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SIMGENET INDUSTRIAL

TELEPROTECTION UNIT SMG50

Protection Signalling & Communication Device

USER MANUAL

Document Code: SMG50-UM

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Compliant with IEC 60834-1 and related IEC standards

Simgenet Mühendislik Enerji San. ve Tic. Ltd. Şti.

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Document Information

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Revision History

Revision	Date	Description
v1.0	2026	Initial release.

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1. Introduction

1.1 Purpose and Scope

This manual contains the information required for the installation, connections, configuration, commissioning, operation and maintenance of the Simgenet Industrial Teleprotection Unit SMG50 (hereinafter referred to as the "device").

The device has been designed on the basis of the IEC 60834-1 teleprotection performance standard.

1.2 Product Description

The Simgenet Industrial Teleprotection Unit SMG50 is a transmitter/receiver teleprotection system that transmits the trip signals received from protection relays on power transmission lines to the substation at the opposite end with low latency and high reliability. The devices operate as a set (2 units) between two opposite ends.

The device is provided as a complete unit featuring 8 digital inputs, 8 relay digital outputs, active/active redundant dual power supplies, fiber optic / E1 / RS232 communication interfaces, SNTP time synchronization, event logging, front-panel indicators, a touch LCD screen and a web-based management interface.

In the device, the display (HMI) board and the 8-input/8-output command board are independent and isolated from each other; their processors (CPU) are also separate. A possible technical fault on the display board is not reflected on the command transmit/receive board, and the protection function continues uninterrupted. This isolated architecture is a Simgenet design approach that increases the reliability of the device.

All electronic components used in the device are selected from qualified components suitable for industrial use, in the industrial temperature and reliability class.

1.3 Device Views

The front panel of the device contains the indicators, display, control buttons and service ports; the rear panel contains the communication, power, digital input/output and alarm connections.

Figure 1 – Front View (Front Panel)

Front Panel Elements

Element	Description / Function
INPUT 1–8 LED	8 digital input status indicators (red, latching); lights when a command signal arrives at the relevant input
OUTPUT 1–8 LED	8 digital output status indicators (red, latching); lights when the relevant output contact is active
Touch LCD screen	Screen on which time information, event logs and device settings are displayed / configured
▲ / ▼ / OK / ESC	Buttons for navigating the screen menu, confirm (OK) and back/exit (ESC)

LED TEST	Test and reset of the input/output LED indicators (LED reset)
ETH. SERVICE	Service Ethernet port (PC connection / web interface)
USB SERVICE	Service USB port (PC connection)
CPU LED	Processor / device operating status indicator
POWER-1 / POWER-2 LED	Status of the two power supplies (green: healthy, red: fault)
TIME LED	Time synchronization status (green: healthy, red: fault)
RS232 LED	RS232 communication channel status
FIBER LED	Fiber optic communication channel status
E1 LED	E1 (G.703) communication channel status

Figure 2 – Rear View (Connection Panel)

Rear Panel Connections

Connection	Description / Function
FIBER	Fiber optic (OPGW single mode) communication port
E1	E1 (ITU-T G.703) communication interface; RJ45 and coaxial (BNC) connection
RS232	RS232 serial communication port (DB9-female); default 19200 baud
110/220 DIP (ON/110 – OFF/220)	Operating-voltage selection switch for the 8 digital input/output contacts: ON = 110 V DC, OFF = 220 V DC
Nameplate	Product name, model, serial no, voltage and communication information
INPUT(A) 1–8 / INPUT(B) 1–8 (A1–A8, B1–B8)	8 digital input terminals; each input consists of the terminals in groups A and B (input n → An/Bn)
OUTPUT NO-COM 1–4 / 5–8 (NO–COM)	8 relay digital output contacts; each output with NO (normally open) and COM terminals
RESET	Device reset button
CLK	Time synchronization (SNTP) Ethernet port
LINE ALARM (NO–COM–NC)	Communication/line fault alarm; changeover (3-terminal) contact
POWER ALARM (NC–COM–NO)	Power/system fault alarm; changeover (3-terminal) contact
POWER-1 / POWER-2 (48V DC)	Two independent power supply inputs (-48 V DC: +, –, ground)

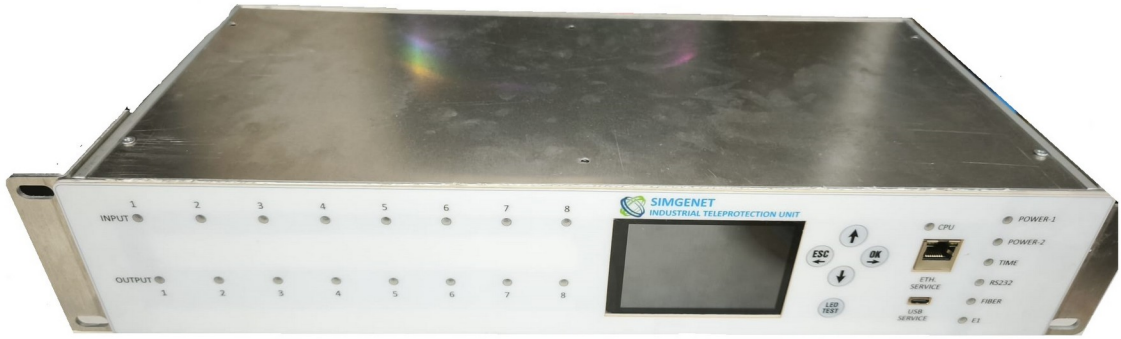


Figure 3 – General View

1.4 Applications

- Protection signalling on 154 kV and 400 kV power transmission lines
- Transmission of trip signals received from the distance protection relay between substations

1.5 Abbreviations and Definitions

Abbreviation	Description
DI	Digital Input
DO	Digital Output
PSU	Power Supply Unit
MOV	Metal Oxide Varistor (surge protection)
OPGW	Optical Ground Wire (fiber optic cable)
SM	Single Mode (single-mode fiber)
E1	2.048 Mbit/s G.703 digital line interface
SNTP	Simple Network Time Protocol
FAT	Factory Acceptance Test
SAT	Site Acceptance Test
Operate Time	Time for the contact to change position after the coil is energized
Release Time	Time for the contact to return to its previous position after the coil is de-energized

2. Safety Warnings

Installation, connection and maintenance of the device must be carried out only by authorized and trained personnel. The following warnings must be observed:

- The device operates with a -48 V DC supply and 110/220 V DC input/output circuits; the relevant circuits must be de-energized before connection.
- The grounding connection point on the rear of the device must be connected to the substation grounding bus before commissioning.
- Terminal connections must comply with the specified cross-section (at least 2.5 mm²) and tightening torque.
- Although the power supply boards are of the plug-in type, it must be ensured that the other PSU is energized during replacement.
- Since the device carries a protection function on transmission lines, any decommissioning operations must be performed in coordination with the relevant protection scheme.

3. General Structure and Operating Principle

3.1 System Architecture

The teleprotection system is a set of two devices placed at two opposite substations. Each device operates simultaneously as both transmitter and receiver; a protection command applied to a digital input at one end is transferred to the corresponding digital output at the opposite end over the communication channel.

The input–output mapping is one-to-one: input 1 of the transmitting unit is delivered from output 1 of the receiving unit; input 2 from output 2, and so on for all channels in the same order. The device performs both input and output functions simultaneously without signal loss.

3.2 Signal Transmission

Teleprotection devices transmit a command from one end to the other, including signal detection, processing, transmission and output, in a very short time. The end-to-end (TPU → TPU) command transmission time is below 10 ms, the upper limit accepted worldwide. The Simgenet Teleprotection Unit SMG50 transmits commands in approximately 6 ms on average; the transmission time is typically in the 5–7 ms range. This stable and low latency is important for protection coordination.

