Končar Electronics and Informatics, Inc

Secondary equipment

TECHNICAL DESCRIPTION

KONPRO

RFC

Numerical protection relay

MULTIFUNCTION PROTECTION RELAYS FOR CAPACITATOR BANKS

Description

Thanks to our rich experience in development and application of protection relays, the research and development team of the company KONCAR – Electronics and informatics, Inc., has developed a series of devices, which answer all requests set for this sort of equipment. The protection relay type RFC is a part of KONPRO generation of protection relays, built for protection of capacitator banks. RFC offers the complete range of protection functions necessary for reliable protection of capacitator banks and ability of oversight and control of complete switchgear. Thanks to its circuit architecture and modular software support, it is suitable for protection of power grids with all types of grounding. Aside from its primary protective role, RFC enables several other options required from present-day protection relays, allowing reduction of devices needed in the field, which in turn reduces equipment maintenance costs. Key options include local and remote display of all current measured values, supervision of devices connected in the field, switchgear management, and fault record of electric values during the time of failure, circuit breaker wear monitoring and transfer of data to the SCADA system. Delayed operation time characteristics in accordance with IEC and IEEE standards allow simple integration of the relay into existing protection systems, while retaining time selectivity applied in the system. Three levels of protective functions parameters allow quick protection adaptation to changes in the system. High level of programmability using the integrated program matrix allows simple signal interconnection to binary inputs and relay outputs of the device.

Predefined switchgear schemes add to the simplicity of relay configuration with the possibility of adding new schemes if current ones do not comply with buyers' demands. Modular design of the circuits and software architecture of the relay allow implementation of additional protection functions along with implementation of basic protection functions, which are part of the common programming package of the device, in accordance with customer needs. Integrated software support allows change of most parameters of protection functions using the control panel. Complete parameterization and parameter read-out is achieved using a computer.

Protective functions

Quick adaptation of the relay with regards to facility conditions is enabled using three levels of settings. The change of settings group is possible using communication means or via binary input. All three groups have the following protection functions on disposal:

- Overcurrent protection
  (ANSI No. 50, 51)
- Directional overcurrent protection
  (ANSI No. 67-DT, 67-IT)
- Overvoltage protection
  (ANSI No. 59)
- Undervoltage protection
  (ANSI No. 27)
- Negative sequence overcurrent protection
  (ANSI No. 46-DT, 46-IT)
- Undercurrent protection
  (ANSI No. 37B)
- Capacitator bank reconnection inhibit function
  (RecInh)
- Unbalance current protection for capacitor bank
  (ANSI No. 51NC-1)
- Zero voltage unbalance protection for cap. bank
  (ANSI No. 59NC)
- Circuit breaker failure protection
  (ANSI No. 50BF)
- Trip circuit supervision
  (ANSI No. 74TCS)

Management/supervision functions

- Predefined binary inputs for switch state supervision (BI1 & BI2),
- Predefined relay outputs for switch energization (RO1 & RO4),
- Programmable binary inputs & relay outputs for switchgear control and signalization,
- Programmable binary inputs for signal acquisition,
- Programmable signalization output relays
- Management of relay outputs for switch energization, local and remote.

Measurement functions

- Voltage: I_{L1}, I_{L2}, I_{L3}, I_E,
- Current: U_{L1N}, U_{L2N}, U_{L3N}, U_E,
  U_{L1L2}, U_{L2L3}, U_{L3L1},
- Symmetric components: I_1, U_1 , I_2, U_2,
- Current P, Q, S, current factor cos φ,
- Energy W_{p+}, W_{p-}, W_{q+}, W_{q-}, $W_{s,}$
- Frequency.

Failure analysis functions

- Event registration:

  - Event recorder,
  - Trip recorder,
  - Overview on device display and using PC software support.

- Disturbance registration:

  - Disturbance recorder,
  - Overview using PC software support,
  - Tripping possibility using binary input.

Communications

- Local:
  - Front panel (foil keypad, LCD),
  - Front user interface COM1 (USB)

- Remote:
  Back optical interfaces:
  - COM 0 (system / service interface)
  - COM 2 (system / service interface)

- Supported communication protocol:
  - IEC 60870-5-103,
  - IEC 61850

Other functions

- Time synchronization
  IRIG B, front panel, software support,
- Continuous self-supervision,
- Testing capability using PC software support.

User interface

- Graphic LCD – 160x128 pixels,
- 2 predefined switchgear schemes,
- Possibility of adding new schemes,
- 8 predefined and 8 programmable LED's,
- Separate password protected parameter setting and switch management.

