Electronic & Programming Systems

TSMC 400

Time
Synchronised
Measurement
&
Control Unit

Installation Manual

SMART GRID SOLUTIONS

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UniFusion® - registered trademark of ELPROS

WAProtector™ - trademark of ELPROS

TSMC 400™ - trademark of ELPROS

Version: 1.01

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List of Abbreviations

In this document, the following abbreviations are used:

Abbreviation	Description
WAMS	Wide Area Monitoring System
WAMPAC	Wide Area Monitoring, Protection and Control
PMU	Phasor Measurement Unit
PDC	Phasor Data Concentrator
FE	Functional Earth
PE	Protective Earth (grounding)
EMC	Electromagnetic compatibility
VT	Voltage transformer
CT	Current transformer
NA	Not Applicable
In	Nominal current
PRP	Parallel Redundancy Protocol
GPS	Global Positioning System
IRIG	Inter-range instrumentation group timecodes
PTP	Precision Time Protocol

Safety instructions

Safety symbols and messages

Read these instructions carefully and look at the device to become familiar with it before its installation, operation, service or maintenance. The following special messages may appear throughout this document or on a device to warn of potential hazards or to call attention to information that clarifies or simplifies a procedure.

Risk of electrical shock

The risk of electrical shock symbol indicates the presence of an electrical hazard, which could result in electrical shock and personal injury if the instructions are not followed.

Safety alert

The safety alert symbol indicates the presence of a hazard, which could result in personal injury. Obey all safety messages that follow this symbol to avoid possible injury or death.

Safety messages

	WARNING indicates a potentially hazardous situation, which, if not avoided, can result in death or serious injury.

	CAUTION indicates a potentially hazardous situation, which, if not avoided, can result in minor or moderate injury.

Important notes

Restricted liability

Electrical equipment should be serviced and maintained only by qualified personnel. No responsibility is assumed by ELPROS for any consequences arising out of the use of this manual. This document is not intended as an instruction manual for untrained persons.

Device operation

The user is responsible for checking that the rated characteristics of the device are suitable for its application. The user is responsible for reading and following the device's operating and installation instructions before attempting to commission or maintain it. Failure to follow these instructions can affect device operation and constitute a hazard for people and property.

Protective earthing

The user is responsible for compliance with all the existing international and national electrical codes concerning protective earthing of any device.

Description

This document describes the guidelines of the installation and connection of the Time Synchronized Measurement and Control unit (TSMC) series 400.

Reasonable effort was made to verify that all contents were accurate as of the time of publication. Check out our official website (http://elpros.si) for any revisions or updates made since the original date of publication.

The ELPROS Time Synchronized Measurement & Control unit (TSMC) is a multifunctional metering and control electronic device. TSMC device can be used for measuring synchro-phasor data (currents, voltages, symmetrical components and frequency information), waveform voltage and current data and digital statuses from power systems. High sampling data rate enables following fast dynamical phenomena on all voltage levels.

ELPROS TSMC unit is optimal solution for different types of the implementation on all levels of the power system from generation, transmission to the distribution also in combination with modern trends as renewable sources, battery storages, charging station and digital substations.

Integration with higher level monitoring and control systems WAMS/WAMPAC (Wide Area Monitoring System / Wide Area Monitoring Protection and Control) as ELPROS WAProtectorTM system offers complete technical platform for complex solutions on regional and wide area level.

1 Getting started

Please read this chapter to help guide you through the initial setup of your TSMC 400 device.

1.1 Inspection list

Open the TSMC400 packaging and inspect the unit for physical damage.

View the rear nameplate and verify that the correct model has been ordered.

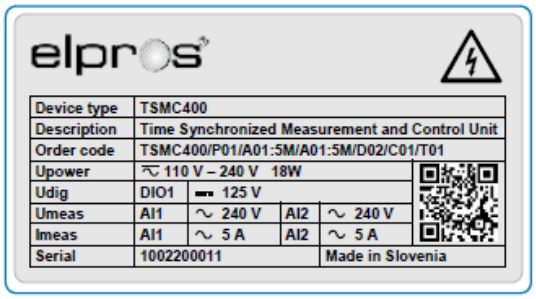

Figure 1: TSCM400 rear nameplate (example)

Ensure that the following items are included:

- 1 x TSCM400 device
- 1 x 3 pin power supply terminal connector
- 1 x 8 pin current input terminal connector (optionally device has 2 terminals)
- 1 x 11 pin voltage/current loop input terminal connector (optionally device has 2 terminals)
- 2 x 12 pin digital input/output terminal connector
- 1 x GPS antenna Trimble Bullet with F-type connector (optionally)
- 1 x GPS antenna cable RG-6 type with F-type connectors (optionally)
- 2 x L brackets
- 1 x 19" rack extender bracket (optionally)

2 Device overview

2.1 Introduction

This section identifies the connectors, indicators and controls available on the front panel of the TSMC400.

2.2 Front pane connectors and indicators

All TSMC400 connections are located on the front panel. Each connector is labelled with a letter of the alphabet and each pin on the connector is labelled with a numerical value for easier installation and cabling.

The connectors are divided in five groups:

1. Analog inputs (AIN1) [A], [B], ((AIN2) [C], [D] Optional)
2. Digital inputs and outputs (DIO1) [E], [F]
3. Communication links [J], [H], [I]
4. Clock synchronization [L] ([J], [K] Optional)
5. Power supply [M]

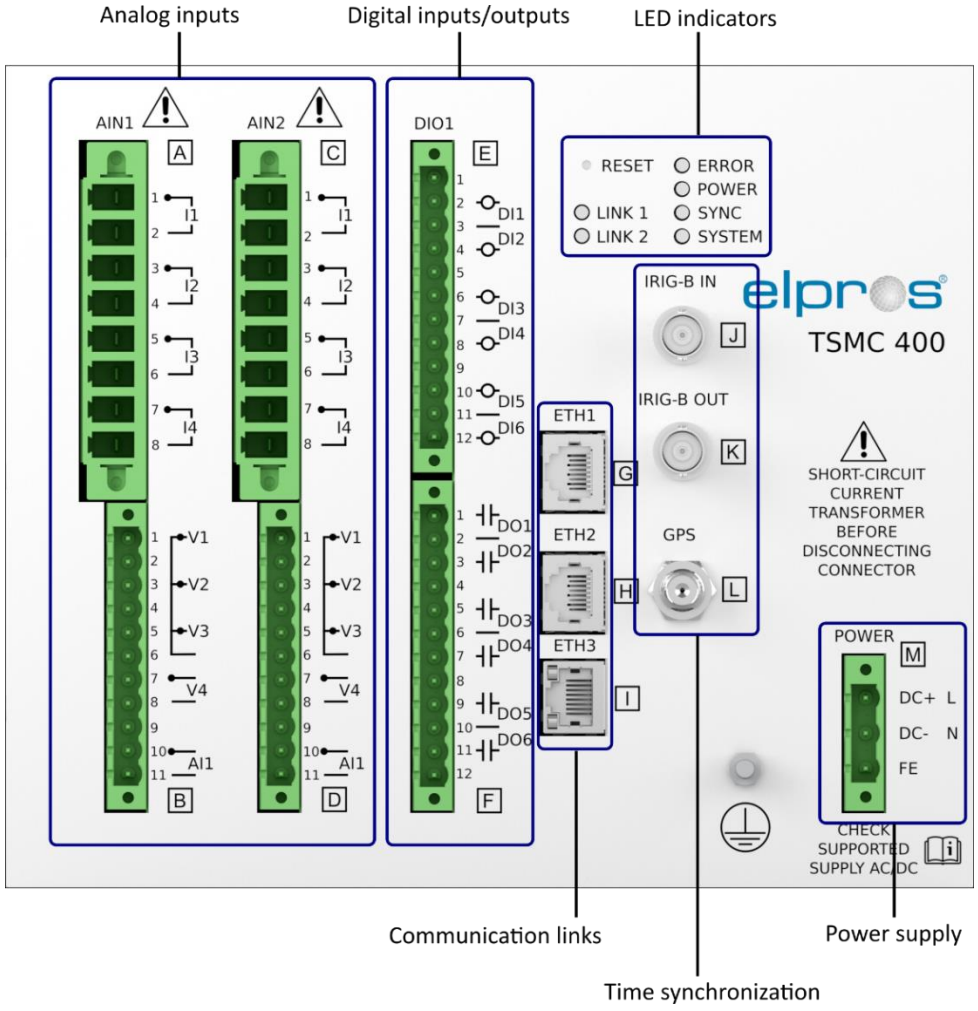

Figure 2: TSCM400 panel and connector overview

The six LED indicators provide the basic device operating status.