Parameter	Value
End-to-end transmission time (TPU → TPU)	≤ 10 ms
Typical (average) transmission time	≈ 6 ms
Transmission time range	5 – 7 ms
Operating mode	Simultaneous bidirectional (full-duplex)
Input–output mapping	One-to-one (input n → output n)
Signal loss	None (zero error over ≥ 5200 signal cycles, tested)

3.3 Isolated Architecture and Reliability

In the device, the display (HMI) board and the 8-input/8-output command board are hardware-independent and isolated from each other; the processors (CPU) of both boards are also separate. A possible technical fault on the display/management side does not affect the command transmit/receive board, so the critical protection function is maintained without interruption. This isolated two-board

architecture is a fundamental Simgenet design approach that increases the field reliability and quality of the device.

4. Model Configurations

The device is offered as standard as a fully equipped model that includes all communication interfaces (RS232 + E1 + Fiber) together. The standard fiber module has a 100 km range. On request, the relevant modules can be removed leaving only the required interfaces, and the following sub-configurations can be provided.

Standard (fully equipped) model

Model Name	Communication Interfaces	Number of Links
SMG50-RS232-FIBER-E1	RS232 + Fiber (100 km) + E1	3 Links

Optional configurations on request

Model Name	Communication Interfaces	Number of Links
SMG50-RS232-FIBER	RS232 + Fiber	2 Links
SMG50-RS232-E1	RS232 + E1	2 Links
SMG50-RS232	RS232	1 Link

5. Mechanical and Physical Specifications

The device is an aluminium-enclosure unit suitable for 19" rack mounting, with a height of 2U. Except for the service port, all communication ports, power supply terminals, digital input/output and alarm terminals are located on the rear of the device. The terminal texts (power supply 1, digital output 1, fiber port, etc.) and terminal numbers are printed on the rear permanently and horizontally.

Parameter	Value
Mounting type	19" rack mount, 2U
Enclosure material	Aluminium
Width	19" (≈ 482.6 mm, standard)
Height	2U (≈ 88.9 mm)
Depth	210 mm (21 cm)
Weight	≈ 7 kg
Grounding	External grounding connection point on the rear
Terminal placement	Rear (except the service port)
Terminal type	Screw type, at least 2.5 mm^2
Terminal removability	Each terminal group can be individually removed and refitted by screw/clamp
Labelling	Permanent, horizontally printed; rear terminals and front indicators
Operating temperature	-20 °C ... +60 °C
Operating humidity	90% RH, non-condensing
Storage temperature	-40 °C ... +85 °C

The mechanical technical drawing and dimensioning of the chassis (top view, section A-A and front view; all dimensions are in millimetres) are given below.

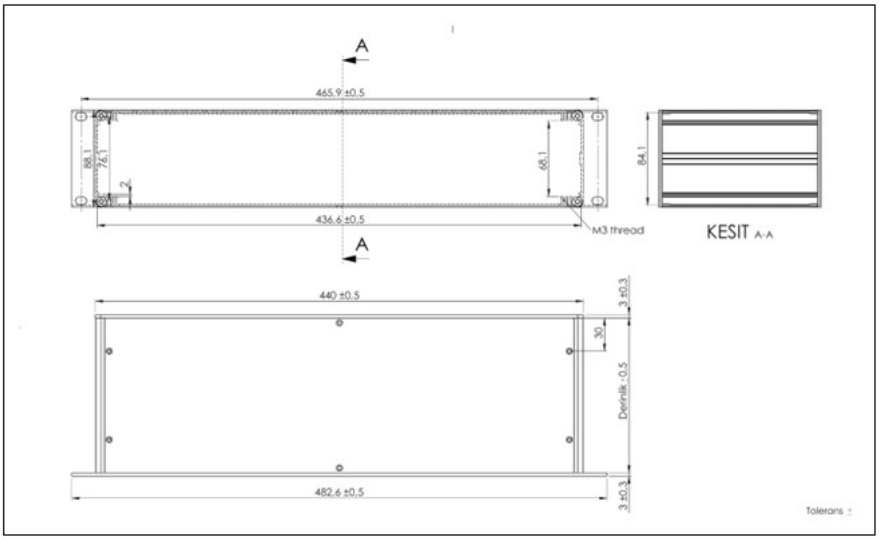


Figure 8 – Chassis mechanical technical drawing and dimensioning (19" 2U; dimensions in mm; general tolerance ±0.5 mm)

6. Power Supply

The device operates with two fully independent, galvanically isolated and active/active redundant power supplies. The power supplies are of the rack-slide, plug-in type. In the event of a problem with one of the power supplies, the device continues to operate without interruption from the other power supply, and no communication alarm is generated in this case.

Any of the power supply boards can be replaced while the device is running, without interruption and without affecting stable operation. No additional converter is required for the device to operate from -48 V DC.

Parameter	Value
Number of power supplies	2 (independent, galvanically isolated, active/active redundant)
Nominal voltage	-48 V DC
Operating range	-42 V DC … -68 V DC
Power supply capacity	15 W (each PSU)
Device power consumption	≈ 5 W (low consumption, high margin)
Construction	Rack-slide, plug-in (hot-swappable)
Converter requirement	None
Surge protection	MOV (Metal Oxide Varistor) – surge and lightning protection
Connection	Rear, screw terminal (≥ 2.5 mm²)

7. Digital Inputs

The device has 8 digital inputs. The inputs can be connected directly to 110 V DC or 220 V DC systems without any converter or auxiliary relay. Signals shorter than 2 ms are not accepted as a command; this prevents false commands caused by noise. When a signal below the specified command-reject voltage is received, the digital outputs are not activated.

Parameter	110 V DC	220 V DC
Operating voltage range	75 – 140 V DC	150 – 280 V DC
Command acceptance time	> 2 ms	> 2 ms
Command-reject voltage	< 66 V DC	< 132 V DC

Number of inputs: 8 · Surge/lightning protection: MOV · Connection: rear, screw terminal (≥ 2.5 mm²).

8. Digital Outputs

8.1 General Specifications

The device has 8 relay digital (contact) outputs. The outputs can be connected directly to 110 V DC (±20%) or 220 V DC (±20%) systems and are equipped with MOV (Metal Oxide Varistor) protection against surge and lightning. The output structure is relay-output; semiconductor solutions such as MOSFET are not used. The transmitted signals (output contacts) are not connected directly to a circuit that would draw excessive load at the substation (such as a circuit-breaker trip coil).

Parameter	Value
Number of outputs	8
Output structure	Relay (not MOSFET, etc.)
Operating voltage	110 V DC (±20%) or 220 V DC (±20%)
Surge protection	MOV (yes)
Connection	Rear, screw terminal (≥ 2.5 mm²)

8.2 Switching Conditions Under Load

The digital output relays meet the following load conditions at 20% above the rated voltage.

Test Type	Condition	Requirement
Momentary make/break	Rated voltage +20%	≥ 0.3 A for ≥ 200 ms
Continuous current carrying	110 V DC (+20%)	1 A – 1 min, 3 repetitions with 1 min rest
Continuous current carrying	220 V DC (+20%)	0.5 A – 1 min, 3 repetitions with 1 min rest

9. Alarm Outputs

The device requires no maintenance, monitors itself and raises an alarm in case of a problem. The device has at least 2 changeover-contact (3-terminal) alarm relays. One of the relays generates a signal upon a communication fault, the other upon a power supply and/or time synchronization fault. The alarm contacts are connected to a 110 V DC or 220 V DC circuit at the substation. The alarm contacts are also equipped with MOV (Metal Oxide Varistor) protection against surge and lightning.

Alarm Relay	Triggering Condition	Contact Type
Communication alarm	Communication link fault	Changeover (3-terminal)
System alarm	Power supply and/or time synchronization fault	Changeover (3-terminal)

Connection: rear, screw terminal (≥ 2.5 mm²).

10. Communication Interfaces

The device supports Fiber Optic (OPGW single mode), E1 (ITU-T G.703) and RS232 communication channels. At least one of these channels is used, and no performance loss occurs in use. The device includes all three interfaces together as standard; on request, only the required interfaces may be retained.

Multi-Interface Simultaneous Transmission – Triple Redundancy

In the model that includes all three interfaces (SMG50-RS232-FIBER-E1), protection commands are transmitted simultaneously over the Fiber, E1 and RS232 interfaces. Thus, even if one of the interfaces fails (for example, a break in the fiber line), the command continues to be transmitted uninterrupted over the other interfaces. This triple redundancy maximizes the reliability of the protection commands and

ensures that the protection function continues even in the event of a failure of a single communication path.

