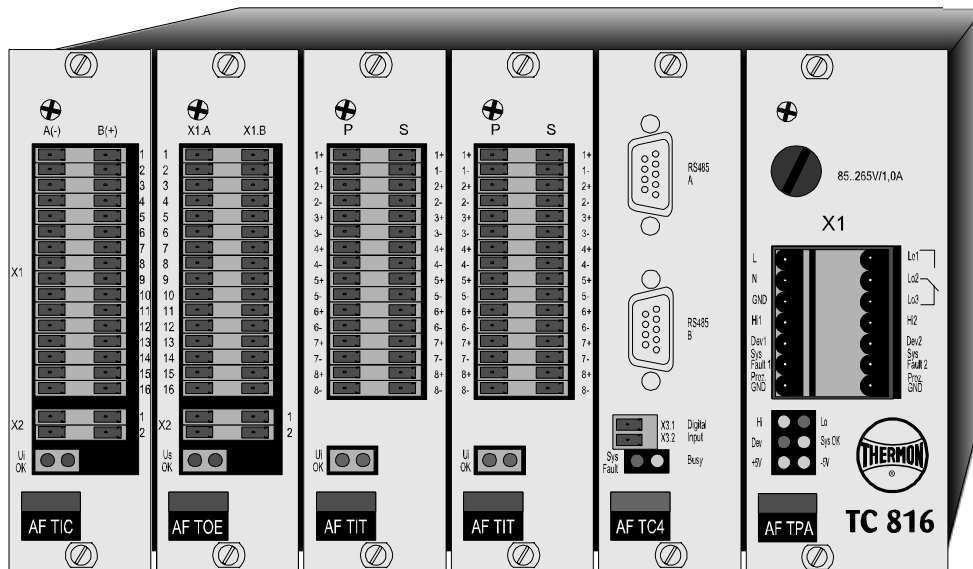
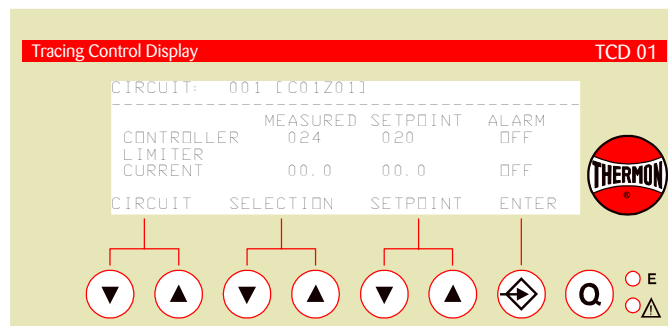




TC 816

Hardware Configuration Guide



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1	Index	
1	Index	2
2	Introduction	3
2.1	Possible Control Concepts	3
2.1.1	Process Temperature Maintenance or Proportional Ambient Control	3
2.1.2	Frost Protection with Staged Start-Up	3
2.1.3	Heat Tracing Cable Temperature Limiter	3
3	General Information for Building Control Panels	4
4	The TC 816 for Process Temperature Maintenance	5
4.1	Enclosure: AF TE1 Thermon Enclosure for TC 816	6
4.2	Slot 1: For AF TPA Thermon Power supply module AC	7
4.2.1	Function of LED's	7
4.2.2	Alarm contacts	8
4.2.3	Connecting TC 816 power supply and enclosure to ground	8
4.3	Slot 2: Tracing Central processing module	9
4.3.1	AF TC4 Tracing Central processing module with 2 independent RS 485 interfaces	9
4.3.2	Function of LED's	10
4.3.3	DIP switches	10
4.4	Slot 3 and 4: For AF TIT Tracing Input module for Temperature or ZD TB1 blind plate	12
4.4.1	AF TIT Tracing Input module for Temperature	12
4.4.2	ZD TB1 blind plate	13
4.5	Slot 5: For AF TOE Tracing Output module for Electronic relays or AF TOM Tracing Output module for Mechanical contactors	14
4.5.1	AF TOE Tracing Output module for Electronic relays	14
4.5.2	AF TOM Tracing Output module for Mechanical contactors	15
4.6	Slot 6: For AF TIC Tracing Input module for load Current or ZD TB1 blind plate	16
4.6.1	AF TIC Tracing Input module for load Current	17
5	The TCD 01 Tracing Control Display	18
5.1	Description of the TCD 01 front side	19
5.2	Description of the TCD 01 back side	20
6	General Specifications	21



2 Introduction

The Thermon TC 816 is a multi circuit temperature controller concept developed for Electrical Heat Tracing control. This concept allows total electrical heat tracing control configured to the needs of the customer.

The TC 816 hardware is based on electronic modules. With this approach the TC 816 can be set up for a huge variety of control tasks required for all electric heat tracing concepts Thermon has to offer.

The TC 816 facilitates one or two data communication busses through which it can either be connected to the Thermon TCD 01 tracing control display, a remote computer running a control and monitoring program and/or a DCS system.

Up to 30 TC 816 temperature controllers can be interconnected through the data communication bus(es) to their host(s). Each communication bus has one host, being either the TCD 01 tracing control display, the computer running the control and monitoring software and/or a DCS system.

2.1 Possible Control Concepts

The controller can be configured per controller and with process temperature maintenance per heat tracing circuit for different control concepts. However all controller regardless of how they are configured can communicate on one data communication bus.

This hardware configuration manual addresses exclusively the Process Temperature Maintenance concept of the TC 816 in conjunction with the TCD 01 tracing control display.

2.1.1 Process Temperature Maintenance or Proportional Ambient Control

- Proportional Integral Differential process temperature maintenance
- ON/OFF process temperature maintenance with configurable hysteresis in °C or °F
- Dummy Pipe or Dead Leg sensing process temperature maintenance
- Ambient Proportional Control (also suitable for **frost protection**)

2.1.2 Frost Protection with Staged Start-Up

- Ambient ON/OFF control with staged start up

2.1.3 Heat Tracing Cable Temperature Limiter

This control concept is required for electrical heat tracing systems in hazardous area (potentially explosive atmospheres) which do not comply with the rated T-class.

The heating cables sheath temperature is sensed, when the sheath temperature exceeds the controller's temperature set point the controller switches the heat tracing of and generates an alarm. The heat tracing can than only be switched back on manually if the high temperature condition has recovered.