LED indicator	Colour	Purpose and definitions
ERROR	Red	Red light indicates unrecoverable device error.
POWER	Green	Green light indicates correct levels of the external power supply and internal power bus. Turned off led indicates an external power supply or internal power bus under-voltage.
SYNC	Green	Turned off LED indicates no external synchronization clock source detected. Blinking once per second indicates a detection of valid external synchronization source detected. Solid green light indicates device synchronized to external clock source.
SYSTEM	Green	When blinking once per second indicates correct device operation. If solid on or off device in an unrecoverable error state, power cycle is required.
LINK1	Green	Indicates link status of the ETH1 communication interface. Solid green indicates link established, blinking green indicates network activity.
LINK2	Green	Indicates link status of the ETH2 communication interface. Solid green indicates link established, blinking green indicates network activity.

LED indicator for different device state:

Device State	LED indicator			
	ERROR	SYNC	SYSTEM	POWER
Device in an unrecoverable error	Solid on	NA	Blinking Solid on / off	NA
Device boot	Solid on	Solid on	Solid on	Solid on
Device running, but is not synchronized to external time source	Solid off	Solid off	Blinking	Solid on
Device running, synchronising to external time source	Solid off	Blinking	Blinking	Solid on
Normal operation	Solid off	Solid on	Blinking	Solid on

The RESET button is located next to the LED indicators. The button is recessed so it cannot be pressed accidently. A point tool like a pen or a small screwdriver is required to press the button. A short press on the button will cause a device reboot. A long press on the button, 10 seconds minimum, will return the device settings to their default values including passwords and network interface settings.

3 Mounting overview

3.1 Mounting options

The TSMC400 provides multiple mounting options for surface and 19” rack.

3.1.1 Installation kit elements

The TSMC 400 has two mounting options for which are used elements from installation kit:

- Rack extended bracket, see Figure 3.
- L-bracket, see Figure 4: L-bracket.

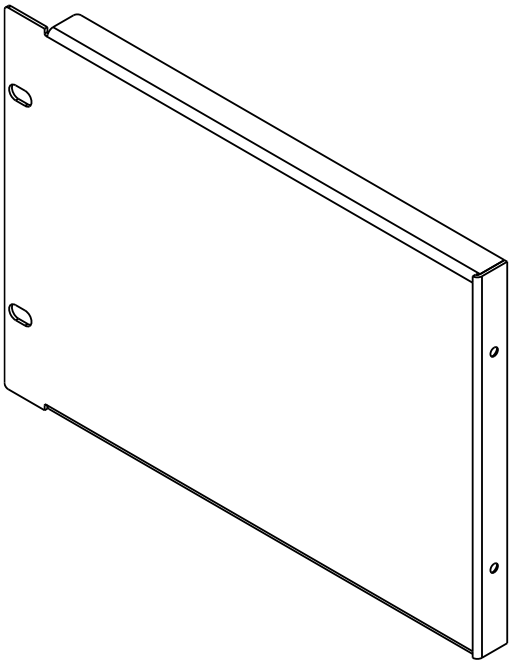

Figure 3: Rack extender bracket

Figure 4: L-bracket

3.2 Single rack mount

Standard 19” rack mounting option for a single device installation requires the 19” mounting kit, which includes the L-bracket and the rack extender bracket, see Figure 5. Both brackets are screwed to the device using two M3 taper screws. The device can be then mounted inside a 19” rack with standard rack-mount screws, see Figure 6. Required rack space height is 4U.

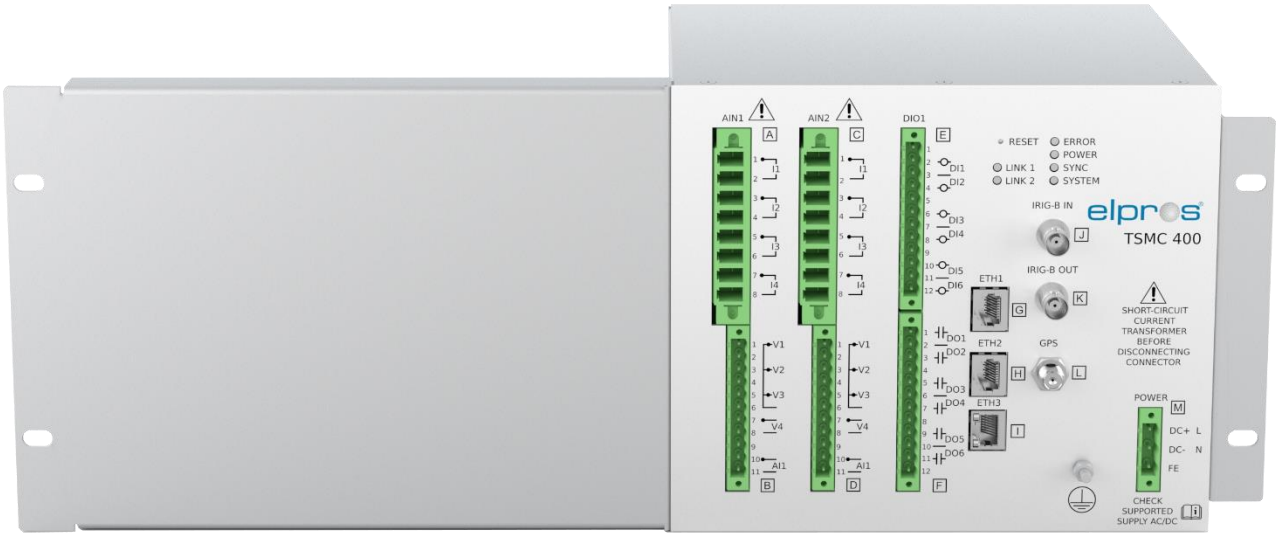

Figure 5: Single rack mount configuration

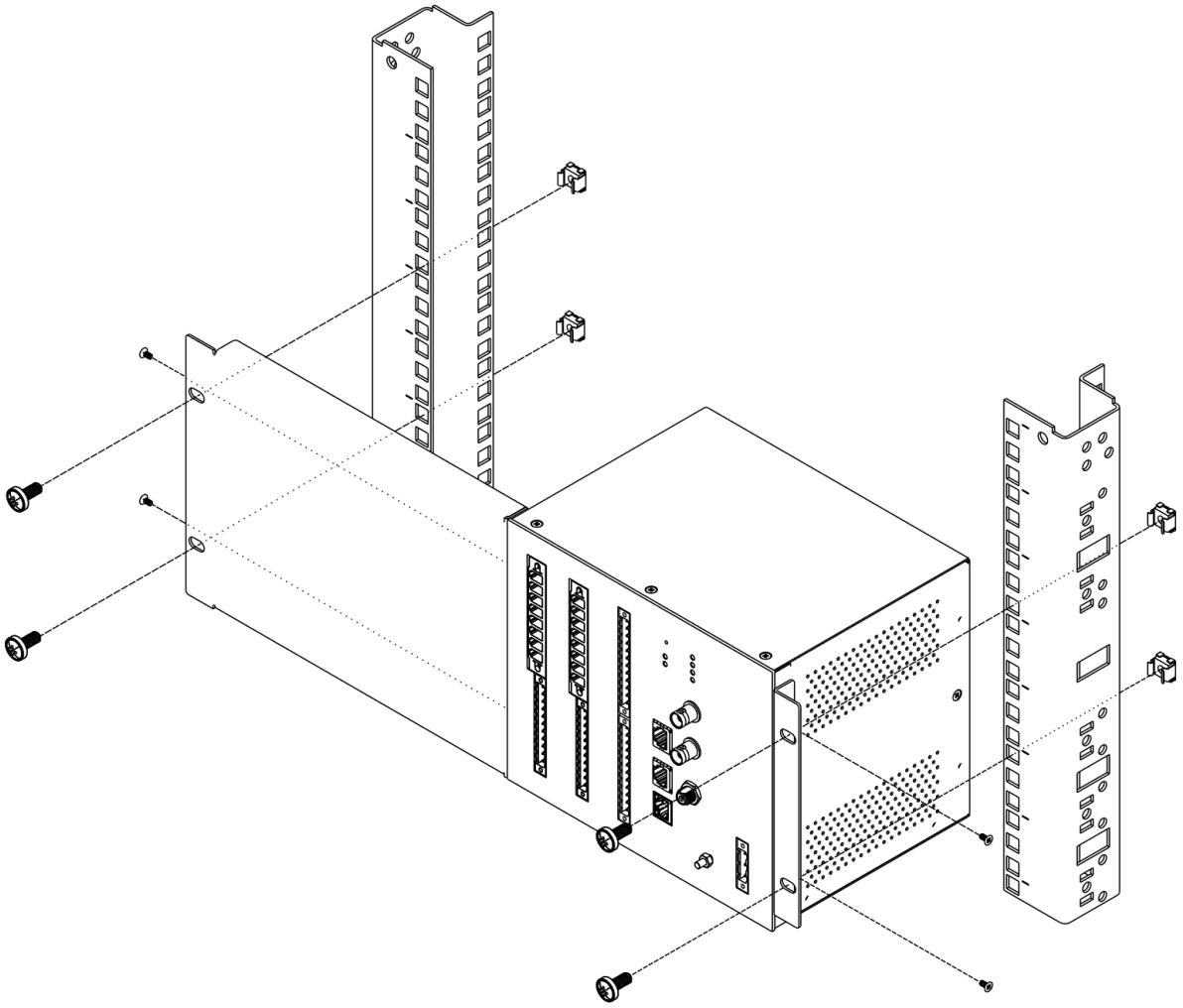

Figure 6: Single rack mount installation

3.3 Dual rack mount

Standard 19” rack mounting option for a double device installation contains six L brackets per device, see Figure 7. All brackets are screwed to the front and inside backside of device using two M3 taper screws. The two separate devices can be now screwed together using standard M6 rack screws and nuts in the front and the back, see Figure 8. The assembly can then be mounted inside a 19” rack with M6 rack-mount screws. Required rack space height is 4U.

