ELVAC

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CATALOGUE | ENERGETICS

RTU / IED • HMI • SCADA • FAULT INDICATION • PROTECTION RELAYS
REMOTE MONITORING, CONTROL, MEASUREMENT AND DATA ACQUISITION

PRODUCTS FOR POWER INDUSTRY | **2023**

Content

General Information
about ELVAC RTU Systems

Basic Information about ELVAC RTU Products

ELVAC RTU are intelligent electronic devices (IED) developed and produced directly in company ELVAC a.s. in Czech Republic and their features are a result of the knowledge and experience gained since the 90s of the last century. Thanks to long-term cooperation with experts and perception of user needs we created devices that meet the highest demands of the energy field. Our own development and production mean a full product control to ensure the top quality based on top quality of components and manufacturing processes and we can provide also the highest standard of technical support along with customization and rapid response to market demands. The results of our work are the satisfied users of the many thousands of installations in the Czech Republic, but also in many other countries.

Compact and Modular Conception

Both conceptions are based on the same SW background, so the principles of system setup and parameterization are the same. The differences mainly concern the hardware capabilities of the various types.

Modular RTU

- optional system size from 2 up to 16 slots for panel, DIN rail or 19" rack mounting,
- "all-in-one" solution = all necessary features in one device,
- unlimited configuration combinations and system expandability,
- wide selection of available interfaces, inputs and outputs with different parameters,
- many special features, see the next chapter with RTU7M features,
- easy system installation, commissioning and maintenance.

Compact RTU

- small devices with fixed configuration for given types of applications,
- usually for DIN rail or panel mounting,
- DC powering,
- customization for large projects is possible – ex. number and types of communication interfaces and other I/Os,
- system expandability is possible via communication interfaces,
- cost-effective solution for given type of configuration.

SW Support for ELVAC RTU

The system setup and parameterization are possible via:

- RTU User Center – free SW for MS Windows,
- integrated web configuration interface and HMI support.
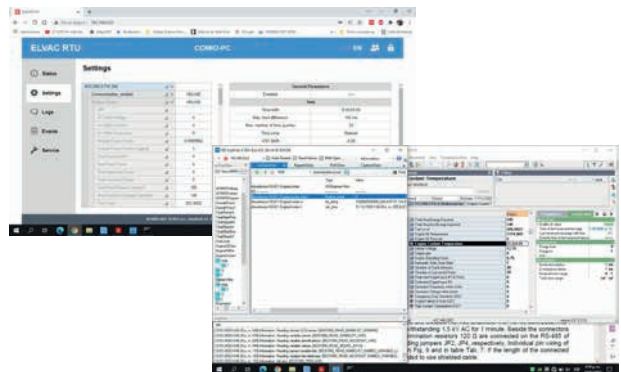
RTU7M – One Modular Platform for Wide Range of Solutions in Power Distribution Monitoring and Control

Over years of development, simple units with digital inputs and outputs and a communication module have been replaced by unique devices that integrate functions of many other devices typically used in energy sector. This simplifies installation, eliminates the troubles of connection and compatibility, increases reliability and user comfort. This all brings also a cost-effective complete solution.

The individual components od system RTU7M can be divided into the following groups:
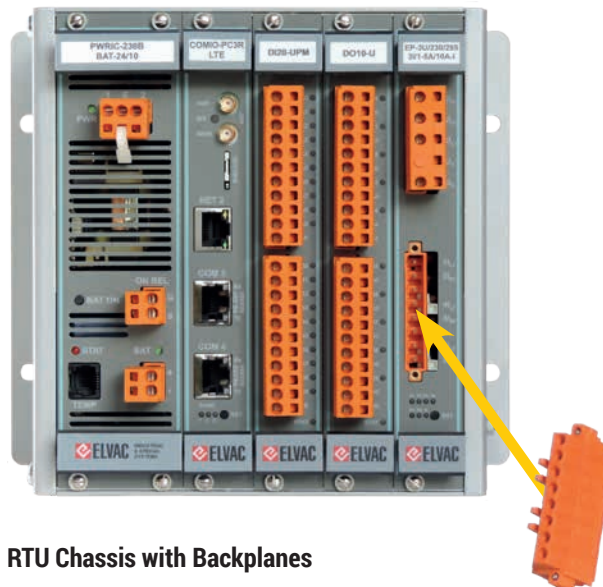
1. Chassis with backplanes
2. Power supply and battery backup cards
3. Communication cards
4. Digital input cards
5. Digital output cards
6. Analog input cards
7. Analog output cards
8. Other special cards

The details for individual components are mentioned in the separate chapter in this catalog.

RTU7M Features Overview

General Information

- Each card in RTU7M has its own processor. Therefore, the system performance is not limited by single CPU power.
- Except the power supply card, all other cards can be used in any slot position in numbers limited only by chassis size.
- Large systems with many I/Os are built from multiple units, one main unit and other slaves, the whole system then looks like one RTU from the perspective of the SCADA system.
- Systems are certified for electronic safety, EMC, EMI and environmental standards usual for power industry systems.
- Available variants of individual cards, datasheets and catalog are at www.rtu.cz, where you can find in Download section the application guides with information about typical use of ELVAC RTU systems.

RTU Chassis with Backplanes

- Optional size:
    - DIN rail mounting (vertical or horizontal) – 2, 3 slots,
    - panel mounting – 2, 3, 5, 8, 10, 16 slots,
    - 19" rack mounting – 16 slots.
- Integrated power supply 10 – 30 V DC in 2 and 3-slot version.
- 8, 10 and 16-slot chassis are available in version for power supply redundancy.

Power Supply Cards

- Optional input voltage:
    - 10 ÷ 60 V DC,
    - 80 ÷ 275 V DC,
    - 80 ÷ 260 V AC.
- Power supply redundancy is possible on "R" version of 8, 10 and 16-slot backplanes.
- Power supply cards are not used in 2 and 3-slot chassis, where PS 10 ÷ 30 V DC is integrated on backplane.

Optional Battery Backup Cards

- Battery can be charged and monitored directly via RTU system for easy and on time maintenance.
- Integrated in AC cards (for 12 V or 24 V batteries).
- Additional card for DC powering (for 24 or 48 V DC).
- Battery chargers are equipped with input for digital temperature sensor for optimal battery charging and protection.

Communication Cards

- Optional HW interfaces according to card version:
  - GSM/LTE modem,
  - Ethernet LAN,
  - RS-232/422/485,
  - Optical (via SFP modules).
- Supported communication protocols: IEC 61850, IEC 60870-5-101, IEC 60870-5-103, IEC 60870-5-104, DNP3, HIOCom2, MODBUS TCP/RTU, DLMS, OPC UA, SNMP and other special protocols. For more details, see the **licensing policy** at www.rtu.cz in RTU support SW.
- Multi-channel communication support (ex. for communication backup).
- Secure communication according to IEC 62351-3 (TLS).
- OpenVPN and IPSEC tunneling.
- Built-in RTC.
- Integrated web configuration interface and HMI support.
- Programmability via standards IEC 61131-3 or proprietary graphical interface.
- NAT, Firewall functionality, user access control, RADIUS, Syslog, NTP, SSH, SCEP, SQL data storage support.
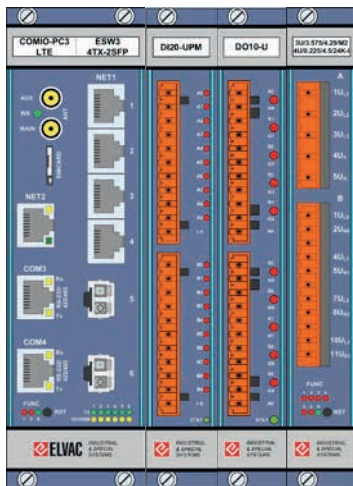
Digital Input Cards

- Variants:
  - 20 x optically isolated digital inputs on standard cards,
  - 10 x optically isolated digital inputs on combined card with 5 x DO.
- Available for dry or wet contacts (different voltage levels).
- Signal filtering (contact bounce, AC signal).

## Digital Output Cards

- Variants:
  - 10 x relay outputs (load up to 8A),
  - 5 x relay outputs (load up to 8A) on combined card with 10 x DI,
  - 20 x optical relay outputs (load up to 800 mA).
- Dual HW and SW control of output – protection against an accidental switching.
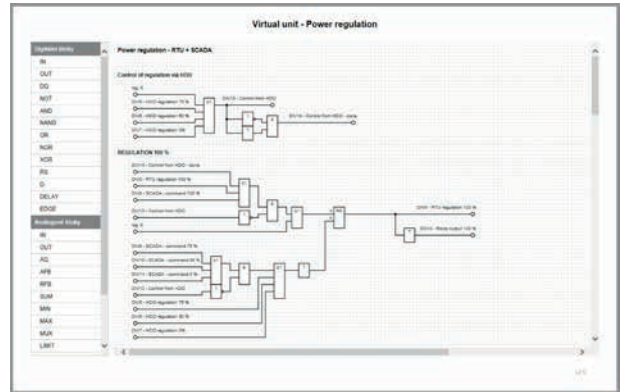
Analog Input and Output Cards

- Variants for:
  - 3-phase voltage and currents measurement,
  - power quality and energy measurement,
  - special fast measurement (up to 40 MS / s),
  - industrial standard I/Os – 20 mA or 10 V,
  - temperature sensors – PT100, PT1000, Ni120, thermocouple K.
- Features of 3-phase measurement cards:
  - measurement and calculation of V (phase, L-L), I, P, Q, S, f, cos φ, THD,
  - calculated V_0 and I_0 (optionally measured directly via 4th input),
  - fault locator,
  - input variants for standard VTs, CTs, low power sensors, Rogowski coils or direct measurement,
  - inputs can be overloaded and still measured, which is useful in protection relay application – see inputs specification in catalog,
  - integration and difference filtering,
  - waveform recording – ELVAC proprietary or COMTRADE format,
  - fault passage indication and protection relay (ANSI 27, 46, 47, 50, 50N, 51, 51N, 59, 59N, 67, 67N, 81H, 81L, 81R).
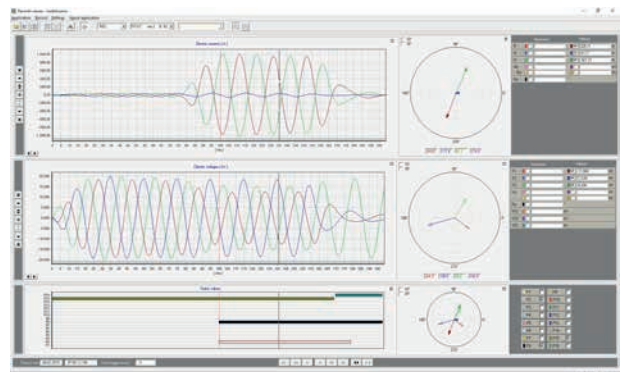
Logging

All internal processes in RTU are logged. There is also memory space for thousands of logs for collected data in RTU system.

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Human-Machine Interface (HMI)

Very interesting feature of ELVAC RTUs is embedded HMI. It means that you can prepare visualization of controlled technology directly in RTU without necessity of using any special and expensive software. Moreover, you do not need any programming skills. Everything is designed to be easy and feasible for common computer users.

HMI in our RTUs use the SVG vector format graphic file, which represents the scheme of technology and the objects in this file can be linked to the addresses in RTU. Then these objects can have different behavior, like changing the color according to internal status in RTU, control button or showing the measuring values.

The graphic file is uploaded in memory of RTU and the access is done through the web interface. There can be used any web browser for access to this HMI or there can be used the ERIC or ESP7 GR panel (see this catalog in chapter Signaling and HMI panels).

As ELVAC RTU supports also SQL database, there is possible to use those features for visualization of monitored and controlled technology with historical data displaying.

Typical ELVAC RTU Applications

- Intelligent Electronic Device (IED) / Remote Terminal Unit (RTU) for remote monitoring and control of:
  - primary substations,
  - secondary substations,
  - switching stations,
  - ring main units,
  - load break switches,
  - sectionalizers,
  - reclosers,
  - renewable energy sources (wind, solar, water, gas, combined etc.),
  - objects for electromobility (chargers, small vehicles municipal infrastructure, etc.),
  - intelligent buildings,
  - enterprise power distribution.
- Central or backup communication unit, communication protocol converter, router and data concentrator in power distribution objects.
- Aerial or cable lines – feeder or node monitoring, control, measurement, fault passage indication, protection relay.
- Other types of applications:
  - SMART GRID automation,
  - fault detection on isolated overhead MV lines,
  - time synchronization through GPS,
  - water treatment monitoring,
  - airport system monitoring,
  - electric machines monitoring.

ELVAC RTU – Safe Device with Wide Choice of Communication Protocols and Security Features
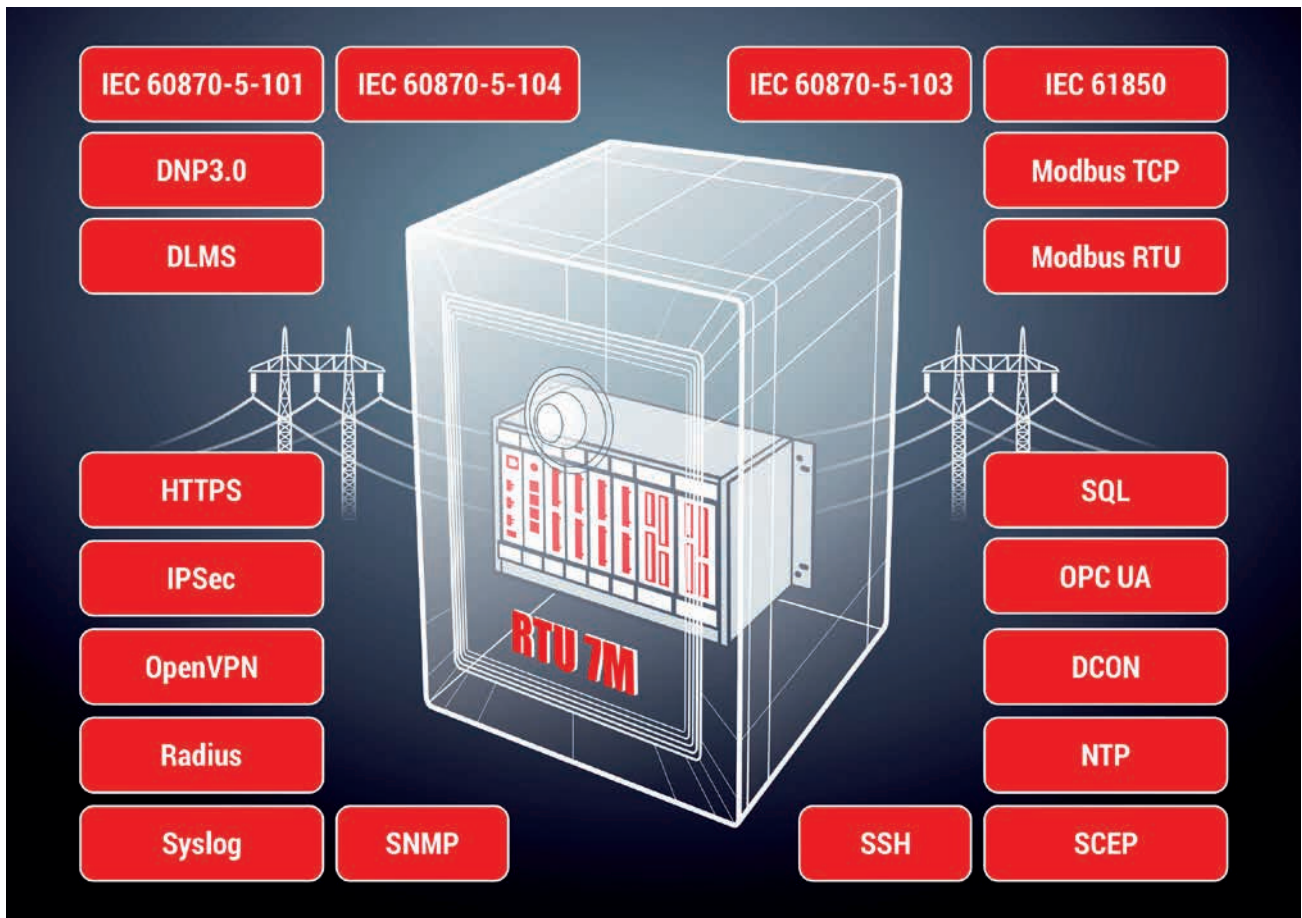
Note: *As a developer and producer of the RTU7M system, we can offer also the implementation of other special communication protocols or customization of standard communication protocols. For the details, please contact the sales department of Power Industry Systems department. See the contacts at www.rtu.cz.*

ELVAC Complete Solutions

Besides the ELVAC RTU development and production, our company ELVAC Inc. has also other departments related to industrial automation. For the complex solutions in power industry, but also in other areas, we can offer:

- RTU systems deliveries including different versions of cabinets with cabling, terminals and other related electronics,
- Software solutions – SCADA, ADMS, Renewable Energy Sources Monitoring Systems, Airport Lights System Monitoring and others.

Quality Management

All development, production, control and optimization processes, same as a management system of data and information protection, leads to the highest possible quality of our products. ELVAC Inc. is a certified holder of ISO 9001, ISO 14001, ISO 27001 and ISO 45001.

Application Guide

ELVAC RTU in Primary Substation

Usual application names:

- Central Communication Unit and Data Concentrator
- Intelligent Electronic Device (IED) / Remote Terminal Unit (RTU) for Monitoring, Measurement, Fault Indication, Protection and Control

Location specification:

- primary substation (HV/MV).

Typical application requirements:

- mounting is usually in 19" rack mount cabinet or on back panel,
- communication with SCADA system usually via Ethernet LAN or optical fiber lines, sometimes communication backup via GSM/UMTS/LTE modem,
- typical communication demands:
  - communication protocols to SCADA – IEC 60870-5-104, DNP3, IEC 61850,
  - communication protocols to IEDs – IEC 60870-5-104, IEC 60870-5-101, IEC 60870-5-103, DNP3, IEC 61850, MODBUS TCP/RTU, sometimes others, when retrofits are demanded,
  - secured communication, router functionality, communication tunnels etc.,
- data collection from many other devices in substation, like protection relays and power meters,
- high number of digital inputs and outputs,
- sometimes – direct feeder measurements, power quality measurement.

Centralized system example

Note: As the standards may vary from country to country, your demands can be always discussed with our professionals.

ELVAC RTU7M System Description

1. **Whole systems** can be generally built as:

   a. Centralized system – all signals from substation are brought to one location. RTU system is large with many inputs and outputs, built from more RTUs interconnected via LAN and they all are located in one or more cabinets next to each other. One RTU is Master, which works as data concentrator, another Slave RTUs resend the data to the Master. This system is more common in primary substations.

   b. Decentralized system – signals are brought to the nearest collection cabinet, then RTU systems are usually smaller but many and they are usually connected in communication ring (optical or metallic) for safe communication. This system is commonly used for substation control in large factories.

2. **Chassis** – as the number of signals is usually high (typically hundreds), the RTU system is usually assembled in 19" chassis with 16 slots for I/O cards. When more RTUs are needed, then system expandability is provided via Ethernet LAN.

3. **Power supply** – there is usually used DC voltage for power supply, because there are usually battery systems in substations available for non-interruptible operation. Available power supply cards for ELVAC RTUs are:

   a. PWRI-60DH .... 10−60 V DC,
   b. PWRI-275DH ... 80−275 V DC.

   If 230V AC is used for powering of whole system, then external power supply 230V AC to 24V DC is used. Exact RTU consumption can be calculated according to catalogue information for each type of a card used in system. Then total load of system can be calculated according to the number of RTUs in whole system plus charging current up to 3A for one battery charger card, if it is used.

4. **Battery charger** – if battery system is not available in substation, there can be used battery charger card directly built in ELVAC RTU7M. There are available versions for 24V and 48V battery pack. One battery charger card can be used for up to 4 RTUs. There is thermal sensor input available for optimal battery charging control. Status of batteries is regularly checked by RTU and alarms are sent to maintenance team.

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5. **Communication** – ELVAC RTUs use the newest type of communication card COMIO PC3, which can be used in different versions according to demanded number of Ethernet, optical or serial ports. There are available versions with embedded GSM/UMTS/LTE modem. This card supports all necessary communication protocols and it has enough power for all tasks, like secured communication with SCADA and maintenance team, collecting all data from I/O cards and IEDs in substation. This card supports routing functions for separation of LANs, role-based access and many other functions used in modern secured networks.

6. **Digital inputs** – the cards DI20-Uxx are in Dry or Wet contact versions with different signaling voltage from 12 to 220V DC/AC. DI cards have the optically isolated inputs, the signal polarity can be bidirectional. The signaling voltage is usually the same as the RTU power supply voltage, so Wet contact are more commonly used in substation applications. The Dry contact version is available in 24V version. If AC voltage is used, there can be used filters for correct signal evaluation.

7. **Digital outputs** – there are two versions in our portfolio. The first option is card type DO10-U with 10 relay outputs 24 V DC / 8 A or 250 V AC / 8 A. This type is used for direct connection to controlled element. The second option is card type DO20-U with 20 photo relays 60 V DC / 40 V AC / 800 mA). This type is used for switching of lower load, typically interposing relays in primary substations,

and as there are more outputs on one card, it is also more price efficient solution. For load switching over the limits of our DO cards, there can be used external contactors/relays.

8. **Analog inputs / measuring cards** – you can find in our portfolio the following types according to different signals used in power industry:
   a. AI card series – standard industrial measuring inputs – typically 10 V, 20 mA or temperature measurement,
   b. EP card series – direct feeder measurement in 3-phase systems (optionally U0 and I0), fault indication with many ANSI standards, usable as a protection relay on MV feeders (together with DI/DO card). They are available in different combinations for voltage and current measurement for usage with wide range of sensors and transformers, including versions for low power resistive or capacitive sensors.
   c. Special cards – for example for power quality monitoring.

All cards specification can be found in our catalogue, the most commonly used variants are on internet e-shop at www.rtu.cz in RTU7M section.

**Example of RTU combining communication, I/O cards and 3 protection relays in one chassis**

ELVAC RTU7M advantages:

- all in one solution – complete remote monitoring, control and maintenance, communication with SCADA, power backup, IEDs data concentration, I/O signals, measurement, indication and protection, waveform recording, programmability, HMI interface,
- wide system expandability – practically unlimited number of signals from substation,
- optional power supply voltages,
- optional battery backup controlled directly from RTU – the battery status is regularly tested and alarms are transferred to SCADA or maintenance system,
- variety of communication ports with support for all state-of-art standards in power distribution control – different protocols, communication security and many others,

- ready for retrofits – older communication support after consultation with producer,
- optional feeder measurement with protection relay functionality for MV feeders – price efficient solution,
- waveform recording, commonly used for evaluation of faults on lines,
- optional power quality monitoring,
- programmable interface for special automation functions,
- HMI interface is embedded in each RTU (free of charge), system visualization is easy and fast. There is no special and expensive SW demanded, there can be visualized schemes and historical data thanks to embedded SQL support in RTU. The systems can be controlled via active elements in scheme including details displaying. The standard computer, panel PC or tablet with internet browser is all you need. There are supported Windows and Android platforms.

Example of cabinet for smaller substation
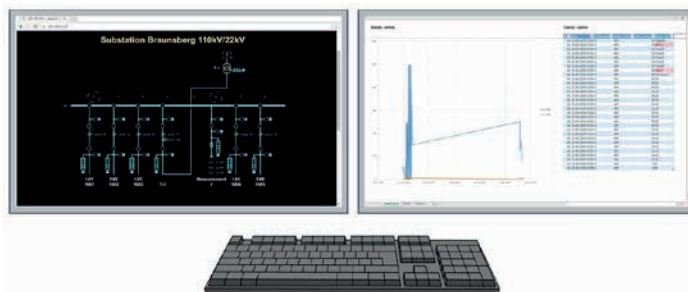
Example of HMI visualization with historical data using separate computer with dual display in control room

Example of HMI installed directly on cabinet door

Configuration Example 1

Primary substation system with the following systems specification:

- ☑ power supply from substation battery system 110 V DC,
- ☑ communication to SCADA via IEC 60870-5-104 or DNP3 via Ethernet,
- ☑ backup communication to SCADA via LTE modem,
- ☑ optional data collection from protection relays in substation via optical interface with protocol IEC 61850,
- ☑ 2 x RS-485 port for data collection from IEDs in substation via MODBUS RTU,
- ☑ 4 x Ethernet LAN port for data collection from IEDs in substation via MODBUS TCP, IEC 61870-5-104 or IEC 61850,
- ☑ demand for 100 x DI and 40 x DO.

Description of this example – system is assembled into one RTU in the following configuration:

Slot 1 – power supply card PWRI-275DH for 80–275 V DC,

Slot 2, 3 – communication card COMIO-PC3 LTE ESW3 with the following features:

a) high performance for communication with SCADA and whole substation data concentration,
b) LTE modem for backup communication with SCADA,
c) 10/100BaseT(X) Ethernet LAN port NET2 for main communication with SCADA,
d) 4 x 10/100/1000BaseT(X) Ethernet LAN port NET1/1-4 for communication with other network devices in substation,
e) 2 x serial RS-232/422/485 port for communication with IEDs,

f) optional 2 x optical interface (SFP slots for modules insertion) for communication with protection relays in optical ring via protocol IEC 61850 or other.

Slot 7 to 11 – digital input cards in version DI20-UPX for external signaling voltage 110 V DC (wet contact), altogether 100 DI,

Slot 13 to 16 – digital output cards DO10-U, altogether 40 x relay DO.

External power supply voltage 110 V DC

Dual antenna for LTE modem

Description:

▬▬▬▬	- DC power wire
▬▬▬▬	+ DC power wire

Configuration Example 2

Primary substation system with the following systems specification:

- ☑ power supply 230 V AC,
- ☑ battery backup 24 V DC, battery monitoring,
- ☑ communication to SCADA via IEC 60870-5-104 or DNP3 via Ethernet,
- ☑ backup communication to SCADA via LTE modem,
- ☑ data collection from protection relays in substation via optical interface with protocol IEC 61850
- ☑ 6 x RS-485 port for data collection from IEDs in substation via MODBUS RTU,
- ☑ 2 x Ethernet LAN port for data collection from IEDs in substation via MODBUS TCP, IEC 61870-5-104 or IEC 61850,
- ☑ demand for 220 x DI and 60 x DO,
- ☑ demand for 12 x 20 mA current inputs from transducers,
- ☑ demand for 4 x 3-phase MV feeder monitoring, fault indication and protection relay 100V, 5A.

Description of this example – system is assembled from 3 RTUs, mountable into 19″ rack. First Master RTU works as main communication unit with SCADA and data concentrator, Slave RTUs resend data to the Master RTU.

Master RTU

Slot 1 – power supply card for 24 V DC powered from battery backup card,

Slot 2 – battery backup card for 24 V battery pack, powered from external power supply 230 V AC / 24 V DC, 10A

Slot 3,4 – communication card COMIO-PC3 LTE ESW2 with the following features:

a) high performance for communication with SCADA and whole substation data concentration,
b) LTE modem for backup communication with SCADA,
c) 10/100BaseT(X) Ethernet LAN port NET2 for main communication with SCADA,
d) 10/100BaseT(X) Ethernet LAN port NET1/1 for communication with IEDs,
e) 10/100BaseT(X) Ethernet LAN port NET1/2 for communication with Slave RTUs,
f) 2 x serial port for communication with IEDs,
g) 2 x optical interface (SFP slots for modules insertion) for communication with protection relays in optical ring with protocol IEC 61850 or other.

Slot 6 to 16 – digital input cards in version DI20-UPM for external signaling voltage 24 V DC (wet contact), altogether 220 DI.

Slave RTU 1

Slot 1 – power supply card for 24 V DC powered from battery backup card in Master RTU,

Slot 3 – communication card COMIO4 485 with the following features:

a) interconnection with Master RTU and another Slave RTUs via LAN chain,
b) RS-485 and RS-232/485 ports for communication with IEDs,

Slot 6 to 11 – digital output cards DO10-U, altogether 60 x relay DO,

Slot 15, 16 – measuring cards AI-6ID/20/20-AI for 20mA transducers connection.

Slave RTU 2

Slot 1 – power supply card for 24 V DC powered from battery backup card in Master RTU,
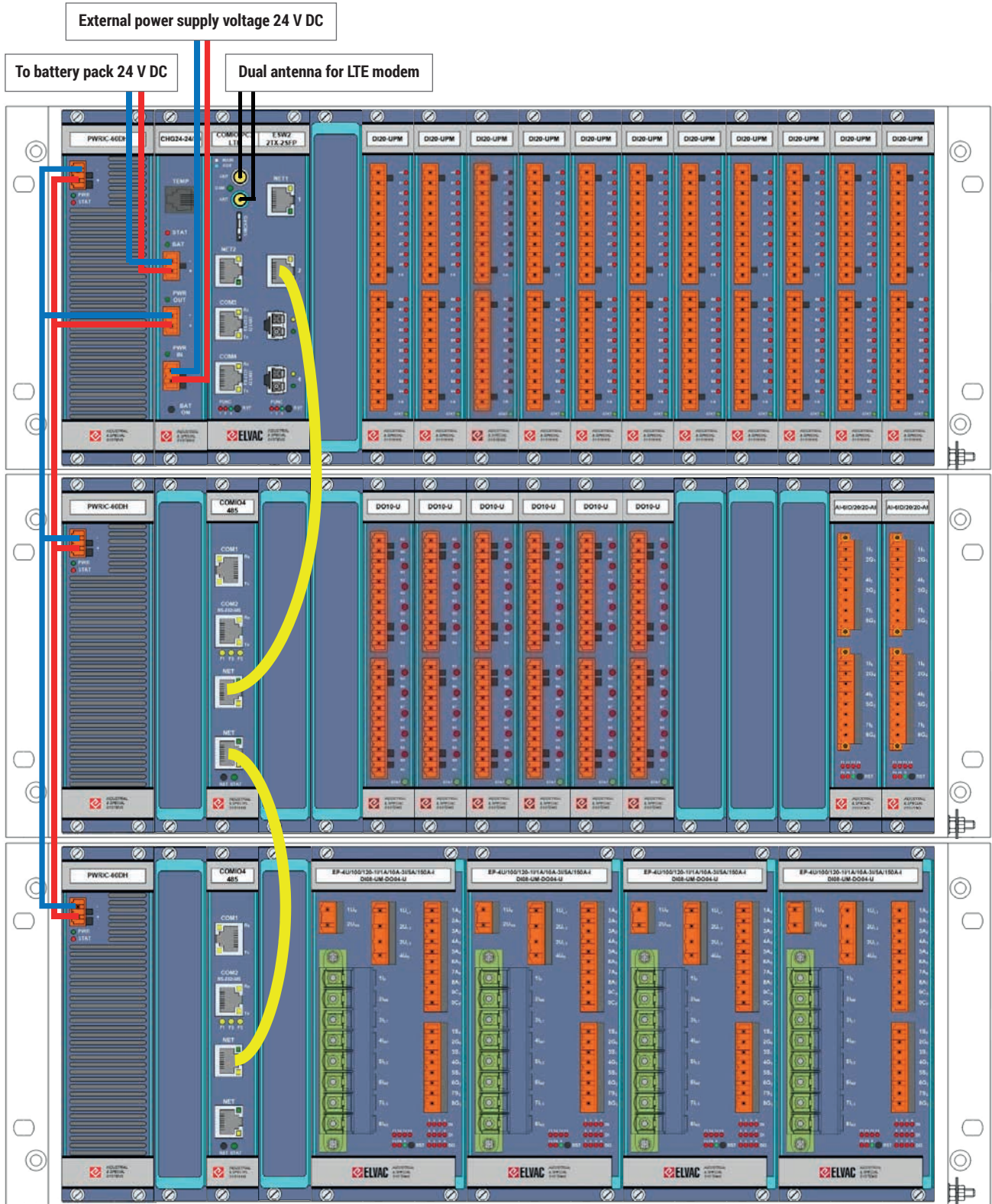
Slot 3 – communication card COMIO4 485 with the following features:

a) interconnection with Master RTU and another Slave RTUs via LAN chain,
b) RS-485 and RS-232/485 ports for communication with IEDs,

Slot 5 to 16 – measuring cards RTU7M EP-4U/100/120-1I/1A/10A-3I/5A/150A-I-DI08-UM-DO04-U, they measure 3-phase 100V (optionally neutral voltage) and 3-phase current 5A with 30 x overloading (still measured value) and 100 x withstand for 1s, neutral current can be calculated or directly measured by 4th current input, they are equipped with 8 x DI and 4 x DO for direct connection to feeders for signaling and automatic control, they calculate another values (P, Q, S, frequency, etc.) from measured values, they evaluate faults on lines upon limits setup using standards ANSI 27/59, 46BC, 47, 50, 50N, 51, 51N, 67, 67N, so they are used as protection relay for MV feeders.

General notes:

1) *All free slots in RTUs can be used for future system extension.*
2) *If external Ethernet switches are used in substation for communication between many Ethernet devices, then this network can be certainly used also for connection between RTUs in standard star topology.*
3) *All ELVAC RTUs are delivered with screw type female connectors for DI, DO and measuring cards for cable connection of signals from substation. Thus, the signals can be quickly disconnected from cards during testing, service works or commissioning.*

External power supply voltage 24 V DC

To battery pack 24 V DC

Dual antenna for LTE modem

Legenda:

- Ethernet LAN cable
- − DC power wire
- + DC power wire

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ELVAC RTU in Cable Network – Ring Main Unit / Secondary Substation

Usual application names:

- Ring Main Unit (RMU) Monitoring and Control
- Intelligent Electronic Device (IED) or Remote Terminal Unit (RTU) for Monitoring, Measurement, Fault Indication, Protection and Control in Secondary Substation

Location specification:

- secondary substation medium voltage to low voltage (MV/LV),
- switching stations (power distribution network is only divided into more MV branches).

Typical application requirements:

- usually wall-mounted cabinet with IED/RTU,
- communication with SCADA system via optical fiber lines or GSM/UMTS/LTE modem, optionally via radio modem,
- communication protocols:
  - to SCADA – IEC 60870-5-104, DNP3, IEC 61850,
  - to other local electronic devices – IEC 60870-5-104, IEC 60870-5-101, IEC 60870-5-103, DNP3, IEC 61850, MODBUS TCP/RTU, DLMS, sometimes others, when retrofits are demanded,
  - secured communication, communication tunnels etc.,
- digital states signaling (switches position, door contact etc.),
- remote control of switches in feeders,

- direct feeder measurements and faults detection in power distribution network, power quality measurement,
- data collection from other electronic devices in object.
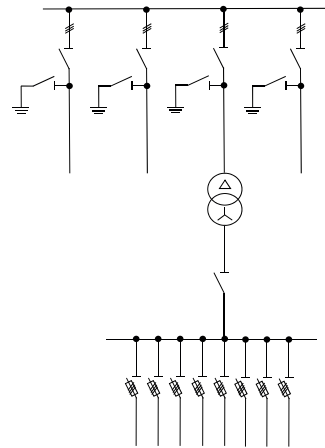
Note: As the standards may vary from country to country, your demands can be always discussed with our professionals.

ELVAC RTU7M System Description

Whole systems can be generally built as:

A. **Centralized system** – all signals are brought into one cabinet with all necessary accessories.

   System features:
   - complete system integration in one cabinet with RTU,
   - system clarity during maintenance and service,
   - common system in cable networks, when automation is added to existing switching technology.

B. **Decentralized system** – each feeder in RMU has its own RTU/IED, which are interconnected into one system from the user point of view.

   System features:
   - it needs an external power supply with battery backup, which is used also for feeder switch drives powering (the separate powering system with battery backup is usual standard in some countries),
   - space saving solution, RTUs/IEDs are embedded directly in feeder cubicles,

   - time saving solution during commissioning, less cabling on site,
   - money saving solution, if no other external cabinet is necessary,
   - some customers want a separate communication cabinet, then it can be much smaller than in centralized system,
   - suitable for RMU producers or system integrators, who want to deliver their products with embedded remote control and monitoring.

A. ELVAC RTU Centralized System

The following example describes a realization of a centralized system according to the usual current customer demands. Certainly, it is one of many possible ways of design, so the details my vary in different realizations according to specific demands of individual customers.