Measurement inputs

- Four current inputs – 1A, 5A (0.2A)**
- Four voltage inputs – 100V (200V)**.

Binary inputs and outputs

- 8 binary inputs
  (5 programmable, 52a, 52b, IRIG),
- 8 relay outputs
  (5 programmable, CB TRIP, CB CLOSE, IRF),
- Possible addition up to two BI/BO outputs type A, B or C,
- Type A – 8 binary inputs and 8 relay outputs,
- Type B – 16 binary inputs,
- Type C – 16 relay outputs.

Modular hardware and software architecture allows the optimization of relay function to the place of use (protecting).

(A detailed description of the differences can be seen from the ordering tags and tables with a list of functions)

*** on demand*

Device enclosure & connectivity

The device enclosure is specified for mounting plate installation, with foil keypad on front and connectivity clamps on the rear side.

- Size (dimensions):
(H x W x D = 296.5 x 176.8 x 222.9 mm).

The mounting plate opening dimensions are 268x174mm. Navigation keys on the front panel allow simple browsing of relay menus, while local parameters and measured value data readout is displayed on a graphic LCD and additional 16 LED diodes.

- The relays connect to the facility using connectivity clamps for lead reception with a cross section of 10 mm^2 (on measurement inputs), 4mm^2 (on relay outputs) and 2.5mm^2 (on binary inputs). The embedded analogue input unit allows reception of current and voltage signals with 1A, 5A & 0.2A** rated current for all device types.

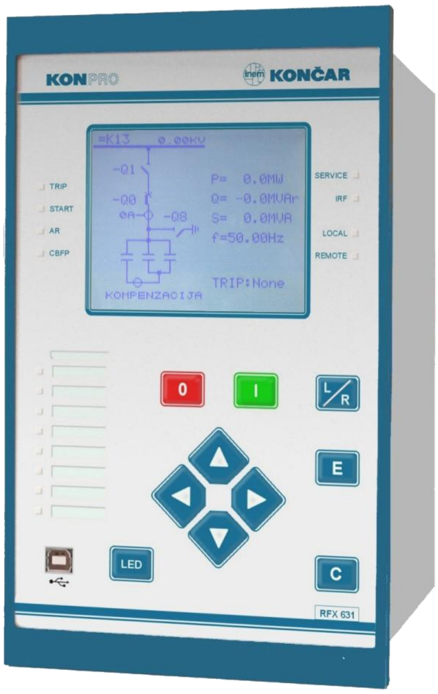


Fig. 1: Front panel of the relay

- An USB interface is used for local communication with a computer. Remote communication is realized using a fibre-optic interface for reception of an optic plastic conduit with a V-Pin connector, on the rear side of the device. It is possible to deliver a special relay on demand, allowing connectivity for a fibre-optic glass conduit with ST connector.

- The device circuit architecture is modular, allowing exchange of hardware modules, which as a result allows cheaper maintenance and simple customization of the device to the needs of almost any facility.

- Thanks to such configuration the RFX relay can be installed for protection of almost any insulated and earthed grid. Additional current input for ground current measurement, as well as the voltage input for measurement of ground voltage allows earthfault detection on various failure types.

- If the facility (installation) has no open delta voltage transformer installed, the ground voltage is calculated from measured values of phase voltage. Thus the calculated value of ground voltage is used for all necessary signal generations, associated with earthfault events.

