. This designation will be stored in the module and is then be used to identify this module.

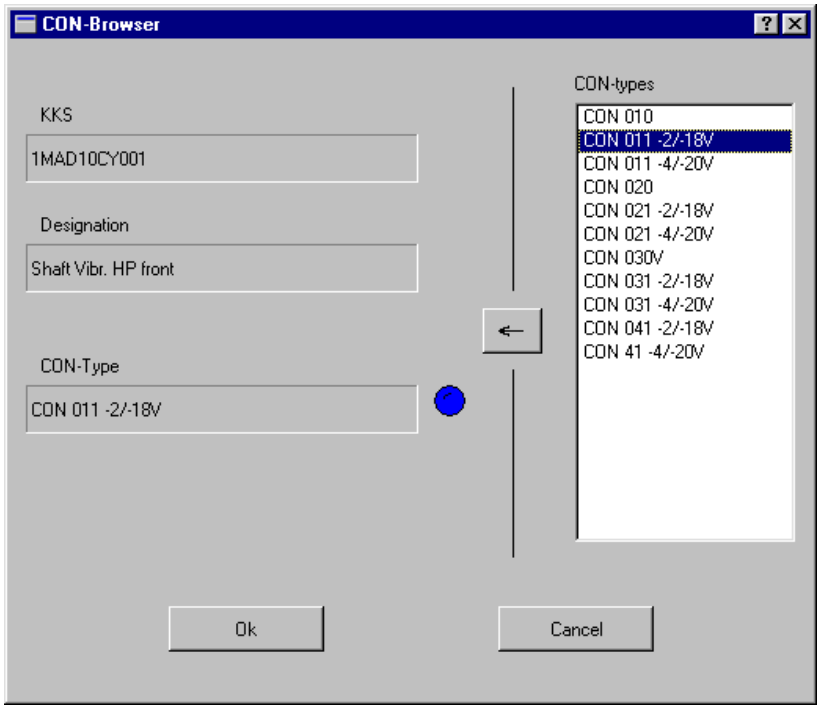
For operating modes where the results of both channels are combined (Smax, Sppmax) six input fields are available. The upper fields are for KKS number and designation of the out-put channel of the combined characteristical value and two further fields for each of the measuring channels.



Status	Parameter	Value	Unit	PreDefined
	KKS Output channel	1MK10CY901		
	Description output channel	Shaft Vibr. Generator Smax		
	KKS channel 1	1MK10CY011		
	Description channel 1	SV1 Gen X		
	KKS channel 2	1MK10CY012		
	Description channel 2	SV1 Gen Y		
	CON-Type	CON 011 -2/-18V		Select
	Sensor-Type	PR 6423		Select
	Sensitivity	8.00	mV/µm	
	Measuring range	125.00	µm	
	Measuring chain operating range highest level (V)	-18.00	Volt	
	Measuring chain operating range greatest distance (mm	2.50	mm	
	Measuring chain operating range lowest level (V)	-2.00	Volt	
	Measuring chain operating range smallest distance (mm	0.50	mm	
	EX-Variant			Select
	EX-series resistance	0.00	Ohm	
	Mounting angle channel 1	0	Degrees	
	Mounting angle channel 2	85	Degrees	

Entry field and Mouse button `CON-Type`

This field shows the select converter type. By clicking button "Selection", with the mouse, window CON-Browser will be opened and indicates the available CON types. The desired converter type may be marked with a mouse click in the type list shown in the right window.



By clicking the button ← with the mouse or by selecting it with the TAB key and confirming the choice with ENTER (↵), the selected converter type is accepted and taken over into field CON-type in the left part of the dialog box.

Fields `KKS` resp. `Designation` show designation and KKS number as it was entered in property page `Channel`.

By clicking button `OK` with the mouse to confirm the choice or button `CANCEL` to abort the action, the program returns to the parameter input.

Having confirmed the choice, the converter-specific data for the operating range (linear range of the output voltage), will also be taken over.

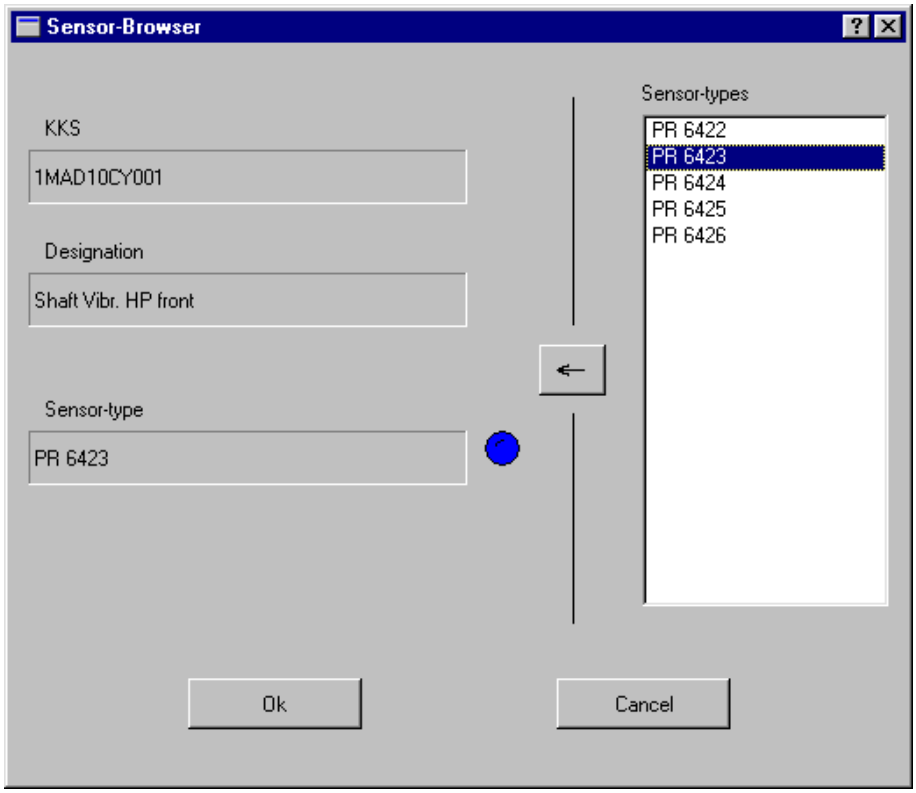
The converter type may also be entered directly in field CON type. In this case the operating range for the measuring chain, upper and lower limit for the linear operating range and the distance between sensor and measuring target for the lower signal level must be entered resp. corrected. The field for the upper distance is calculated from the voltage range, the distance at the lower signal level and the sensor sensitivity.

If the specifications for the measuring chain taken over from the converter list are modificated, the converter designation in field `CON type` will be shown in square brackets.

Entry field and Mouse button `Sensor-Type`

The entry field shows the sensor-type for which the configuration has been prepared.

By clicking button "Selection", with the mouse, window `Sensor-Browser` will be opened and will indicate the list with all sensor types to be used for this monitor. The handling of this list is identical to that of the CON type.



By clicking button ← with the mouse or by choosing it with the tabulator- key and confirming with key ENTER (↵) on the keyboard, the sensor type will be taken over into the determination field.

Fields KKS resp. Designation shows channel designation and KKS number that were entered in property page Channel.

By clicking button OK with the mouse to confirm the choice or button CANCEL to abort the action, the program returns to the parameter input. On selecting a sensor of the type list, its sensitivity will also be taken over.

The type may also be entered directly in field `sensor type`. In this case, the sensitivity of the sensor must be entered manually.

If the sensitivity taken over from the sensor list was changed, the sensor designation in field `Sensor type` will be shown in square brackets.

Entry field und List `Sensitivity`

This field must show the sensitivity indicated in the sensor list by selecting one of the types. This value may be modified and, in case the sensor-type was entered directly, the sensitivity must be entered manually without using window `Sensor Browser`.

The sensitivity is indicated with the measuring unit chosen from the list. The program converts the value to the chosen unit.

Entry field and list `Measuring range`

In this field the measuring range for the characteristical value must be entered. Now, the correct evaluation shown in field `evaluation` must be taken into account and, if required, be chosen. The choice of the measuring range is limited by minimum and maximum value. The lowest measuring range is 400 mVpp divided by the sensor sensitivity (e.g. for PR 6423: 400mV / 8mV/µm = 50 µm peak-peak), the highest possible measuring range is 8000 mVpp divided by the sensor sensitivity.

Exceeding or underrun of limits will be indicated by a red status field.

Entry fields
`Measuring chain operating range highest/lowest level (V)`
`Measuring chain operating range greatest/smallest distance (mm)`

These input fields serve the definition of the measuring chains' limits of the linear measuring range. The limits are defined for the input signal (depending on converter type) and for the proportional measuring unit according to the sensor sensitivity.

On selecting predefined converter types and sensors, these limits are taken over automatically. If necessary, the limits can be freely selected or modified.

If there is no entry for the signal limits, the relevant field will be indicated in red color, the same applies if values are outside the defined limits.

☞ The limit values of the linear signal range are used for defining the OK thresholds as well. This means the measuring chain is considered to be faulty if the signal level exceeds the upper limit of the linear range plus 0.5V or underruns the lower limit minus 0.5V.

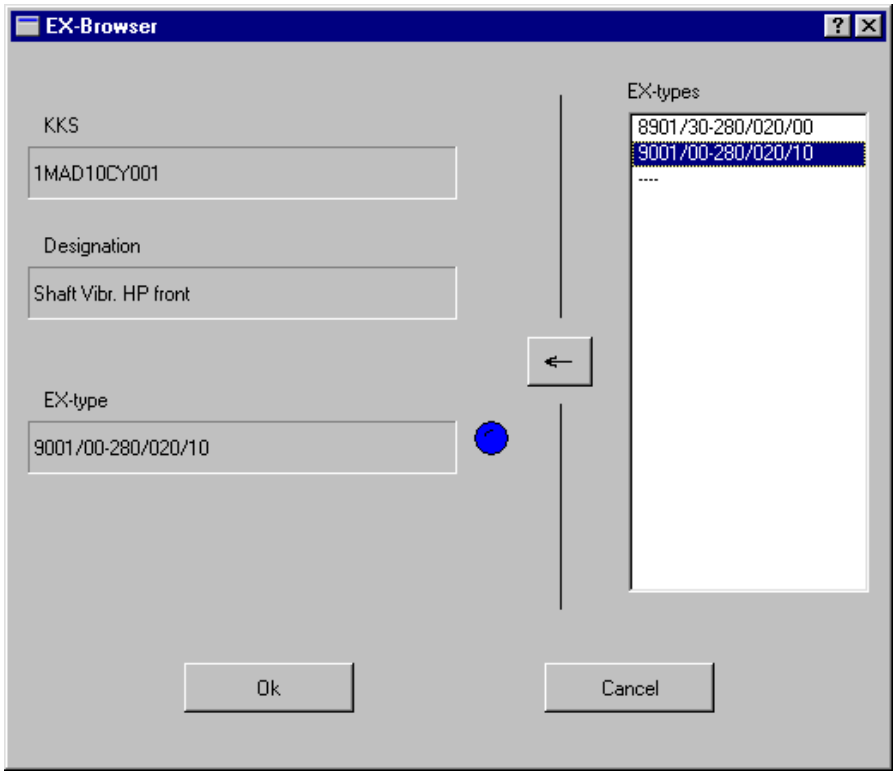
☞ Limit values for the minimum and maximum distance to the measuring target are nominal values and may differ of up to 0.2mm e.g. for the PR 6423. These deviations do not have any influence on the measuring result as long as the gap is in the centre of the sensor measuring range (NGL approx. 50%, refer to section 3.9).

Entry fields `EX-Variant` and `EX-Series resistance`

If on property page "Basis" parameter switch EX-i has been switched on, status field of "series resistance" will be red if no value for a series resistance for a safety barrier is defined (selection EX type).

Types of safety barriers can be taken over from the Ex -Browser into field Ex-variant, the resistance value of the safety barrier's series resistance must be entered in this field with measuring unit Ohm.

By clicking button "Selection", with the mouse, window EX-Browser will be opened, indicating the available predefined types of safety barriers.



By clicking button ← with the mouse or by choosing it with the tabulator- key and confirming the choice with key ENTER (↵) on the keyboard, the chosen EX-type will be taken over into determination field `EX-type`.

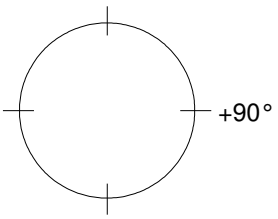
The series resistance for this type will automatically be inserted in field EX-series resistance.

