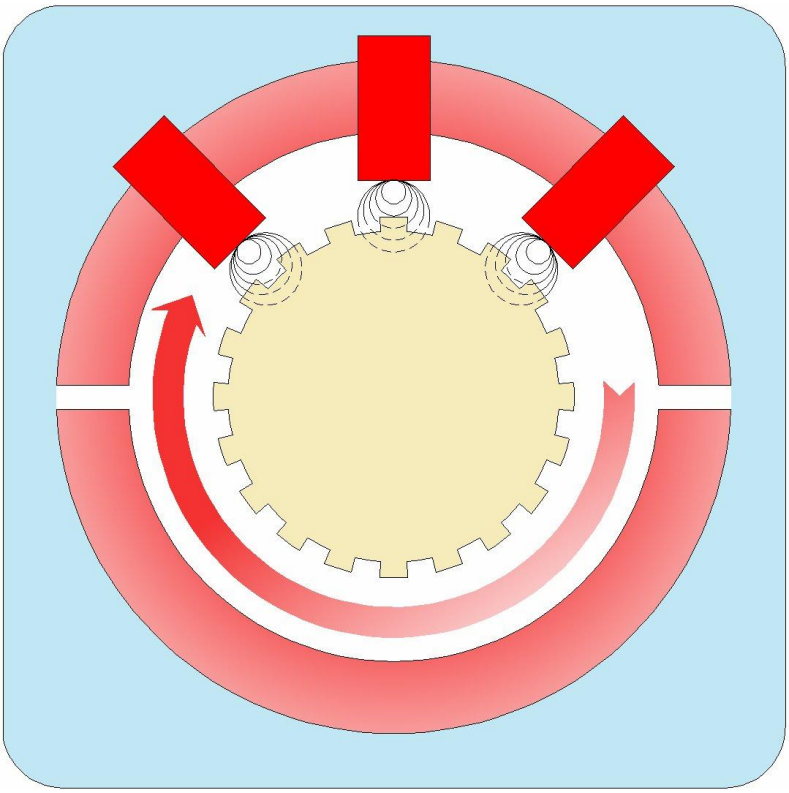
DOPS
Digital Overspeed – Protection System



- **Microcontroler based measuring system**
- **Up to 6 limit values per channel, different operating modes depending on installed back plane**
- **Two current outputs per channel with zoom function and dual current function, one of them galvanically isolated**
- **Mutual comparison of pulses and output signals between all channels**
- **Redundant power supply**
- **Self-test functions for electronic circuits and transducers**
- **Simplified fault detection by display messages in plaintext**
- **Galvanical isolation of binary input and output signals**
- **Wiring by means of preformed cables and converters in the control cubicle**
- **RS 232 interface for parameter setting**
- **RS 485 interface for data exchange with the epro MMS 6850 analysis and diagnosis system**
- **Hot swap of boards during operation**

Short description:

The speed measurement and protection system **DOPS** serves measurement of and protection against inadmissible overspeeds at any kind of rotating machinery.
With the consistent three channel construction, starting with the signal detection via signal processing up to the evaluation of the measured speed, the system offers the maximum safety for the machines to be monitored.
Safety relevant limits (e.g. overspeed limit values), are combined in a 2 out of 3 logic and operate in the closed circuit mode. Thus it can be ensured that beside operational safety, the protection function on a high level standard is met as well.

With a suitable sensor arrangement at the trigger wheel of the machine it is possible to detect the direction of rotation.
The integrated peak value memory permits reading out the maximum speed value that has occurred before the machine was switched off. This function provides important information for evaluating the mechanical machine load caused by the overspeed.
Alarm outputs and error messages are output via potential-free optocoupler outputs. Beside this, the alarm outputs, combined in a 2 out of 3 logic, as well as message line and channel clear line of the channel supervision, are output via potential-free relay contacts.

The system includes an extended fault detection function. The three speed sensors are continuously checked on operating within the permitted limits. Moreover, the channels mutually check and supervise the output signals of each other. If the internal fault detection circuit detects an error, this will be indicated via the output contacts and shown on the display as plaintext.
By using preformed connection cables and screw terminals, the system may be integrated economically in a 19“ cabinet.

epro

Technical data:

Signal inputs:

Differential input, nonreactive, open-circuit and short-circuit proof

Input voltage range:
0...27,3 V DC

Limit range:
0...30 V

Input resistance:
> 100 kOhm

Sensor signal outputs:
SMB front sockets, buffered, open-circuit and short-circuit proof, non-reactive

Signal output:
0...4,1 V; output = 0.15 x sensor signal

Accuracy:
±1% of f.s.d

Frequency range:
0...16 kHz (-3dB) ±20%

Permissible load:
> 1 MOhm

Internal resistance:
10 kOhm

Dynamic outputs:

TTL – output:
The prepared input pulses are output as TTL – pulses.

