

OPERATING INSTRUCTIONS

for the

PLUGSYS®

Thermocouple Amplifier Module TCAM Type 706

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Fehler! Unbekanntes Schalterargument.. Introduction, manufacturer's details

These Operating Instructions describe the function and use of the PLUGSYS Thermocouple Module **TCAM** Type 706. They form part of the module and have to be kept close to it, readily accessible to the user.

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.

This PLUGSYS[®] module is manufactured by:

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PLUGSYS is a registered trademark of Hugo Sachs Elektronik, March-Hugstetten.

Fehler! Unbekanntes Schalterargument.. Safety note

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

This equipment is not permitted for use on humans !

Fehler! Unbekanntes Schalterargument.. General description and application

The Thermocouple Amplifier Module TCAM Type 706 is a module of the HSE PLUGSYS measuring system and is used for temperature measurement in conjunction with Type T copper/constantan thermocouples. The accuracy of the module is 0.1°C within the range from 30°C to 45°C, and 0.2°C outside this range.

Special thermocouple probes are available for different applications:

- rectal probes for measuring rectal temperature
- flexible micro probes for vascular temperature measurement
- special needle probe for temperature measurement in tissue

See also Section 0, Temperature probes.

All temperature probes are directly interchangeable and require no individual calibration.

The measured temperature is indicated on a 3 ½-digit LED display.

The temperature signal is available as an analogue voltage at a BNC socket on the front panel. It is also available for recording via the internal PLUGSYS system bus through a Recording Output Module.

The TCAM module incorporates a device for simulating two fixed temperature values (which can be freely selected) for simple calibration of a recorder or data acquisition system.

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

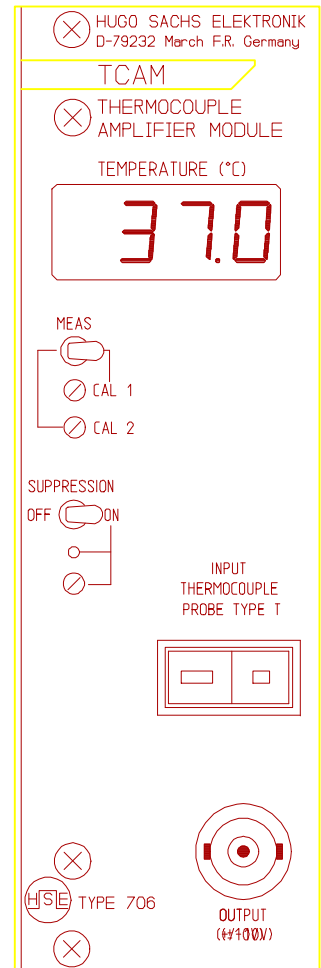


Fig. 1: Front panel

Fehler! Unbekanntes Schalterargument.. **Description of the front panel - controls**

- (1) Digital display to indicate the measured temperature in °C
- (2) Switch **CAL 2/MEAS/CAL 1** to select between **calibration** and **measurement**.

This switch can be used to indicate the CAL values 1 and 2 (as set on the trimmers (3) and (4)) instead of the measured value, and to apply them to the signal outputs. This provides a simple method for calibrating a recorder or data acquisition system.

Measurement takes place with the switch set to the centre position MEAS.

(3) **Trimmer CAL 1**

This trimmer is used to adjust the first simulation value. For setting the simulation value, move switch (2) to the right. Then set the required simulation value CAL 1 using the small screwdriver supplied (e.g. 30°C, for further information see Section 0).

(4) **Trimmer CAL 2**

This trimmer is used to adjust the second simulation value. For setting the simulation value, move switch (2) to the left. Then set the required simulation value CAL 2 using the small screwdriver supplied (e.g. 40°C, for further information see Section 0).

(5) Switch **SUPPRESSION OFF/ON**

This switch is used for switching the zero suppression on and off.

Zero suppression is used to suppress a certain (temperature) range on a recorder. For example, to show on the recorder not the temperature from 0°C to 40°C but instead only the temperature from 30°C to 40°C, it is possible with the switch set to **SUPPRESSION ON** to suppress the range from 0°C to 30°C. The result is a recording of a restricted range at a high resolution (spread out).