Fields KKS resp. Designation show channel designation and KKS number, entered in property page `Channel`.

Entry field `Mounting angle`

In this field the mounting angle of the sensors must be defined if an order or FFT analysis including phase measurements shall be performed.

For operating modes Smax and Sppmax mounting angles of 0° for channel 1 and 90° for channel 2 are predefined. For calculating the characteristical value for Smax, this mounting angle will be incorporated in the calculation.



☞ For the modes Smax and Sppmax the program calculates the difference between the mounting angles and takes this result for calculating Smax. If the difference between the

two angles differs by more than 5° from the nominal value 90°, the entry fields for the mounting angles will be shown red as warning indication.

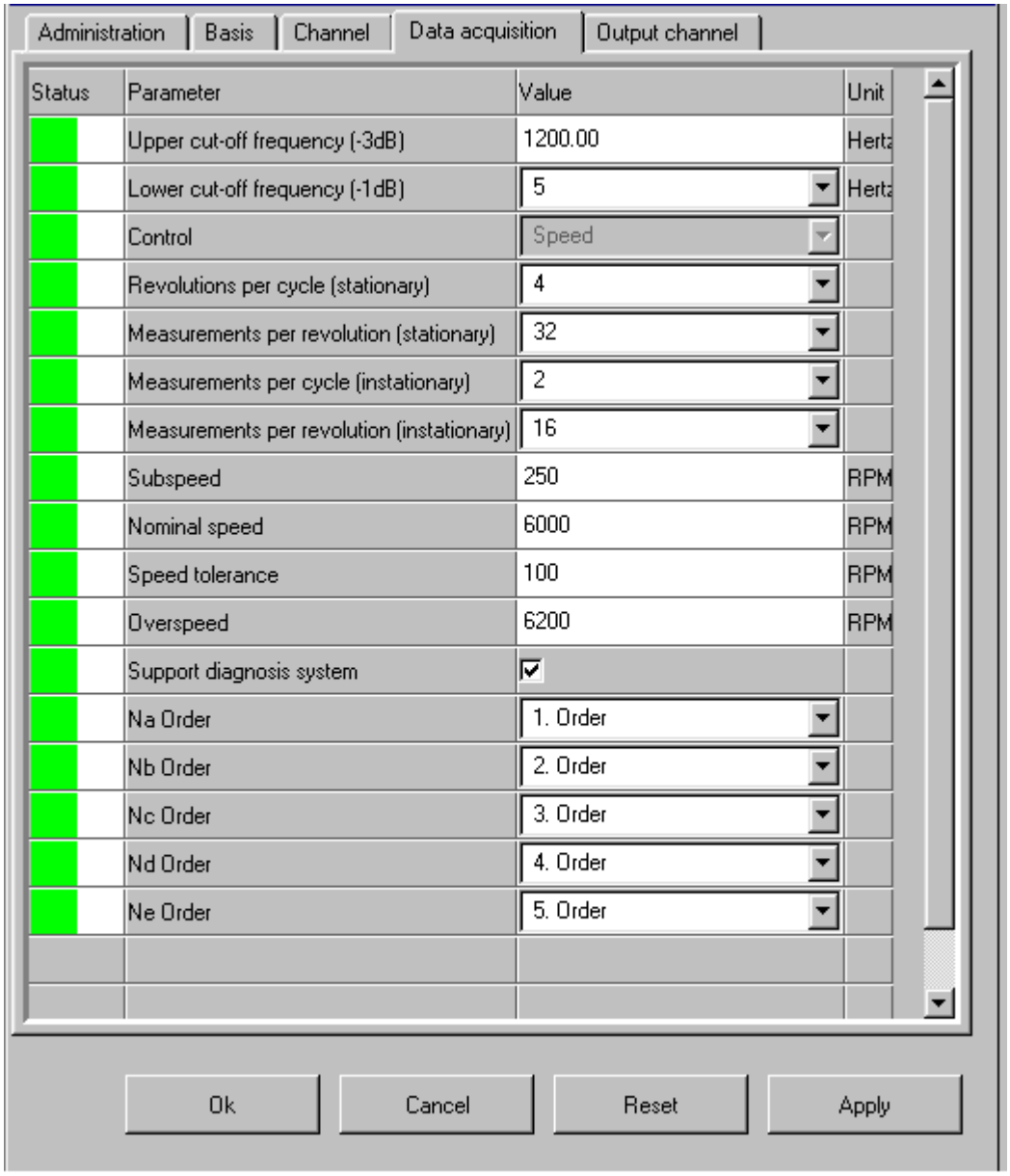
List `Evaluation`

This field is only available at the dual channel mode.

This field shows the actual evaluation of the characteristical value resp. the desired evaluation of the list may be chosen and entered into this field. Two methods are possible:

Peak-to-peak:	Characteristical variable proportional to the peak-peak value ($S_{pp} = S_{peak\text{-}peak}$) of the measuring quantity (vibration amplitude)
Zero-peak:	Characteristical variable proportional to zero–peak value ($S_{op} = S_{0\text{-}peak}$) of the measuring quantity (vibration amplitude)

2.3.4 Property page `Data Acquisition`



Property page "`Data acquisition`" may only be edited with access authorization SERVICE, the authorization "OPERATION" only permits watching of the parameters.

Entry field `Upper cut-off frequency (-3dB)`

This field serves the definition of the upper cut-off frequency for indication purposes and for calculation of the characteristical variable. The cut-off frequency defines the -3dB point of the low-pass filter, it may be set to any value between 50 and 2000Hz in steps of 0.01Hz.

☞ DIN 45670 for shaft vibration measuring equipment comprises operating frequency ranges for characteristical values of different groups of machines. According to fig. 4 of the standard, this range is limited by the -1 dB points. Thus, the upper cut-off frequency at the -3 dB point is higher than that of the operating frequency range at the -1 dB point. For this reason a safety margin of 20Hz can be added up for consideration of tolerances.

This shows the following:

250 Hz Operating cut-off frequency ≅ 312 Hz cut-off frequency (-3dB)+20 Hz = 332 Hz
1500 Hz Operating cut-off frequency ≅1880 Hz cut-off frequency (-3dB)+20 Hz =2000 Hz

List `Lower cut-off frequency (-1dB)`

With this list the lower cut-off frequency of the operating range (-1 dB point) can be set to either 1 Hz or 5 Hz. For the operating frequency of 1 Hz the -3 dB point of the high pass filter is 0.5 Hz, with an operating frequency of 5 Hz this point is at 2 Hz.

List `Control`

Calculation and indication of measuring data can be set to the time or speed controlled mode by means of this parameter list. If toggle key "Support diagnosis system" has been activated, the program switches automatically to the speed controlled mode.

- In the time-controlled mode, no measurement results can be shown with functions "display order analysis" and "display run-up/run-down". The maximum measuring speed is 5120 samples/sec. The number of samples per measuring cycle resp. the duration of a measuring cycle depends on the defined lower operating frequency.
- Having chosen the speed controlled mode, the trigger signal at the key input is used to control processing and indication of the measuring signals. If this signal is not available or if the frequency is smaller than the defined `subspeed` or greater than `overspeed`, the diagnostic program runs in the time controlled mode. The contents of the list field is not changed by this, the measuring results for displaying the `order analysis`, `measuring data` and `run-up/run-down` will be processed and displayed.

In the speed-controlled mode the upper frequency limit may be reduced at higher speeds (refer to list field revolutions per cycle and measurements per revolution). In this case it is recommended to choose the time controlled mode for the monitoring function and to select the speed controlled mode only for performing the order analysis.

List fields

`Revolutions per cycle (stationary / instationary)`
`Measurements per revolution (stationary / instationary)`

The speed ranges for the stationary and the instationary mode are defined by the nominal speed and its tolerance ranges and by the maximum and minimum speed,refer to diagram 2. For the stationary mode the speed is within the tolerance range of the nominal speed. The instationary speed range is between the `Subspeed` and the lower limit of the nominal speed and on the other hand between the upper limit of the nominal speed and the `Overspeed`.

The values in the list fields are only valid if the `speed controlled mode` has been chosen. Depending on the defined speed values and the chosen upper cut-off frequency and if admitted by the processing speed, the values will be accepted and may be modified. At incorrect values the corresponding field is shown red.

List fields `Measurements per revolution` serve the defining of how many measurements per shaft revolution shall be made. The max. number of measurements is limited by the maximum sample frequency fs = 5120 Hz.

$$\text{MPT max} = \frac{\text{Fs x 60}}{\text{max. speed}}$$

MPT = measurements / turn

max. speed = max. speed for the stationary resp. instationary range

The max. speed in the stationary mode (nominal speed + speed tolerance) and the chosen value for measurements per revolution determine the upper cut-off frequency as shown in diagram 1.

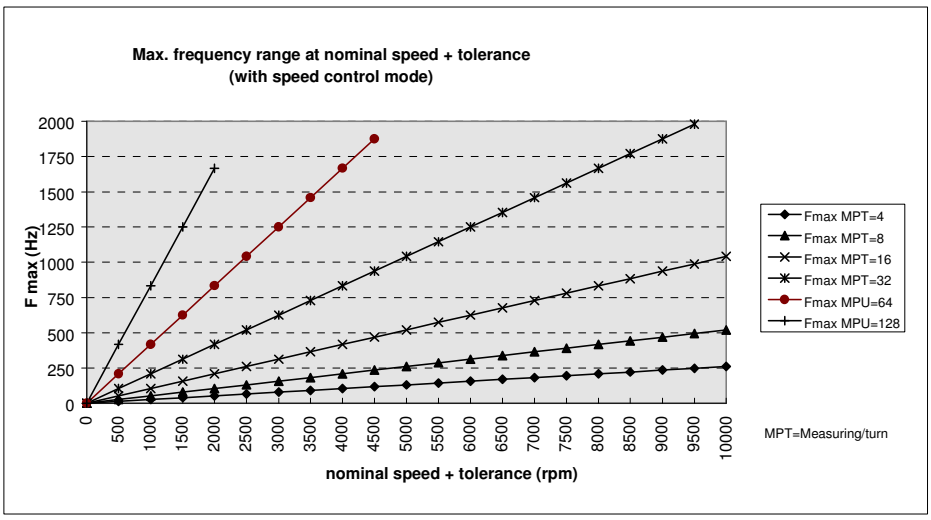


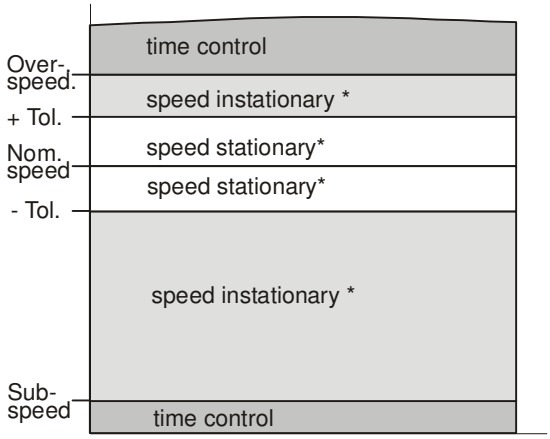
Diagram 1

If necessary, at high nominal speeds the upper cut-off frequency must be reduced, when the presettings for measurements per revolution are too high or too low.

In list fields `revolutions per cycle` the definition of how many revolutions are taken for one measuring cycle can be found. If this number is multiplied with the number of `measurements per revolution`, the result is the total number of measurements per measuring cycle.

Entry field `Subspeed`

If the `speed controlled mode` has been chosen, the key pulses will be used to detect the direction of rotation and for controlling the data processing of the diagnosis function. If the speed falls below the limit value defined in field `subspeed`, the program switches from the speed controlled to the time controlled measuring mode.



* only if speed controlled mode is selected, otherwise time controlled mode

Diagram 2

Input fields `Nominal speed` and `Speed tolerance`

If the speed controlled mode with key pulse was chosen and if the speed is within the tolerance range of the nominal speed, the program uses the stationary control. This means, the values of the list fields stationary for revolutions per cycle and measurements per revolution are valid for displaying purposes. For speed values above limit subspeed and below the lower limit of the tolerance range of the nominal speed, as well as in the range above the upper tolerance of the nominal speed and below the max. speed limit, the program operates with values of lists „instationary“, refer to diagram 2.

Entry field `Overspeed`

If the shaft speed exceeds the value defined in this field, the diagnosis program switches from the speed controlled to the time controlled measuring mode.