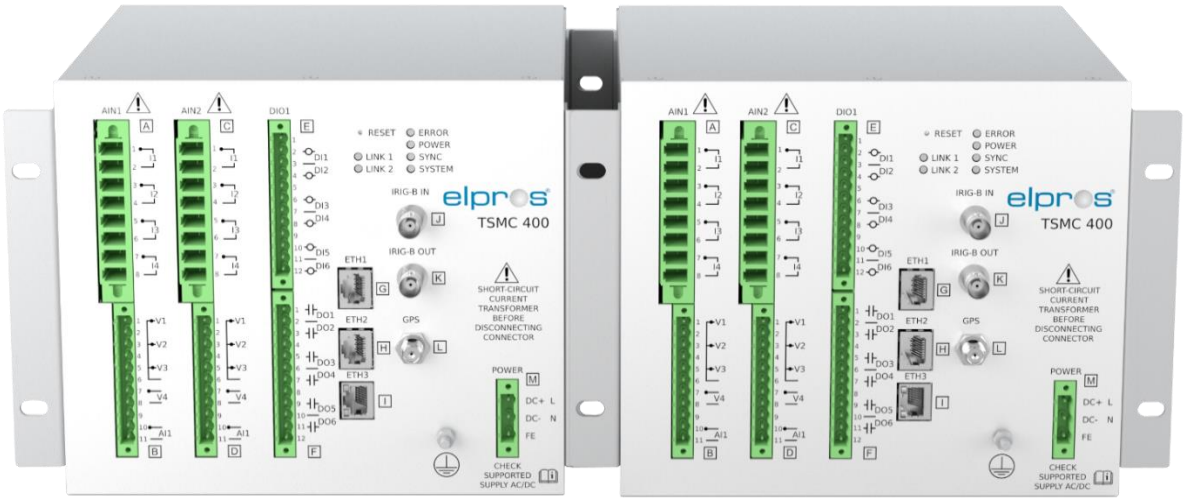

Figure 7: Dual rack mount configuration

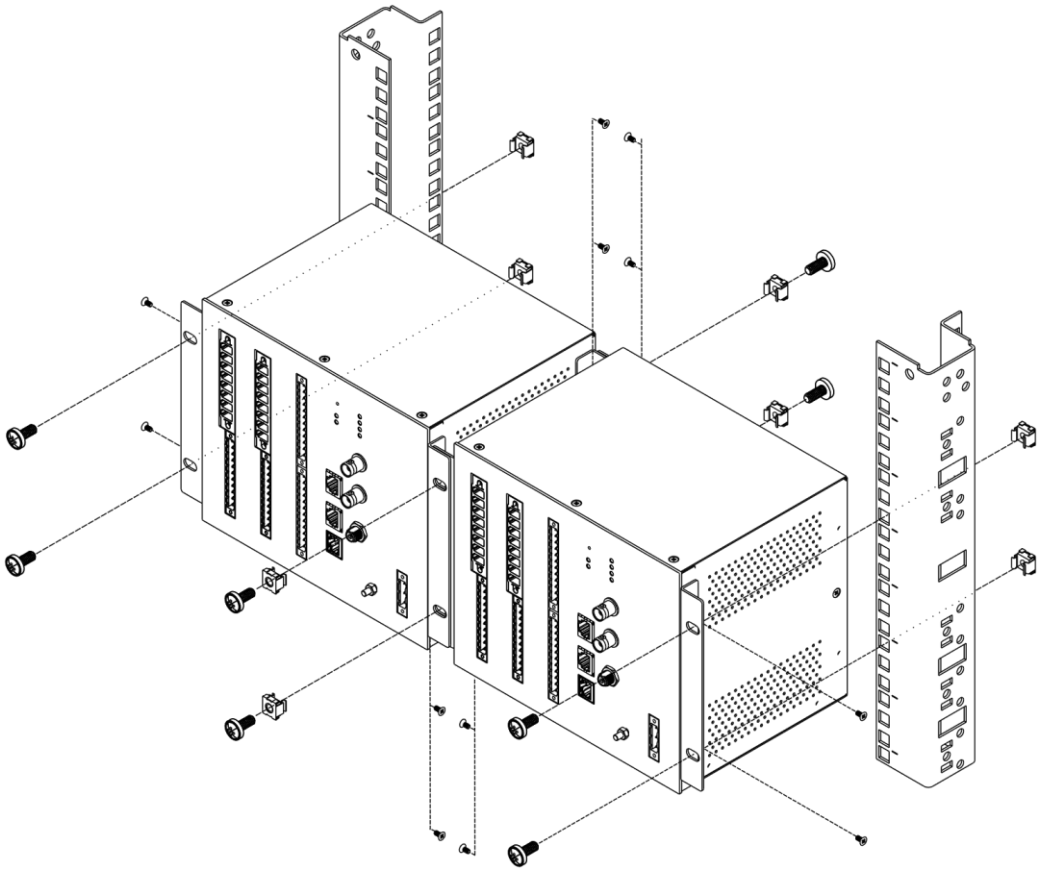

Figure 8: Dual rack mount installation

3.4 Wall mount

Wall mounting option requires two L brackets which are screwed to the back side of the device using two M3 taper screws per bracket, see Figure 9. The device can be mounted to a wall using four minimum size M5 wall screws and 8 mm wall plugs. See the assembly drawing for holes spacing and dimensions in Figure 9.