3 General Information for Building Control Panels

The TC 816 controller has to be mounted into a CE complying control and/or power distribution panel. The panel shall be designed in a way, that the general specifications (see chapter 6) of the TC 816 heat tracing controller and it's accessories are met.

Furthermore the panel shall comply with all local requirements for safe use.



4 The TC 816 for Process Temperature Maintenance

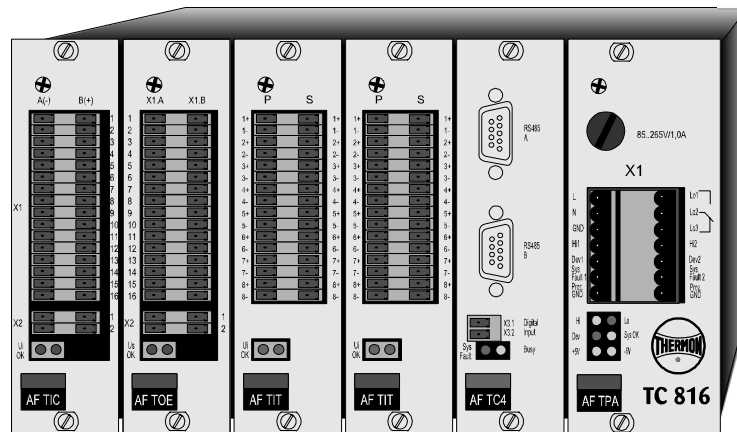


Figure 4.1 TC 816 equipped with hardware modules for process temperature maintenance of 16 circuits with load current monitoring.

The AF TE1 enclosure of the TC 816 controller facilitates 6 slots for electronic modules.

Numbering the slots from the right hand side starting with slot 1 up to the left hand side ending with slot 6 the AF TE1 is generally equipped:

- Slot 1: Power supply module
- Slot 2: Central processing module
- Slot 3 and 4: Input module(s) for temperature
- Slot 5: Output module
- Slot 6: Input module for load current

The following chapters give the detailed specifications of the hardware.

4.1 Enclosure: AF TE1 Thermon Enclosure for TC 816

The enclosure AF TE1 of the TC 816 is constructed to be mounted on the back plane of a panel. With the integrated bus circuit board the AF TE1 enclosure facilitates 6 slots for electronic modules.

It also facilitates space for a numbering plate at the top. The numbering plate can be fixed with 2 M 4 bolts.

The enclosure is made out of 2mm aluminium chromated in yellow and it is manufactured as a totally closed cabinet ensuring best EMC (Electro Magnetic Compatibility) specifications.

On the right hand side there is an M4 threaded earth stud which serves as a safety earth for the whole system. This earth stud should be connected to the common ground rail of the panel by a separate earth wire.

This construction and technology makes the TC 816 at least complying with the CE EMC and Low Voltage directives.

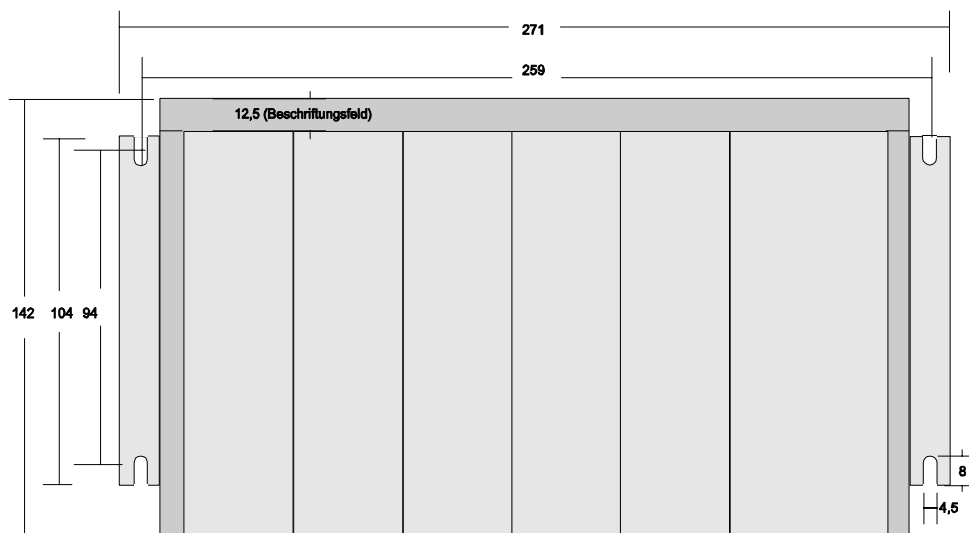


Figure 4.1 Dimensions of AF TE1 enclosure for TC 816 heat tracing controller. All dimensions in mm.

Dimensions:

- Height: See figure 4.1
- Width: See figure 4.1
- Depth: 166 mm
- Mounting holes: See figure 4.1

Minimum required mounting space:

These dimensions are specified in order to enable wiring on the front side of the controller and enable a bit of air ventilation space.

Wiring shall be put in Cable trunking not deeper than 60 mm allowing the below mentioned mounting space.

- Height: Add on each side 25 mm to the height dimension from figure 4.1
- Width: Add on each side 25 mm to the width dimension from figure 4.1
- Depth: 220 mm