TTL – Pulse:
open circuit and short-circuit proof, nonreactive

Nominal range:
0...5 V_{SS}

Frequency range:
0Hz...20 kHz

Permissible load:
> 1 MOhm

Internal resistance:
5,1 kOhm

Pulse outputs:
The prepared input pulses are output via potential-free opto couplers

Max. voltage:
+24 V at UC, +48 V at the collector

Max. current, C-E conducting:
100 mA

Signal conditioning for characteristical values:

Before processing, the input signals are standardized by the processor. The characteristical value is proportional to the speed, i.e. to the input pulse frequency divided by the number of teeth of the trigger wheel.

Max. measuring range:
limited by the max. signal frequency of 20 kHz at the input

Max. speed:
65.535 rpm (limited to max. 18 teeth at the trigger wheel by the max. input frequency of 20 kHz)

Max. number of teeth at the trigger wheel
255 (max. 4700 rpm)

Current outputs of characteristical values:
Calculation of characteristical values and evaluation depend on the functions defined during the configuration

Current output 1:
0/4...20 mA galvanically isolated

Accuracy:
±0.1% of f.s.d. /16 bits

Current output 2:
0/4...20 mA galvanically not isolated, with feed back of the output signal for comparison of analog results

Accuracy:
±0.1% of f.s.d. /16 bits

Speed zoom:
One speed zoom per current output, accuracy 0,1% of f.s.d. /16 bit

Channel supervision and visualization:
Each channel does not only check the signal of the accompanying speed sensor continuously, but also compares pulses and current outputs of the other two channels with those of the own channel.
Thus a maximum in safety can be ensured. Faults are indicated with two green LEDs at the monitor front. Signalling of the channel supervision is carried out via opto-decoupled collector /emitter lines.

Status = fault:
Umax. = 48 V DC

Status = o.k.:
Imax. = 100 mA

Binary inputs:
The binary inputs of the module are galvanically isolated, but however, have a common GND.

Signal level:
Low: 0...+3 V
High: +13...+48 V

External blocking:
To disable the function-/ alarm outputs, e.g. for service and maintenance works etc.

Reset Latch:
To reset the latch function of function and alarm outputs

Test input:
For testing the monitoring functions with an internally generated test value

Binary outputs:

Altogether six function outputs with separate function or limit setting. The functions of the binary outputs as well as the switching characteristics are defined during configuration.

Limit setting:
by parameter setting, depending on the assigned function.

Visualization of the condition:
With a red LED for each of the function-/ alarm outputs.

Limit data for binary outputs:
Output 1 -3
C - E open:
max. U_{CE} 48 V
C - E conducting:
max. I_{CE} 50 mA
Output 4 –6
C - E open:
max. U_{CE} 48 V
C - E conducting:
max. I_{CE} 100 mA

Communication interface

RS 232:
Front socket to connect a laptop for configuration and visualization

RS 485:
Bus interface for communication with the epro MMS 6850 analysis and Diagnosis system via the MMS 6831 interface card.

Power supply:

Two redundant inputs, decoupled via diodes, for nominal +24 V with common ground

Permissible voltage range:
18...31,2 V DC according to IEC 654-2 class DC 4

Sensor supply:
Decoupled and galvanically isolated to the system voltages and to the supply voltage. Open circuit and short-circuit proof.