The general features are:

- communication into SCADA through GSM/UMTS/LTE modem,
- 3-phase voltage and current measurement for individual feeders,
- DI/DO cable for each feeder and other signals in object,
- user friendly HMI for local control.
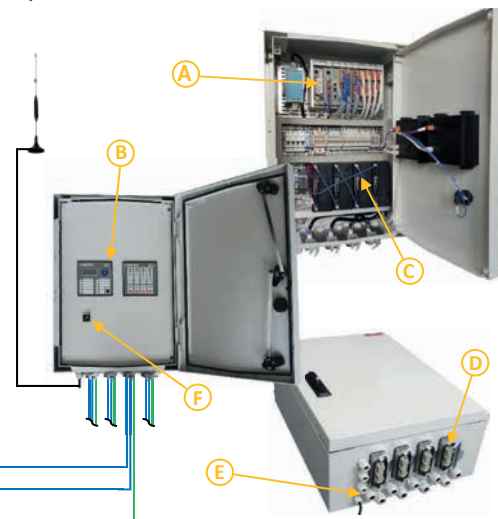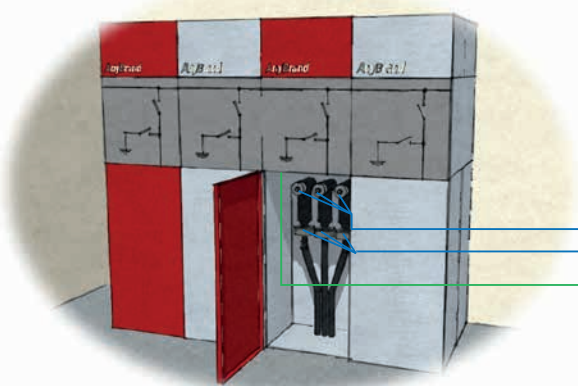
Example of cabinet with centralized system:
A. ELVAC RTU7M
B. HMI on internal door
C. internal wiring with accessories, embedded batteries,
D. rugged monitoring and control connectors for each feeder – DI/DO signals
E. bushings for measuring signals, powering, antenna and other signals (door contact, etc.)
F. Remote/Local Control switch

1. **Cabinet** – modular architecture of RTU7M allows to build a whole system into one device with all necessary functions. The cabinet size is mainly defined by number of feeders, which defines size of the RTU7M system, number of terminal strips, fuses, battery pack and other electronic components related to customer demands. The terminal strips block is defined also according to the type of measuring transformers (VT, CT) or sensors (some sensors are recommended to be connected directly to measuring cards, others types need the terminal strips with shorting option, etc.). HMI can be installed either on the main door or on the second internal door.

2. **Chassis** – there are usually used chassis with 8 or 10 slots on backplane. They are sufficient for monitoring and control in secondary substations with 3–4 feeders, which are widely used in field. If the number of feeders is higher, then the system can be built in the larger chassis, or it can be assembled from more RTUs next to each other and connected into one system.

3. **Power supply** – there are usually used 24V or 48V DC voltage systems in secondary substations, which are in relation with signaling voltage and with powering of motor drives for switches. This voltage range is fully covered by RTU7M power supply card PWRI-60DH, which works on voltages from 10 to 60 V DC. The main powering is usually provided from the secondary (LV) side of the transformer via a separate AC/DC power supply, which provides the input voltage for the power supply card and the battery charger card in the RTU. Smaller systems (up to 8 slots without need of any other devices and drives powering) can be powered directly from the transformer via the card PWRI-230B with its own battery charger.

4. **Battery charger** – there can be used battery charger cards in ELVAC RTU7M. They are available in versions for 24V and 48V battery

pack. One battery charger card can be used for up to 4 RTUs. There is thermal sensor input for optimal battery charging control. Status of batteries is regularly checked by the RTU and alarms can be sent to the maintenance team. Optionally there can be used external battery charger systems in secondary substations. Then the ELVAC RTU monitors the signals from these systems.

5. **Communication** – ELVAC RTUs use the latest type of communication card COMIO PC3, which can be used in different versions according to demanded number of Ethernet, optical or serial ports. There are available versions with a buill-in GSM/UMTS/LTE modem. This card supports all the necessary communication protocols mentioned above and has enough power for all tasks such as secure communication with SCADA and maintenance system, collection of all data from I/O cards and IEDs in the substation. This card supports routing functions for LAN separation, role-based access and many other functions used in secure networks.

6. **Digital inputs** – the cards DI20-Uxx are in Dry or Wet contact versions with different signaling voltage from 12 to 220V DC/AC. DI cards have the optically isolated inputs, the signal polarity can be bidirectional. The signaling voltage is usually the same as the RTU power supply voltage, so Wet contact are more commonly used in substation applications. The Dry contact version is available in 24V version. If AC voltage is used, there can be used filters for correct signal evaluation.

7. **Digital outputs** – there are two versions in our portfolio. The first option is card type DO10-U with 10 relay outputs 24 V DC / 8 A or 250 V AC / 8 A. The second option is card type DO20-U with 20 photo relays 60 V DC / 40 V AC / 800 mA). For load switching over the limits of our DO cards, there can be used external contactors/relays.

8. **Feeder measurement** – the cards from the RTU7M EP series have high accuracy, fault indication functions for MV feeders (ANSI 27/59, 46BC, 47, 50, 50N, 51, 51N, 59, 59N, 67, 67N, 81) and can be used also as protection relays on MV feeders. They support data sharing (e.g. voltage can be measured only at one place and then distributed to individual current measurements for power calculation, which significantly saves investment in measuring sensors). They are available in various combinations of measuring inputs for voltage and current transformers and sensors, including versions for low-power resistive or capacitive sensors. All measuring groups are isolated from each other and from the system. There are available also cards from the RTU7M AI series for power quality monitoring and measuring from transducers or other type of sensors.

9. **Transformer secondary side monitoring (LV)** – optionally, it is possible to monitor the low voltage side using the measuring card from EP series or via the power quality measuring card. There can be detected also the voltage presence behind the fuses via DI card with 230 V AC inputs. Another option is available for cross networks, where the voltage can be coming from both sides. Then a comparison of signals in front and behind the fuses can be evaluated.

All cards specification can be found in our catalogue, the most commonly used variants are on internet e-shop at www.rtu.cz in RTU7M section.

ELVAC RTU certificates:
- Electrical safety – EN 61010-1, 60255-27, 60950-1
- EMC – EN 61000-4-xx, 61000-6-5, 50130-4, 60255-26
- EMI – EN 55022, 55032
- Environment – EN 60068-2-xx
- Certified protocols:
  - IEC 60870-5-104
  - IEC 61850
- Security – Penetration Tests
- ISO 9001, 14001, 27001, 45001

ELVAC RTU7M advantages:

- all in one solution – complete remote monitoring, control and maintenance, communication with SCADA, battery backup, IEDs data concentration, I/O signals, measurement, indication and protection, waveform recording, programmability, HMI interface, etc.,
- wide system expandability – practically unlimited number of signals from substation,
- optional power supply voltages 10–220 V DC or 80–230 V AC,
- optional battery backup controlled directly from RTU – the battery status is regularly tested and alarms are transferred to SCADA or maintenance system,
- variety of communication ports with support for all state-of-art standards in power distribution control – different protocols, communication security and many others,
- suitable for retrofits – older communication protocols support after consultation with the producer,

- 3-phase measurement with high accuracy (V_0 and I_0 can be directly measured or calculated), fault detection with protection relay functionality for MV feeders – price efficient solution, support for wide range of VTs, CTs and low power sensors,
- high speed data sharing support between I/O cards,
- fully isolated digital and analog inputs and outputs,
- waveform recording (COMTRADE format), commonly used for evaluation of faults on power distribution lines,
- optional power quality monitoring,
- optional broken fuse detection on LV side,
- optional signal comparison (in front and behind fuses or switches – voltage difference, phasor shift),
- user programmable automation functions (embedded PLC),
- web interface for configuration and custom interactive HMI (modern web browsers on Windows/Android/iOS are supported),
- SQL database connector available.

Configuration Example A.1

This is an example for applications, where no other devices were previously installed or only some specific tasks were solved (e.g. power meters, fault indicators or power quality meters that can be connected to SCADA through a new RTU system).

ELVAC RTU7M configuration

Slot 1 – power supply card for 10–60 V DC powered from the battery backup card,

Slot 2 – battery backup card for 24V (optionally 48V) battery pack, powered from an external power supply 230V AC / 24 (opt. 48) V DC,

Slot 3 – communication card COMIO-PC3 LTE with the following features:

a) high performance for communication with SCADA and whole substation data concentration,
b) GSM/UMTS/LTE modem for communication with SCADA,

c) Ethernet LAN port for local parameterization and interconnection with a local HMI,
d) 2 x serial port RS-232/422/485 for communication with other IEDs (power meters, power quality meters, etc.),

Slot 4 – digital input card in version DI20-UPM for external signaling voltage 24 V DC (wet contact, optionally 48 V DC),
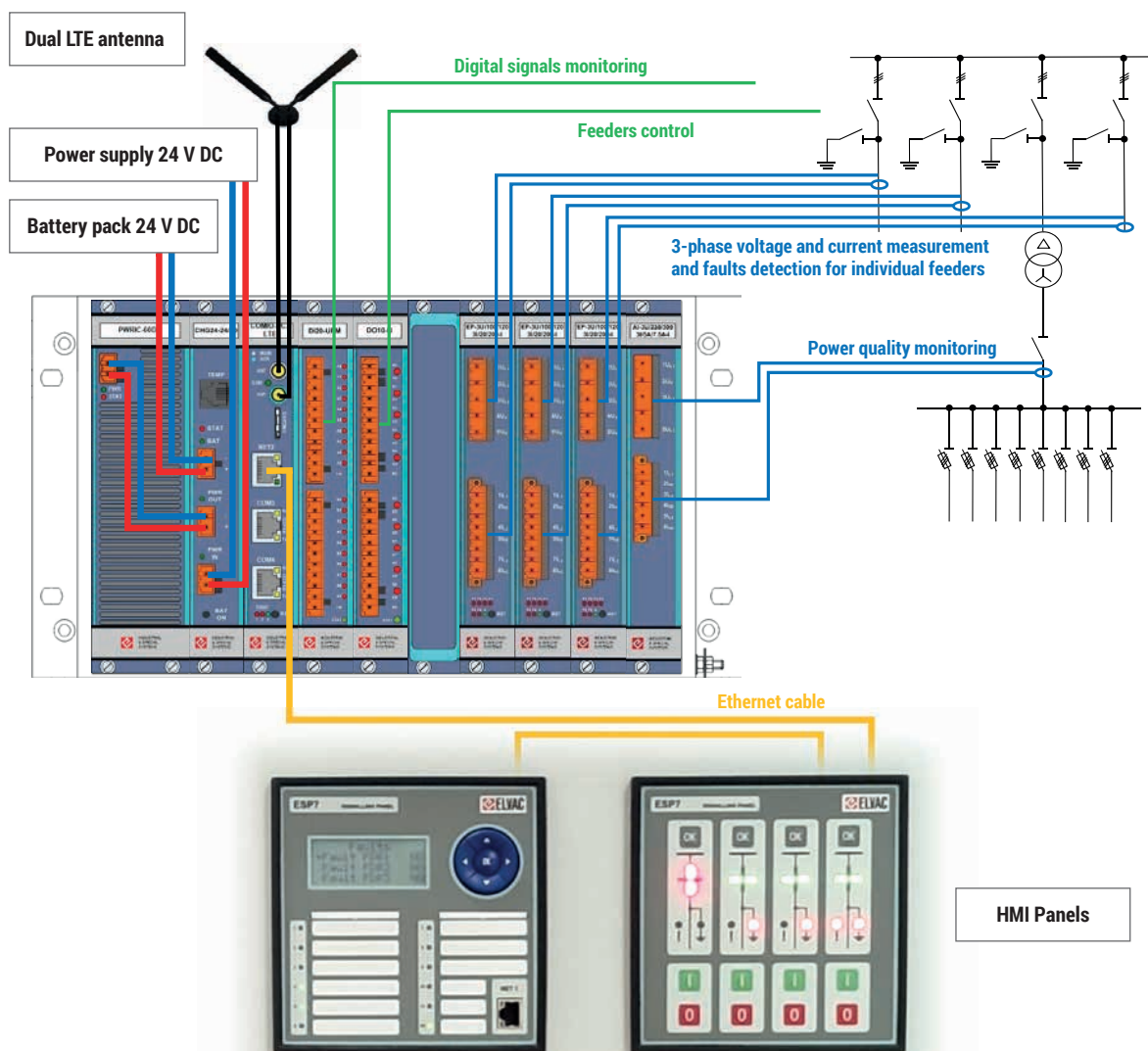
Slot 5 – digital output card DO10-U for feeders control,

Slot 6 – blind, free slot for future expansion by another I/O card,

Slot 7, 8, 9 – measuring cards EP-3U3I for feeder measurement and faults detection,

Slot 10 – power quality measuring card for the transformer secondary side monitoring.

HMI panel – two ESP7 panels connected in chain, the first one with LCD display and LEDs for digital states monitoring, the second one for up to 4 feeders control and monitoring (can be added another one, when more feeders shall be monitored and controlled).

Dual LTE antenna

Power supply 24 V DC

Battery pack 24 V DC

Digital signals monitoring

Feeders control

3-phase voltage and current measurement and faults detection for individual feeders

Power quality monitoring

Ethernet cable

HMI Panels

Hasičská 44, 700 30 Ostrava, Hrabůvka, Czech Republic
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Configuration Example A.2

When the RMU cubicles are equipped with protection relays (or feeder terminals), then the RTU system has mainly the function of data concentration and communication to SCADA, including backup communication. The RTU can optionally monitor the secondary side of the transformer. The measured data from the MV feeders are taken from the protection relays, the digital signals go partly through the protection relays and partly directly to the RTU system. In this configuration, the protection relays, switch drives and RTU system are usually powered from a separate power supply with battery backup. The HMI interface can be similar to the previous example.

ELVAC RTU7M configuration

Slot 1 – power supply card for 10–60 V DC powered from external powering system with battery backup,

Slot 2, 3 – communication card COMIO-PC3 LTE/ESW2 with the following features:

a) high performance for communication with SCADA and whole substation data concentration,

b) Ethernet LAN port (optionally optical converter) for communication with SCADA, GSM/UMTS/LTE modem for backup communication,

c) optical Ethernet LAN ports in communication ring for measured and digital data collection from protection relays,

d) another 2 Ethernet LAN ports for local parameterization, interconnection with local HMI, communication with IEDs (energy meters, power quality meters, etc.), communication ring is also available,

e) 2 x serial port RS-232/422/485 for communication with IEDs, usually for Modbus or IEC 60870-5-103 devices,

Slot 4 – digital input card in version DI20-UPM for monitoring of digitals signals, which are not coming through protection relays (ex. door contact),

Slot 5, 6 – blinds, free slots for future expansion,

Slot 7, 8, 9 – digital input cards in version DI10-UPXL for low voltage presence monitoring behind fuses,

Slot 10 – power quality measuring card for transformer secondary side monitoring.
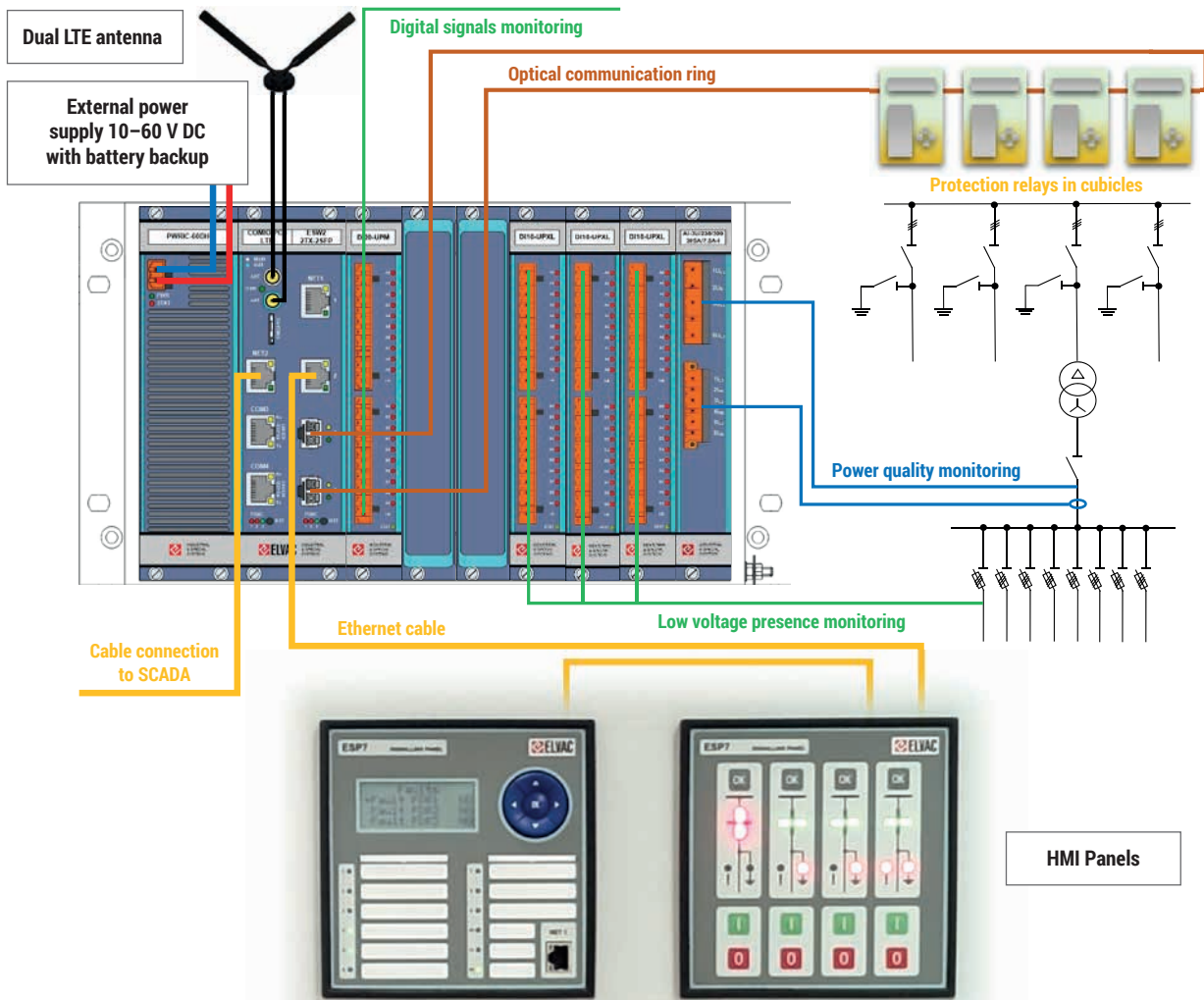
B. ELVAC RTU Decentralized System

The whole system is divided into individual RTUs located in separate cubicles or in a small space above the feeder switches. The number of RTUs can be the same as the number of feeders, so each feeder is monitored and controlled by its own RTU. All RTUs are interconnected via serial line using the proprietary ELVAC protocol HioCom2, which provides also time stamps data transfer and system parameterization. One of the RTUs is equipped with a communication card for communication with the SCADA or other superior system. From the user point of view, all RTUs look like one system, parameterized via the communication card.

The power supply input for the RTUs and the serial line port for the RTU interconnection are located on the bottom of 2 or 3-slot chassis, which saves the necessary space (no RTU7M power supply card is used). The decentralized system is then usually powered from an external AC/DC power supply unit with battery backup, which is also used for powering of switch drives in cubicles and other devices in the secondary substation. The standard power supply voltage is 24 V DC (other voltages after consultation with producer).

This system allows RMU manufacturers to integrate the monitoring and control system directly into their product without necessity of separate control cabinet, which is then very cost-effective and saves also time and money during commissioning.

External power supply with battery backup
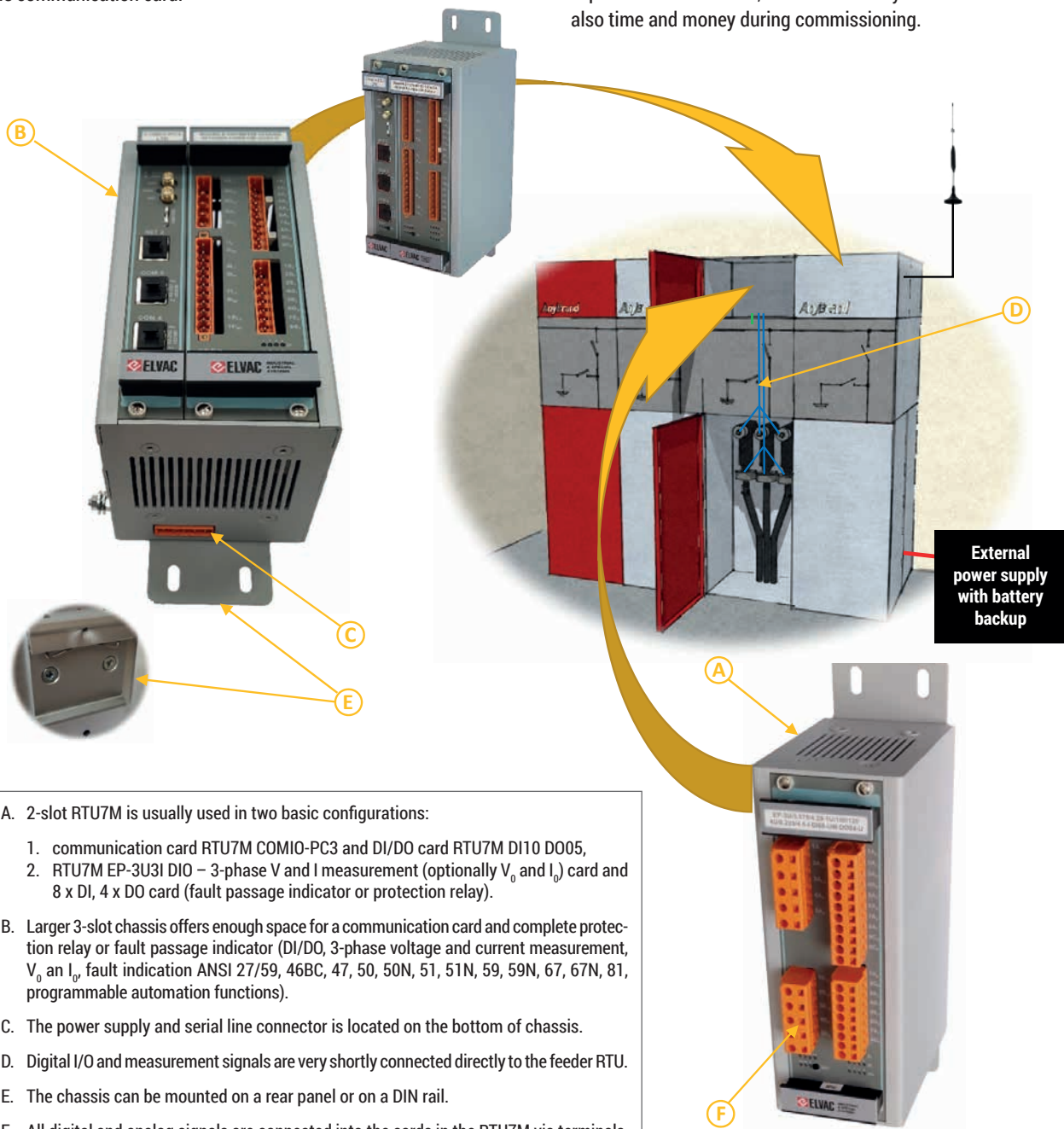
A. 2-slot RTU7M is usually used in two basic configurations:

1. communication card RTU7M COMIO-PC3 and DI/DO card RTU7M DI10 DO05,
2. RTU7M EP-3U3I DIO – 3-phase V and I measurement (optionally V_0 and I_0) card and 8 x DI, 4 x DO card (fault passage indicator or protection relay).

B. Larger 3-slot chassis offers enough space for a communication card and complete protection relay or fault passage indicator (DI/DO, 3-phase voltage and current measurement, V_0 an I_0, fault indication ANSI 27/59, 46BC, 47, 50, 50N, 51, 51N, 59, 59N, 67, 67N, 81, programmable automation functions).

C. The power supply and serial line connector is located on the bottom of chassis.

D. Digital I/O and measurement signals are very shortly connected directly to the feeder RTU.

E. The chassis can be mounted on a rear panel or on a DIN rail.

F. All digital and analog signals are connected into the cards in the RTU7M via terminals, which is useful for easy disconnection during commissioning and service works.

Configuration Example B.1

As an example, there is shown the system with 4 feeders, where:

- ❖ the feeders 1–3 are medium voltage feeders with complete monitoring, control, measurement and fault passage indication,
- ❖ the feeder 4 is output for the MV/LV transformer, which is only controlled and monitored by digital states, but not measured,
- ❖ the RTU in 4th feeder is used also for main communication with the SCADA.

ELVAC RTU7M configurations for 1st–3rd feeder:

Slot 1, 2 – a combined 2-slot card with 8x DI, 4x DO, 3-phase voltage and current measurement (optionally direct measurement of V_0 and I_0), it works as a complete measurement, fault passage indicator and protection relay. Exact type of measuring inputs depends on used voltage and current sensors (see ELVAC catalogue for power industry).

ELVAC RTU7M configurations for 4th feeder:

Slot 1 – the communication card COMIO-PC3 LTE with the following features:

a) high performance for communication with SCADA and whole substation data concentration,
b) GSM/UMTS/LTE modem for communication with SCADA,
c) Ethernet LAN port for local parameterization and interconnection with local HMI, or for communication with other devices,
d) 2 x serial port RS-232/422/485 for communication with other IEDs (power meters, power quality meters, etc.),

Slot 2 – combined DI/DO card RTU7M DI10-UPM DO05-U.

HMI interface – it can be realized on one of feeder front panels for all units in system using ESP7 panels.

GSM/UMTS/LTE
to SCADA

I

H

External power supply

Serial line RS-485

Ethernet cable
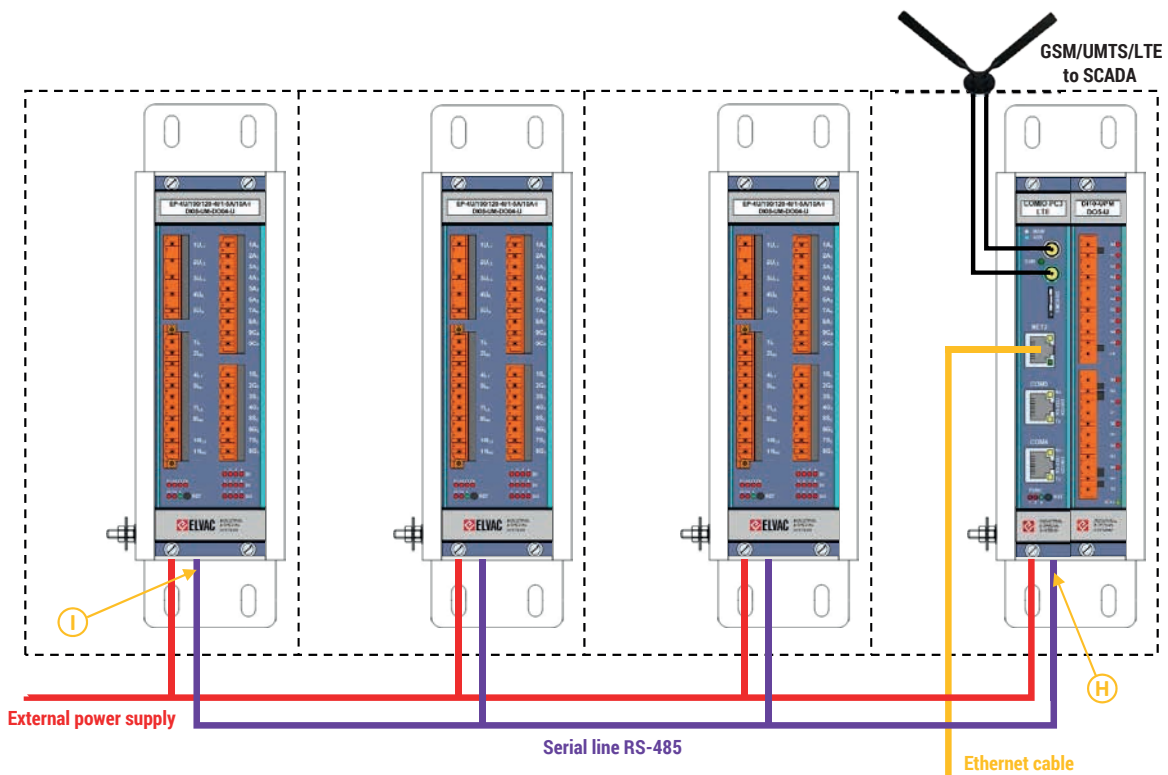
Note:

When using the RS-485 communication line, please do not forget about using the terminators, pull-high and pull-low resistors, which ensures the best communication line conditions.

As an example, we can recommend the device tM-SG4 from ICPDAS.

H. Termination resistor is required at the beginning of the line.

I. Termination, pull-high and pull-low resistors are required at the end of the line.

Configuration Example B.2

When other electronic devices are also located in the secondary substation, then there can be interesting to use some data concentrator in a separate cabinet mounted on the wall. Then the communication part is moved to this cabinet and the feeders are equipped only with digital inputs, outputs and measuring inputs. All data then goes through the serial line to the data concentrator.

The basic system features are:

- the feeders 1–4 are medium voltage feeders with complete monitoring, control, measurement and fault passage indication,
- the wall mounted cabinet is equipped with an RTU, which works as data concentrator and communicator with SCADA or other systems.

Note: When cables go out of RMU and cabinet, all communication interfaces and power supply must be galvanically isolated type.

ELVAC RTU7M configurations for 1st–4th feeder:

Slot 1, 2 – a combined 2-slot card with 8x DI, 4x DO, 3-phase measurement voltage and current (optionally direct measurement of V_0 and I_0), it works as a complete measurement, fault passage indicator and protection relay. Exact type of measuring inputs

depends on used voltage and current sensors (see ELVAC catalogue for power industry).

ELVAC RTU7M configuration in the wall mounted cabinet:

Slot 1 – power supply card for 10–60 V DC powered from external power supply with battery backup,

Note: This configuration can optionally be equipped with a battery backup card, so it can also work as the main powering system for feeder RTUs.

Slot 2 – communication card COMIO-PC3 LTE with the following features:

a) high performance for communication with SCADA and whole substation data concentration,
b) GSM/UMTS/LTE modem for communication with SCADA,
c) Ethernet LAN port for local parameterization and interconnection with local HMI, or for communication with other devices,
d) 2 x serial port for communication with other IEDs (power meters, power quality meters, etc.),
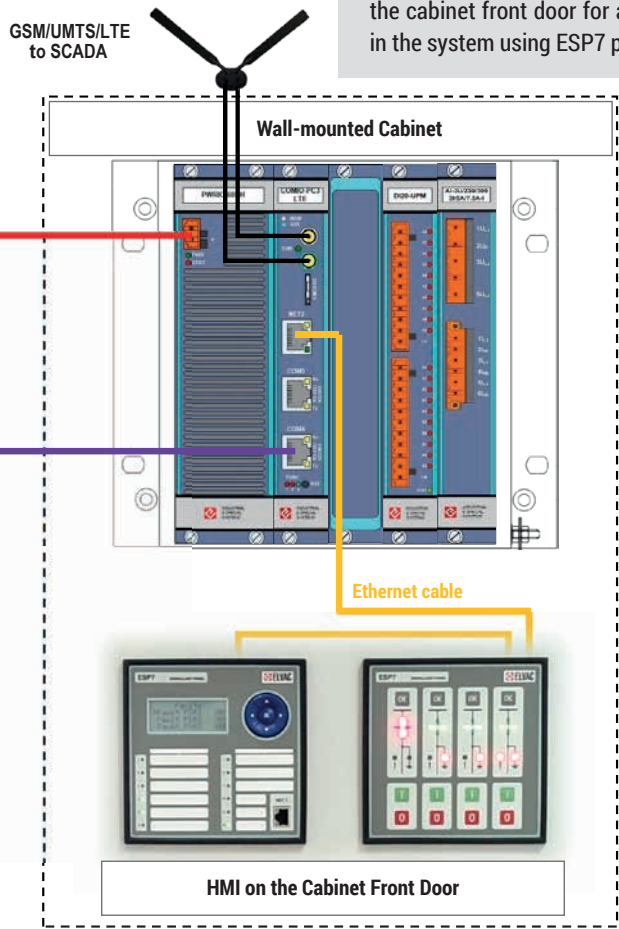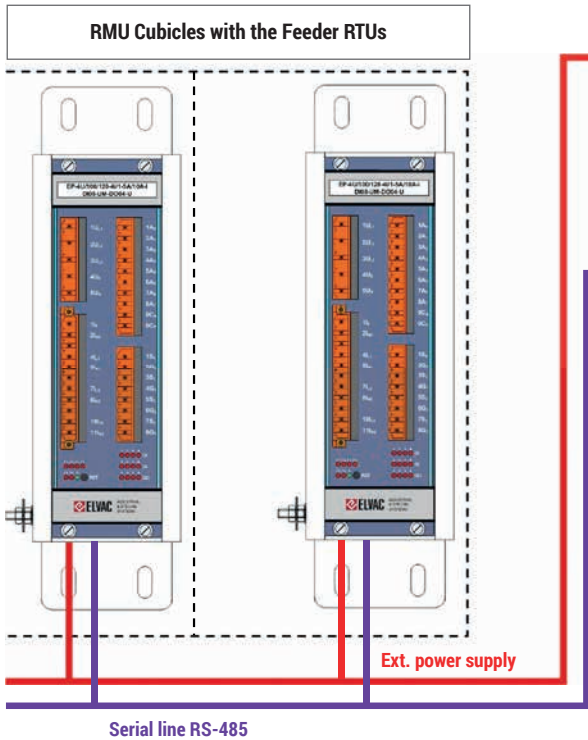
Slot 3 – blind, free slot for another I/O card,

Slot 4 – digital input card in version DI20-UPM for external signaling voltage 24 V DC (wet contact),

Slot 5 – power quality measuring card for transformer secondary side monitoring.

HMI interface – it can be realized on the cabinet front door for all units in the system using ESP7 panels.

Note:
In this case, the termination, pull-high and pull-low resistors are required at the end of the RS-485 line. The beginning of the line is terminated inside the communication card COMIO PC3, where it is activated as a default setting.

GSM/UMTS/LTE to SCADA

RMU Cubicles with the Feeder RTUs

Wall-mounted Cabinet

Ethernet cable

Ext. power supply

Serial line RS-485

HMI on the Cabinet Front Door

Hasičská 44, 700 30 Ostrava, Hrabůvka, Czech Republic
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ELVAC RTU as Main Communication Unit in Power Industry

Usual application names:

- Main Communication Unit for Power Distribution or Power Transmission Objects
- Data Concentrator
- Communication Gateway
- Router
- Protocol Converter
- Redundant (Backup) Communication to SCADA

Location specification:

- primary substation – high voltage to medium voltage (HV/MV),
- switching stations (power distribution network is only divided into more MV branches),
- secondary substation – medium voltage to low voltage (MV/LV),
- renewable energy sources (water, wind, solar power plants),
- cogeneration units,
- other objects in power transmission and distribution (pole mounted reclosers, load break switches, indicators etc.).

Typical application requirements:

- communication with SCADA system via optical or metallic Ethernet, GSM/UMTS/LTE or radio modem,
- communication protocols:
    - to SCADA – IEC 60870-5-101, IEC 60870-5-104, DNP3, IEC 61850,
    - to other electronic devices in object – IEC 60870-5-101, IEC 60870-5-103, IEC 60870-5-104, IEC 61850, DNP3, MODBUS TCP/RTU, DLMS, sometimes others, when retrofits are demanded,
    - secure communication, communication tunnels etc.,
- data concentration from other electronic devices – protection relays, energy meters, fault passage indicators, power quality meters.
- HMI.

Note: As the standards may vary from country to country, your demands can be always discussed with our professionals.

ELVAC RTU System Description

Above mentioned applications are related mainly to the system communication abilities. For ELVAC RTU systems, there were developed communication cards from series COMIO. They are available in the following versions:

COMIO4 – basic type of communication card, focused on small systems with low price. It offers up to 4 communication interfaces in different combinations. Its internal resources allow to use maximally up to 5 additional RTU cards or devices in whole system. This card supports communication protocols IEC 60870-5-101, IEC 60870-5-103, IEC 60870-5-104, DNP3 to SCADA, MODBUS RTU/TCP, HIOCom2, HTTP. This card does not support encryption (e.g. https is not supported).

COMIO PC3 – third generation of communication card based on Linux core. This card offers much higher performance than COMIO4, so it supports wider range of communication protocols used in power industry, see the picture above with ELVAC RTU communication abilities. This card is available in one or two-slot versions with various number on communication interfaces and its combinations, see the ELVAC catalogue for power industry. As the card performance is very high, it has sufficient internal resources for evaluation of data from much higher number of additional RTU cards or external devices, which is usually sufficient for the largest existing
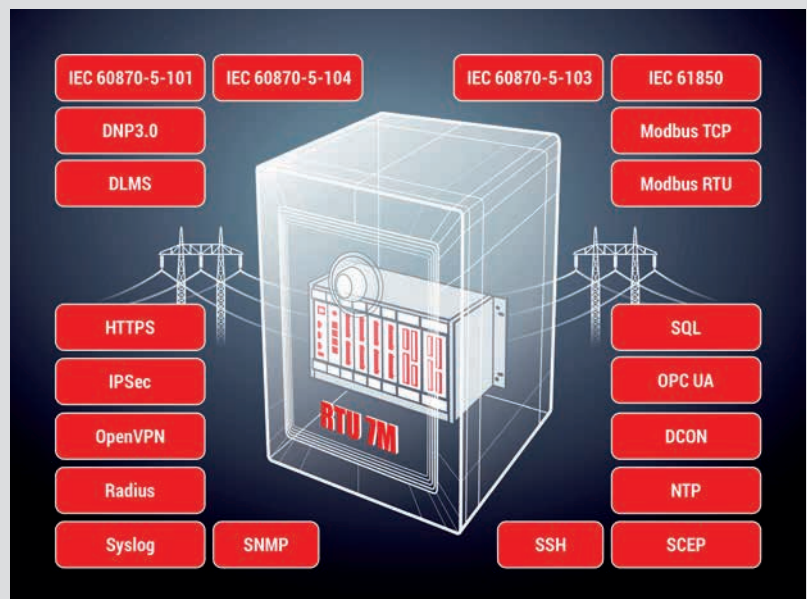
ELVAC RTU communication abilities

applications in power industry. This card also supports the secure communication demanded by actual IT standards in power industry, routing and Firewall function. ELVAC RTU then combines standard RTU functions with wide communication functions. And wise versa, when this card is used only with RTU7M power supply cards in small chassis, it can be used as main communication unit with optional communication interfaces combinations and with optional power supply input voltages (10 – 220 V DC or 80 – 230 V AC) including optional battery backup.

