

# Operating Instructions

for the  
PLUGSYS® module

## MAPM Monophasic Action Potential Module Type 703

6-channel DC amplifier for evaluating  
monophasic action potentials

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## 1. Introduction, manufacturer's details

These Operating Instructions describe the operation and use of the **MAP** module Type 703. It is part of the equipment and should be kept close to it.

All the information in these Instructions has been drawn up after careful examination but does not represent a warranty of product properties. Alterations in line with technical progress are reserved.

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## Trademark

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## 2. Safety note



**Warning:** the equipment is not suitable for operation in hazardous areas and/or in a flammable atmosphere.

### 3. General description, application

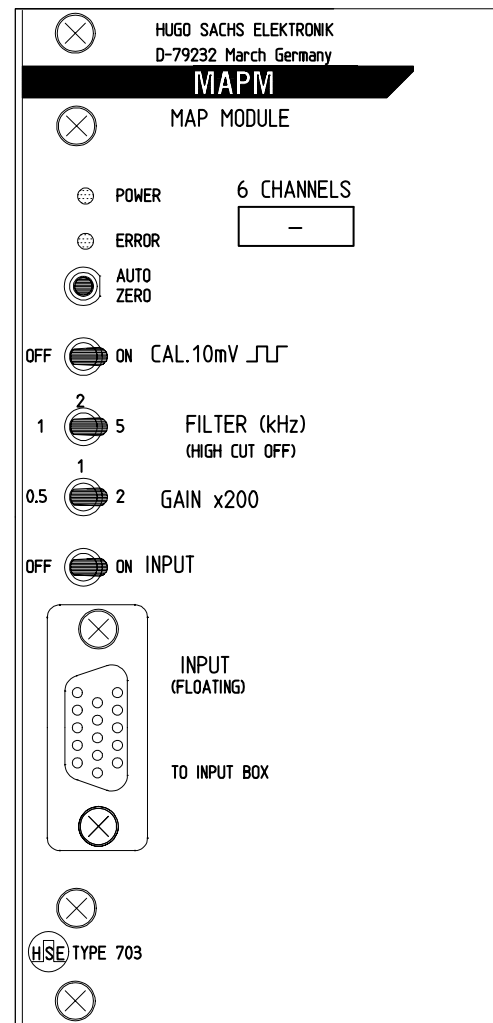
The **MAP** module Type 703 is a module of the HSE PLUGSYS measuring system and is used for capturing and amplifying 6 monophasic action potentials (MAPs). Special **MAP** electrodes have to be connected to it. This module incorporates isolating input amplifiers in order to avoid hum interference. In this way the inputs are isolated from the output circuits and from the housing.

The output voltages of the 6 amplified **MAP** signals can be linked through jumpers to the PLUGSYS system bus. From there the signals can be taken for recording or for computerised data evaluation via a ROM module (Recorder Output Module, e.g. ROM-DL).

A square-wave calibration generator with a 10 mV amplitude is incorporated for calibrating the amplitudes.

**Inputs:** A special connection box with separate switching facility for each channel is recommended for connecting the **MAP** electrodes. The connection box should be located close to the electrodes so that the unscreened electrode leads can be kept as short as possible. The box is not part of the module and has to be ordered separately.

For use, the **MAP** module has to be installed in a PLUGSYS housing Series 600.



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**Fig. 1:** Front panel

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## 4. Installing the module in a housing

If you have received the module as a separate unit you should carefully read and observe the details in this Section. If the module has however been supplied already installed you can omit Section 0 and continue at Section 0.

Before you can use the **MAP** module it has to be installed in a suitable HSE PLUGSYS housing Series 600 (July 97: 601 to 609). If the module is supplied as part of a completely installed PLUGSYS measuring system, the work described below has already been carried out and the selected signal paths have been entered in the bus diagram.

### 4.1 Installation procedure

Before the module is installed in a housing the connections of the module to the bus lines have to be determined by plugging in jumpers as described in the next section (Section 0).

Do not forget to enter the selected connections in the bus diagram (in the white Operating Manual folder for the PLUGSYS housing under Section 1).