In fiber optic communication, the device operates as a transmitter/receiver pair over OPGW single mode fiber and can operate directly over the OPGW fiber cores without any additional amplifier at ranges up to 80 km. For ranges shorter than 80 km, signal attenuators can be used. The optical interfaces are selected to operate at a total loss of 23 dB, providing at least a 3 dB margin over the 80 km line loss (≈20 dB).

Interface	Specification
Fiber Optic	OPGW single mode; up to 80 km without amplifier; total optical budget ≥ 23 dB
E1	ITU-T G.703, 2.048 Mbit/s
RS232	Default 19200 baud (up to 115200 baud on request)
Multi-interface / redundancy	Fiber + E1 + RS232 simultaneous transmission; triple redundancy (uninterrupted operation if one interface fails)
Performance	No performance loss when using any channel
Connection	Rear; permanent, horizontally labelled

10.1 RS232 Interface Technical Specifications

The RS232 communication interface operates at 19200 baud by default and is terminated with a DB9 (female) connector. The baud rate and parity can be made configurable from the web interface on request (before ordering).

Parameter	Value
Speed (Baud)	Default 19200; adjustable up to 115200 baud from the web interface on request
DataBit	8 (fixed)
StopBit	1 (fixed)
Parity	Adjustable from the web interface: Even / None
Flow Control	None
Connector	DB9 – female

RS232 Port Connector and Pin Input/Output Table

Pin	Signal	Description
2	Rx	Data receive
3	Tx	Data transmit
5	GND	Ground

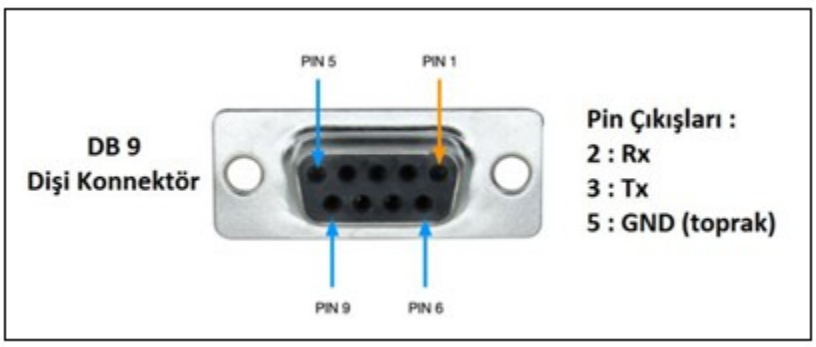


Figure 4 – RS232 DB9 (female) connector and pin layout

10.2 E1 (G.703) Interface Technical Specifications

The E1 interface is a 2.048 Mbit/s balanced (120 Ω) digital interface compliant with the ITU-T (CCITT) G.703 standard and is terminated with an RJ45 (female) connector.

Parameter	Value
Number of interfaces	1
Electrical compliance	G.703 (E1)
Frame structure	ITU-T (CCITT) G.704
PCM sampling rate	8000 samples/s
Bit rate	2048 Kbit/s ± 50 ppm
Code	HDB3
Nominal impedance	120 Ω balanced
Mark peak voltage (120 Ω)	3.0 V ± 0.3 V
Nominal pulse width	244 ns
Pulse mask	ITU-T (CCITT) G.703
Output jitter	< 0.05 UI (20 Hz – 100 kHz)
Permitted attenuation	6 dB @ 1 MHz
Return Loss	51.2–102.4 kHz: 12 dB · 102.4–2048 kHz: 18 dB · 2048–3072 kHz: 14 dB
Jitter tolerance	ITU-T (CCITT) G.823
Frame alignment loss/recovery	ITU-T (CCITT) G.732, clause 3
Connector	RJ45 (female)

E1 G.703 Port Female Connector Pin Input/Output Table

Pin	Signal	Direction
1	NC (reserved)	–
2	RX+ (received data +)	Input
3	RX– (received data –)	Input
4	GND (ground)	–
5	GND (ground)	–
6	TX+ (transmitted data +)	Output
7	TX– (transmitted data –)	Output
8	NC (reserved)	–

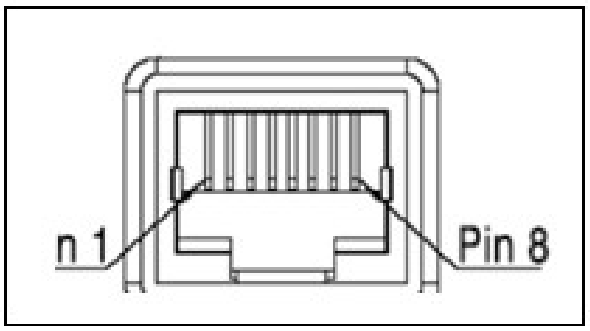


Figure 5 – E1 G.703 RJ45 (female) connector (Pin 1 … Pin 8)

10.2.1 E1 CLOCK Setting and DIP Switch

In E1 (G.703) technology, parameters such as the line clock (CLOCK) and impedance/grounding are normally set with jumpers/DIP switches. The Simgenet TPU operating system (TPU OS) manages these

CLOCK/synchronization matters automatically in the background; therefore the following DIP switch settings are not mandatory for the device to operate.

These settings are for integration purposes only: when connecting to the E1 circuits of SDH/PDH multiplexer devices in the field, if those devices have an alarm/synchronization mechanism, compatible integration can be achieved by setting the jumpers according to the table below. It is not mandatory.

For the clock reference, when one of the two interconnected sides is defined as "internal", the other side is defined as "Line CLOCK"; thus the second side obtains its clock from the first side over the E1 line and clock drift is prevented (SW4 – MASTER/SLAVE).

E1 G.703 Port DIP Switch Settings (for integration)

Switch	Function	Description
SW1	OFF: 120 Ω · ON: 75 Ω	OFF is used for the default/recommended 120 Ω (balanced)
SW2	OFF: ungrounded · ON: TX port grounded (BNC 75 Ω)	Generally not used; permanently OFF (ungrounded) is recommended
SW3	OFF: ungrounded · ON: RX port grounded (BNC 75 Ω)	Generally not used; permanently OFF (ungrounded) is recommended
SW4	OFF: internal clock · ON: line clock	In a P2P link: side 1 OFF (internal) → the master side generating the clock; side 2 ON (line) → obtains its clock from side 1 over the line (slave). Thus the systems operate in synchronization
SW5	Must be OFF	Not required
SW6	Must be OFF	Not required
SW7	Must be OFF	OFF is used by default

10.3 Fiber Optic Interface Technical Specifications

The fiber optic interface operates as a transmitter/receiver pair over OPGW single mode fiber and uses an SC connector.

Parameter	Value
Modulation / laser	Single-mode 1310 nm and 1550 nm laser; Multi-mode 850 nm
Fiber module (standard)	100 km single mode
Fiber module construction	Embedded on the fiber board (not a pluggable SFP module)
Other range options	20 / 40 / 60 / 80 / 120 km — to change the range, the entire fiber board is replaced; this must be specified before sale
Multi-mode communication distance	550 m
Connector type	SC
Number of fiber ports	1
Module operating temperature	-40 … +85 °C (industrial grade)

Fiber Modules – Mode, Tx/Rx Sensitivity and Optical Budget

LD / Wavelength and Mode	Tx Power	Rx Sensitivity	Module Gain	Range
1310 nm FP – SM 1310 nm	≥ -12 dBm	≤ -34 dBm	22 dB	20 km
1310 nm FP – SM 1310 nm	≥ -10 dBm	≤ -35 dBm	25 dB	40 km
1310 nm FP – SM 1310 nm	≥ -6 dBm	≤ -36 dBm	30 dB	60 km
1550 nm DFB – SM 1550 nm	≥ -4 dBm	≤ -36 dBm	32 dB	80 km
1550 nm DFB – SM 1550 nm	≥ -3 dBm	≤ -37 dBm	34 dB	100 km
1550 nm DFB – SM 1550 nm	≥ -1 dBm	≤ -38 dBm	37 dB	120 km