RTU7MC3 – standalone communication device with the same communication features as above mentioned COMIO PC3. The main differences are, that RTU7MC3 has fixed communication interfaces combination (see RTU7MC3 variants in our catalogue) and as a standalone device is mounted in DIN rail or panel mounting chassis.

Detailed technical specifications can be found in our catalog of products for power industry. The parameterization of all above mentioned cards/devices can be done either through web interface or via ELVAC parameterization software RTU User Center, which is free of charge.

COMIO PC3 and RTU7MC3 features:

- variety of communication ports with support for all state-of-art standards in power distribution control,
- multiple communication support with upper systems (SCADA, maintenance, communication backup),
- multiple APN support (on demand),
- two independent network interfaces (valid for versions with 2 and more ETH ports, useful for Firewall function or networks separation),
- supported communication protocols – IEC 61850, IEC 60870-5-101, IEC 60870-5-103, IEC 60870-5-104, DNP3, MODBUS TCP/RTU, DLMS, OPC UA, SNMP, HIOCom2,
- L2TP, OpenVPN and IPSEC tunneling,
- secure communication according to IEC 62351-3 (TLS),
- web based configuration interface HTTP/HTTPS,
- NAT, Firewall functionality,
- user access control, RADIUS,
- Syslog, NTP, SSH, SCEP,

- SQL database connector available,
- user programmable automation functions according to standard IEC 61131-3 (embedded PLC),
- built-in RTC,
- internal microSD socket for storage expansion,
- web interface for configuration and custom interactive HMI (modern web browsers on Windows/Android/iOS are supported).

RTU7MC3

ELVAC RTU Communication Roles for Different Applications

As our communication units and cards in ELVAC RTU systems have many functions, so there is not usually used only one function, but they can be used simultaneously. Then RTU system can be understood as:

- **Main Communication Unit** – when it is main communication device between power distribution object and SCADA systems (or others),
- **Data Concentrator** – when it concentrates data from many devices in power distribution object, usually from I/O cards and other RTUs in large systems, energy meters, protection relays, power quality meters etc.,
- **Communication Gateway** – when it offers communication services for other devices, which do not have communication interfaces (for example devices with digital outputs only, like various fault indicators, energy meters, switches etc.) or their communication protocols or interfaces are not optimal for communication with SCADA system,

- **Router** – when it separates two networks for higher communication security, usually the communication with SCADA and local network in power distribution object,
- **Protocol Converter** – when data from devices in power distribution object coming through some communication protocol are converted into other protocol usually used with SCADA and other upper systems, like IEC 870-5-101 to IEC 870-5-104, MODBUS to IEC 870-5-104 or IEC 61850, or IEC 61850 to IEC 870-5-104 and other combinations,
- **Redundant Communicator** – when there are created backup communication lines for communication with SCADA or there can be created separate communication lines into more SCADA systems or other system (e.g. a maintenance system).

All above mentioned roles can be combined in ELVAC RTUs using the communication card COMIO PC3 or RTU7MC3 without any limitations. Some communication features (usually the data concentrator) are licensed. The products with communication card COMIO4 are used for easier tasks, like protocol conversion, because of its limited internal resources. The typical device for basic protocol conversion or communication gate is smallest RTU in our portfolio – RTU7C.

Application Guide

Configuration Example 1

This is an example of configuration for substation, combining all above mentioned communication roles. Usually one RTU unit has the function of main communication RTU and data concentrator. If there are another RTUs, they are subordinated to the main communication unit. This situation is also described in more details in document "ELVAC_RTU in Primary Substation".
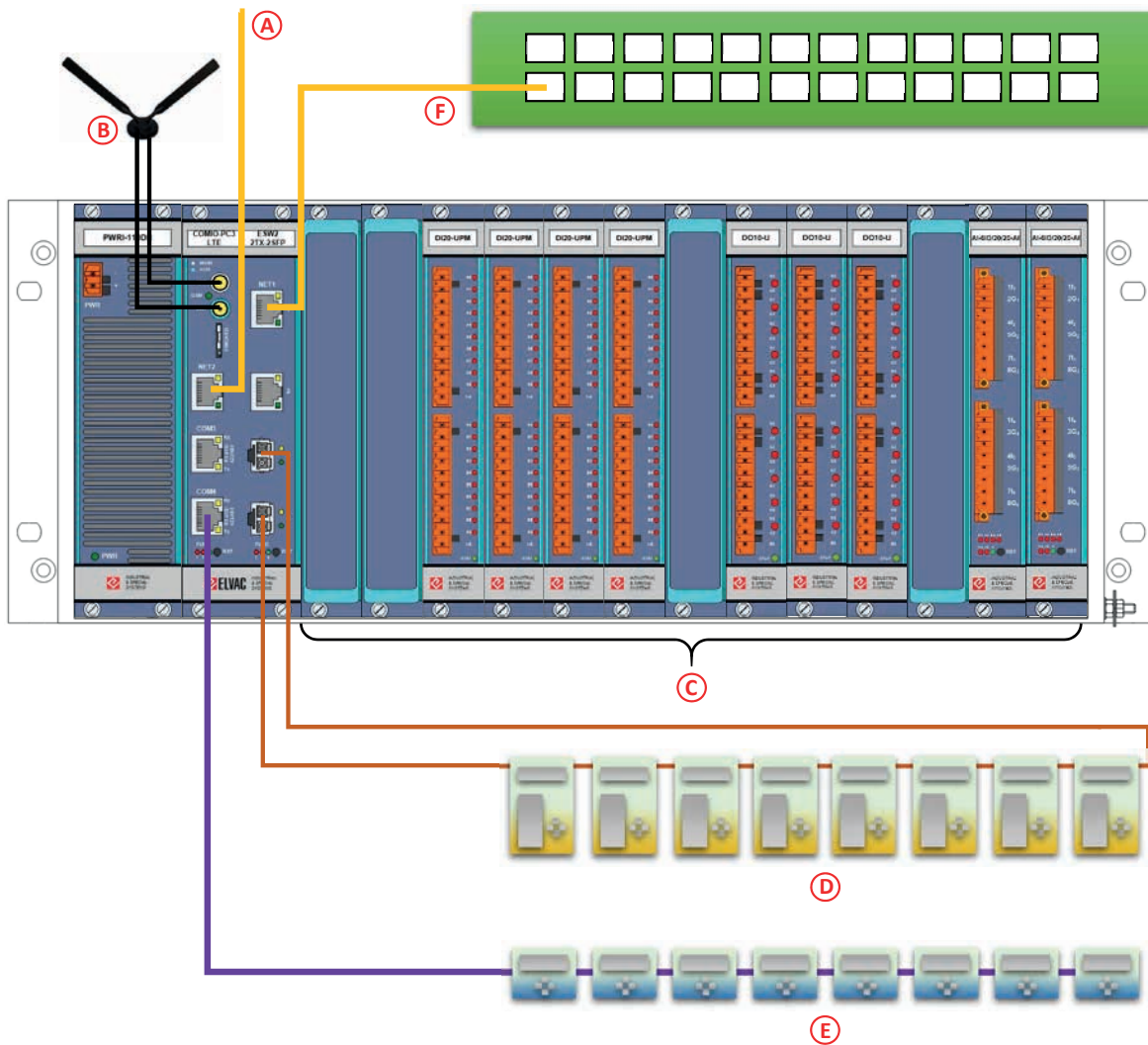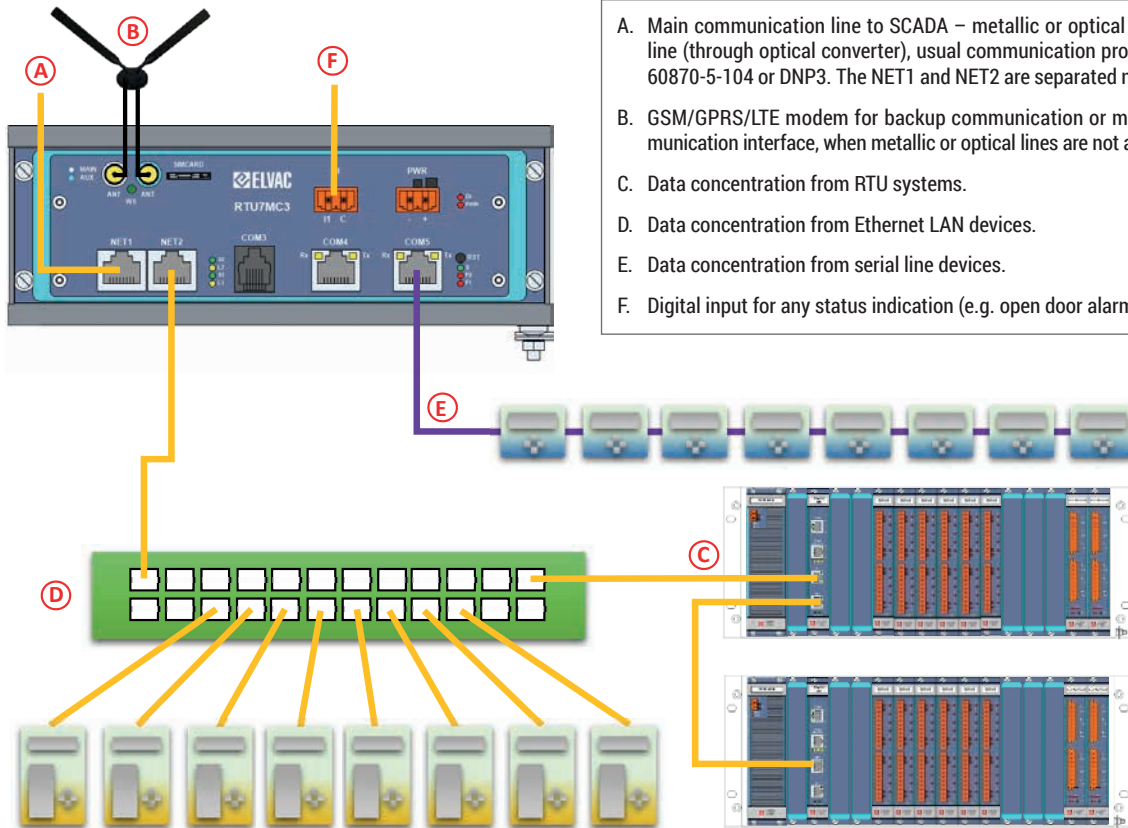

A. Main communication line to SCADA – metallic or optical Ethernet line (through optical converter), usual communication protocol IEC 60870-5-104 or DNP3.

B. Optional GSM/GPRS/LTE modem for backup communication or main communication interface, when metallic or optical lines are not available.

C. Data collection from internal I/O cards in RTU. It is also possible to collect the data from energy meters through pulse counter at digital inputs in our RTU systems.

D. Data concentration from protection relays via optical ring (optionally metallic ring), usual communication protocols IEC 61850, MODBUS TCP, IEC 60870-5-104.

E. Data concentration from other devices (energy meters, power quality meters) via serial line.

F. Data concentration from other devices (another RTUs, energy meters, power quality meters) via Ethernet switch.

Configuration Example 2

This is an example of standalone unit RTU7MC3 as main communication unit in power distribution applications. It works also as router, protocol converter and data concentrator.

A. Main communication line to SCADA – metallic or optical Ethernet line (through optical converter), usual communication protocol IEC 60870-5-104 or DNP3. The NET1 and NET2 are separated networks.

B. GSM/GPRS/LTE modem for backup communication or main communication interface, when metallic or optical lines are not available.

C. Data concentration from RTU systems.

D. Data concentration from Ethernet LAN devices.

E. Data concentration from serial line devices.

F. Digital input for any status indication (e.g. open door alarm).

Configuration Example 3

This is an optional configuration of the previous example no. 2 assembled from modular RTU7M. Comparing to example 2, the main difference is an optional power supply card, so the unit can be directly powered from wide range of powering voltages from 10 – 220 V DC (which enables the direct powering from any battery system in substation) or 80 – 230 V AC. Another optional component is a communication card, where, for example, a GSM/GPRS/LTE modem can be integrated or not. The typical usage of this configuration is protocol IEC 61850 converter in substations, or main communication unit with data concentration and routing functions.

ELVAC RTU certificates:
- Electrical safety – EN 61010-1, 60255-27, 60950-1
- EMC – EN 61000-4-xx, 61000-6-5, 50130-4, 60255-26
- EMI – EN 55022, 55032
- Environment – EN 60068-2-xx
- Certified protocols:
  - IEC 60870-5-104
  - IEC 61850
- Security – Penetration Tests
- ISO 9001, 14001, 27001, 45001

ELVAC RTU as Monitoring and Control System for Pole Mounted Recloser

Usual application names:

- Pole Mounted Recloser Monitoring and Control System
- Remote Control and Monitoring of Recloser

Location specification:

- Power distribution overhead lines – pole mounted Recloser

Typical application requirements:

- pole-mounted cabinet (vandal resistant) with IED/RTU,
- communication with SCADA system via GSM/UMTS/LTE or radio modem, sometimes via optical lines,
- communication protocols to SCADA – IEC 60870-5-104, IEC 60870-5-101, DNP3, IEC 61850,
- secure communication, communication tunnels,
- digital states signaling (Recloser status, door contact etc.),
- remote and local control of Recloser,
- 3-phase voltage and current measurements,
- faults detection on power lines,
- automatic functions – protection relay, reclosing, interlock conditions etc.
- GOOSE support, when fast communication with other protection relays and Reclosers is required (optical communication is necessary).

Note 1: *As the standards may vary from country to country, your demands can be always discussed with our professionals.*

Note 2: *Company ELVAC a.s. is a producer and developer of monitoring and control systems with wide options of connection to different brands of Reclosers. ELVAC a.s. does not produce any mechanical switches – Reclosers. Our goal is to provide the best monitoring and control systems based on great experience with worldwide customers. We offer our knowledge to different system integrators and Recloser producers to achieve the best user friendly and reliable solution.*

ELVAC RTU7M System Description

1. **Cabinet** – there is usually required some weather and vandal resistant construction for mounting on a pole in public places. The size of the cabinet is given mainly by dimensions of monitoring and control system and its accessories (see the scheme of solution below), but also with regard to good system cooling and comfortable space during a commissioning and maintenance. A switch drive of Recloser is not located in cabinet, because it is usually a part of mechanical construction of Recloser itself. The cabinet is usually produced from galvanized, stainless or powder coated metal sheets, IP54 or better. There can be used either half cylindrical lock insert or padlock.

2. **RTU chassis** – the whole monitoring and control system is integrated in few components (power supply with battery backup, communication, DI/DO and voltage and current measurement). Therefore, it is usually sufficient the chassis with 5 slots on backplane.

3. **Power supply and battery backup** – this part of system is designed in the following way:

a. Powering from power distribution lines is done via interphase MV/LV transformer with output 100 or 230 V AC, which is located on source side of Recloser.

b. This voltage from transformer goes directly to an internal power supply of RTU7M. It can be directly measured there, which offers the voltage presence information on power lines on source side of Recloser.

c. Another power supply is necessary for powering of Recloser switching drive. The parameters are different for different types of Reclosers, so this power supply is usually separate component, which is powered from batteries in system.

d. The important part is a battery charger for backup batteries, which also regularly checks their status, so it is not necessary to check the status of batteries personally, but messages come automatically into maintenance system. There is usually 24 V DC backup voltage (other options are 12V and 48V DC). The battery capacity is given by customer demand for system operation time during main power loss. Battery charging process is optimized in relation to external temperature, which is measured by temperature sensor connected to power supply card with charger. There is also a function of automatic battery disconnection as a protection against deep battery discharge.
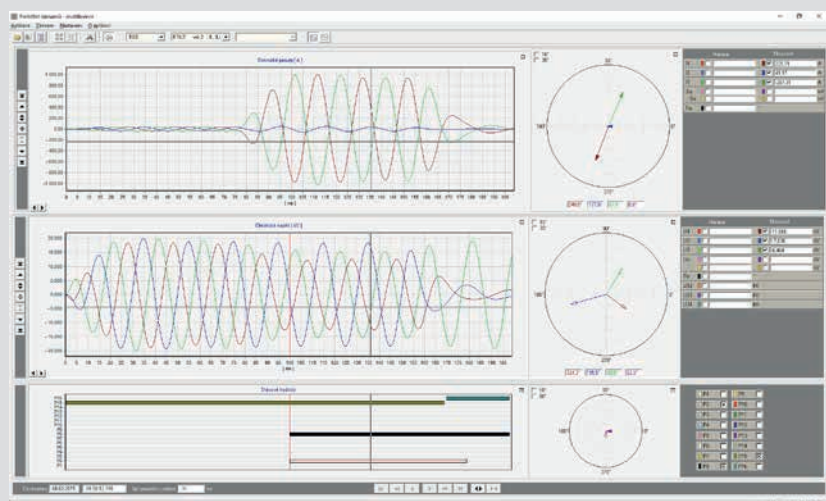
4. **Communication with SCADA and maintenance systems** – there is used the newest type of communication card COMIO PC3 with embedded GSM/UMTS/LTE modem. This card supports all necessary communication protocols and features for secure communication with SCADA and maintenance system (see the picture ELVAC RTU communication abilities) that are required by current IT standards. There is possible to setup multiple communication channels into different SCADA or maintenance systems. Sometimes there is used optical communication, especially when GOOSE communication is used with other protection relays and Reclosers in network for the fastest possible fault isolation.

5. **Digital inputs** – they are necessary for monitoring of Recloser states and door contact of cabinet. The signaling voltage is 24 V DC. DI card have optically isolated inputs, the signal polarity can be bidirectional.

6. **Digital outputs** – they are used for local and remote control of switches in Recloser. Another output is used for heating control, when the external temperature can be dangerous due to water condensation inside the cabinet or for better operating conditions for batteries.

7. **Overhead lines measurement and protection** – the cards from RTU7M EP series have high measurement accuracy, fault indication functions for MV feeders (ANSI 27/59, 46BC, 47, 50, 50N, 51, 51N, 59, 59N, 67, 67N, 81) and they can be used in combination with DI and DO also as protection relays on MV lines, including the current inputs overloadability up to 30 x In. They are available in different combinations of measuring inputs for voltage and current transformers and sensors, including versions for low power resistive or capacitive sensors. We support also Rogowski coils. The integrator for them is directly embedded in our EP cards. All measuring groups are isolated from each other and from system. There are available different versions of EP cards for different types of sensors in different brands of Reclosers.

8. **Heating control** – RTU7M has wide operating temperature range, but there are used also other components in cabinet, which are more sensitive for operating temperatures. The backup batteries are a typical example. As they generally do not like very low temperatures, there can be used a heating for adjustment of internal temperature in the cabinet. The heating element can be directly controlled from digital outputs of RTU, because RTU measures continuously the temperature inside the cabinet, so it is easy to setup the limits in RTU parameterization.

9. **HMI interface** – there are more options in our product portfolio with HMI devices. As the Recloser is mostly remotely controlled device and local HMI is not used regularly, customers usually prefer a simple type of HMI
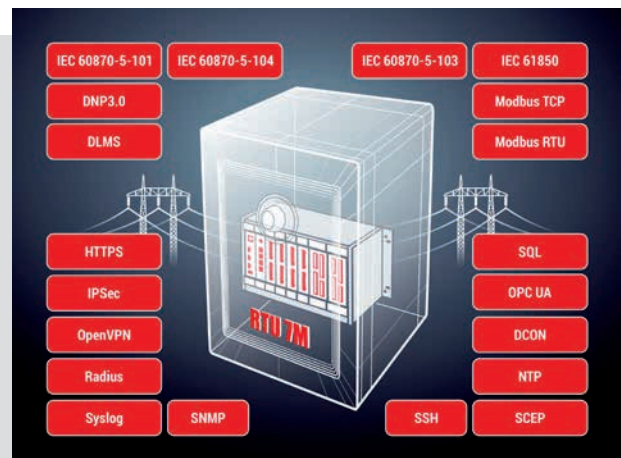
ELVAC RTU Communication Abilities

for local control, which includes some states indication, Remote/Local control switch and control button for Open/Close operation of Recloser. There are available also more comfortable HMIs with LCD display or graphical display with touchscreen. The final choice depends on customer preferences.

10. **Waveform recording** – when any fault (short circuit, earth fault etc.) occurs on power distribution lines, the system RTU7M can record immediately the measured values with flags and defined pretrigger time, so there is clearly visible the beginning and complete course of fault in waveforms for all three phases. These records can be remotely transferred into SCADA or maintenance system for a deeper analysis. There are supported COMTRADE and ELVAC proprietary formats. We offer our own software for analysis called Records Viewer supporting both formats, COMTRADE can be used in third party SW. The recorded waveforms can be useful during installation and commissioning of RTU devices for identification of phases order etc.

Recorded fault example displayed in SW Records Viewer:
- First two frames show the electric current and voltage waveforms.
- The progress bar shows the instantaneous measured values.
- The flags (status values) describe the reasons for activation of recording (e.g. activation of protection principles in RTU).
- There are visible phase shifts, neutral voltage and current in the phasor diagrams.
- There is visible also 100 ms pretigger record for better identification of fault beginning.

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ELVAC a.s.

ELVAC RTU7M Advantages for Recloser Solution

- RTU7M – the great advantage for end users is based on possibility to use the compatible systems in wide range of power distribution tasks and applications (reclosers, load break switches / sectionalizers, fault indicators, primary substations, secondary substations MV/LV etc.), which is very efficient from the commissioning and maintenance point of view.
- All-in-one solution – communication, battery backup, Recloser states monitoring and control, measurement, indication and protection, waveform recording, programmability, HMI interface, remote maintenance (parameterization, FW updates, fault records download), etc.
- System is powered directly from pole mounted voltage transformer connected between two phases, usually with 100 or 220 V AC output, this voltage is measured by input of internal power supply in RTU, so this information can be used also for voltage presence detection on source side of Recloser.

- Battery backup controlled directly from RTU – the battery status is regularly tested and alarms are transferred to maintenance system. The battery is protected against deep discharge.
- Variety of communication ports with support for all state-of-art standards in power distribution control – different protocols, communication security and many others, multiple communication channels with different SCADA or maintenance systems.
- 3-phase measurement with high accuracy (V_0 and I_0 can be directly measured or calculated), fault detection with protection relay functionality for MV feeders – price efficient solution, support for wide range of VTs, CTs, low power sensors or Rogowski coils.
- Fully isolated digital and analog inputs and outputs.
- Waveform recording (COMTRADE format), commonly used for evaluation of faults on power distribution lines.
- User programmable automation functions (embedded PLC).
- Web interface for configuration and custom interactive HMI (modern web browsers on Windows/Android/iOS are supported).

Configuration Example

This configuration has been proven in thousands of installations in different countries. As all functions are integrated into one IED, the solution is very user friendly, organized, easy for maintenance and very reliable.

ELVAC RTU7M configuration in pole mounted cabinet:

Slot 1 – power supply card RTU7M PWRIC-230B BAT-24/10 with input for 80–260 V AC, powered from MV/LV transformer, with thermal sensor, this card solves also battery backup,

Slot 2 – communication card COMIO-PC3 LTE with the following features:

a) wide communication protocols support including IT security features (see the picture ELVAC RTU communication abilities),
b) GSM/UMTS/LTE modem for communication with SCADA,
c) Ethernet LAN port for local parameterization and interconnection with local HMI, eventually for communication with other devices,
d) 2 x serial port for communication with other IEDs (e.g. HMI with serial communication, power meters, power quality meters, etc.),

Slot 3 – blind, free slot for system extension, e.g. another 3 voltage measurements via EP card, when also source side is measured in Recloser.
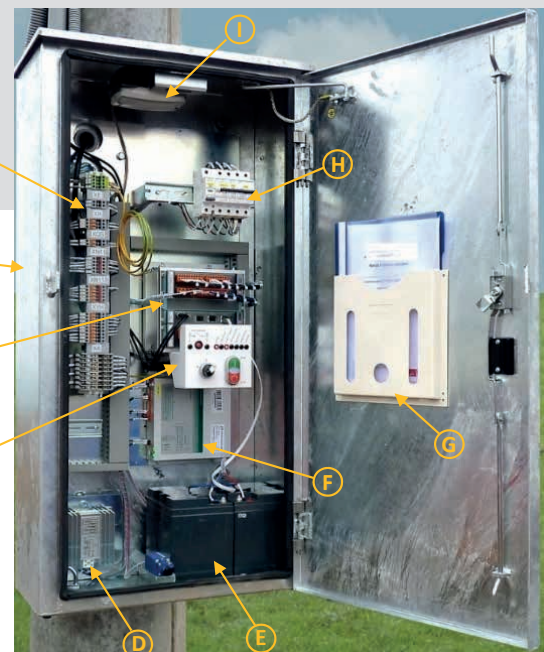
Slot 4, 5 – combined RTU7M EP series card with 8 x DI, 4 x DO, 3-phase voltage and current measurement (inputs specification depends on type of Recloser), there is available also 4th current input (it can be used for Holmgren connection IE/I0 or as sensitive input for IE/I0) and 4th voltage input (it can be used for auxiliary voltage measurement, e.g. on source side of Recloser).

HMI interface – either RTU7M SIG-D-EXT05 or ESP7 panels.

Note: All components specification can be found in our catalogue at www.rtu.cz.
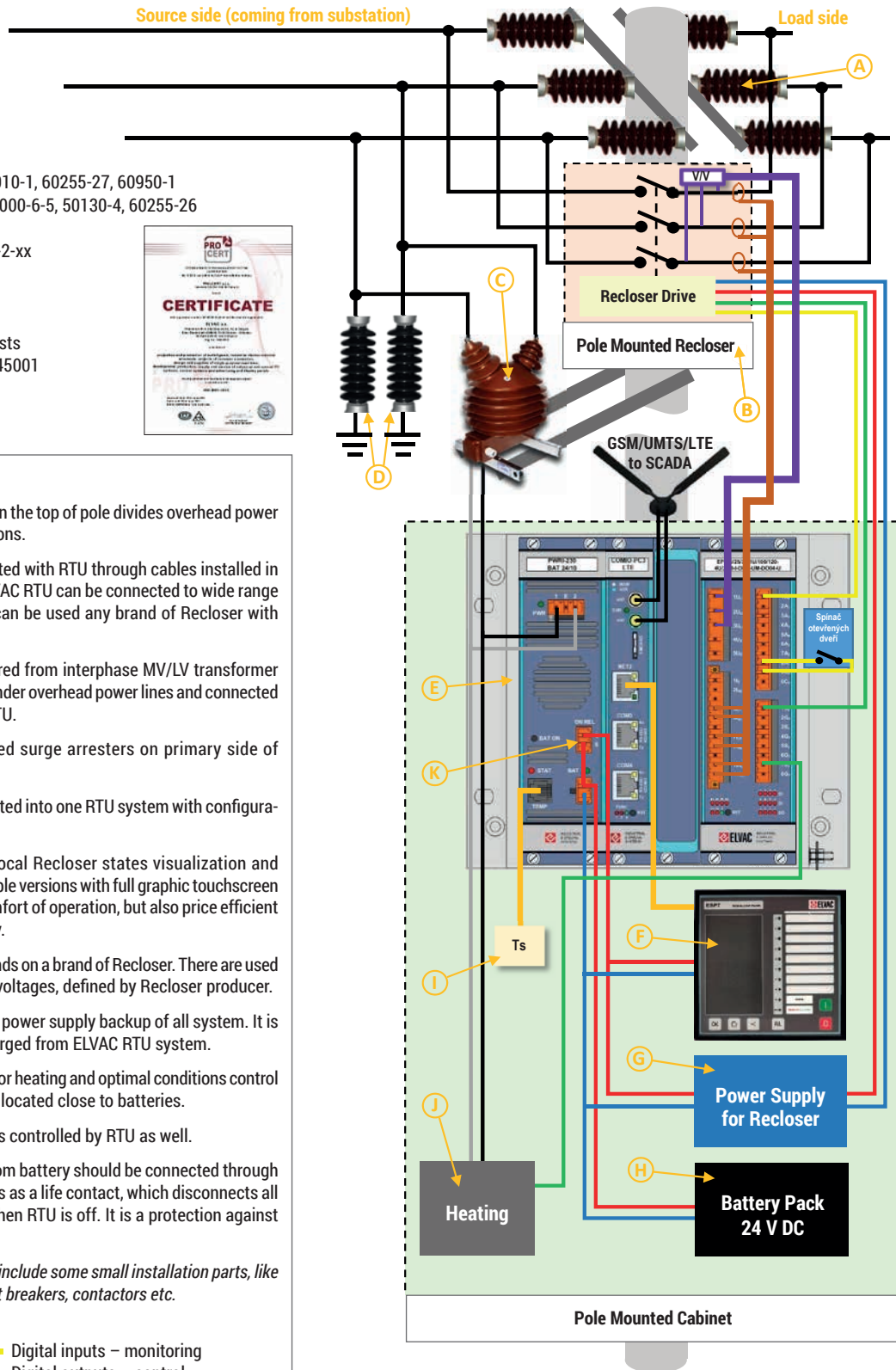
Description of example on the picture:

A. galvanized vandal proof cabinet with lockable door, IP 54, with switch for open door detection,

B. RTU7M in configuration mentioned above,

C. optional HMI panels – basic indication and control panel RTU7M SIG-D-EXT05 (the white one) or ESP7-2ETH-GR-60 (the black one) with graphic display and touchscreen, indication LEDs and control buttons,

D. cabinet heating,

E. backup battery pack 24 V DC, 28 Ah,

F. power supply for Recloser,

G. place for documentation,

H. circuit breakers block,

I. light inside the cabinet,

J. terminal strips block.

Rough Scheme of the Pole Mounted Recloser Monitoring and Control System

Source side (coming from substation)

Load side

ELVAC RTU Certificates

- Electrical safety – EN 61010-1, 60255-27, 60950-1
- EMC – EN 61000-4-xx, 61000-6-5, 50130-4, 60255-26
- EMI – EN 55022, 55032
- Environment – EN 60068-2-xx
- Certified protocols:
  - IEC 60870-5-104
  - IEC 61850
- Security – Penetration Tests
- ISO 9001, 14001, 27001, 45001

Recloser Drive

Pole Mounted Recloser

GSM/UMTS/LTE to SCADA

Scheme Description

A. Console with isolators on the top of pole divides overhead power lines into isolated sections.

B. Recloser is interconnected with RTU through cables installed in protective pipes. As ELVAC RTU can be connected to wide range of sensor types, there can be used any brand of Recloser with our RTU.

C. Whole solution is powered from interphase MV/LV transformer mounted on a console under overhead power lines and connected directly to the ELVAC RTU.

D. There are recommended surge arresters on primary side of transformer.

E. All functions are integrated into one RTU system with configuration described above.

F. HMI panel allows the local Recloser states visualization and control. There are available versions with full graphic touchscreen display for maximal comfort of operation, but also price efficient solution without display.

G. Power supply type depends on a brand of Recloser. There are used different power supply voltages, defined by Recloser producer.

H. Battery pack is used for power supply backup of all system. It is fully monitored and charged from ELVAC RTU system.

I. Thermal sensor is used for heating and optimal conditions control for batteries. It shall be located close to batteries.

J. The heating in cabinet is controlled by RTU as well.

K. The devices powered from battery should be connected through contact ON REL. It works as a life contact, which disconnects all devices from battery, when RTU is off. It is a protection against deep battery discharge.

Note: This scheme does not include some small installation parts, like terminal strips, fuses, circuit breakers, contactors etc.

Power Supply for Recloser

Battery Pack 24 V DC

Heating

Pole Mounted Cabinet

Scheme legend

▬	AC voltage	▬	Digital inputs – monitoring
▬	+ DC voltage	▬	Digital outputs – control
▬	– DC voltage	▬	Voltage measurement
▬	Communication	▬	Current measurement
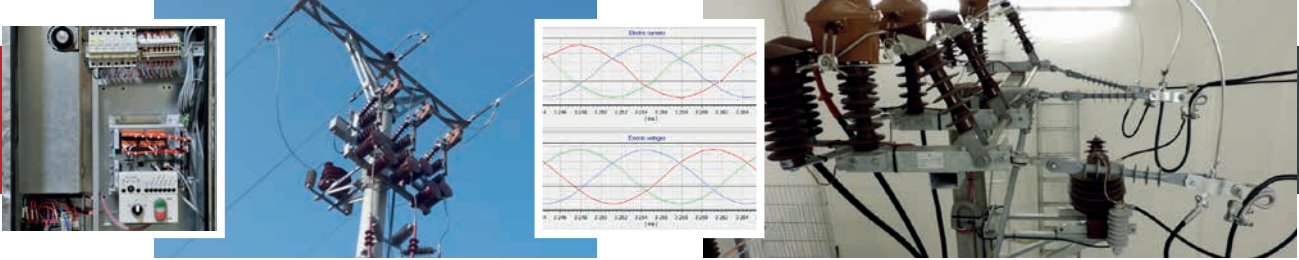
ELVAC RTU as Monitoring and Control System for Load Break Switch

Usual application names:

- Pole Mounted Load Break Switch (LBS) Monitoring and Control System
- Remote Control and Monitoring of Load Break Switch (LBS)

Location specification:

- Power distribution overhead lines – pole mounted LBS.

Typical application requirements:

- pole-mounted cabinet (vandal resistant) with IED/RTU,
- communication with SCADA system via GSM/UMTS/LTE modem, optionally via radio modem,
- communication protocols to SCADA – IEC 60870-5-104, IEC 60870-5-101, DNP3, IEC 61850,
- secured communication, communication tunnels,
- digital states signaling (LBS status, door contact etc.),
- remote and local control of LBS,
- 3-phase voltage and current measurements,
- faults detection on power lines,
- automatic functions – automatic disconnection after short circuit detection in voltage-free pause, interlock conditions etc.

Note 1: As the standards may vary from country to country, your demands can be always discussed with our professionals.

Note 2: Company ELVAC a.s. is a producer and developer of monitoring and control systems with wide options of connection to different brands of LBS. ELVAC a.s. does not produce any mechanical switches – LBS. Our goal is to provide the best monitoring and control systems based on great experience with worldwide customers. We offer our knowledge to different system integrators and LBS producers to achieve the best user friendly and reliable solution.

ELVAC RTU7M System Description

1. **Cabinet** – there is usually required some weather and vandal resistant construction for mounting on a pole in public places. The size of the cabinet is given mainly by dimensions of monitoring and control system and its accessories (see the scheme of solution below), but also with regard to good system cooling and comfortable space during a comminssioning and maintenance. According to the type of LBS, its switch drive can be located in cabinet with control system, or in separate cabinet, or it is a part of mechanical construction of LBS itself. The cabinet is usually produced from galvanized, stainless or powder coated metal sheets. Ingress protection is given by weather conditions, usually IP54 or better. There can be used either half cylindrical lock insert or padlock.

2. **RTU chassis** – the whole monitoring and control system is integrated in few components (power supply with battery backup, communication, DI/DO and voltage and current measurement). Therefore, it is usually sufficient the chassis with 5 slots on backplane.

3. **Power supply and battery backup** – this part of system is designed in the following way:

a. Powering is done via interphase MV/LV transformer with output 100 or 230 V AC, which is located on source side of LBS.

b. This voltage from transformer goes directly to an internal power supply of RTU7M. It can be directly measured there, which offers the voltage presence information on power lines on source side of LBS.

c. LBS motor drive is usually powered directly from batteries. If LBS uses its own special power supply, then it can be powered from batteries as well.

d. The important part is a battery charger for backup batteries, which also regularly checks their status, so it is not necessary to check the status of batteries personally, but messages come automatically into maintenance system. There is usually 24 V DC backup voltage (other options are 12V and 48V DC). The battery capacity is given by customer demand for system operation time during main power loss. Battery charging process is optimized in relation to external temperature, which is measured by temperature sensor connected to power supply card with charger. There is also a function of automatic battery disconnection as a protection against deep battery discharge.