(6) LED **SUPPRESSION ON**

This LED lights up when zero suppression is switched on.

(7) **Suppression trimmer**

Zero suppression is used to suppress a certain (temperature) range on a recorder. For example, to show on the recorder not the temperature from 0°C to 40°C but instead only the temperature from 30°C to 40°C, it is possible with the switch set to **SUPPRESSION ON** to suppress the range from 0°C to 30°C. The result is a recording of a restricted range at a high resolution (spread out). Rotating this trimmer clockwise increases the zero suppression.

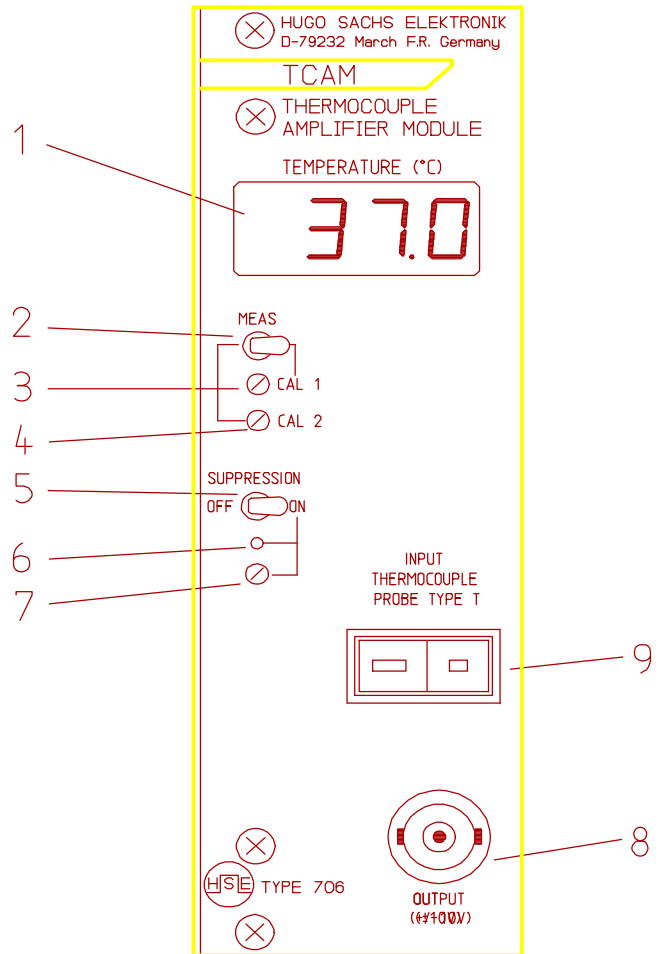


Fig. 2: Controls and indication

(8) BNC socket OUTPUT (± 10 V)

This socket carries an output voltage corresponding to the measured temperature, e.g. for feeding into a recorder.

The output voltage is 100 mV/°C or 10 mV/0.1°C.

With zero suppression switched off, there is e.g. an output of 3.70 V at 37.0°C

With zero suppression switched on this value is shifted by the amount of suppression. The output voltage is still 100 mV/°C.

(9) Input socket for Type T thermocouple

The copper/constantan thermocouple is plugged in at this 2-pin socket.

**Please note: The module operates in principle only with Type T
copper/constantan thermocouples!**

When other thermocouples are used, e.g. Type K (NiCr-Ni or chromel-alumel), the temperature reading is incorrect!

Fehler! Unbekanntes Schalterargument.. **Temperature probes**

Special temperature probes are available to suit different applications:

- rectal probes are used for measuring rectal temperature
 - RET-1 for larger animals
 - RET-2 for rats and guinea-pigs
 - RET-3 for mice
- flexible micro probes are available for vascular temperature measurement, for example
 - IT 14 (D = 1.3 mm, L = 90 cm, TC = 0.3 sec)
 - IT 21 (D = 0.4 mm, L = 30 cm, TC = 0.08 sec)
 - IT 23 (D = 0.23 mm, L = 90 cm, TC = 0.005 sec)

These probes have a very fast response and can also be implanted.