Brief procedure (for full details see the Operating Manual of the housing):

- Pull out the mains plug on the housing.
- Remove the blank panel at the housing slot position intended for the **MAP** module.
- Prepare module according to Section 0 (set jumpers).
- Insert the **MAP** module, note the guide rails.
- Push the module firmly into the bus connector.
- Screw on the front panel.
- Reconnect the mains plug to the housing.
- Plug in the input cable and connect up the electrodes
- Switch on the housing

### 4.2 Internal instrument settings, jumpers

**Warning:** The **MAP** module has to be protected against electrostatic discharges while it is outside the housing!

The **MAP** module contains highly sensitive MOS components which can be damaged or destroyed by electrostatic discharges. If you are removing the module from the housing or carry out any operations on the module outside the housing you must ensure potential equilibration before touching part of the printed circuit. (Touch an earthed item, such as earthed housing, PLUGSYS housing or similar).

Before you install the **MAP** module into the PLUGSYS housing it is necessary to set 6 cable jumpers on the circuit board in order that the output signals are linked to the appropriate or required bus lines. The module can only be used as intended if the bus lines have been connected up correctly.

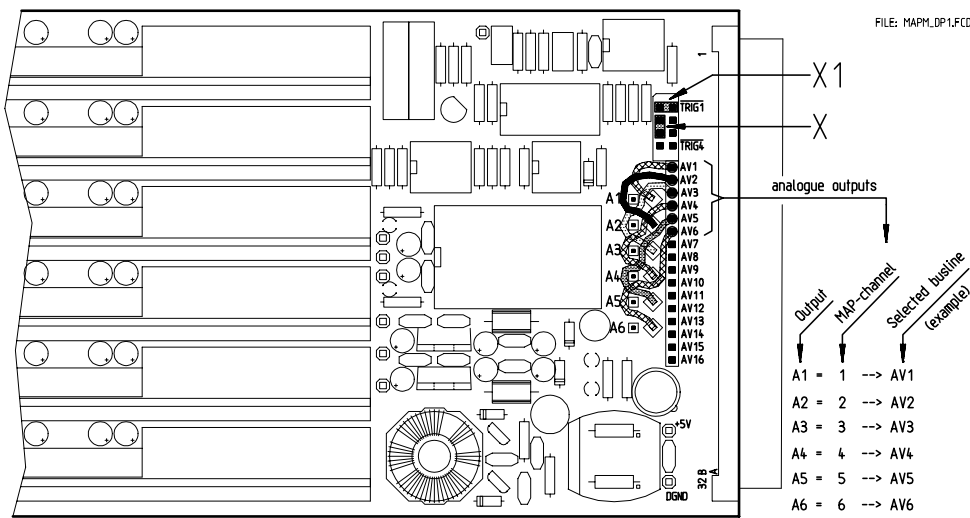
Do not forget to enter the selected signal assignment in the bus diagram for the PLUGSYS housing (the bus diagram is filed in the Operating Manual folder of the PLUGSYS housing under Section 1).

If the module is supplied as part of a completely installed PLUGSYS measuring system, the operations described below have already been completed and the selected signal paths have been entered in the bus diagram.



**Note:** When selecting the bus line (AV1...16) be sure to use a free line and check this in the bus diagram. If there is no appropriate information in the bus diagram you can determine the bus line assignment only by removing all the modules and determining the signal paths selected on them using the corresponding operating instructions.

The position of the cable jumpers is shown in 2. 6 analogue outputs (A1 to A6) have to be linked to the required bus lines (AV1 to AV16). If the "AUTO ZERO" function is to be operated not only with the key on the front panel but also centrally via the system bus, it is necessary to set also the jumper X.



**Fig. 2:** Position of the internal jumpers

**Cable jumpers A1 to A6:** The 6 channels of the **MAP** signals are carried on the corresponding cable jumpers A1 to A6. The connectors of these cable jumpers have to be plugged on to the pins for the analogue bus lines (AV1 to AV16).

**Jumper X:** The "AUTO ZERO" function is generally activated by pressing the "AUTO ZERO" key. When several amplifiers are being used simultaneously it may be desirable to operate this function centrally. In this case the jumpers X of all the modules involved have to be set to the same line of the trigger bus TRIG1 to TRIG4. If this trigger line is then activated, either manually by a central key or e.g. by a PC connected to this line, all modules connected to this trigger line are zeroed simultaneously. As an example, 2 shows the jumper X1 set to trigger line TRIG1.