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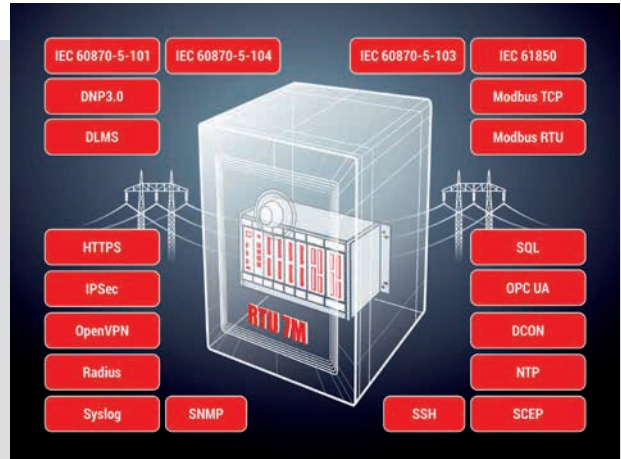
ELVAC RTU communication abilities

some states indication, Remote/Local control switch and control button for Open/Close operation of LBS. There are available also more comfortable HMIs with LCD display or graphical display with touchscreen. The final choice depends on customer preferences.

10. **Waveform recording** – when any fault (short circuit, earth fault etc.) occurs on power distribution lines, the system RTU7M can record immediately the measured values with flags and defined pretrigger time, so there is clearly visible the beginning and complete course of fault in waveforms for all three phases. These records can be remotely transferred into SCADA or maintenance system for a deeper analysis. There are supported COMTRADE and ELVAC proprietary formats. We offer our own software for analysis called Graphical Records Viewer supporting both formats, COMTRADE can be used in third party SW. The recorded waveforms can be useful during installation and commissioning of RTU devices for identification of phases order etc.
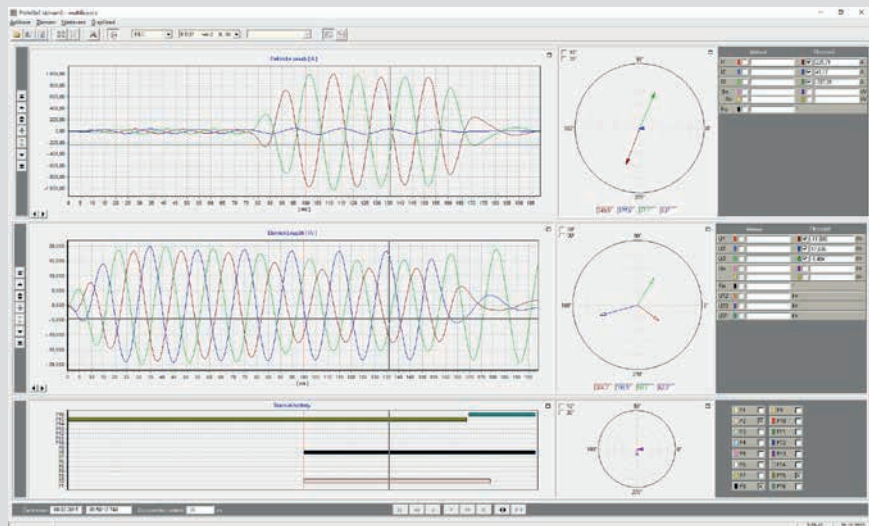
Recorded fault example displayed in SW Graphical Records Viewer:
– First two frames show the electric current and voltage waveforms.
– The progress bar shows the instantaneous measured values.
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– There are visible phase shifts, neutral voltage and current in the phasor diagrams.
– There is visible also 100 ms pretrigger record for better identification of fault beginning.

ELVAC RTU7M Advantages for LBS Solution

- RTU7M – the great advantage for end users is based on possibility to use the compatible systems in wide range of power distribution tasks and applications (reclosers, load break switches / sectionalizers, fault indicators, primary substations, secondary substations MV/LV etc.), which is very efficient from the commissioning and maintenance point of view.
- All-in-one solution – communication with SCADA, battery backup, LBS states monitoring and control, measurement, indication and protection, waveform recording, programmability, HMI interface, remote maintenance (parameterization, FW updates, fault records download), etc.
- System is powered directly from pole mounted voltage transformer connected between two MV phases, usually with 100 or 220 V AC output, this voltage is measured by input of internal power supply in RTU, so this information can be used also for voltage presence detection on primary side of LBS.
- Battery backup controlled directly from RTU – the battery status is regularly tested and alarms are transferred to maintenance system.

- Variety of communication ports with support for all state-of-art standards in power distribution control – different protocols, communication security and many others, multiple communication channels with different SCADA or maintenance systems.
- 3-phase measurement with high accuracy (V_0 and I_0 can be directly measured or calculated), fault detection with protection relay functionality for MV feeders – price efficient solution, support for wide range of VTs, CTs, low power sensors or Rogowski coils.
- Fully isolated digital and analog inputs and outputs.
- Waveform recording (COMTRADE format), commonly used for evaluation of faults on power distribution lines.
- User programmable automation functions (embedded PLC). As the LBS is not designed for disconnection of the power lines during short circuit, ELVAC RTU7M can be programmed for automatic disconnection after short circuit detection in voltage-free pause (when Recloser disconnects the power lines).
- Web interface for configuration and custom interactive HMI (modern web browsers on Windows/Android/iOS are supported).

Configuration Example

This configuration has been proven in thousands of installations in different countries. As all functions are integrated into one IED, the solution is very user friendly, organized, easy for maintenance and very reliable.

ELVAC RTU7M configuration in pole mounted cabinet:

Slot 1 – power supply card RTU7M PWRIC-230B BAT-24/10 with input for 80–260 V AC, powered from MV/LV transformer, with thermal sensor, this card solves also battery backup,

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b) GSM/UMTS/LTE modem for communication with SCADA,
c) Ethernet LAN port for local parameterization and interconnection with local HMI, eventually for communication with other devices,
d) 2 x serial port for communication with other IEDs (e.g. HMI with serial communication, power meters, power quality meters, etc.),

Slot 3 – blind, free slot for system extension, e.g. another 3 voltage measurements via EP card, when also source side of LBS is measured.

Slot 4, 5 – combined RTU7M EP series card with 8 x DI, 4 x DO, 3-phase voltage and current measurement, inputs specification depends on type of sensors or measuring transformers mounted on console under power lines or inside the LBS (depending on LBS construction), there is available also 4th current input (it can be used for Holmgren connection IE/I0 or as sensitive input for IE/I0) and 4th voltage input (it can be used for auxiliary voltage measurement, e.g. on source side of LBS).

HMI interface – either RTU7M SIG-D-EXT05 or ESP7 panels

Note: All components specification can be found in our catalogue at www.rtu.cz.

Description of example on the picture:

A. galvanized vandal proof cabinet with lockable door, IP 54, with switch for open door detection, internal light, place for documentation,
B. RTU7M in configuration mentioned above,
C. optional HMI panels – basic indication and control panel RTU7M SIG-D-EXT05 (the white one) or ESP7-2ETH-GR-60 (the black one) with graphic display and touchscreen, indication LEDs and control buttons,
D. cabinet heating,
E. backup battery pack 24 V DC, 28 Ah,
F. terminal strips blocks,
G. circuit breakers block,
H. motor drive for LBS.
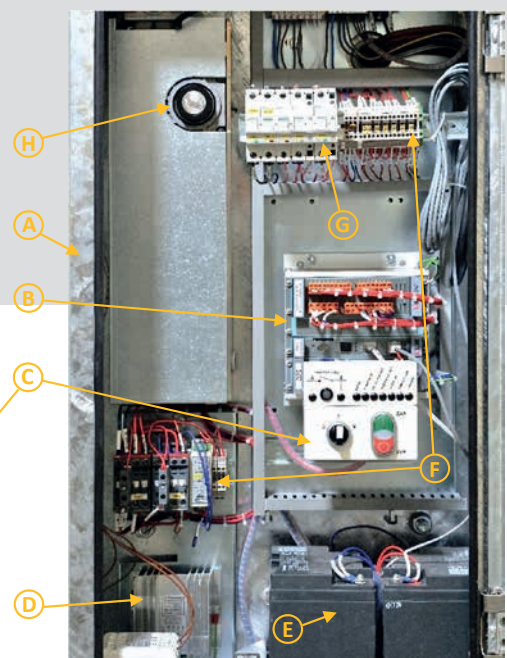
Rough Scheme of the Pole Mounted Load Break Switch Monitoring and Control System

Source side (coming from substation)   **Load side**

ELVAC RTU Certificates

- Electrical safety – EN 61010-1, 60255-27, 60950-1
- EMC – EN 61000-4-xx, 61000-6-5, 50130-4, 60255-26
- EMI – EN 55022, 55032
- Environment – EN 60068-2-xx
- Certified protocols:
  - IEC 60870-5-104
  - IEC 61850
- Security – Penetration Tests
- ISO 9001, 14001, 27001, 45001

Pole Mounted LBS

Scheme Description

A. Console with isolators on the top of pole divides overhead power lines into isolated sections.

B. LBS can have various construction – either a closed type with integrated sensors, or an open type with separate sensors. LBS detects open/close position by limit switches and is interconnected with RTU through cables installed in protective pipes. Open type of LBS can be preferred, when visual check of its status shall be possible.

C. LBS motor drive is usually installed inside the control cabinet or in a separate cabinet above the control cabinet. Then the LBS is driven by a control rod. Unwanted operation can be mechanically prevented with a padlock. Sometimes the motor drive is integrated inside the closed type of LBS.

D. Voltage and current sensor can be combined or separate type. They can be integrated in LBS or mounted on a console on pole. As ELVAC RTU can be connected to wide range of sensor types, there can be used any brand of LBS with our RTU.

E. Whole solution is powered from interphase MV/LV transformer mounted on a console under overhead power lines and connected directly to the ELVAC RTU.

F. There are recommended surge arresters on primary side of transformer.

G. All functions are integrated into one RTU system with configuration described above.

H. HMI panel allows the local LBS states visualization and control. There are available versions with full graphic touchscreen display for maximal comfort of operation, but also price efficient solution without display.

I. Battery pack is used for power supply backup of all system. It is fully monitored and charged from ELVAC RTU system.

J. Thermal sensor is used for heating and optimal conditions control for batteries. It shall be located close to batteries.

K. The heating in cabinet is controlled by ELVAC RTU as well.

L. The devices powered from battery should be connected through contact ON REL. It works as a life contact, which disconnects all devices from battery, when RTU is off. It is a protection against deep battery discharge.

Note: This scheme does not include some small installation parts, like terminal strips, fuses, circuit breakers, contactors etc.

GSM/UMTS/LTE to SCADA

Motor Drive for LBS

Open Door Switch

Ts

Heating

Battery Pack 24 V DC

Pole Mounted Cabinet

Scheme legend

■ AC voltage		■ Digital inputs – monitoring	
■ + DC voltage		■ Digital outputs – control	
■ – DC voltage		■ Voltage measurement	
■ Communication		■ Current measurement	
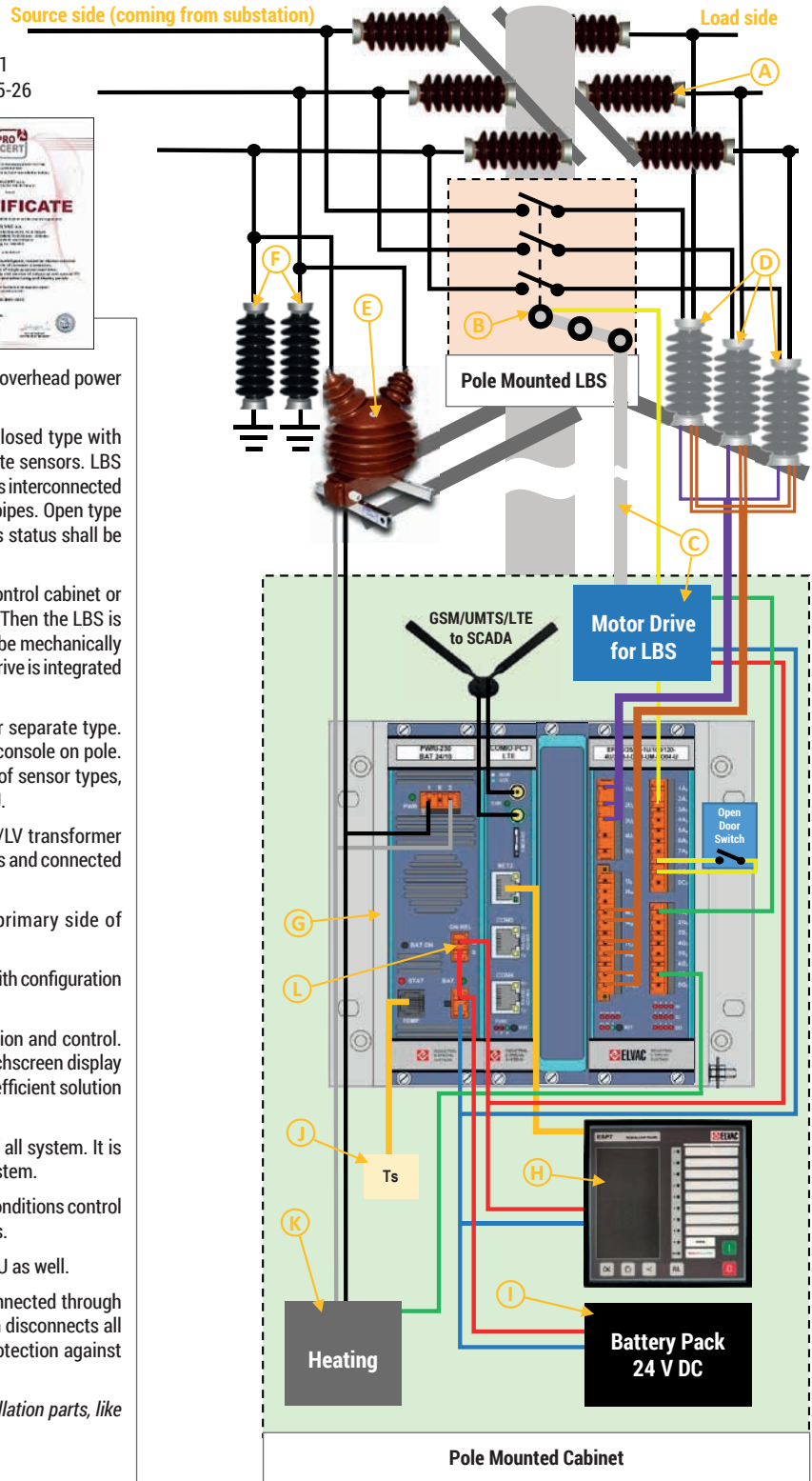
Modular RTU

RTU7M – Modular RTU System

General Description

Modular system RTU7M is designed for maximal flexibility in solution designing for different types of applications across the power distribution monitoring and control.

RTU7M uses distributed data and signal processing. It means, that each modular card in system has its own dedicated processor, which solves independent tasks and cards only exchange the data between themselves via highspeed bus. This topology offers highest reliability and excellent computing power, while system power consumption is not high. It allows also high flexibility for future development and customization for different users.
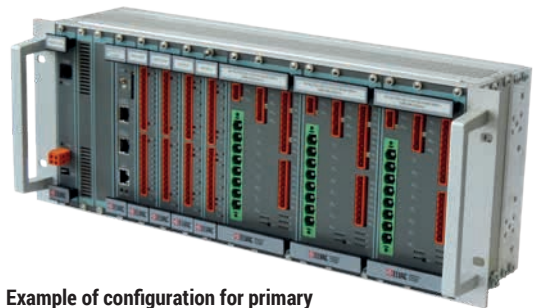
System expansion for large systems with hundreds and thousands of signals is realized via interconnection of communication cards in individual RTU7M units. One chosen unit then works as data concentrator and communication unit with SCADA for all other units. From the point of user, system then looks like one large Remote Terminal Unit (RTU). Power supply or communication redundancy can be solved as well.

Highspeed bus allows fast data exchange between cards, including time stamps. It is possible to link any measuring card and their evaluated data to any other analog and digital I/O card signal. It is especially useful for applications, like for example:

- ◆ Protection relay functionality of RTU7M – fast reaction of any digital output in system for measured data, if they are evaluated as a fault on power lines according to ANSI standards.
- ◆ There can be measured currents on each feeder, but voltage can be measured only at one point (for ex. on busbar) and this information including phase shift can be shared for precise calculation of P and Q for each feeder. It saves a lot of costs.
- ◆ Broken fuse detection in grids – there can be evaluated phase shift or other values differences between feeders or in front and behind the fuse.

Example of configuration for primary substation monitoring and control with integrated 3 protection relays for MV feeders

Example of small RTU7M solution – complete protection relay with wide communication abilities

Standards

The whole modular unit RTU7M and its components were tested according to the following technical standards (unless stated otherwise in the detailed technical specifications of each card):

EMC

EN 61000-4-2	EN 61000-4-8	EN 61000-4-17
EN 61000-4-3	EN 61000-4-9	EN 61000-4-18
EN 61000-4-4	EN 61000-4-10	EN 61000-4-29
EN 61000-4-5	EN 61000-4-11	EN 61000-6-5
EN 61000-4-6	EN 61000-4-12	EN 50130-4
EN 61000-4-7	EN 61000-4-16	EN 60255-26

EMI

EN 55022	EN 55032

Electrical safety

EN 61010-1	EN 60255-27	EN 60950-1

Environment

EN 60068-2-1	EN 60068-2-6	EN 60068-2-27
EN 60068-2-2	EN 60068-2-14	EN 60068-2-30

Technical Specification for All RTU7M Products

Operating temperature	-25 °C ÷ +55 °C (after consulting with producer up to 70 °C)
Storage temperature	-30 °C ÷ +75 °C
Ambient relative humidity	5 % ÷ 95 % non-condensing
Ingress protection	IP 20

Example of configuration for Recloser or Load Break Switch monitoring and control

RTU7M – Chassis and Bus Backplanes

Example of chassis for 8 cards with bus backplane

General Description

In standardized configurations, we offer 2, 3, 5, 8, 10 and 16-slot chassis made of aluminum sheets with protective powder coating. The 2 and 3-slot versions are standardly intended for mounting on a DIN rail and 5, 8, 10 and 16-slot on a wall/panel. The 16-slot version is available also for 19" rack mounting.

The previously used aluminum profile construction is now only used in a special 2,5 version of the chassis with two slots, where the first slot is used for standard power supplies (PS) for communication converter applications with a wide range of supply voltages.

All slots and cards have keyed connectors, which protect them against inserting a non-matching card into the slot. Individual specifications for inserting specific types of cards into the corresponding slots are described in the user manual of the modular RTU units.

RTU7M chassis have two subgroups of product lines:

- **Standard** – chassis with 2 up to 16 slots for standard backplanes,
- **Chassis with integrated power supply and/or communication interface on backplane** – they are 2-slot and 3-slot chassis focused for small standalone applications or for expansion of larger RTU7M systems. The integrated power supply saves the space and these chassis are used for applications, where older compact RTUs were used. They have the following features:
  - DIN rail or panel mounting, both horizontally or vertically,
  - integrated power supply on bus backplane 10 ÷ 60 V DC, isolated or non-isolated, 3-slot chassis optionally with battery charger,
  - optional additional serial communication RS-485 on backplane, isolated or non-isolated, supported MODBUS RTU and HioCom2 communication protocols for expansion of other RTUs or for distributed system architecture.

  Power supply and serial line connector is located on the bottom of chassis.

Basic Features

- chassis with bus backplane with 2, 3, 5, 8, 10 or 16 slots,
- keyed slots, protection against the insertion of improper card into the position,
- 2 and 3-slot bus backplanes available with integrated power supply, optionally with communication interface and battery charger,
- power supply hot-swap redundancy in 8, 10 and 16-slot chassis with redundant version backplanes, two power supply card can be located in two first slots, third slot in backplane is not used,
- modularity, easy expandability of I/O,
- according to type – DIN rail, wall / panel or 19" rack mounting.
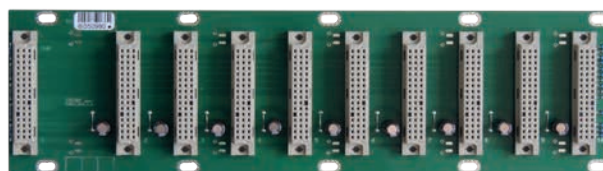

Example of RTU7M bus backplane with 10 slots

Technical Specification of Chassis

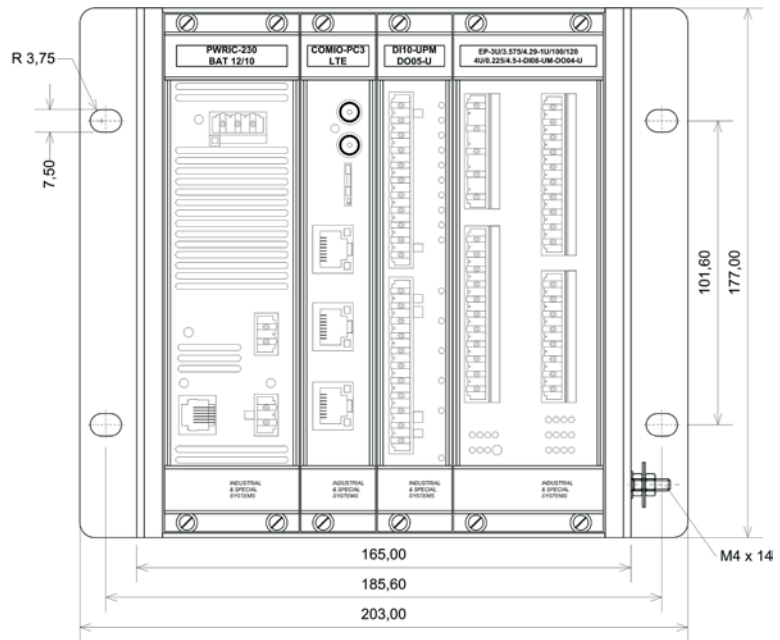| Standard chassis	RTU7M CASE-5E P RTU7M CASE-8E P RTU7M CASE-10E P RTU7M CASE-16E P RTU7M CASE-16E	Panel Panel Panel Panel 19" rack
Aluminum chassis	RTU7M CASE-2,5	Panel or DIN rail
Chassis with integrated PS	RTU7M CASE-2E DIN-PD RTU7M CASE-3E DIN-PD	DIN rail DIN rail

Technical Specification of Backplanes

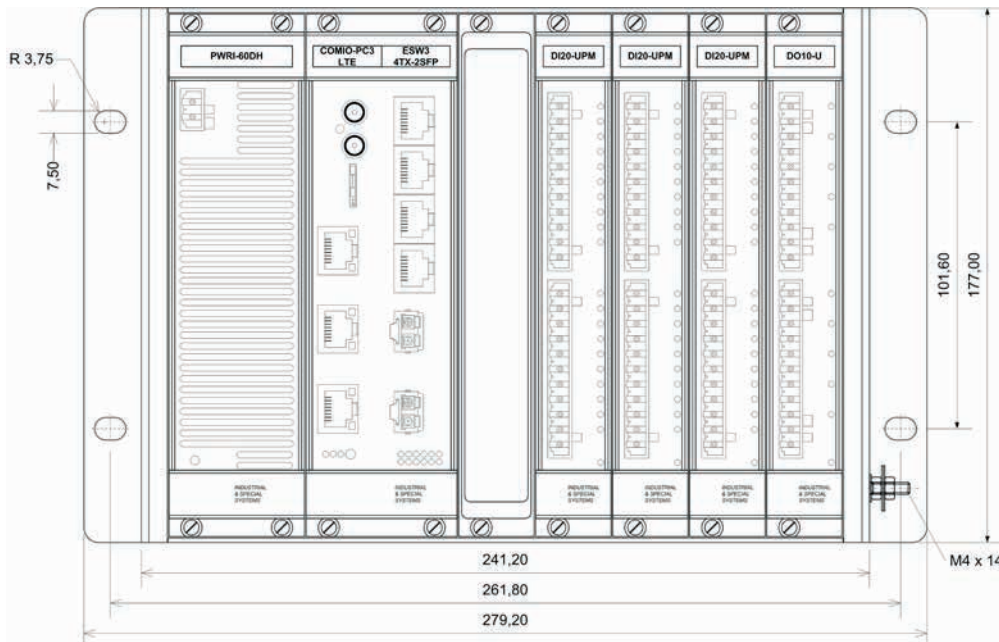| Standard backplanes	RTU7M BUS-2,5N RTU7M BUS-5N RTU7M BUS-8N RTU7M BUS-10N RTU7M BUS-16N	
Backplanes for redundant PS	RTU7M BUS-8R RTU7M BUS-10R RTU7M BUS-16R	
Backplanes with integrated PS	RTU7M BUS-2E-x RTU7M BUS-3E-x RTU7M BUS-3P-x RTU7M BUS-3PB-x	PS + comm. PS + comm. PS only PS with bat. charger

Dimensions of Standard Chassis with Powder Coating Protection (mm)
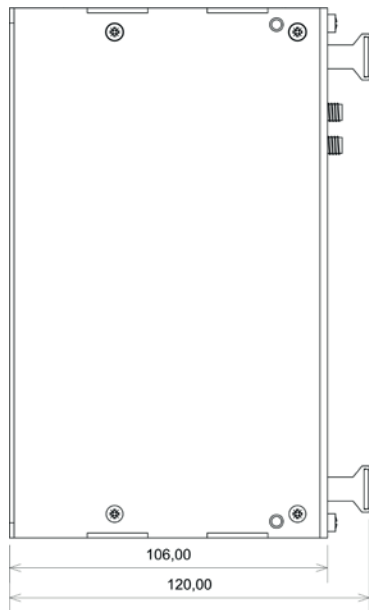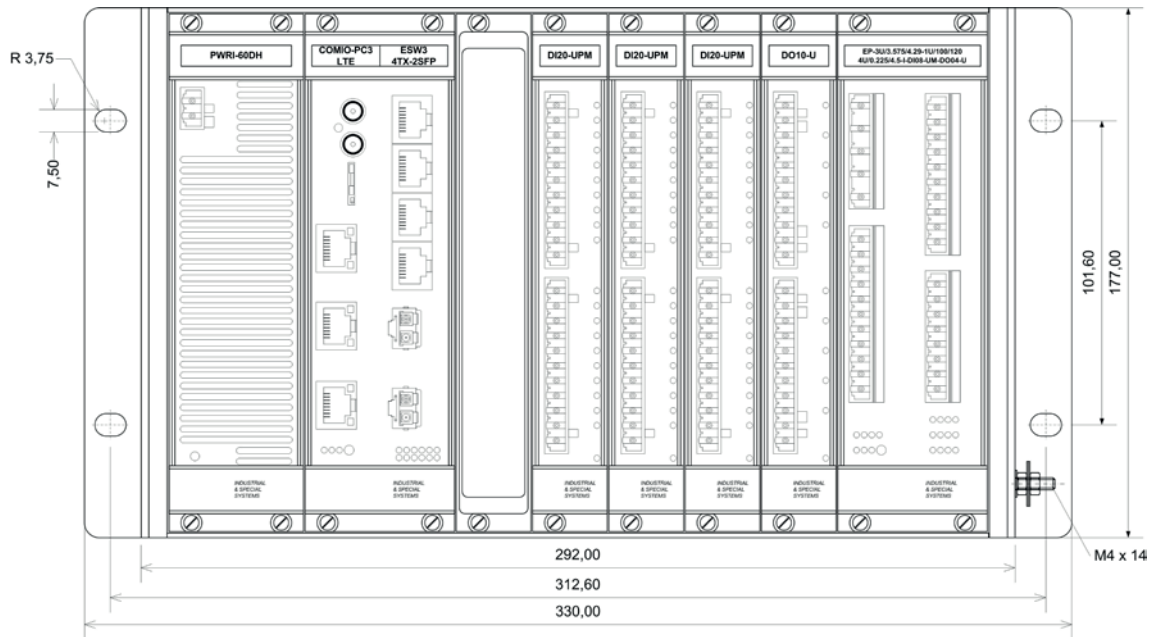

Side dimensions of panel
mounting chassis

Dimensions of chassis CASE-5E with 5 slots

Dimensions of chassis CASE-8E with 8 slots

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Tel.: +420 597 407 310 | rtu@elvac.eu | www.rtu.cz

ELVAC a.s.

Dimensions of chassis CASE-10E with 10 slots
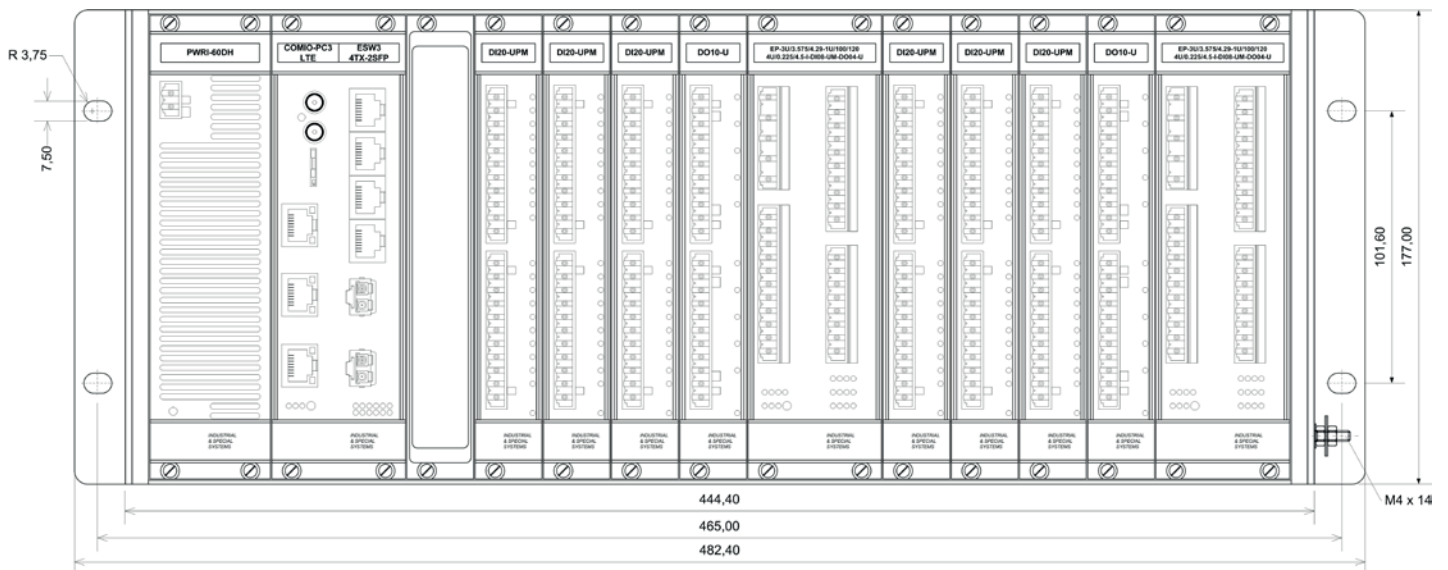
Dimensions of chassis CASE-16E with 16 slots

Modular RTU

Aluminum Chassis Dimensions (mm)

**Dimensions of chassis with 2 slots
in aluminum version with 1st wider slot
for power supply card**
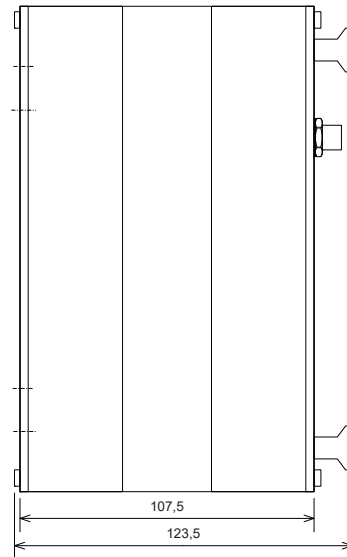
Side dimensions of all types of chassis
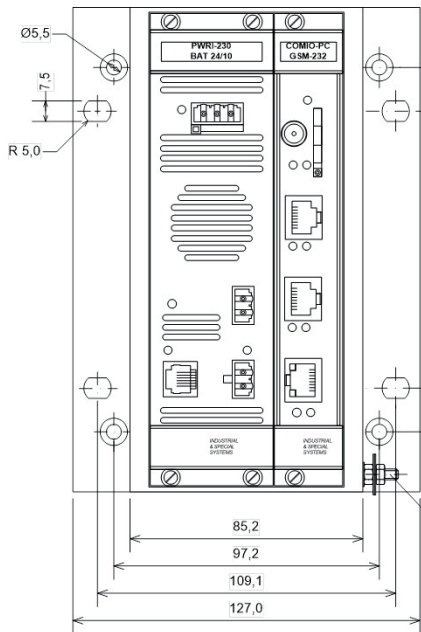
Dimensions of Chassis with Integrated Power Supply (mm)
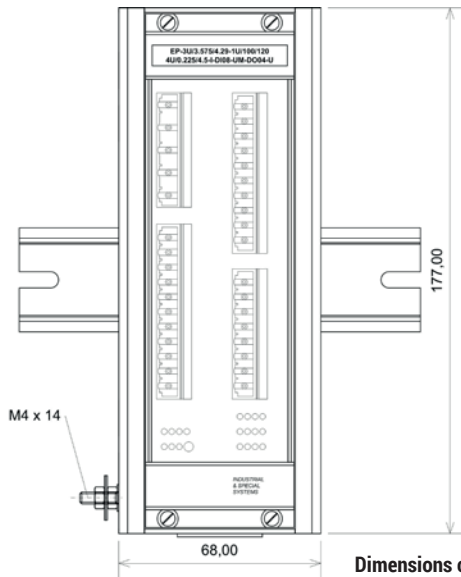
Dimensions of chassis CASE-2E with 2 slots
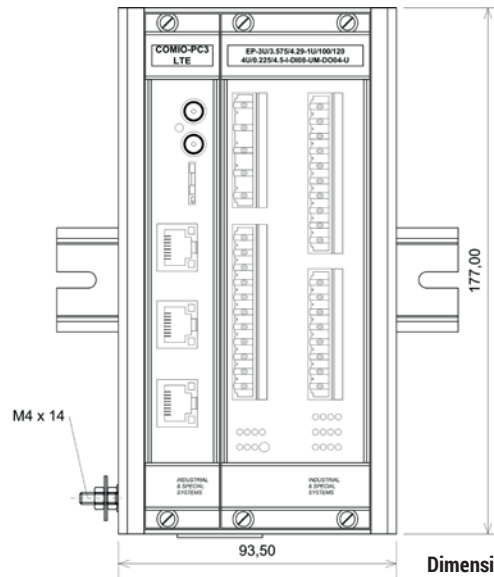
Dimensions of chassis CASE-3E with 3 slots
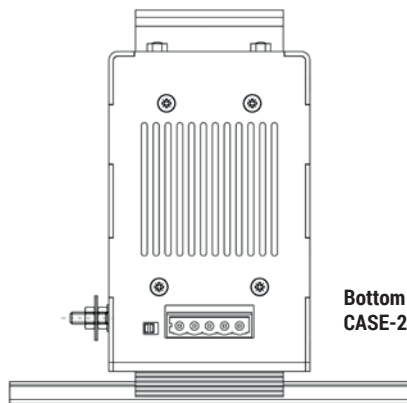
Bottom view of chassis CASE-2E with 2 slots
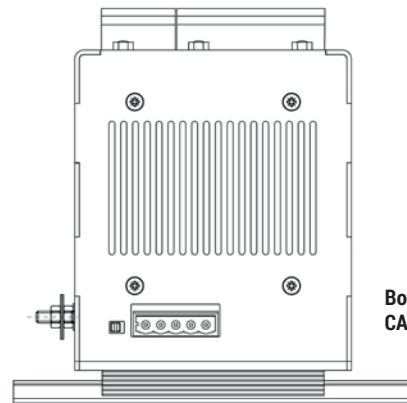
Bottom view of chassis CASE-3E with 3 slots
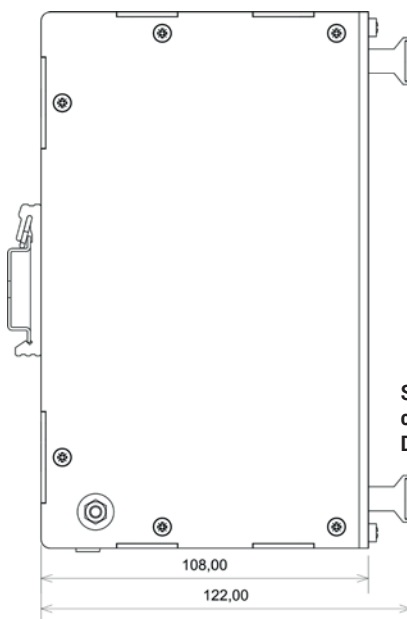
Side dimensions of both chassis for DIN rail mounting

Termination
OFF   ON   RS-485
A   B SG P- P+
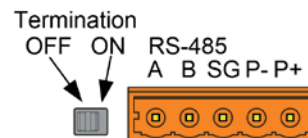
Connector connection and termination switching on BUS-2E a BUS-3E

RTU7M – Power Supply Cards

General Description

Power supply cards serve for the powering of RTU7M, all cards and slave units in bus. We deliver two principally different types:

- DC, galvanically isolated card,
- AC / DC, galvanically isolated card with battery backup.

DC, Galvanically Isolated Card

This card has a galvanically separated input from the output, a wide range of power supply voltage (according to the version of the card) and does not enable to connect the backup battery. The card is mostly used for the powering from DC power supplies or from a battery with various voltage levels according to the specification. In version C (with processor), it allows to measure the input value of the primary supply voltage in the entire supply range.