List fields `Na-Ne Order`

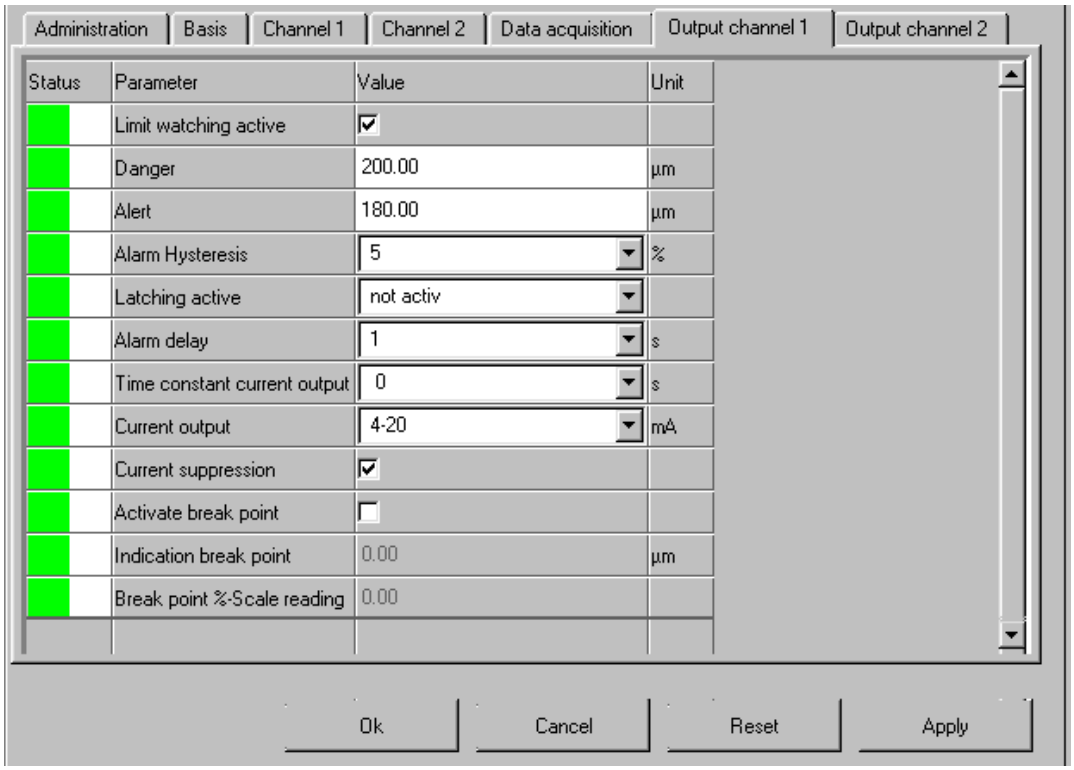
By means of list fields `Na - Ne order` the order number for the order analysis in menu "`display`" can be defined. To make a choice in these fields, toggle key "Support Diagnosis-system" must have been set to active.

The lists indicate the maximum available order numbers which depends on the selected number of measurements per revolution (Omax = MPT/2.56).

2.3.5 Property pages `Output channel 1/2`

Property page "`Output channel`" shows dialog "`Parameter setting`". For modules with combined channels and one characteristical value (modes Smax and Sppmax) only one

page is available, since the outputs refer to just one characteristical value. For the dual channel mode it is necessary to configure the parameters for two separate output channels.



Access authorization OPERATION permits activation or deactivation of the limit value supervision and modification of alarm limits ALERT and DANGER. Access authorization SERVICE permits modification of all parameters.

Parameter switch `Limit watching active`

With this switch the supervision of alarm limits is activated, the relevant limit values can be defined in entry fields `Alert` and `Danger`. However, in case of deactivating the alarms, the alarm outputs are set to their default states bat the alarm limits are still indicated in menu `Display characteristical values`.

Entry fields `Danger` and `Alert`

These fields serve the input of alarm limits for the pre-alarm `Alert` and main alarm `Danger`. The direction of action of the alarms is increasing, i.e. the alarm will be triggered if an alarm limit is exceeded. The permissible range for the alarm limits is 5...100 % of the measuring range, in any case the value for the `Alert` alarm limit must be smaller than that for the `Danger` alarm limit.

List field `Alarm Hysteresis`

The hysteresis value may be set to any value of 1%....20% of the measuring range. The hysteresis defines how far the characteristical value must fall below the limit value again to reset the alarm.

List field `Latching active`

If this function has been activated, the alarm output will be set to latching after the limit was exceeded. The alarm is reset again only when the limit value is not exceeded anymore and when command `Reset latch channel 1` resp. `channel 2` is given by the configuration software in menu `Extras > Commands`.

List `Alarm delay`

With this parameter field the response delay of the alarms may be set to any value of between 0...5 seconds. The response delay time indicates, how long a limit value must be exceeded by the measuring value before an alarm is triggered.

List `Time constant current output`

In order to avoid unstable measuring results when measuring at very slow speeds, the output current can be smoothed with a time constant with a value of between Ƭ = 0 and 10sec. This time constant effects a slow change of the current even when the value of the variable changes quickly. With a time constant Ƭ of 10sec and a sudden change of the measuring value from 100% to 0%, it will last appr. 10 sec till the output current has changed by 63%. The characteristic of the changes correspond to the e-function, i.e. the changing rate of the amplitude decreases resp. increases over the time.

List `Current output`

By means of this list the range of the output current may be set to either 0...20 mA or 4...20 mA.

Parameter switch `Current suppression`

The current suppression can only be activated when the current output range is set to life zero (4...20 mA).

With the activated current suppression the output current will be set to 0 mA if a channel error has been detected or during the settling time e.g. after power on (refer to section 4.2.1. of the function description).

Parameter switch `Activate break point`
Entry fields `Indication break point` and `break point % scale reading`

By activating parameter `Activate break point`, the scale of the output current with a normally linear course from 0 to 100%, will be splitted. By entering a indication value and the relevant output value in % of the measuring range the break point will be defined, which splits the characteristical curve in two linear parts.

In the example below, the values for the break point are as follows:

Display value: 160 µm

% Scale factor:60 %

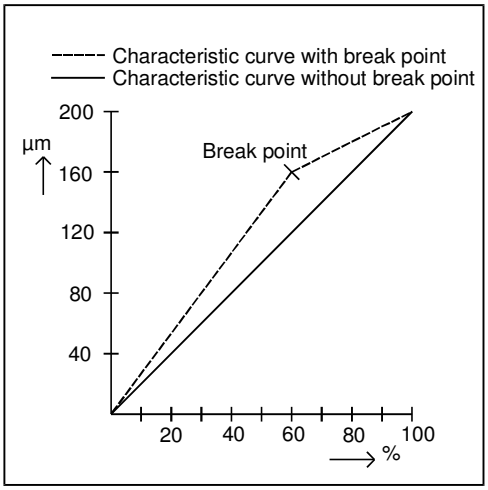


Diagram 3

3. VISUALIZATION, MENU DISPLAY

Display panels only can be opened, if the communication with a module has been estab-lished (status online). It is recommended first to download the configuration, i.e. to execute menu point `File > receive`. As soon as display panels are opened, the measuring data are continuously requested from the module and refreshed in the display.

3.1 Speed

Dialog `Speed` is opened via menu point `Display`.

Field RPM shows the shaft speed if key pulses are available at input d22 and if the control function in property page `data acquisition` was set to `Speed`.

3.2 Monitor LEDs

This dialog can be activated via menu `Display monitor.> LEDs`.

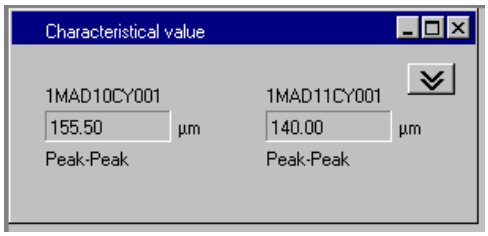
Two circles (LEDs) in the upper field show the channel states `Channel Clear`. Green cir-cles indicate that the channel conditions are o.k., the LEDs are steadily switched on. The cir-cle color will change to gray if the channel condition is not good, i.e the Channel Clear LED on the monitor front is off or flashes.

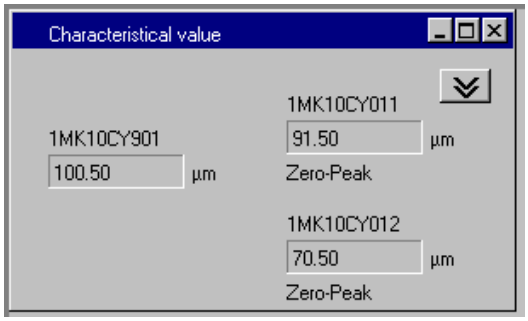
The two lower circles (LEDs) in field alarm show the alarm states.

gray color	–	no alarm
yellow color	–	Pre-alarm (Alert)
red color	–	Main alarm (Danger)

3.3 Characteristical variables

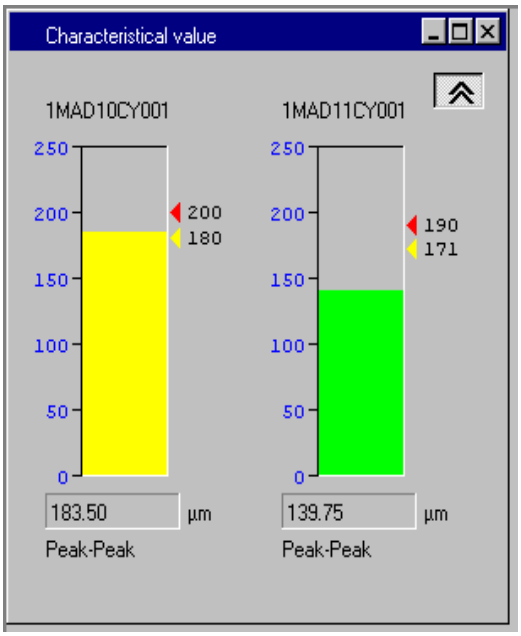
The relevant dialog is opened via menu point `Display > characteristical vari-ables` depending on the chosen operating mode.

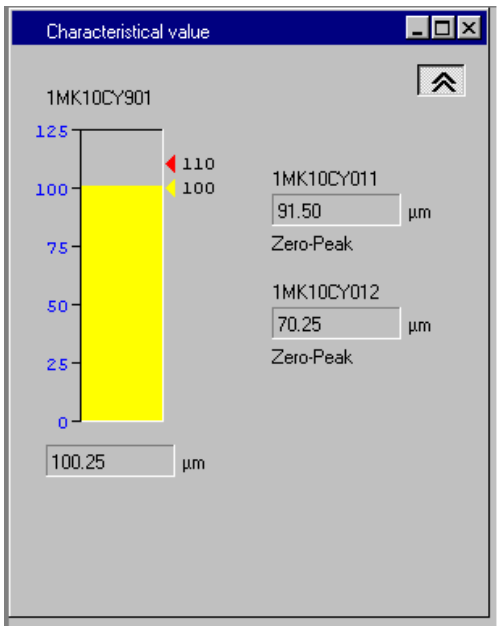




In the dual channel mode display panel `Characteristical variables` shows the singles channel results (picture left). At the modes S_{max} and S_{ppmax} with combined measuring results (right illustration), the calculated characteristical variable is shown left and the actual values of the vibration amplitudes (in µm) of the individual channels on the right side of the panel. The according KKS description is assigned to the channels.

With a mouse click on the button the indication will be enlarged – another mouse click on the button now visible reduces the panel size again.