**Note:** when selecting the trigger line (TRIG1 - TRIG4), be sure to use a free line and check this in the trigger bus diagram (the trigger bus diagram is filed in the Operating Manual folder of the PLUGSYS housing under Section 1). If there is no appropriate information in the diagram you can determine the bus line assignment only by removing all the modules and determining the signal paths selected on them using the corresponding operating instructions.

Do not forget to enter the selected trigger signal assignment in the trigger bus diagram for the PLUGSYS housing (the trigger bus diagram is filed in the Operating Manual folder of the PLUGSYS housing under Section 1).

If central triggering of automatic zeroing is not required, the jumper has to be placed in the parking position (jumper **X** in 2).

## 5. Operation of the module

### 5.1 Starting up

After the input box has been connected to the input socket, and to the output sockets a monitor or data acquisition system (= **visualisation unit**) you can switch on the housing.

Immediately on switching on, the internal automatic system automatically zeroes each channel.

Check first the function, of the entire measurement system from MAPM to the visualisation unit by switching off the input on the MAPM, setting the gain to 200 and switching on the calibration generator:

- set switch "**INPUT**" to "**OFF**"
- set switch "**GAIN x200**" to "**1**"
- set switch "**CAL. 10 mV**" to "**ON**".

All outputs then show a square-wave signal with a frequency of 2 Hz (= 120 min<sup>-1</sup>) and an amplitude of 2 Volt. Now set the required zero and amplitude on the visualisation unit by suitable adjustment of the position and sensitivity of the channels.

During recording the switches should be set to the following positions:

- switch "**CAL 10 mV**" to "**OFF**"

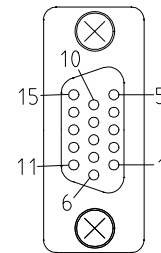
- switch "FILTER (kHz)" to "2"
- switch "GAIN x200" to "1"
- switch "INPUT" to "ON"

"GAIN" and "FILTER" may require a different setting depending on the actual conditions of your experiment.

## 5.2 Input socket

The input socket of the **MAP** module is a 15-pin socket (D-SUBMIN HD15). The front view of the socket with details of the pin number is shown in 3. The push-pull inputs of the 6 **MAP** channels are on the following socket pins:

channel	positive	negative
1	14	13
2	8	15
3	4	5
4	2	3
5	6	1
6	12	7



**Fig. 3:** Input socket

The reference potential ("tissue null") has to be connected to the socket contacts 10 or 11. The metal case serve as screen null.

## 5.3 Electrode connection

The use of an input box for connecting up the **MAP** electrodes is recommended; it should be positioned as close to the **MAP** electrodes as possible. The electrode leads (usually unshielded) can then be kept short so that there should be little interference pick-up. It is also useful to have a switch assigned to each channel to switch the channel off. The input box is not part of the module and has to be ordered separately.

## 5.4 AUTO ZERO

Immediately after the equipment has been switched, on the internal automatic circuit automatically zeroes each channel and stores the resulting values. During zeroing the inputs are automatically switched to zero. Any potentials applied to the inputs are therefore disregarded.

**Please note:** when the equipment is switched off the stored parameters are lost.

Automatic zeroing can be triggered at any time by pressing the "AUTO ZERO" key. This operation can be altered by the duration of pressing the key.

- (a) short key operation (key pressed 0.5 sec or less)
- (b) long key operation (longer than 1 sec, any duration)

**On (a):** in this case (short key operation) the zeroing sequence operation starts up and automatically searches for the optimum zero. The red LED "ERROR" lights up during zeroing and normally goes out when it is completed. If optimum zero could not be determined, the LED flashes after the zeroing operation:

- **flashing 4 times:** when **no precise zeroing** was possible, e.g. because of superimposed

interference (hum).

- **flashing 32 times**: when **no zeroing** was possible at all because the maximum available adjustment range has been exceeded ( $\pm 0.2$  V at input). In this case the zero compensating voltage for the particular channel is set to 0 V (= zeroing is off!). The amplifier outputs then carry the amplified but otherwise unmodified input signals which can be suitably evaluated.

**On (b)**: if the key is not pressed briefly but is held down, zeroing is continuously repeated. The stored zeroing condition is the one at the instant the key is released.

**6. Description of the controls**

The item numbers in the descriptions below refer to 4.