- so-called needle probes for temperature measurement in tissue
 - MT-23 (23G needle (0.63 mm), TC = 0.15 sec)
 - MT-29 (29G needle (0.33 mm), TC = 0.025 sec)

All temperature probes are directly interchangeable (plug-in) and do not require any individual calibration.

Please note: The module operates in principle only with Type T copper/constantan thermocouples!

Use only Type T (copper/constantan) temperature probes.

Type T temperature probes are identified by a blue input plug (IEC standard, USA). In Europe, copper/constantan (Cu/CuNi) temperature probes are sometimes fitted with a brown input plug (DIN standard).

When other thermocouples are used, e.g. Type K (NiCr-Ni or chromel-alumel), the temperature reading is incorrect!

Fehler! Unbekanntes Schalterargument.. **Start-up**

Fehler! Unbekanntes Schalterargument..Fehler! Unbekanntes Schalterargument. **Preparation**

It is assumed that the TCAM module is completely installed in a PLUGSYS housing. If this is not the case, you must first install the module according to Section 0. Then return to this section.

To make a measurement it is only necessary to plug in a temperature probe. No special probe calibration is required. The module is only suitable for Type T thermocouples (copper/constantan).

The principle of the measurement is based on the thermal voltage between the two metals copper and constantan.

Fehler! Unbekanntes Schalterargument..Fehler! Unbekanntes Schalterargument. **Setting the**

calibration values "CAL 1" and "CAL 2"

The two positions "CAL 1" and "CAL 2" of the switch "CAL 2 - MEAS - CAL 1" provide a simple method for quickly calibrating a recorder or data acquisition system (computer).

When the switch is moved to position CAL 2, the value set for CAL 2 is indicated and the outputs carry the output voltage corresponding to this indicated value.

When the switch is moved to position CAL 1, the value set for CAL 1 is indicated and the outputs carry the output voltage corresponding to this indicated value.

When the module is shipped from the factory the following calibration values have been set: CAL 1 = 30.0°C, CAL 2 = 40.0°C. If you require different values, the settings can readily be altered as described below.

Setting procedure:

Push the switch "**CAL 2 - MEAS - CAL 1**" to the right to position **CAL 1**. Then rotate the corresponding trimmer CAL 1 so that the digital display shows the required CAL value (e.g. 30.0°C). Clockwise rotation increases the reading, anticlockwise rotation reduces the reading. Use the small screwdriver supplied with the module.

Push the switch to the left to position **CAL 2**. Then adjust the corresponding trimmer CAL 2 so that the digital display shows the required second simulation value CAL 2 (e.g. 40.0°C). Use the small screwdriver supplied with the basic system case.

Fehler! Unbekanntes Schalterargument..Fehler! Unbekanntes Schalterargument. Setting a temperature scale on a recorder (without suppression)

After the CAL values have been set as explained in Section 0, setting a temperature scale on the recorder chart is a very simple operation.

For this procedure it is assumed that the PLUGSYS housing with the TCAM module installed has been switched on and that a recorder with 8 cm writing width is connected to it and is also switched on. The recorder should always have a sensitivity of at least 1 Volt for full-scale deflection.

Assumptions:	
Required temperature range:	0 to 50 °C
Recording width:	80 mm
Chart graduation:	cm and mm

For these conditions the two CAL values should be set to CAL 1 = 0°C and CAL 2 = 50.0°C (see Section 0). The recorder pen deflection can now readily be adjusted so that the lower edge of the writing range corresponds to 0°C and full-scale deflection (5 cm) corresponds to 50.0°C. A deflection of 1 cm then corresponds to a temperature of 10°C.