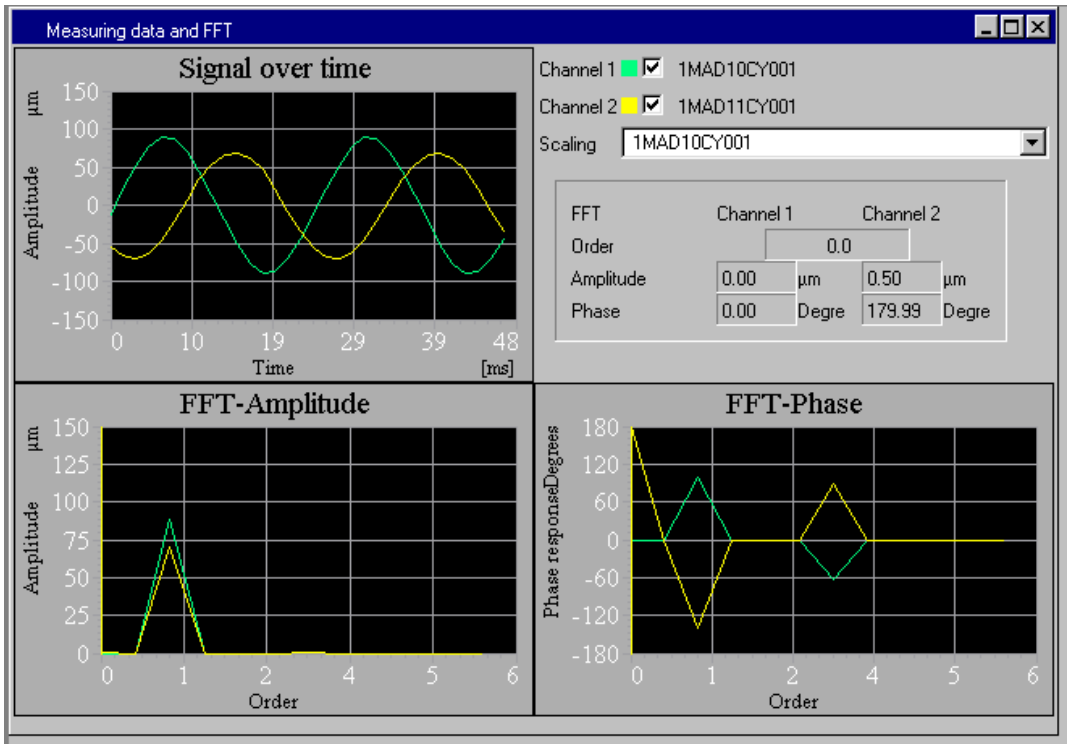
Display panel `Characteristical values` shows additionally the actual results of the single characteristical values resp. the value of the output channel in form of a bar diagram. Beside the bar the relevant actual limit values are shown with a yellow mark for ALERT and with a red mark for DANGER.

If function `Limit increase` has been activated (input d18 = low, parameter switch `Limit increase on` on property page `Basis` has been activated and a multiplication factor entered, refer to section 2.3.2.), the limit values increased by this factor will be indicated.

Characteristical variables will be shown in colored in the bar diagram. A green bar means, measurement ok and no limit exceeding, a yellow bar means ALERT alarm and a red bar means DANGER alarm. If the bar is shown in blue color, the "Channel Clear" status is not given for this module (channel error, overload or delay time still active).

3.4 Measuring Data and FFT

Display function `Meas. data` shows on three display panels the amplitude response in a trend diagram and the spectrum analysis as frequency (FFT) or order analysis of amplitude and relative phase.



The signal analysis of both channels is started by calling up this dialog. The three displays show the curves for channel 1 in green and for channel 2 in yellow (default setting, menu `Options > Program > Configuration > Colors`).

Parameter switch `channel 1` and `channel 2`

These switches activate the display functions for both channels.

List `Scaling`

In the dual channel mode selection "Scaling" serves the modification of the display scaling if the channels have been configured differently.

Display panel `Time function`

The time function shows the amplitudes of the dynamic signal for the two channels around a symmetrical center line. The scaling of the time axis depends on the mode chosen in property page `Data acquisition`.

- Having chosen the speed controlled mode, the program distinguishes between the stationary and instationary range and speeds outside of them. In the stationary and instationary range the time axis corresponds to one measuring cycle. i.e. the indicated number of revolutions corresponds to the setting revolutions per cycle (property page `Data acquisition`). Outside the instationary and stationary ranges data acquisition and visualization

operate in the time controlled mode, the length of the time axis depends on the upper and lower operating frequency limits and the actual speed.

- At chosen time control mode, the time axis length depends on the lower and upper operating frequency.

Indication `FFT Amplitude` and `FFT Phase`

- At chosen speed control the spectrum of amplitudes (zero-peak) and phases is represented depending on the order number according to the principle of a digital order transformation.

  This display mode was chosen to avoid blurring and jitter at little speed changes, which may easily happen when performing FFT analysis.

- At chosen time control mode, amplitude and relative phase responses are displayed over the frequency according to the Fast Fourier Transformation (FFT).

☞ The values of the relative phase are suitable for long term monitoring or observation on changes but without further action they are not suitable for evaluating the actual phase e.g. for balancing activities.

Cursor

Both diagrams show a common cursor in form of a vertical line.

Selection:	Click it with the mouse or strike the TAB key. Having done this, triangle marks will appear at the ends of the X and Y axis.
Moving:	Draw the cursor by keeping the mouse key pressed and clicking a measuring point or by moving the cursor with the cursor keys →←↑↓.

The cursor may be moved in parallel to the X - axis, but it can only be fixed at measuring points.

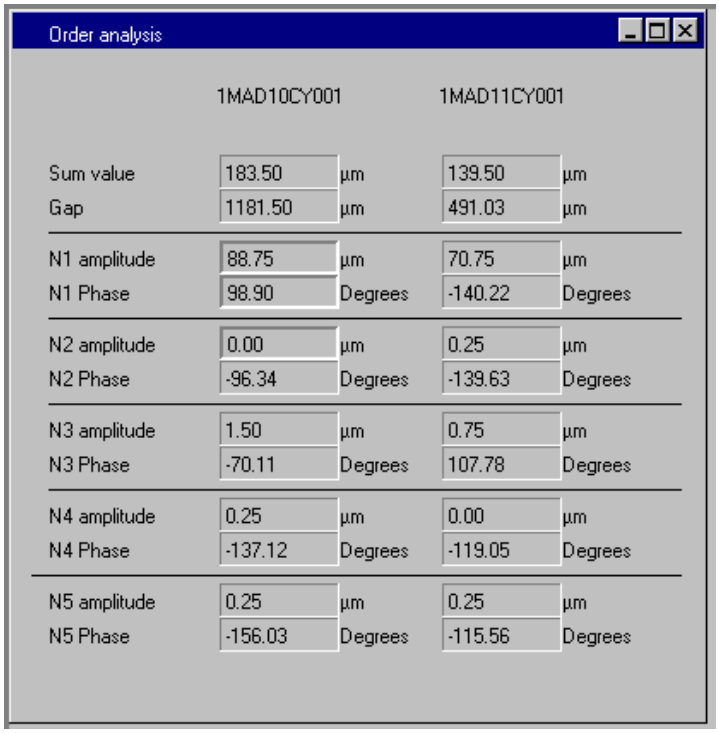
Fields `FFT Order, Amplitude` and `Phase`

The fields in the upper right part show the values of the measuring points marked with the cursor. The upper line shows order number resp. frequency, then the values for amplitude (o-peak) of channels 1 and 2 (in µm) and the relative phases of channels 1 and 2 (in degree) related to the key pulse.

3.5 Order analysis

Dialog `Order Analysis` is called up via menu `Display - Order analysis`.

An order analysis is only carried out, if in property page `Data acquisition` function Diagnosis system has been switched on. Otherwise only the sum value (vibration amplitude) and the GAP are shown.



Order analysis

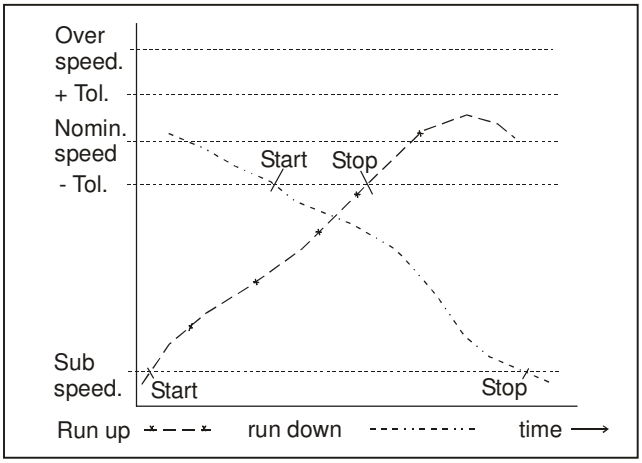
	1MAD10CY001		1MAD11CY001	
Sum value	183.50	µm	139.50	µm
Gap	1181.50	µm	491.03	µm
N1 amplitude	88.75	µm	70.75	µm
N1 Phase	98.90	Degrees	-140.22	Degrees
N2 amplitude	0.00	µm	0.25	µm
N2 Phase	-96.34	Degrees	-139.63	Degrees
N3 amplitude	1.50	µm	0.75	µm
N3 Phase	-70.11	Degrees	107.78	Degrees
N4 amplitude	0.25	µm	0.00	µm
N4 Phase	-137.12	Degrees	-119.05	Degrees
N5 amplitude	0.25	µm	0.25	µm
N5 Phase	-156.03	Degrees	-115.56	Degrees

Five groups with measuring results for five order numbers indicate amplitudes (`Nn Amplitude`) and relative phases (`Nn Phase`) for each of both channels. Selection of the order numbers is made on property page `Data acquisition`.

☞ The values of the relative phase are suitable for long term monitoring or observation on changes but without further action they are not suitable for evaluating e.g. the actual phase for balancing activities.

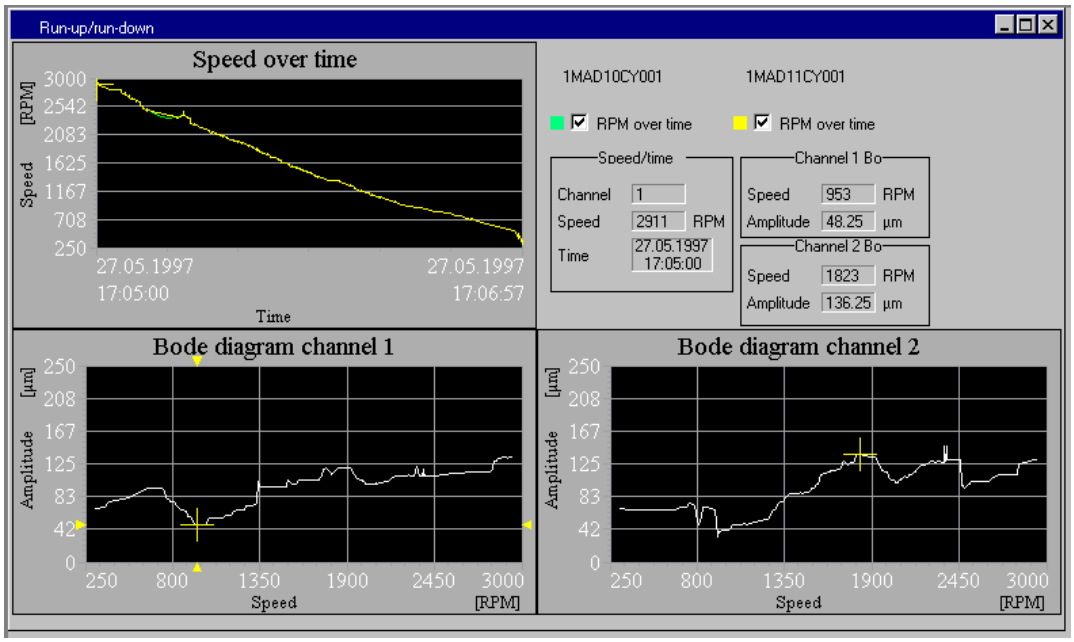
3.6 Run-up/ Run-down

This display panel can only be loaded when a run-up/run-down data set is stored. A run-up will be stored if the lower speed limit, as defined in property page `Data acquisition`, has been exceeded and (without time limit) the tolerance limit of the nominal speed, too. For a run-down the limits must be underrun in the reverse order. Only the last run-up/run-down can be displayed.



Each run-up resp. run-down consists of approx. 600 measuring points. For each of them speed, amplitudes of both channels and time are stored. In order to achieve continuous time distances between the measuring points, the program performs a time optimizing function without loosing amplitude peaks (neither in positive nor in negative direction).

A started but interrupted run-up or run-down will be discarded, only the last complete run remains stored.



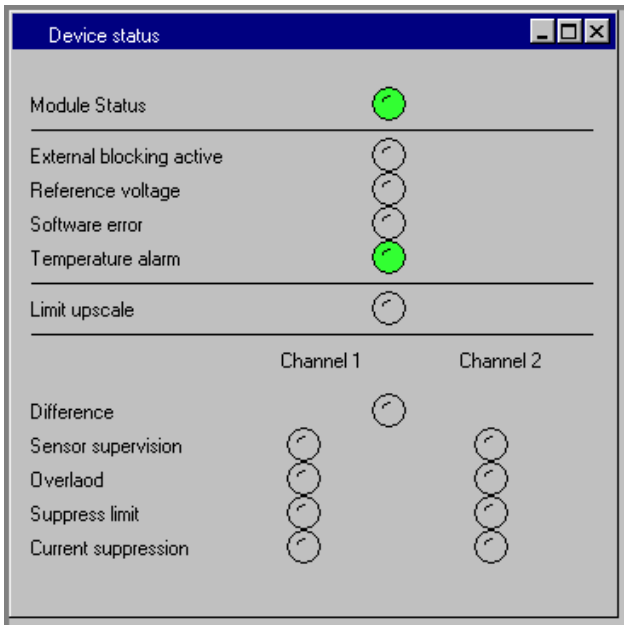
By means of the cursor, individual measurements may be chosen.