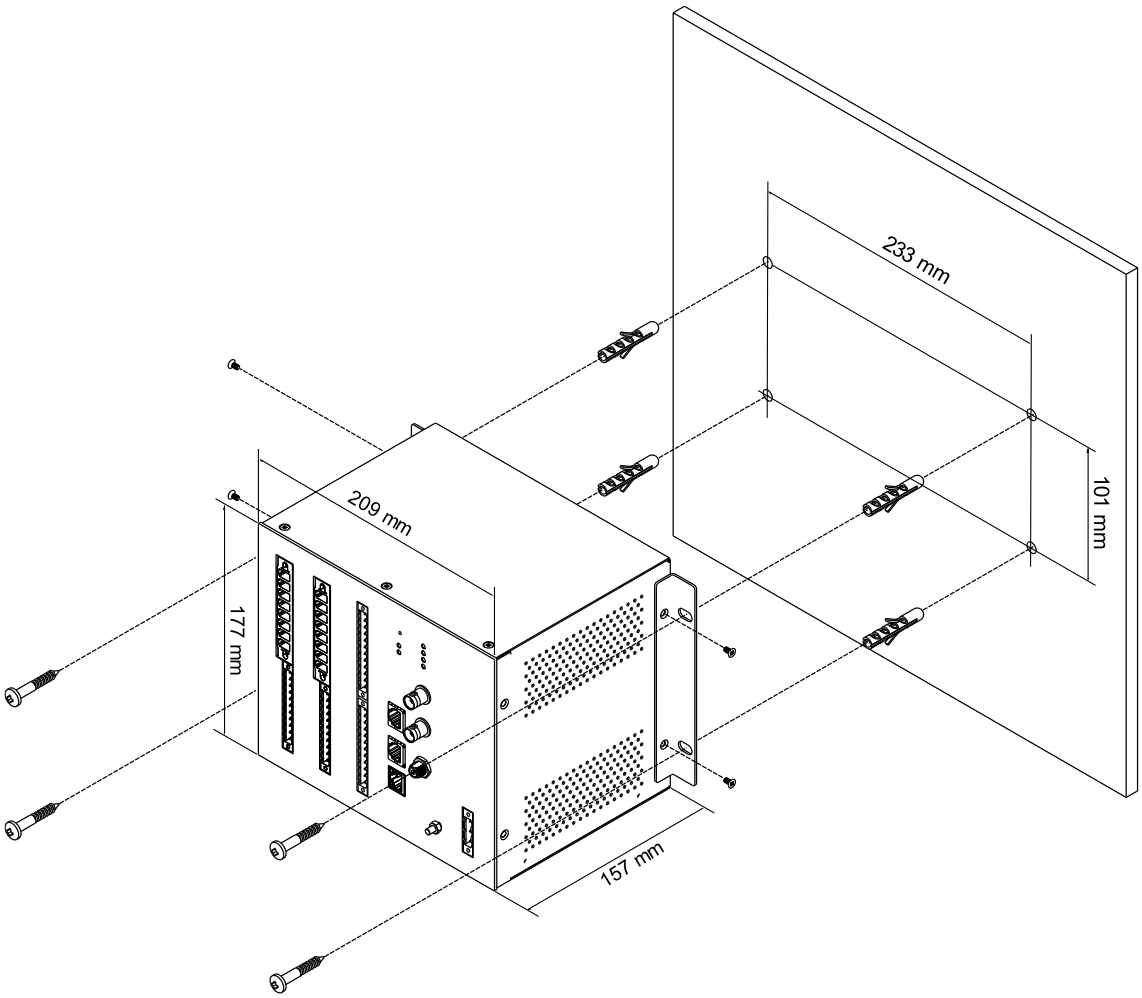

Figure 9: Wall mount installation

3.5 Surface mount

Surface mounting option requires two L brackets which are screwed to the bottom side of the device using two M3 taper screws per bracket, see Figure 10. The device can be mounted to a surface using four minimum size M5 wall screws and 8 mm wall plugs or other type of screws appropriate for the mounting surface. See the assembly drawing for holes spacing and dimensions in Figure 11.

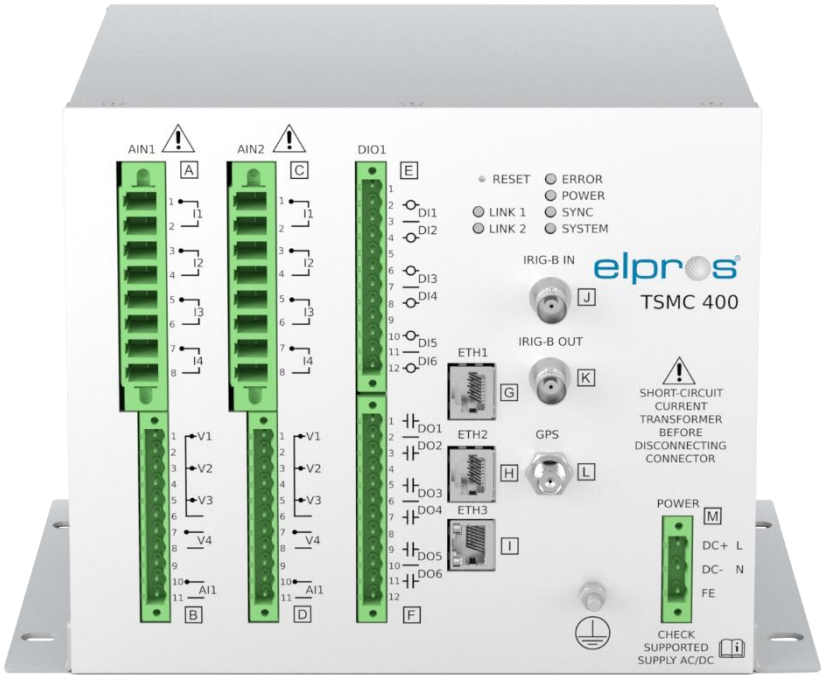

Figure 10: Surface mount configuration

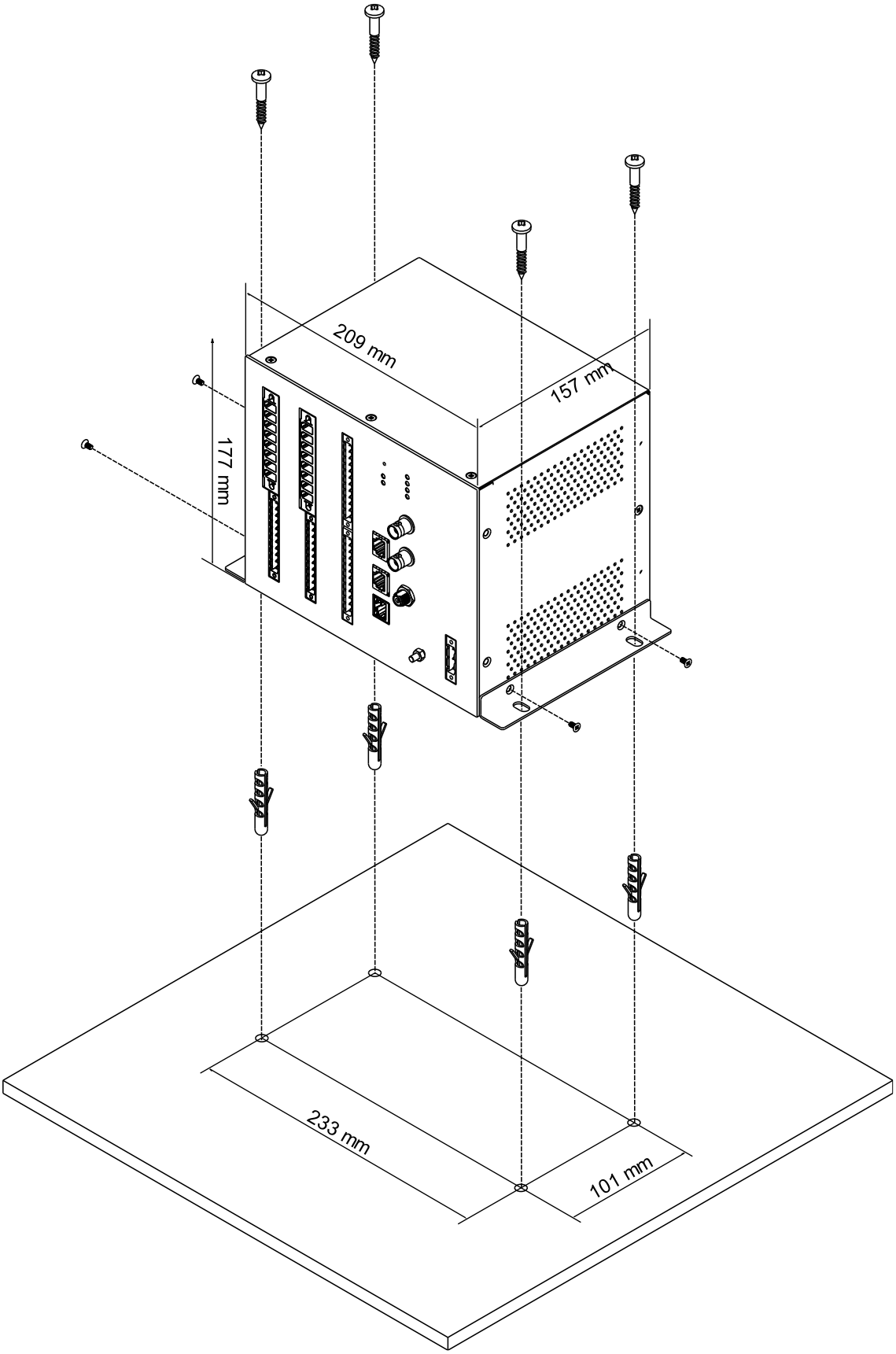

Figure 11: Surface mount installation

4 Device connection

4.1 Introduction

The TSMC400 has multiple application options thus it can be integrated in any power system on generation, transmission and distribution level.