Adjustment procedure:

- (A) First switch off the amplifier input of the recorder (OFF) and adjust the zero position of the pen or pen trace with the corresponding recorder control (position) to the bottom graduation of the recording range.
- (B) Move the switch "**CAL 2 - MEAS - CAL 1**" to position **CAL 1**. The output is now the value for 0°C, the display shows 00.0°C.
- (C) Switch on the amplifier input on the recorder and start the recorder with a slow chart speed, e.g. 2 cm/min. The pen should remain on the zero position as set under (A). The bottom line of the graduation now corresponds to 0°C.
- (D) Next move the switch "**CAL 2 - MEAS - CAL 1**" to position **CAL 2**. The display now shows 50.0°C. The recorder pen deflects by a certain amount. Adjust the recorder gain (control marked gain or amplification or amplitude or sensitivity or ...) so that the pen is on 5 cm deflection. The trace now corresponds to 50.0°C.
- (E) Check the settings by running the chart, selecting on the switch "**CAL 2 - MEAS - CAL 1**" first position **CAL 1** and then **CAL 2** and checking the trace. If there are slight errors in the pen deflections they should be readjusted using the controls mentioned above (for 0°C: position or zero, for 50°C: gain, amplitude, sensitivity ...).

Calibration of the recorder is now completed. The recorder settings can be checked at any time, even during an experiment, by moving the switch "CAL 2 - MEAS - CAL 1".

Fehler! Unbekanntes Schalterargument..Fehler! Unbekanntes Schalterargument. **Setting a suppressed temperature scale on a recorder**

After the CAL values have been set as explained in Section 0, setting a temperature scale on the recorder chart is a very simple operation.

For this is procedure it is assumed that the PLUGSYS housing with the TCAM module installed has been switched on and that a recorder with 8 cm writing width is connected to it and is also switched on. The recorder should always have a sensitivity of at least 1 Volt for full-scale deflection.

Assumptions:	
Required temperature range:	32 to 40 °C
Recording width:	80 mm
Chart graduation:	cm and mm

For these conditions the two CAL values should be set to CAL 1 = 32°C and CAL 2 = 40.0°C (see Section 6.2). The recorder pen deflection can now readily be adjusted so that the lower edge of the writing range corresponds to 32°C and 8 cm deflection corresponds to 40.0°C. A deflection of 1 cm then corresponds to a temperature of 1°C.

Adjustment procedure:

- (A) First switch off the amplifier input of the recorder (OFF) and adjust the zero position of the pen or pen trace with the corresponding recorder control (position) to the bottom graduation of the recording range.
- (B) Move the **SUPPRESSION** switch to **ON**. The green LED "SUPPRESSION ON" is alight.
Now move the switch "**CAL 2 - MEAS - CAL 1**" to position **CAL 1**. The output is then the value for 32.0°C, the display shows 32.0°C.
- (C) Switch on the amplifier input on the recorder and start a slow chart speed, e.g. 2 cm/min. Adjust the trimmer **SUPPRESSION** (on the TCAM) to bring the pen to the zero line. The bottom line of the graduation now corresponds to 32.0°C.
- (D) Next move the switch "**CAL 2 - MEAS - CAL 1**" to position **CAL 2**. The display now shows 40.0°C. The recorder pen then deflects by a certain amount. Adjust the recorder gain (control marked gain or amplification or amplitude or sensitivity or ...) so that the pen is on 8 cm deflection. The trace now corresponds to 40.0°C.
- (E) Check the settings by running the chart, selecting on the switch "**CAL 2 - MEAS - CAL 1**" first position **CAL 2** and then **CAL 1** and checking the trace. If there are slight errors in the pen deflections you have to repeat the above procedure.

Calibration of the recorder is now completed. The recorder settings can be checked at any time, even during an experiment, by moving the switch "CAL 2 - MEAS - CAL 1".

Fehler! Unbekanntes Schalterargument..Fehler! Unbekanntes Schalterargument. **Calibration for computer data acquisition**

Most high-quality data acquisition programs incorporate 2-point calibration by reading in a low and a high calibration value.

After the CAL values have been set as explained in Section 0, calibration of a computer system is a very simple operation.