Selection: By clicking with the mouse cursor or by striking the TAB key, the measurement points can be selected. Having done this, triangle marks will appear at the ends of the X and Y axis.

Moving: Draw the cursor by keeping the mouse key pressed and clicking a measuring point or by moving the cursor with the cursor keys →←↑↓.

3.7 Device Status

The indication of the module status serves the localisation of reasons for a „Channel not ok“ message (LED channel clear switched off or flashing) and for incorrect alarm functions resp. output currents.

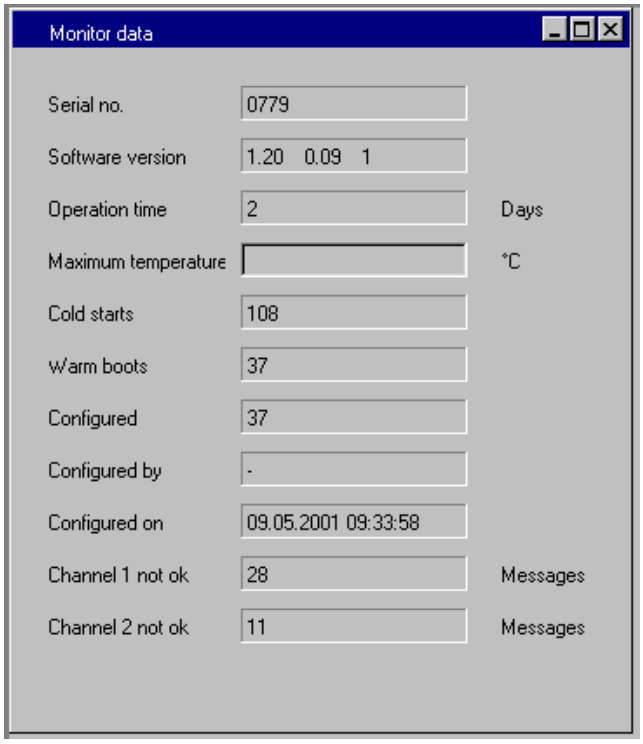


Signalling and handling is described in section 2.4.7 of the system manual part 1. The following signalling conditions are valid especially for the MMS 6110 monitor.

Sensor supervision	gets red in case of a detected fault of the measuring chain i.e. when the signal DC voltage exceeds the upper limit +0.5V resp. falls below the lower limit -0.5V of the sensor operating range. This applies independently of the absolute range values thus for the operating range -2...-18 V as well as for -4...-20 V.
Overload	gets red when the dynamic signal (AC part) of the channel input voltage exceeds the measuring range + approx. 1%.
Difference	Not relevant for the MMS 6110 monitor

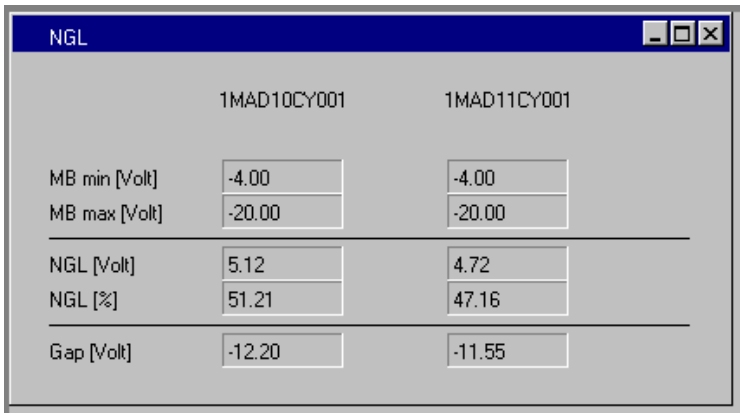
3.8 Monitor data

On activating the dialog, the monitor data are downloaded and displayed. These data are only for information purposes and cannot be modified. The meaning of the fields is described in part 1 of the system manual, section 2.4.8.



3.9 Display NGL

Dialog "NGL " is opened via menu point "`Display NGL`". It shows the static parts of the input signals.



Fields `MB min [Volt]`

Indicates the lower limit of the measuring chain's operating range.

Fields `MB max [Volt]`

Indicates the upper limit of the measuring chain's operating range (sensor with converter). The operating range limits have been defined in property page „`Channel`".

Fields `NGL [Volt]`

Indicate the scaled d.c. parts for both measuring chains. The d.c. parts (x1 and x2) represent the mean values of the amplitude values according to DIN 45670, section 3.2.1. The NGL range is identical to the operating range, with the lower range limit set to 0V NGL and the upper range limit to NGLmax.

Fields `NGL [%]`

Shows the relation between the actual NGL and the maximum NGL value.

☞ We recommend setting the relative NGL value (%) to approx. 50%, because in this case the static distance of the sensor is in the centre of the operating range.

Fields `Gap [Volt]`

Defines the dc level of the channel input voltage.

4. FUNCTION DESCRIPTION

This chapter mainly describes the hardware functions of the MMS 6110 Shaft Vibration Monitor. The function of the monitor depends on the configuration which is described in chapter 2.

The function of the hardware (electric circuits) is shown in block diagram figure 1, the connection diagram fig. 4 shows the connection to external devices.

4.1 Measuring Amplifier and Signal Conditioning

4.1.1 Signal inputs and sensor supply

The MMS 6110 shaft vibration monitor has two differential signal inputs for eddy current sensors, SENS1H (z8)/SENS1L (z10) and SENS2H (d8)/SENS2L (d10). They are matched to epro sensors of the PR 642. family together with the relevant converters. However, it is possible to adapt other measuring chain with an identical measuring principle and corresponding characteristics. The input voltage range is -1 to -22 V DC.

The MMS 6110 module provides a sensor supply output for each channel with a supply voltage of -26,75 Vdc, SENS1+ (z6)/ SENS1- (b6) and SENS2+ (d6)/SENS2-(b8). The supply outputs of both channels are galvanically isolated from the remaining circuits of the monitor and the supply voltage.

The supply voltage of -26,75 may be used for supplying the converters CON 010, CON 020 and CON 030 although their supply voltage is indicated to nominally to 24 V. Measuring errors due to the higher supply voltage will not occur.

The connection of converter and sensor should be carried out according to connection diagram figure 4. The Low - input of the amplifier must be linked to the relevant +Sens output of the sensor supply, because otherwise the potential-free input could cause measuring errors. For reasons of improving the electromagnetic compatibility (EMC), we recommend linking +Sens and Sens Low at the converter.

In the MMS 6110 monitor, output SENS- C (b10) is connected to ground and is intended for connection of the internal cable shield of twisted pair cable e.g. of type LiYCY-CY2x2x0, 25 (refer to figure 4, connection diagram). The external cable screen of the sensor cables should be linked to external ground (protective earth) or to the earth connection of the cabinet ot housing.

The sensor signals at the module input can be measured at sockets "Sensor signal" at the module front. With the help of the SMB- mini coax cables and SMB-BNC adapters, contained in the MMS 6910 Operating Kit, oscilloscopes or corresponding measuring devices may be connected to the MMS 6110. The sockets are connected to the signal inputs via 1:1 buffer amplifiers. Thus they permit measurement of the static signal (dc level) which is proportional to the distance between sensor and measuring target and the analysis of the dynamic signal.

4.1.2 Signal conditioning and calculation of characteristical values

The signal conditioning is determined by the configuration. The configuration parameters define type and data of sensor and converter (sensitivity, linear operating range). More-over, they serve the definition of the operating mode (dual channel mode, Smax according to DIN 45 670 or or Sppmax according to DIN 45 670 B or API 670. Measuring range, signal evalua-

tion and cut-off frequencies of high-pass and low-pass filter are also defined during the monitor configuration.

If the measuring chains are used in hazardous areas, only safety barriers according to the instructions of the Direction for uses for sensors and converters may be used for instal-lation in measuring and supply circuits. During configuration, the types of barriers and their series resistance have to be entered and will be taken into account by the monitor software.

4.2 Signal outputs

4.2.1 Output of characteristical values

The monitor has two analog outputs for characteristical values I1+ (z18) / I1- (b18) und I2+ (z20) / I2- (b20) for impressed currents of either 0...20 or 4...20 mA. In the dual channel mode the current outputs are assigned to the relevant channel. In operating modes S_{max} and S_{PPmax} each of the outputs provide the same current in parallel.

If the output current has been configured to 4...20 mA, a characteristical value "0" corresponds to an output current of 4 mA. If in property page `channel` switch `current suppression` has been activated, a channel or module fault will cause the output current to be set to 0 mA (refer to section 4.5 Condition monitoring). In case that in one of the operating modes Smax or Sppmax a measuring chain is disturbed, the measuring result of this channel will be set to 0mA. Only the measurement of the undisturbed channel is used for the calculation of the characteristical value.

4.2.2 EO Voltage outputs characteristical value

Outputs **EO1 (d14)** und **EO2 (d16)** provide an output voltage of 0...+10 V proportional to the shaft vibration according to the configuration of the characteristical value for the dual channel mode. In operating modes S_{max} und S_{PPmax} the output voltage 0...10 V corresponds to EO1 resp. EO2 the single channel measuring results with identical measuring range and signal evaluation as the combined characteristical value.

The EO outputs mainly serve the combination with the EI inputs, however this feature is not effective for the MMS 6110 shaft vibration monitor. When these voltage outputs are used to provide characteristical values for indication purposes or for further processing, it must be taken into account that these outputs have a resolution of 8 bit (resolution of current outputs = 16bit).

4.2.3 Dynamic outputs

The two dynamic ouputs **AC1 (z14) a**nd **AC2 (z16)** provide the dynamic part of the measuring signal. The input signal is fed to a low-pass filter to divide dynamic and static part of the signal in order to provide the original dynamic signal for a frequency analysis, e.g. with an analysis system, in the frequency range of 0,1...16 kHz. The output voltages 0...20 Vpp correspond to the configured range of the characteristical variable.

4.2.4 Scaled d.c. outputs

The scaled d.c. outputs **NGL1 (z12)** and **NGL2 (d12)** provide a d.c. voltage in the range 0...+10 which is proportional to the distance between sensor and measuring target (machine shaft). The measuring range is defined by the linear operating range for this sensor entered

during the configuration. Thus a level of 0V corresponds to the lower limit of the sensor's operating range (e. g. - 4 V/0,5 mm for PR 6423 and CON 010) and +10 V to the upper range limit (-20 V / 2,5 mm) – refer to section 2.3.2 property page `Channel`.

4.3 Signal inputs

4.3.1 Voltage input characteristical value EI

The voltage inputs **EI1 (b14)** und **EI2 (b16)** for 0...+10 V level of characteristical values serve the combination with voltage outputs EO of identical channels. This feature is not effective for the MMS 6110 shaft vibration monitor.

4.3.2 Signal input KEY

The key input of the monitor permits connection of the key reference pulse. It is possible to use key pulses from either an Key Monitor MMS 6310 or Speed Monitor MMS 6312 or directly from a speed sensor such as the PR 9376 - provided their pulses have amplitudes of at least 13V. Prerequisite is a supply voltage of 24V for the PR 9376 speed sensor.

Key pulses are required to process the measurements speed controlled and to perform the order analysis functions.

4.4 Limit supervision

4.4.1 Alarm channels and limit values

Two alarm channels, each of them with a pre alarm (ALERT) and a main alarm (DANGER) check the characteristical values on limit exceedings. Activation of the limit value super-vision and setting of limit values is made during the configuration.

In the dual channel mode the characteristical values are supervised by the relevant alarm channel. The limit values for pre alarm (Alert) and main alarm (Danger) may be adjusted separately.

With operating modes Smax and Spp max resp. max (X,Y) the characteristical value, calculated from both channels, is supervised only one "Alert" and one "Danger" limit.

The switching characteristics of the limiting switches is increasing; i.e. as soon as the characteristical value exceeds the limit value, the alarm output will be triggered. A hysteresis selectable from 1...10% of fsd. (only effective at decreasing values) prevents an undefined switching of the alarm outputs in case of little changes of the measuring value around the limit value.