TC 816 Hardware Configuration Guide

4.2 Slot 1: For AF TPA Thermon Power supply module AC

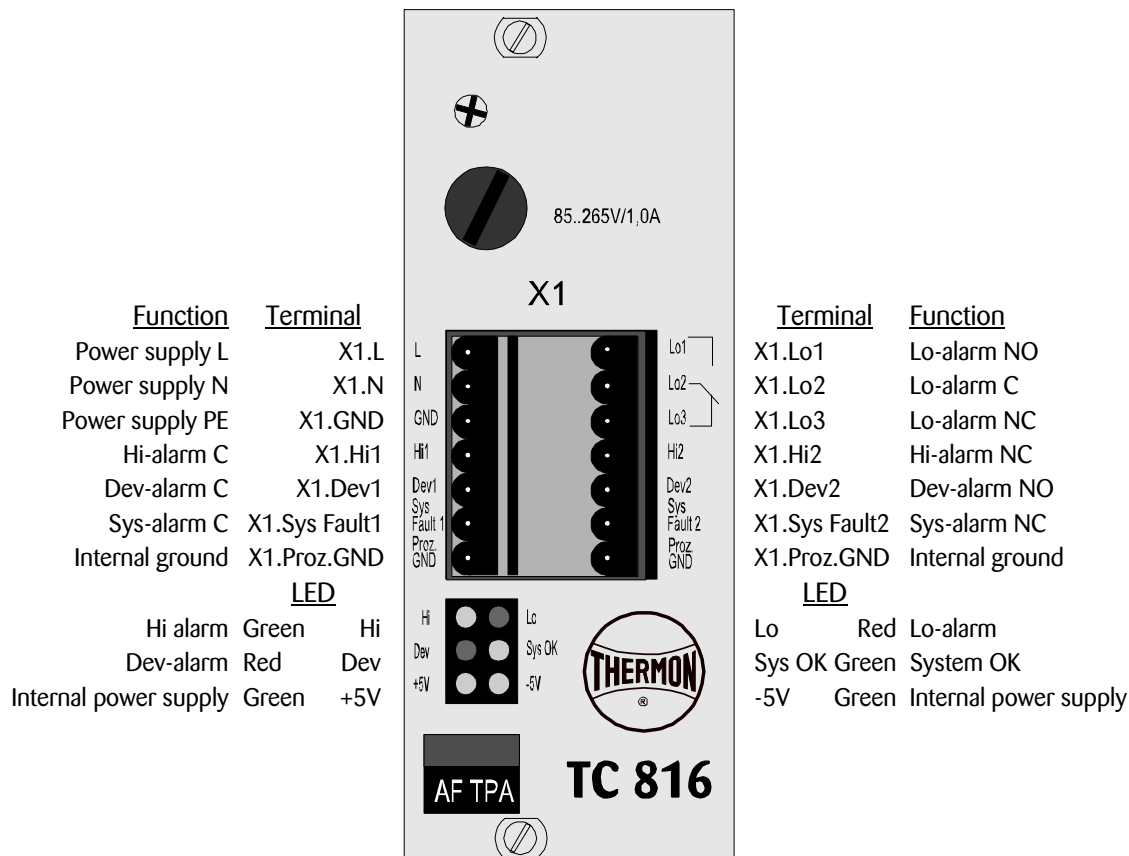


Figure 4.2 Front view of AF TPA Thermon Power supply modules for AC including terminal descriptions.

The AF TPA module is a multi voltage switching power supply suitable for voltages between 85 and 265 Vac and frequencies of 50 or 60 Hz.

The Thermon power supply module for AC is protected by a 1A fuse of the medium acting (mT: German, mittel Trage) type.

4.2.1 Function of LED's

The green LED's for:

- Hi-alarm
- Sys OK

are illuminated in normal operating condition (no alarms).

The red alarm LED's for:

- Dev-alarm
- Lo-alarm OK

are illuminated only in case of such alarms, Lo alarm LED also for temperature sensor fault.

The green status LED's for:

- +5Vdc
- -5Vdc

indicate that the power supply is properly working if illuminated.

TC 816 Hardware Configuration Guide

4.2.2 Alarm contacts

This module also facilitates common voltage free alarm contacts for:

- LO-Alarm: - low temperature
- low current (only if AF TIC module is applied in slot 6)
- MCB/RCD trip (only if AF TOE module is applied in slot 5)
- HI-Alarm: - high temperature
- high current (only if AF TIC module is applied in slot 6)
- open or short circuited RTD sensor
- DEV-Alarm: - too much deviation from temperature set point
- too much deviation from load current set point (only if AF TIC module is applied in slot 6)
- System-Al.: Hardware controlled self check

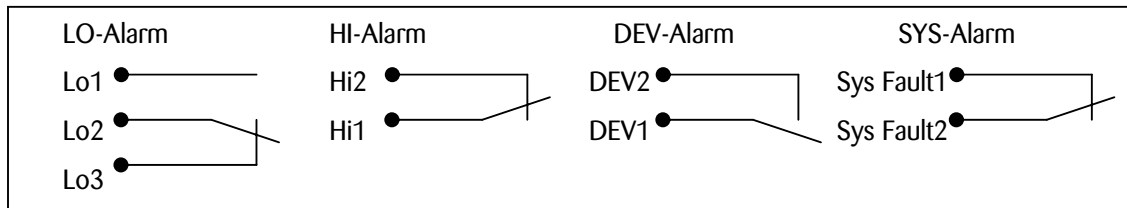


Figure 4.3 Internal wiring schematic of alarm contacts (terminal X1) in normal position in case the controller is switched on (no alarms).

Alarm contact ratings:

- 250 Vac
- 2 A

4.2.3 Connecting TC 816 power supply and enclosure to ground

The earth stud of the enclosure should be connected to the common ground rail of the panel by a separate earth wire. The same practice applies to the power supply PE terminal X1.GND.

Under normal circumstances the internal ground terminals X1.Proz.GND should not be connected.

4.3 Slot 2: Tracing Central processing module

The central processing module is the intelligence of the TC 816. It allows the controller independent operation. This means that the TC 816 can operate even if the communication bus is disconnected.

The non volatile memory of this module enables fast and safe start-up and automatic recovery after eventual power failures. The last set parameter values are still stored in the memory.