The basic installation scheme requires the following connections:

- Power supply
- External clock reference source
- Communication
- Analog input values

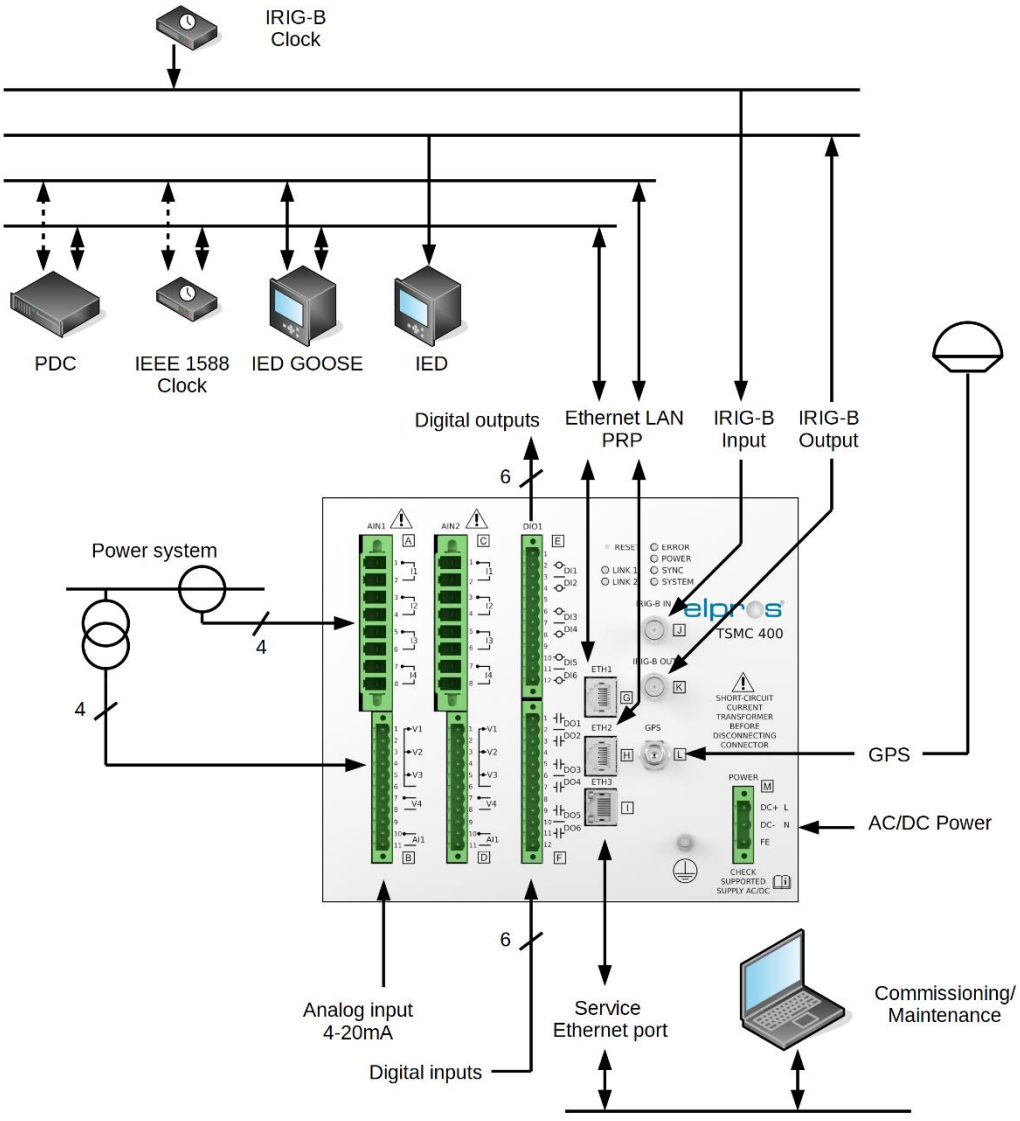

Figure 12: TSMC400 system integration overview

The example of the typical wiring diagram is given in Figure 13.

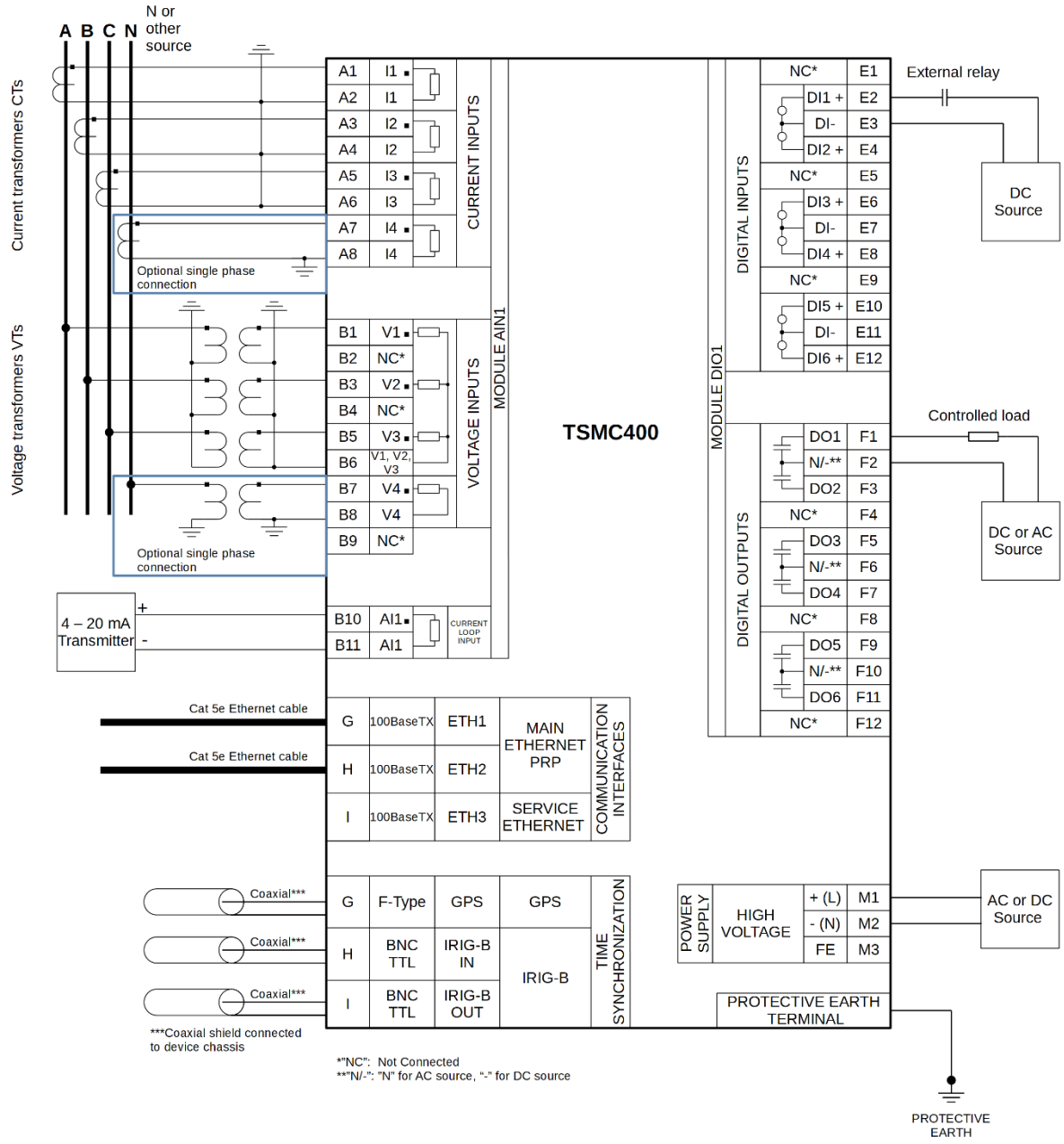

Figure 13: Typical wiring diagram

⚠	CAUTION: This diagram is based on the following order code: TSMC400/P01/A01:5M/D02/C01/T01/T02. The purpose of this diagram is to provide a typical example of the TSMC 400 wiring. Exact wiring must be considered based on your TSMC 400 device configuration.

4.2 Power supply

The TSMC 400 enables two options for power supply:

- The low voltage DC option supporting power supply from 24 to 48 V DC.

- The high voltage AC / DC option supporting power supply from 110 to 250 V DC, and 100 to 250 V AC.

Please examine the power supply rating label on the side of the device to make sure you have correctly identified the power supply.

The TSMC 400 rated power consumption is 18 W.

Power supply is connected to the M terminal connector using a supplied 3 pin 7.62 mm pitch pluggable terminal, Phoenix Contact type 1858772.

Cables with cross-sections between 0,75 mm2 and 2,5 mm2 should be used.

⚠	WARNING: Check the power supply rating label on the side of the device for the installed power supply option!

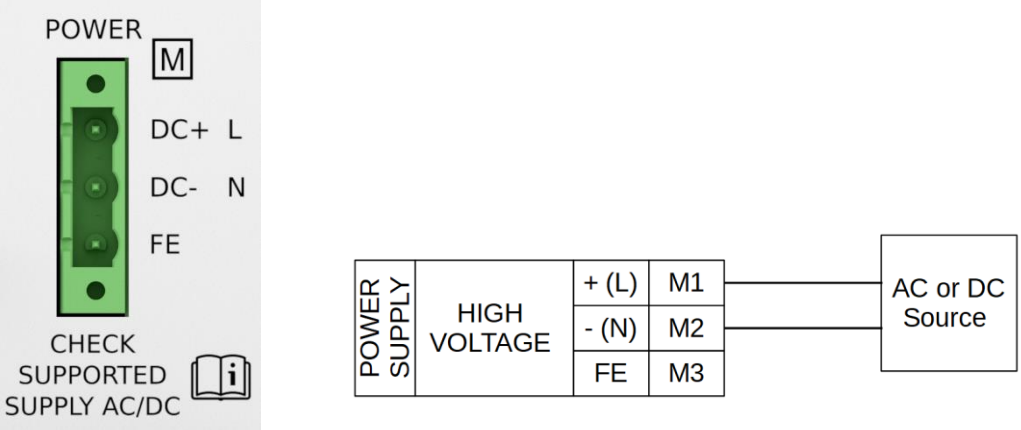

Figure 14: Power [M] connector detail and wiring diagram

4.2.1 Low voltage DC power supply

The low voltage DC power supply option supports power supply from 24 to 48 V DC. The internal power supply is galvanically isolated (test voltage 2500 V) and internally fused in the positive terminal. The internal fuse is slow-blow type rated at 4 A. The fuse is not user replaceable.