For this is procedure it is assumed that the PLUGSYS housing with the TCAM module installed has been switched on and that the cable connection for data acquisition has been made correctly. The input voltage range for data acquisition must be ± 10 V (output voltage range of the PLUGSYS system). TCAM provides a voltage of 100 mV per °C at the output.

Assumptions:	
Required temperature range:	30 to 40 °C

For these conditions the two CAL values should be set to CAL 1 = 30°C and CAL 2 = 40°C (see Section 0). Suppression is not required. The output is 3.00 V for 30°C and 4.00 V for 40°C.

Calibration procedure:

- (A) Start the software and select the calibration menu.
- (B) Move the switch "**CAL 2 - MEAS - CAL 1**" to position **CAL 1**. The output is now the value for 30.0°C, the display shows 30.0°C.
Enter this value for the menu item "Low Cal".
- (C) Move the switch "**CAL 2 - MEAS - CAL 1**" to position **CAL 2**. The output is now the value for 40.0°C, the display shows 40.0°C.
Enter this value for the menu item "High Cal".

Calibration of the data acquisition system is now completed. The measurement can be compared with the Cal values at any time, even during an experiment, by moving the switch "**CAL 2 - MEAS - CAL 1**".

Fehler! Unbekanntes Schalterargument.. Experiment

After the recording equipment has been calibrated the experiment can be started.

Fehler! Unbekanntes Schalterargument.. Input

The input socket fitted in the module is a Cu/Constantan thermocouple socket. The module operates only with Type T thermocouples (plug marked blue or brown).

When using other thermocouples, e.g. Type K (NiCr-Ni or chromel-alumel) the temperature measurements are incorrect!

The input circuit is isolated from the housing null (floating input).

Fehler! Unbekanntes Schalterargument.. Installing the module in a PLUGSYS housing

You should read this Section if you have received the TCAM module as a separate item. If however the TCAM module has been supplied to you fitted in a housing and completely installed, you can omit this Section.

Before you can use the TCAM module it has to be installed in a PLUGSYS housing Series 600 (July 1998: 601 to 609).

Before you fit the module into a housing you have to decide which of the 16 bus lines (AV1 to AV16) should carry the output signal, and make the appropriate connections on the circuit board. The procedure is described in the next Section 0.

Do not forget: enter the selected bus line (AV1...AV16) in the bus diagram (in the white Operating Manual folder for the PLUGSYS housing under Section 1).

Brief description of the installation procedure:

(for full details see the Operating Manual folder of the PLUGSYS housing under Section 2):

- Pull out the mains plug on the PLUGSYS housing (on the back of the housing).
- Remove the blank panel at the housing position where you want to fit the TCAM module.
- Prepare the module for installation according to Section 0.
- Slide the module into the housing at the intended position. Note the plastic guide rails.
- Push firmly on the module in the region of the circuit board so that the multi-pin connector engages fully with its socket.
- Screw on the front panel of the TCAM.
- Connect the Type T probe to the TCAM.
- Fit the mains cable back on to the housing.

This completes the installation procedure. After switching on the housing the TCAM module is immediately ready for use.

Fehler! Unbekanntes Schalterargument.,Fehler! Unbekanntes Schalterargument. Preparations before installation**WARNING:**

The TCAM module must be fully safeguarded against electrostatic discharges as long as it is on "open circuit" and not installed in a housing. The circuit board carries highly sensitive MOS semiconductor 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 module's printed circuit. The simplest method is to briefly touch a conducting earthed object (e.g. earthed metal instrument housing or switch on front panel of a build-in PLUGSYS module).

Before you install the TCAM module into the PLUGSYS housing it is necessary to set a connection of the output to the PLUGSYS system bus (AV1 - AV16). The module can only be used in conjunction with the complete system if the connection has been correctly selected and connected up.

Do not forget: enter the selected bus line (AV1...AV16) in the bus diagram (in the white Operating Manual folder for the PLUGSYS housing under Section 1).

If the TCAM module is supplied fitted in a housing and completely installed, you can omit the next Section 0. The necessary settings have then already been made and the selected system bus line has been entered in the bus diagram in the white Operating Manual in Section 1.