4.3.1 AF TC4 Tracing Central processing module with 2 independent RS 485 interfaces

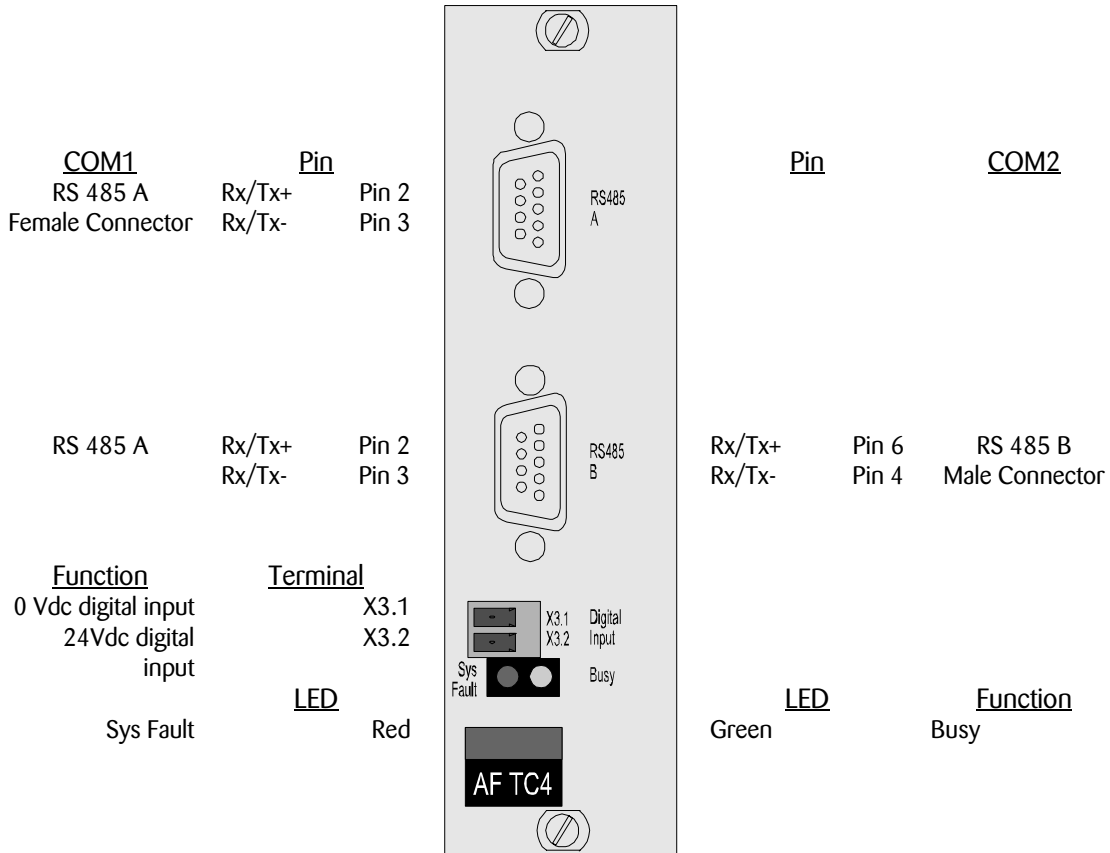


Figure 4.4 Front view of AF TC4 Tracing Central processing module including terminal descriptions.

The AF TC4 central processor module facilitates 2 independent RS 485 communication busses (utilising galvanic separation) and a 24 Vdc digital input for ambient thermostat connection in case the TC 816 is configured for “Frost Protection with Staged Start-Up”.

The 2 independent RS 485 communication busses allow the TC 816 to communicate with 2 independent masters. For instance:

- RS 485 A connected to a data communication bus linked with panel mounted TCD 01 tracing control display
- RS 485 B connected to a data communication bus linked to a PC located in the control/maintenance room running control and monitoring software available from Thermon.

The above practice enables full control over the heat tracing system from the sub station and the control/maintenance room.

In case only one data communication bus is required the RS 485 B connector functions as a second RS 485 A connector allowing easy loop through of the RS 485 A bus with single ended communication cables. For that reason pins 2 and pins 3 of both connectors are internally connected.

4.3.2 Function of LED's

The red LED for:

- Sys Fault

Is illuminated or blinks in case of a hardware failure. The controller will shut down all outputs and the system fault alarm is triggered.

The green status LED's for:

- Busy

Blinks fast while the TC 816 starts-up and blinks with a frequency of about 4 Hz in normal operating condition.

4.3.3 DIP switches

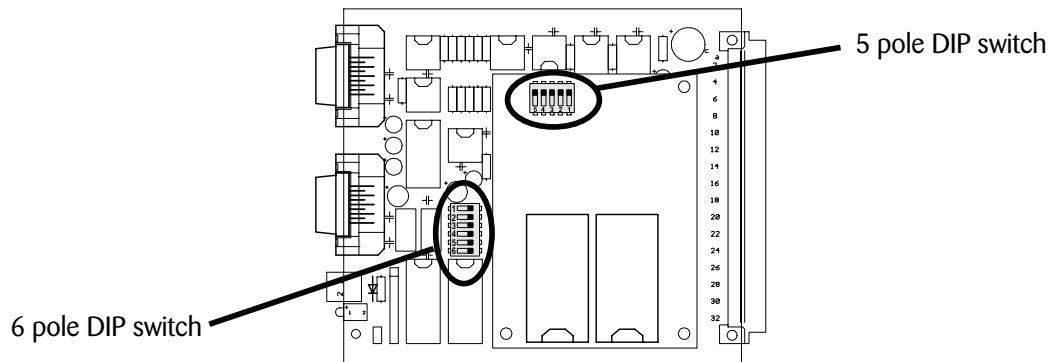


Figure 4.5 View on Tracing Central processing modules printed circuit boards showing the 5 and 6 pole DIP switches.

4.3.3.1 5 pole DIP switch

The 5 pole DIP switch determines following settings:

Position	DIP1	DIP2	DIP3	DIP4	DIP5
ON	AF TOM in slot 5	Enable changes in parameters P16 through P29	Temperature in °F (degree Fahrenheit)	TC 816 control concept*	TC 816 control concept*
OFF	AF TOE in slot 5	Disable changes in parameters P16 through P29	Temperature in °C (degree Celsius)	TC 816 control concept*	TC 816 control concept*

Table 4.1 5 pole DIP switch settings, bold positions indicate factory default settings.

NOTE: * The control concept of the TC 816 is determined by the DIP4 and DIP5 settings, see table 4.2. For information about control concepts see Thermon TC 816 Operation Manual, chapter "Possible Control Concepts".

DIP4	DIP5	Control Concept
OFF	OFF	Process Temperature Maintenance or Ambient Proportional Control, CONT
OFF	ON	Heat Tracing Cable Temperature Limiter, LIM
ON	OFF	Frost Protection with Staged Start-Up, FPSS
ON	ON	Spare position

Table 4.2 5 pole DIP switch settings for TC 816 control concepts, bold positions indicate factory default settings.



TC 816 Hardware Configuration Guide

4.3.3.2 6 pole DIP switch

The first 5 DIP switches of the 6 pole DIP switch determine the TC 816 data communication address in binary mode with least significant bit on DIP1:

DIP1	DIP2	DIP3	DIP4	DIP5	Communication Address
ON	OFF	OFF	OFF	OFF	1
OFF	ON	OFF	OFF	OFF	2
ON	ON	OFF	OFF	OFF	3
OFF	OFF	ON	OFF	OFF	4
ON	OFF	ON	OFF	OFF	5
.
.
.
.
OFF	ON	ON	ON	ON	30

Table 4.3 Settings of DIP1 through DIP5 of 6 pole DIP switch for communication address. Bold positions indicate factory default settings.

