



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

Usual application names:

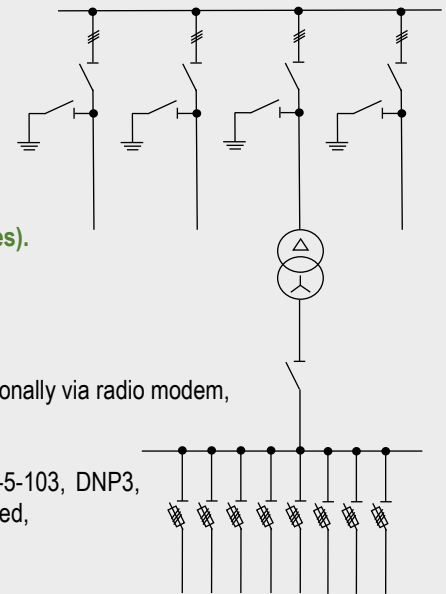
- Ring Main Unit (RMU) Monitoring and Control
- Intelligent Electronic Device (IED) or Remote Terminal Unit (RTU) for Monitoring, Measurement, Fault Indication, Protection and Control

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 demands:

- 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:
 - o to SCADA – IEC 60870-5-104, DNP3, IEC 61850,
 - o 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,
 - o 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 RTU cabinet is possible, including power supply, battery backup,
- system clarity during maintenance and service,
- common system in cable networks, when automation is added to existing 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,
- money saving solution, if no other external cabinet is not 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.