Fig. 2: Rear side of the relay

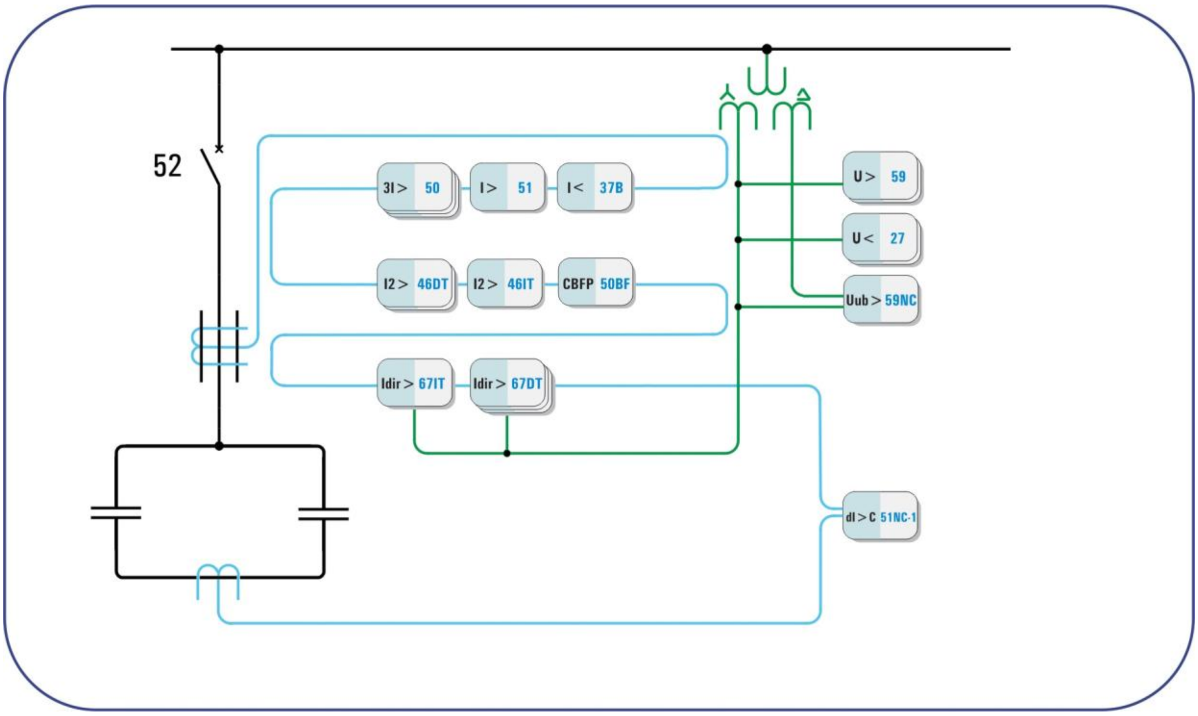


Fig. 3: Block diagram of the RFC relay

- By simply changing parameters describing the connection of the relay to the power transformers, the relay adapts to the set of power transformers in the facility. It is possible to connect linear or phase voltages to the power measurement inputs. If linear voltage is connected to the relay, phase voltages are calculated using an appropriate algorithm based on symmetric voltage components.

- While setting voltage protection for pickup value it is possible to choose the effect on size of linear voltage, and direct or inverse voltage component. Common relay connection options are shown on fig. 4 and 5.

Protection of torodial and radial networks

- Directional protection functions for radial network protection are realized for protection from short-circuit and earthfault events. Setting of a distinctive angle from -90° to +90°, as well as direction of operation parameters (forward/reverse), covers all four quadrants of the directional protection operation.

- **Advanced failure analysis**

  In order to enable quality event analysis in case of disturbances or failures in the facility, the device has an implemented event log list, as well as a trip log.

  Each list can store a maximum of 512 events, with expansion capability according to the users' wishes. Events are stored on lists in 2ms intervals. The selection of events that are to be stored is chosen via software support.

  The integrated battery allows storing of all events even after auxiliary device power supply failure or disappearance.

- **Time synchronization**

  In order to keep internal relay time synchronized with the time of other relays in the facility, remote synchronization using communications (SCADA) or the provided binary input prepared for IRIG-B time code is enabled.

  Time setting is possible using software support or using the front panel. The integrated battery backup allows undisturbed work of the clock mechanism even after auxiliary power failure or disappearance.