NOTE: Highest possible address number is 30.

DIP6	Data Communication Bus Speed
OFF	9.600 Baud
ON	19.200 Baud

Table 4.4 Settings of DIP6 of 6 pole DIP switch for data communication bus speed. Bold positions indicate factory default setting.

TC 816 Hardware Configuration Guide

4.4 Slot 3 and 4: For AF TIT Tracing Input module for Temperature or ZD TB1 blind plate

The AF TIT is an 8 circuit, 4 wire, RTD PT 100 temperature input module. By bridging the compensation terminals this module is also suitable for 3 wire and 2 wire RTD PT 100 sensors.

Whether slot 4 is equipped with an AF TIT module or with a ZD TB1 blind plate determines whether the TC 816 is set up for 16 or 8 heat tracing circuits.

Thus if 2 AF TIT modules are inserted:

- slot 3: for Zone 1 through 8 RTD inputs
- slot 4: for Zone 9 through 16 RTD inputs (terminal 1 for circuit 9, terminal 8 for circuit 16)

4.4.1 AF TIT Tracing Input module for Temperature

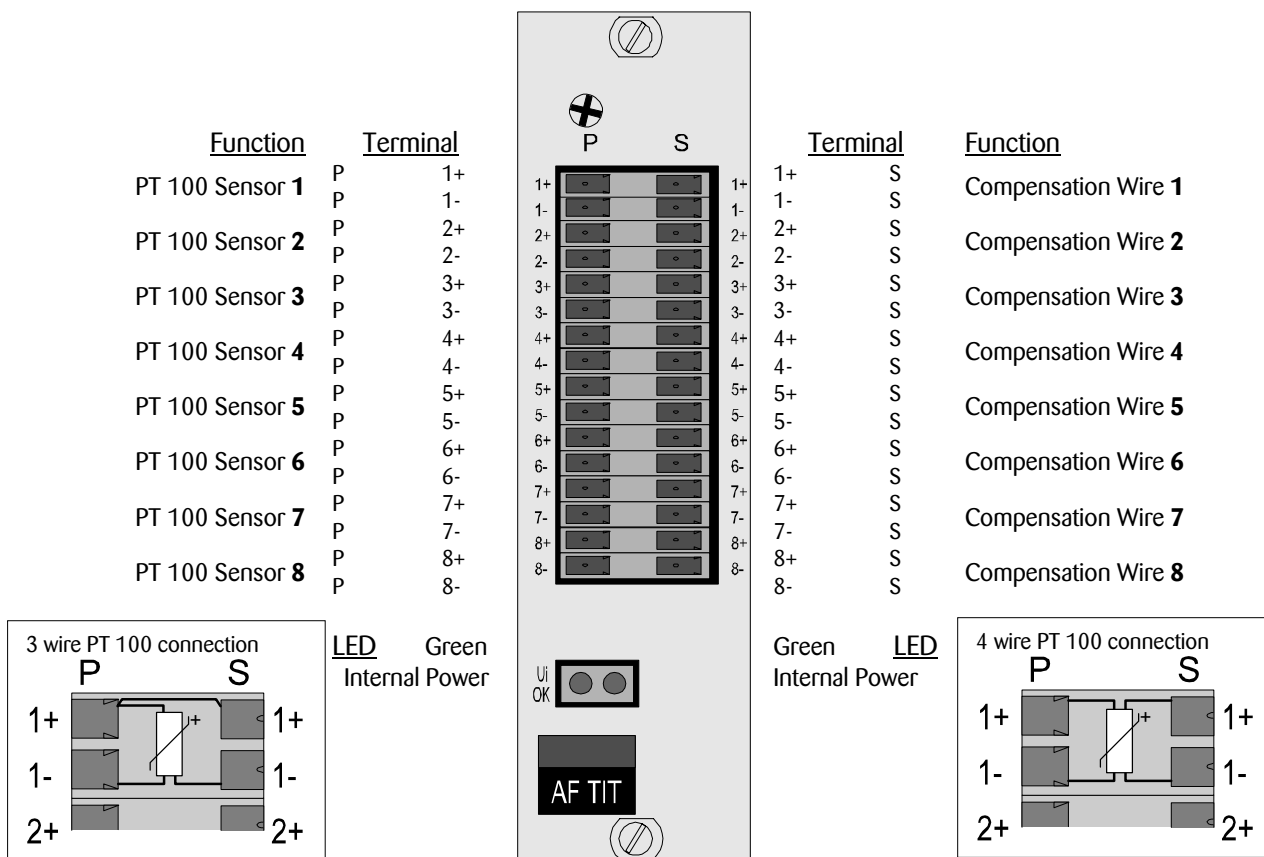


Figure 4.6 Front view of AF TIT Tracing Input module for Temperature including terminal descriptions.

The AF TIT Tracing Input module for Temperature facilitates 8 times 4 wire PT 100 RTD inputs. The sensor wires are to be connected between the “P+” and “P-” terminals, the compensation wires are to be connected to the related “S+” and “S-” terminals.

In case 3 wire PT 100 are connected, the compensation wire to the “S+” terminal does not exist, instead a bridge wire between terminal “S+” and “P+” must be provided. See figure 4.6.

Rule of the thumb for checking sound RTD connection:

Measuring resistance over the 4 terminals, resistance over horizontal opposite terminals should be very low, resistance over vertically opposite terminals should be roughly between 90 and 130 Ω (typical PT 100 RTD sensor resistance).



4.4.2 ZD TB1 blind plate

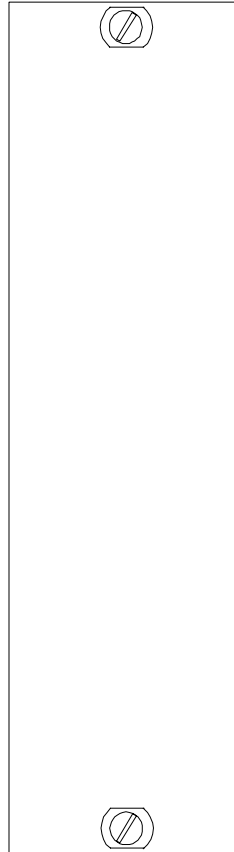


Figure 4.7 Front view of ZD TB1 blind plate.