Card PWRI-60DH

Card PWRIC-230B BAT24/10

## AC / DC, Galvanically Isolated Card with Battery Backup

This card can be used for powering from AC or DC. The CPU on card PWRIC controls the battery charging, input voltage and temperature measurement. During operation from the backup battery, the battery status is checked for protection against the full discharging. In the case of a decrease of the battery voltage below the minimal value, the unit enters into the shutdown regime for one minute. Information about this status, as well as the information about the outage of the input voltage is transferred into the master system. After one minute, if there is no restoration of the supply of input voltage, the unit is automatically switched off. The power supply card includes the integrated charger for 12 V or 24 V backup batteries with various capacities. The maximum maintenance charging current is 1 A. The charging of the battery is controlled by the CPU depending on the temperature, measured by digital sensor connected via RJ-12 connector on card. The battery capacity is periodically tested (loaded with a current 9 A for a 24 V battery and 4.5 A for a 12 V battery) and the value is transferred to the master system. The card is equipped with an auxiliary contact – connector ON REL, which works as life contact, used for battery protection against another discharging, when system is off. There is button BAT ON on card, which activates the unit during the operation only from the backup battery. The card also enables to measure the effective value of the primary power supply voltage within the whole supply range.

Technical Specification of Galvanically Isolated Power Supply Cards

Card	PWRI-60DH	PWRIC-60DH	PWRI-275DH	PWRIC-275DH
Input voltage	10 ÷ 60 V DC (max. 60 W)		80 ÷ 275 V DC (max. 60 W)	
Range in RTU UC	Card is without CPU	0 ÷ 60 V	Card is without CPU	0 ÷ 275 V
Max. input current	6 A DC		0.8 A DC	
Input protection	SMD fuse F 10 A		SMD fuse F 4 A	
External protection	In case of connection to network system IT, it is necessary two-pole protection			
Output voltage	+5 V DC/10 A (50 W)			
Isolation	Input-output: 2210 V AC/1 min.		Input-output: 3250 V AC/1 min., input–PE: 2200 V AC/1 min.	
Connectors	1× WAGO 231-302/026-000 (part of delivery)			
Wire cross-section	0.08 ÷ 2.5 mm²			
Signaling LED	PWR	PWR, STAT	PWR	PWR, STAT
Dimensions (with mounted front panel)	45 mm × 172 mm × 92 mm (W × H × D)			
Measuring accuracy	Card without measuring	±0.5 %	Card without measuring	±0.5 %
Position in bus	1			

Technical Specification of Galvanically Isolated Power Supply Cards with Battery Backup

Card	PWRIC-230B BAT24/10	PWRIC-230B BAT12/10
Input voltage	80 ÷ 260 V AC/47–63 Hz 110 ÷ 360 V DC	
Range in User Center	0 ÷ 360 V	
Max. input current	1.4 A AC; 0.7 A DC	
Permanent output power	40 W	
Input protection	Fuse T 4 A	
External protection	Recommended circuit breaker 4 A or 6 A char. C. In case of connection to network system IT, it is necessary two-pole protection.	
Output voltage	+5 V DC / 5 A (25 W), no -5 V DC / 0.3 A (1.5 W)	
Isolation	Primary – secondary 3 kV AC for 1 minute Primary – ground 1.5 kV AC for 1 minute Secondary – ground 500 V AC for 1 minute	
Battery voltage	24 V	12 V
Range in User Center	0 ÷ 30 V	0 ÷ 15 V
Max. battery loading current	1 A (optionally lower current after consulting with producer)	
Max. battery maintenance voltage	27.4 V	13.7 V
Battery protection	3.2 A polyswitch	
Switch off voltage (battery protection)	22 V	11 V
Battery tester	Yes	
Testing current	9 A	4.5 A
Auxiliary contact ON REL	Contact (type NO) 250 V / 3 A AC, 30 V / 3 A DC	
BAT ON (switch on button)	Yes, usage for switch on of unit running from battery	
Measurement accuracy	±0.5 %, measuring of voltage on input and battery	
Temperature sensor	Measured range -55 ÷ +125 °C, accuracy ±0.5 °C in range -10 ÷ +85 °C	
Connectors	2 × WAGO 231-302/026-000, 1 × WAGO 231-303/026-000 (part of delivery), RJ-12	
Wire cross-section	0.08 ÷ 2.5 mm^2	
Signaling LED	PWR, STAT, BAT	
Dimensions (with mounted front panel)	45 × 172 × 92 mm (W × H × D)	
Position in bus	1	
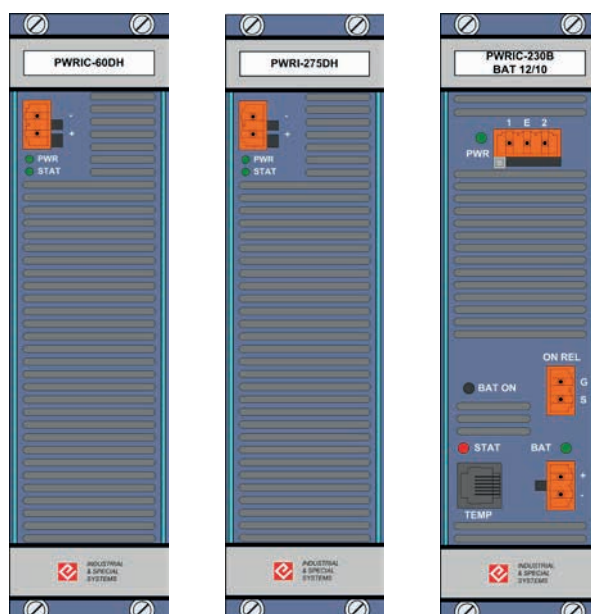
Front panels with connectors for individual types of power supply cards

RTU7M – Power Backup Cards

General Description

Power backup card enables to use the batteries for RTU7M backup. Card switches automatically between external power supply and connected battery, if the power is lost. It also charges the battery and checks the status.

Power Backup Card RTU7M CHG(I)

Power backup cards are designed for DC. They do not have the function of power supply for the RTU, they only provide stable voltage on output, if the power is lost. There must be installed the appropriate power supply card in the RTU. The output from power backup card is connected to the input of power supply card.

Card RTU7M CHG24-24/30

One power backup card can provide the backup for the RTU, where it is fitted in and also for another RTUs (up to maximal load). Thus, it is not necessary to have the power backup card in each RTU in system, there is only necessary to use the batteries and external power supply with sufficient performance.

The charging process is controlled in accordance with ambient temperature and the status of battery is regularly checked. Version CHGI is galvanically isolated from bus.
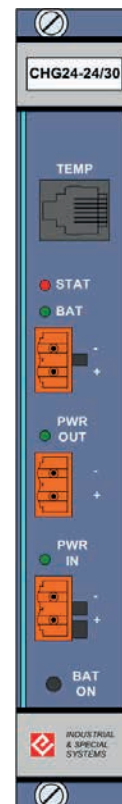
Front panel of card RTU7M CHG

Technical Specification

Card	RTU7M CHG24-24/30	RTU7M CHGI48-48/30
Input voltage	20 ÷ 30 V DC (max. 250 W)	42 ÷ 60 V DC (max. 450 W)
Range in User Center (Source voltage)	0 ÷ 30 V	0 ÷ 60 V
Max. input current	10 A DC	8,5 A
Input / output / battery protection	Fuse 5 × 20 F 16 A	Fuses F 12 A / F 8 A / F 8 A
External protection	In case of connection to network system IT, it is necessary two-pole protection.	
Output voltage / current	Same as input voltage 20 ÷ 30 V DC / 8 A (200 W)	Same as input voltage 42 ÷ 60 V DC / 5 A (250 W), 39V – when running from battery
Battery voltage	24 V	48 V
Range in User Center (Battery voltage)	0 ÷ 30 V	0 ÷ 60 V
Max. battery loading current	3.0 A (can be set in parameterization SW)	
Max. battery maintenance voltage	27.4 V	54.8 V
Switch off voltage (battery protection)	22 V	44 V
Battery tester	Yes	
Testing current	8.5 A	8 A
Temperature sensor	Measured range -55 ÷ +125 °C, accuracy ±0.5 °C in range -10 ÷ +85 °C	
Connectors	2 × WAGO 231-302/026-000 (part of delivery), RJ-12	
Wire cross-section	0.08 ÷ 2.5 mm²	
Signaling LED	STAT, PWR IN, PWR OUT, BAT	
Measurement accuracy	±0.5 % for input and battery voltage	
Dimensions (with mounted front panel)	25 × 172 × 92 mm (W × H × D)	
Position in bus	Any	

RTU7M – Communication Cards and Modules

General Description

The communication cards serve for ensuring the communication of the RTU7M with the master system and for communication with slave units. These cards contain several communication interfaces and they have the direct support of many industrial communication protocols and services. The cards also support various company protocols.

We produce two principally different versions of the cards. The first version labeled as COMIO4 contains a 32-bit processor and the second version labeled as COMIO-PC3 contains a built-in PC with operating system on the basis of OS LINUX.

Both types of communication cards have some interfaces defined as fixed and some as optional. Optional interfaces can be fitted with modules CIOMOD and configured according to the demands of the stated application. It is necessary to separately specify these modules in orders. You can see the available options in the table below. Communication parameters are set via the web interface or configuration SW User Center.

The firmware and OS, which is digitally signed for the PC3 version, can be upgraded remotely. The RTU7M system has user-programmable logic (function blocks) available, in the case of the PC3 version, also in accordance with the IEC 61131-3 standard.

Examples of communication modules
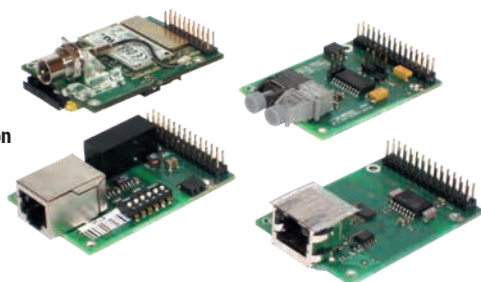
Supported communication protocols and services

IEC 60870-5-101	DCON	RADIUS
IEC 60870-5-104	DLMS	Syslog
IEC 60870-5-103	SQL	SNMP
IEC 61850	OPC UA	NTP
DNP3.0	HTTPS	SSH
Modbus TCP/RTU	IPSec	SCEP
HioCom2	OpenVPN	RBAC
IEC 62351-3	NAT	Firewall

The license policy for the use of individual supported protocols can be found at www.rtu.cz in the section Products/RTU support SW.

Communication card COMIO4

This card is fitted with four communication interfaces, which provide the user with freedom during the selection of a suitable communication protocol and the interface. The card can also be used as a communication converter or a data concentrator for slave units.

Cards COMIO4 and COMIO-PC3

Table of standard combinations for individual interfaces of COMIO4 cards

Card	COMIO4-1ETH	COMIO4-2ETH	COMIO4-CIR	COMIO4-O
Communication interface COM1	Position for module CIOMOD-232/485 UMTS/GSM/(E)GPRS	Position for module CIOMOD-232/485/UMTS/GSM/(E)GPRS/GPS2	Position for module CIOMOD-OPT	Position for module CIOMOD-232/485/OPT UMTS/GSM/(E)GPRS
Communication interface COM2	Switchable RS-232/422/485			Fixed optical interface OPT
Communication interface COM3	Position for module CIOMOD-232/485	Ethernet 10/100 Mbps	Position for module CIOMOD-OPT	Position for module CIOMOD-232/485-OPT
Communication interface COM4	Ethernet 10/100 Mbps			
Supported com. protocols	MODBUS, HIOCom2, IEC 60870-5-101, IEC 60870-5-103, IEC 60870-5-104, DNP3 Server, HTTP			
Memory	FLASH 64 Mbit, MRAM 256 kbit, optionally MicroSD card			
Consumption	1.5 W			
Position in bus	Any, recommended 2 or 3			

Note: other combinations can be supplied according to the demands of customer after consultation with product manager.

Communication Card COMIO-PC3

This card is also equipped with several communication interfaces and offers wider possibilities than the COMIO4 card thanks to higher intelligence and power. This includes, for example, the ability to manage a large number of subordinate units, the use of special protocols for secure communication, or in the case of special requirements, this card can offer customer modifications for communication options, such as the implementation of other standard and special protocols, etc.

In addition to basic communication functions, this card can also be used as a communication converter and a communication concentrator (can be used simultaneously). The communication protocols for communicating with slave devices may differ from the communication protocol for communicating with superior systems. The COMIO-PC3 card contains a backup real-time RTC circuit and an internal temperature sensor. The communication interface can be extended via the ESW2 or ESW3 card, which are then internally connected to the COMIO PC3 card and offer physical separation of the two networks.

Table of Standard Combinations for Individual Interfaces of COMIO-PC3 Cards

| Card	COMIO-PC3	COMIO-PC3-LTE
Communication interface COM1	Ethernet 10/100 Mbps, isolation 3 kV AC/1 min. (NET1)	Module CIOMOD with LTE modem
Communication interface COM2	Ethernet 10/100 Mbps, isolation 3 kV AC/1 min. (NET2)	Ethernet 10/100 Mbps isolation 1.5 kV AC/1 min. (NET2)
Communication interface COM3	Console RS-232 (RJ11)	Switchable RS-232/422/485 isolation 2.5 kV DC/1 min.
Communication interface COM4	Switchable RS-232/422/485 isolation 2.5 kV DC/1 min.	Switchable RS-232/422/485 power supply +5 V / 0,3 A isolation 2.5 kV DC/1 min.
Communication interface COM5	Switchable RS-232/422/485 power supply +5 V / 0,3 A isolation 2.5 kV DC/1 min.	–
Supported communication protocols	All mentioned on previous page in the list of Supported communication protocols and services	
Memory	FLASH 8 GB, RAM 256 MB, optionally MicroSD	
Other functions	Thermal sensor, RTC	
Consumption	3.5 W	4.5 W
Position in bus	Any, recommended 2 or 3	

Communication Interface Expansion Cards

| Interface	10/100BaseT(X)	10/100/1000BaseT(X)	SFP slot 100Base-FX	SFP slot 1000Base-X/SERDES
Modul ESW2	2		2	
Modul ESW3		4		2

Technical Specification of CIOMOD Modules

Module	CIOMOD-GSM4	CIOMOD-GSM5	CIOMOD-GSM8	CIOMOD-LTE1	CIOMOD-LTE2
Communication interface	UMTS Dual-Band GSM Dual-band GPRS Class 12 EDGE Class 12 HSDPA Cat. 8 HSUPA Cat. 6	UMTS Dual-Band GSM Dual-band GPRS Class 12 EDGE Class 12 HSDPA Cat. 8 HSUPA Cat. 6	LTE Penta-band UMTS Dual-band GSM Dual-band LTE UE Cat. 1 HSDPA Cat. 24 HSUPA Cat. 6 GPRS Class 12 EDGE Class 12	GSM Quad-band LTE Cat. 1bis	GSM Dual-band LTE Cat. 1bis
Antenna connector	FME	FME	2 x SMA	1 x SMA	1 x SMA
Max. consumption	1 W	1 W	1 W	1 W	1 W

Module	CIOMOD-OPT	CIOMOD-232	CIOMOD-485	CIOMOD-GPS2
Communication interface	Optical interface	RS-232 (isolation 2 kV AC for 1 min.)	RS-485 (isolation 2 kV AC for 1 min.)	GPS antenna GPS/QZSS GLONASS
Connector	SC	RJ45	RJ45	SMA
Max. communication speed	–	230.4 kbps (460.8 kbps)	230.4 kbps (921.6 kbps)	–
Signals	RxD, TxD	RxD, TxD, RTS, CTS	A, B, (+5 V)	–
Max. consumption	1 W	1 W	1 W (2 W)	0.5 W
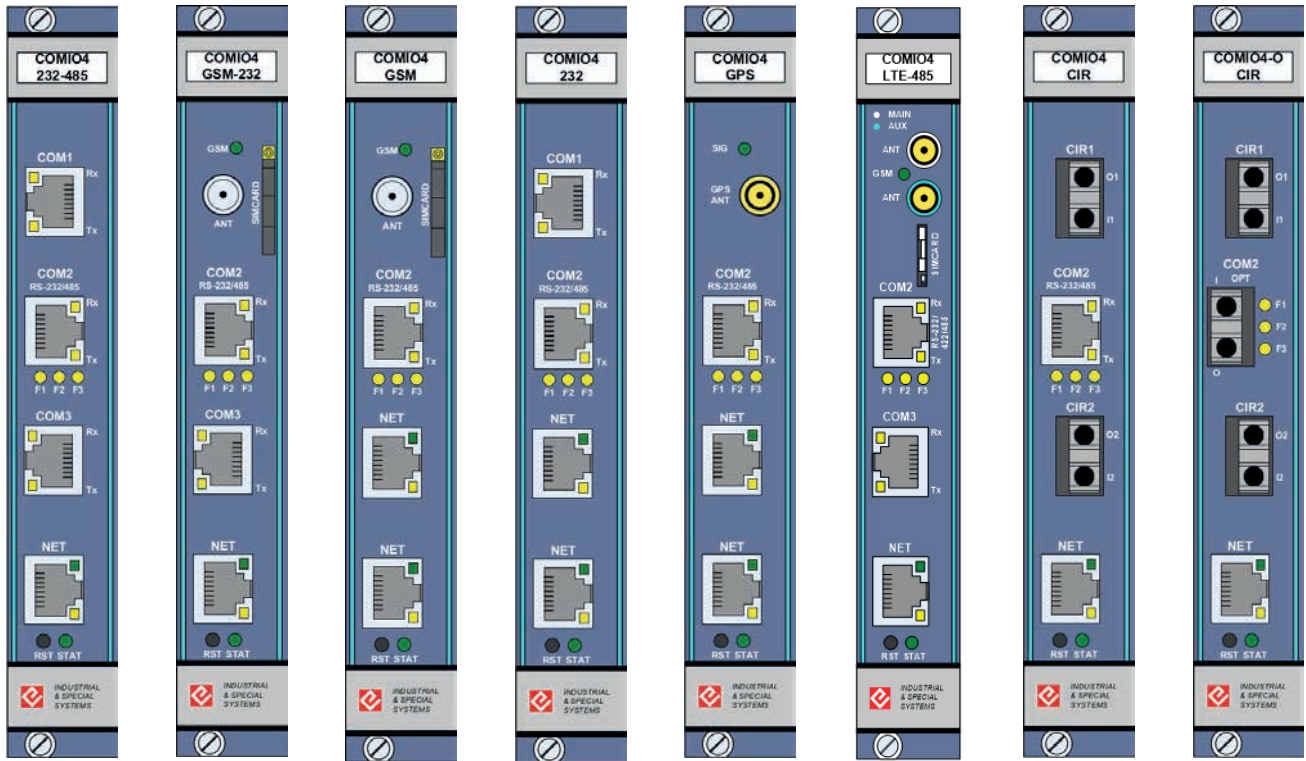
Front panels with connectors of cards COMIO4
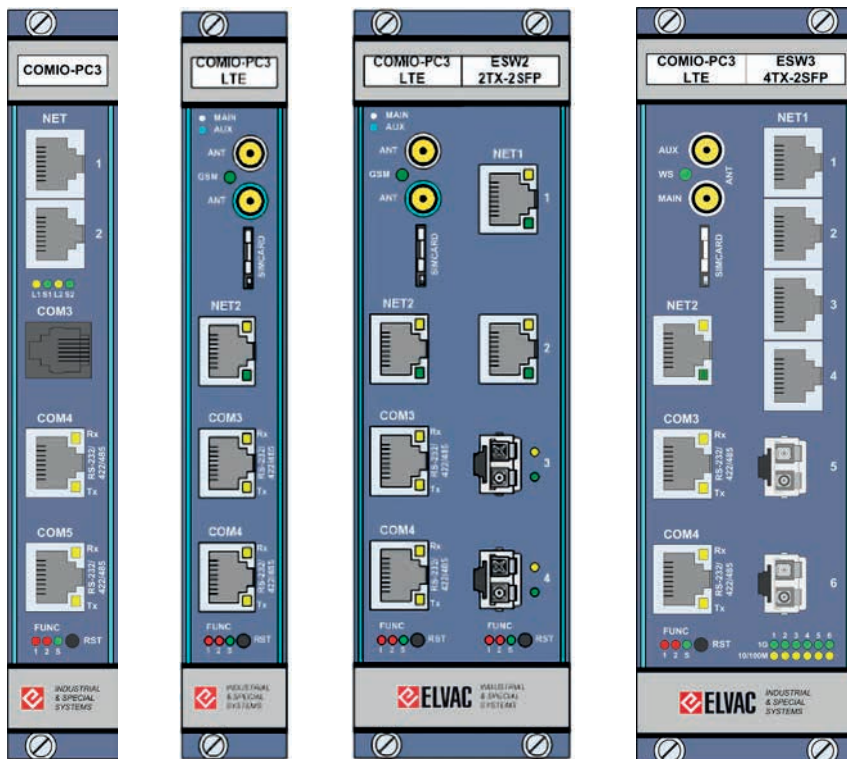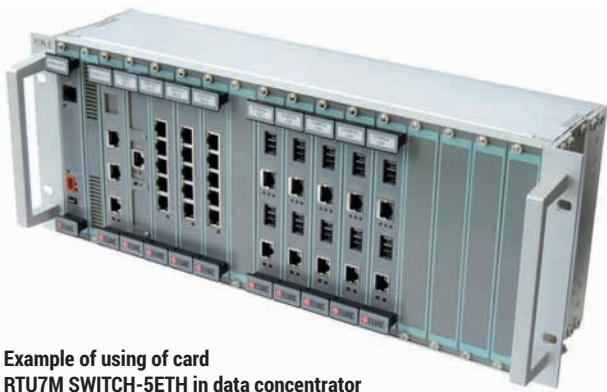
Front panels with connectors of cards COMIO-PC2 and PC3
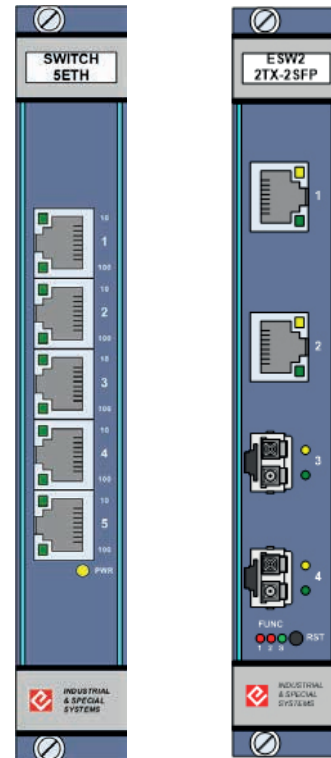
RTU7M – Card with Ethernet Switch

General Description

In cases where it is necessary to expand the number of communication links with an Ethernet interface, the RTU7M SWITCH-5ETH card is available. Basically, it is the traditional Ethernet switch in the form of the card for RTU7M, which means that internally, this card does not communicate with the RTU unit, it only takes the power from it. All connections are done externally using connecting cables. The advantage is that it is not necessary to resolve the power supply and backup as in the case of external switches, and it will save the space. The number of cards installed into the system is limited only by the space in the chassis.

Another option is card ESW2 equipped with two metallic Ethernet ports and two SFP ports, which can be internally connected with COMIO-PC3 communication card. Then Ethernet ports on COMIO PC3 card and on ESW2 can work in physically separated networks.

Front panel of cards RTU7M SWITCH-5ETH and ESW2 2TX-2SFP

Example of using of card RTU7M SWITCH-5ETH in data concentrator

Technical Specification

| Card	RTU7M SWITCH-5ETH	ESW2 2TX-2SFP
Interface	5 × RJ-45, 10/100BaseT(X) auto negotiation speed, Full/Half duplex mode, auto MDI/MDI-X connection	2× RJ-45, 10/100BaseT(X) auto negotiation speed, Full/Half-duplex mode, auto MDI/MDI-X connection, 2× SFP module
Standards	IEE 802.3, 802.3u, 802.3x	
Consumption	Max. 3 W	Max. 1,5 W without SFP modules
Position in bus	Any	

RTU7M – Digital Inputs

General Description

Digital input cards for RTU7M are produced in two variants:
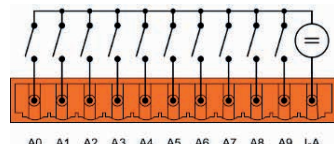
Active DI – Dry Contact

Card is equipped with its own galvanically isolated voltage source. Input is excited after connection of input pin with external shared pin via external contact.
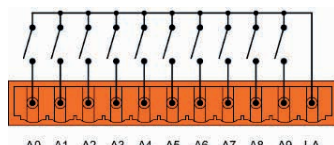
Active inputs connection
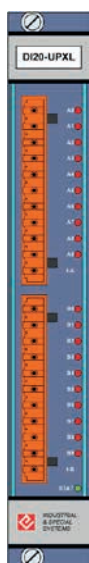
Passive DI – Wet Contact

These inputs do not have the voltage source fitted. They are activated after connection of external voltage.

Passive inputs connection

Digital input card

Front panel of DI card

Basic Features

- 20 × digital input,
- isolation 3.75 kV AC,
- indication of excitation of input,
- time filter can be set up by SW for both logical levels,
- optional double-bit signaling (ex. defining of interposition of power element),
- configurable maximal allowed number of changes on input per time interval,
- input sampling with period 1 ms,
- impulse counter and period measuring with data storage into memory with backup.

Processing of Input Digital Signals

The digital input card has its own processor, which processes the input signals and communicates with other cards in RTU chassis through the internal bus. Digital inputs are sampled with the period of 1 ms. The following step is filtration of the signal changes. The time filter can be set for both logical levels. If the change on the digital input lasts the stated time, the stated logical level is declared valid and sent to the master system, if required. With each change, it is monitored the exceeding of the maximal set number of changes per minute. If the maximal number of changes is exceeded, the value is transferred with a telemetric error. This prevents the useless transfer of oscillating values. The card can be parameterized also for usage with AC signaling voltage.

These cards can be used as simple digital inputs with one or double-bit signaling and can also be used for reading of impulses and measuring of the period with the storage of the status into the memory with backup. This can be used in applications for measuring of energy and media consumption (the function depends on the firmware used).

Technical Specification of DI Cards

Card	DI20-UAM	DI20-UPS	DI20-UPM	DI20-UPL	DI20-UPX	DI20-UPXL	DI10-UPXL
Inputs number	20						10
Inputs type	Active (switching by dry contact)	Passive (switching by external voltage, both polarities)					
Level H	Closed	9 ÷ 25 V	20 ÷ 60 V	35 ÷ 60 V	75 ÷ 150 V	150 ÷ 300 V	150 ÷ 300 V
Level L	Open	0 ÷ 4 V	0 ÷ 10 V	0 ÷ 17 V	0 ÷ 20 V	0 ÷ 60 V	0 ÷ 60 V
Current in inputs	2.4 mA	2.5 ÷ 7 mA	1.9 ÷ 6 mA	1.7 ÷ 3 mA	1.3 ÷ 2.7 mA	1 ÷ 2 mA	1 ÷ 2 mA
SW filter for level H and L	0 ÷ 16777.215 seconds, step 1 ms						
Allowed number of changes per minute	0 ÷ 255						
Isolation voltage	3.75 kV AC for 1 minute						
Overvoltage category						CATIII/300V	CATIII/600V CATIV/300V
Consumption	2.3 W	1.1 W					
Connectors	2 × WAGO 231-311/026-000, part of delivery						
Wire cross-section	0.08 ÷ 2.5 mm^2						
Position in bus	Any						

RTU7M – Digital Outputs

General Description

We offer digital output (DO) cards in two variants, with mechanical or electronic relays. Thanks to this, the user can decide on the optimal variant according to the required switching power, the number of required outputs, or whether or not isolating relays are used in the system.

Digital output card

The digital output card has its own processor, which, through the signal exciter, switches the relay according to the stated requirements. The card behaves as a slave unit in the RTU7M series, data is transferred on an internal bus of the RTU7M, which serves as the communication bridge. New versions of card (from Y2019) support new high-speed bus, which enables to use automation functions. There is also available backward reading of relay status. The card enables the remote upgrading of FW.

Basic Features

- HW and SW protection against accidental switching of output,
- adjustable time of closed contact,
- interference protection during switching of relay contact,
- special functions of some DO (thermostat control, protection relay).

Security of Digital Outputs

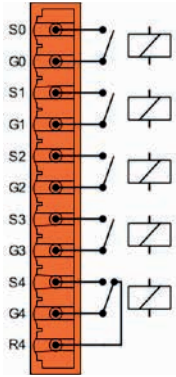Great attention is focused on protection against accidental switching of the DO. It is resolved at two levels:

- SW level – a two-phase control of the relay switching is used. To be the command executed, the unit must receive two identical commands for switching of a relay in the stated time interval,
- HW level – each relay is controlled by two exciters. To perform the switching, both exciters must be activated at the same time. Each exciter is controlled by its own processor.

Special Functions

Depending on the type of FW, some DO may have a reserved function. An example is the switching of the heating in the switchboard cabinet depending on the temperature measured by the external sensor, function for controlling of the power switch during the evaluation of the earth fault, short circuit or overcurrent, etc.

Technical Specification of DO Cards

Card	DO10-U	DO20S-U
Outputs number	8 × relay (NO contact), 2 × relay (changeover contact)	20 optical relays
Time of closed contact	10 ms to 655 s with step 10 ms	10 ms to 655 s with step 10 ms, max. output change frequency 250 Hz
Isolation contact-coil	5 kV AC for 1 minute	
Isolation between open contacts	1 kV AC for 1 minute	–
Contacts load	8 A/250 V AC, 8 A/24 V DC	60 V DC / 40 V AC 50 Hz, 800 mA permanently / 2 A @ 1s
Durability	2 × 107 cycles	–
Relay switching	Protected against accidental switching. It is separated slave unit for RTU7 series.	
Consumption	3 W	2W
Connectors	2 × WAGO 231-311/026-000, part of delivery	
Wire cross-section	0.08 ÷ 2.5 mm^2	
Position in bus	Any	

Relay output connection on card DO10-U
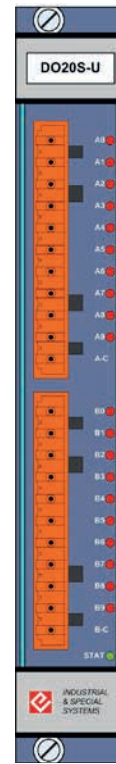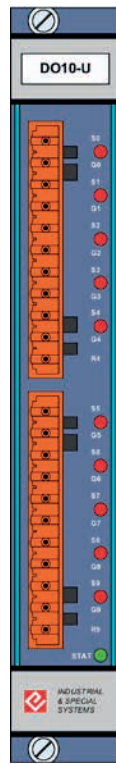
All outputs of individual connectors on card DO20S-U are connected to a common potential which can have both polarities.

Front panel with connectors on individual DO card types

RTU7M – Combined Cards of Digital Inputs and Outputs

General Description

The card provides 10 digital inputs, 5 relay outputs with 4 normally open contacts and 1 changeover contact. It is also available in version with passive or active DI.

The card has its own CPU and time stamps are assigned directly on card. New versions of card (from Y2019) support new high-speed bus, which enables to use automation functions. There is also available backward reading of relay status.

Combined card of digital I/O

Active DI – Dry Contact

The card is equipped with its own galvanically isolated voltage source. Input is excited after connection of input pin with external shared pin via external contact.
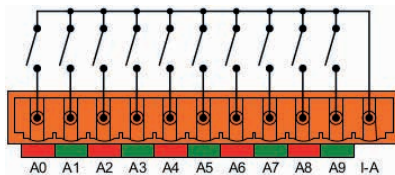
Active inputs connection

Passive DI – Wet Contact

These inputs do not have the voltage source fitted. They are activated after connection of external voltage.
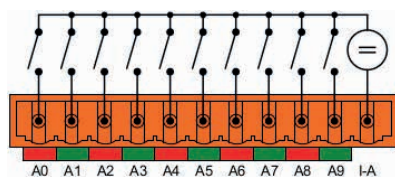
Passive inputs connection

Basic Features

Inputs

- ☑ 10 × digital input with indication of input excitation,
- ☑ isolation 3.75 kV AC,
- ☑ time filter can be set up by SW for both logical levels,
- ☑ optional double-bit signaling,
- ☑ configurable maximal allowed number of changes on input per time interval,
- ☑ input sampling with period 1 ms,
- ☑ impulse counter and period measuring with data storage into memory with backup.
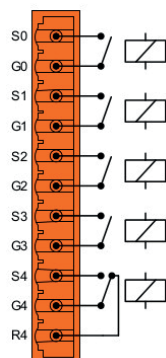
Outputs connection

Outputs

- ☑ 5 × relay 8 A@250 V AC / 8 A@24 V DC,
- ☑ 4 × normally open contact, 1 × changeover contact,
- ☑ HW and SW protection against accidental switching,
- ☑ adjustable time of closed contact,
- ☑ interference protection during switching of relay contact,
- ☑ special functions (thermostat control, protection relay).

Processing of Input Digital Signals

DI are sampled with the period of 1 ms. The following step is filtration of the signal changes. The time filter can be set for both logical levels. If the change on the DI lasts the stated time, the stated logical level is declared valid and sent to the master system, if required. With each change, it is monitored the exceeding of the maximal set number of changes per minute. If the maximal number of changes is exceeded, the value is transferred with a telemetric error. This prevents the useless transfer of oscillating values. The card can be parameterized also for usage with AC signaling voltage.

Cards can be used as DI with one or double-bit signaling and can also be used for reading of impulses and measuring of the period with the storage of the status into the memory with backup (ex. for consumption metering applications).

Security of Digital Outputs

Great attention is focused on protection against accidental switching of the DO. It is resolved at two levels:

- ☑ SW level – a two-phase control of the relay switching. To be the command executed, the unit must receive two identical commands for switching of a relay in the stated time interval.
- ☑ HW level – each relay is controlled by two exciters. To perform the switching, both exciters must be activated at the same time. Each exciter is controlled by its own processor.

Special Functions

Depending on the type of FW, some DO may have a reserved function. An example is the switching of the heating in the switchboard cabinet depending on the temperature measured by the external sensor, function for controlling of the power switch during the evaluation of the fault on the line, etc.

Technical Specification of Combined DI and DO Cards

Card	DI10-UAM DO05-U	DI10-UPS DO05-U	DI10-UPM DO05-U	DI10-UPL DO05-U	DI10-UPX DO05-U	DI10-UPXL DO05-U
Inputs number	10					
Inputs type	Active (switching by dry contact)	Passive (switching by external voltage, both polarities)				
Level H	Closed	9 ÷ 25 V	20 ÷ 60 V	35 ÷ 60 V	75 ÷ 150 V	150 ÷ 300 V
Level L	Open	0 ÷ 4 V	0 ÷ 10 V	0 ÷ 17 V	0 ÷ 20 V	0 ÷ 60 V
Current in inputs	2.4 mA	2.5 ÷ 7 mA	1.9 ÷ 6 mA	1.7 ÷ 3 mA	1.3 ÷ 2.7 mA	1 ÷ 2 mA
SW filter for level H and L	0 ÷ 16777.215 seconds, step 1 ms					
Allowed number of changes per minute	0 ÷ 255					
Isolation voltage	3.75 kV AC for 1 minute					
Outputs number	4 × relay (NO contact), 1 × relay (changeover contact)					
Time of closed contact	10 ms ÷ 655 s with step, 10 ms					
Isolation contact-coil	5 kV AC for 1 minute					
Isolation between open contacts	1 kV AC for 1 minute					
Contacts load	8 A / 250 V AC, 8 A / 24 V DC					
Durability	2×10^7 cycles					
Relay switching	Protected against accidental switching. Controlled via digital signals from main CPU.					
Consumption	Max. 2.5 W	Max. 2 W				
Connectors	2 × WAGO 231-311/026-000, part of delivery					
Wire cross-section	0.08 ÷ 2.5 mm^2					
Position in bus	Any					

Front panel of combined DIO card

RTU7M – Combined Analog Input Cards, Fault Indicators and Protection Relays

EP Card Without DI/DO with 3V and 3I Measurement

This card is the basic type of card fitted with three voltage inputs with overloading of 1.2 (optionally $1.3 \times U_n$) and three current inputs with different overloadability according to the type of application. Nominal ranges are adapted to various types of measuring transformers of voltage (VT) and current (CT). The values in the overloaded ranges are also measured. In all cases, the maximal overloading (the robustness) of the analogue inputs is 100 A for 1 s.

Usually, the overloading about $2 \times I_n$ is used in applications of P, Q, U, I measurement, the overloading $10 \times I_n$ is used in applications like indicator of earth faults and short circuits and the overloading $30 \times I_n$ is used in applications working as a protection relay.

Three-phase measurements of current and voltage are processed by a powerful signal processor. Other values are calculated, e.g. U_{12}, U_{23}, U_{13}, P, Q, S, f, cos φ, THD. Both groups of inputs are galvanically isolated from the remaining part of the unit with 4 kV AC isolation for one minute. This isolation is also between both groups of analogue inputs and between individual current inputs.

The card provides two blocks of protective functions with the optional local and remote indication of faults and provides faults recording (COMTRADE). From the protective functions, the ANSI 27, 46, 47, 50, 50N, 51, 51N, 59, 59N, 67, 67N, 81H, 81L, 81R are supported.