Fehler! Unbekanntes Schalterargument..Fehler! Unbekanntes Schalterargument. **Selecting the internal module settings and the connection to the system bus**

Two things have to be done:

A) set the jumper for filtering the output signal

B) select the system bus line AV1...AV16, jumper for connecting the output signal to the system bus

On A): jumper for filtering the output signal

The circuit board provides two jumper positions for filtering (smoothing) the output signal, filter 1 Hz and 10 Hz. When the module is supplied from the factory the jumper is set for 1 Hz.

The position of this jumper has to be considered in relation to the time constant of the temperature probe and the particular application.

For measuring fast temperature changes it is necessary to select a temperature probe with a short time constant. For such applications it is advisable to use setting 10 Hz.

When measuring slow temperature variations, e.g. the temperature in a water bath or the rectal temperature, a temperature probe with a time constant longer than 1 sec can be used. For such applications the filter setting 1 Hz is recommended.

When the module is shipped from the factory this jumper is set to 1 Hz.

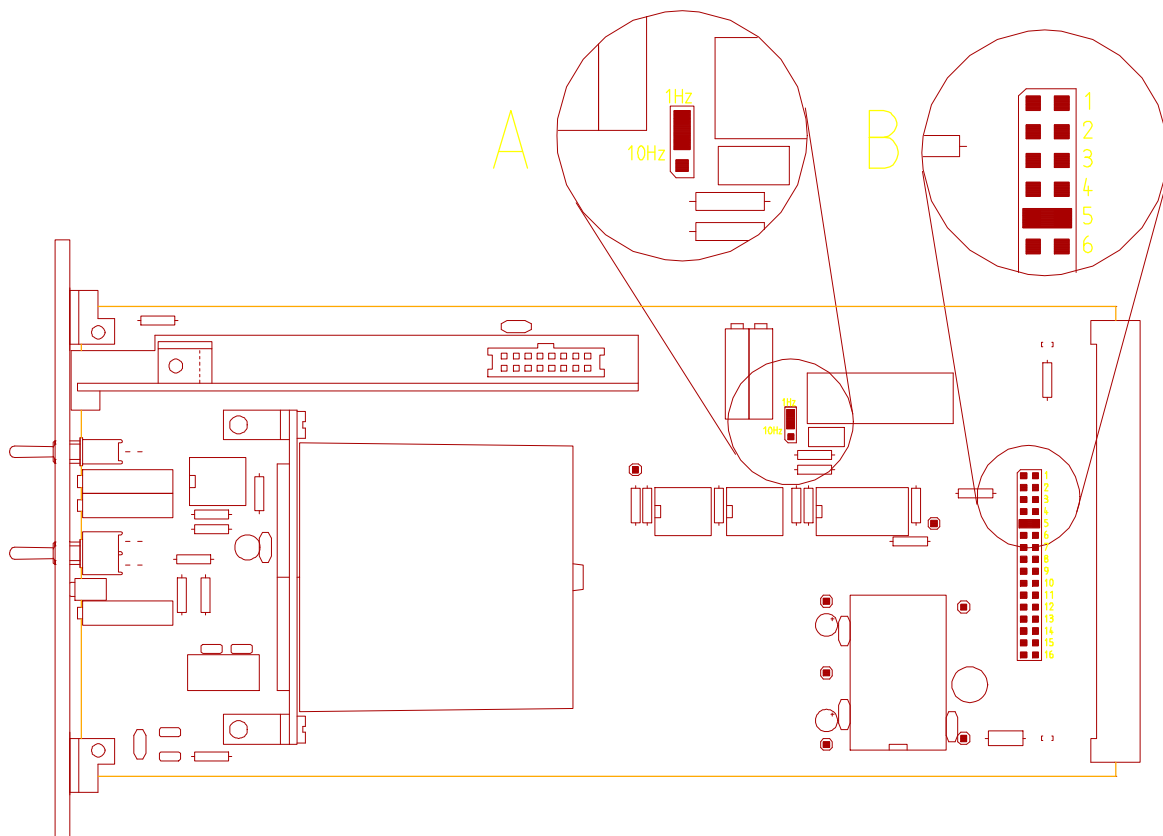


Fig. 3 Position of the internal jumpers. In this example the filter **(A)** is set for 1 Hz, and AV5 has been selected as the output channel **(B)**.