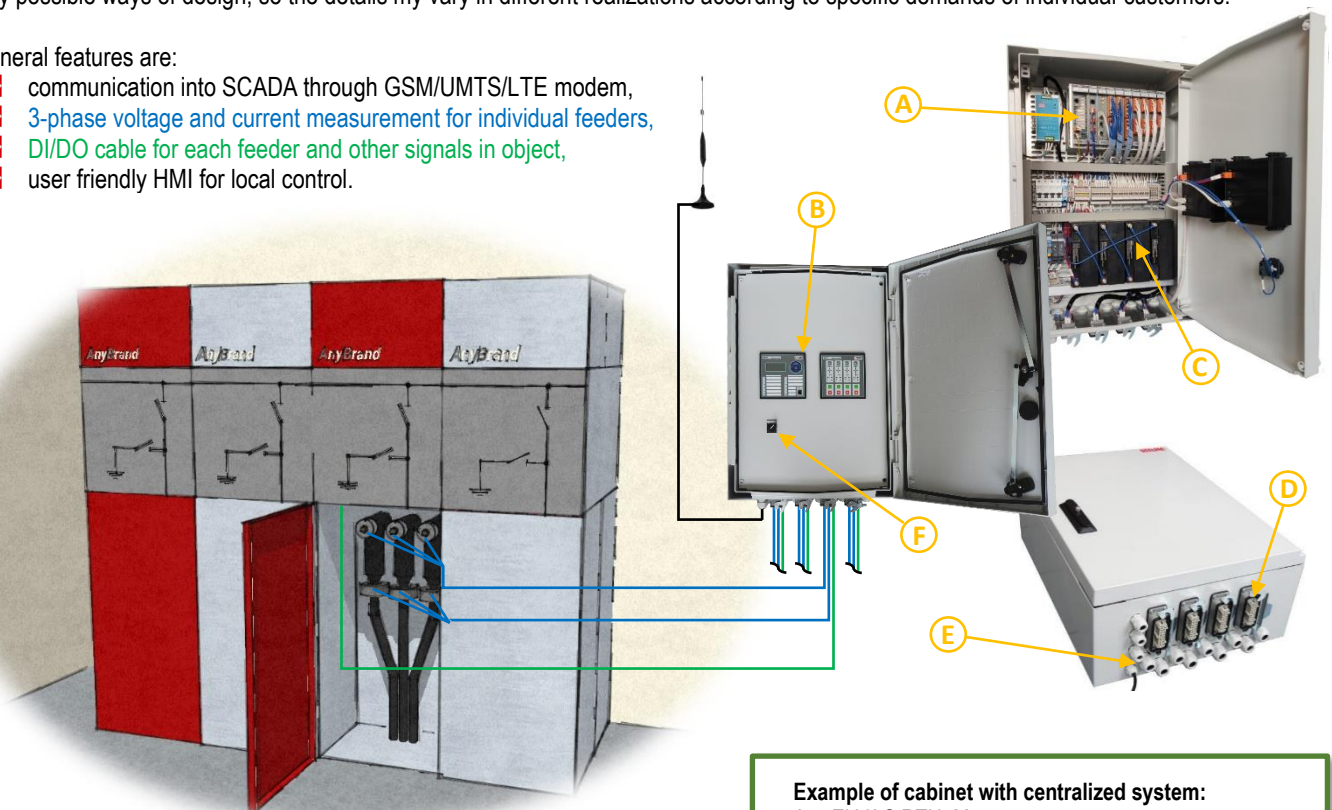


A. ELVAC RTU centralized system

The following example describes a realization of centralized system according to the typical current customer demands. Certainly, it is one of many possible ways of design, so the details may 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:

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. This is in accord with the space needed by 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 main door or on second internal door.
2. **Chassis** – there are usually used chassis with 8 or 10 slots in busbar. 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 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 secondary (LV) side of transformer via separate AC/DC power supply, which provides the input voltage for power supply card and battery charger card in RTU. Smaller systems (up to 8 slots without need of any other devices and drives powering) can be powered directly from transformer via 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 RTU and alarms can be sent to maintenance team. Optionally there can be used external battery charger systems in secondary substations. Then ELVAC RTU monitors the signals from those systems.
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 mentioned above and it has enough power for all tasks, like secured communication with SCADA and maintenance system, 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 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 card have optically isolated inputs, the signal polarity can be bidirectional. Signaling voltage is usually the same as RTU power supply voltage, so Wet contact are more commonly used in substation applications. 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** – the card DO10-U have relay outputs 24 V DC / 8 A (250 V AC / 8 A). There are 8 x NO contacts and 2 x changeover contacts. When other DC voltage is used for relay outputs, then the current load shall be considered according to loading curve visible in user manual for RTU7M. If DO card relay load limit is not sufficient, there can be used external contactors/relays with higher load.
8. **Feeder measurement** – the cards from 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 they can be used also as protection relays on MV feeders. They support data sharing (for example the voltage can be measured only in one place and then distributed to individual current measurements for power calculation, which significantly saves the investments into measuring sensors). 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. All measuring groups are isolated from each other and from system. There are available also cards from RTU7M AI series for power quality monitoring and measuring from transducers or other type of sensors.
9. **Transformer secondary side monitoring (LV)** – there is possible optionally to monitor the low voltage side via measuring card from EP series or via power quality measuring card. There can be detected also 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 the comparison of signals in front and behind 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, 18001, 27001



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 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 installations, where no other devices were previously installed or only some specific tasks were solved (for example power meters, fault indicators or power quality meters, which 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 battery backup card,

Slot 2 – battery backup card for 24V (optionally 48V) battery pack, powered from external power supply 230V AC / 24 (opt. 48) V DC, 240 W,

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

- high performance for communication with SCADA and whole substation data concentration,
- GSM/UMTS/LTE modem for communication with SCADA,
- Ethernet LAN port for local parameterization and interconnection with local HMI,
- 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),

