

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

- In-field power distribution overhead lines – pole mounted LBS.

Typical application demands

- 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 demanded 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. 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 in busbar.
- 3. Power supply and battery backup** – this part of system is designed in the following way:
 - a. Powering is done via inphase 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.



4. Communication with SCADA and maintenance systems – recently, the standard communication card for these small LBS systems was type RTU7M COMIO4 with GSM/GPRS modem. But as there is still more important the encrypted communication, so 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 secured communication with SCADA and maintenance system (see the picture ELVAC RTU communication abilities), which is demanded by IT standards of these days. There is possible to setup multiple communication channels into different SCADA or maintenance systems.

5. Digital inputs – they are necessary for monitoring of LBS 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.

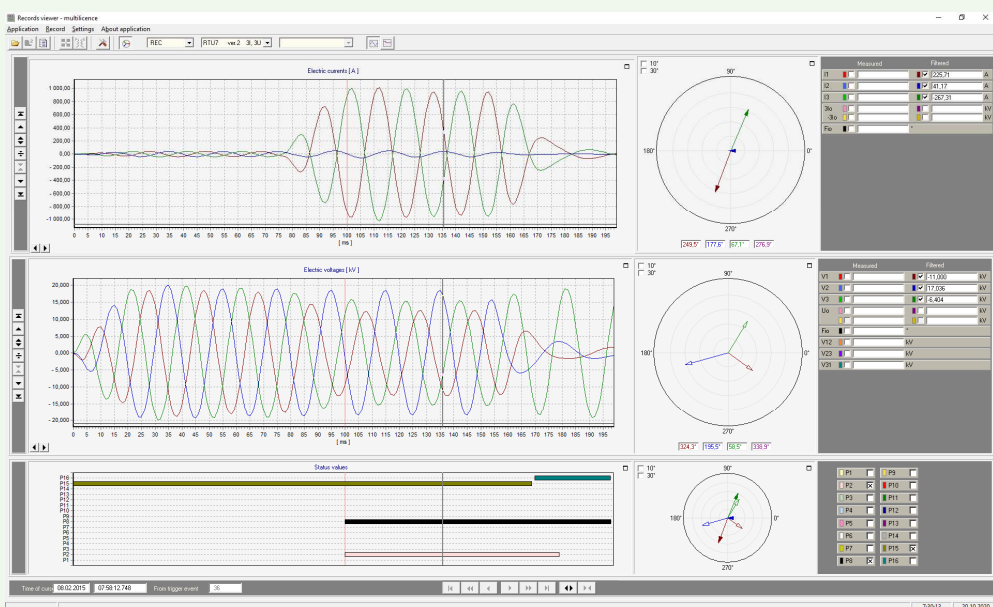
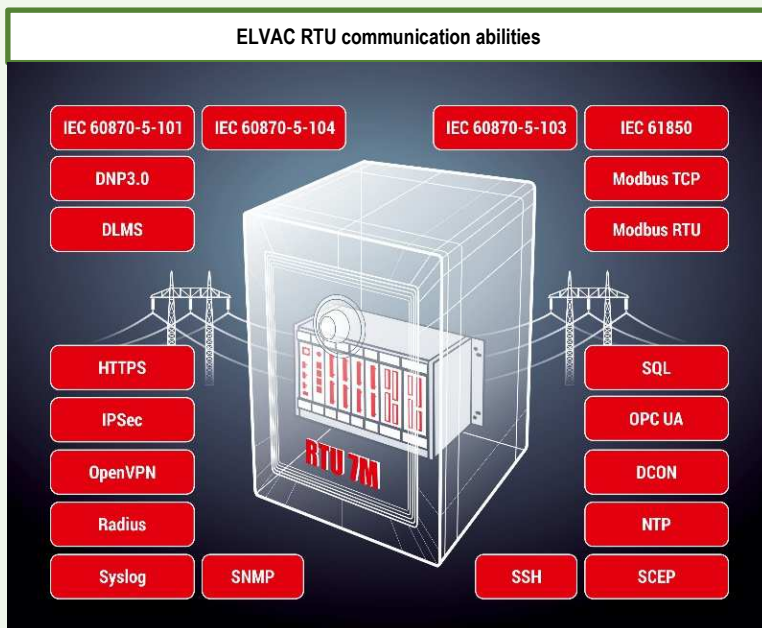
6. Digital outputs – they are used for local and remote control of switches in LBS. Another output is used for heating control, when the external temperature can be dangerous due to water condensation inside the cabinet or for better operating conditions for batteries.

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 feeders. 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 LBS.

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 LBS is mostly remotely controlled device and local HMI is not used regularly, customers usually use only simple type of HMI for local control, which includes 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 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.
- 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 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,
- 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 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 I_E/I_0 or as sensitive input for I_E/I_0) and 4th voltage input (it can be used for auxiliary voltage measurement, e.g. on source side of LBS).

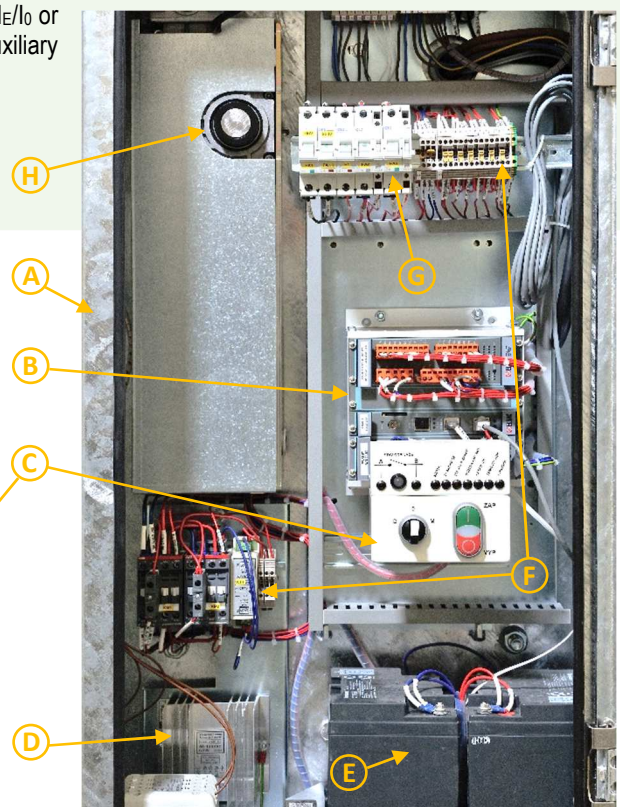
HMI interface – either RTU7M SIG-D-EXT05 or ESP7 panels

Note: All components specification can be found in our catalogue or in e-shop 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, 18001, 27001



Scheme description

- Console with isolators on the top of pole divides overhead power lines into isolated sections.
- 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.
- 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.
- 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.
- Whole solution is powered from interphase MV/LV transformer mounted on a console under overhead power lines and connected directly to the ELVAC RTU.
- There are recommended surge arresters on primary side of transformer.
- All functions are integrated into one RTU system with configuration described above.
- HMI panel enables 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.
- Battery pack is used for power supply backup of all system. It is fully monitored and charged from ELVAC RTU system.
- Thermal sensor is used for heating and optimal conditions control for batteries. It shall be located close to batteries.
- The heating in cabinet is controlled by ELVAC RTU as well.
- 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.

Scheme legend

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

