Digital Axial Position Protection System with PROFIBUS-DP Interface
DAPS, DAPS AS, DAPS TS

- Microcontroller based 3-channel measuring system
- PROFIBUS-DP Interface (optional)
- High safety level due to password protection at each of the monitors
- Up to 6 limit values per channel
- Two current outputs per channel, one of them electrically isolated
- Analog comparison between the three channels
- Redundant supplies for monitors and backplane
- Self-test functions for electronic circuits and sensors
- Simplified fault detection by display messages in plaintext
- Electrical isolation of binary input and output signals
- RS 232 Interface for input of parameters
- RS 485 interface for data exchange with the host computer
- Hot swap of boards during operation

Application:

The axial-position measuring and protection system DAPS, DAPS AS and DAPS TS serve the measurement and protection of inadmissible high axial displacements of the turbine shaft.

DAPS systems in combination with safety shut-off valves in power plants are suitable to replace older mechanical position control and protection systems.

Due to the consistent triple channel design, beginning with the signal acquisition up to the evaluation of the measured shaft displacement, the operational safety and also the protection function on a high level can be ensured. Alarm outputs and error messages are output as potential-free relay outputs and as short-circuit proof binary 24 V outputs. Beside this the alarm outputs are also available as potential free relay contacts in 2-out-of-3 logic.

The system includes an extended fault detection function. The three 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 function detects an error, this will be indicated via the output contacts and shown on the display as plaintext.

By using prefabricated connection cables and screw terminals, the systems may be integrated economically in 19" cabinets.
System lines of the DAPS system:

For the measurement of shaft displacements and the protection against inadmissible high displacements of the turbine shaft, epro offers three different DAPS lines.

**System DAPS**

This system offers a maximum in functionality, it requires the following components:

- 3 x Monitor MMS 6250
  (incl. firmware appl. no. 0) *alternatively*
- 3 x Monitor MMS 6250D (/DP)
  with display,
  (incl. firmware appl. no. 0)
  Profibus-interface (option)

Additionally:

- 1 x Backplane MMS 6351/00
- 1 x 19" Frame MMS 6352
- 6 x Screw terminal MMS 6361
- 6 x Cable 0.5 m MMS 6362
  *alternatively*
  Cable 3 m MMS 6360
- 1 x Configuration kit MMS 6950
- 3 x Blind plate BLE 008,
  required for the installation of monitors without display

When using this system line, there are additional relay outputs available as logical combinations of the normal function outputs OUT1,...,OUT6 and of the system supervision Channel Clear.

2 v 3 combination output OUT1
2 v 3 combination output OUT2
2 v 3 combination output OUT3
2 v 3 combination output OUT4
2 v 3 combination output OUT5 (TRIP + CC) Channel A
OUT5 (TRIP + CC) Channel B
OUT5 (TRIP + CC) Channel C

**System DAPS AS**

This system line offers a special functionality for Alstom applications. It requires the following components:

- 3 x Monitor MMS 6250 (/DP)
  (incl. firmware appl. no. 2) *alternatively*
- 3 x Monitor MMS 6250D (/DP)
  with display
  (incl. firmware appl. no. 2)
  Profibus-interface (option)

Additionally:

- 1 x Backplane MMS 6351/10
- 1 x 19" Frame MMS 6352

When using this system line, there are additional relay outputs available as logical combinations of the normal function outputs OUT1,...,OUT6 and of the system supervision Channel Clear.

2 v 3 combination output OUT1
2 v 3 combination output OUT2
2 v 3 combination output OUT3
2 v 3 combination output Channel Clear
1 v 3 combination Channel Clear

**System DAPS TS**

This system line serves the replacement of MMG 1211TS shaft position monitors of the AEG-Turloop system.

For the redesign on the new system, the old measuring amplifiers MMG 1211TS have to be removed from the slots and each of them replaced by an MMS 6250 monitor with an MMS 6253TS adapter.

The existing Turloop frame remains in the rack, there is no need to rewire the system.

The following components are required:

- 3 x Monitor MMS 6250
  (incl. firmware appl. no. 1)

Additionally:

- 3 x Adapter MMS 6253TS
- 1 x Configuration kit MMS 6950
- 1 x Blind plates MMS 6354

The DAPS TS system replaces the functions of the old Turloop shaft displacement monitoring system.