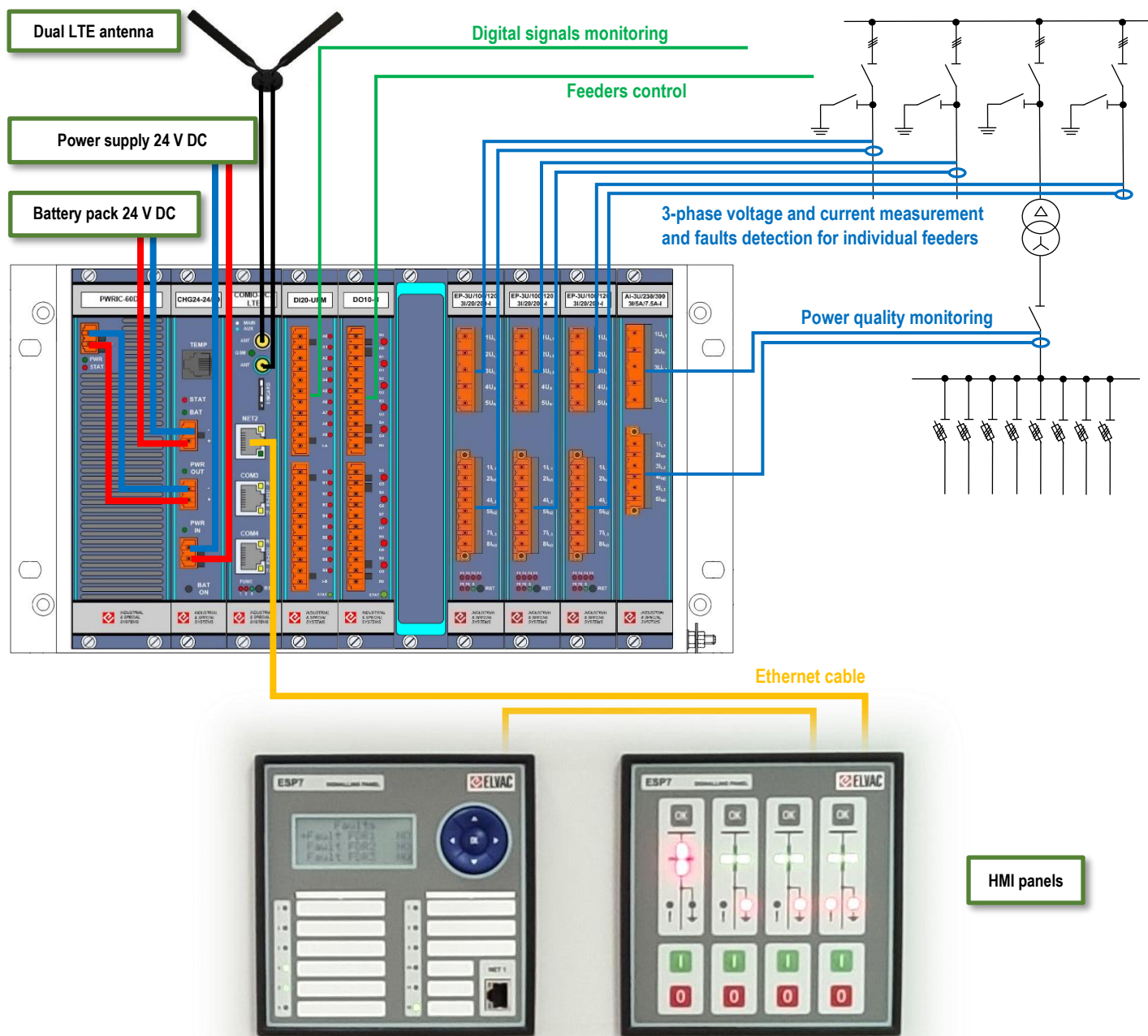
Slot 5 – digital output card DO10-U for feeders control,

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 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).



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 a backup communication. RTU can optionally monitor the secondary side of transformer. Measured data from MV feeders are taken from protection relays, digital signals go partly through protection relays and partly directly to RTU system. In this configuration, protection relays, switch drives and RTU system are usually powered from separate power supply with battery backup. 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:

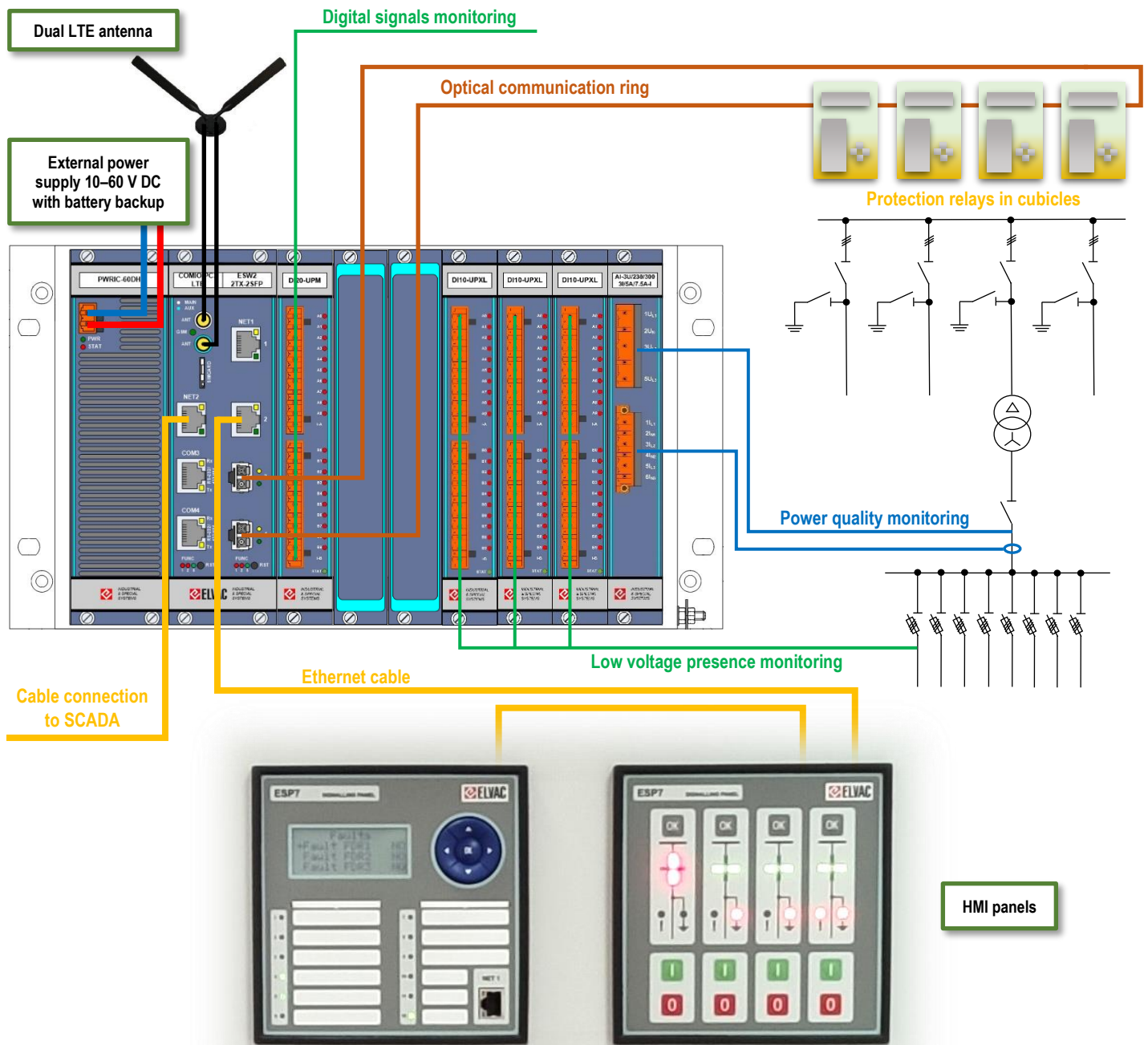
- high performance for communication with SCADA and whole substation data concentration,
- Ethernet LAN port (optionally optical converter) for communication with SCADA, GSM/UMTS/LTE modem for backup communication,
- optical Ethernet LAN ports in communication ring for measured and digital data collection from protection relays,
- 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,
- 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.