- The positive lead of the power supply should be connected to “DC+” pin 1 of the M connector.
- The negative lead of the power supply should be connected to “DC-” pin 2 of the M connector.
- The earth/ground lead of the power supply should be connected to the functional earth “FE” pin 3 of the M connector. Functional earth is internally connected to the protective earth “PE” terminal ⏚.

⚠	WARNING: The functional earth is only used for EMC immunity. It is not a safety connection!

4.2.2 High voltage AC / DC power supply

The high voltage AC / DC option supports power supply from 110 to 250 V DC and 100 to 250 V AC nominal. The internal power supply is galvanically isolated (withstand voltage 3250 V

AC) and internally fused in the positive terminal. The internal fuse is slow-blow type rated at 4 A. The Fuse is not user replaceable.

⚠	WARNING: Terminal is under high voltage when energized! Do NOT touch!

High voltage DC power supply connection:

- The positive lead of the power supply should be connected to “DC+” pin 1 of the M connector.
- The negative lead of the power supply should be connected to “DC-” pin 2 of the M connector.
- The earth/ground lead of the power supply should be connected to functional earth “FE” pin 3 of the M connector. Functional earth is internally connected to the protective earth “PE” terminal ⏚.

⚠	WARNING: The functional earth is only used for EMC immunity. This is not a safety connection!

High voltage AC power supply connection:

- The phase lead of the power supply should be connected to “L” pin 1 of the M connector.
- The neutral lead of the power supply should be connected to “N” pin 2 of the M connector.
- The earth/ground lead of the power supply should be connected to functional earth “FE” pin 3 of the M connector. Functional earth is internally connected to the protective earth “PE” terminal ⏚.

⚠	WARNING: The functional earth is only used for EMC immunity. This is not a safety connection!

4.2.3 Earthing

The device needs to be connected to the protective earth (PE) (ground) through the earthing terminal / screw (M4). An earthing wire terminated with a ring terminal is placed between the two M4 nuts and washers. Nominal cross-section of the wire should be no less than 1.5 mm2. The wire should be as short as possible.

Figure 15: Grounding terminal detail

⚠	WARNING: The device must be properly grounded before energizing any input!

4.3 Measurement inputs

The TSMC400 device enables up to two independent analog measurement input modules.

Measurements from each module are reported in a separated IEEE C37.118 data frame (this means PMU1 and PMU2).

4.3.1 AC voltage inputs

Voltage transformers (VT) secondary should be connected to the B and D (for two analog module option) terminal. The plugin terminal is an 11 pole 5.08 mm pitch Phoenix Contact type 1778072. Three channels with a common ground and single channel inputs are provided for each terminal. Pins 1 to 6 are used for three-phase source while pins 7-8 are used for single-phase source.

AC voltage terminal supports phase to ground voltages up to 250 V AC. The three channels with a common ground and single channel inputs are galvanically insulated between each other and from the system ground. The tested withstand voltage is 3250 V AC. The resistance between inputs V1, V2, V3 (pins 1, 3 and 5) and neutral (pin 6) and V4 (pin 7) and neutral (pin 8) is 900 Ω. Input burden of each input is less than 0.1 VA.

	WARNING: Terminal under high voltage when energized! Do NOT touch!

	WARNING: Do not exceed maximum voltage limit of 250 V rms!

Three phase voltage connection:

- Phase voltages from VT secondary should be connected to V1 (phase A), V2 (phase B) and V3 (phase C) inputs, pins 1, 3 and 5.
- Neutral voltage from VTs should be connected together to pin 6 and grounded for safety.

Auxiliary single-phase voltage connection:

- Phase voltage from VT secondary should be connected to V4 input, pin 7.
- Neutral voltage from VT should be connected to pin 8 and grounded for safety.

	WARNING: Pins 2, 4 and 9 must be left unconnected

Cables with cross-sections between 0,75 mm2 and 2,5 mm2 should be used.

Shielded cables are recommended for maximum analog measurement signal integrity.

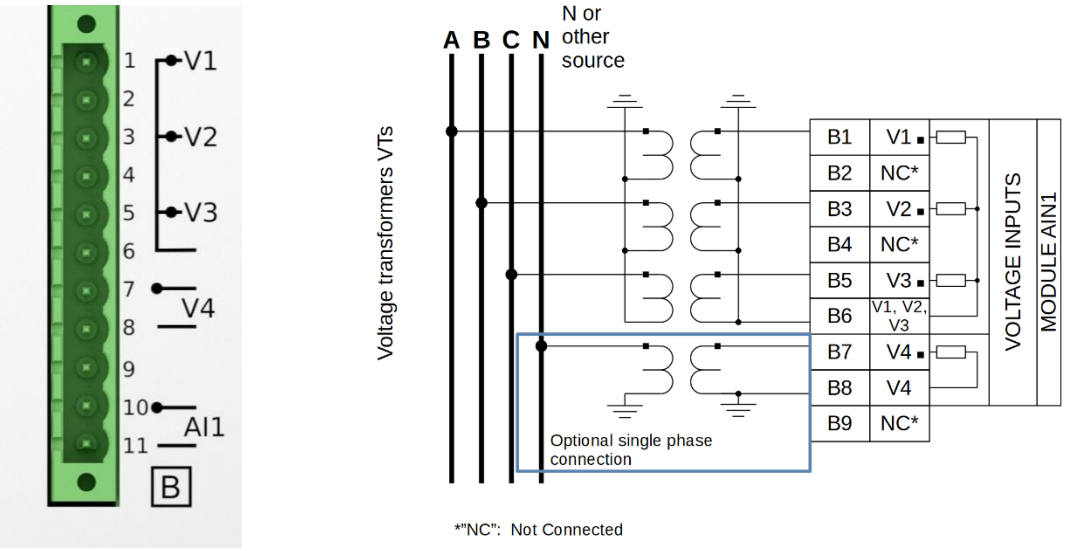

Figure 16: AC voltage input connector (left), wiring diagram (right)

AC current inputs

Current transformers (CT) secondary should be connected to the A and C (two analog card option) terminal. The plugin terminal is a 11 pole 7,62 mm pitch Phoenix Contact type 1720851. Four independent measurement channels are provided for each terminal.

The TSMC400 supports nominal currents (In) of 1 or 5 A (depending on order option).

Current inputs withstand overload current of 100 times rated current for 1 second. Current inputs are galvanically insulated from each other and from system ground (test voltage 3000 V AC). Input resistance of the inputs is less than 10 mΩ. Input burden of each input is less than 0.1 VA.

⚠	WARNING: Before disconnecting / removing A or C terminal or any of the wires connected to this terminal, the current transformer secondary outputs must be SHORTED!

⚠	WARNING: Terminal under high voltage when energized! Do NOT touch!

Phase current measurement transformers connection:

- Phase currents from CT secondary should be connected to I1 (phase A), I2 (phase B) and I3 (phase C) inputs, pins 1, 3 and 5. Additional current input is available. It should be connected to pin 7.
- Neutral current from CT should be connected to I1, I2, I3 and I4 inputs, pins 2, 4, 6 and 8 and grounded for safety.

Cables with cross-sections between 2,5 mm2 and 6,0 mm2 should be used.

Cables should be as short as possible with as big as possible cross-section to reduce resistive losses and heating in the cabling. Shielded cables are recommended for maximum analog measurement signal integrity.

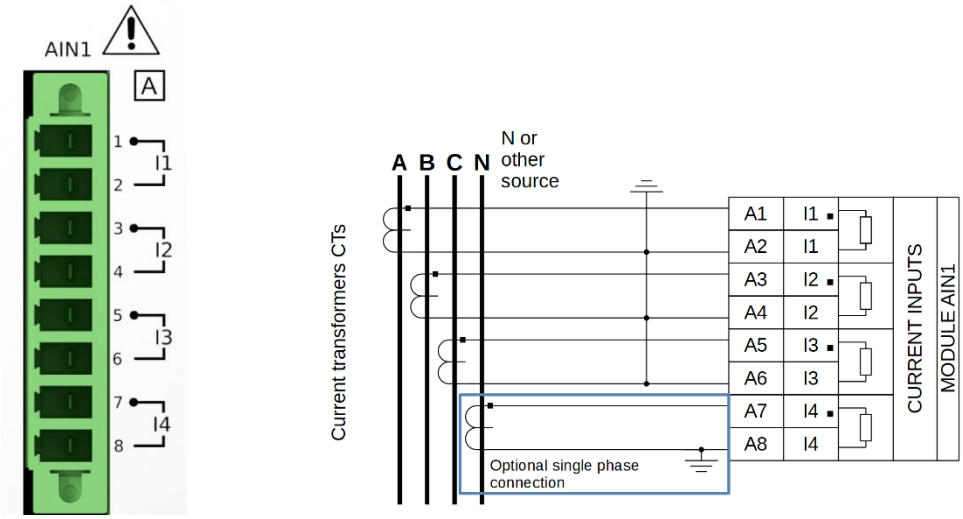

Figure 17: AC current measurement [A][C] connector detail (left) and wiring diagram (right)

4.3.2 DC current loop 4 – 20 mA input

Transducer with 4 - 20 mA outputs can be connected to the B and D (two analog card option) terminal. The plugin terminal is 11 pole 5.08 mm pitch Phoenix Contact type 1778072. One independent measurement channel is provided per terminal.