For the replacement in the Turloop frame only DAPS TS monitors without display and without Profibus may be used.

With the DAPS TS system line not all functions of DAPS or DAPS AS are at disposal.

**Module supervision**

All three DAPS system lines offer the same extensive system supervision functions.

Reasons for module disturbances can be read out in detail via the communication interface or are displayed in plain text on the display.

This permits the technicians to recognize the reason for the fault immediately.

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 5 sec.

Depending on the backplane or the installed firmware, the indication of faults or overspeeds is made via function outputs and beside this via relay outputs with 2-out-of-3 combinations of the alarm outputs.

**Sensor supervision**

The systems lines DAPS and DAPS AS offer the following supervision functions:

- Analog comparison
- Gap supervision
- Sensor supervision:
  - (Short-circuit or interruption of the sensor cable)
- Sensor signal
  (Supervision of the signal levels)
- Supply current of the measuring chain
- System supply voltages
- System Watch-Dog
  (Supervision of the software)
- Temperature supervision
Technical Data:

Signal input:
- Differential input, non-reactive, open-circuit and short-circuit proof
- Input voltage range: 0...27.3 V DC
- Limit range: 0...30 V DC
- Input resistance: >100 KΩ

Sensor signal output:
- Front socket SENS.
  - decoupled, open circuit and short-circuit proof, non-reactive,
  - Voltage range: 0...4.1 V
  - Accuracy: ±1% of the measuring range

Signal conditioning of characteristic values
- Before processing by the processor, the input signals are standardized. The characteristic value is proportional to the axial displacement.
  - Max. measuring range: depending on the sensor used e.g. ±1mm with PR 6423/xxx-xxx
  - Measuring error: < 1% of the measuring range

Current outputs of characteristic values
- Calculation of characteristic values and signal evaluation depend on configured functions.

Current output 1 (Iout1):
- 0/4...20 mA or 20...4/0 mA electrically separated from system ground
  - Accuracy: ±1% of full scale / 16 bit

Current output 2 (Iout2):
- not available at DAPS TS
  - 0/4...20 mA / 20...4/0 mA with reference to system ground, feed back of output signal 0...±10 V for internal analog comparison.
  - Accuracy: ±1% of full scale / 16 bit

Channel supervision and visualization:
- Each monitored and permanently checks the signal of the sensor connected to its input and compares the current outputs of the two other channels with the signal of the own current output continuously. Thus a maximum in safety can be ensured.
- Faults are indicated with two green LEDs at the monitor front. An indication of the channel supervision is carried out via electrically isolated voltage outputs.

Output “Channel Clear”
- Operating mode open circuit or closed circuit mode freely selectable.
- Voltage output
  - +24 VDC = High state
  - 0 VDC = Low state
  - Max. current: 25 mA (Current limitation)

Alarm/function outputs:
- by configuration, depending on the assigned function. Visualization of the state with a yellow LED for each of the function-/ alarm outputs.
- Operating mode open circuit or closed circuit mode freely selectable.
- Voltage output
  - +24 VDC = High state
  - 0 VDC = Low state
  - Max. current: 25 mA (Current limitation)

Binary inputs:
- Altogether six function outputs with separate function and limit setting. The functions of the binary outputs as well as the switching characteristics are defined during configuration. The outputs are designed as 24V voltage outputs.
- Voltage range
  - Binary outputs:
    - The binary outputs are supplied redundantly from the backplane via terminals DC3, DC4 and DC5 at the analog screw terminals, decoupled via diodes, electrically separated from system ground

Voltage range
- Binary outputs:
  - The binary outputs are supplied redundantly from the backplane via terminals DC3, DC4 and DC5 at the analog screw terminals, decoupled via diodes, electrically separated from system ground

Binary inputs:
- electrically separated from system ground, common reference.
- Voltage inputs: 24 V

Signal level:
- “Low”: 0...+3 V
- “High”: +13...+32 V
- Input resistance: 6.8 kΩ

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

- Reset Latch:
  - To reset the latched function and alarm outputs.

- Test1 enable / Test2 enable:
  - Test values for testing the monitoring functions with internally simulated test values. The test-values replace the measuring values.