The ZD TB1 blind plate covers slot 4 in case the TC 816 is configured for 8 heat tracing circuits.

4.5 Slot 5: For AF TOE Tracing Output module for Electronic relays or AF TOM Tracing Output module for Mechanical contactors

4.5.1 AF TOE Tracing Output module for Electronic relays

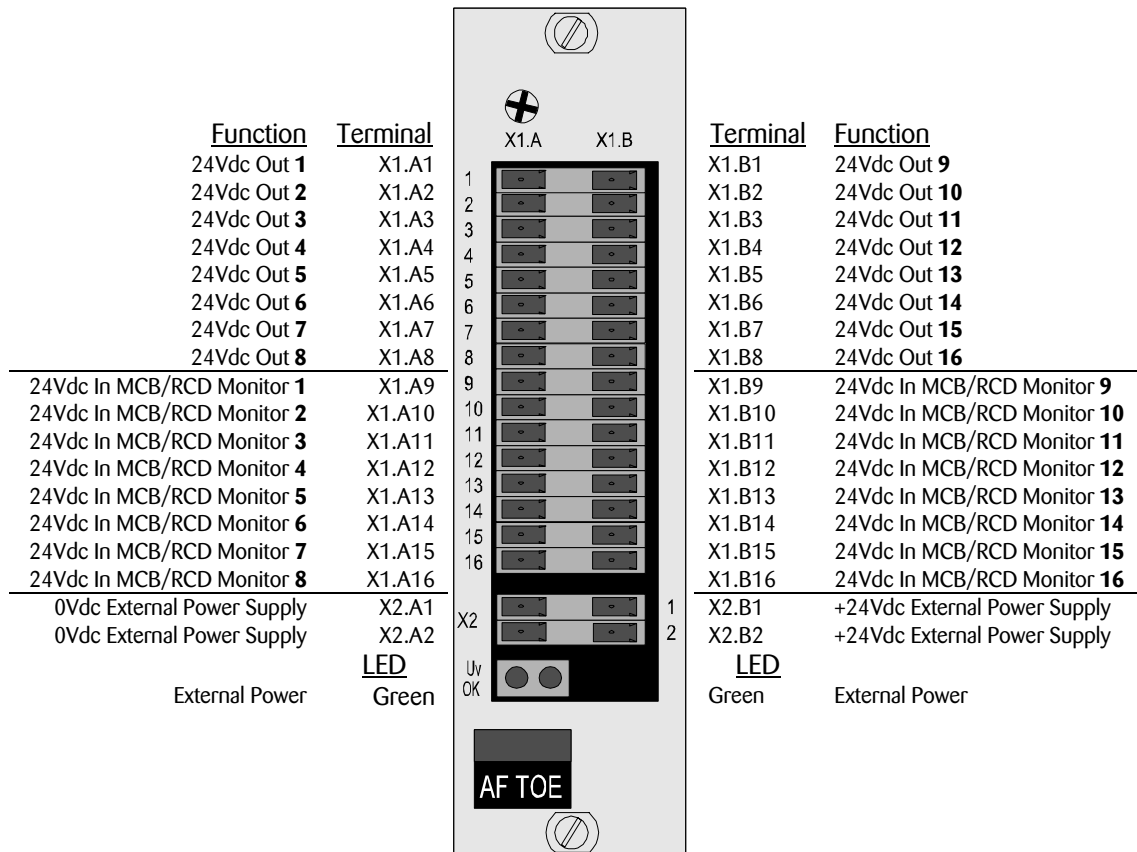


Figure 4.8 Front view of AF TOE Tracing Tracing Output module for Electronic relays. Illustration is shown including terminal descriptions.

The AF TOE utilises 2 terminals for external 24 Vdc power supply in order to provide enough capacity to drive up to 16 solid state relays or small 24Vdc driven mechanical contactors.

Output ratings:

- 24 Vdc
- 25 mA

In general this module is applied if PID process temperature maintenance control (also for dummy pipe or dead leg sensing) or ambient proportional control is required. Solid state relays are the best solutions for those control concepts because they do not wear out considering the amount of switch actions they have to fulfil. The advantage is that off the shelf Solid State relays can be connected to the TC 816. Therefore the switching capacity of a TC 816 system is only limited by the panel construction parameters like feeding power, cooling capacity in the panel.

Additional this module offers the unique possibility to monitor 16 individual MCB/RCD statuses by a 24Vdc input which is wired through the MCB/RCD's auxiliary contact(s). Only the AF TOE module offers this feature.

4.5.1.1 Function of LED's

The green LED's for:

- Us

Are illuminated in case the external 24Vdc power supply is connected correctly.