Current loop power supply is up to 24 V DC are supported. Current loop input is galvanically insulated from system ground (test withstand voltage 2000 V). Input is protected against reverse polarity and over current, cut of current ~30 mA. Input resistance is ~30 Ohm.

Transducer current loop connection:

- Positive current loop output should be connected to A1 pin 10.
- Negative current loop output should be connected to A1 pin 11.

Cables with cross-sections between 0,75 mm2 and 2,5 mm2 should be used. Shielded cables are recommended for maximum analog measurement signal integrity.

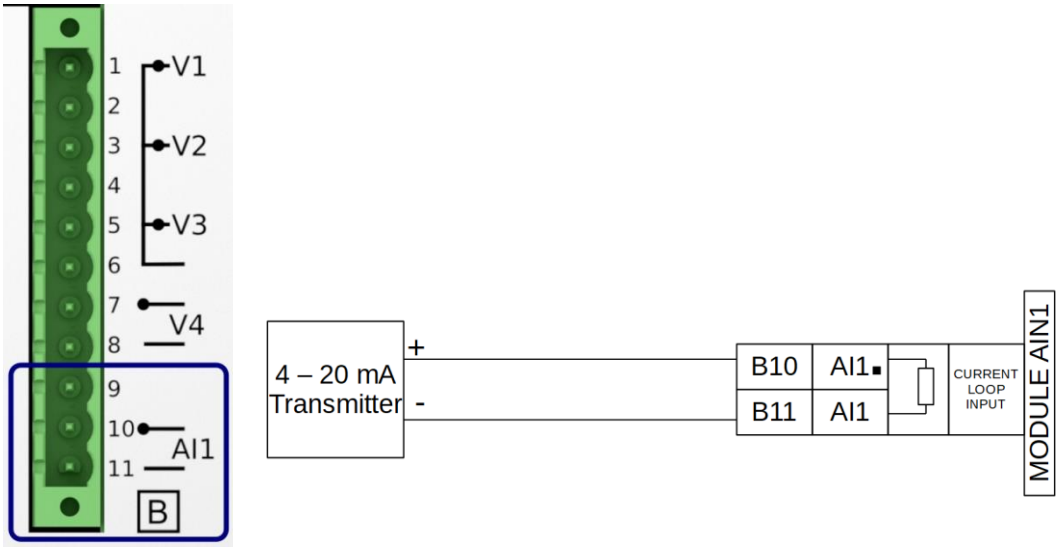

Figure 18: DC current loop [B][D] connector detail (in blue square)

4.4 Digital input/output module

Digital input/output module has 24 terminal connections for 6 digital inputs and 6 digital outputs. Digital inputs are on terminal E and digital outputs are on terminal F.

4.4.1 Digital inputs

Digital inputs plugin terminal is a 12 pole 5.08 mm pitch Phoenix Contact type 1778085.

Inputs are of opto-coupler type and are available in three voltage options:

- 24 - 48 V DC (internal resistance 33 kΩ), threshold voltage ~3 V.
- 125 V DC (internal resistance 132 kΩ), threshold voltage ~12 V.
- 220 V DC (internal resistance 272 kΩ), threshold voltage ~24 V.

The inputs are grouped in pairs. Each pair has a common pin for negative voltage. The input pairs are galvanically insulated from each other and from ground (withstand voltage 3250 V AC). Digital inputs pairs are:

- DI1 and DI2
- DI3 and DI4
- DI5 and DI6

Digital inputs are used for custom applications. They can be connected for example to circuit breaker or isolation switches position contacts, protection relays or other devices.

Input connection:

- For user configurable digital input 1 positive voltage should be connected to DI1 pin 2
- For user configurable digital input 2 positive voltage should be connected to DI2 pin 4
- Negative voltage should be connected to pin 3 for DI1 and DI2.
- For user configurable digital input 3 positive voltage should be connected to DI3 pin 6
- For user configurable digital input 4 positive voltage should be connected to DI4 pin 8
- Negative voltage should be connected to pin 7 for DI3 and DI4.
- For user configurable digital input 5 positive voltage should be connected to DI5 pin 10
- For user configurable digital input 6 positive voltage should be connected to DI6 pin 12
- Negative voltage should be connected to pin 11 for DI5 and DI6.

WARNING: Pins 1, 5 and 9 should not be connected.

Cables with cross-sections between 0,75 mm2 and 2,5 mm2 should be used.

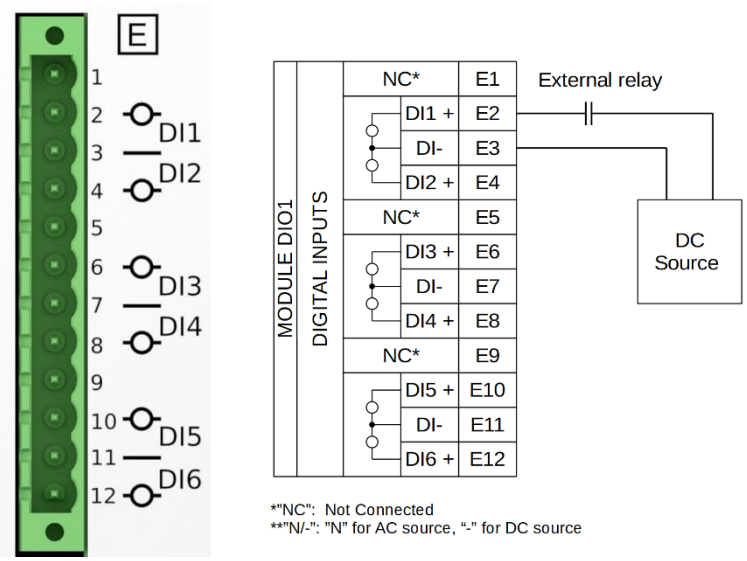

Figure 19: Binary input [E] connector detail

4.4.2 Digital outputs

Digital outputs plugin terminal is a 12 pole 5.08 mm pitch Phoenix Contact type 1778085.

Outputs are of bi-stable relay type and do not change state if power is removed from device.

Relay loading:

- AC type loads: maximum voltage: 250 V AC, maximum current: 4 A.
- DC type loads: maximum voltage: 300 V DC, maximum current: 300 mA

The outputs are grouped in pairs and each pair has a common pin. The output pairs are galvanically insulated from each other and from ground (withstand test voltage 3250 V AC).

Digital outputs pairs are

- DO1 and DO2
- DO3 and DO4
- DO5 and DO6

Outputs connection:

- Positive voltage should be connected to DO1 pin 1.
- Positive voltage should be connected to DO2 pin 3.
- Neutral/Negative voltage should be connected to pin 2 for DO1 and DO2.
- Positive voltage should be connected to DO3 pin 5.
- Positive voltage should be connected to DO4 pin 7.
- Neutral/Negative voltage should be connected to pin 6 for DO3 and DO4
- Positive voltage should be connected to DO5 pin 9.
- Positive voltage should be connected to DO6 pin 11.
- Neutral/Negative voltage should be connected to pin 10 for DO5 and DO6

⚠	WARNING: Pins 4, 8 and 12 should not be connected.

Cables with cross-sections between 1,0 mm2 and 2,5 mm2 should be used.