10.3.1 Optical Power Budget Calculation

The optical interfaces are selected to operate over OPGW single mode fiber and to provide reliable communication over the target range. In accordance with good engineering practice, the optical modules are determined so that, in addition to the total line loss (fiber cable, splice loss, connector loss), at least a +3 dB system performance margin remains:

System Performance Margin ≥ +3 dB

The optical power budget is calculated using the following method and formulas:

Budget Item	Calculation / Formula
Total fiber loss	Cable length (km) × loss per km (1550 nm: 0.22 dB/km)
Total splice loss	Splice loss (0.1 dB) × number of splices (1 splice every 4 km)
Total connector loss	Connector loss (0.3 dB) × number of connectors (2)
Total losses	Fiber loss + splice loss + connector loss
System gain	Min. output power (dBm) − min. receiver sensitivity (dBm)
Total power loss margin	Power margin (3 dB) + repair margin (30% of total splice loss)
System Performance Margin	System gain − (Total losses + Total power loss margin) ≥ +3 dB

Optical Power Budget by Module Range (Result Table)

Budget Item (unit)	40 km	60 km	80 km	100 km	120 km
Cable length (km)	40	60	80	100	120
Total fiber loss (dB)	8.8	13.2	17.6	22	26.4
Number of splices	10	15	20	25	30
Total splice loss (dB)	1	1.5	2	2.5	3
Total connector loss (dB)	0.6	0.6	0.6	0.6	0.6
Total losses (dB)	10.4	15.3	20.2	25.1	30
Min. output power (dBm)	≥ -10	≥ -6	≥ -4	≥ -3	≥ -1
Min. receiver sensitivity (dBm)	≤ -35	≤ -36	≤ -36	≤ -37	≤ -38
System gain (dB)	25	30	32	34	37
Total power loss margin (dB)	3.3	3.45	3.6	3.75	3.9
System Performance Margin (dB)	11.3	11.25	8.2	5.15	3.1

As shown in the table, the System Performance Margin is greater than +3 dB for all of the 40, 60, 80, 100 and 120 km fiber modules; therefore all modules operate with a safe optical budget over the target ranges.

Calculation basis: One splice is assumed every 4 km. The min. output power and min. receiver sensitivity are referenced to the S (output) and R (input, BER < 10^{-10}) points defined in ITU-T G.956/G.957. The repair margin is calculated as 30% of the total splice loss. Detailed calculation tables are provided on request.

dBm interpretation: As the range increases, the module output power INCREASES (e.g. −12 dBm → −1 dBm; a value closer to zero is higher power) and the receiver sensitivity becomes more SENSITIVE (e.g. −34 dBm → −38 dBm; a more negative value detects a weaker signal). For this reason, the system gain is higher for long-range modules.

11. LED Indicators, Reset Button and Labels

The front panel of the device has at least 4 dual-color LEDs indicating the supply status (separate for each power board), the communication channel status and the time synchronization status. These LEDs light green when the system is healthy and red when there is a problem. There are also red LED indicators for the 8 inputs and 8 outputs. The total number of LEDs is at least 20.

The total of 16 LEDs used for inputs and outputs are latching; the information on the LED indicators is not lost when the signal comes and goes. There is 1 reset button for these 16 LEDs, and the indicators are reset with this button. The input/output LED labels are of a user-replaceable type; no adhesive or vertically printed labels are used.

Indicator	Qty	Color	Latching	Location
Communication LED	≥ 1	Green/Red (dual-color)	—	Front
Power supply LED	2	Green/Red (dual-color)	—	Front
Time sync. LED	1	Green/Red (dual-color)	—	Front
Digital input LED	8	Red (single color)	Yes	Front
Digital output LED	8	Red (single color)	Yes	Front
LED reset button	1	—	—	Front

Total number of LEDs: at least 20. Input/output labels are replaceable, horizontally printed.

12. LCD/LED Display and Control Buttons

The device has 1 touch LCD/LED screen. Time information and the event logs kept by the device can be monitored on the screen; at least 4 event records can be viewed simultaneously on the screen together with their time stamps. Screen access is password protected; once the password has been entered, if no operation is performed on the screen for a certain period, the device detects this idle state and automatically closes the session, returning itself to the (locked) mode that again requires the password.

The backlight of the touch screen is off by default to save energy. When someone approaches the device, the proximity sensor detects the person and automatically turns on the screen backlight so that the screen can be seen clearly. When there is no approach or operation for a while, the backlight turns off again.

Device settings (device IP address, time server IP, RS232 transmission rate, etc.) can be viewed and configured directly from the touch screen. In addition to the screen, there are at least 3 physical buttons (up, down, confirm) on the front of the device; settings can be made from the touch screen or via these buttons.

Parameter	Value
Display	1 touch LCD/LED, at least 4 lines
Displayed on screen	Time information, device settings and event logs (at least 4 event records are listed on screen at the same time)
Access	Password protected
Physical buttons	At least 3 (up / down / confirm)
Setting / configuration	Via touch screen or buttons (IP, time server, RS232 rate, etc.)
Backlight	Off by default; turns on automatically on approach via the proximity sensor
Location	Front

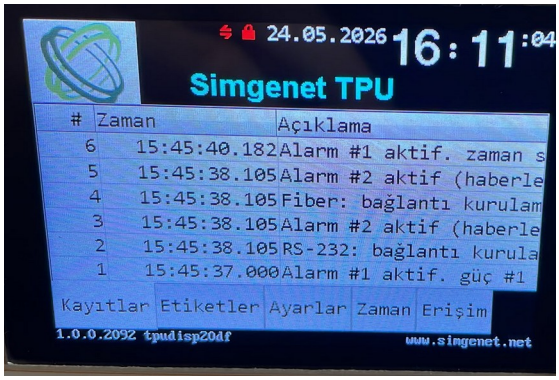
12.1 Touch-Screen Menus and Settings

The touch screen consists of five main menus: Records (Kayıtlar), Labels (Etiketler), Settings (Ayarlar), Time (Zaman) and Access (Erişim). Device settings (IP address; primary/secondary time server definitions – including the GPS/GNSS server–; RS232 rate; event log viewing, etc.) can be made directly from these screens. The functions of the menus are summarized below:

- Records (Kayıtlar): listing of the event logs kept by the device (time stamp, time difference, description, health status).

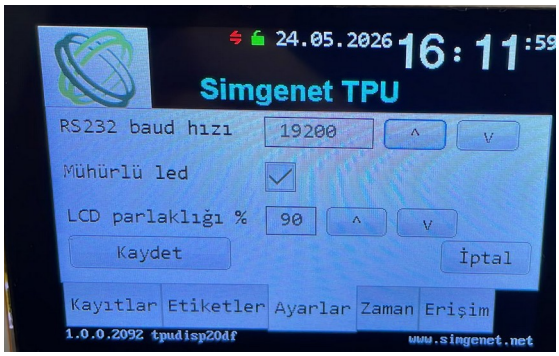
- Labels (Etiketler): display of the user-defined labels of the 8 digital inputs and 8 digital outputs.
- Settings (Ayarlar): RS232 transmission rate, latching LED and LCD brightness settings.
- Time (Zaman): time synchronization with date/time, SNTP enable, NTP server address and query interval (seconds).
- Access (Erişim): LCD PIN definition, web password reset, screen locking and restart (Reboot LCD / Reboot MAIN).

Example views of the touch-screen menus are given below.