- (1) Green LED. This always lights up while the equipment is switched on.
- (2) The **"AUTO ZERO"** key initiates automatic zeroing of all channels. **Pressing the key briefly** starts the zeroing operation. The DC voltages at the inputs are automatically compensated to zero. The red LED (2a) "ERROR" lights up during zeroing and normally goes out again afterwards. If however automatic zeroing is not completed correctly, the ERROR LED flashes either 4 times or 32 times.

**Pressing the key longer** (more than 0.5 sec) produces continuously repeated zeroing until the key is released. The final compensation value is stored. For further information see Section 0.

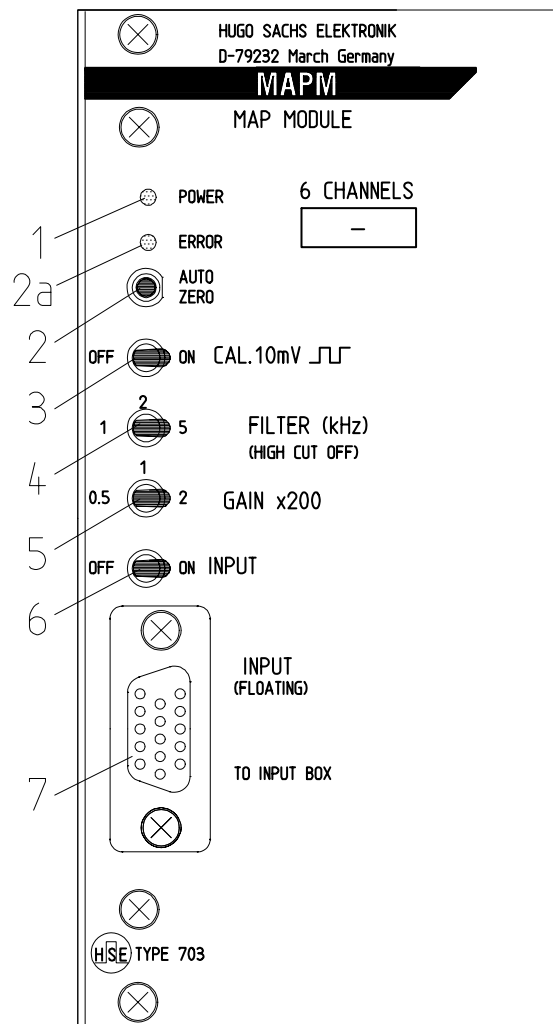
- (3) Switch **"CAL 10 mV"**. When set to "ON" a square-wave calibration signal with a frequency of  $120 \text{ min}^{-1}$  (2 Hz) and an amplitude of 10 mV is generated and superimposed on the input signal. With the input switched off (switch INPUT set to OFF) the output carries the pure calibration signal.

The calibration signal appears simultaneously on all channels.

The 10 mV amplitude is referred to the input and serves for evaluating the amplitude of the **MAP** signal. The calibration signal appears at the output with different amplitudes depending on the selected gain setting (switch GAIN); at GAIN = 100, output = 1 V; at GAIN = 200, output = 2 V; at GAIN = 400, output = 4 V.

- (4) Switch **"FILTER (kHz)" "(HIGH CUT OFF)"** is used to set the upper frequency limit. This filter permits some smoothing of the **MAP** signal. When selecting the filter setting, note that "excessive filtering" may reduce the amplitude of the steep parts of the trace!

The switch setting should therefore always be selected from the top downwards, i.e. always start



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**Fig. 4: Controls**



with 5 kHz, then switch to the lower steps (2 kHz - 1 kHz) and observe the curve shape.

The filter acts simultaneously on all channels.

- (5) Switch "**GAIN x200**". This switch selects the amplification for all channels simultaneously. The actual gain is obtained by multiplying the selected switch position by 200: at "0.5" the gain is then x100, at "1" it is x200, and at "2" it is x400.
- (6) Switch "**INPUT**". Using this switch all signal inputs can be simultaneously switched on (position ON) and switched off (position OFF). The setting of the switch affects the input impedances of the input circuit.
- (7) Input socket (D-SUBMIN 15HD), 15-way (for details see Section 0). The input circuit of the isolating amplifier has a floating input.

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## 7. Frequent errors, causes and remedies

**Error:** No output signal, although input cable is connected correctly.

**Cause:** Input switched off.

**Remedy:** Set switch "**INPUT**" to "**ON**".

**Error:** Signal amplitude very small. Deflection on monitor screen barely visible.

**Cause:** Amplification "**GAIN**" too small.

**Remedy:** Increase amplification (switch "**GAIN**"). The oscilloscope or monitor used may not have sufficient sensitivity.