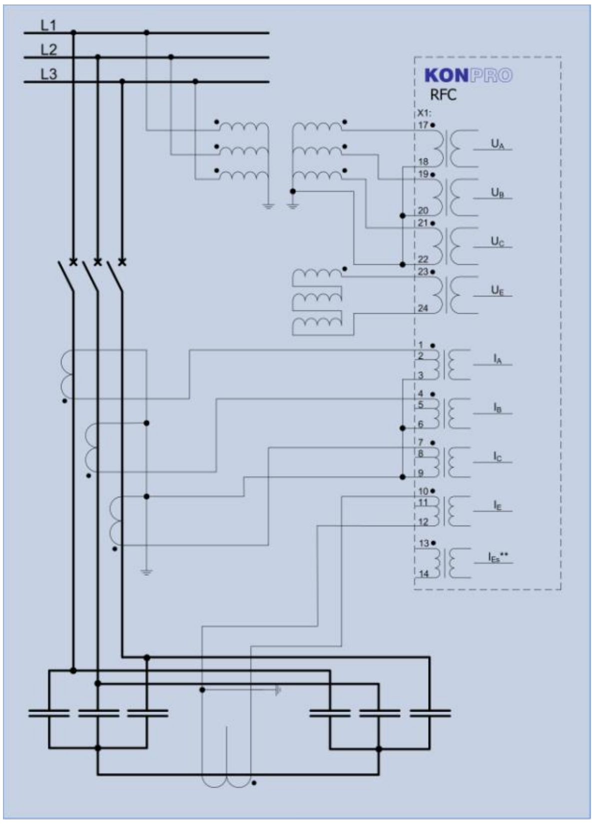


Fig. 4: Relay connection schematic RFC with ground voltage transformer

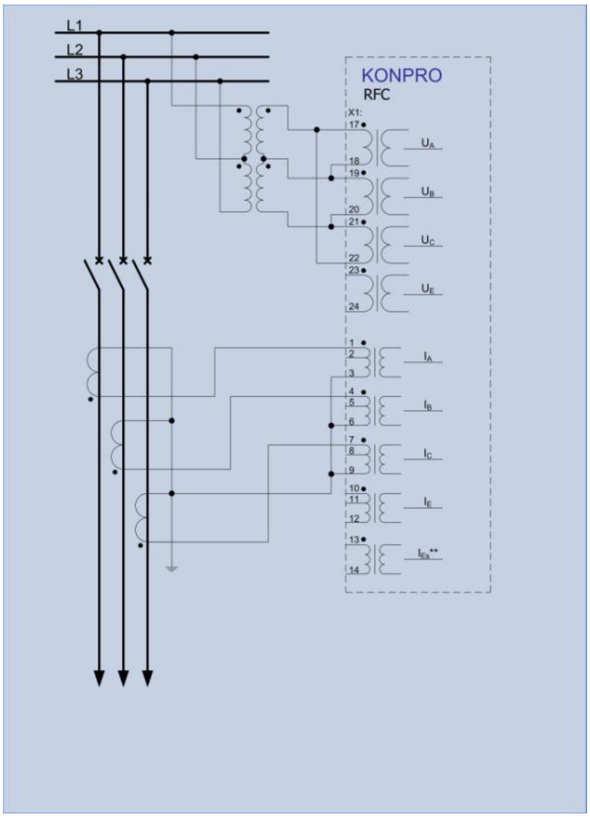


Fig. 5: Relay connection schematic RFC without ground voltage transformer

Overview of protection functions for RFC

ANSI relay indication	IEC indication	Function
50 – Phase OC	I>/>>/>>>	Overcurrent protection with *definite time* characteristic
51 – Phase OC	I>	Overcurrent protection with *inverse time* characteristic
67DT – Dir. OC	I_{dir}>/>>/>>>	Directional overcurrent protection with *definite time* char.
67IT – Dir. OC	I_{dir}>	Directional overcurrent protection with *inverse time* char.
59 – Phase OV	U>	Overvoltage protection
27 – Phase UV	U<	Undervoltage protection
46DT – Neg. Seq.	I_2>/>>	Negative sequence overcurrent protection with *definite time* characteristic
46IT – Neg. Seq.	I_2>	Negative sequence overcurrent protection with *inverse time* characteristic
37B Phase UC	I<	Capacitor bank undercurrent protection
RecInh	RecInh	Capacitor bank reconnection inhibit function
51NC-1 Cap. bank unb.	dI>C	Capacitor bank unbalance current protection
59NC Cap. bank volt. unb.	dU>C	Zero voltage unbalance protection for capacitor banks
50BF	CBFP	Circuit breaker failure protection

- **Overcurrent protection with *definite time* characteristic (50 – Phase OC)**

The function is derived by measuring the current in all three phases, and comparing measured values with preset ones. Inter-independent algorithms for each phase enable shortest failure detection time. Three levels of settings for pickup current and time threshold allow selective protection settings. In order to enable proper protection start-up in case of intermitting failure, the *t-drop* parameter is added, keeping the function in start-up during set period of time after pickup disappearance. Thus protection start-up is enabled in case of brief consecutive short-circuits. The start-up time delay is independent towards current size.