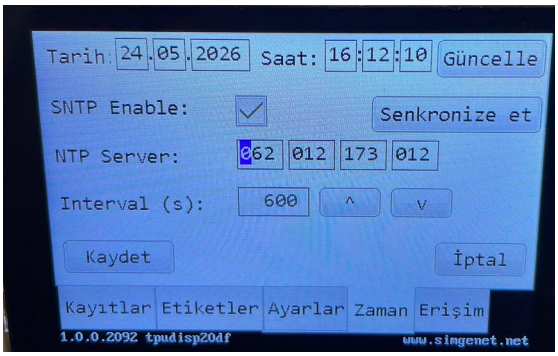


Records menu (Kayıtlar)

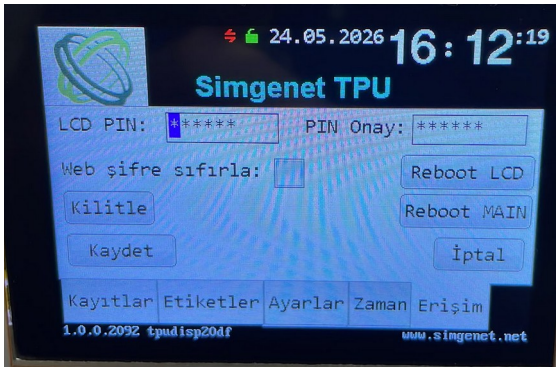
Labels menu (Etiketler)



Settings menu (Ayarlar)



Time menu (Zaman)



Access menu (Erişim)

Figure 9 – Touch-screen example menu views (Records/Kayıtlar, Labels/Etiketler, Settings/Ayarlar, Time/Zaman, Access/Erişim)

13. Event Logging

The device records all alarms that occur (power fault, communication fault, operation of inputs and outputs, etc.) in its memory with time stamps. The event logs are kept together with the input and output numbers, with millisecond, second, hour, day, month and year information. The standard log capacity is at least 2000 events; on request (especially for multiple orders) this capacity can be set much higher, for example up to 10,000 records.

When the device power is completely cut off, the event logs and configuration files are not deleted by themselves; no battery is used for this function. When the memory reaches its maximum capacity, event logging is not disabled; the oldest record is automatically deleted and the new event is stored. The logs can be read from the LCD/LED screen, the service port and the web interface, and can be downloaded to a computer in CSV and Excel format.

Parameter	Value
Capacity	Standard ≥ 2000 events; can be increased up to ≈ 10,000 on request
Time stamp	Millisecond – second – hour – day – month – year
Record content	All alarms and events; with input/output numbers
On power loss	Logs and configuration are preserved (no battery used)
When capacity is full	The oldest record is automatically deleted (FIFO)
Reading	LCD/LED screen, service port, web interface
Export	Download to a computer in CSV and Excel format

14. Time Synchronization

The device supports the SNTP time protocol. For this, there is at least 1 Ethernet (CLK) port on the rear panel. The device's own IP number and the SNTP server IP number can be defined within the device. As the time server, a GPS/GNSS-based SNTP time server fed from GPS/GNSS satellites (for example, the Simgenet GNSS-based time server), the central RTU or an automation server can be used. When the primary time server fails, the IP of a second time server can be defined and the time information can be obtained from the secondary server.

The device IP address and the IP definitions of the primary and secondary time servers (including the GPS/GNSS-based time server) and other time synchronization settings can be configured both from the front-panel touch screen and from the web interface over the service port.

When a time synchronization error occurs, the relevant alarm contact and the time synchronization LED are activated. Even if time synchronization cannot be achieved, the device continues to operate with its internal clock and to keep event logs.

Parameter	Value
Protocol	SNTP
Port	At least 1 Ethernet (CLK) on the rear
Time source	GPS/GNSS-based SNTP time server, RTU or automation server
Number of time servers	2 (primary + secondary), separately definable
IP definition	Device's own IP + primary and secondary time server IP
Configuration interface	Touch screen and web interface (both)
Loss of synchronization	Alarm contact + time sync. LED activated
Fallback operation	Continues to operate with the internal clock

15. Service Port and Web Interface

There is 1 service port on the front of the device. A connection to a computer is established via this port; event logs can be examined from the computer and downloaded in CSV and Excel format. For the service port, a connection cable at least 2 metres long is supplied by the manufacturer, 1 per substation.

A multilingual (Turkish / English) web interface is provided for the computer connection. Through the web interface, the device status and LEDs can be monitored dynamically, event logs can be viewed/exported, and device configuration (device IP address, primary/secondary time server –including the GPS/GNSS

server– IP definitions, RS232 rate, etc.) can be performed. These settings can also be made from the touch screen. Access to the web interface is password protected.

Parameter	Value
Service port	1, front
Connection cable	At least 2 m; 1 per substation (supplied by manufacturer)
Web interface language	Turkish / English
Web interface access	Password protected
Web interface features	Dynamic LED and device status monitoring, configuration
Event logging	Reading via service port and web + CSV/Excel download

15.1 Web Interface Screenshots

The multilingual (Turkish/English) web interface consists of six pages: Dashboard (Göstergeler), Network (Ağ), Logs (Kayıtlar), Settings (Ayarlar), Tools (Araçlar) and About (Hakkında). The function of each page and an example screenshot are given below.

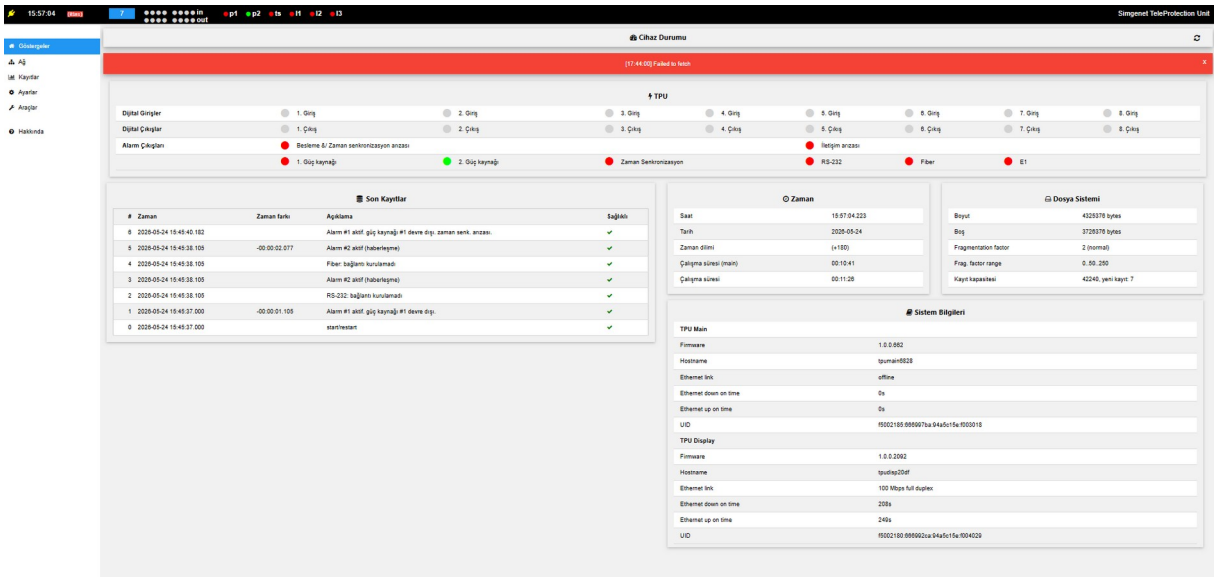


Figure 10 – Web interface: Dashboard (Göstergeler) – device status, digital input/output and alarm monitoring, recent event logs, time, file system and firmware information (example view)