There are six programmable LED indicators on the front panel of the card that can be used for local signaling of faults. For the local reset of the signaling, it is possible to use the RST button whose function can also be programmed.

EP Card with DI/DO with 4V and 4I Measurement

Compared with EP cards without DI/DO, these cards are fitted with digital inputs and outputs and with analogue inputs for measurement of I_0 and U_x (for measurement of U_0 or other voltage variable). The card can serve as complete protection relay. Cards are produced with eight digital inputs and four digital outputs. Through the card parameterization, it is possible to set the source of measurement I_0 and U_0. The card can calculate I_0 and U_0 from the measurements of the phase currents and voltages or can measure them via fourth analogue inputs. This solution increases the sensitivity and accuracy of earth fault protection, if summation measuring current and voltage transformers are available.

Similarly to EP card without DI/DO, all protective functions are available, as well as fault recorder. In addition, automation functions for reclosing and disconnection in the voltage-free pause are available.

According to the type of the card, digital inputs are designed for various values of signaling voltages 24, 48, 110 and 220 V DC. They can be connected as active or passive.

EP card 3U3I without DI/DO

EP card 4U4I with 8DI 4DO

EP card 4U4I with 8DI 4DO, 5A inputs with 30x overloadability

EP cards with special combinations of inputs

EP cards are designed with certain number of analog inputs that can be combined according to the needs of customer. After consultation with the producer, it is possible to prepare special combination of voltage or current inputs adjusted to the specific range of sensors used in given application. All protective functions, automation functions and fault recorder are available (same as EP cards with 4U 4I measurements). This way there were developed special cards for remotely controlled recloser and LBS applications, where are used different types of current and voltage sensors and many other applications. Another group are the EP-6I cards equipped with only current inputs used for common outlet measurements or as fault passage indicators.

Typical applications with special EP cards

- ☑ Fault passage indicators,
- ☑ sensors FSI 36 and FSU 36,
- ☑ capacitive sensors VSO 25,
- ☑ GVR reclosers,
- ☑ Tavrida reclosers (including the solution with Rogowski coils for current measurements),
- ☑ transducers VPIS V3 VO,
- ☑ sensors Zelisko,
- ☑ sensors TE.
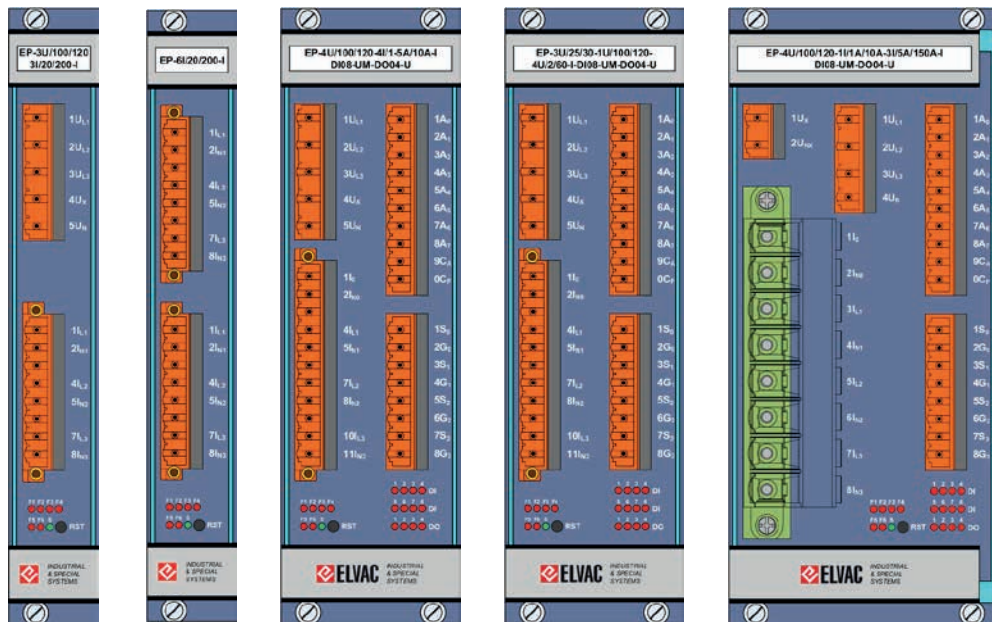
Examples of front panels of EP cards in 1-slot, 2-slot and 3-slot version

| Passive DI connection | Active DI connection | DO connection |
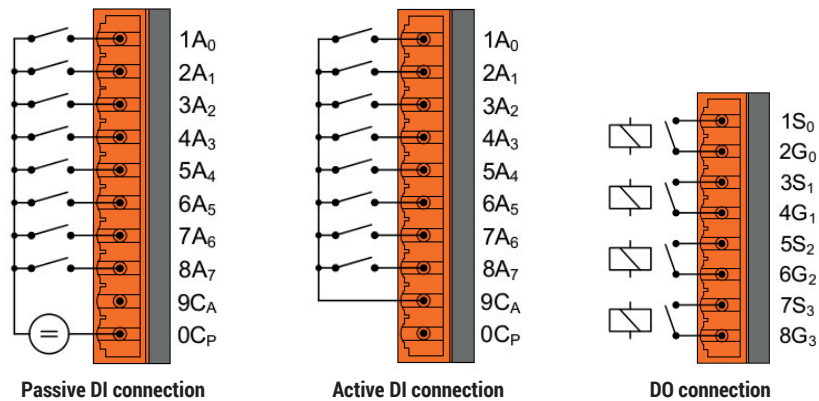
Product Code Description of EP Cards

RTU7M EP-4U/100/120-4I/20/200-I-DI08-U M-DO04-U

- Product group
- Number of voltage inputs (optionally AC or DC only)
- Nominal range of voltage inputs
- Range for overloading of voltage inputs
- Number of current inputs (optionally AC or DC only)
- Nominal range of current inputs
- Range for overloading of current inputs
- Isolation of inputs and the rest of card
- Eight digital inputs
- Indirect DI card
- Signaling (excitation) voltage level for DI
- Four digital outputs
- Indirect DO card

General Parameters of EP Cards

Signal processing	Its own processor, 16-bit A/D converter
Position in bus	Any

Voltage Inputs Specification

Part of code	0,176/0,352	0.225/4.5	0,88/17.6	0.75/3	2/60
Inputs type	Isolation 4 kV AC for 1 min. from other parts of unit and second analog inputs group.				
Nominal range	0,176 V AC ±0,176 V DC	0,225 V AC ±0,225 V DC	0.88 V AC ±0.88 V DC	0.75 V AC	2 V AC ±2 V DC
Overloadability	0,352 V AC perm. ±0,352 V DC perm.	4,5 V AC perm. ±4,5 V DC perm.	17.6 V AC perm. ±17.6 V DC perm.	3 V AC	60 V AC perm. ±60 V DC perm.
Input consumption	–	0.9 mW by 4.5 V	2 mW by 17.6 V	2.65 mW	31 mW by 60 V
Measuring accuracy (nominal range)	±0.3 %	±0.3 %	±0.3 %	±0.3 %	±0.5 %
Measuring accuracy (overloaded)	±0.3 %	±0.3 %	±0.3 %	±0.3 %	±0.3 %
Typical use	Reclosers Tavrida with Rogowski coils	Zelisko CTs with voltage outputs	Reclosers Tavrida with Rogowski coils	Schneider Electric VPIS V3 VO	Sensors FSI 36

Part of code	2.2/2.64	2.5/3	3.25/3.9	3.575/4.29	4/4.8
Inputs type	Isolation 4 kV AC for 1 min. from other parts of unit and second analog inputs group.				
Nominal range	2.2 V AC ±2.2 V DC	2.5 V AC	3.25 V AC ±3.25 V DC	3.575 V AC ±3.575 V DC	4 V AC
Overloadability	3.9 V AC perm. ±3.9 V DC perm.	3 V AC perm.	3.9 V AC perm. ±3.9 V DC perm.	4.29 V AC perm. ±4.29 V DC perm.	4.8 V AC perm.
Input consumption	0.9 mW by 2.64 V	–	–	0.1 mW by 4.29 V	–
Measuring accuracy (nominal range)	±0.3 %	±0.3 %	±0.3 %	±0.3 %	±0.3 %
Measuring accuracy (overloaded)	±0.3 %	±0.3 %	±0.3 %	±0.3 %	±0.3 %
Typical use	Capacitive sensors with voltage transducer in Reclosers GVR	Capacitive sensors VSO 25	Low power voltage sensors on 20 kV networks	Low power voltage sensors on 22 kV networks	Capacitive sensors in Reclosers Tavrida, sensors VSO 25 and others

Part of code	4,4/5,28	25/30	100/120	230/295
Inputs type	Isolation 4 kV AC for 1 min. from other parts of unit and second analog inputs group.			
Nominal range	4.4 V AC ±4.4 V DC	25 V AC ±25 V DC	100 V AC ±100 V DC	230 V AC ±230 V DC
Overloadability	5.28 V AC perm. ±5.28 V DC perm.	30 V AC perm. ±30 V DC perm.	120 V AC perm. ±120 V DC perm.	295 V AC perm. ±295 V DC perm.
Input consumption	0.1 mW by 5,28 V	2 mW by 30 V	70 mW by 120 V	0.1 W by 295 V
Measuring accuracy (nominal range)	±0,3 %	±0.3 %	±0.3 %	±0.3 %
Measuring accuracy (overloaded)	±0,3 %	±0.3 %	±0.3 %	±0.3 %
Typical use	Voltage sensors in Reclosers Tavrida	Resistive sensors in Reclosers GVR or sensors FSU36	Standard VTs	Direct measurement on low voltage

Current Inputs Specification

Part of code	1,66/6,64	5/150	20/200	1/2A
Inputs type	Isolation 4 kV AC for 1 min. from other parts of unit and second analog inputs group. Individual current inputs are mutually isolated.			
Nominal range	1.66 mA AC ± 1.66 mA DC	5 mA AC ±5 mA DC	20 mA AC ±20 mA DC	1A AC ± 1 A DC
Overloadability	6.64 mA AC perm. ± 6.64 mA DC perm. 0.166 A AC for 1 s ± 0.166 A DC for 1 s	150 mA AC perm. ± 150 mA DC perm. 0.5 A AC for 1 s ± 0.5 A DC for 1 s	200 mA AC perm. ±200 mA DC perm. 2 A AC for 1 s ±2 A DC for 1 s	2 A AC perm. ± 2 A DC perm. 30 A AC for 1 s ± 30 A DC for 1 s
Input consumption	1.2 mW	25 mW by 150 mA	35 mW by 200 mA	0.27 W by 2 A
Measuring accuracy (nominal range)	±0.3 %	±0.5 %	±0.3 %	±0.3 %
Measuring accuracy (overloaded)	±0.3 %	±0.5 %	±0.3 %	±0.3 %
Typical use	Split core CTs used for measuring on secondary side of another CTs	Recloser GVR	Split core CTs with 20 mA outputs	I0 measurement with 1 A CTs in Holmgren connection

Part of code	1-5A/10A	1A/20A	1A/30A	5A/150A
Inputs type	Isolation 4 kV AC for 1 min. from other parts of unit and second analog inputs group. Individual current inputs are mutually isolated.			
Nominal range	1 A AC ±1 A DC	1 A AC ± 1 A DC	1 A AC ± 1 A DC	5 A AC ± 5 A DC
Overloadability	5 A AC perm. ±5 A DC perm. 10 A AC for 1 min. ±10 A DC for 1 min. 100 A AC for 1 s ±100 A DC for 1 s	5 A AC perm. ±5 A DC perm. 10 A AC for 1 min. ±10 A DC for 1 min. 100 A AC for 1 s ±100 A DC for 1 s	8 A AC perm. ± 8 A DC perm. 20 A AC for 1 min. ± 20 A DC for 1 min. 100 A AC for 1 s ± 100 A DC for 1 s	20 A AC perm. ± 20 A DC perm. 150 A AC for 1 min. ± 150 A DC for 1 min. 500 A AC for 1 s ± 500 A DC for 1 s 1250 A peak for 100 ms
Input consumption	0.85 W by 10 A	1.7 W by 20 A	5 W by 30 A	7 W by 150 A
Measuring accuracy (nominal range)	±0.3 %	± 0.5 %	± 0.5 %	± 0.5 %
Measuring accuracy (overloaded)	±0.3 %	± 0.3 %	± 0.3 %	± 0.3 %
Typical use	Standard CTs 1 or 5 A for usual measurements or faut passage indication	Standard CTs 1 A in Protection Relay application with 20 x overloadability	Standard CTs 1 A in Protection Relay application with 30 x overloadability	Standard CTs 5 A in Protection Relay application with 30 x overloadability

Technical Specification of Digital Inputs and Outputs of EP Cards

Part of code	DI08-UM-DO04-U	DI08-UL-DO04-U	DI08-UPX-DO04-U	DI08-UPXL-DO04-U
Inputs number	8			
Inputs type	Active (dry contact switching) Passive (switching by ext. voltage, both polarities)		Passive (switching by external voltage, both polarities)	
Level H of active DI Level H of passive DI	Closed 20 ÷ 60 V	Closed 35 ÷ 60 V	– 75 ÷ 150 V	– 150 ÷ 300 V
Level L of active DI Level L of passive DI	Open 0 ÷ 10 V	Open 0 ÷ 17 V	– 0 ÷ 20 V	– 0 ÷ 60 V
Input current of active DI Input current of passive DI	2.4 mA 1.9 ÷ 6 mA	2.4 mA 1.7 ÷ 3 mA	– 1.3 ÷ 2.7 mA	– 1 ÷ 2 mA
SW filter for level H and L	0 ÷ 16777.215 seconds, step 1 ms			
Allowed number of changes per min.	0 ÷ 255			
Isolation voltage	4 kV AC for 1 minute			
Outputs number	4 × relay (NO contact)			
Time of closed contact	10 ms ÷ 655 s, step 10 ms			
Isolation contact-coil	5 kV AC for 1 minute			
Isolation between open contacts	1 kV AC for 1 minute			
Contacts load	8 A/250 V AC, 8 A/24 V DC			
Durability	2×10^7 cycles			
Relay switching	Protected against accidental switching			
Connectors	1 × WAGO 231-310/026-000, 1 × WAGO 231-308/026-000, part of delivery			
Wire cross-section	0.08 ÷ 2.5 mm^2			

Power Consumption of EP Cards

- ☑ one-slot card – voltage and current measurement – 1.6 W,
- ☑ two or three-slot card – voltage and current measurement combined with passive DI/DO – 3.1 W,
- ☑ two or three-slot card – voltage and current measurement combined with active DI/DO – 3.5 W.

Available Combinations of EP Cards – Supported Sensors and Transformers

According to above mentioned list of voltage, current and digital inputs and outputs, there can be delivered different I/O combinations of EP cards. Some of them are standardly available, some of them can be prepared on demand. Then the combination can perfectly fit into any application with sensors used by different customers. Actual situation can be checked with producer.

There are typically supported the following sensors and transformers:

Voltage Measurement

- ☑ direct measuring of 230 V AC,
- ☑ measuring transformers with 100 V output,
- ☑ other measuring transformers with outputs lower than 230 V AC,
- ☑ capacitive dividers – example brand KPB Intra,
- ☑ resistive type sensors with output 3.25 V – example brand Zelisko,
- ☑ capacitive type sensors with output 3.25 V – example brand TE Connectivity,
- ☑ voltage sensors in different types of Reclosers – Tavrida, GVR, Siemens and others,
- ☑ outputs from modules VPIS V3 VO in Schneider Electric switchgear.

Current Measurement

- ☑ standard current transformers with 1 A or 5 A outputs,
- ☑ split-core or closed core current transformers with outputs from 1.66 mA up to 5 A,
- ☑ current transformers with voltage outputs 225 mV – example brand Zelisko,
- ☑ Rogowski coils.

RTU7M AI-3U3I – Power Quality Metering Card

General Description

This card is designed for measurement of voltages and currents in three-phase systems with consecutive evaluation of quality of electrical energy and associated pointers, what is providing a complex picture about distribution grid and energy stream. Measured data can be stored into database and then analyzed and evaluated in SW application ENVIS (free of charge). System can send regular reports about the power quality in given time period or can send automatic alarms, if some selected parameters exceed the set values.

Typical Applications

- power quality metering,
- diagnosis and searching for causes of problems in network,
- remote monitoring of energy consumption or production.

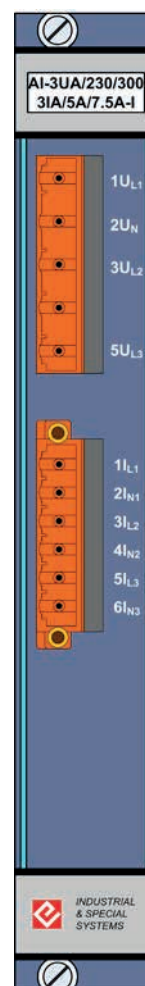## Basic Features

- three or four independent voltage and current inputs (3x1p, 3p-wye, 3p-delta),
- energy meter supports 3 tariffs, single and three phase measurement in four quadrants for active and reactive energy,
- measurement U, I, P, Q, S, harmonic distortion power, PF, cos φ, symmetrical components, unbalance factor, THD, 50 harmonics, fundamental harmonics, frequency, active energy, reactive energy,
- 512MB memory for data logging,
- internal battery for 1-hour power backup,
- standards IEC61557-12, EN50160, class S (class A under development, check the availability with producer).

**Card RTU7M
AI-3UA/230/300-3IA/5A/7.5A-I**

**Front panel RTU7M
AI-3UA/230/300-3IA/5A/7.5A-I**

Technical Specification

Card	RTU7M AI-3UA/230/300-3IA/5A/7.5A-I
Voltage inputs number	3
Nominal range	3 × 230 V AC (wye, delta, aron)
Overloadability	300 V AC perm.
Range in RTU UC	4 ÷ 300 V
Current inputs number	3
Nominal range	3 × 5 A AC
Overloadability	10 A AC perm., 90 A AC for 1s
Range in RTU UC	0,0125 ÷ 7,5 A AC
Measuring accuracy	class S (class A under development, check the availability with producer)
Consumption	1W
Connectors	1× WAGO 231-536/108-000, 1× WAGO 231-935/001-000 (part of delivery)
Wire cross-section	0,08 ÷ 2,5 mm^2
Position in bus	Any

RTU7M AI-4UF – Fast Analog Input Card

General Description

Fast measuring card is indirect card (card with internal CPU communicating through the internal serial bus with communication CPU) equipped with A/D converter and powerful signal CPU for processing of measured signals with fast changes. The card is equipped with 2 Ethernet ports, that allow to transfer a huge amount of data directly into communication card without occupation of internal bus.

This card is designed for measuring of fast voltage signals from various sensors. There are four voltage inputs, that are galvanically isolated from the rest of unit, but not between each other. The inputs are fitted with BNC connectors with input impedance 75 Ohms. The measuring range is adjustable in parameterization. Maximal voltage value on input is 1.28 V. Voltage is measured by 8-bit A/D converter with maximal sample rate 40MS/s. The card processes the signal from 10Hz to 20MHz. The upper frequencies are limited by fourth-order filter to 20 MHz.
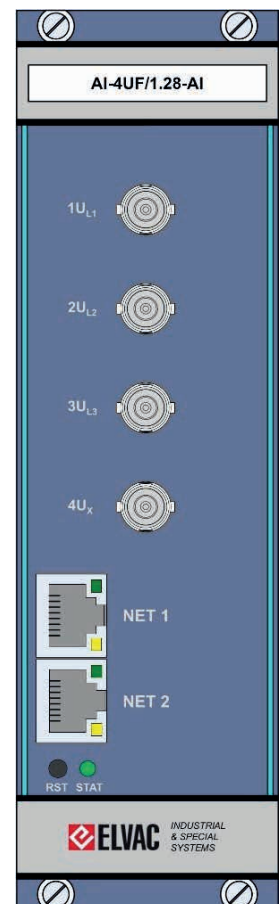

Card RTU7M AI-4UF/1.28-AI

Typical Applications

- fault detection on isolated overhead MV lines (contact of isolation with vegetation, subject lying on lines, conductor fallen on the ground),
- early warning of insulation failure and its transition into the earth fault or short circuit.

Front panel of RTU7M AI-4UF/1.28-AI

Technical Specification

| Card	RTU7M AI-4UF/1.28-AI
Inputs	4
Measured variable	Voltage
Maximal measured value	1.28 Vpeak
Overloadability	4.3 V AC
Inputs type	Isolated 4 kV DC for 1 second from rest of the unit
Input impedance	75 Ω
Signal processing	8-bit A/D converter
Measured frequencies	10 Hz ÷ 20 MHz for 3dB decrease
Accuracy	1% (10kHz, 25 °C)
Measuring category	CAT III, 150V
Sampling	According to used FW, usually 40 MS/s
Interfaces	2 × Ethernet 10/100 Mbps, embedded isolation 1.5 kV AC / 1 minute
Memory	SRAM 4MB
Connectors	4 × BNC, 2 × RJ-45
Consumption	6 W
Position in 5 / 8–10 / 16 slots bus	Any

RTU7M – Industrial Analog Inputs

General Description

The measurement cards are equipped with their own powerful signal processor for processing the measured signals. In this case, the RTU7M unit serves only as a communication bridge for data transmission. The advantage of these cards is the possibility of using several such cards in one chassis in any positions. After consultation with the manufacturer, it is also possible to design inputs other than those shown here.

These cards are designed to measure DC voltage or current signals for general use in industrial applications. They are manufactured with different numbers of inputs that are galvanically isolated from the rest of the unit. Depending on the type of card, individual inputs can be galvanically isolated from each other. The measuring range is parameterizable in the SW RTU User Center. If the measured value is outside the parameterized measurement range, the measurement values are transmitted as invalid.
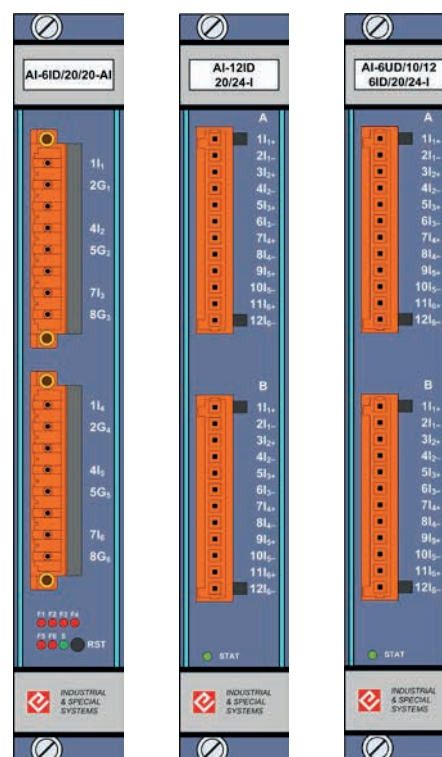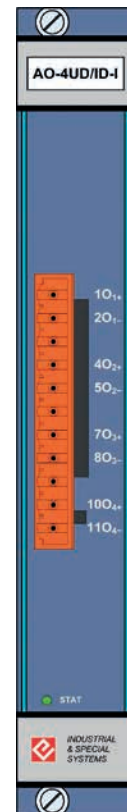
Technical Specification

Card	AI-6ID/20/20-AI	AI-12ID/20/24-I	RTU7M AI-6UD/10/12-6ID/20/24-I
Inputs number	2 × 3 × I	12 x I	6 × U / 6 × I
Inputs type	Isolated from rest of the unit and from each other, 4 kV for 1 minute	Isolated from rest of the unit, 2.21 kV AC for 1 minute, groups from each other 2.5 kV AC	
Signal processing	Own processor, 16-bit A/D converter		
Nominal voltage range			10 V DC, both polarities
Voltage inputs overloadability			12 V DC permanently
Nominal current range	0 ÷ 20 mA DC 4 ÷ 20 mA DC ±20 mA DC		
Current inputs overloadability	24 mA		
Range in RTU UC	0 ÷ 20 mA for measurement 0 ÷ 20 mA 0 ÷ 20 mA for measurement ±20 mA 4 ÷ 20 mA for measurement 4 ÷ 20 mA		
Current inputs impedance	10 Ω	206 Ω	
Voltage inputs impedance	–		364 kΩ
Measurement accuracy (from nominal range)	± 0.3 %	± 0.1 %	
Measurement accuracy (overloaded)	± 0.3 %	± 0.1 %	
Consumption	2.5 W		
Connectors	2 × WAGO 231-308/107-000, part of delivery		
Wire cross-section	0.08 ÷ 2.5 mm^2		
Position in bus	Any		

RTU7M – Industrial Analog Outputs

General Description

The analog output card is equipped with its own powerful signal processor. The RTU7M unit serves only as a communication bridge for data transmission. The advantage of this card is the possibility of using several such cards in one chassis in any positions.

The card is designed to generate voltage or current signals for general use in industrial applications.

Technical Specification

Card	AO-4UD/ID-I
Outputs number	4
Outputs type	Isolated 2.2 kV AC for 1 minute (isolation output / unit and outputs from each other)
Signal processing	Own processor, 16-bit A/D converter
Output quantity	Current / Voltage
Output current nominal range	0 ÷ 20 mA DC
Output voltage nominal range	0 ÷ 10 V DC
Current output loadability	≤ 1000 Ω
Voltage output loadability	≤ 12 mA, CLOAD ≤ 2 uF
Output current accuracy (from range)	±0.05 %
Output voltage accuracy (from range)	±0.05 %
Output resistance	140 mΩ
Refresh frequency	10 Hz
Consumption	3 W
Connectors	WAGO 734-102, part of delivery
Wire cross-section	0.08 ÷ 1.5 mm^2
Position in bus	Any

# RTU7M AI-8T-I – Temperature Measuring Card

General Description

This card is designed for temperature measuring via RTD or thermocouples. The advantage is the possibility of simultaneous temperature measurement using different sensors. There are 8 independent measuring channels.

Basic Features

- 8 inputs for temperature sensors,
- supported sensors: PT100, PT1000, Ni120, Thermocouple K,
- 2 or 3-wire sensors connection (3-wires eliminate the cable length influence).

Typical Applications

- general temperature measuring in power industry applications,
- temperature check on voltage or current measuring sensors (provided by some type of sensors) – used for operating temperature check.
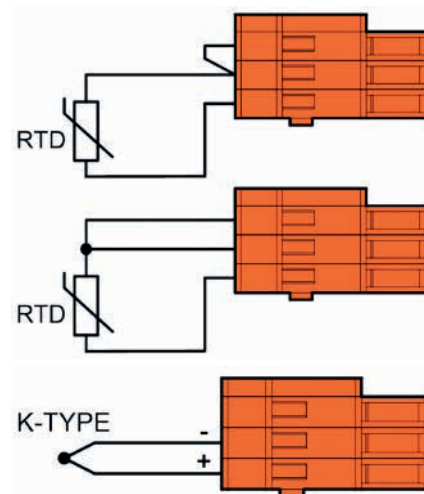

Different sensor types connection

Front panel of RTU7M AI-8T-I

Technical Specification

Card	RTU7M AI-8T-I			
Number of inputs	8			
Input types	Differential inputs isolated from the rest of unit, 2.5 kV 1 minute			
Signal evaluation	Own processor, 20-bit A/D converter			
Measured value	Temperature			
Sampling	9 Hz (all sensors)			
Consumption	1.6 W			
Connectors	8EDGK-2.50-03P-15			
Wire diameter	0.2 ÷ 1.5 mm^2			
Operating temperature	-20 ÷ 65 °C			
Storage temperature	-30 ÷ 85 °C			
Sensor type	PT100	PT1000	Ni120	Thermocouple K
Nominal range	-130 ÷ 130 °C	-130 ÷ 130 °C	-80 ÷ 130 °C	-130 ÷ 130 °C
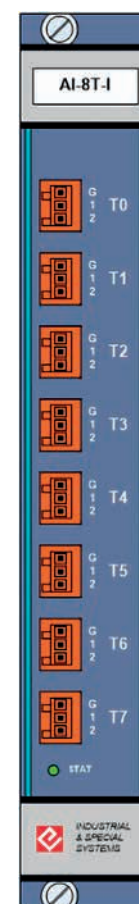
Compact RTU

RTU7MC3 – Communication Unit

Unit Description

The RTU7MC3 is advanced universal communication unit, based on embedded computer with Linux core. The HW core is extended by ELVAC SW based on long time experience in power distribution field and protocols used in this area.

These all features offer to the user of this device very powerful tool for protocol conversion and communication between devices and SCADA system.

The device supports complete remote management, FW and OS updates.

Typical Applications

- main communication unit in substations and other energetics objects,
- protocol conversion from IEC 61850 to IEC 60870-5-104 in power distribution objects (or other protocol combinations),
- redundant (backup) communicator with SCADA,
- data concentrator,
- router.

Basic Features of Unit

- 2 × independent network interfaces 10/100 Mbps Ethernet, VLAN support,
- 1 × RS-232 console port,
- 2 × RS-232/422/485,

- LTE modem with two antennas, connector SMA,
- 1 × DI (dry contact),
- supported communication protocols – IEC 61850, IEC 60870-5-101, IEC 60870-5-103, IEC 60870-5-104, DNP3, HIOCom2, MODBUS TCP/RTU, DLMS, OPC UA, SNMP,
- L2TP, OpenVPN and IPSEC tunneling,
- secure communication according to IEC 62351-3 (TLS),
- web based configuration interface HTTP/HTTPS,
- NAT, Firewall functionality,
- user access control, RADIUS, RBAC,
- Syslog, NTP, SSH, SCEP,
- digitally signed FW,
- SQL data storage,
- user programmable logic, proprietary or according to IEC 61131-3 standard,
- built-in RTC,
- internal microSD socket for storage expansion,
- stand alone or DIN rail or panel mounting, possible horizontal or vertical placement.

RTU7MC3

Technical Specification

Power supply voltage	24 V DC ±20 % (or others after consultation with producer)
Max. input current	0.6 A DC
Input protection	1.35 A polyswitch
Mobile network interfaces	LTE (700/800/900/1800/2100 MHz) Dual-Band UMTS/HSPA+ (900/2100MHz) Dual-Band GSM (900/1800 MHz) LTE UE Cat. 1, GPRS Class 12, EDGE Class 12
Interfaces NET1, NET2	2 x Ethernet 10/100 Mbps (RJ-45), isolation 1 kV AC for 1 minute
Interface COM3	Console RS-232 (RJ-11)
Interfaces COM4, COM5	2 x RS-232/422/485 (RJ-45), isolation 1.5 kV AC for 1 minute
Memories	Flash 8 GB, RAM 256 MB, MicroSD card
Another functions	1 x digital input (screw type connector), thermal sensor, RTC
Operating temperature	-25 °C ÷ +70 °C
Storage temperature	-30 °C ÷ +75 °C
Ambient relative humidity	≤ 95 % non-condensing
Dimensions	177 (W) x 68 (H) x 122 (D) – chassis including connectors and DIN rail holder, earthing screw M4 x 14
Ingress protection	IP20

RTU7MC3-D – Communication Unit

Unit Description

The RTU7MC3-D is advanced universal communication unit, based on embedded computer with Linux core. The HW core is extended by ELVAC SW based on long time experience in power distribution field and protocols used in this area.

These all features offer to the user of this device very powerful tool for protocol conversion and communication between devices and SCADA system.

The device supports complete remote management, FW and OS updates.

Typical Applications

- main communication unit in substations and other energetics objects,
- protocol conversion from IEC 61850 to IEC 60870-5-104 in power distribution objects (or other protocol combinations),
- redundant (backup) communicator with SCADA,
- data concentrator,
- router.

Basic Features of Unit

- 2 × independent network interfaces 10/100 Mbps Ethernet, VLAN support,
- 2 × RS-485,
- 1 × RS-232 console port,

- LTE modem with two antennas, connector SMA,
- 4 × DI (dry contact),
- supported communication protocols – IEC 61850, IEC 60870-5-101, IEC 60870-5-103, IEC 60870-5-104, DNP3, HIOCom2, MODBUS TCP/RTU, DLMS, OPC UA, SNMP,
- L2TP, OpenVPN and IPSEC tunneling,
- secure communication according to IEC 62351-3 (TLS),
- web based configuration interface HTTP/HTTPS,
- NAT, Firewall functionality,
- user access control, RADIUS, RBAC,
- Syslog, NTP, SSH, SCEP,
- digitally signed FW,
- SQL data storage,
- user programmable logic, proprietary or according to IEC 61131-3 standard,
- built-in RTC,
- internal microSD socket for storage expansion,
- stand alone or DIN rail or panel mounting, possible horizontal or vertical placement.

RTU7MC3-D

Technical Specification

Power supply voltage	24 V DC ±20 % (or others after consultation with producer)
Max. input current	0.6 A DC
Input protection	1.35 A polyswitch
Mobile network interfaces	LTE (700/800/900/1800/2100 MHz) Dual-Band UMTS/HSPA+ (900/2100MHz) Dual-Band GSM (900/1800 MHz) LTE UE Cat. 1, GPRS Class 12, EDGE Class 12
Interfaces NET1, NET2	2 x Ethernet 10/100 Mbps (RJ-45), isolation 1 kV AC for 1 minute
Interface COM3	Console RS-232 (RJ-11)
Interfaces COM4, COM5	2 x RS-485 (screw type connector), isolation 1.5 kV AC for 1 minute
Memories	Flash 8 GB, RAM 256 MB
Another functions	4 x digital input (screw type connector), thermal sensor, RTC
Operating temperature	-25 °C ÷ +70 °C
Storage temperature	-30 °C ÷ +75 °C
Ambient relative humidity	≤ 95 % non-condensing
Dimensions	177 (W) x 68 (H) x 122 (D) – chassis including connectors and DIN rail holder, earthing screw M4 x 14
Ingress protection	IP20

RTU7B – Battery Powered RTU

Unit Description

The RTU7B is designed for remote data acquisition and control in places without power supply. It was optimized for extremally low power consumption, which allows long life battery operation. Typical battery life cycle is more than one year for usual communication period (3 x daily for 2 minutes). Besides battery powering it is possible also external powering 5 ÷ 12 V DC.

RTU is installed in robust aluminum wall-mount housing with IP68 and signals are connected to RTU through the bushings. Front panel is equipped with magnetic contact for communication wake-up without necessity of opening the housing. The communication of unit can be evoked by change of value, limit, alarm, full buffer or periodically.

Typical Applications

- in-field data acquisition and control in utilities, ex. water management.

Basic Features of Unit

- 4 × digital inputs, pulse counters, period measuring,
- 4 × OC digital outputs,
- 4 x analog inputs (2 x 10 V, 2 x 20 mA),
- battery powering, optionally external powering,
- communication interfaces – GSM/GPRS (optionally LTE), USB, RS-485, M-BUS,
- supported communication protocols – DNP3, MODBUS TCP,
- optionally user programming by logical and relational expressions,
- RTC synchronized from SCADA,
- other values: battery status, temperature, GSM signal strength, logs,
- wall or panel mounting.

RTU7B

Technical Specification

Battery powering	2 × 3,6 V Li-SOCl2 (optionally external battery box for operation extension)
External power supply (optionally)	5 ÷ 12 V DC
Digital inputs	4 × active or passive inputs (signaling voltage 12 V DC), pulse counters 20 ms
Digital outputs	4 × 30 V / 50 mA (open collector)
Voltage inputs	2 × 0 ÷ 10 V (overloadability 12,5 V), configurable measuring period
Current inputs	2 × 0 ÷ 20 mA (overloadability 25 mA), configurable measuring period
External sensors powering	2 × output (12 or 24 V / 25mA), active only during value measurement
Communication interfaces	GSM/GPRS (optionally LTE)
	USB for parameterization
	RS-485 (optional)
	M-BUS – master, maximally two Slave devices
Temperature sensor	Measured range -25 °C ÷ 70 °C, accuracy ±2 °C
Operating temperature	-25 °C ÷ 70 °C
Storage temperature	-30 °C ÷ 75 °C
Ambient relative humidity	5 % ÷ 95 % non-condensing
Dimensions	200 × 160 × 100 mm (W × H × D) without bushings
Ingress protection	IP68

Compact RTU

RTU7C – Control and Communication Unit

Unit Description

The RTU7C is compact device, designed for remote monitoring of energy networks, and further areas with high requirements for system reliability and robustness. The compact design integrates in one unit a communication module, digital inputs and outputs.

This compact unit is internally resolved as a modular system which enables high flexibility and the possibility to adapt to requirements of the client. An example is the wide range of communication interfaces ((E)GPRS, UMTS, LTE, Ethernet, RS-232, RS-485), which can be fitted into the unit in various combinations. Various communication protocols can be set for each communication interface. It is possible to communicate via several protocols in one time, for example with protocol IEC 60870-5-104 into the master system and protocol HioCom2 into the parameterization SW (remote parameterization, signal transmission, FW upgrade, etc.). Another communication options are various methods of backup communication.