Technical data:

Supply voltage:
26.75 V dc
Residual ripple:
< 20 mVpp (at nominal current 20 mA)
Max. current:
35 mA

Environmental conditions:

Application class:
KTF according to DIN 40 040
Reference temperature:
+25°C
Nominal operating range:
0...+65°C
Temperature for storage and transport
-30...+85°C
Rel. humidity 5...95% non-condensing
Protection class:
IP 00, open construction according to DIN 40050
EMC
according to EN 50 081-1 / EN 50 082-2 fulfilled

Mechanical design of the printed circuit board:

Euro-format (100 x160 mm) according to DIN 41 494
Width:
with display 14 TE (approx. 71 mm)
without display 6 TE (approx. 30 mm)
Connector:
DIN 41 612, type F 48 M
Dimension of the total system:
DOPS
42 TE (approx. 213 mm)
DOPS AS
42 TE (approx. 213 mm)

Measuring modes:

The speed measurements are based on time measurements between pulses generated by the trigger wheel. There are two different measuring modes:

1. **n Measurements per revolution**
With this measuring mode the incoming pulses from the pulse wheel are measured within a variable time window of 5...10 ms and the speed calculated from the result of these measurements. Thus the measuring time with this mode is between 5...10 ms.
Since at this measuring mode the result directly depends on the precision of the trigger wheel, it is essential to use precisely manufactured trigger wheels to get exact measuring results.

2. **One measurement per revolution**
The time for one revolution of the machine shaft is measured and from the result of this measurement the speed value is calculated.
The measuring time for this mode depends on the actual speed, e.g. 20 ms at 3000 rpm. The higher the speed of the machine, the shorter the measuring time.
This measuring mode is particularly suitable to measure the speed very exactly since mechanical influences caused by differences between the teeth of the pulse wheel are eliminated over a complete shaft revolution.

Programmable measuring parameters:

- Measuring range
- Speed zoom
- Gear transmission ratio
- Analog difference
- Number of trigger wheel teeth
- Warning and alarm limits
- Principle of action
- Alarm functions
- Test value 1
- Test value 2
- Hysteresis
- Channel identification by means of KKS numbers or freely selectable designations
- Current outputs
- Current calibration
- Current suppression
- Current smoothing
- Duty cycle
- Stand still detection
- Gap limit
- Trigger levels
- Channel clear limits
- Preferred direction of rotation
- Measuring mode
- Peak value latch
- Pulse comparison

Different system configurations:

DOPS

- 3 x MMS 6350/D (incl. firmware application no. 0)
- 1 x MMS 6351/00
- 1 x MMS 6352
- 6 x MMS 6361
- 6 x MMS 6360
- 1 MMS 6950 W alternatively
- 3 x MMS 6350 (incl. firmware application no. 0)

DOPS AS

- 3 x MMS 6350 (incl. firmware application no. 2)
- 1 x MMS 6351/10
- 1 x MMS 6352
- 6 x MMS 6361
- 6 x MMS 6360
- 1 MMS 6950 W alternatively
- 3 x MMS 6350/D (incl. firmware application no. 2)

DOPS TS

Replacement of Turloop speed measurement system in the Turloop frame

- 3 x MMS 6350 (incl. firmware application no. 1)
- 3 x MMS 6353/TS
- 1 x MMS 6950 W

With this replacement version not all functions of DOPS or DOPS AS are at disposal. However, all functions and specifications of the Turloop system are fulfilled.