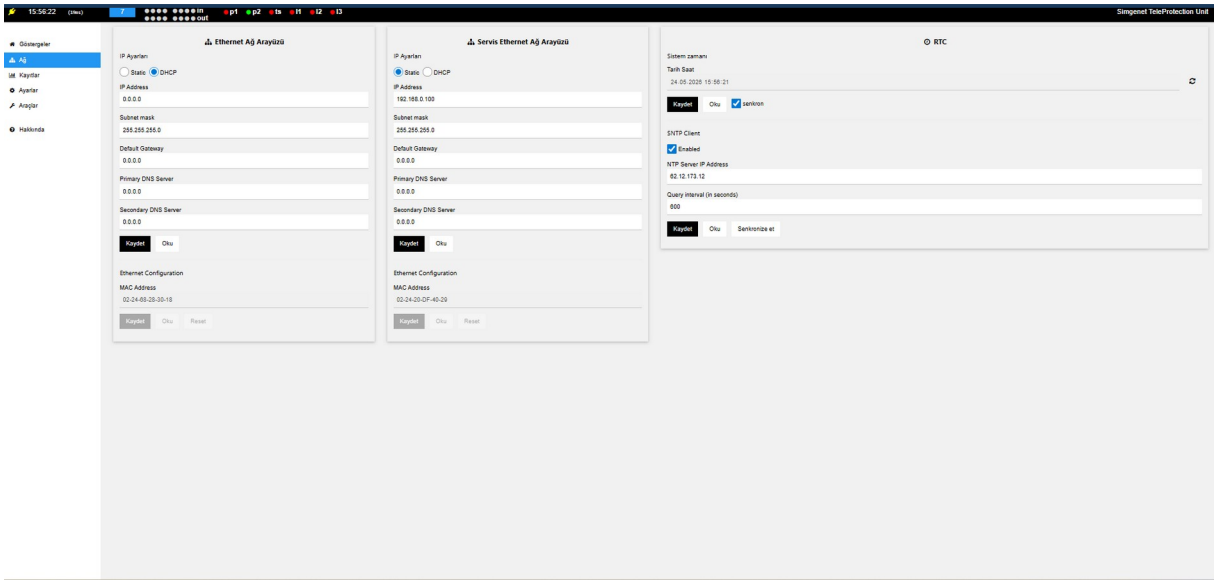


Figure 11 – Web interface: Network (Ağ) – Ethernet and Service Ethernet IP settings (Static/DHCP, MAC) and RTC/SNTP time server configuration (example view)

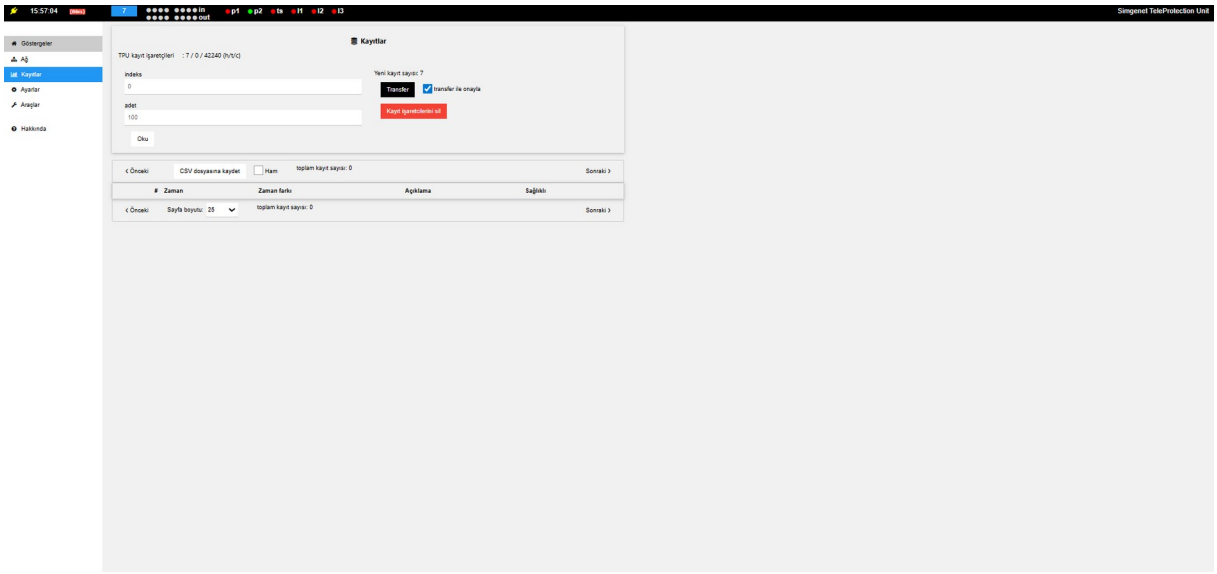


Figure 12 – Web interface: Logs (Kayıtlar) – reading, paging and exporting event logs to a CSV file (example view)

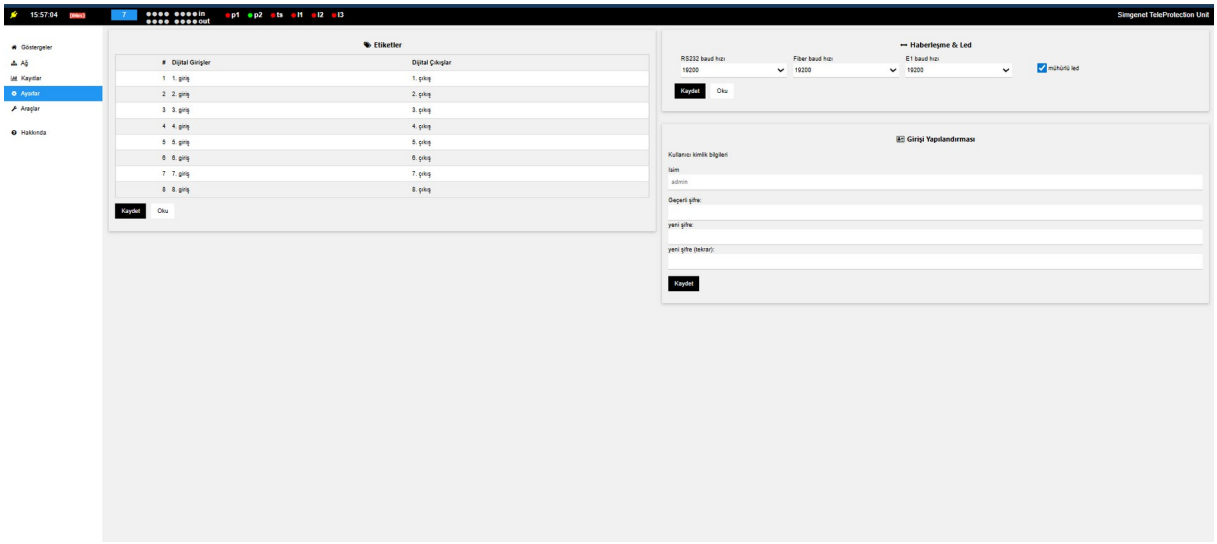


Figure 13 – Web interface: Settings (Ayarlar) – input/output labels, communication (RS232/Fiber/E1 baud) and LED setting, user name/password configuration (example view)

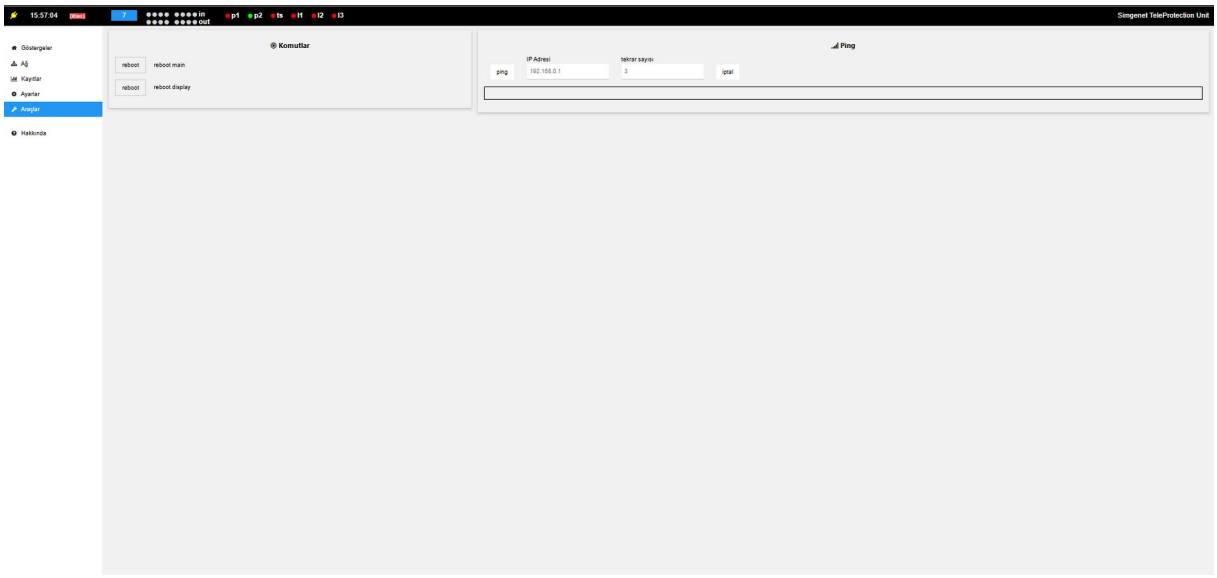


Figure 14 – Web interface: Tools (Araçlar) – restart commands (Reboot Main / Reboot Display) and ping tool (example view)