4.4.2 Limit value multplier and binary input Factor X

In menu `Edit > Basis` function `limit multiplier on` can be activated and a multiplication factor entered. The increase of the limit values will get effective, not before input d18 "factor x" is set to LOW. With input "factor x" open or HIGH, this function is inactive. Upscaling of limit values is effective on pre and main alarms and in the dual channel mode on the alarm levels of both measuring channels.

4.4.3 Alarm visualization

Two red LEDs on the front plate indicate the alarm state of the relevant channel. Main alarms (DANGER) are indicated by a steady red light, in case of pre-alarms (ALERT) the LEDs are flashing – provided, neither the alarm blocking function has been activated nor digital input "external blocking" is set.

4.4.4 Alarm outputs

The four alarm outputs are open collector outputs and are galvanically isolated from each other and from the remaining circuits of the module. Thus the switching function of the output is only given with an external supply.

Channel 1: Main alarm D1-C, D1-E (d26,d28), Pre-alarm A1 -C, A1-E (b26,b28)

Channel 2: Main alarm D2-C, D2-E (d30,d32), Pre-alarm A2 -C, A2-E (b30,b32)

If several alarm outputs are to be connected in series, (closed-circuit mode), it has to be taken into account that each of the outputs takes a voltage drop of max. 1.5V. For this reason, not more than four optocoupler outputs (C-E) should be connected in series, when driving a REL 020 with 24V relay supply. When using an REL 010, up to 8 C-E outputs and with the REL 054 up to 12 C-E-outputs may be connected in series.

4.4.5 Alarm latching

Function `Alarm latching` may be activated on property sheet `Output channel`. If with this function an alarm is generated, it will be latched and only be reset if the alarm condition is no longer true and if in menu `Extras > commands` command `Reset latch channel 1` resp. `channel 2` is given.

Without latching function the alarm will be reset as soon as the measuring value falls below the upper limit (minus hysteresis) or exceeds the lower limit (plus hysteresis).

4.4.6 Switchover open-/ closed-circuit mode SC-A, SC-D

The signal states at the digital inputs SC-A (d24) for ALERT alarms and SC-D (z24) for the DANGER alarms define the alarm output operating mode.

- In case the SC- input is open or HIGH (+24V), the relevant alarm outputs operate in the open circuit mode, i.e. at activated alarms the transistor's collector- emitter line is conducting and an external connected relay activated (see fig. 4, connection diagram).
- In case the SC- input is Low (0 V), the relevant alarm outputs operate in the closed-circuit mode, i.e. at activated alarms the transistor's collector- emitter line is open, thus an external connected relay will be deactivated (see fig. 4, connection diagram).

☞ **Note: When the module operates in the closed circuit mode, an alarm will be trig gered if the supply voltage fails or if the card is removed from the rack.**

In the following chapters there is talk about the default state (= no alarm) of the alarm outputs. Default state means an open collector-emitter line (relay not activated) for the open circuit mode and a conducting transistor output (relay activated) for the closed circuit mode.

☞ **Note:**
Modules of type **MMS 6110 C** are delivered from the factory with the alarm outputs fixed to the closed-circuit mode. Alarm outputs of these modules cannot be operated in the open circuit mode.

4.4.7 Alarm blocking

Switches off alarm LEDs and sets the alarm outputs to the default state. The alarm blocking function always gets active in the following cases.

- At module faults (supply or software failures).
- During running delay times after power-on or power breaks and during a time of 18 + 60 sec. after module configurations
- At temperature main alarm
- If external blocking is active (input ES z22 set to 0V).

The alarm blocking function will only get active in case a measuring chain fails to operate (input dc level < measuring chain operating range, lower limit -0,5 V or > upper limit +0.5 V) and during the delay time after remedying this disturbance, if in property page `Basis` parameter switch `Limit value suppression` has been activated.

The measuring chain error message `Overload` (dyn. Input voltage > measuring range) does not have any influence on the alarm blocking.

In Display `Device status` of the configuration program all states are indicated, section 4.5.5 shows the module supervision in a clear form.

4.4.8 External blocking/ alarm stop

If input external blocking z22 is set it to LOW (0 V/ground), the alarm output will be deactivated – independently of the alarm configuration: Alarm-LEDs are switched off and alarm outputs are set to their default state. Moreover, the "Channel Clear" LEDs will be switched off and the relevant collector-emitter outputs opened (closed circuit mode).

If the input is open or HIGH (+24 V), the alarms will not be blocked resp. only by the faults as described in section 4.4.7. The actual state of signal `External locking` can be found in menu Device status of the configuration program.

4.4.9 Response delay

The response delay may be adjusted in the range 0...5 seconds by means of the configuration software. The response delay time indicates, how long a limit value must be exceeded by the measuring value before an alarm is triggered.

4.5 Condition monitoring

The condition supervision function checks the functionality of monitor and measuring chains. This function shall ensure that in case of faulty measurements this is indicated and, if necessary, the output of alarms deactivated.

Indication of the condition is made in three ways

- by means of the Channel Clear LEDs on the front
- by means of Channel Clear outputs 1 and 2
- by means of the configuration program on a computer in menu `Diagnosis – device status`.

4.5.1 Channel supervision

The dc voltage of the input signal is checked. If the input voltage exceeds the upper limit of the sensor operating range +0,5 V, entered during the configuration, or if it falls below the lower value -0,5 V, a channel error will be indicated.

4.5.2 Overload - supervision

If the amplitude of the dynamic signal exceeds the measuring range defined during configuration (plus approx. 1 %), an **Overload** message will be given.

4.5.3 Channel Clear LEDs

During the correct measuring and supervision operation, the Channel Clear LEDs show a steady green light.

The Channel Clear LEDs operate independently for every channel, i. e. during a channel error or during the delay time after a channel error this will be indicated by the relevant Channel Clear LED.

In principal, delay times and module faults are signalled by both LEDs.

The table in section 4.5.5 shows the signalization depending on different operating modes.

4.5.4 Channel Clear Outputs

The two Channel Clear outputs are open-collector outputs and galvanically isolated from each other and from the remaining circuits of the module. Thus the switching function of the output is only given with an external supply.

channel 1 C1-C, C1-E (z26,z28) channel 2 C2-C, C2-E (z30,z32)

During correct measuring operations and when the supervision function does not indicate a module error, the collector-emitter line of the Channel Clear output transistors are conducting - i. e. they operate according to the closed circuit mode. In case of a disturbance of the relevant channel or during the delay times after an error, the collector emitter line of the output is open (see table in section 4.5.5). In case of a module fault or during delay times after a module fault, both Channel Clear outputs are switched off.

If several CHANNEL CLEAR outputs are to be connected in series, it has to be taken into account that each of the outputs takes a saturation voltage of max. 1.5 V. For this reason, not more than four optocoupler outputs (C-E) should be connected in series, when driving a REL 020 with 24V relay supply. When using an REL 010, up to 8 C-E outputs and with the REL 054 up to 12 C-E-outputs may be connected in series.

4.5.5 Effect of the module supervision

Function Channel Clear (CC) LEDs

	Steady light		□□□□□□□□□□□□□□	OK-State
0	Off		_____	Fault state
FS	Flashing slowly	0,8 Hz, 2:1	□□□□__□□□□__□	Channel state
FQ	Flashing quickly	1,6 Hz, 1:2	□__□__□__□__□	Module state

after power on

Normal start phase	both CC-LEDs flash synchronously for appr. 15 sec.
Module not configured	the CC-LEDs are flashing alternatingly
Module not calibrated*	all LEDs are flashing alternatingly

* in case this message appears, the module has lost his parameters or has got a hardware problem and must be recalibrated or repaired in the factory.

The following table shows the signalization depending on different error situations.

Description	I out		Chan.		Alarms			
	Is	4...20	LE	Out	Lsu	LED´s	Daou	Aaou
Module error (System supply	0	X	0	BL	X	0	BL	BL
Software errrors, reconfigura-	1	0	0	BL	X	0	BL	BL
Temperature	0	X	X	BL	0	0	BL	BL
Main alarm	1	0	0	BL	X	0	BL	BL
Temperature pre-alarm	X	X	FQ	X	X	X	X	X
	0	X	FQ	BL	X	X	X	X
	1	0	FQ	BL	X	X	X	X
Delay time after module er-	X	X	FQ	BL	0	X	X	X
	X	X	FQ	BL	1	0	BL	BL
Channel error (input signal	0	X	0	BL	X	X	X	X
Outside measuring chain	1	0	0	BL	X	X	X	X
operating range,	X	X	0	BL	0	X	X	X
Measuring chain error)	X	X	0	BL	1	0	BL	BL
	0	X	FS	BL	X	X	X	X
	1	0	FS	BL	X	X	X	X
Delay time after channel	X	X	FS	BL	0	X	X	X
	X	X	FS	BL	1	0	BL	BL
Channel error Overload	X	X	0	BL	X	X	X	X
Delay time after Overload	X	X	FS	BL	X	X	X	X

Is	Current suppression
Lsu	Limit suppression
Daout	Output main alarm (DANGER)
Aaout	Output pre-alarm (ALERT)
BL	Output CC blocked, outputs ALERT and DANGER in default state (no alarm)

X	No influence
1	On
0	Off

For the operating mode with one characteristical variable calculated from both channels (S_{pp} and S_{ppmax}) and in case of a channel error or during the delay time after an error, the relevant input will be set to zero in order to keep a reduced protection function.

5. INSTALLATION AND COMMISSIONING

5.1 Installation

Monitors of the MMS 6000 system are designed as printed boards in the standard euro format. They may be used in any operating position in 19" racks with 3 HE e.g. IMR for 011, as well as in other intermas compatible systems and frames.

The pin allocation can be found in figure 2, pin allocation, from block diagram figure 1, or from the connection diagram figure 4.

The supply of the monitor requires +24V dc (18...31 V). Redundant supply of the monitor is possible by means of two supply inputs, decoupled via diodes.

For connection of the converters for the eddy current sensors we recommend using double screened twisted pair cables (e.g. LiYCY-CY 2 x2x0.25) to ensure the EMC specifications.

Before switching on the monitor, the correct connection of supply and signal inputs / outputs must be checked.

5.2 Commissioning

If not ordered otherwise, upon delivery from the factory the monitor has been programmed with a restricted set of parameters. For this reason, at the first commissioning a configuration of the monitor is required. In the configuration software predefined configurations for different operating modes of the monitor are at the disposal.

5.3 Maintenance and repair

During operation the MMS 6000 monitors do not require any maintenance.

The storage of the cards do not require special precautions. The environmental conditions are specified in section 6.6. technical data.

If a technical problem should arise, please contact your local sales outlet or agent or one of the communication addresses to be found in main menu ? point "`Info`" in order to solve the problem.

Repair or calibration of MMS 6000 monitors is only possible in the workshop at **epro**. Opening the module (removing the sandwich board) and exchange of EPROMs by the customer are not allowed without expressed permission by **epro** and lead to the loss of the warranty. The sandwichboard is calibrated on the main board and must not be changed.

If repair or recalibration of an MMS 6000 monitor is required, it must be sent to **epro**.

Provide the monitor with an undetachable label containing the name of the customer, the complaint and the version of the MMS 6910 configuration software.

Address: **epro** Elektronik und Systemtechnik
Warenannahme Reparatur
Jöbkesweg 3

D-48599 Gronau

6. TECHNICAL DATA

Only specifications with tolerances are guaranteed. Data without tolerances or without error limits are only for information purposes and are not guaranteed. Technical changes, especially of the software, are subject to alterations.

If not stated otherwise, the specifications in the following chapter are valid for channel 1 and channel 2.

6.1 Signal conditioning

Two separate signal inputs for channel 1 and channel 2 with the signal conditioning decoupled from each other.