On B): selection of the system bus line AV1...AV 16

Note:



When selecting the bus line (AV1...AV16) 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.

Therefore do not forget: enter the selected bus line (AV1...AV 16) in the bus diagram!

WARNING: if you select a bus line which is already being used by another module, the output amplifiers of the two modules are connected in opposition and you obtain completely false measurement signals!

Fehler! Unbekanntes Schalterargument.. **Errors, causes and remedies**

Error: the digital display shows +132.5

Cause: range 0 - 100°C has been exceeded, no temperature probe connected, or probe faulty

Remedy: plug in the probe, check probe

Error: the temperature reading remains constant at a fixed value although it is expected that it should change.

Cause: switch CAL 2-MEAS-CAL 1 is set not on MEAS but on CAL 1 or CAL 2

Remedy: move switch to position MEAS

Fehler! Unbekanntes Schalterargument.. **Maintenance and cleaning**

The PLUGSYS modules do not really require any maintenance. The TCAM module is supplied fully calibrated and adjusted for Type T thermocouple probes. 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!

Fehler! Unbekanntes Schalterargument.. **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 be protected against electrostatic discharges and also be packed with adequate padding. The module should first be enclosed in antistatic foil or envelope and then placed in a sufficiently large carton with adequate padding.

Fehler! Unbekanntes Schalterargument.. **Block diagram of the TCAM module**

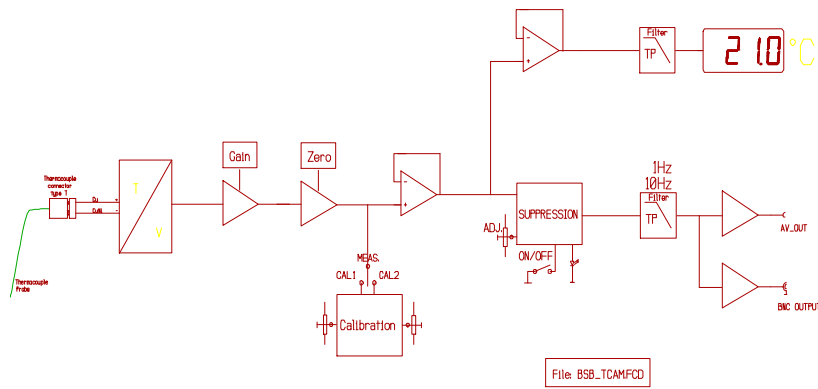


Fig. 4: Block diagram

Fehler! Unbekanntes Schalterargument.. **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.

Fehler! Unbekanntes Schalterargument.. **Technical data**

Input:	isolated differential input (floating input) max. isolation voltage 1500 V rms Transient protection to ANSI/IEEE C37.90.1-1989 Input protection for 240 V AC continuous
Input socket:	blue thermocouple socket, Cu/Constantan
Measuring range:	0 to 100°C
Resolution:	0.1°C
Accuracy:	0.1°C in the physiological range between 30 and 45°C 0.2°C outside this range
Indication:	3 ½-digit LED display
Output:	100 mV per 1°C or 1 V per 10°C on the BNC socket OUTPUT at the front panel (±10 V, 5 mA max.) The same output voltage is also available internally on the PLUGSYS bus.
Calibration:	2-point calibration with two adjustable temperature values
Recorder outputs:	the internal output is linked to the PLUGSYS bus system through a jumper. The temperature signal is linked to a recorder through the Recorder Output Module installed in the same PLUGSYS housing. In addition it is possible to make a direct connection to the BNC socket on the front panel.
Environmental conditions:	Operating temperature: 10 to 40°C Relative humidity: 20 to 80%, no condensation Storage temperature: -20 to 60°C
Supply:	5 V 450 mA, via 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
Weight:	400 g
Accessories:	BNC output cable and Operating Instructions