Principle circuit diagram of DOPS with back plane MMS 6351/00

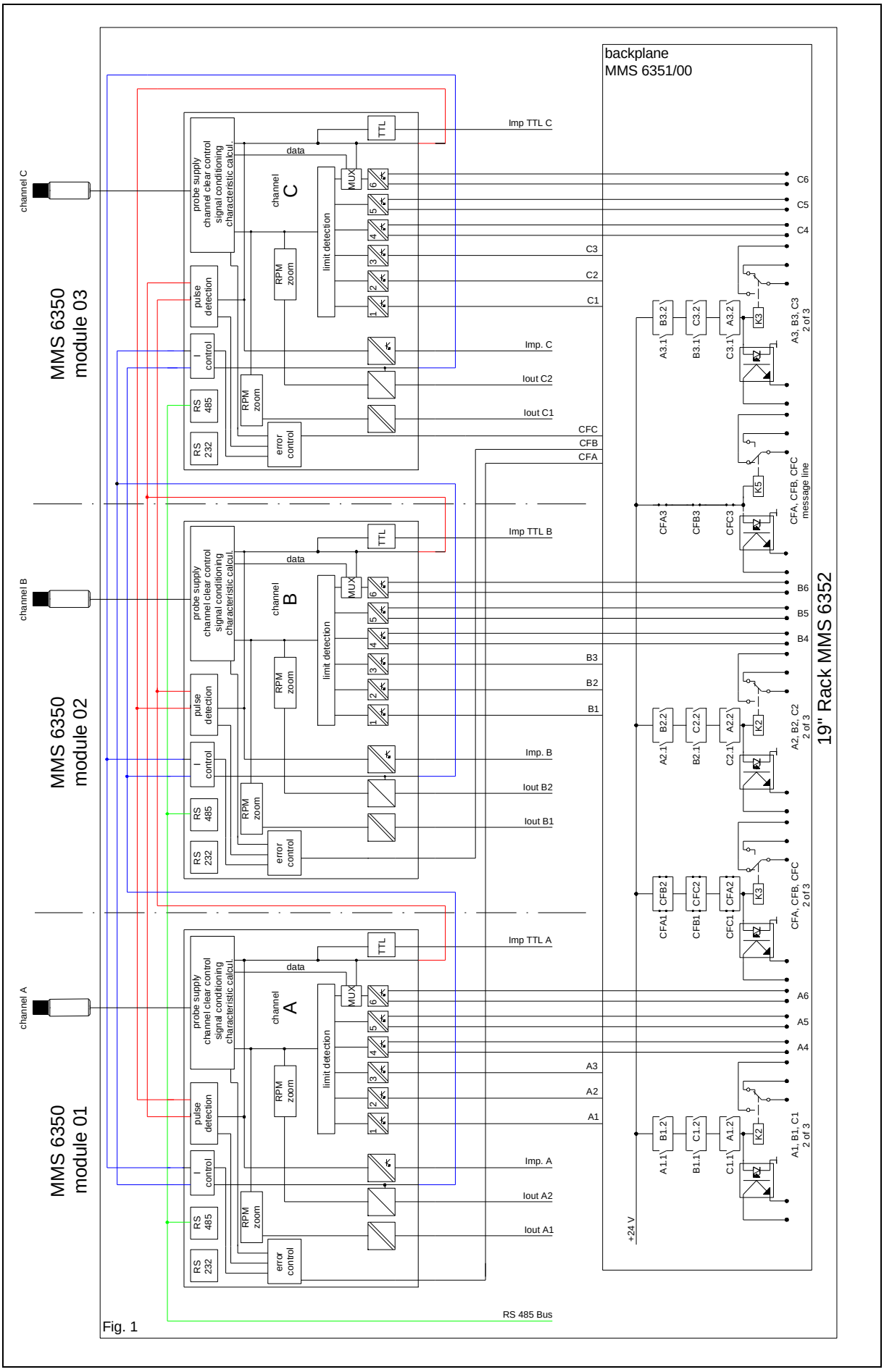


Fig. 1

Principle circuit diagram DOPS AS with back plane MMS 6351/10:

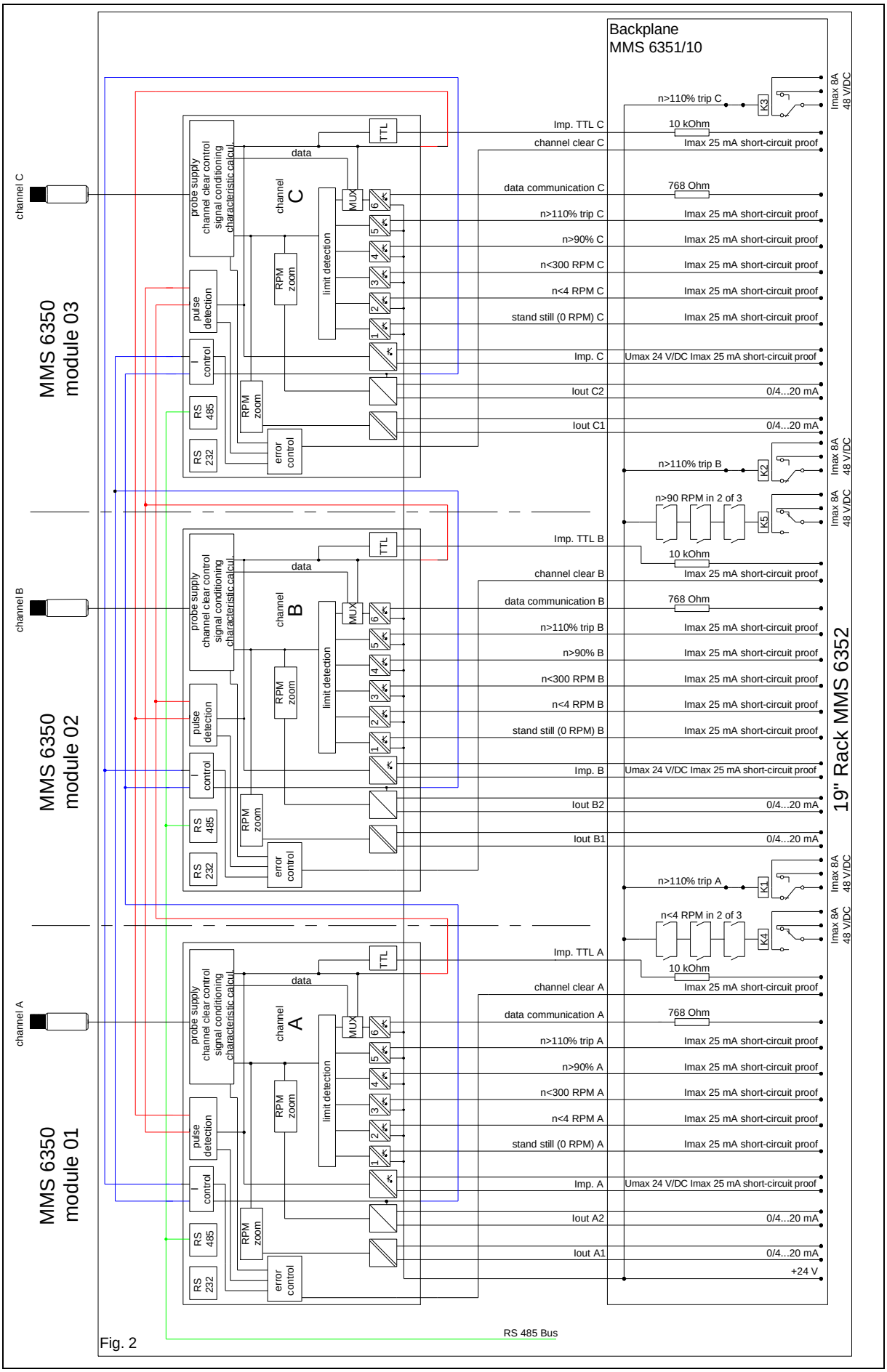


Fig. 2

Limit value-/ function supervision

The **MMS 6350** module provides altogether 6 so-called function outputs. These function outputs may be used as alarm outputs as well as for indication of individual measuring states. Moreover, the sixth function output offers the possibility to provide a digital signal for an external digital speed indicator or to output speed pulses.
The following functions can be assigned to function outputs 1 to 5:
Aus

- > Limit
- < Limit
- > LIMIT + Latch
- < LIMIT + Latch
- Standstill
- Direction of rotation
- Dual current Out 1
- Dual current Out 2
- Pulse comparison

Beside this, function output 6 includes the following functions:

- Ext. display
- Pulse output

Description of the function outputs:

> LIMIT
Speed limit, the output switches at exceeding the limit value. The output will be reset to its initial state after the measuring value has fallen below the limit value minus hysteresis value.

< LIMIT
Speed limit, the output switches at falling below the limit value. The output will be reset to its initial state after the measuring value has exceeded the limit value plus hysteresis value.

> LIMIT + Latch
same as > LIMIT but with latching function

< LIMIT + Latch
same as < LIMIT but with latching function

Standstill
standstill of the machine is indicated via the function output

Direction of rotation
the function output shows the machine's direction of rotation

Dual current Out 1
if current output 1 is operated as dual current output, the function output indicates the switching over from the lower to the upper current range.

Dual current Out 2
if current output 2 is operated as dual current output, the function output indicates the switching over from the lower to the upper current range.

Pulse comparison
in case of differences between the pulse outputs, this will be indicated via this function output.

Ext. Display
(Only function output 6)
If this function has been chosen, an external display to indicate the speed value may be connected to this output

Pulse output
(Only function output 6)
If this function has been activated, digital pulses can be transmitted to an external system. The pulses of the trigger wheel are prepared, buffered and transmitted via this output. Each pulse at the signal input effects the output of one pulse at this output.

When using the DOPS AS system with the MMS 6351/10 backplane, the 768 ohm resistors must be bridged by using solder jumpers (see fig. 2).

Dual current function:

On activating this function, a selectable range, e.g. 0...300 rpm (see fig. 3) is output as current range 0/4...20 mA.
When exceeding the limit of 300 rpm, the module switches over and will then output the complete measuring range as current range 0/4...20 mA.
The switching between the two current ranges is indicated via the relevant function output.