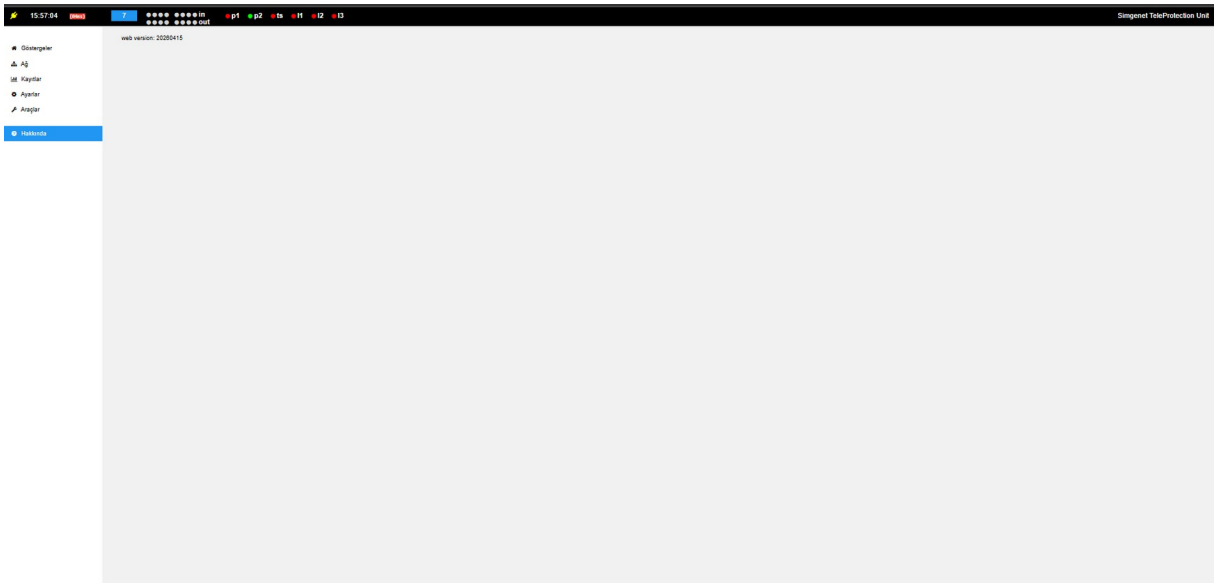


Figure 15 – Web interface: About (Hakkında) – web version information (example view)

16. Configuration

Device configuration (device and time server IP definitions, time synchronization settings, RS232 transmission rate, etc.) can be performed in two ways: via the front-panel touch LCD screen and/or physical buttons, or from the web interface using a computer over the service port. Both access methods are password protected.

- Touch screen + buttons: device settings (IP, time server, RS232 rate, etc.) and monitoring
- Service port + web interface (PC): full configuration and event log transfer

17. Cyber Security

As part of the cyber security measures, access to the device from both user interfaces is password protected: the front-panel touch screen and the web interface accessed over the service port. Against unauthorized access, viewing/changing device settings and accessing event logs is possible only after authentication (password).

On the touch screen, if no operation is performed for a certain period after the password has been entered (idle), the session is automatically closed and the screen returns to the locked mode that again requires the password. This automatic locking prevents unauthorized persons from gaining access through a session left open.

Interface	Access Protection
Touch screen (front panel)	Password protected + automatic locking on idle (session timeout)
Web interface (service port / PC)	Password protected

18. Installation and Commissioning

18.1 Installation

- Mount the device in a 2U slot in a suitable 19" rack/cabinet.
- Connect the grounding point on the rear to the substation grounding bus.
- Connect the two power supplies to the -48 V DC supply bus(es) with screw terminals (≥ 2.5 mm²).
- Connect the digital input/output and alarm contacts to the 110/220 V DC circuits according to the project diagram.
- Connect the selected communication interface (Fiber/E1/RS232) and the Ethernet port for SNTP.

18.2 Command Input/Output Terminal Mapping

The mapping of the device's command input, command output and alarm terminals is as follows. The input and output pinouts are the same in all versions of the device.

Input	Terminal	Output	Terminal
INPUT-1	A1 / B1	OUTPUT-1	NO1 / COM
INPUT-2	A2 / B2	OUTPUT-2	NO2 / COM
INPUT-3	A3 / B3	OUTPUT-3	NO3 / COM
INPUT-4	A4 / B4	OUTPUT-4	NO4 / COM
INPUT-5	A5 / B5	OUTPUT-5	NO5 / COM
INPUT-6	A6 / B6	OUTPUT-6	NO6 / COM
INPUT-7	A7 / B7	OUTPUT-7	NO7 / COM
INPUT-8	A8 / B8	OUTPUT-8	NO8 / COM

Alarm terminals: LINE ALARM (NO / COM / NC) and POWER ALARM (NC / COM / NO) — both are changeover (3-terminal) contacts.

18.2.1 Example Wiring Diagram and Application Example

Below are an example field wiring diagram for 8 inputs / 8 outputs and a typical system application example established over OPGW fiber between two substations.

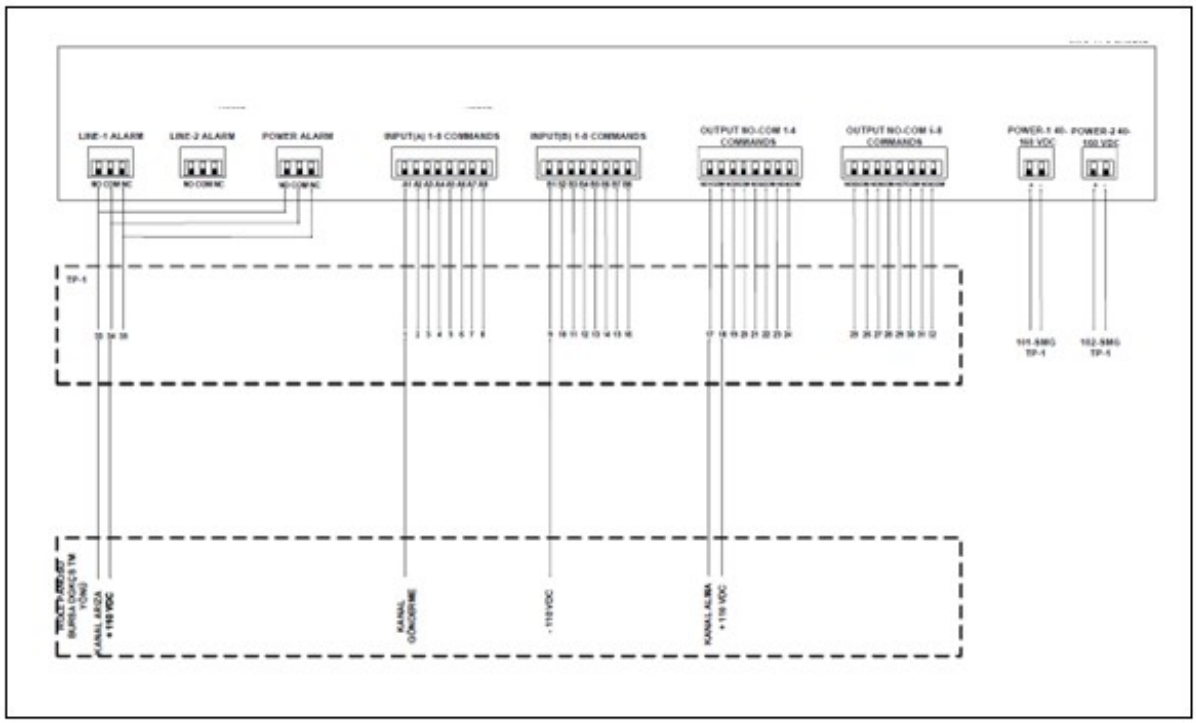


Figure 6 – Example wiring diagram (8 inputs / 8 outputs, rear panel field wiring)