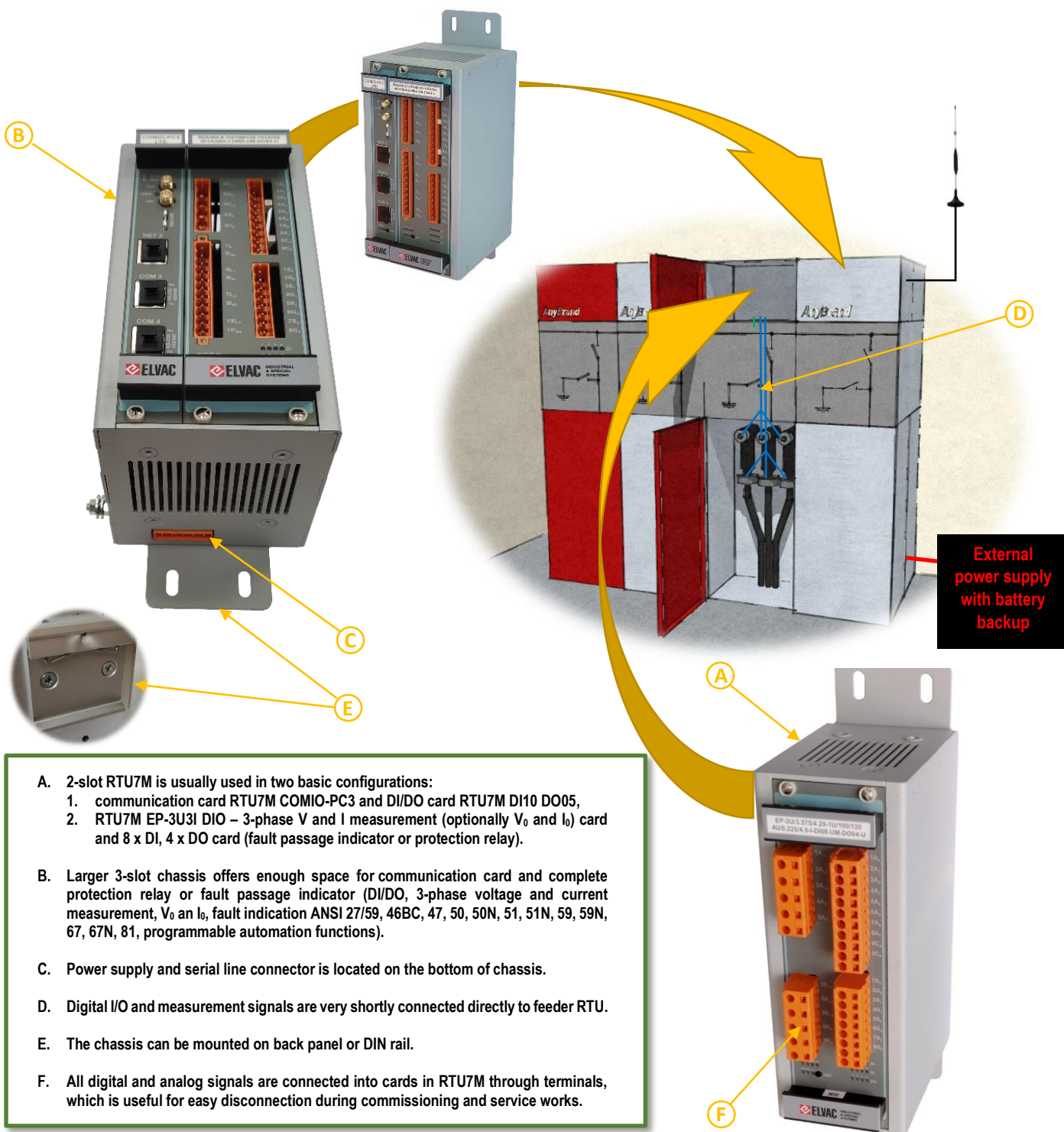


B. ELVAC RTU decentralized system

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

Power supply input for RTUs and serial line port for RTU interconnection are located at 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 external AC/DC power supply unit with battery backup, which is used also for powering of switch drives in cubicles and other devices in secondary substation. Standard power supply voltage is 24V 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 price efficient and it saves also the time and money during commissioning.



- 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 communication card and complete protection relay or fault passage indicator (DI/DO, 3-phase voltage and current measurement, V_0 and I_0 , fault indication ANSI 27/59, 46BC, 47, 50, 50N, 51, 51N, 59, 59N, 67, 67N, 81, programmable automation functions).
- C. 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 feeder RTU.
- E. The chassis can be mounted on back panel or DIN rail.
- F. All digital and analog signals are connected into cards in RTU7M through 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:

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

ELVAC RTU7M configurations for 1st–3rd feeder:

Slot 1, 2 – 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).