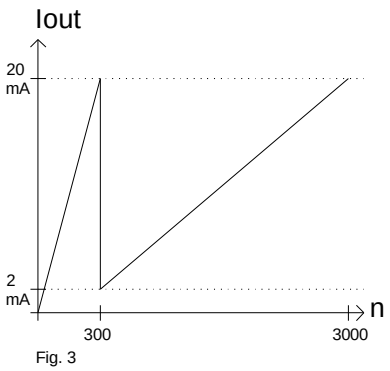


Fig. 3

Speed zoom function:

By means of this function, a certain speed range to be defined with start and end speed can be spread to the current output range 0/4...20 mA.

For the use of this function, the galvanically isolated current output has preferably to be used. When using the other current output, no analog comparison of the channels will be performed below the start value of the zoom range.

Module/transducer supervision:

The internal module supervision comprises the following functions:

- Transducer signal within a predefined good range
- Wiring between sensor and module (interruption, short-circuit of sensor supply)
- System supply voltage within predefined limits
- Measuring values within measuring range
- System watch – dog

During the change from the error to the ok-state and after power-on of the module, all functions of the module are blocked for a delay time of 5s.
Indication of a fault runs, depending on the chosen back plane, via own opto coupler outputs or, however, via the trip limit. See also principle diagrams fig. 1 and fig. 2.

Reasons for module disturbances can be read out in detail via the communication interface or, at modules with a display, directly on the display. This permits the technicians to locate the reason for the fault immediately.

Operating elements at the module front:

One nonreactive sensor signal output via SMB socket:

Range:	0...4,1 V
Load resistance:	≥1 MOhm
Internal resistance:	10 kOhm

One nonreactive pulse output via SMB socket:

Range:	0...5 V
Load resistance:	≥1 MOhm
Internal resistance:	5,1 kOhm

6 yellow LEDs:
One LED for each of the function- limit values

2 green LEDs
LED 1
Channel supervision for the channel assigned to this card
LEDs 2,3
Indication of the state of the two adjacent system channels. If one of the adjacent channels fails, this will be indicated via this LED.

1 Mini DIN diode socket:
RS232 interface for connection of a computer for configuration and data interchange with the module.

Handle:
To pull out and insert the module and for labelling purposes.

Power supply:

Redundant supply input via two supply inputs, decoupled via diodes. At least one supply input is required for the supply of the module.

Supply voltage:
18....24....31.2 V DC according to IEC 654-2, class DC4

Power consumption:
max. 20 W (max. 840 mA at 24 V)

Other supply voltages can be realized with additional system power supplies.

Environmental conditions:

Protection class:
module: IP 00 according to DIN 40050
Front plate:: IP21 according to DIN 40050

Climate conditions:
according to DIN 40040, class KTF
operating temperature range:
0....+65°C

Temperature range for storage and transport:
-30....+85°C

Permissible relative humidity:
5....95%, non condensing

Permissible vibration:
according to IEC 68-2, part 6

Vibration amplitude:
0.15 mm in range 10...55 Hz

Vibration acceleration:
16.6 m/s^2 in range 55...150Hz

Permissible shock:
according to IEC 68-2, part 29
peak value of acceleration:
98 m/s^2
nominal shock duration:
16 ms

EMC resistance:
according to EN50081-1 / EN50082-2

Requirements on configuration PC:

Configuration of modules is made via the RS 232 interface on the module front or via the RS 485 bus by means of a computer (laptop) with the following minimum specifications:

Processor:
486 DX, 33 MHz

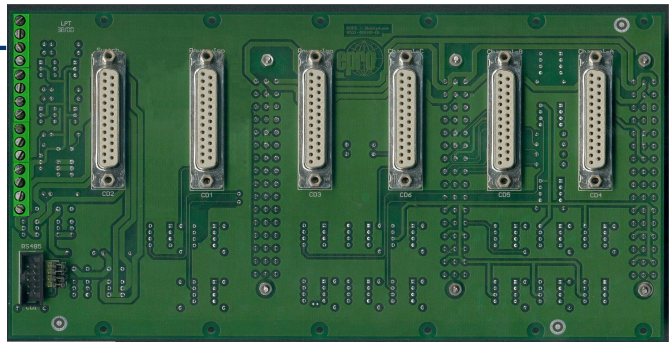
Interfaces:
one free RS 232 interface (COM 1 or COM 2) with FIFO type 156550 UART

