elpros®

Electronic & Programming Systems

TSMC 400

Time
Synchronised
Measurement
&
Control Unit

SMART GRID SOLUTIONS

Trademarks and brands

UniFusion® - registered trademark of ELPROS

WAProtector™ - trademark of ELPROS

TSMC 400™ - trademark of ELPROS

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Time Synchronised Measurement & Control unit

The ELPROS Time Synchronised 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 as ELPROS WAProtector^{TM} system offers complete technical platform for complex solutions on regional and wide area level.

TSMC unit APPLICATIONS

TSMC unit has implemented different applicational logical interfaces. All logical interfaces are complied with international standards and are compatible with third party vendors which comply with standards. Logical interfaces which are supported are:

❖ IEEE C37.118 PMU (Phasor Measurement Unit) standard for data exchange.
❖ IEC 61850 GOOSE (Generic Object-Oriented Substation Event) data exchange.

IEEE C37.118 Phasor Measurement Unit (PMU)

PMU functionality is a key element of the Wide Area Measurement System. PMU functionality inside the TSMC unit enables:

❖ Communication and measuring by the IEEE C37.118 requirements for both M and P class accuracy.
❖ Mapping the GOOSE messages into the IEEE C37.118 communication protocol for time synchronised data exchange.
❖ Time synchronisation by four time-synchronisation options GPS/PTP1588/IRIG-B/PPS.
❖ Off-line data exchange by IEEE C37.118 communication protocol with vendor extension. Such solution is optimal for data exchange in communication infrastructure with low reliability.
❖ Control commands activation by IEEE C37.118 communication protocol with vendor extension. Such solution is optimal for control actions which require short communication delays. It enables activation of the physical relays in TSMC unit or relays over GOOSE messages which are available in the substation.

PHASOR MEASUREMENT COMMUNICATION	
Communication interface	Data Ethernet ports
Number of user configurable virtual PMUs	4
Number of the simultaneously sessions	2
IP transport	UDP, TCP

PMU communication standard	IEEE C37.118.2-2011
Nominal frequency	50 Hz or 60 Hz
Reporting rate (50Hz)	1, 10, 25, 50, 100, 200
Reporting rate (60Hz)	1, 10, 12, 15, 20,30, 60, 120, 240
Reporting number format	Integer or float (IEEE Std 754)
Phasor format	Rectangular or polar

PHASOR MEASUREMENT METERING	
Accuracy class	M and P
Total Vector Error (TVE)	<0.50% in steady state conditions
Frequency accuracy	<5mHz in steady state conditions
Complying PMU measuring standard	IEEE C37.118.1-2014/2018

IEC 61850-8-1 GOOSE data exchange

IEC 61850 GOOSE (Generic Object-Oriented Substation Event) data exchange is a new way of data exchange in digital substation which does not need the physical wiring. GOOSE messages provide very efficient way of using the data information from the whole substation. It enables sharing of information and physical resources.

The TSMC unit enables using the GOOSE messages for different applications as:

❖ GOOSE messages mapping in the time synchronised data exchange by IEEE C37.118 protocol of digital statuses in the substation which are available on the technical network.
❖ Control actions send over IEEE C37.118 with vendor control option and message distributed over GOOSE messages.

IEC61850 GOOSE options	
Protocol standard	IEC 61850-8-1 GOOSE
Maximal number of GOOSE mapped digital statuses in IEEE C37.118	2 x 16
Maximal number of the GOOSE commands mapped for distribution	1 x 16

TSMC unit PHYSICAL INTERFACES

TSMC 400 series is a device 4U x 1/2 19' rack size. It enables up to 2 analogue input cards in combination of one digital DIO card and different options of the integrated time synchronisation clocks and power supply.

The TSMC unit combines the data acquisition from different sources as:

❖ AC currents and voltages from conventional current and voltage transformers (CTs and PTs).
❖ DC 4-20ms input from different sensors which support such outputs.
❖ Digital inputs and outputs from directly wired sources.
❖ Digital inputs and outputs by GOOSE messages.