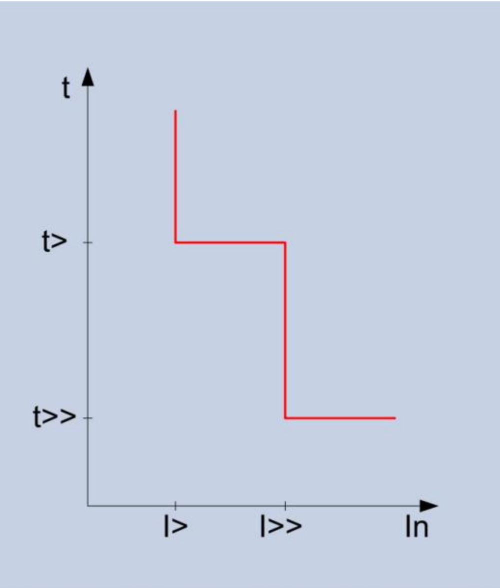


Fig. 6: Pickup characteristics of overcurrent protection with definite time

- **Overcurrent protection with *inverse time* characteristic (51 – Phase OC)**

Inter-Independent algorithms supervise current values in all three phases. Implemented characteristics enable delayed pickup time depending on current size or in regard to characteristics set by IEC or ANSI standards. The protection function is enabled in case when the current surpasses the set value by 10%. The pickup releases after current drops under value 1.05 I>. The derived pickup characteristics are shown in Table 1.

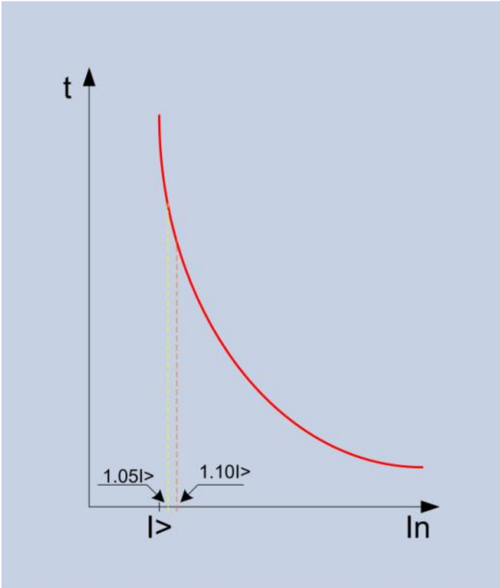


Fig. 7: Pickup characteristics of overcurrent protection with inverse time

Table 1. Implemented pickup characteristics of overcurrent protection

IEC		α	β	
Normal inverse	$t = k \cdot \dfrac{\beta}{\left(\dfrac{I}{I>}\right)^{\alpha} - 1}$	0.02	0.14	
Very inverse		1	13.5	
Extremely inverse		2	80	
Long time inverse		1	120	
ANSI		**α**	**β**	**γ**
Normal inverse	$t = TD \cdot \left(\dfrac{\beta}{\left(\dfrac{I}{I>}\right)^{\alpha} - 1} + \gamma \right)$	2.0938	8.9341	0.17966
Short inverse		1.2969	0.2663	0.03393
Long inverse		1	5.6143	2.18592
Moderately inverse		0.02	0.0103	0.0228
Very inverse		2	3.922	0.0982
Extremely inverse		2	5.64	0.02434
Definite inverse		1.5625	0.4797	0.21359

- **Directional overcurrent protection with *definite time* characteristic (67DT – Dir. OC)**

The aforementioned function is activated when two conditions are met. First – measured current exceeds preset value, and second – the direction of the current matches the direction of the protection. The direction of protection system is set using direction parameters, i.e. the Relay Characteristic Angle. Setting of said parameter is possible within limits of -90°÷90°, enabling coverage in all four quadrants with *forward/reverse* direction change capability. Three groups of settings, with three direction

parameters meet the demands of even the most complex protection cases in both directions and with different current and time settings. The direction is set using the faulted phase current and line voltage of two healthy phases. If said voltage amount is too small to determine failure current direction (three phase fault) with certainty, the appropriate voltage is used, stored in device memory before failure. Pickup characteristic of this protection, for failure in phase A, is shown on Fig. 8.

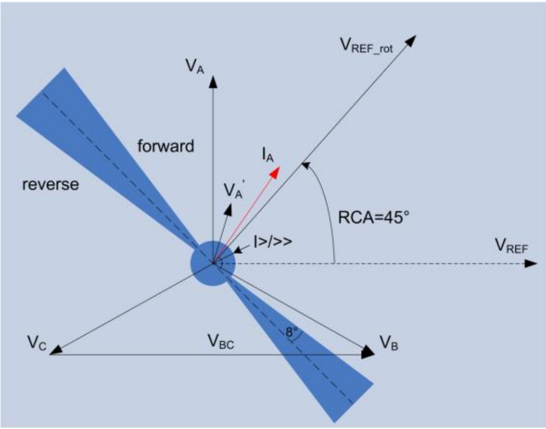


Fig. 8: Pickup characteristic of directional overcurrent protection

- **Directional overcurrent protection with *inverse time* characteristic (67IT – Dir. OC)**

Directional overcurrent protection with *inverse time* characteristic is also activated when terms of direction and conditions of current, described in function 67DT – Dir. OC. are met. Current condition will be fulfilled when the current value surpasses the set value by 10%. Time delay for pickup is set using characteristics determined by IEC and ANSI standards, equal to those of non-directional overcurrent protection.