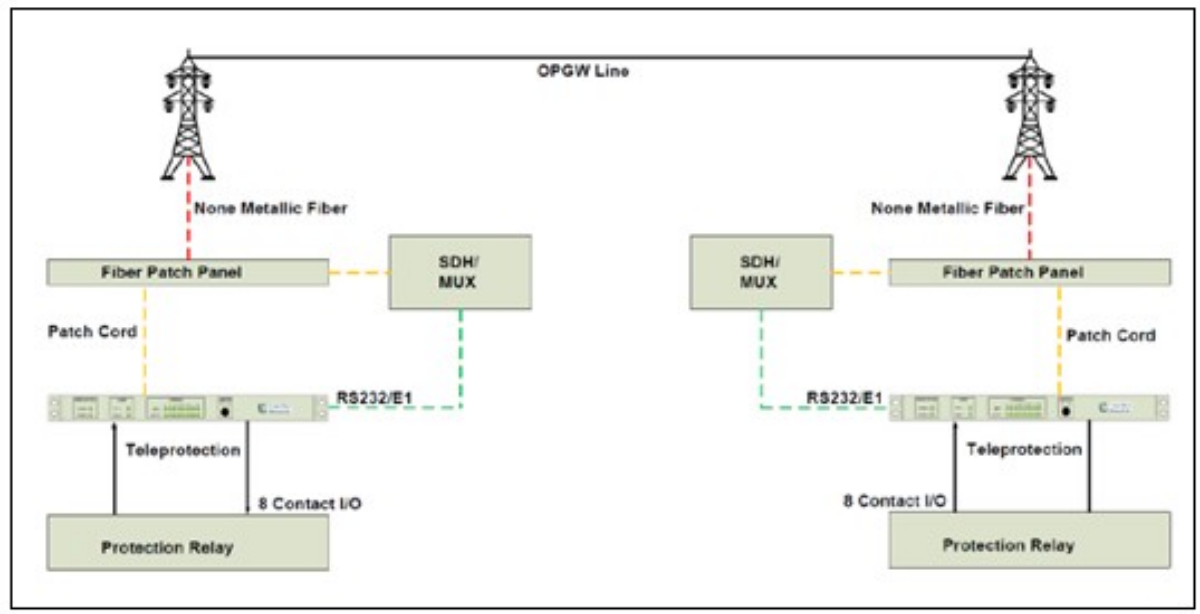


Figure 7 – Application example: teleprotection link between two substations over OPGW fiber (SDH/MUX – Protection Relay)

18.3 Commissioning

- When power is applied, verify that the power LEDs light green.
- Enter parameters such as IP, SNTP server and RS232 rate from the service port/web interface.

- Verify that the communication LED is green (link active) and the connection with the opposite substation.
- Verify the input/output mapping and the end-to-end transmission time under field conditions.
- Check event logging and time synchronization.

18.4 Acceptance Tests (FAT / SAT)

Factory acceptance tests (FAT) are applied to all devices at the manufacturer's facilities and the results are recorded. The devices are subjected to site acceptance tests (SAT) in the field, between the opposite substations. The scope of FAT and SAT is defined in detail in the relevant FAT/SAT Test Procedure and report documents.

19. Testing, Verification and Standards

The device is of the industrial type and has been designed with reference to the IEC 60834-1 standard. The following type tests are carried out in accredited laboratories and the type test reports are submitted for the customer's approval.

19.1 Applied Standards

Standard	Scope	Level / Value
IEC 60834-1	Teleprotection performance	Command transmission performance (end-to-end ≤ 10 ms; typical ≈ 6 ms)
IEC 60255-27	Product safety / dielectric	48 V DC: 0.5 kV; 110/220 V DC: 2 kV – 1 min
IEC 60068-2-1	Cold	-20 °C / 2 hours
IEC 60068-2-2	Dry heat	+60 °C / 2 hours
IEC 61000-4-2	ESD	8 kV contact / 15 kV air
IEC 61000-4-3	Radiated RF immunity	10 V/m
IEC 61000-4-4	EFT / Burst	Level 3
IEC 61000-4-5	Surge	2 kV
IEC 61000-4-6	Conducted RF immunity	10 V
IEC 61000-4-8	Power-frequency magnetic field	30 A/m
IEC 61000-4-18	Damped oscillatory wave	2.5 kV (differential and common mode)
IEC 61000-6-4 / 55032	Emission (industrial)	Industrial limits

19.2 Type Test Status

EMC, environmental and dielectric type tests are being carried out in an accredited laboratory. The test result reports (will be updated after the type tests are completed) will be added to this manual.

20. Relay Performance and Life

The digital output relays provide the following guaranteed minimum switching performance. These values have been tested and are minimums; the device actually meets higher values as well.

Guaranteed Minimum Switching Performance

Parameter	Value
Momentary switching (make/break)	≥ 0.3 A, ≥ 200 ms (rated voltage +20%)
Continuous current carrying – 110 V DC	1 A, 1 minute, 3 repetitions
Continuous current carrying – 220 V DC	0.5 A, 1 minute, 3 repetitions
Switching endurance	≥ 5200 make/break cycles, zero failure (tested)

Surge protection	MOV (Metal Oxide Varistor)

Mechanical Life

The output relays have a mechanical life of min. 100×10^6 (100 million) operations.

21. Maintenance and Troubleshooting

The device is designed to be maintenance-free and monitors itself. In case of a fault, it provides information via the front-panel LEDs and the alarm contacts. The following table provides a preliminary assessment for commonly encountered situations.

Symptom	Possible Cause	Recommended Check
Power LED red	Relevant PSU or supply fault	Check the supply voltage and the PSU board; replace the plug-in board if necessary
Communication LED red	Link failure / fiber-E1-RS232 fault	Check the cable, the optical budget (≤ 23 dB) and the device at the opposite substation
Time sync. LED red	SNTP server unreachable	Check the Ethernet connection and the primary/secondary server IPs
Input/output LED does not turn off	Latching LED, awaiting reset	Reset with the LED reset button
System alarm active	Power and/or time sync. fault	Examine the relevant alarm source from the event log

22. Technical Specifications Summary Table

Specification	Value
Operating temperature	-20 °C … +60 °C
Mounting / enclosure	19" rack / aluminium
Power supply	2 × -48 V DC (-42…-68), active/active redundant, plug-in; PSU 15 W, consumption ≈ 5 W
Digital input	8 (110/220 V DC, command acceptance > 2 ms)
Digital output	8 relay, MOV protected (110/220 V DC ±20%)
Alarm contact	2 changeover (communication + system), MOV protected
Surge protection	MOV – on power supply, digital input/output and alarm contacts (surge/lightning)
End-to-end transmission	≤ 10 ms (typical ≈ 6 ms; range 5–7 ms)
Communication	Fiber OPGW SM (80 km / 23 dB), E1 (G.703), RS232 (≥ 19200 baud); simultaneous triple redundancy
LED indicator	At least 20 (16 latching I/O LEDs + reset)
Display / button	Touch LCD/LED ≥ 4 lines + at least 3 buttons (password protected; IP and other settings from the screen)
Event logging	≥ 2000, ms time-stamped, CSV/Excel download, preserved on power loss
Time sync.	SNTP, primary + secondary server, internal clock backup
Service / web	Front-panel service port (≥ 2 m cable), password-protected web interface (Turkish / English)
Compliance	Compliant with IEC 60834-1 and related IEC standards

23. Manufacturer Information and Warranty

The user manual of the device is available in its most current version on the manufacturer's website and can be downloaded free of charge.

Field	Information
Manufacturer	Simgenet Mühendislik Enerji San. ve Tic. Ltd. Şti.
Origin	Türkiye (domestic manufacture)
Website	www.simgenet.net
Document access	Manufacturer's website (most current version)