Signal inputs

Differential inputs, non-reactive, open-circuit and short-circuit proof.

channel 1	z8: SENS1H (+); z10: SENS1L (- Signal)
channel 2	d8: SENS2H (+); d10: SENS2L (- Signal)
Nominal input signal range	-1,0...-22,16 V
Limit range	0...-30 V DC
Input resistance	> 100 kΩ

Sensor signal outputs

SMB front sockets, decoupled, open-circuit and short-circuit proof, non-reactive

channel 1 - SENS 1	SMB K1
channel 2 - SENS 2	SMB K2
Signal output	-1...-24 V; signal 1:1 to sensor input signal
Accuracy	±1 % of f.s.d.
Frequency range	0...16 kHz (-3dB) ±20 %
permissible load	>100 kΩ
Internal resistance	1 kΩ

Dynamic outputs

The dynamic part of the sensor signal is output as scaled value.

channel 1 - AC1/channel 2 - AC2	z14 / z16 open-circuit and short-circuit proof, non-reactive
Nominal range	0...20 V pp
Measuring range	according to the measuring range configured for the characteristical value, min. 400 mVpp, max. 8000 mVpp
Accuracy	±1 % of f.s.d.
Frequency range	0,1 Hz...16 kHz (-3dB), ±20 %
permissible load	>10 kΩ

Internal resistance	appr. 20 Ω

Scaled d.c. outputs

The DC part of the sensor signal is proportional to the distance between sensor and measuring target and is output as standard dc signal NGL (see section 4.2.4).

channel 1 - NGL1 / channel 2 - NGL2	z12 / d12 open-circuit and short-circuit proof, non-reactive
Nominal range	0...+10 V DC
Measuring range	according to the sensor‘s operating range
	0V corresponds to the lower limit of the operating range
	+10V corresponds to the upper limit of the operating range
Accuracy / resolution	±1 % of f.s.d. / 12 Bit
Permissible load	> 10 kΩ
Internal resistance	appr. 50 Ω

Signal conditioning for characteristical values

Before converting from analog to digital, the input signals are scaled and filtered by matching amplifier, range amplifier, high-pass and low-pass filter.

Range setting	determined during configuration
minimum measuring range	400 mV pp
maximum measuring range	8000 mV pp
Frequency range	
High pass filter	2 pole Butterworth - characteristic
- configurable	fu 0,5 Hz (-3dB) for operating frequency 1 Hz
	fu 2 Hz (-3dB) for operating frequency 5 Hz
- tolerance	± 20 %
Low pass filter	5 pole Butterworth-characteristic
	Parameter range 50 Hz...2000 Hz in steps of 0.01 Hz
Calculation of characteristical values	depending on configuration
Dual channel mode	S1 and S2 separate values in 0-p or p-p – evaluation
Maximum amplitude S_{max} according to DIN 45670 variable A	$S_{max} = \max sk(t);\ sk(t) = \sqrt{s1^2(t) + s2^2(t)}$
Maximum amplitude S_{ppm} according to DIN 45670 variable B	$S_{ppm} = (S_{pp}1, S_{pp}2)$ Max
Or max (X,Y) acc. to API 670	$S_{ppm} = \text{Max}\ (s_{p\text{-}p}1 \text{ or } s_{p\text{-}p}2)$

Current outputs of characteristical values

Calculation of characteristical values and evaluation depend on the functions defined during the configuration.

Current output 1 - I1+ /I1-	z18 / b18 (0 V / common)
Current output 2 - I2+ / I2-	z20 / b20 (0 V / common)
Nominal range	0...20 mA or 4...20 mA, depending on configuration
- Life zero-mode	During configuration the definition is made for the 4...20mA range, that in case of an error the output will be set to 0mA.
Accuracy / resolution	±1 % of f.s.d / 16 Bit
Permissible load	500 Ω

Signal outputs EO 1 / EO 2

d14 / d16

Voltage output O...10V. In the dual channel mode the current outputs are assigned to the relevant characteristical value. For the operating modes S_{max} and S_{PPmax} outputs of single channel values. Measuring range and evaluation corresponds to the characteristical values.

Depending on application and configuration the outputs EO may be used for combination with other values or for indications.

open-circuit and short-circuit proof, non-reactive.

Nominal range	0...+10 V DC
resolution	8 Bit
permissible load	> 10 kΩ
Internal resistance	appr. 50 Ω

Signal inputs EI1 / EI2

Inputs for single channel values 0...+10 V for connection to EO-outputs.

Voltage input EI1 / EI2	b14 / b16
Nominal voltage range	0...+10 Vdc
Resolution	10 Bit
Input resistance	> 100 kΩ

Signal input KEY

The key pulse is required to control the internal measuring procedure for the signal analysis.

Signal input KEY (N)	d22
Signal level	24 V Logic,: 0...3V = LOW; 13...48V = HIGH
Input resistance	> 10 KΩ

6.2 Channel supervision

Monitoring function	
Continuous monitoring	
Sensor signals	GOOD-range (depending on configuration)
GOOD thresholds	
- lower thresholds	Operating range of sensor lower limit -0,5 V
- upper threshold	Operating range of sensor upper limit + 0.5V
System voltages	Supply voltage - OK
µP function (watchdog)	WD – OK
Configuration & parameter setting	K&P – OK
External blocking	ES
Status channel supervision	
Channel status = no error (OK)	if (voltage_OK = yes) AND (WD_OK = yes) AND (K&P_OK = yes) AND (Sensor signal in the good range) AND (External blocking = off)
Channel status = error	If previous condition is not fulfilled
Channel status = enable delay	at switching to the ok state in case of an error or in the moment of power on, an enable delay of 15 s (±2 s) will be active.

Visualization

Green LED at the monitor front	
Channel state = no error (OK)	steady light
Channel state = error	dark
Channel state = enable delay	flashing (see section 4.5.5)

Outputs Channel Clear

opto-decoupled collector / emitter - lines	
Channel Clear channel 1, C1C / C1E	z26 (collector) / z28 (emitter)
Channel Clear channel 2, C2C / C2E	z30 (collector) / z32 (emitter)
Ext. blocked or status = error or enable delay	C-E switched off, max. voltage: 48 V
not ext. blocked and status = OK and no enable delay	C-E conducting, max. current: 100 mA

Input external blocking ES

z22 – for locking the alarm limit watching; e.g. during maintenance etc.

Function locking	Input LOW = limit watching and alarm output blocked
Enable	Input HIGH or open = limit watching and alarm output not blocked
Signal level	LOW: 0...+3 V, HIGH: +13...+48 V

6.3 Limit watching and alarms

Two alarm channels each of them with alarm outputs ALERT and DANGER and separate limit setting. Alarm output if the characteristical value exceeds the programmed limit. (Set value > limit value)

Limit setting

During configuration, depending on the parameters for measuring mode, calculation of characteristical values, measuring range etc..

Adjustment condition	Limit value ALERT < Limit value DANGER
Adjustment range	5...100 % of the configured measuring range
Resolution and reproducibility	1 % related to f.s.d.
Hysteresis	Configurable to 1...20 % related to f.s.d
	The hysteresis is only effective at decreasing measuring values.

Response delay

configurable to 1,2,3,4,5 sec.; effective on the alarm outputs.

Alarm blocking

Blocking (see section 6.2)	if (K&P active = yes)	OR
	(Voltage or watchdog not ok)	OR
	(Ext. blocking = blocking)	OR
	(channel status = error and limit suppresion on*)	OR
	(Channel status = enable delayed)	
No blocking	If the condition above is not met	

* During the configuration it can be determined whether the alarm outputs shall be disabled by the channel supervision.

Alarmvisualization

By means of two red LEDs for channel 1 and channel 2

No limit exceeded or alarms blocked	LED off
Pre alarm (ALERT), no main alarm	LED flashes with 2 Hz (duty cycle 50%)

Main alarm (DANGER)	LED switched on (steady light)

Alarm outputs

Opto - decoupled collector / emitter – lines

Pre alarm channel 1 1 A1-C / A1-E	b26 (collector) / b28 (emitter)
Main alarm channel 1 D1-C / D1-E	d26 (collector) / d28 (emitter)
Pre alarm channel 2 A2-C / A2-E	b30 (collector) / b32 (emitter)
Main alarm channel 2 D2-C / D2-E	d30 (collector) / d32 (emitter)
Maximum values for alarm outputs	C-E off: max. voltage U_{CE}: 48 V
	C-E conducting: max. current I_{CE}: 100 mA
Alarm state of alarm outputs	Conducting in the open circuit mode, switched off in the closed circut mode

Open circuit / closed circuit mode

Selectable by means of external signal inversion at digital inputs SC-A and SC-D

At **MMS 6110 C** modules only closed-circuit mode, no switchover to open circuit mode possible.

Switch over ALERT	d24 - SC-A = HIGH / open = open circuit mode
	d24 - SC-A = LOW = closed circuit mode
Switch over DANGER	z24 - SC-D = HIGH / open = open circuit mode
	z24 - SC-D = LOW = closed circuit mode
Switching level	LOW = 0...+3 V HIGH = 13...48 V
Input resistance	> 10 kΩ

6.4 Communication interfaces

RS 232 Interface

Front socket for connection of a laptop for configuration and visualization

Mini socket at the module front	Mini-DIN-socket type TM 0508A/6 for configuration cable (order no.: 5700-00003, part of operating kit)

RS 485 Interface

d4, z4 Bus interface for communication with the epro analysis and Diagnosis system MMS 6850

6.5 Power supply

The system supply voltages with their grounds, the signal inputs and supervision inputs / outputs are galvanically isolated from each other.

Supply inputs	two redundant inputs, decoupled via diodes, for nominal +24 V with common ground.
Voltage input UB+ / UN+	d2 / z2
Common ground, 0 V U-	b2
permissible voltage range	18...31,2 V dc according to IEC 654-2 class DC 4
Power consumption	max 6 W, at 24 V max. 250 mA

Module system supply

The module system voltages required for the internal supply are permanently checked on low voltage. If "Low voltage" is detected, an error message will be detected (see section 6.2 -- channel supervision).

Sensor supply

for both channels of the module.

Isolation	decoupled and galvanically isolated to the other system voltages and to the supply voltage.
	to be used non-reactively in parallel with other modules
	open-circuit and short-circuit proof
Sensor supply channel 1	SENS1- /SENS1+ b6/z6
Sensor supply channel 2	SENS2- / SENS2+ b8/d6
Sensor supply voltage	26,75 V DC; tolerance ± 2%
Residual ripple	< 20 mVpp (at nominal current 20 mA)
max. current	35 mA
max. short circuit current	0 mA ≤ Ishort ≤ 5 mA;
	open-circuit and short-circuit proof

6.6 Environmental conditions

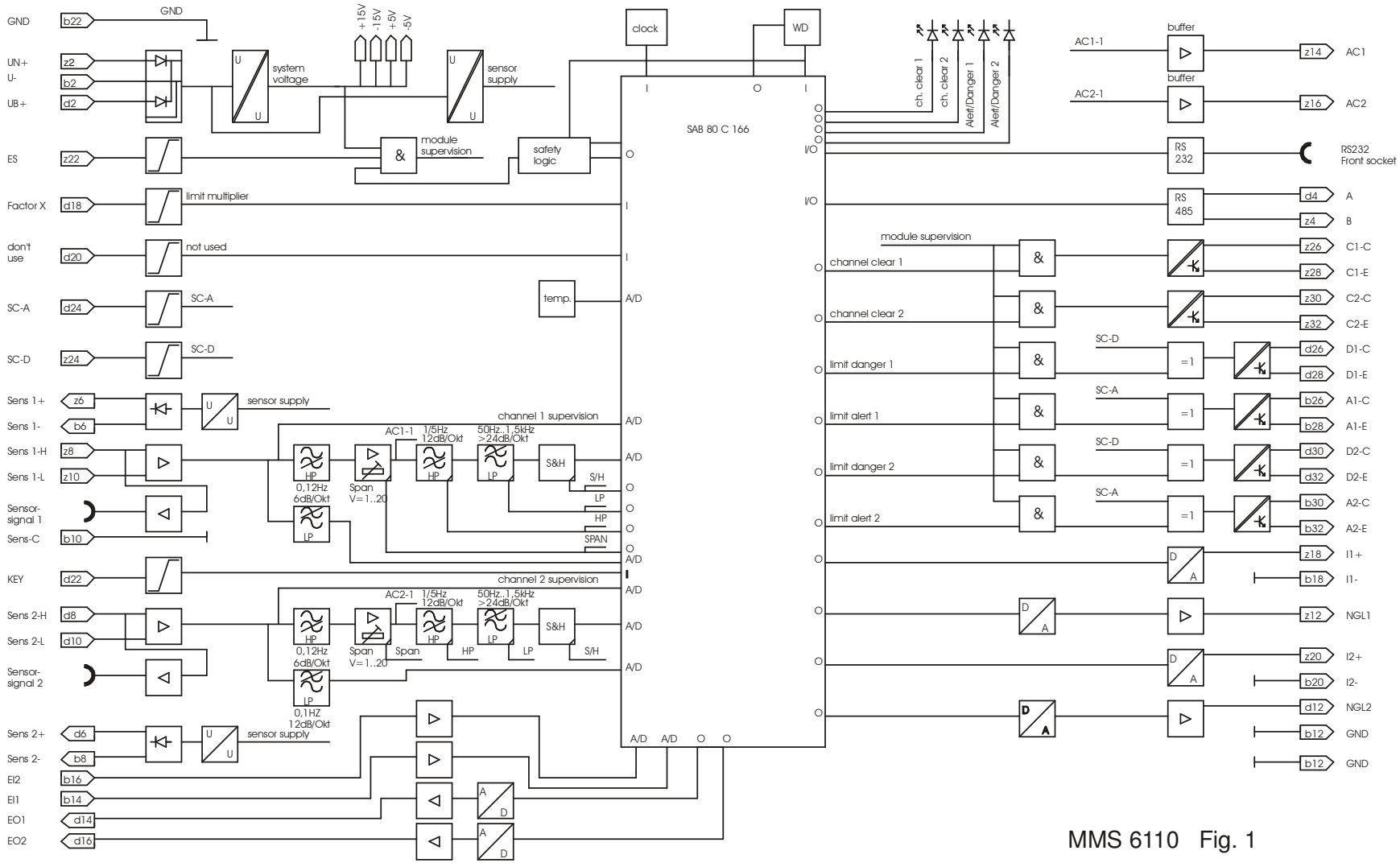
Application class	KTF according to DIN 40 040
Environmental temperature	
Reference temperature	+25 °C
Nominal operating range	0...+65 °C
Storage-, transport temperature	-30... +85 °C
Relative humidity	5...95 % non-condensing
Vibration	According to IEC-68 - 2 part 6
Amplitude	0.15 mm at 10...55 Hz
Acceleration	19,6 mm/s^2 at 55...150 Hz