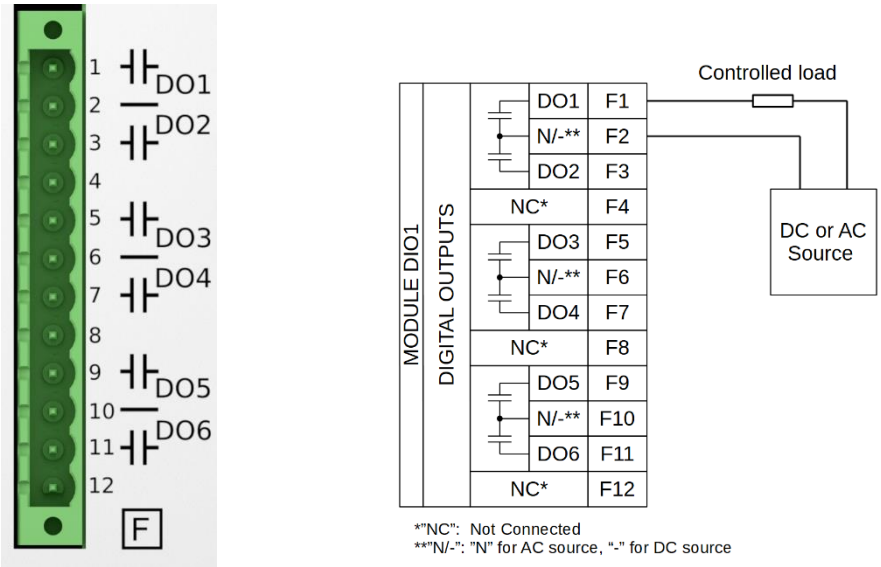

Figure 20: Binary outputs [F] connector detail

4.5 Communication links

The TSMC400 provides 3 Ethernet ports:

- Port 1 (ETH1) and 2 (ETH2) are main Ethernet ports and can be configured for C37.118 communications, time synchronization and secured access to web interface and configuration tools.
- Port 3 (ETH3) is a service local port used for configuration and commissioning.

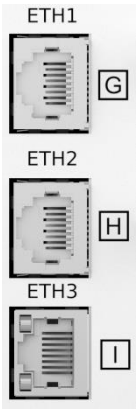

Figure 21: Communication links

4.5.1 Main PRP Ethernet interface

The main Ethernet interface ETH1 G and ETH2 H supports the Parallel redundancy protocol (PRP). Multiple option for the physical interface are available:

- Copper Ethernet connection (100BASE-TX, Full-Duplex) with RJ-45 shielded connector. Minimum CAT5e UTP cable is required. Maximum length of cable can be 100m. Shielded Ethernet cables SFTP are recommend for maximum immunity against external interference.
- Fibre-optic connection (100BASE-FX, Full-Duplex) with ST or SC type connector. Fibre-optic multimode type cable should be used. Maximum length of cable can be 2 km.

- SFP connection (100BASE-X SFP, Full-Duplex, MSA Standard). This connection supports SFP 100BASE-X modules with different fibre-optic connectors and cable types. Cable type and maximum length depend on the SFP module selected.

The device can be connected to a redundant PRP network through the main Ethernet interface using the two Ethernet ports (ETH1 (G), ETH2 (H)). If the device is connected to a non-PRP network either of the two ports can be used but use only one.

4.5.2 Service Ethernet interface

The Service Ethernet interface ETH3 is provided for on-site configuration and commissioning of the TSMC400.

Physical interface of the management Ethernet port is 100BASE-TX, Full-Duplex, RJ45 shielded connector.

The interface is intended only for onsite configuration and should not be connected to a permanent network. Maximum cable length is 3 m.

The Ethernet service port (RJ45 connector) is by default configured with:

- IP Address: 192.168.255.10
- Network Mask: 255.255.255.0

This configuration is hardcoded and cannot be changed.

4.6 Clock synchronization

Multiple options are provided for time synchronization inputs and outputs. The internal clock based on a stable OCXO (Oven Controlled Crystal Oscillator), is frequency and time locked to an external time source. Multiple inputs can be used simultaneously in a redundant configuration.

4.6.1 GPS input (option)

An internal GPS receiver is provided for time synchronization. The GPS antenna is connected to GPS L input by coaxial cable. The GPS input supports F-type connector. Antenna LNA 5 VDC current limited power supply is integrated in the device.

The following GPS antenna cables should be used:

- RG6 type coaxial cable lengths up to 30 m.
- RG11 type coaxial cable for lengths beyond 30 m and up to 90 m

Lengths beyond 90 m are not supported.

The GPS antenna should be installed outside of the building on an antenna mast. Coaxial cable, antenna and mast should be grounded according to local regulations. The GPS antenna should have full visibility of the sky. At least 1 m space should be around the antenna that is free of metallic object or other antennas. A RF surge arrestor should be installed on the antenna cable entry into to the building on the inside of the building and properly grounded.

Figure 22: GPS antenna [L] connector detail

4.6.2 IRIG-B (option)

The TSMC400 can be connected to existing time sources and equipment by an IRIG-B interface.

Figure 23: IRIG-B input [J] and output [K] connectors

4.6.2.1 IRIG-B Input

IRIG-B time source can be connected to the IRIG-B IN input supporting coaxial BNC type connector.

The IRIG_B input supports unmodulated 5 V TTL level time codes. Input resistance 10 kΩ.

The IRIG-B IEEE 1344 extension is supported for additional time source information reception.

IRIG-B time source should be connected by RG58 type coaxial cables to assure the best performance.

Cabling can be daisy chained from device to device using BCN T splitters. For cabling detail refer to the time source manual.

4.6.2.2 IRIG-B output

If IRIG -B output is used for synchronisation of other devices then the TSCM400 unit must be time synchronised by GPS or PT.

The IRIG-B output is of the unmodulated 5 V TTL type. Output driver strength 100 mA, output resistance 30 Ohm.

IRIG-B output should be connected by RG58 type coaxial cables to assure the best performance.

Cabling can be daisy chained from device to device using BCN T splitters.

Connection of an IRIG-B time device:

When connecting multiple devices in parallel to the output the driver strength and output resistance must be observed. It is recommended not to exceed 50 mA of load current. To estimate the load current the lump resistance of all the devices that will be connected to the IRIG-B output must be established. The lump resistance is the resistance of each device connected in parallel:

$$R_{lump} = R_{d1} \| R_{d2} \| R_{d3} \| \dots$$

The current of the IRIG-B output can be calculated as:

$$I_{IRIG-B\ OUT} = \frac{5\ V}{R_{lump}}$$

Length of the cable is limited by the electrical interference and voltage drop. It is recommended that the combined resistance of the signal and signal return conductor does not exceed 10 Ohm.

4.6.3 IEEE 1588 PTP

Main Ethernet interface (G and H) supports:

- PTP over IEEE 802.3,
- Peer to Peer (P2P) mode (IEEE 1588 v2, Annex F) for non-PRP networks and PTP over PRP,
- Peer to Peer (P2P) mode (IEC 62439-3 Ed 2.0 Annex A).

The implementation supports Ordinary Clock mode as slave and the Power Profile.

Network switchers between the device and grandmaster supporting PTP protocol IEEE 1588 PTP should be used to assure correct operation of time synchronisation.

5 Compliance with type tests

5.1 Electromagnetic compatibility

Test	Reference standard	Type test values
Dielectric withstand voltage analogue inputs and digital I/O	IEC 60255-27	2200 VRMS for 1s
Dielectric withstand voltage communication (excluding GPS)	IEC 60255-27	1650 VRMS for 1s
Surge immunity test	IEC 60255-27	2-4 kV, 1.2/50 us high energy
Fast transient disturbance	IEC 60255-26	4 kV
1 MHz burst disturbance	IEC 60255-26	2.5 kV
Electrostatic discharge Air	IEC 61000-4-2	8 kV
Electrostatic discharge Contact	IEC 61000-4-2	6 kV
Radiated emission immunity	IEC 60255-26	10 V/m, 80-1000 MHz, 1.4-2.7 GHz
Conducted emission immunity	IEC 60255-26	10 V, 0.15-80 MHz
Radiated emission	IEC 60255-26	30-5000 MHz
Conducted emission	IEC 60255-26	0.15-30 MHz

5.2 Insulation

Test	Reference standard	Type test values
Dielectric withstand voltage analogue inputs and digital I/O	IEC 60255-27	2200 VRMS for 1s
Dielectric withstand voltage communication (excluding USB, GPS)	IEC 60255-27	1650 VRMS for 1s
Surge immunity test	IEC 60255-27	2-4 kV, 1.2/50 µs high energy

5.3 Environmental tests

Test	Type test values
IP rating for enclosure	IP30
IP rating for connectors	IP20
Maximum altitude	2000m
Operating temperature range	-40 °C to +65 °C
Storage temperature range	-40 °C to +85 °C
Relative humidity (R.H.)	< 95% without condensation

5.4 CE Compliance

Test	According to
Immunity	EN 60255–26
Emissivity	EN 60255–26

Low voltage directive	EN 60255–27

5.5 Mechanical tests

Test	Reference standard	Type test values
Mechanical vibration	IEC 60255-21-1	Class I
Mechanical vibration	IEC 60255-21-1	Class II
Mechanical shock	IEC 60255-21-2	Class I
Mechanical bump	IEC 60255-21-2	Class I
Mechanical seismic	IEC 60255-21-3	Class I

5.6 Materials

Used materials	According to
Materials	RoHS

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