All data is time synchronised with different time synchronisation options.

The data exchange with the higher-level systems is carried out according to internationally standardised communication protocols.
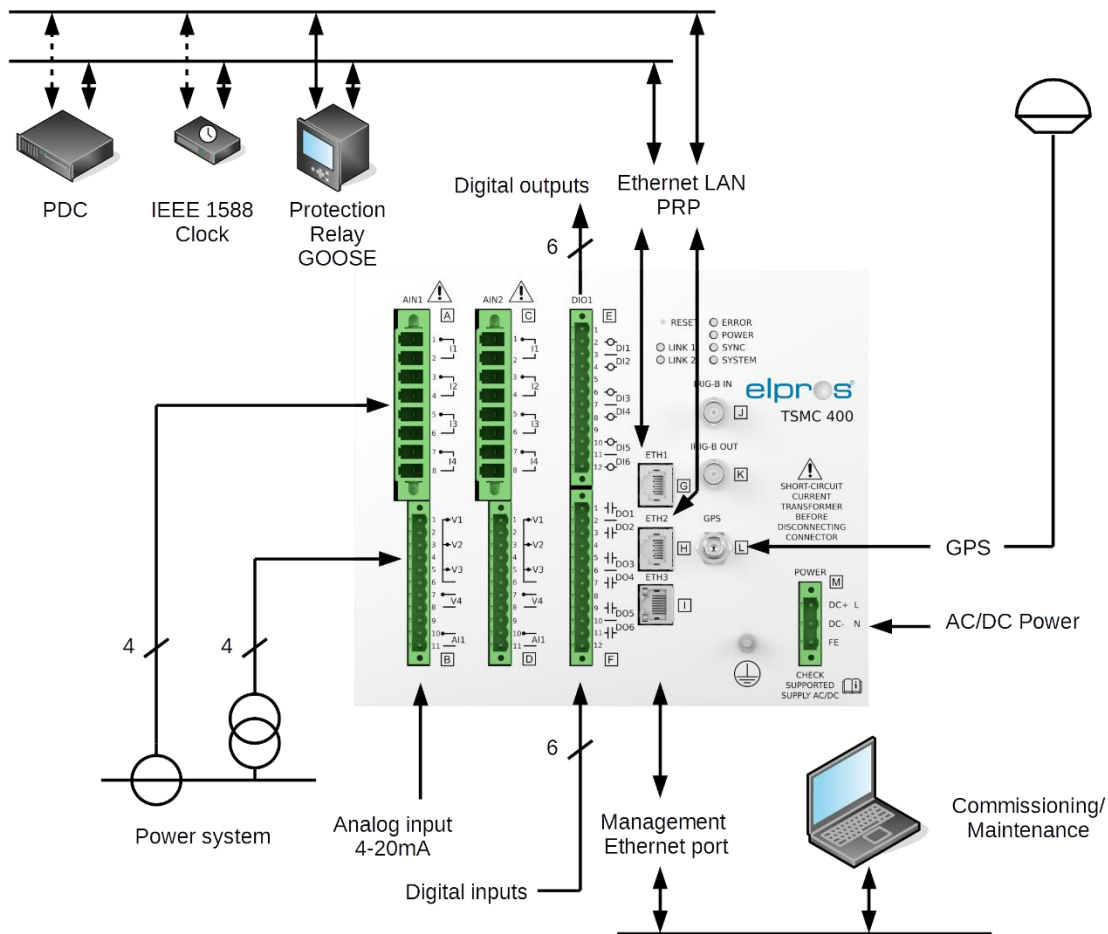

Figure 1: TSMC in relation between measurement and information infrastructure

Central Processor Unit (CPU)

The TSMC processor unit provides 3 integrated ethernet ports and integrated PTP clock:

❖ Port1: data transfer and time synchronisation by IEEE 1588 (PTP) protocol; (PRP redundant with port2).
❖ Port2: data transfer and time synchronisation by IEEE 1588 (PTP) protocol; (PRP redundant with port1).
❖ Port3: local use for TSMC unit configuration management.