4.5.2 AF TOM Tracing Output module for Mechanical contactors

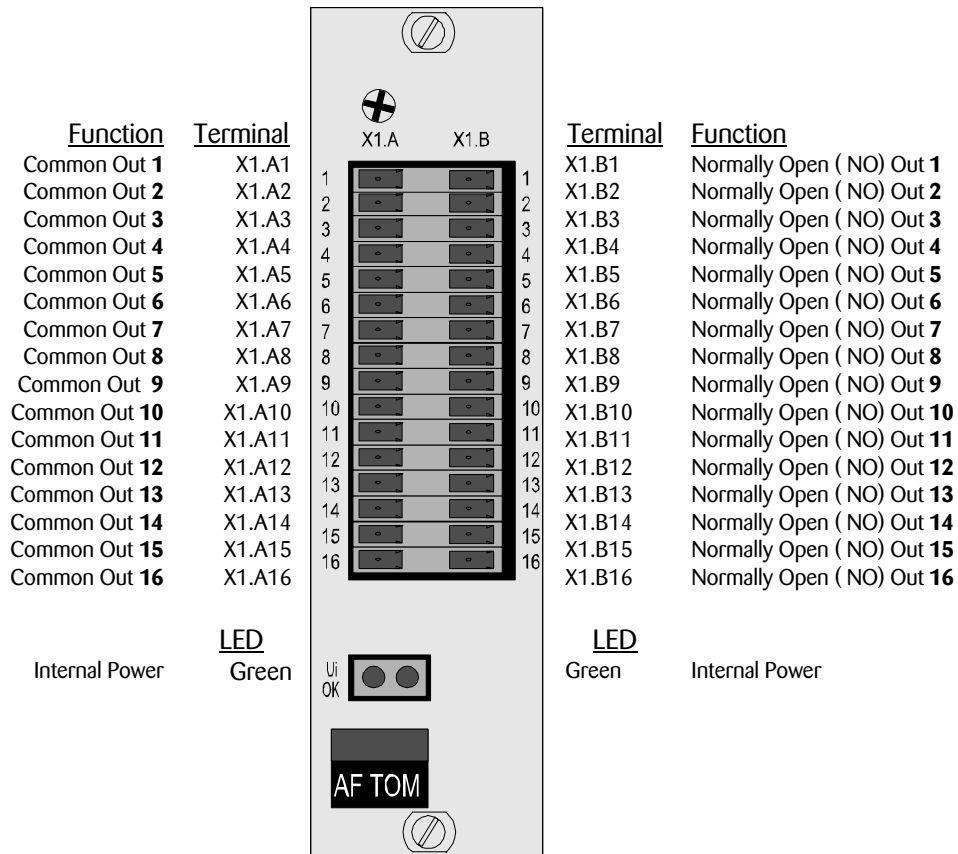


Figure 4.9 Front view of AF TOM Tracing Output module for Mechanical contactors. Illustration is shown including terminal descriptions.

The AF TOM utilises 16 voltage free contactors capable of driving up to 250 Vac mechanical contactor coils. Output ratings:

- 250 Vac
- 1 A

In general this module is applied if ON/OFF process temperature maintenance control (also for dummy pipe or dead leg sensing) is required without power clamping. Mechanical relays are the most economic solutions for those control concepts because their price is more attractive. The advantage is that mechanical contactors produce limited heat compared to solid state relays. Off the shelf mechanical can be connected to the TC 816. Therefore the switching capacity of a TC 816 system is only limited by the rating of the mechanical contactors and wiring of the panel.

4.5.2.1 Function of LED's

The green LED's for:

- Ui

Are illuminated in case the internal power supply works correctly.



4.6 Slot 6: For AF TIC Tracing Input module for load Current or ZD TB1 blind plate

Whether slot 4 is equipped with an AF TIC module or with a ZD TB1 blind plate (see chapter 4.4.2) determines whether the TC 816 is set up for load current monitoring or not.

Load current monitoring is extremely useful for total heat tracing system control, since monitoring load current can tell the user about open circuits other than tripped RCD/MCB or loss of power caused by damaged heat tracing systems.

4.6.1 AF TIC Tracing Input module for load Current

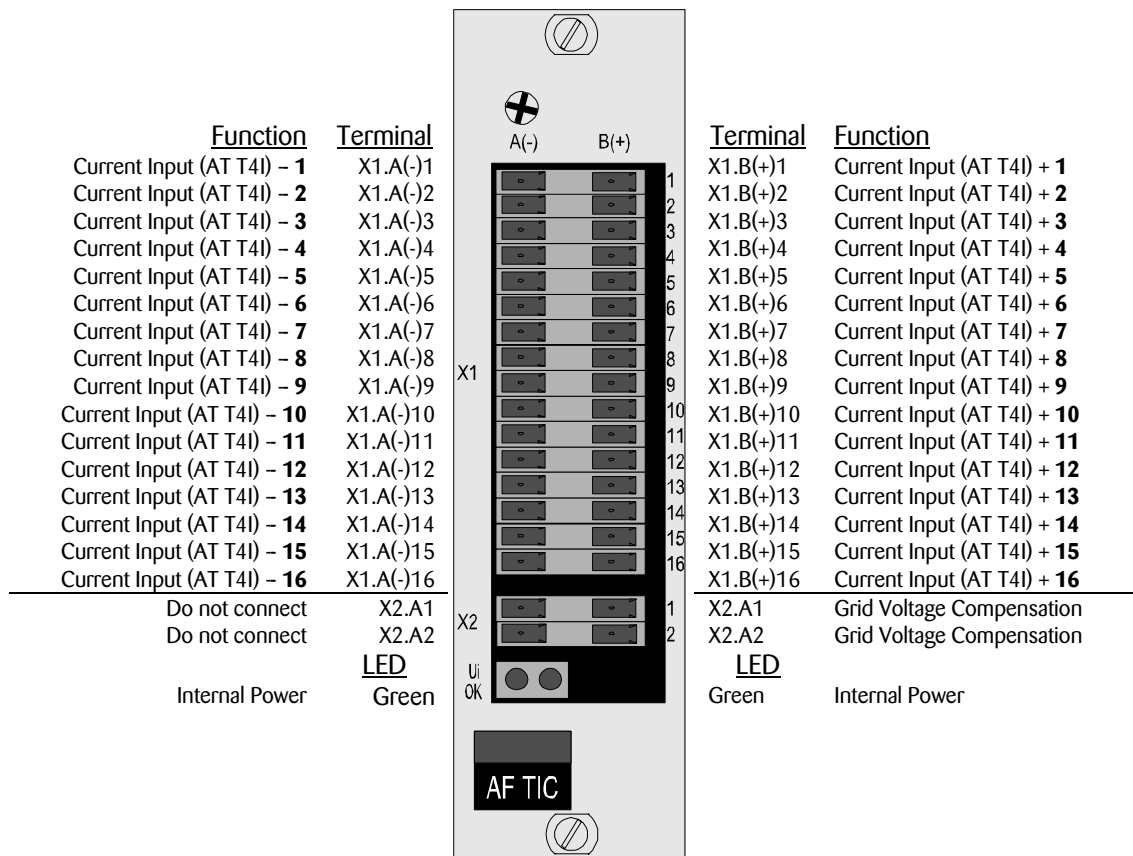


Figure 4.10 Front view of AF TIC Tracing Output module for Electronic relays. Illustration is shown including terminal descriptions.

The AF TIC tracing Input module for load current facilitates 16 current transformer inputs. To those inputs the AT T4I DIN rail mounted 4 circuit current transformer module has to be connected. One AT T4I module facilitates current monitoring for 4 circuits. In order to fully equip the AF TIC, 4 AT T4I modules are needed this provides current monitoring for 16 circuits.

In addition the AF TIC utilizes a grid voltage compensation input. To this input either a fixed resistor 68kΩ (default factory delivery) or the AT TU1 DIN rail mounted grid voltage compensation module can be connected. This option enables automatic current set point shifting to avoid current deviation alarms in case of supply voltage variations, which can be common in industrial environment. This option should only be applied with constant watt heat tracing cables.