- Enable Test value:
  - To enable the test values Test1 / Test2.

Relay outputs DAPS AS
- Backplane MMS 6351/10
  - 5 relays, function outputs and channel clear
    - 2 out of 3 OUT2
    - 2 out of 3 OUT4
    - Trip OR CC channel A
    - Trip OR CC channel B
    - Trip OR CC channel C
    - Umax = 48 VDC, 20 Vrms AC
    - Imax = 4 AAC, DC
  - max. cable cross-cut at screw terminals: 1.5 mm²

Relay outputs DAPS
- Backplane MMS 6351/00
  - 6 relays, function outputs and channel clear
    - 2 out of 3 OUT1
    - 2 out of 3 OUT2
    - 2 out of 3 OUT3
    - 2 out of 3 Channel Clear
    - 1 out of 3 Channel Clear
    - one relay reserved for special applications
    - Umax = 48 VDC, 20 Vrms AC
    - Imax = 4 AMC, DC
  - max. cable cross-cut at screw terminals: 1.5 mm²
Technical Data:

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

RS 485:
Bus interface for communication with external systems.

No RS 485 bus connection at the Turloop backplane of the DAPS TS system.

PROFIBUS–DP (optional)
connection via SUB-D socket at the front plate

Not for DAPS TS

Sensor supply:
Decoupled from the remaining system supply and electrically isolated to the module supply voltage.
Open circuit and short-circuit proof.

Supply voltage: 26,75 V\textsubscript{DC}
Max. current: 38 mA
Residual ripple: \textless 20 mV\textsubscript{SS} (at supply current 20 mA)

Module supply:
Two redundant inputs, decoupled via diodes, nominal +24V with common ground.

Current consumption:
max. 250 mA per card (with display)

Permissible voltage range:
18....32 V\textsubscript{DC} according to IEC 60654-2

Mechanical design of the printed circuit board:
Euro- Format (100 x 160 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, design F 48 M

Dimension of total system:
DAPS, DAPS AS, DAPS TS
42 TE (approx. 213 mm)

Programmable measuring parameters:
- Measuring range
- Analog difference
- Warning and alarm limits
- Operating mode of outputs
- Alarm functions
- Test value 1
- Test value 2
- Hysteresis
- Analog comparison
- Channel identification by means of KKS numbers or freely selectable designations
- Current outputs
- Current calibration
- Current suppression
- Current smoothing
- Gap limit
- Channel Clear limits
- Linearization
- Sensor current supervision
- Limit downscaling
- Response delay for alarms

Function outputs, Alarm outputs:

DAPS modules MMS 6250 provides altogether 6 function outputs. These function outputs may be used as alarm outputs as well as for indications of individual module or error conditions.

The following functions may be assigned to the function outputs:
- off
- GW
- GW + Latch
- Sensor fault
- Gap error
- Test 1
- Test 2
- Analog error
- Ch. Clear 1

Module 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

Supply current of the measuring chain within a predefined good range
- Gap voltage (initial distance between sensor and measuring target) within a predefined good range
- System watch-dog, check of software and processor

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. Reasons for module disturbances can be read out in detail via the communication interface or, at modules with display, in plain text on the display.

This permits the technicians to remove the reason for the fault immediately.
### Components of the DAPS system:

<table>
<thead>
<tr>
<th>Eddy current sensors</th>
<th>PR 642x</th>
</tr>
</thead>
<tbody>
<tr>
<td>Signal converters</td>
<td>CON 0x1</td>
</tr>
</tbody>
</table>

| 19" mounting frame with 3 shaft position monitors | MMS 6250 and backplane MMS 6351/x0 |

<table>
<thead>
<tr>
<th>25-pole connection cable</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.5 m length – MMS 6362</td>
</tr>
<tr>
<td>or</td>
</tr>
<tr>
<td>3 m length – MMS 6360</td>
</tr>
</tbody>
</table>

| Screw terminals MMS 6361 to connect input / output signals and supply voltages |

<table>
<thead>
<tr>
<th>Backplane</th>
</tr>
</thead>
<tbody>
<tr>
<td>MMS 6351/00 for system DAPS and MMS 6351/10 for system DAPS AS</td>
</tr>
</tbody>
</table>

with relay contacts on additional board for 2-out-of-3 combination of alarms and fault indications
Display- and operating elements at the module front:

One non-reactive output
SENS (SMB socket):
Sensor signal, unfiltered, buffered, open circuit and short circuit proof.
Range: 0...4,1 V
Load resistance: ≥10 kOhm
Internal resistance: 10 kOhm

SENS
(SMB socket):
Sensor signal, unfiltered, buffered, open circuit and short circuit proof.
Load resistance: ≥10 kOhm
Internal resistance: 10 kOhm

MMS 6250D/DP
8-digit alphanumerical LED-matrix, green

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

2 green LEDs:
- LED 1: Supervision of this channel
- LED 2,3: Indication of the state of the two adjacent channels. If one of these channels fails (analog comparison), it will be indicated via this LED.

1 Mini DIN diode socket:
RS232 interface for connection of a computer for configuration and visualization purposes.

1 SUB-D socket (9-pole)
For connection of the Profibus DP system cable

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

Power supply of the monitors:

Redundant supply via two supply inputs, decoupled via diodes.

Supply voltage:
+18...24...32 Vdc according to IEC 60654-2

Current consumption:
max. approx. 250 mA per card (approx. 250 mA per card, with display and Profibus).

Power consumption of the DAPS system
max. 20 W ( 840 mA / 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

Climatic conditions:
according to DIN 40040 class KTF
Operating temperature range: 0...+55°C max. +65°C
Reference temperature: +23°C

Temperature range for storage and transport:
-40...+70°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: 19.6 m/s² in range 55....150Hz
Permissible shock:
according to IEC- 68-2 part 29
peak value of acceleration: 98 m/s²
nominal shock duration: 16 ms

EMC resistance:
according to EN 50081-1/EN 50082-2

Requirements on configuration PC:

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

Processor:
Pentium II, 266 MHz or better
Interfaces:
One free RS 232 interface
Capacity of hard disk:
min. 150 MB

Required working memory:
min. 500 MB (according to the requirements of the operating system)

Operating system:
Windows® 2000 or XP
Additional board on backplane MMS 6351/x0:

Additional board on backplane MMS 6351/00 for the DAPS system
2 out of 3 combinations of the function outputs

Order numbers:

<table>
<thead>
<tr>
<th>Order number</th>
<th>Description</th>
<th>Order code</th>
</tr>
</thead>
<tbody>
<tr>
<td>MMS 6250</td>
<td>Shaft displacement monitor</td>
<td>9100 – 00057</td>
</tr>
<tr>
<td>MMS 6250/D</td>
<td>Shaft displacement monitor with display</td>
<td>9100 – 00056</td>
</tr>
<tr>
<td>MMS 6250/DP</td>
<td>Shaft displacement monitor with display and Profibus DP</td>
<td>9100 – 00084</td>
</tr>
<tr>
<td>MMS 6351/00</td>
<td>Backplane for System DAPS</td>
<td>9100 – 00047</td>
</tr>
<tr>
<td>MMS 6351/10</td>
<td>Backplane for System DAPS AS</td>
<td>9100 – 00049</td>
</tr>
<tr>
<td>MMS 6352</td>
<td>19” ” mounting frame</td>
<td>9100 – 00053</td>
</tr>
<tr>
<td>MMS 6360</td>
<td>Cable 25 pole SUB D 3 m.</td>
<td>9510 – 00006</td>
</tr>
<tr>
<td>MMS 6362</td>
<td>Cable 25 pole SUB D 0.5 m.</td>
<td>9510 – 00015</td>
</tr>
<tr>
<td>MMS 6363</td>
<td>Profibus cable 4 m.</td>
<td>9510 – 00024</td>
</tr>
<tr>
<td>MMS 6361</td>
<td>Screw terminal 25 pol. SUB D</td>
<td>9100 – 00052</td>
</tr>
<tr>
<td>MMS 6950</td>
<td>Configuration kit</td>
<td>9510 – 00005</td>
</tr>
<tr>
<td>MMS 6354</td>
<td>Set of blind plates</td>
<td>9501 – 00005</td>
</tr>
<tr>
<td>BLE 008</td>
<td>Blind plate 8 TE</td>
<td>9501 – 00003</td>
</tr>
</tbody>
</table>

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