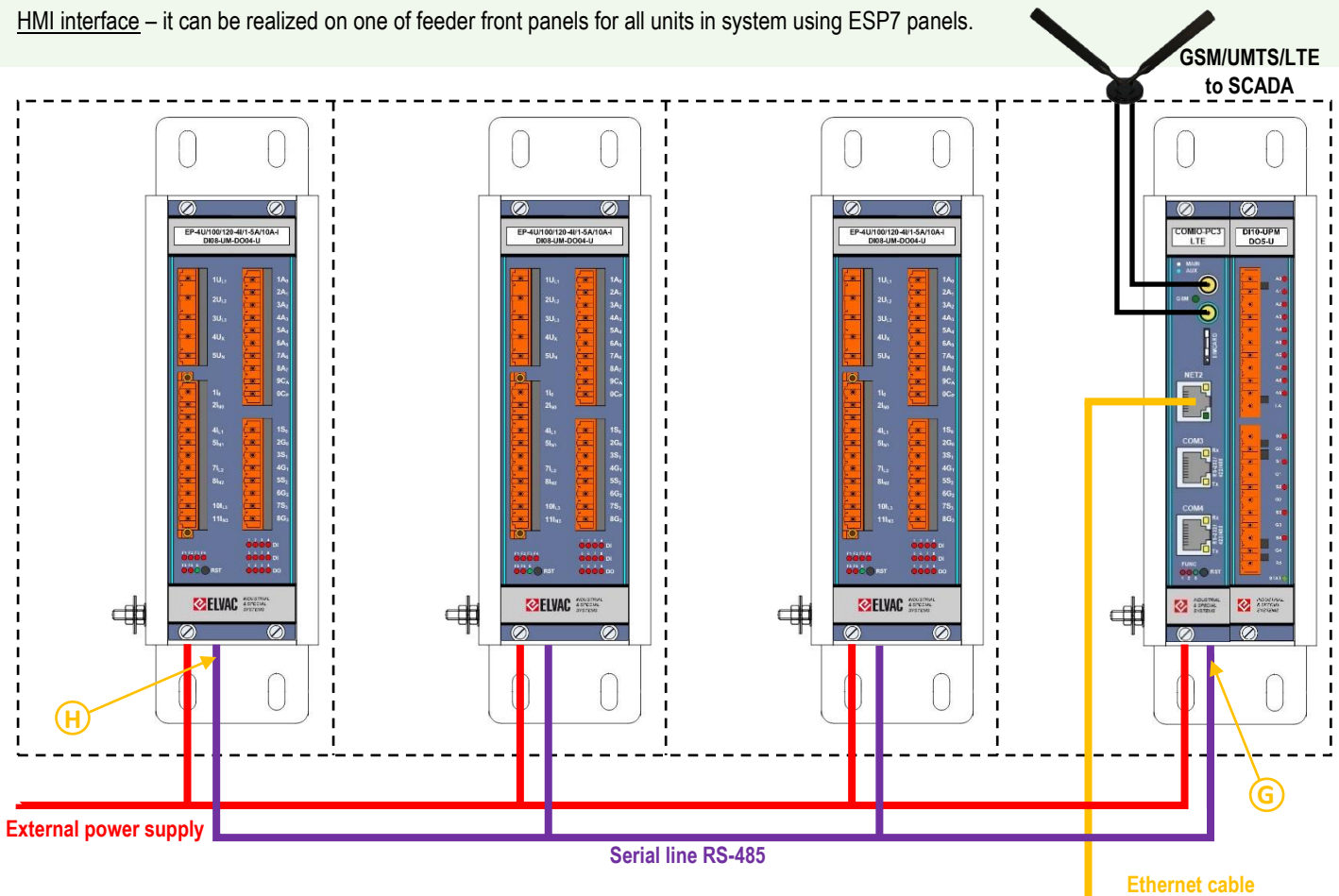
ELVAC RTU7M configurations for 4th feeder:

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

- high performance for communication with SCADA and whole substation data concentration,
- GSM/UMTS/LTE modem for communication with SCADA,
- Ethernet LAN port for local parameterization and interconnection with local HMI, or for communication with other devices,
- 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.



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.

G. Termination resistor is required in the beginning of line.

H. Termination, pull-high and pull-low resistors are required in the end of line.



Configuration example B.2

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

Basic system features are:

- 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 – 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 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 be optionally equipped with battery backup card, so it can work also as a main powering system for feeder RTUs.

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

- high performance for communication with SCADA and whole substation data concentration,
- GSM/UMTS/LTE modem for communication with SCADA,
- Ethernet LAN port for local parameterization and interconnection with local HMI, or for communication with other devices,
- 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 cabinet front door for all units in system using ESP7 panels.