- **Overvoltage protection (59)**

Overvoltage protection is realized in two degrees with the *definite time* characteristic. Three inter-independent algorithms process the measured voltage on each measurement input. It is possible to use linear voltages or inverse voltage component U_2 as pickup value. The calculated value of voltage U_2 will be accurate only in case when the relay is connected to three phase voltages. If the relay is connected to linear voltages, the value of calculated voltage U_2 will differ from real voltage value for the ground component. Wide latitude of settings for voltage and time, as well as setting of pickup/release (*R-drop*) ratios, allow adequate protection in almost all installation conditions.

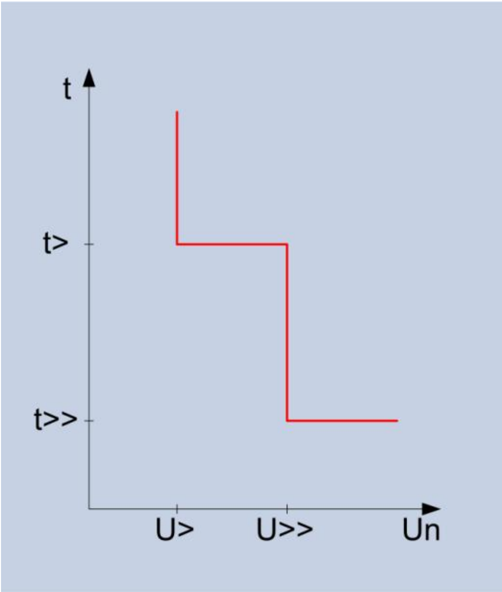


Fig. 9: Pickup characteristic of overvoltage protection

- **Undervoltage protection (27-Phase UV)**

Undervoltage protection is implemented in two degrees with the *definite time* characteristic. Linear voltages or direct voltage component can be used as measured values. In order to avoid unnecessary pickup caused by trip circuit activation or any other reason, the protection algorithm supervises current through the switch. If current through the switch is smaller than set value, the *Current threshold* function concludes that the protected field is out of commission and does not generate any signals connected to the protection pickup. If the undervoltage protection has to be active regardless of the trip circuit state or current, the current supervision through the trip circuit can be turned off.

- **Negative sequence overcurrent protection with *definite time* characteristic (46DT-NEG. SEQ.)**

  In order to allow desired operation of protection in all failure conditions, the protection is realized in two degrees with *definite time* characteristic. Said protection is used to detect failure conditions that can lead to damage of equipment powered by electric energy. Those states can arise from e.g. phase interruption, unsymmetrical phase load, or absence of switching in all three poles of the trip switch. Based on measured phase currents, the function algorithm calculates the inverse component I_2 value, and compares it to preset value. The pickup in case of intermittent current I_2 occurrence is realized through the prolongation of pickup, set by the t-drop parameter.

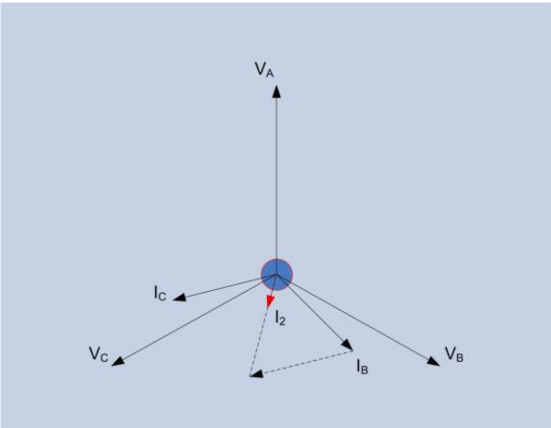


Fig 10: The calculation of current I_2 with one phase missing

- **Negative sequence overcurrent protection with *inverse time* characteristic (46IT-NEG. SEQ.)**

  Said protection for inverse component I_2 calculation uses the same algorithm as the protection described before. The difference being in time delay of trip, which depends on the current (*inverse time*) in this case, in accordance with IEC standard characteristics. The protection will generate adequate pickup signals, when the inverse current component exceeds 10% above preset value.