CPU	
Processor	Cortex A9 @ 1GHz
RAM	256MB
Permanent storage	4GB
CPU Integrated Time Synchronisation Clock	
Clock type	IEEE PTP 1588
SNTP client	
Ethernet 1	

Interface	100/10BASE	
Connector	Option1: copper Ethernet connections (100BASE-T) with RJ-45 connectors	C01
	Option2: fibre-optic connections 100BASE-FX with ST type connectors	C02
	Option3: SFP port (100BASE-X, Full-Duplex, MSA Standard)	C03
Isolation RJ-45	1500 VRMS	
Function	Data transfer, IEEE PTP 1588 (PRP redundant)	
Ethernet 2		
Interface	100/10BASE	
Connector	Option1: copper Ethernet connections (100BASE-T) with RJ-45 connectors	C01
	Option2: fibre-optic connections 100BASE-FX with ST type connectors	C02
	Option3: SFP port (100BASE-X, Full-Duplex, MSA Standard)	C03
Isolation RJ-45	1500 VRMS	
Function	Data transfer, IEEE PTP 1588 (PRP redundant)	
Ethernet 3		
Interface	100/10BASE	
Connector	RJ-45	
Isolation RJ-45	1500 VRMS	
Function	Management port	

Analog Inputs (AI)

AC analogue inputs enables precise measuring of the electrical values with possibility of monitoring fast dynamical phenomena. Data exchange allows data frames transmission up to 256 samples per period of the nominal frequency.

DC inputs enables connection of different additional sensors for time synchronised monitoring measuring which are important for control systems and analysis. An example of using DC input are sensors for direct measuring rotation of the generator rotor in power plants.

VOLTAGE INPUTS	
Number of inputs	4 (3 with common ground, 1 differential)
Measurement input range	250 VRMS
Isolation	5000 VRMS
Connector	Terminal type, screwable flange, 5,08 mm pitch, conductor cross section max. 2,5 mm^2
Range	Nominal:100V/110V, Max range: 2.5 x Nominal
Accuracy	0,1%
CURRENT INPUTS	
Number of inputs	4
Measurement input range	1 ARMS
Burden	0,02 Ohm
Isolation	5000 VRMS

Connector	Terminal type, screwable flange, 7,62 mm pitch, conductor cross section max. 6 mm^2	
Range	Nominal:1A, Type:M, Max range: 5xNominal	A01
Range	Nominal:1A, Type:P, Max range: 80xNominal	A03
Range	Nominal:5A, Type:M, Max range: 5xNominal	A02
Range	Nominal:5A, Type:P, Max range: 80xNominal	A04
Accuracy	Type:M 0.1%, Type:P 1%	
ANALOG 4-20mA INPUTS		
Number of inputs	1	
Burden	21,5 Ohm	
Isolation	1500 VRMS	
Connector	Terminal type, screwable flange, 5,08 mm pitch, conductor cross section max. 2,5 mm^2	

Digital Inputs/Outputs (DIO)

Digital inputs are important for control systems. Digital inputs enable time synchronized monitoring of the dynamical phenomena with system statuses which are crucial for correct real-time data analysis in the case of control systems.

Digital outputs enable control actions directly from the TSMC device. Such solution is optimal in case of the control actions which require short delays between detection and control reaction. Option is suitable for WAMPAC systems which operates with activation of the RAS/SIPS scenarios.