Shock	According to IEC-68 - 2 part 29 Peak value acceleration 98 m/s^2 Nominal duration shock 16 ms
Protection class	IP 00, open construction according to DIN 40 050
Electromagnetic compatibility	According to EN 50 081-1 / EN 50 082-2 fulfilled

6.7 Mechanical Design

Printed circuit board	Euro-format (100 mm x 160 mm) according to DIN 41 494
Width	6 TE (appr. 30 mm)
Connector	DIN 41 612, type F 48 M
Front elements	
2 LEDs green	Channel Clear channel 1 / 2
2 LEDs red	Alarms channels 1 / 2
2 SMB connectors	for sensor signal channels 1 / 2
1 Mini-DIN socket	RS 232 interface for connection of a laptop (configuration and visualization)
Weight	appr. 320 g (without packing) appr. 450 g with standard packing

Fig. 1: Block diagram



MMS 6110 Fig. 1

Block diagram

Blockschaltbild

6140-00002 971201

WSCAD\MMS6110.001

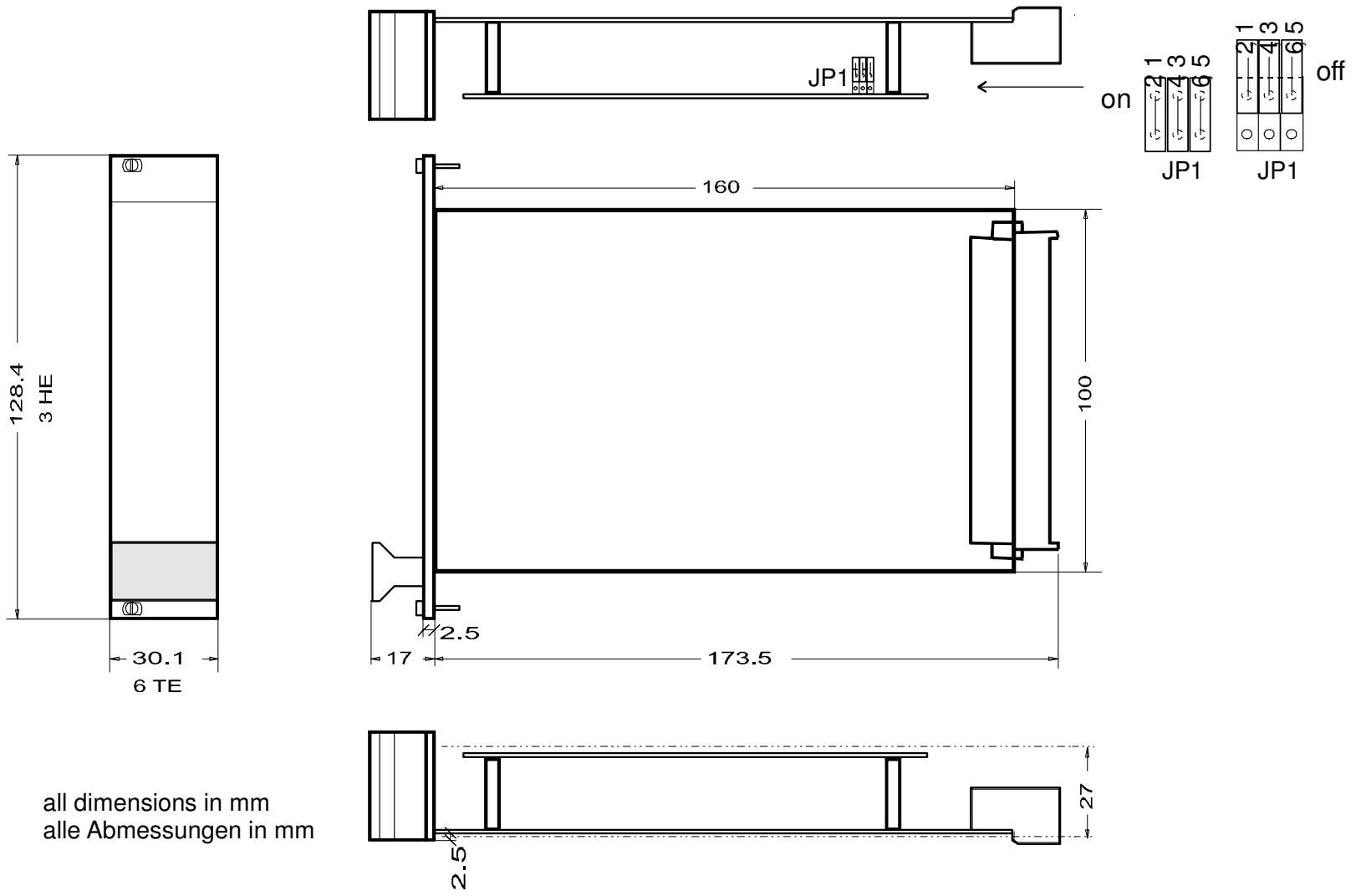
	d	b	z		d	b	z
2	o	o	o	2	+UB Supply + 24V	U- 0V Common Supply	Un+ Redu.Supply +24V
4	o	o	o	4	A RS 485 Interface	Common	B RS 485 Interface
6	o	o	o	6	SENS2+ Supply+ Sens 2	SENS1- Supply- Sens 1	SENS1+ Supply+ Sens1
8	o	o	o	8	SENS2-H Input Hi Sens2	SENS2- Supply- Sens 2	SENS1-H Input Hi Sens1
10	o	o	o	10	SENS2-L Input Lo Sens2	SENS-C Screen / Common	SENS1-L Input Lo Sens1
12	o	o	o	12	NGL2 Stat. Displ. V Ch2	GND Common	NGL1 Stat.Displ.V Ch1
14	o	o	o	14	EO1 0...+10V outp Ch1	EI1 0...+10V inp Ch1	AC1 Dyn. V outp Ch1
16	o	o	o	16	EO2 0...+10V outp Ch2	EL2 0...+10V inp Ch2	AC2 Dyn. V outp Ch2
18	o	o	o	18	FX Limitmultipl. Factor X	I1- Iout1- / Common	I1+ Iout 0/4..20mA Ch1
20	o	o	o	20	F2 don´t use	I2- Iout2- / Common	I2+ Iout 0/4..20mA Ch2
22	o	o	o	22	KEY (N) Key pulse input	GND Common	ES Alarm Stop
24	o	o	o	24	SC-A Current Mode Alert	GND Common	SC-D Current Mode Danger
26	o	o	o	26	D1-C Danger1 out Col	A1-C Alert1 out Col	C1-C Chan Clear1 out Col
28	o	o	o	28	D1-E Danger1 out Emit	A1-E Alert1 out Emit	C1-E Chan Clear1 out Em
30	o	o	o	30	D2-C Danger2 out Col	A2-C Alert2 out Col	C2-C Chan Clear2 out Col
32	o	o	o	32	D2-E Danger2 out Emit	A2-E Alert2 out Emit	C2-E Chan Clear2 out Em

MMS 6110 Fig. 2

Pin Allocation

Steckerbelegung

Fig. 2: Pin allocation



all dimensions in mm
alle Abmessungen in mm

Module MMS 6110, 6120, 6130, 6210, 6220, 6410 Fig. 3

Dimensions

Abmessungen

COREL3\MMS6000\6110DIMS.CDR

980629

Fig. 3: Dimensions

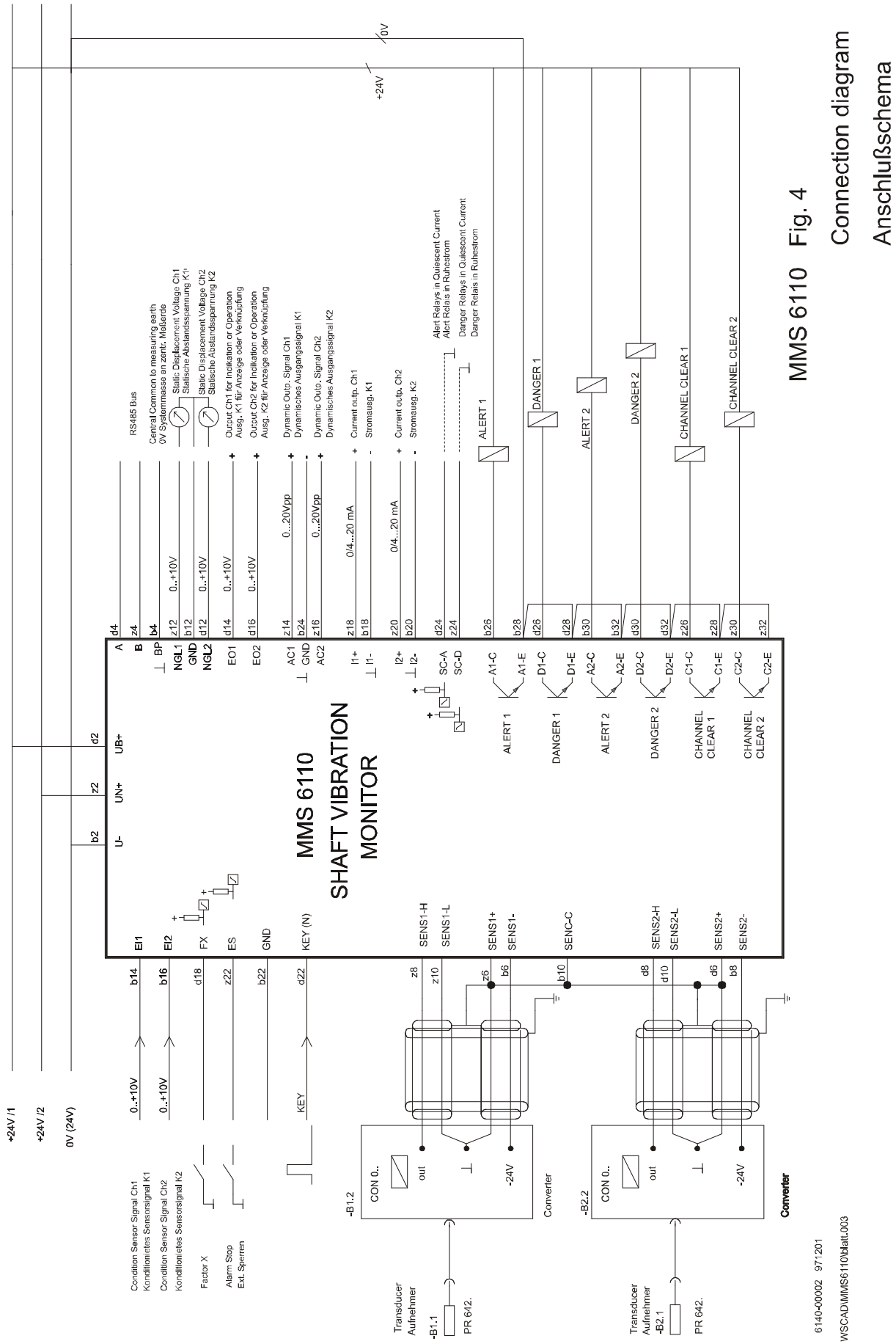


Fig. 4: Connection diagram