**Error:** Interference on the **MAP** signal through "mains hum" (superimposed 50 Hz interference).

**Cause:** - Not all the electrode leads are connected up.

- There is a source of 50 Hz interference close to the electrodes (mains cable, lamp etc.)

- Electrode resistances are too high.

- Unsuitable arrangement of the electrode leads.

**Remedy:** - Check the electrode leads for proper connection to the electrodes.

- Search for source of 50 Hz interference (try to pull out the plug, switching off is frequently not sufficient) and remove it, or provide screening to prevent interference pick-up.

- High electrode contact resistances enhance interference pick-up. Check electrode contact and improve if necessary.

- The electrode leads should preferably be run parallel to each other, perhaps twisted together.

**Error:** **MAP** signal is "smoothed", the trace steepness is not sufficient.

**Cause:** Excessive filtering, selected filter step is too low.

**Remedy:** Set filter "**HIGH CUT OFF**" to 5 kHz and observe the signal on the screen. Switch down to 2 kHz and 1 kHz and observe the shape of the trace.

**NOTE:** in order to reproduce an **MAP** signal with steep parts of the trace at the correct amplitude, the monitor or recorder must have a sufficiently high frequency limit (better than 10 kHz). "Slow" potentiometric recorders, so-called laboratory recorders (usually with a width of 250 mm) are not suitable.

**Error:** Output shows only square-wave signals.

**Cause:** The Cal generator is still switched on and the input is switched off.

**Remedy:** Set switch "**CAL. 10 mV**" to "**OFF**" and switch "**INPUT**" to "**ON**".

## 8. Maintenance and cleaning

The PLUGSYS modules do not really require any maintenance. The **MAP** module is supplied fully calibrated. Any contact with or modification of the electronic circuit invalidates the warranty and the product liability of the manufacturer.

The front panel can be cleaned if necessary with a slightly moistened (not wet!) cloth. Before cleaning, always pull out the mains supply plug to ensure operator safety!

No moisture must find its way into the unit and especially not into the switches and keys, since this leads to corrosion at the switch contacts resulting in faulty operation. In general the PLUGSYS housing should be protected against splash water and salt solutions as this may damage individual components and may cause a short-circuit!

## 9. Transport and storage

In order to avoid transport damage when returning the unit to the factory, the PLUGSYS housing should be packed in a suitably large carton. (The carton should allow a spacing of about 10 cm all round to provide sufficient space for padding material, e.g. polystyrene, foam plastic or similar, to absorb any shocks.) When shipping an individual module it should also be protected by adequate padding and should first be enclosed in antistatic foil or envelope.

## 10. CE Conformity



This product and accessories conform to the requirements of the Low-Voltage Guideline 73/23/EWG as well as the EMC Directive 89/336/EWG and are accordingly marked with the CE symbol. For conformity with the standard it is essential that the details in these Instructions are strictly observed during operation.