DIGITAL INPUTS		
Number of inputs	6	
Voltage rating options	48V	D01
	125V	D02
	220V	D03
Isolation	5300 VRMS	
Isolation between channels	Functional	
Burden	2mA to 4mA	
Connector	Terminal type, screwable flange, 5,08 mm pitch, conductor cross section max. 2,5 mm^2	
DIGITAL OUTPUTS		
Number of outputs	6	
Type	Relay Form A	
Rating AC	250 VRMS @ 4A	
Rating DC	250 V @ 300mA	
Isolation	5000 VRMS	
Isolation between channels	Functional	
Connector	Terminal type, screwable flange, 5,08 mm pitch, conductor cross section max. 2,5 mm^2	

Power Supply (PS)

Power supply is available in two options:

- ❖ AC/DC is combined powers supply which operates in wide range of the AC and DC voltage.
- ❖ DC is power supply which operates in industrial DC voltage range.

POWER SUPPLY		P01
Power supply rating, high voltage option	85-264 VRMS 47-63 Hz or 110-370VDC	

Isolation	3000 VRMS	
Fuse	Internally fused, not user replaceable	
Connector	Terminal type, screwable flange, 7,62 mm pitch, conductor cross section max. 2,5 mm^2	
POWER SUPPLY		P02
Power supply rating, low voltage DC option	24-48VDC	
Isolation	1500 VRMS	
Fuse	Internally fused, not user replaceable	
Connector	Terminal type, screwable flange, 7,62 mm pitch, conductor cross section max. 2,5 mm^2	

Time Synchronisation Clock (TSC)

The TSMC's time synchronization can be achieved with CPU integrated PTP clock or with two additional options:

❖ GPS clock.
❖ IRIG-B/1PPS clock.

TIME SYNCHRONIZATION CLOCK		T01
Clock type	IRIG-B/1PPS	
Connector	Coaxial BNC In, BNC Out	
Maximum cable length	50m over RG58	
Modulation	Unmodulated DC Level Shift (DCLS) 5Vdc	
Clock input mode	IRIG-B or 1PPS (needs SNTP for absolute time)	
TIME SYNCHRONIZATION CLOCK		T02
Clock type	GPS (GNSS)	
Antenna supply	5VDC LNA supply	
GNSS Constellation	GPS, Galileo, GLONASS (BeiDou with proper antenna)	
Connector	Coaxial F-Type	
GPS RF port protection	External surge voltage coaxial protection required	
Communication port	Ethernet 1 and/or Ethernet 2	

INSTALLATIONS

The TSMC unit is available in two installation options:

❖ Standard installation.
❖ Rack installation.

Dimensions

SPECIFICATIONS	VALUE
Width	209mm (½ 19' rack)
Height	178mm (4U)
Depth	155mm

Weight	3,8kg

Standard installation

The TSMC standard installation enables mounting directly inside the cabinet. The mounting kit includes movable mounting brackets for multiple mounting positions (horizontal or vertical).
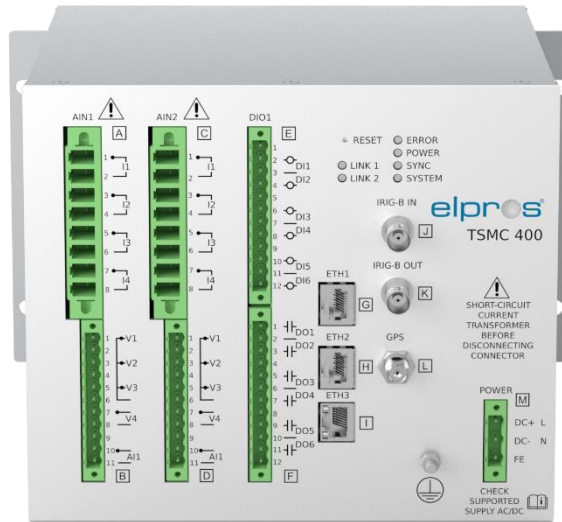