Capacity of fixed disk:
min. 5 MB

Required working memory:
min. 620 KB

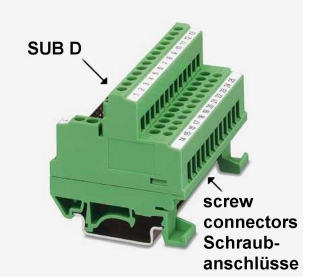
Operating system:
WIN® 95/98 or NT 4.0

Backplane MMS 6351/00:



MMS 6361

Terminal block:



Trigger wheel and mounting angle of sensors:

The more precise the trigger wheel has been fabricated, the more exact the speed measurement can be performed.
A tooth depth of 1 mm has proved to be advantageous when using the PR 6423/.. sensor with a measuring range of ± 1 mm. With this tooth depth a continuous distance supervision of the sensor is possible.
The mounting angles of the sensors should be chosen in such way, that one tooth in each case is placed directly below a sensor, at the second sensor the tooth is just leaving the sensor range and at the third sensor the tooth is just moving into the sensor range.
These settings are important for a correct detection of the signal pulses and the direction of rotation.

As example for this see fig. 4 on the right side.

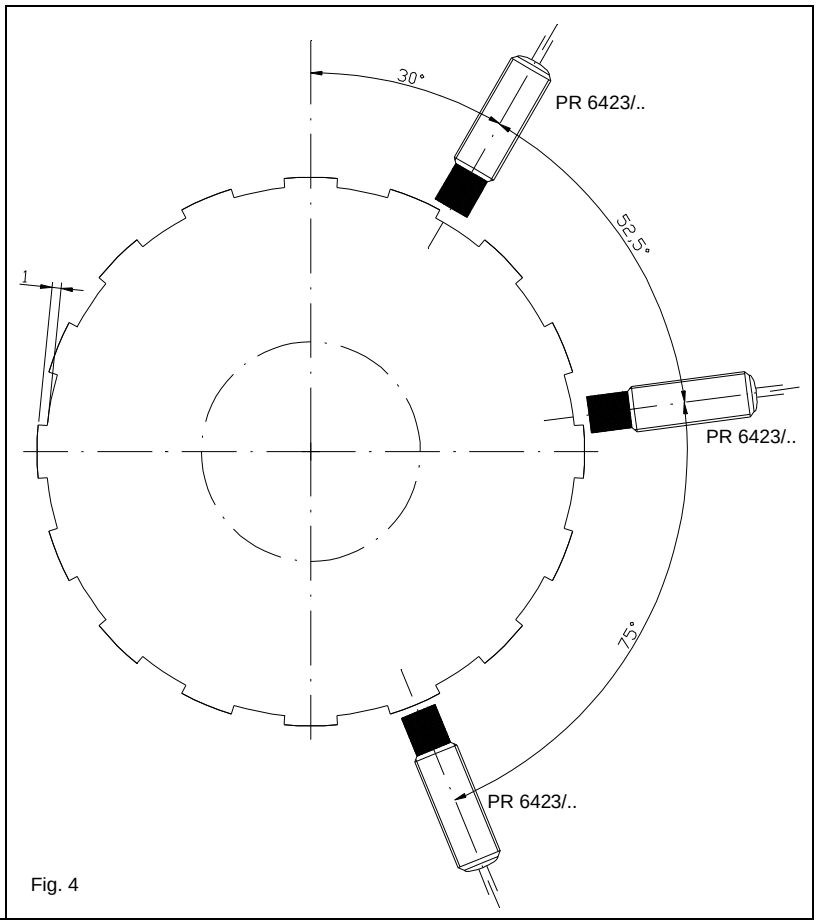


Fig. 4

Order numbers:

MMS 6350	Speed measurement card	**9100 – 00039**
MMS 6350/D	Speed measurement card with digital indicator	**9100 – 00040**
MMS 6351/00	Backplane DOPS	**9100 – 00047**
MMS 6351/10	Backplane AS	**9100 – 00049**
MMS 6352	19“ Mounting rack	**9100 – 00053**
MMS 6353/TS	Adapter card replacement AEG Turloop (MMG 1222)	**9120 – 00001**
MMS 6360	Connection cable 25-pole SUB D	**9510 – 00006**
MMS 6361	Adapter 25 pole SUB D on screw terminals	**9100 – 00052**
MMS 6950 W	Configuration software	**9510 – 00005**

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