Typical Applications

- connection of devices without necessary communication,
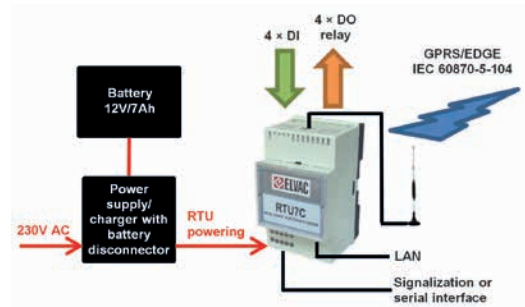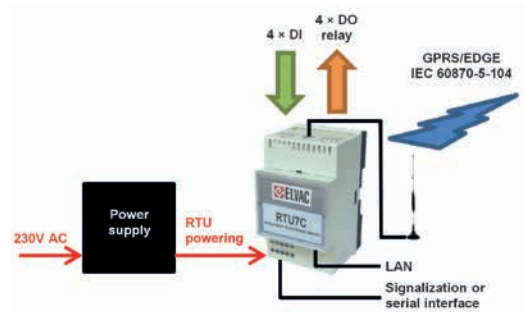- communication converter,
- communication gate.

RTU7C

Basic Features of Unit

- 4 × digital inputs (active/passive),
- 4 × relay outputs,
- external power supply 10 ÷ 30 V DC,
- communication interfaces – GPRS/EDGE/UMTS (optionally LTE), Ethernet, RS-232/485,
- supported communication protocols – MODBUS, HIOCom2, IEC 60870-5-101, IEC 60870-5-103, IEC 60870-5-104, DNP3 Server,
- user programming by logical and relational expressions,
- DIN rail mounting.

Variant of connection RTU7C with power supply backup

Variant of connection RTU7C without power supply backup

Technical Specification

Digital inputs	4 × optocoupler, active or passive inputs, signaling voltage 24 V (optionally 12 V)
Digital outputs	4 × relay (NO contact) 3 A / 240 V AC / 30 V DC
Power supply voltage	10 V DC ÷ 30 V DC
Consumption (all DO closed)	400 mA / 420 mA by 12 V DC
Communication interfaces	Ethernet LAN, GPRS/EDGE/UMTS (optionally LTE), RS-232/485
Antenna connector	FME(m) 50 Ohm
Temperature sensor	Measured range -55 °C ÷ 125 °C, accuracy ±0.5 °C in range -10 °C ÷ 85 °C
Operating temperature	-25 °C ÷ 50 °C (possible increase up to 65 °C − on demand)
Storage temperature	-30 °C ÷ 75 °C
Ambient relative humidity	5 % ÷ 95 % non-condensing
Dimensions	53 × 90 × 60 mm (W × H × D) without connectors
Ingress protection	IP20

SMC 133 – Class S Power Monitor, Energy Meter and Data Logger

Unit Description

The SMC 133 is a 3-phase multimeter designed for local and remote monitoring of Class S power quality and power consumption. It is designed in the 300V / CAT IV measurement category (DC powered variants), making it suitable for installation in power industry facilities.

Measured data can be stored in memory and subsequently analysed and evaluated in the ENVIS software application. The system can send regular reports on power quality at given periods or can send automatic alarms if any of the events exceeds the set values.

In the area of power quality monitoring and power consumption metering, we work closely with company KMB, whose products complement the functionality of our RTU systems, and provide comparable commercial terms.

Typical Applications

- power quality metering,
- remote monitoring of energy consumption.

Basic Features of Unit

- three voltage and current inputs 1p, 3p-wye, 3p-delta,
- energy meter in class 1 supports 3 tariffs, single and three phase measurement in four quadrants for active and reactive energy,
- measurement U, I, P, Q, S, harmonic distortion power, PF, cos φ, symmetrical components, THD, 50 harmonics, frequency, active energy, reactive energy,
- internal 1 h UPS at version for DC power supply,
- RTC, internal temperature sensor,
- communication interface RS-485, optionally Ethernet,
- communication protocol MODBUS,
- standards IEC61557-12, EN50160, class S,
- DIN rail mounting,
- frequently used software expansions:
  - module PQ S – for quality evaluation class S,
  - GO – recording of oscilloscope waveforms.

SMC 133

Technical Specification

Voltage inputs	Optionally 3 × 100 V / 230 V
Current inputs	Optionally 3 × 100 mA / 5 A
Current inputs overload	X/100mA: 0.25 mA ÷ 0.15 A (10A/1s) X/5A: 12.5 mA ÷ 7.5 A (90A/1s)
Communication interfaces	RS-485, optionally Ethernet
Memory	512 MB
Display	Optionally
Power supply voltage	Optionally 230 V AC / 12 V DC / 24 V DC / 48 V DC
Consumption	Max. 3.5 W
Operating temperature	-25 °C ÷ 60 °C
Storage temperature	-40 °C ÷ 85 °C
Ambient relative humidity	5 % ÷ 95 % non-condensing
Dimensions	105 × 90 × 58 mm (W × H × D)
Ingress protection	IP20

SMC 233 – Class S Power Monitor, Energy Meter and Data Logger

Unit Description

The SMC 233 is a 3-phase multimeter with high accuracy designed for local and remote monitoring of Class S power quality and power consumption. It is designed in the 300V / CAT IV measurement category, making it suitable for installation in power industry facilities.

Measured data can be stored in memory and subsequently analysed and evaluated in the ENVIS software application. The system can send regular reports on power quality at given periods or can send automatic alarms if any of the events exceeds the set values.

In the area of power quality monitoring and power consumption metering, we work closely with company KMB, whose products complement the functionality of our RTU systems, and provide comparable commercial terms.

- measurement U, I, P, Q, S, harmonic distortion power, PF, cos φ, symmetrical components, THD, 128 harmonics, frequency, active energy, reactive energy,
- optional superharmonic analysis up to 9 kHz,
- RTC, internal temperature sensor, input for external temperature sensor Pt100,
- communication interface RS-485 and Ethernet,
- USB port for local data management and data acquisition,
- communication protocol MODBUS, optionally IEC 60870-5-104,
- standards IEC61557-12, EN50160, class S,
- DIN rail mounting,
- frequently used software expansions:
    - module PQ S – for quality evaluation class S,
    - GO – recording of oscilloscope waveforms.

Typical Applications

- power quality metering,
- remote monitoring of energy consumption.

Basic Features of Unit

- three voltage and current inputs 1p, 3p-wye, 3p-delta,
- energy meter in class 0.5S supports 3 tariffs, single and three phase measurement in four quadrants for active and reactive energy,

SMC 233

Technical Specification

|	
Voltage inputs	5 ÷ 1470 V_{LL} 3 ÷ 850 V_{LN}
Current inputs	3 x 5 A
Current inputs overload	X/5A: 12.5 mA ÷ 10 A (70A/1s)
Communication interfaces	RS-485 and Ethernet
Memory	512 MB
Inputs and outputs	4 × DIO, Pt100
Display	Optionally color TFT LCD, 160x128 pixels, 1.8"
Power supply voltage	10 ÷ 30 V DC
Consumption	3 W
Operating temperature	-25 °C ÷ 60 °C
Storage temperature	-30 °C ÷ 80 °C
Ambient relative humidity	5 % ÷ 95 % non-condensing
Dimensions	105 × 90 × 61 mm (W × H × D)
Ingress protection	IP20

SMY 133 – power monitor and data logger with display

Unit description

The SMY 133 is advanced 3-phase multimeter with large color LCD display designed for local or remote monitoring of electricity in power lines and its quality in class S.

Measured data can be stored into database and then analyzed and evaluated in SW application ENVIS (free of charge). System can send regular reports about the power quality in given time period or can send automatic alarms, if some events exceed the set values.

Digital outputs can also work as an S0 pulse output from the embedded electricity meter.
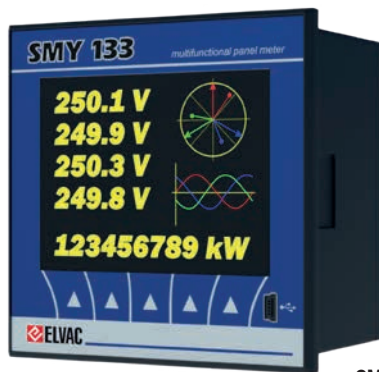
SMY 133

Typical applications

☑ power quality metering,
☑ remote monitoring of energy consumption.

Basic features of unit

☑ three voltage and current inputs 1p, 3p-wye, 3p-delta, Aron,
☑ energy meter supports 3 tariffs, single and three phase measurement in four quadrants for active and reactive energy,
☑ measurement U, I, P, Q, S, harmonic distortion power, PF, cos φ, symmetrical components, unbalance factor, THD, 50 harmonics, fundamental harmonics, frequency, active energy, reactive energy,
☑ built-in temperature sensor,
☑ 512MB memory for data logging,
☑ optionally 2 × digital input, 2 × digital output,
☑ USB communication interface, optionally RS-485 or Ethernet,
☑ optional communication protocol MODBUS,
☑ standards IEC61557-12, EN50160, class S,
☑ panel mounting.

Technical specification

Voltage inputs	Optionally 3 × 100 V / 230 V / 400 V
Overvoltage category	230, 400: CAT III / 300 V 100: CAT IV / 150 V
Current inputs	Optionally 3 × 100 mA / 5 A
Current inputs overload	100mA: 1 mA ÷ 390 mA (max. 10A/1s) 5A: 5 mA ÷ 7 A (max. 70A/1s)
Digital inputs	Optionally 1 × DI (24 V)
Digital outputs	Optionally 2 × DO
Communication interfaces	USB, optionally RS-485 or Ethernet
Power supply voltage	Optionally 230 V AC / 12 V DC / 24 V DC / 48 V DC
Consumption	3 W
Operating temperature	-25 °C ÷ 60 °C
Storage temperature	-40 °C ÷ 80 °C
Ambient relative humidity	5 % ÷ 95 % non-condensing
Dimensions	96 × 96 × 64 mm (W × H × D)
Installation depth	58 mm
Mounting hole dimensions	92 × 92 mm (W × H)
Ingress protection	IP40

ARTIQ 233 – Class A Power Quality Analyzer and Energy Meter in Class 0.2S

Unit Description

The ARTIQ 233 is a 3-phase multimeter with high accuracy designed for local and remote monitoring of Class A power quality and power consumption in class 0.2S. It is designed in the 300V / CAT IV measurement category, making it suitable for installation in power industry facilities.

Measured data can be stored in memory and subsequently analysed and evaluated in the ENVIS software application. The system can send regular reports on power quality at given periods or can send automatic alarms if any of the events exceeds the set values.

In the area of power quality monitoring and power consumption metering, we work closely with company KMB, whose products complement the functionality of our RTU systems, and provide comparable commercial terms.

Typical Applications

- power quality metering in critical points,
- accurate energy metering.

Basic Features of Unit

- three voltage and current inputs 1p, 3p-wye, 3p-delta,
- energy meter in class 0.2S supports 3 tariffs, single and three phase measurement in four quadrants for active and reactive energy,

- measurement U, I, P, Q, S, deformed power, PF, cos φ, symmetrical components, THD, 128 harmonics, frequency, active energy, reactive energy,
- optionally superharmonic analysis up to 9 kHz,
- RTC, internal temperature sensor, input for external temperature sensor Pt100,
- communication interface RS-485 and Ethernet,
- USB port for local data management and data acquisition,
- communication protocol MODBUS, optionally IEC 60870-5-104,
- standards IEC61557-12, EN50160, class A,
- DIN rail mounting,
- frequently used software expansions:
    - module PQ S – for quality evaluation class S,
    - GO – recording of oscilloscope waveforms.

ARTIQ 233

Technical Specification

|	
Voltage inputs	$5 \div 1470\ V_{LL}$ $3 \div 850\ V_{LN}$
Current inputs	3×5 A
Current inputs overload	X/5A: 2,5 mA ÷ 10 A (70 A / 1 s)
Communication interfaces	RS-485 and Ethernet
Memory	512 MB
Inputs and outputs	4 × DIO, Pt100
Display	Optionally color TFT LCD, 160x128 pixels, 1.8"
Power supply voltage	10 ÷ 30 V DC
Consumption	3 W
Operating temperature	-25 °C ÷ 60 °C
Storage temperature	-30 °C ÷ 80 °C
Ambient relative humidity	5 % ÷ 95 % non-condensing
Dimensions	108 × 90 × 61 mm (W × H × D)
Ingress protection	IP 20

Signaling and HMI Panels

Panel SIG-D-EXTxx

General Description

This panel is designed and adapted for mounting to the RTU7M modular units. It is fitted with LED indication, control buttons and a switch for local and remote control. The panel is used in the power industry applications, mainly for remotely controlled disconnectors and remotely controlled reclosers. There are signaled the statuses of the disconnector, as error statuses on the lines, the communication and the backup battery statuses.

The panel is typically installed so that after opening the switchboard cabinet door, only this signaling and control panel is visible when passing through the sub-panel which covers the other electronic system, including RTU. As the panel is mounted directly on the RTU7M unit, it is not necessary to use the sub-panel if the user does not require it.

SIG-D-EXT can be connected to the RTU7M unit using the RS-485 line. The supply voltage for this panel is installed on the same communication line (RS-485). The panel can be supplied on client demand in a version where the signaling is solved using electro-magnetic flip dot signs instead the LED. In this case, the status after the RTU switch off remains displayed.
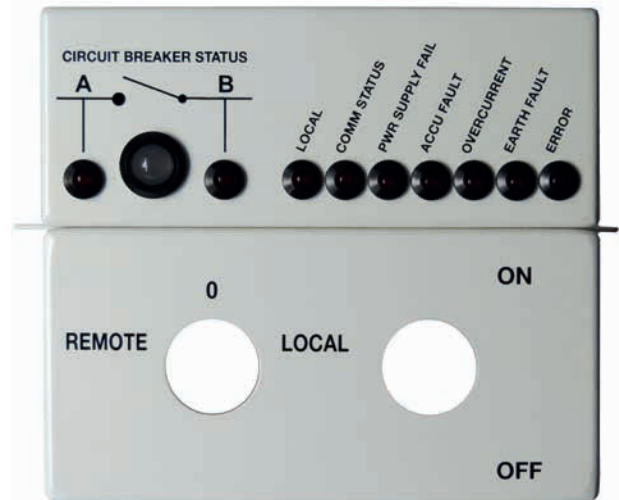
**Signaling panel SIG-D-ETX
without fitted switch and buttons**

Technical Specification

Panel	SIG-D-EXT05	SIG-D-EXT30
Number of LED	10 × LED (9 × red LED ø 5 mm and 1 × red-green LED ø 10 mm)	
Communication with RTU	RS-485	
External power supply	5 V DC	5−30 V DC (max. 3 W)
Consumption	1 W	0.5 W
Connector	1 × WAGO 231-304/026-000, part of delivery; wire 0.08−2.5 mm²	
Ingress protection	IP20	

Example of application with signaling panel

Connector Wiring on SIG-D-EXTxx

Pin	Description
+, -	Power supply
A, B	Signals of communication line RS-485
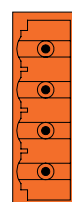
+
-
B
A

**Connector
on rear panel**

Panels ESP7

General Description

Panel ESP7 – Basic Version

This panel is fitted with 22 LEDs, where the function can be configured using the standard parameterizing software supplied with RTU (RTU User center). The parameterization is carried out in the expressions editor. The RTU FW must be 105.02 or higher. The function of the individual LED can be set on the basis of the internal statuses of the RTU (digital inputs, digital outputs, analog inputs, virtual analog and digital inputs, internal statuses, etc.). Permanent on or off, fast or slow flashing, response delay, etc. can be set for each LED. The description of the LED functions on the front panel can be changed by the user using insert labels. This signaling panel is powered by the voltage which is available on RS-485 connector of the communication interface on the RTU7M. Therefore it is not necessary to solve the backup of the power supply for the signaling panel. Interconnection is via a direct cable with RJ-45 terminals on the rear of the panel.

Panel ESP7-2ETH/F-xxx

This version of signaling panel contains the same number of signaling LEDs as the basic version, but it communicates with RTU via an Ethernet interface. The same options for individual LED setting and displaying are valid as in basic version. Unlike the basic version, this panel has the option of configuration via the web interface. The panel has two RJ-45 communication connectors – from the front part of the panel, the other from the rear (the panel works as a 2-port Ethernet switch). In the rear of the panel are a power supply connector and a reset button for the initial parameters setting of the Ethernet interface. The panel can be connected to all RTU7M, RTU7K/KL and RTU7.4 units that have an Ethernet communication interface.

Panel ESP7-2ETH/F-LCD-xxx

Against previous, a third version of signaling panel contains only 12 signaling LEDs. However, is equipped with an LCD display for displaying of measured values and control buttons for possible changes of selected parameters. Panel can be powered by DC voltage, see table below.

Panel ESP7-2ETH-GR-xxx

The most important feature of this panel is graphic LCD display, which allows the visualization of controlled element and more detailed data reading. The panel is also equipped with 10 x indication LEDs (8 x LEDs have user definable 2 colors) and control buttons usually used in power distribution applications, like OK, HOME, BACK, REMOTE/LOCAL, On (1), Off (0).

Panel ESP7-60-DTS

This panel was designed as an extension of previous types and offers direct status displaying and control of up to 4 feeders in switching stations and substations. It indicates the states of load break switch in feeder, earthing knife and any fault. Each feeder can be controlled by pushing button OK and button On or Off simultaneously, which ensures safe operation. These panels can be connected more in chain, so more feeders can be indicated and controlled. It is equipped with wide range power supply for 24 V and 48 V system support.

Panel ESP7 – serial line version

Panel ESP7-2ETH/F-xxx

Panel ESP7-2ETH/F-LCD-xxx

Panel ESP7-2ETH-GR

Panel ESP7-60-DTS

Technical specification

Panel	ESP7	ESP7-2ETH/F-230	ESP7-2ETH/F-60
Status signaling	22 × LED (ø 3 mm, green)	22 × LED (ø 3 mm, green)	22 × LED (ø 3 mm, green)
Display	–	–	–
Keyboard	–	–	-4x navigation button, 1x OK Buttons OK, Home, Back, Remote/Local, On (1), Off (0)
Communication with RTU	1 × RS-485	2 × Ethernet 10/100 Mbps (front + rear)	
External power supply	5 V DC	90−260 V AC / 90−270 V DC	10-60 V DC
Consumption	Max. 1 W	Max. 3 W	Max. 3 W
Communication connector	1 x RJ-45	2 × RJ-45	
Powering connector	–	1× WAGO 231-302/026-000	
Power supply wire cross-section	–	0.08 ÷ 2.5 mm^2	
Dimensions	144 × 144 × 71 mm (W × H × D)		
Mounting hole dimensions	138 × 138 mm		
Max. thickness of the mounting sub-panel	Max. 5.5 mm		
Installation depth	64 mm (without connectors)		
Operating temperature	-20 ÷ +55 °C		
Storage temperature	-30 ÷ +75 °C		
Ambient relative humidity	5% ÷ 95 % non-condensing		
Ingress protection	IP20 (optionally IP54 on front panel)		

Panel	ESP7-2ETH/F-60-LCD	ESP7-2ETH-GR-60	ESP7-60-DTS
Status signaling	12 × LED (ø 3 mm, green)	8 x bi-color LED user definable 1x bi-color LED STATE 1 x bi-color LED REMOTE/LOCAL	8 x LED,4 x cross LED (green and red)
Display	Alphanumeric LCD, 4x16 characters	Graphic LCD 480x272 pixels	–
Keyboard	4x navigation button, 1x OK	Buttons OK, Home, Back, Remote/Local, On (1), Off (0)	12 × control buttons (3 × button for each feeder)
Communication with RTU	2 × Ethernet 10/100 Mbps (front + rear)	2 × Ethernet 10/100 Mbps rear	
External power supply	10−60 V DC		
Consumption	Max. 3 W	Max. 5 W	Max. 2 W
Communication connector	2 × RJ-45		
Powering connector	1× WAGO 231-302/026-000		
Power supply wire cross-section	0.08 ÷ 2.5 mm^2		
Dimensions	144 × 144 × 71 mm (W × H × D)		
Mounting hole dimensions	138 × 138 mm		
Max. thickness of the mounting sub-panel	Max. 5.5 mm		
Installation depth	64 mm (without connectors)		
Operating temperature	-20 ÷ +55 °C		
Storage temperature	-30 ÷ +75 °C		
Ambient relative humidity	5% ÷ 95 % non-condensing		
Ingress protection	IP20 (optionally IP54 on front panel)		

Panel ERIC TCP/SP

General Description

Panel ERIC TCP/SP is the set of two devices, which work as user interface for ELVAC RTUs. The core is created by a touch control panel (TCP) with installed application ERICA, which works as a viewer of web interface in ELVAC RTU and a communicator for side panel (SP) connected into TCP. Side panel has three functions. Main function is the button Execute, which carries out the chosen action on TCP screen. This increases the security to prevent an accidental control. Another function of SP is an indication Attention, which can be user defined, for example for some system alarms signalization. Third function is the motion sensor, which automatically wakes up the TCP, when somebody is close, what saves the energy and screen. Some types of applications do not need SP, so the system can operate without it.

The set uses state of the art technologies and an average IT user is able to create a graphic application interface and setup of a control functions. It is possible to define any pictures, menu etc. for easy switching between screens and to display a data from ELVAC RTU in certain places or to define the control commands.

The set can be mounted in front panel (door) holes or in 19" rack using the reduction 5U panel.

Typical Applications

- user interface of control systems for substations, secondary substations etc.,
- user interface for applications like EMS, building management, family houses etc.,
- substitution of easy local SCADA system in substations, renewable energy sources etc.

Technical Specification

Panel	ERIC TCP/SP
Size of TCP touchscreen	8"
Communication with ELVAC RTU	Ethernet
Communication TCP and SP	Cabling is a part of delivery
External power source voltage	24 V DC
Power supply connector	2-pin terminal block
Wire cross-section	1.5 ÷ 2.5 mm^2
Dimensions of TCP	219 × 163 × 47 mm (W × H × D)
Dimensions of mounting hole for TCP	170 × 119 mm (W × H)
Dimensions of SP	72 × 144 × 84 mm (W × H × D)
Dimensions of mounting hole for SP	67 × 136 mm (W × H)
Installation depth (TCP / SP)	26 / 75 mm
Operating temperature	-10 ÷ +50 °C
Storage temperature	-20 ÷ +60 °C
Ambient relative humidity	5 % ÷ 90 % non-condensing
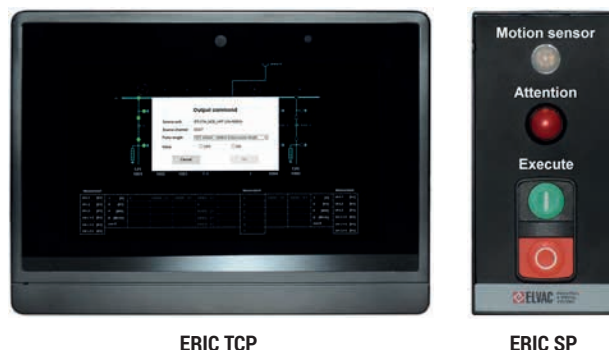
ERIC TCP   ERIC SP

Basis Features

- graphical intuitive interface and displaying of applications data for applications controlled via ELVAC RTU,
- unlimited number of read details (DI states, measurements etc.) and controlled outputs (DO), given only by RTU system configuration,
- button On/Off for selected command execution,
- alarms signalization, source of alarm can be shown on display,
- automatic wake up by motion sensor,
- another options, like switching of local and remote control, signaling reset etc.,
- substitution of complicated cabling used in other types of signalization,
- saves the number of inputs and outputs in RTUs, which are usually used for other types of signalization.

19" cabinet with ELVAC RTU and ERIC TCP/SP

Notes

RTU Accessories

GSM and GPS Antennas

ELVAC RTUs are used with GSM antennas with these types of connectors:

- FME – the most frequently used version by ELVAC RTU. The female antenna connector has an outside thread and the RTU has a male connector with an inside thread,
- SMA – male antenna connector with inside thread and the RTU has a female connector with an outside thread.

In addition to the required type of connectors, for the specification it is necessary to mention the following requirements for the type of antenna:

- antenna is fastened directly to RTU connector or through the cable with defined length,
- outdoor or indoor placement,
- type of fixation of the antenna rod – magnetic, screwed,
- a gain of the antenna in dB.

According to these specifications, we can provide the most suitable type of the antenna. The most frequently used types of GSM aerials are in the pictures.

GPS signal used in systems for time synchronization can be received through outdoor screw GPS antenna. An example is the type in the picture.

**Magnetic GSM antenna 5dB
for indoor use
with connector FME
with length of cable 3 m**

**Screw GSM antenna 3dB
for outdoor use
with connector FME
with length of cable 4.5 m**

**Screw GPS antenna 30 dB for outdoor use
with connector SMA with length of cable 3 m**

Backup Batteries

ELVAC RTUs use lead acid batteries with the voltage 12V for backup. The capacity is chosen according to the system consumption and the operation time when powered from battery.

Two most frequently used types are shown in the pictures. The upper one shows the battery with capacity 7Ah used for backup of the separate RTU. The lower one shows the battery with capacity 28Ah used for powering the RTU including another devices, like motor of disconnector. These batteries are connected two into 24V backup.

We can provide for smaller types also battery holders for DIN rail or panel.

Battery 12 V/7 Ah

Battery 12 V/28 Ah

Measuring Transformers, Power Supply Transformers and Sensors

In situations where the measured variable achieves values outside the range of measuring inputs, various types of transformers and sensors are used which modify the signal for the required range. We offer:

- power supply (phase-to-phase) transformers,
- measuring voltage transformers,
- measuring current transformers,
- low power resistive or capacitive sensors for voltage measuring,
- measuring current transformers with split core,

- capacitive sensors for voltage measuring,
- Rogowski coils.

The measuring range of cards can be modified via external modules with the following labels:

- EXT AI-MTI for current measuring,
- EXT AI-MTU for voltage measuring.

Examples of power supply transformer, capacitive sensor for voltage measurement, measuring transformer with split core, Rogowski coil and low power resistive sensor.

External Power Supplies

In some cases, due to various reasons regarding the RTU configuration, it is necessary to use an external power supply. We offer high-quality and reliable power supplies from verified brands.

Power supply 12 V for mounting on DIN rail

Panel Computers and HMI

In modern energy applications, there are requirements for high-quality visualization of monitored processes, simple control and setting of required parameters. Wide range of panel computers and HMI panels connected through Ethernet interface or RS-485 can be used for these purposes. The powerful processors with the required LCD displays with touchscreen, eventually with membrane keyboards for easy control, fully satisfy all requirements. Of course, we offer custom configurations including HMI applications for controlling and SCADA systems, dispatchers and server workstations.

Examples of panel PCs and HMIs

Testing Devices

EPG7 – Voltage and Current Generator

- operating parameters setting of the generator in remote control mode, setting of primary and secondary values conversion, generating of V and I,
- user parameters settings of device,
- work with fault records,
- formats REC and COMTRADE,
- records player,
- records storage in device,
- uploading of records from device,
- uploading of license numbers,
- FW updates,
- support of all EPG7 functions, tests of protective functions and automatics.

General Description

The EPG7 is a compact generator of AC or DC three-phase currents in values up to the tens of mA primarily designed for testing of the correct functions of the measurements and protections of RTU units or other devices, where are the parameters of EPG7 suitable. The device can also be used as a simple process calibrator – the output current corresponds within the declared accuracy to the value shown on the display.

When fitted with a voltage card, the device can generate three-phase AC or DC voltage up to units of volts. There are 4 digital inputs and 4 digital outputs which can be used in advanced functions for testing of the protections.

All versions of the device are fitted with a 4-line LCD display with a rotary knob with an integrated control button. A USB interface is used for communication with the user SW. The analogue outputs, digital outputs, digital inputs and USB interface are galvanically isolated.

The device can be powered by 4 x AA NiMh batteries or from an external adapter. When powered from batteries, the operating time is approximately 2 hours (permanent generation of 45 mA AC currents on all outputs). The discharging of batteries is indicated by the LED diode. The internal fast charger has LED signaling of the charging process.

EPG7 Ways of Using

- currents generation, eventually voltage, AC / DC,
- P, Q generation,
- phase to phase voltage setup,
- independent amplitude, frequency, phase setup for individual outputs,
- playing of records from protections (proprietary format REC from ELVAC RTU, COMTRADE),
- simulator of status of power element, including the interposition,
- optional control and reading of DI/DO,
- protection tests – current, earth, voltage, frequency,
- tests of fault currents indicators,

- test of reclosing,
- test of disconnecting in voltage-free pause,
- multichannel process calibrator.

EPG7

Basic Features

- three-channel currents generator in range 0 ÷ 45 mA AC and 0 ÷ ±60 mA DC,
- in extended version three-channel voltage generator 0 ÷ 7 V AC and 0 ÷ ±10 V DC,
- analog output protection against overloading with indication,
- 4 × DI and in extended version 4 × DO for tests of protection relay functions,
- alphanumeric LCD display and rotary knob with integrated button for easy control,
- powering from NiMH batteries or external adapter,
- integrated fast battery charger,
- USB 2.0 interface with galvanic isolation,
- wide range of user FW,
- optional user upgrade of FW according to demanded functionality,
- upper versions of FW can generate fault waveforms obtained from protections (format COMTRADE, proprietary format REC of ELVAC RTU),
- optional storage of generated waveforms in internal memory,
- another functions for tests of protective functions are in specialized FW,
- operating SW is available for PC.

Available HW Variants of EPG7

Equipment according to variant	Basic	Advanced
Current AC/DC outputs	3	3
Voltage AC/DC outputs	–	3
Digital inputs	4	4
Digital outputs	–	4
Batteries	–	4 × NiMH AA
Power adapter	–	230 V AC / 9 V DC
Type of FW	Basic	Basic + Voltage generator

Note: *FW versions, which are not mentioned in equipment of given version, are extra cost.*

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Tel.: +420 597 407 310 | rtu@elvac.eu | www.rtu.cz

ELVAC a.s.

Description of Available FW for EPG7

FW-EPG7-A

This version of Firmware can be used for generating of AC or DC current with Basic HW version of EPG7 and also for voltage generating with Advanced version of EPG7. This FW is free of charge.

Fixed frequency 50Hz and phase shift 120° are set for AC waveforms. The user only changes the amplitude of the generated signal – the same in all three phases. There is the option to read DI in Basic version and the option to read DI and control DO is available in Advanced version.

FW-EPG7-B

This version of firmware is licensed and has to be activated via SW EPGAP in EPG7. It is available only for Advanced version of EPG7 and can be purchased for expansion with the following functions:

Function Generator – it enables to set independent amplitudes, frequencies and phase shifts on individual voltage and current outputs.

Record Player – option to play fault records from protections (formats COMTRADE, proprietary REC) – requires SW on PC.

IPP Tester – automatic testing of the indicators of fault currents.

Protection Relay Tester – automatic testing of protective functions in RTU units and other similar devices.

EPG7

User SW for EPG7

For maximal user comfort of EPG7, the software **EPGAP** for PC (OS MS Windows) can be used. Available functions correspond to equipment and firmware type in EPG7.

Besides the comfortable control of all parameters (amplitude, frequency, phase, etc.), it is possible to download fault records from ELVAC RTU units in the REC format, or from any protection relays in the standard format COMTRADE, upload them into the generator memory and then to generate on its output. There is also the option to create own waveforms for specific testing purposes. There can be read from the generator an error states (diagnostics, checking of generated values is available) and timestamps of changes on digital inputs (DI data logger). The user interface also enables to set the digital outputs, eventually the parameters of the routines for automatic testing of the RTU units (including simulation of the response of the power element).

Bi-directional communication between the PC and the generator is ensured through an USB communication interface.

SW EPGAP

Summary of SW EPGAP Functions

- operating parameters setting of the generator in remote control mode, setting of primary and secondary values conversion, generating of V and I,
- user parameters settings of device,
- work with fault records,
- formats REC and COMTRADE,
- records player,
- records storage in device,
- uploading of records from device,
- uploading of license numbers,
- FW updates,
- support of all EPG7 functions, tests of protective functions and automatics.

Testing Devices

Technical Specification of EPG7 (According to the Equipment of Particular Type)

Basic Specification		
Display	LCD 16×4	
Control	Rotary knob with integrated button	
Power supply voltage	9 V DC	
Input protection	Polyswitch 2.5 A	
Backup battery	4 × NiMH AA, capacity 2100 mAh max.	
Charging current of battery	1.5 A	
Battery protection	Polyswitch 2.5 A	
Dimensions	196 (207) × 100 × 40 mm	
Weight	1 kg	
Operating temperature	0 °C ÷ +50 °C	
Storage temperature	-20 °C ÷ +75 °C	
Ambient relative humidity	5% ÷ 95 % non-condensing	
Ingress protection	IP20	
Current Outputs		
Number	3	
Generated currents ranges	45 mA AC / ±60 mA DC	
Accuracy of generated currents	±0.1 % from range	
Load impedance	Max. 100 Ω @ 45 mA AC	
Frequency of generated current	40 ÷ 350 Hz	
Individual outputs phase shift setup	0 ÷ 360 °	
Protection against current loop disconnection	Yes, indication of exceeding of maximal load impedance – LED AOF	
Signal processing	16-bit D/A converter	
Connectors	2 × WAGO 734-102; spacing 3.5 mm; part of delivery	
Wire cross-section	0.08 ÷ 1.5 mm^2	
Voltage Outputs		
Number	3	
Generated voltages ranges	7 V AC / ±10 V DC	
Accuracy of generated voltages	±0.1 % from range	
Output current	Max. 30 mA AC	
Frequency of generated voltage	40 ÷ 350 Hz	
Individual outputs phase shift setup	0 ÷ 360 °	
Overload protection	Yes, indication of low load impedance connection – LED AOF	
Signal processing	16-bit D/A converter	
Connectors	2 × WAGO 734-102; spacing 3.5 mm; part of delivery	
Wire cross-section	0.08 ÷ 1.5 mm^2	
Digital Inputs		
Number	4 digital inputs	
Signaling voltage	12 V / 24 V	
Inputs configuration	Active (dry contact)	Passive (switching by external voltage, both polarities)
Level H	Close	11 ÷ 40 V
Level L	Open	0 ÷ 8 V
Input current	6.6 mA max.	2 ÷ 6.6 mA; 3.3 mA @ 12 V
Isolation voltage	1.5 kV DC for 1 minute	
Connectors	2 × WAGO 734-108; spacing 3.5 mm; part of delivery	
Wire cross-section	0.08 ÷ 1.5 mm^2	
Digital Outputs		
Number	4 digital outputs	
Isolation voltage	3750 Vrms for 1 minute	
Switch loadability	1.75 A @ 35 V AC; 2.5 A @ 50 V DC	
Resistance in close status	0.1 Ω max.	
Connectors	1 × WAGO 734-108; spacing 3.5 mm; part of delivery	
Wire cross-section	0.08 ÷ 1.5 mm^2	
Communication Interface		
Type	USB 2.0	
Connector	Mini USB B, 5 pins	
Isolation	4 kV for 1 minute	

EPG7 HP – Power Outputs Extension

Basic Features

- extension of generator EPG7 by power outputs,
- designed for testing the correct function of protection and measurements in the standard ranges (100 V, 1 or 5 A),
- communication between the generator and the power module, transmission of ranges, calibration and error messages,
- easy transport in case with wheels, the device can be removed and placed on a table,
- optional external battery pack, converter for powering from 12 / 24 V.

Technical Specification

Current outputs	3 × max. 20 A AC
Voltage outputs	3 × max. 300 V AC
Amplitude control	0 ÷ 100 % (signal from EPG7)
Frequency	40 ÷ 350 Hz (signal from EPG7)
Angle between phases	0 ÷ 360 ° (signal from EPG7)
Digital inputs	3 × optocoupler (from EPG7)
Digital outputs	3 × SSR (from EPG7)
Control and signaling	through EPG7
Communication	Connected with EPG7 through 1 × DI/DO
Powering	230 V AC, 50 Hz optional converter from 12 / 24 V optional battery pack
Dimensions	600 × 490 × 300 mm (case)
Weight	32 kg (with case)

EPG7 HP

EPG7 OC

General Description

The module EPG7 OC is output converter from current outputs to voltage outputs. As there are available on the market the low power current sensors with voltage outputs (for ex. 225 mV), the generator EPG7 can simulate these sensors on its current outputs via this converter.

The module EPG7 OC can be directly inserted into current outputs connector in handheld generator EPG7.

EPG7 OC

Technical Specification

Module	EPG7 OC-45/2.25/50
Current inputs	3 × 0 ÷ 45 mA AC
Voltage outputs	3 × 0 ÷ 2.25 V AC

ELF7 – Portable Earth Fault Locator

General Description

Definition of a specific earth fault location, based on values measured at suppling substations is still not fully satisfactory and reliable, so there is still necessary to perform visual inspections directly in the field. Portable device ELF7 was designed as a lightweight tool for the service teams to help them with searching of a problematic line segment.

The measurement is done directly under the overhead MV lines by a service technician – during evaluation process must be ELF7 in parallel orientation with the overhead lines, no matter in which direction. Locator can`t only automatically recognize an earth fault occurrence, but also can determine its relative position. So, the result of this process is a clear information, if the earth fault is behind or in front of a measurement point relatively to the supplying substation.

Basic Features

- fast and reliable determination of an earth fault location on compensated, isolated and low impedance earthed MV networks,
- contactless method based on electric and magnetic field measurement principle,
- simple and accurate definition of examined fault location – behind or in front of a measurement point relatively to the supplying substation,
- possibility of device configuration and fault records downloading via USB connector,
- acoustic and optical signalization, lightweight and durable case,
- rechargeable accumulator with status signalization (USB charging).