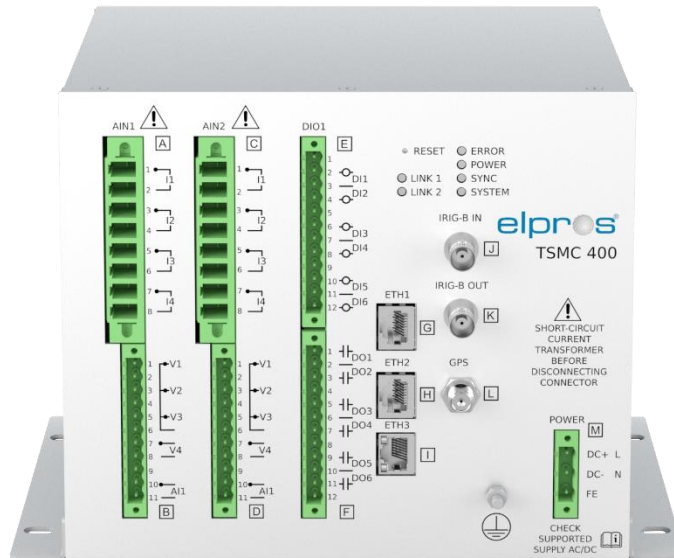*Figure 2: TSMC standard vertical mounting on the wall*

Figure 3: TSMC standard horizontal mounting

Rack installation

The TSMC installation for the rack is designed for an EIA 482.6 mm (19 in) rack. The usual installation is in the racks inside substation automation building.
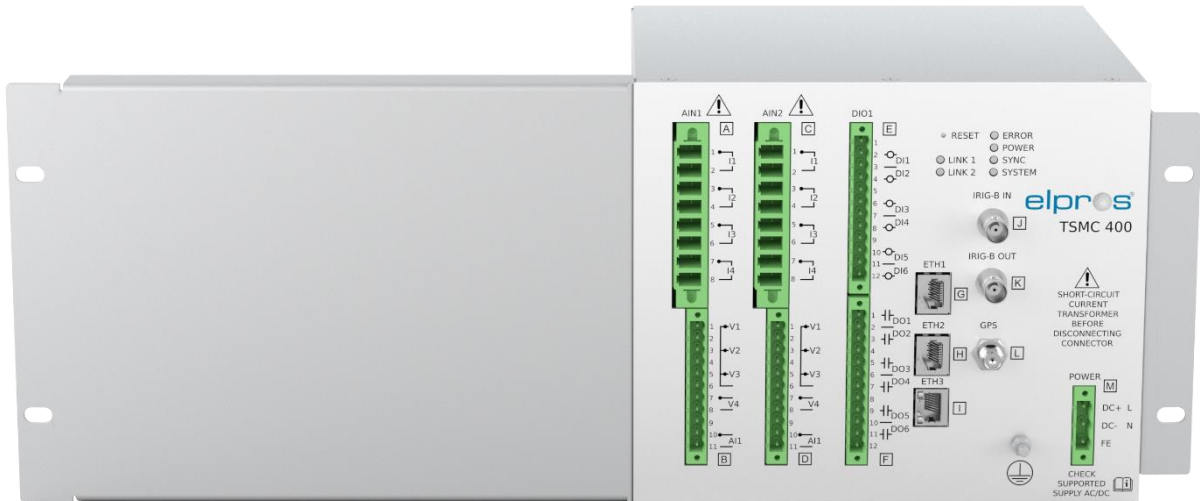
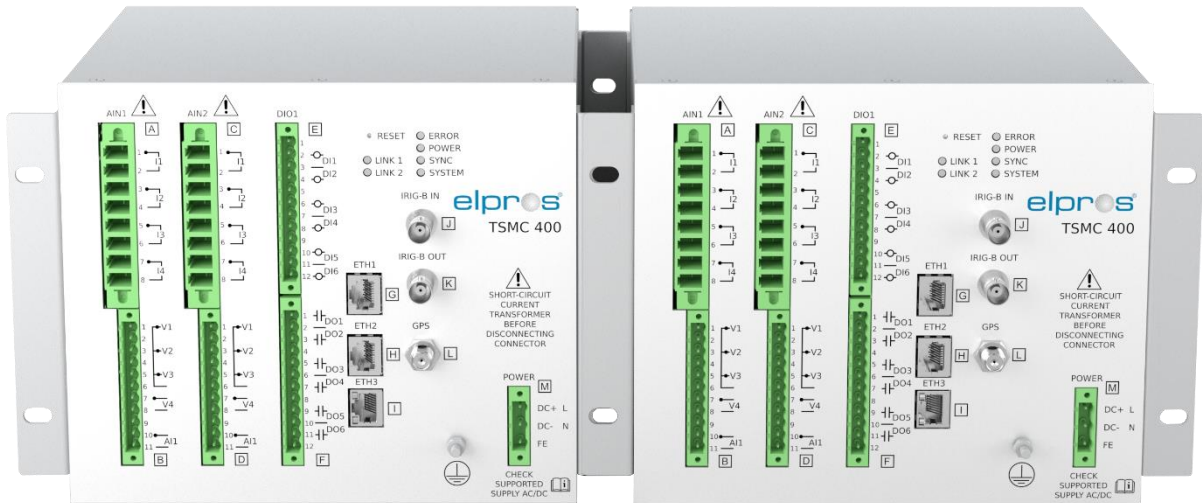Figure 4: Mounting TSMC unit in a rack installation