- **Capacitator bank undercurrent protection (37B – Phase UC)**

  Undercurrent protection for capacitor banks is used for triping capacitor banks in case of prolonged low-voltage on capacitator bank which is reflected by a small current. The functions inputs are TRMS values for comparison with the parameter.

  Protection function is achieved with one degree for triping capacitor banks with an integrated "definite time" time chacacteristic. Imput measured units used are all three phase currents. As input values for the comparison TRMS values of current are used.

- **Capacitator bank reconection inhibit function (RecInh)**

  Capacitator bank reconection function detects bank disconection from the network and protects a charged bank from being reconectoed before being discharged. Function uses TRMS current values to detect whether the bank is connected to the network.

  The function is performed with one degree that is designed to block energization of capacitor banks with integrated "definite time" time characteristic. Imput measured units used are all three phase currents. As input values for the comparison TRMS values of current are used.

- **Capacitor bank current unbalance protection (51NC-1 Cap. bank unb)**

  Protection of capacitor banks using the current imbalance is used in the capacitor connected to a double star. Protection function is performed with two degrees of tripping as an incentive to take the value of the current imbalance.

  The first stage is designed as an alarm stage with integrated definite time characteristics. The second level of protection is provided for disconnecting the capacitor bank with integrated "inverse time" characteristics (using the IEC inverse time characteristics from Table 1).

- **Zero voltage unbalance protection for capacitor banks (51NC-1 Cap. bank unb)**

Protection of capacitor banks using imbalance zero sequence voltage is used in capacitors connected in a non-grounded star. Protection function is performed with two degrees of tripping as an incentive to take the size of the voltage is calculated using the relation:

$$V_{OP}=\frac{1}{3}\cdot\left|\begin{array}{l}(1+k_{AB}+k_{AC})\cdot V_X-\\ 3\cdot V_0+V_B\cdot(1-k_{AB})+V_C\cdot(1-k_{AC})\end{array}\right|$$

Where:

$$k_{AB}=\frac{Z_A}{Z_B}\approx\frac{X_A}{X_B};\ k_{AC}=\frac{Z_A}{Z_C}\approx\frac{X_A}{X_C}$$

The first stage is designed as an integrated alarm with definite time characteristics. The second stage is scheduled for disconnection of capacitor banks and is also integrated with a definite time characteristics.

- **Trip circuit failure protection (50BF-CBFP)**

After the general trip warrant generation, it is possible that the trip circuit does not trip for some reason. Circuit failure reasons can be various, from line braking towards tripping coil, to a fault in the circuit itself. In order to cut power supply to the failed area, the trip circuit failure protection is activated, whose task is to control whether the trip based on warrant is realized, and if not to either trip the breaker trough the second tripping circuit, or to trip the corresponding next trip circuit that supplies power to the failure. The trip circuit supervision is also possible based on signal contact, and current size through the switch. If the value ON is chosen for parameter *CB-contact*, the switch state function deduces based on the state of the signal switch. If the chosen value is OFF, the function deduces the state of the switch based on measured current through the switch. If that current exceeds the parameter set by function *Current threshold* (0,05In=default), the function deduces that the switch remains closed. After the expiration of time function set by parameter *t-BF*, the function will generate the trip signal on the corresponding relay output.

- **Trip circuit supervision (74TC-Trip C.S.)**

In case of trip circuit failure, the trip command will not cause breaker tripping. Such a state is extremely dangerous; therefore trip circuit supervision is used in order to alert personnel to failure as soon as possible. Trip circuit control is realized using adequate binary inputs. Depending on binary input state, the function deduces whether the trip circuit is in sound or erroneous state.

Two connectivity schemes are possible – with one or two binary inputs. When supervising the trip circuit with one binary input (TCS2), the binary input shall be in lead state, with a working trip circuit with the breaker on and off, required that the TRIP contact is not closed.

In order to avoid trip circuit signal failure on protection pickup, a *definite time* characteristic time delay is integrated.

TC failure signal will be generated after expiration of the time delay. It is necessary to set the time delay so it is longer than the duration of TRIP relay closure. Such connectivity keeps the TC failure signal even in case the TRIP relay contacts remain permanently closed after tripping.