Example of Use – a Line Segment with Branches

The numbers below represent the measurement order, each colors represent the result of each measurement – so as a LED color on ELF7. Service technician performs the measurement on each branch – when the branch is affected by the earth fault, the LED is shining red.
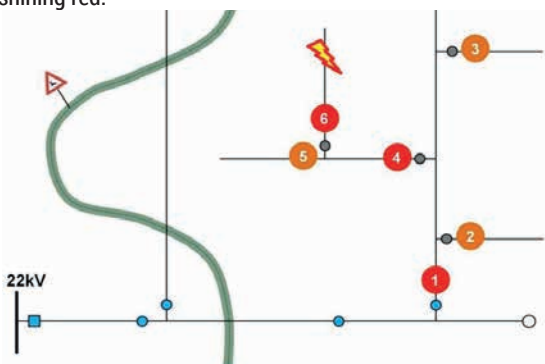
Main Benefits

- significant reduction of time required to find a specific fault location,
- shortening of power outages,
- reduced number of necessary manipulations in the network,
- limitation of fire risk and other destructions caused by high current at the earth fault location,
- positive impact on SAIDI and SAIFI indicators.

Example of Use – a Long Line Segment

The numbers below represent the measurement order, each colors represent the result of each measurement – so as a LED color on ELF7. Service technician performs the measurement on places with easy access – for example directly from the road.
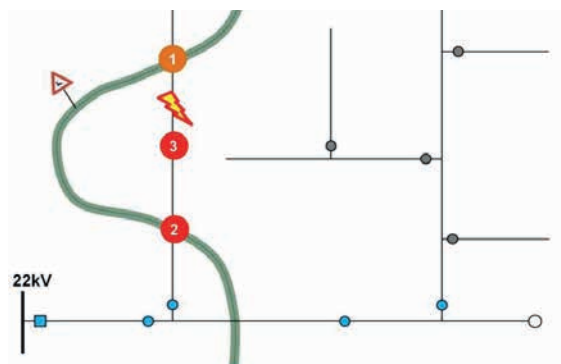
EFA7 – Personal Detector of Proximity to Dangerous Voltage

General Description

The purpose of the EFA7 hand-held electric field detector is to signal the proximity of a dangerous medium voltage (typically from 6 to 110 kV), 50 Hz (optionally 60 Hz) in a timely and clear manner, which will prevent electric shocks due to unwanted safety distances. The detector measures the level of the basic harmonic intensity of the alternating electric field and, when the set level is exceeded, immediately warns the worker with a strong signal of the occurrence of a dangerous situation, so that he can react in time.

EFA7-A – allows the use of different lengths of wrist straps to be worn under or over work clothes

Basic Features

- signaling of dangerous approach to a place where high voltage occurs,
- housing with IP67 protection,
- wrist attachment,
- suitable for outdoor and indoor electrical wiring,
- an additional level of protection to prevent electric shocks,
- light, sound and vibration signaling,
- configurable levels of electric field detection according to the used voltage levels of distribution networks,
- detector settings and FW update via Bluetooth,
- support application for mobile devices – Android OS,
- active mode is automatically switched on by user's movement – detected by accelerometer,
- automatic shutdown after 1 hour of inactivity,
- battery life approx. 40 hours of active mode,
- wireless charging according to the Qi standard,
- the charging base is an optional accessory and is powered via the USB interface,
- battery status indication,
- optionally other color versions, e.g., for distinguishing of voltage levels,
- operating temperatures -20 to +60 ° C,
- charging temperatures 0 to +45 ° C,
- relative humidity 20 to 90% without condensation,
- weight 65 g (without packaging).

EFA7 – standard wrist strap version

Reasons for the Product Purchasing

- a failure of standard security measures can never be completely prevented,
- if the device is used correctly, this measure does not depend on human factors,
- this is the last warning in case of failure of other measures.

Testing Devices

SW Support

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RTU Communication Set

Brief Characteristics

- parametrization of RTUs and similar devices (redundant power supplies RPS II),
- archiving of parameters in database or XML files,
- diagnostics of units and connected technologies,
- continuous indication of momentary status of units,
- recording of communication with units to file,
- control of units outputs,
- communication link between units and control and visualization system,
- recording of communication with control and visualization system to file,
- support of standards DDE and OPC,
- support of communication protocols IEC 60870-5-101 and IEC 60870-5-104,
- various system topologies,
- optional redundant use in hot backup mode.

Basic Description

The RTU Communication set is a set of programs which enable the complete and comfortable operation of RTU units and similar equipment. By using these programs, it is possible to use the mentioned equipment to its full potential. The communication set consists of the following basic programs:

- RTU Communicator,
- RTU User center.

The RTU communicator ensures communication with the operated equipment or with the SCADA system and RTU. The User center provides the user of the Communication set with a comfortable graphic user interface. The Communication set requires/uses the Microsoft SQL database server.

Communication scheme
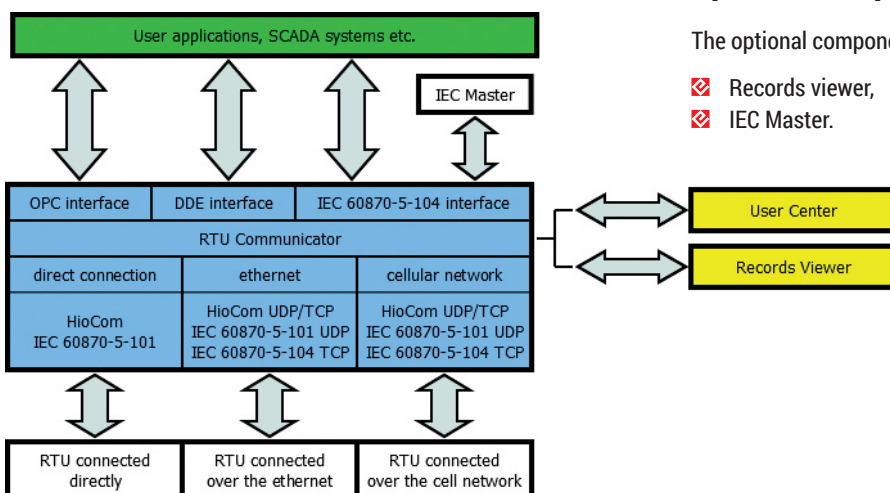
Topology of Communication Set

The Communication set programs (including the SQL server) can be installed on one computer or each on separate computer or they can be arbitrarily combined on their host computers. It is also possible to use a multi-user installation where the Communicator and the SQL server are located on one or two central computers and the User center is installed on several client computers.

Redundancy

The RTU Communicator can be doubled and used with the redundant connection of such a pair. In this mode, the connection and communication with RTU units is maintained by one of the Communicators from the pair and the second fulfills the role of hot backup. In the case of the breakdown of the first communicator, the second communicator automatically takes over the communication. Depending on the MS SQL server used, the backup Communicator provides services for the User center.

If one MS SQL server in the Express edition is installed with each Communicator (standard Communication set), then in the case of the failure of the main Communicator, the backup Communicator only takes over communication functions, so it maintains the communication between the SCADA system and the units. It is not possible to connect to the backup Communicator through the User center.

However, if the user provides MS SQL server with guaranteed availability or selects the set with MS SQL server standard edition, the backup Communicator takes over all functions in the case of failure of the main Communicator, including the possibility of work in the User center.

Optional Components

The optional component of the Communication set can be:

- Records viewer,
- IEC Master.

The Records viewer is a suitable accessory of basic programs if the function for recording of fault waveforms is used in the RTUs. The IEC Master serves for the diagnosis – during the verification of communication with the units or by RTU Communicator, it simulates the master SCADA system.

ELVAC a.s.

RTU Communicator

Brief Characteristics

- ✅ communication gate or concentrator between the control and visualization system and the RTUs,
- ✅ communication with RTUs through the TCP/IP network by TCP and UDP communication protocols,
- ✅ communication with RTUs through the RS485 network and RS232 line,
- ✅ standards DDE and OPC,
- ✅ communication protocols IEC 60870-5-101, IEC 60870-5-104, IEC 61850 (optionally),
- ✅ operation on the background as OS service,
- ✅ configuration in the database and/or in XML file,
- ✅ storage of records from RTUs into files,
- ✅ recording of values into daily files,
- ✅ recording of communication with units into the file,
- ✅ recording of communication with control and visualization system into the file,
- ✅ recording of fault and operating messages into the file,
- ✅ option of redundant application in hot backup mode.

Basic Description

The RTU Communicator is a server for communication with remote terminal devices which use the communication protocol HioCom2 (RTUs, RPS II), communication protocol IEC 60870-5-101 or IEC 60870-5-104 (IEC 61850 optionally). It collects a data from the connected terminal devices and enables the control of these devices. Over the HioCom2 it is possible to change the configuration of connected devices and download fault records. It runs in the background of the operating system as its service. The actual status of the signals and measurements (only for these transmitted via protocols IEC 60870-5-101/104) can be browsed on the service web interface. The communicator itself does not have a user interface; it is implemented by the RTU User center. This pair of applications must be completed by the database server Microsoft SQL.

Communication on the Line

The RTU Communicator, in addition to the standard implementation of the IEC 60870-5-101 protocol, has implemented a special optimizing algorithm for communication on the line. The line communication is optimized for the radio network with high latency where commands from the control station must be sent preferably before less critical data. During the command, the stated communication channel is reserved only for the control which ensures the shortest possible time for the execution of the command and gathering back information about the execution.

For communication on the line, it is not necessary to implement any additional configuration. The Communicator itself detects a way of communication with slave devices on the basis of the presence of one or more devices under one communication interface.

External Data Interfaces

The communicator can provide a collected data to other applications through its external data interfaces. The applications can also control terminal devices by means of these interfaces. The Communicator has three interfaces:

- ✅ DDE – interface uses DDE technology,
- ✅ OPC – the interface uses OPC technology. The interface is implemented through the DLL library which operates without the license only for the first 30 minutes after start of the Communicator. For full operation, the Communicator with OPC license must be purchased,
- ✅ IEC-104 – operates according to the standard IEC 60870-5-104, in the role of TCP server.

Implementation of the RTU Communicator

The most common implementation of the RTU Communicator is use as a part of the Communication set delivered to the RTUs (including the SQL server in the Express edition). In this implementation, the Communicator is used as a parametrizing tool, so external data interfaces are not used. The configuration of the parameterized units is stored in the database or in an XML file. No extended license is provided for the Communicator, at the stated moment it is possible to communicate only with one RTU. All Communication set programs are installed on one computer and the Communication set is a single user.

A further type of implementation is the independent concentrator or communication gate. The Communicator is used this way if there is demanded a mediator between RTUs and SCADA. It is presumed that the number of terminal units is static. Then it is possible to apply the Communicator independently without the User center and without the MS SQL server, to set it for using an XML file as a storage area for configurations of RTUs and to exploit some of its external interface. In this case, it is necessary to purchase the Communicator with the expanded license for the appropriate number of terminal units. To achieve the redundancy, the Communicator can be doubled.

If the mediator is required between the SCADA system and the RTUs but it is presumed that during the operation the system will be expanded or decreased or that the configuration of the units will be changed during the operation, it is recommended to apply the whole Communication set in the role of the concentrator or the communication gate. The Communicator is then installed on the central server and is set so that the storage of the configuration only uses the database. The SQL server is installed either on the same computer as the Communicator or on another central server. The User centers are installed on client computers. Such an implemented Communication set is multi-user and it is necessary to purchase the Communication set with the expanded license for the appropriate number of terminal units and for the appropriate number of the User centers installations. By doubling the Communicator, eventually also the MS SQL server, it is possible to achieve a redundant character of the operation in the hot backup mode (the detailed description is in the chapter about the RTU Communication set).

RTU User Center

Brief Characteristics

- user interface for configuration of RTUs,
- data organization in tree structure,
- filtered displaying of tree structure,
- bulk operations,
- easy user scripts,
- multi-user mode, access control,
- possibility of connection of hundreds of units,
- storage of tree structure into XML file,
- data storage in SQL server,
- support of Drag&Drop operations,
- integrated function blocks editor,
- management of users and access to RTUs
- support of Windows authentication,
- Import/export of IEC 61850 SCL files.

Basic Description

The RTU User center is a user add-on of the RTU Communicator and enables the complete and comfortable service of ELVAC RTUs and similar devices. It does not communicate with RTUs directly, but through the RTU Communicator. Both applications use the SQL database as a storage area of the whole data structure. All three programs are an integral part of the whole package with the name RTU Communication set and they communicate between each other through the Ethernet network.

The User center is designed so that it can run in the system in several installations, it means in multi-user work. Each User center in the system can only display an image of the status of the system (measurements and signals) – the off-line mode, or can display live data as it changes in real time – the on-line mode. The number of User center running at the stated moment in the on-line mode is restricted by the provided license. The license provided free of charge to any purchased ELVAC RTU enables only one on-line User center.

However, it is always valid that one RTU can be configured at the same time only by one user, the other users only have access for reading.

All data concerning RTUs is arranged into the tree structure. At the lower layer are the communication channels used by RTUs for communication (RS-232, UDP / HioCom, TCP client / IEC 60870-5-104, etc.), then there are its own units or the slave units and then there are channels or sub-channels. Each node of this tree structure contains a set of parameters which describes its properties and also a set of the actual data which, after the connection to the unit, displays the status of the node. The display of this information can be configured according to the demands of the user. The optional display also includes the option of filtering and help for individual parameters.

The selected operations can be executed together for more terminal units or measuring, signaling or control channels. Some mass operations are directly integrated into the user interface, some must be implemented through simple user scripts.

The main goal of the application is the parameterization of units which represents setting the correct values of all parameters and then the transfer of these parameters through parametrizing files into the RTU. Everything is fully simplified. There is Help for parameter settings, displaying of data types, ranges of values and units, option for the mass change of parameters for more nodes and some functions for finding potential conflicts in the setting.

The process of transferring/writing parameters to the unit requires only the selection of this function and then there is a whole series of actions which remain hidden from the user although the results are logged into the information window.

Records Viewer

Brief Characteristics

- viewer of records from ELVAC RTUs,
- easy analysis of failures (short circuits, overcurrents, earth faults),
- analysis of the behavior of protections and signaling,
- automatic detection of the type of record (according to the type of unit),
- display of waveforms with the instantaneous voltage and current value,
- display of waveforms with effective voltage and current values,
- calculation and display of waveforms of instantaneous and effective values I_0, U_0,
- calculation and display of waveforms of instantaneous and effective values of harmonic I_0, U_0,
- display of phase diagrams,
- calculation and display of the time waveform of angle φ_0,
- change of the scale on the timeline, timestamps (real time),
- export of records (formats CSV and COMTRADE),
- demo mode for testing.

Basic Description

The Records viewer displays the time waveforms of the measured values, calculated values and flags of protections, indicators of fail currents and the automatics generated by the ELVAC RTU series.

This enables a fast analysis of failure states, such earth fault, short circuits and overcurrents. This SW can be used with an advantage during the verification of the correct function of the newly installed devices, e.g. for checking the phase sequence.

The main window of the application is divided into three parts:

- the first and second panel contain the waveforms of three-phase measurements of the voltages or currents (combination of 3V+3I, 6V, 6I according to the RTU configuration),
- in the third panel are timelines for individual protection flags, the reasons for running the records.

In the first two panels is possible to display the waveforms of instantaneous values of three-phase measurements of the voltages or currents. The values can also be displayed in the form of phasor diagrams.

In addition, it is possible to switch display into the mode with timeline of the effective values of three-phase measurements. Instantaneous and effective values I_0 and U_0 and the first harmonic I_0 and U_0 are calculated. There can also be displayed timeline of the angle φ_0, which is also calculated.

The displaying of individual waveforms can be enabled or disabled using the check boxes next to both panels. In this area, all the values are displayed depending on the position of the cursor in the graphs.

Third panel shows the protection flags, flags for signaling of the protection activation, status of the power element etc. It is possible to detect the reason of running the record and the protection activation. The meaning of each flag is displayed using the tooltip.

In ELVAC RTU series, the waveforms are recorded typically 300 ms before the trigger event. The trigger event is displayed on all three panels. The records also include the timestamps (real time). On the timeline, it is possible to change the scale and it is possible to scroll fluently through the records.
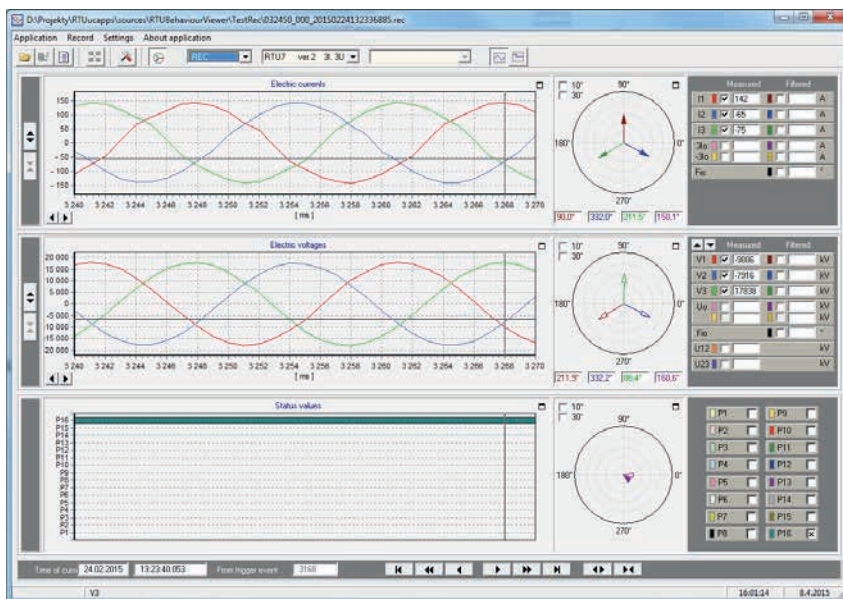
The Records viewer enables to export data in several formats for use in further applications – with respect to the option of analysis of the records from ELVAC RTUs in third parties SW, where the COMTRADE format is especially important.

IEC Master

Brief Characteristics

- communicates through protocols IEC 60870-5-101 and IEC 60870-5-104,
- data transfer through serial line, TCP (client and server) and UDP,
- displaying of actual signal states and measurement values,
- generating of general query, time synchronization, commands,
- ongoing communication recording and storage,
- statistics displaying,
- easy configuration of application,
- possibility of storage and uploading of configuration,
- demo mode for testing.

Basic Description

The IEC Master primarily serves for testing and verifying the slave devices which communicate through IEC 60870-5-101 and IEC 60870-5-104 protocols. For the data transfer, it is possible to use serial line, TCP protocols (client and server) and UDP. In the configuration of the application, it is sufficient to set only several communication parameters and the application is ready for the use. The database of signals and measurements is created dynamically, it is not necessary to define it in advance. The application provides the states of the signals and the values of measurements (standardized values and decimal numbers), including quality attributes. It is possible to send a general query to the slave device, time synchronization, testing command, single-bit and double-bit command with or without the timestamp. For diagnostic purposes, the list of the ongoing communication is displayed. For automatic testing of the application, there is the interface for running of the test scripts.

Communication Log

The ongoing communication can be logged. The user can select the level of logging. At the first level, clean data is logged which is sent/comes into/from the selected communication interface. At the second level, transferred data is processed at the level of the connecting/transport layer (establishment and maintenance of the connection, …). The third level logs the application data (values of signals, measurements …). It is possible to save the communication log for further analysis at the request of the user, or automatically.

Testing Interface

The IEC Master automatically tests the inputs and outputs of the slave device. It is possible to define the scenario with the events (output control) and the responses to them (requested signal states). In addition, there is defined the time limit (the response must occur within the predefined time). The output of the test is the report which contains the list of changes occurred on the monitored device, including information of whether this change was or was not expected. After termination of the test, there is displayed the statistics of faulty (unexpected) signal states. The incoming measurement only evokes a warning.

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SCADA & DMS

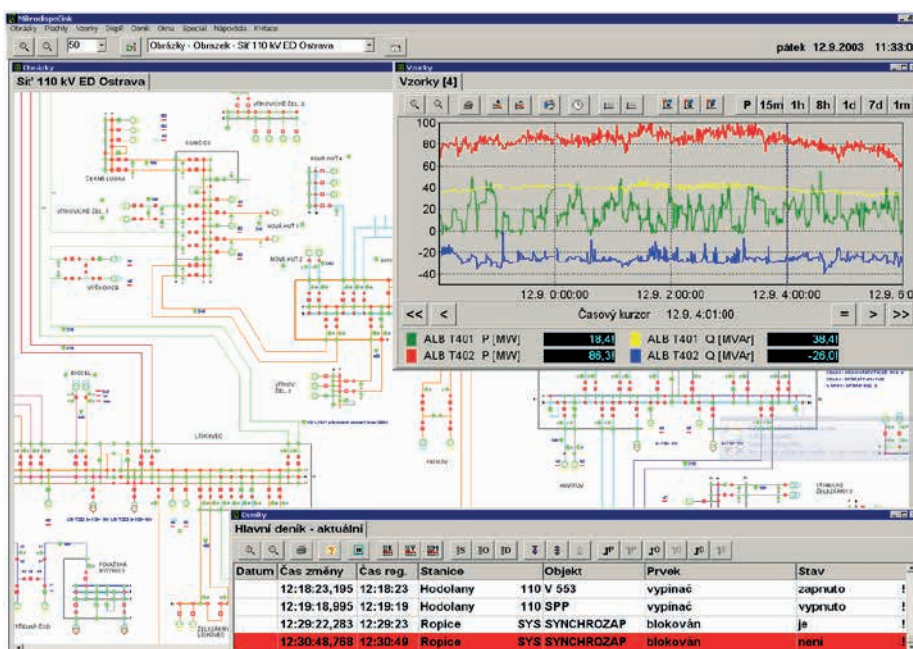# SCADA SW Mikrodispečink

General Description

Mikrodispečink is a specialized SCADA system for the monitoring, control and evaluation of processes in real time which is particularly recommended for the control of electrical grids with high, medium and low voltage, for applications in power stations and in control centers. The system provides schematic views of the controlled grid, actual and historical values display in table or charts form and event logs witch state changes and alarms.

The system in the control center may be designed with certain level of redundancy, so in the case of a breakdown of one or more elements, the access to functions and data is still ensured. Remote service and user access is possible, including access through the Intranet (Internet). System enables the operative change of the scope of the area controlled from each dispatcher workplace. The uniform central model of the whole controlled electricity network is important for ensuring the effective and safe system administration. In one control system, there is an actual telemetric, eventually manually inserted image of all controlled networks of high, medium and low voltage.

Various types of communications are supported, point to point and point to multipoint, including communication through mobile networks (according to available mobile network generation in the stated region). Mikrodispečink has the implemented support of communication TG 800 Master and Slave (point to point, transit, line emulation), IEC 870-5-xxx, MDXL including network version, MCS, CVM Modbus, DMS, DO100, SAIA S-Bus and others, with the RTU Communicator there is available also protocol IEC 61850.

Brief List of Features

- **Images** – diagrams of electric stations and networks with the actual states and values of measurement, with the option to place marks and comments.
- **Diary** – protocol with changes and alarm messages with wide options of display filters, acknowledgement of messages, insertion of comments.
- **DispP** – the module automatically evaluates the actual and planned values of loading, supports trade dispatching control in real time.
- **Sheets** – actual and archive summaries of measurements of hourly sections, maximal, minimal and mean values of loading.
- **Samples** – module for sampling and archiving of all changes of measured values, graphical representation of data.
- **Simulation of connection** – the user can set the required configuration (model) of the network with the consequent automatic recalculation of the topology and evaluation (colouring) of the network parts and consumers without voltage (for ex. during a downtime).
- **Colouring of diagrams** – according to various criteria it is possible to colour the diagrams of the electric stations and networks, e.g. according to sources, i.e. with the indication of the connection to the defined supply node, etc.
- **Web based access for Intranet/Internet clients** – ability to display most important information from the SCADA system to authorized users outside of SCADA network using web browser.
- **Cybersecurity features** – role based user access management using standard technologies, Syslog support.
- **Easy export of schemes** – for RTU based web HMI in substations – complete HW solutions for HMI systems in substations are included in our product portfolio.

Substation HMI Edition

Specific package of SCADA Mikrodispečink software designed to fit requirements for local control interface of primary substations. This system is capable to communicate directly with protection relays and other monitoring and control equipment, so it is independent of higher level control systems and their communication infrastructure.

ELVAC & ETAP

ELVAC acts as the system integrator of ETAP Real-TimeTM products family to cover growing demand for complex features of dispatch control systems. ETAP software may be used as a high level extension of existing SCADA MicroDispečink systems or as main platform of whole control center. Wide range of available ETAP SW modules and its model driven architecture allow to build suitable solutions for almost all applications in power engineering sector – from single small substation level to large enterprises, from energy production through transmission to distribution level.

ETAP software offers a wide range of tools that cover both off-line and on-line functions to analyze events in power grids and their parts. These functions may be simply linked to ETAP Real-TimeTM SCADA solution, DMS (Distribution Management System), EMS (Energy Management System), OMS (Outage Management System) etc., what significantly reduces the cost of deploying, maintaining, and extending of system while minimizing the risk of data inconsistency which may happen with stand-alone databases for each function module.

ETAP SW (analysis, SCADA, DMS, EMS, OMS)

ETAP is a suite of fully integrated electrical engineering software that provides engineers, operators, and managers a platform for continuous functionality from modeling to operation.
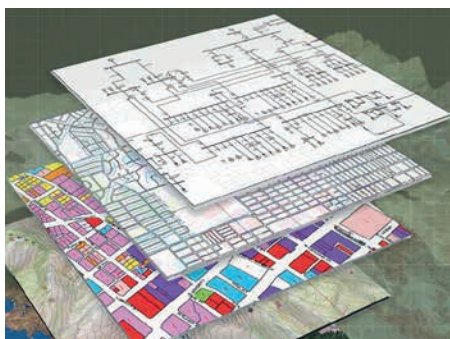
Modeling & Visualization

A one-stop solution with intelligent interface views and core capabilities to create, configure, customize, and manage your electrical power system model. Core modeling tools allow you to quickly and easily build 3-phase and 1-phase AC and DC network one-line diagrams and GIS views with unlimited buses and elements including detailed instrumentation and grounding components.

- one-line diagram,
- geographic information systems,
- feeder & substation views,
- functional & logic view – UDM,
- U/G raceways & ground grid views,
- schematic & control diagrams,
- multi-dimensional database,
- web clients & mobile views.
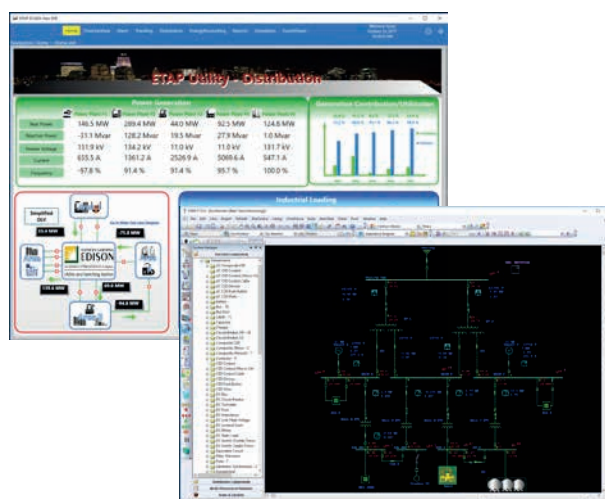
Analysis & Optimization

A powerful set of analysis and optimization software products that allow for simulation, prediction, design and planning of system behavior, utilizing an intelligent one-line diagram and the flexibility of a multi-dimensional database.

- network analysis,
- dynamic & transients,
- cable systems,
- power quality,
- renewable energy,
- unified AC / DC solutions,
- systems optimization,
- multi-study analyzers.

Protection & Coordination

Fully integrated Protective Device Coordination software for steady-state and dynamic device coordination, protection, and testing. ETAP provides intelligent tools and powerful capabilities to analyze system protection and troubleshoot false trips, relay and breaker mis-operation, mis-coordination, and more.

- protective device coordination – Star™,
- auto protection & coordination evaluation,
- distance relay coordination – StarZ™,
- sequence-of-operation,
- selectivity zone detection,
- protective device library.

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Electrical Safety & Grounding

Comprehensive and integrated solution to help evaluate, analyze, and assess the safety and grounding of AC and DC electrical systems. Generate Arc Flash labels, create a switching sequence management plan, or evaluate the most efficient configuration for ground grid systems.

- arc flash analysis,
- switching management,
- ground grid systems,
- electric shock protection,
- protective earthing conductor sizing,
- system grounding & earthing.
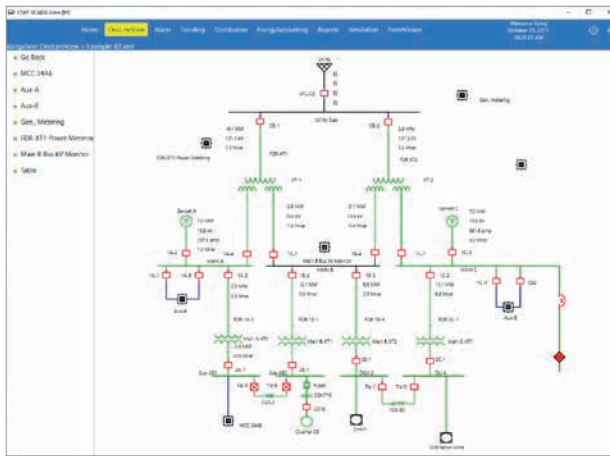
Data Exchange & Conversion

ETAP offers conversion tools from legacy power system analysis software. In addition, ETAP offers data import/export capabilities to other third-party platforms and provides bi-directional data Exchange interfaces to complimentary products.

ETAP Real-TimeTM
As a fully integrated enterprise solution, ETAP extends to a Real-Time Intelligent Power Management System to monitor, control, automate, simulate, and optimize the operation of power systems.

SCADA & Monitoring – eSCADA
Model-driven monitoring provides an intuitive real-time visualization and analyses platform via intelligent graphical user interface, one-line diagram, geospatial view, and digital dashboards.

Power Management System – PMS
PMS includes powerful analytical tool that allows for detection of system behavior in response to operator actions and events via the use of real-time and archived data.

Generation Management System – GMS
GMS provides system balance and optimization changes to meet network security, economic, operational, regulation, and environmental requirements. Monitor, control, and optimize the performance of generation and transmission systems.

Transmission Energy Management System – EMS
Reduce energy consumption, increase electrical system reliability, improve equipment utilization, and predict system performance, as well as optimize energy usage.

Distribution Management System – DMS / ADMS
ETAP ADMS provides the necessary mission critical applications to efficiently, reliably and securely manage, control, visualize, and optimize distribution networks.

Microgrid Master Controller – MMC
MMC allows for design, modeling, detailed analysis, islanding detection, optimization and automated control of Microgrids used for offices, retail parks, industrial facilities, data centers, campuses, offshore facilities, ships, etc.

Intelligent Load Shedding – ILS™
ILS is a model-driven load preservation system offering proactive and optimal load shedding that can dynamically manage the stability of the system by responding faster to disturbances.

**Intelligent Substation Automation – iSub™**
iSub provides protection, control, automation, monitoring, and communication capabilities as a part of a comprehensive substation solution.

# ELVAC RTU Based HMI Solution with Historical Data Logging and Analysis

For specific small-size and simple applications may use of complex SCADA SW become useless luxury, when costs of licenses, training of staff and system config may cause unacceptable price increase. Since ELVAC RTUs offer wide range of communication capabilities, data processing and control features, integrated web HMI and SQL database storage support, it allows to create simple, cheap and easy to config set, which might change the approach to

SCADA implementation for some applications. It is very efficient to use this approach for energy monitoring and control applications (simple EMS) when utilizing also ELVAC RTU autonomous control capabilities. Renewable energy sources, charging stations or substation monitoring and control may be some of the right tasks for this platform.
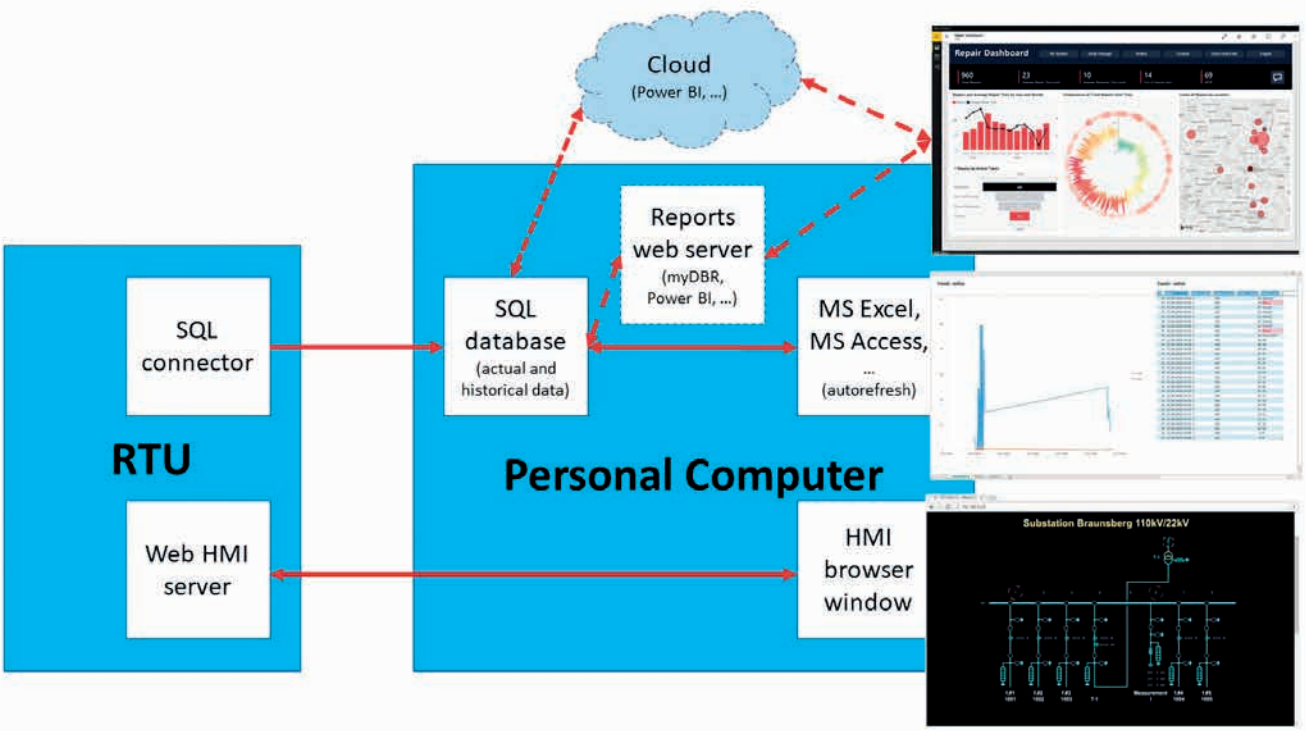
What is needed:

- ELVAC RTU with COMIO-PC3 level communication card (also used in RTU7MC3) as a data concentrator with internal web HMI server and SQL storage driver.
- Any reliable PC with OS (MS Win), web browser, MS SQL Express and web server installed.
- SQL reporting tool installed on data storage / operator PC or cloud, display charts and tables:
  - Simple trends and event display using general software – basic office applications like MS Excel, MS Access or others supporting MS SQL database connection.
  - Specific applications focused to data collection, display and analysis like BO!MES (www.bomes.cz).
  - Reports web server – server app enabling creation of custom reports like myDBR (https://mydbr.com), Power BI Report Server (https://powerbi.microsoft.com/en-us/report-server) or others.
  - Cloud solution – cloud-based reporting and analytics, enabling data collection from a number of locations around the world like Power BI in the cloud (https://powerbi.microsoft.com/en-us/enterprise) or other similar solutions.
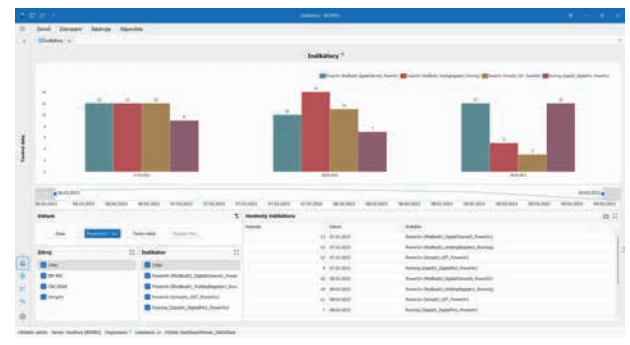
The solution described here should provide almost all functionalities as a SCADA software, but without SCADA SW licenses. Setting up web HMI is an easy task (just some additional work after RTUs parametrization), creating reports takes some time, but it still should be less work time compare to SCADA SW installation and configuration for a smaller application. All „data and reporting" related tasks can be performed by general IT staff and maintained as a part of existing IT solutions in the company.

RTU / IED ▪ HMI ▪ SCADA ▪ FAULT INDICATION ▪ PROTECTION RELAYS
REMOTE MONITORING, CONTROL, MEASUREMENT AND DATA ACQUISITION