Figure 5: Mounting of two TSMC units in a rack installation

TSMC unit CONFIGURATION

Configuration of the TSMC unit is provided over the WEB interface. All configuration can be done by WEB graphical user-friendly interface. Configuration is provided across intuitive configuration concepts which gives the user fast and simple access to all settings.

CONFIGURATION	
Local access	Over Management Ethernet port
Remote access (configurable)	Over Data Ethernet ports
Security	Two level user access: ❖ Administrator ❖ Monitor
Software upgrade	Remote upgrade with auto installation over WEB access.

COMPLIANCE WITH TYPE TESTS

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

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

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

CE Compliance

Test	According to
Immunity	EN 60255–26
Emissivity	EN 60255–26
Low voltage directive	EN 60255–27

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

Materials

Used materials	According to
Materials	RoHS

ORDERING GUIDELINES

Ordering codes

Unit code	Unit options
Power Supply (P)	
P01	AC: 85-264 VRMS; 47-63 Hz DC:110-370V
P02	DC:24-48V
Analog Input (AI)	
A01	Voltage:100V/110V; Current:1A; Class:M; DC:4-20mA
A02	Voltage:100V/110V; Current:5A; Class:M; DC:4-20mA
A03	Voltage:100V/110V; Current:1A; Class:P; DC:4-20mA
A04	Voltage:100V/110V; Current:5A; Class:P; DC:4-20mA
Digital Input/Output (D)	
D01	DI: 6x48V; DO: 6x relay
D02	DI: 6x125V; DO: 6x relay
D03	DI: 6x220V; DO: 6x relay
Central Processor Unit (C)	
C01	Procesor:1GHz; RAM:8GB; Time-synchronisation:PTP; Ethernet:2 x redundant RJ45; Local ethernet: RJ45
C02	Procesor:1GHz; RAM:8GB; Time-synchronisation:PTP; Ethernet:2 x redundant fiber-optic ST type; Local ethernet:RJ45
C03	Procesor:1GHz; RAM:8GB; Time-synchronisation:PTP; Ethernet:2 x redundant SFP type; Local ethernet: RJ45
Time Synchronisation Clock (T)	
T01	IRIG-B/1PPS clock time synchronisation
T02	GPS clock time synchronisation
Housing (H)	
H01	Base mounting kit brackets; Rack mounting brackets
GPS antenna (G)	
G01	GPS antenna
G02	GPS antenna coaxial cable RG-6:15m
G03	GPS antenna coaxial cable RG-6:30m
G04	GPS antenna mounting kit
User Manuals (M)	
M01	TSMC configuration user manual
M02	TSMC installation user manual

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