4.6.1.1 Function of LED's

The green LED's for:

- Ui

Are illuminated in case the internal power supply works correctly.



5 The TCD 01 Tracing Control Display

The TCD 01 tracing control display allows the operator to have full control over the heat tracing circuits which are controlled by the connected TC 816 temperature controllers.

The TCD 01 is the host on the RS 485 data communication bus. It searches on the communication bus for TC 816 heat tracing temperature controllers which need to have their own unique communication address (to be set by DIP switches on the AF TC4 tracing central processing module).

The TCD 01 is mounted in a non-metallic enclosure.

Size:

- 192 mm width
- 96 mm high
- 65 mm depth

In order to mount it in a panel door, a rectangular hole of:

- 186 mm width
- 90 mm high

shall be provided.

The TCD 01 is supplied with 2 mounting brackets for easy mounting without any additional facilities needed in the panel door.

To the back of the tracing control display a space of at least 130 mm (measured from the panel door surface) shall be left for sufficient air movement in the panel and wiring space.

The TCD 01 tracing control display shall be powered by an external 24 Vdc power supply. That supply can be the same providing the 24 Vdc power to drive the solid state relays or mechanical contactors in the panel.

For operation of the TCD 01 tracing control display refer to Thermon TC 816 Operation Manual.

5.1 Description of the TCD 01 front side

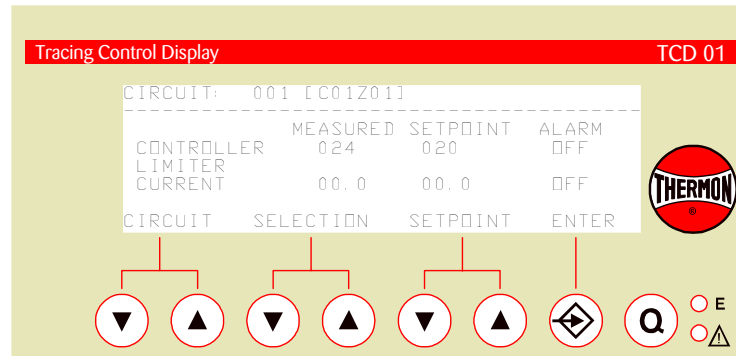


Figure 5.1 Typical front side view of TCD 01 Tracing Control Display

Description of buttons and indication lights:



Down Button:

Allows you to scroll down particular set points, parameter numbers etc. as shown in the display above the applicable down button.

Pressing this button for a short time decreases by single steps, holding it will accelerate the scroll.



Up Button:

Allows you to scroll up particular set points, parameter numbers etc. as shown in the display above the applicable down button.

Pressing this button for a short time decreases by single steps, holding it will accelerate the scroll.



Enter Button:

Is generally used to enter or save settings. However, sometimes can have a different function as shown in the display above this particular button.



Acknowledge Button:

Is generally used to acknowledge alarms. After acknowledging alarms of one heat tracing circuit the TCD 01 tracing control display will automatically show the next circuit with alarm conditions to be acknowledged.



Tracing Alarm Light:

Illuminates when an un-acknowledged Alarm condition is detected in a controller connected to the data communication bus. The TCD 01 tracing control display will automatically show the circuit with alarm conditions to be acknowledged.



TCD 01 System Alarm Light:

Illuminates when the hardware controlled self check detects a program stop in the TCD 01 tracing control display

5.2 Description of the TCD 01 back side

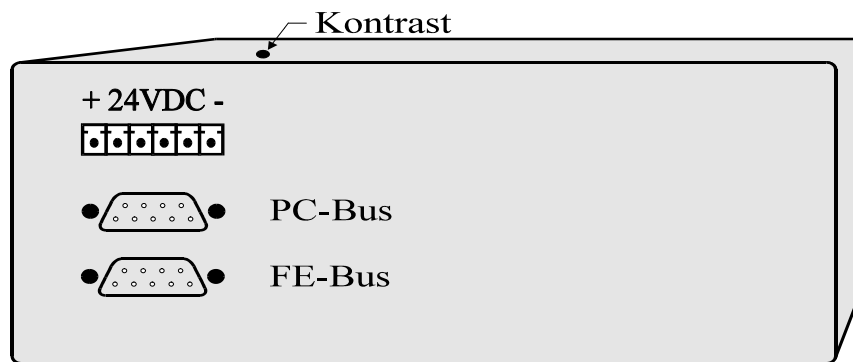


Figure 5.2 Front side view of TCD 01 Tracing Control Display

On the back side of the TCD 01 tracing control display there are 2 communication bus connectors.

The PC-Bus connector shall not be connected. It is for manufacturers use only.

The FE-Bus connector provides the RS 485 data communication with Rx/Tx+ on Pin 2 and Rx/Tx- on Pin 3.

Above the communication connectors you can find the 24V dc power supply connector. The TCD 01 tracing control display shall be powered by an external 24 Vdc power supply. That supply can be the same providing the 24 Vdc power to drive the solid state relays or mechanical contactors in the panel.

Power consumption:

- 9 W, with 24 Vdc power supply

A hole in the top surface of the non-metallic enclosure provides external access to a potentiometer which enables adjustment of the contrast of the display.



TC 816 Hardware Configuration Guide

6 General Specifications

<u>Power Supply:</u>	AF TPA	85..265VAC, 50/60Hz
<u>Power consumption:</u>	Depending on configuration	10-20W
<u>Fuse:</u>	AF TPA	1 x 1A medium fast (5 x 20mm)
<u>RTD sensor:</u>	PT 100 4 Wire Measuring current	0 ... 700 °C 0,5 mA
<u>Outputs:</u>	per Zone	Galvanic isolated
<u>Common alarm oputputs:</u>	max. Voltage max. Current	250Vac 4A with $\cos\varphi = 1$ 2A with $\cos\varphi = 0,5$
<u>Data storage (EEPROM)</u>	Data stored	min. 10 Jears
<u>Data communication interfaces:</u>	RS485 / Profibus *)	galvanic isolated
<u>Ambient conditions:</u>	Max. Operating temperature Storage temperatur Humidity	+55 °C -25 ... +75 °C < 95% rel. humidity, no condensate
<u>Weight:</u>	All slots equipped	2 kg