11. Block diagram of the MAP module

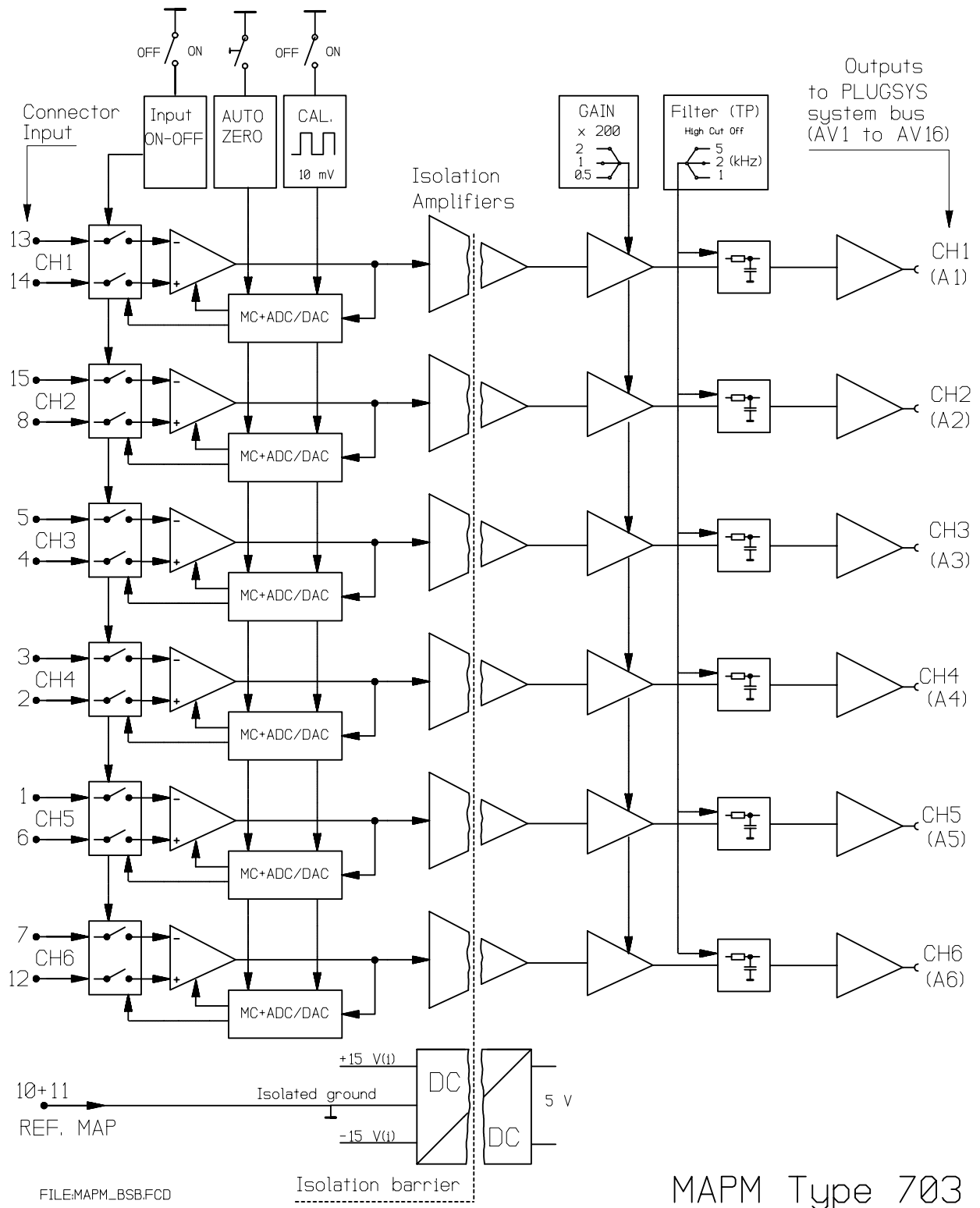


Fig. 5: Block diagram

12. Technical data

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Amplifier type:	DC amplifier with auto zero function, 6-channel
Input circuit:	differential inputs, isolated construction (floating input), max. isolation voltage 200 V DC
Input impedance:	switched on (INPUT ON) $10^{10}$ Ohm switched off (INPUT OFF) 5000 Ohm approx.
Common mode suppression:	better than 1 : 50 000 at 50 Hz
Zero adjustment:	voltage range: $\pm 200$ mV referred to the individual input resolution: 0.1 mV
Filter:	low-pass filter 1 kHz, 2 kHz and 5 kHz
Gain:	in position x0.5 100 in position x1 200 in position x2 400
Calibration:	square-wave signal 10 mV, 2 Hz ( $120 \text{ min}^{-1}$ ). The calibration signal is switched on with a toggle switch.
Outputs:	the output signals of the 6 <b>MAP</b> signals are linked by cable jumpers to the PLUGSYS bus system. The connection to the monitor is made through the Recorder Output Module (ROM) installed in the PLUGSYS system.
Ambient conditions:	operating temperature: 10 to 40°C humidity: 20 to 80% rH, no condensation storage temperature: -20 to +60°C
Supply:	5 V 1.2 A, supplied through PLUGSYS system bus

**Mechanical data:**

Dimensions:	module for PLUGSYS housing width 8 E (40.8 mm) height 3 U (128.7 mm) depth Eurocard (220 mm)
Connector:	DIN 41612, 96-way VG connector D-SUBMIN HD15
Weight:	0.5 kg
Accessory:	Operating Instructions
Input box: (must be ordered separately)	- input box with 6 differential inputs, sockets suitable for 2 mm dia. pin plugs, including approx. 2 m connecting cable