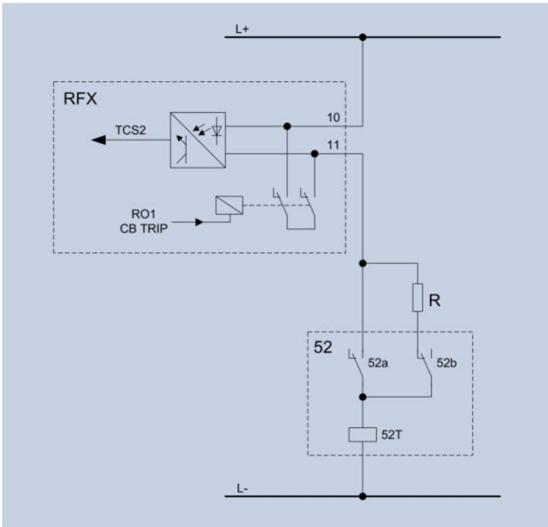


Fig. 11: Trip circuit supervision with TCS2

Oper. selectivity is achieved using two binary inputs and the *Meas. mode* parameter. When monitoring via two binary inputs (TCS1 & TCS2), the function deduces that the TC is sound if at least one binary input operates in lead state. In addition, a request in case of TC failure is the need to block the breaker closing next to the failed TC. Breaker closing blockade, on given command and with TCS function, is achieved by setting *TC fail blk.* to state ON.

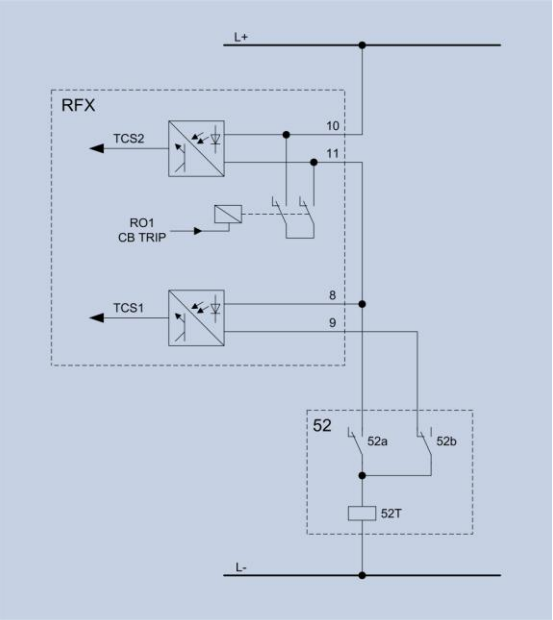


Fig. 12: Trip circuit supervision w/TCS1 & TCS2

- **Complete adjustment to facility equipment**

The circuit and software architecture of protective relays allows adjustment of protection to implemented measurement transformers and switches in the facility.

With regards to the power transformers in the facility, the relay can be connected to a set of two pole isolated power transformers, and a set of one pole isolated power transformers, i.e. three wire and four wire. Selection of connectivity modes is performed using *VT conn.* parameter. If the relay is connected to a set of one pole isolated power transformers, and voltage measurement UE is unavailable, said voltage can be calculated from measured phase voltage using *VT conn. = 3P-UE-C*. All relay types from RFX series are equipped with analogue current inputs for rated current 1A and 5A (0.2A on demand), as well as voltage inputs for rated voltage 100V (200V on demand).

Circuit breaker tripping/closing is often realized using auxiliary relays, therefore it is sometimes necessary to ensure a sufficient time interval for trip/close command impulse. Close command impulse duration can be adjusted. The factory setting for trip/close impulse duration is 250ms.

- **Apparatus wear monitoring**

Circuit breaker wear monitoring function, which is usually performed as an additional function in the relay protection, gives a good enough insight into the MV circuit breaker, and as such allows the rationalization of maintenance costs. Circuit breaker wear usually depends on the tripping current and therefore tripping currents in all three phases are taken as measuring inputs of the specified function. With circuit wear monitoring over current an overview of the number of trips, operating time and number of manipulations for all other apparatus is given.

- **Energy metering**

The function of electrical energy measurement is increasingly being used in devices of this type. The purpose of the function is the ability to track active and reactive energy at a measurement point. Energy is obtained by integrating measured values of power in the time period and summing the obtained values. Energy is measured in all four quadrants.

- **Communications capabilities**

The layout and markings of keys on the front panel allow intuitive usage of the local communications interface. The USB interface on front panel, and optical interface on the rear, allow local and remote communications using IEC 60870-5-103 (61850 optional) protocol. This protocol is accepted as the international standard for protection parameter transfer and failure recording.

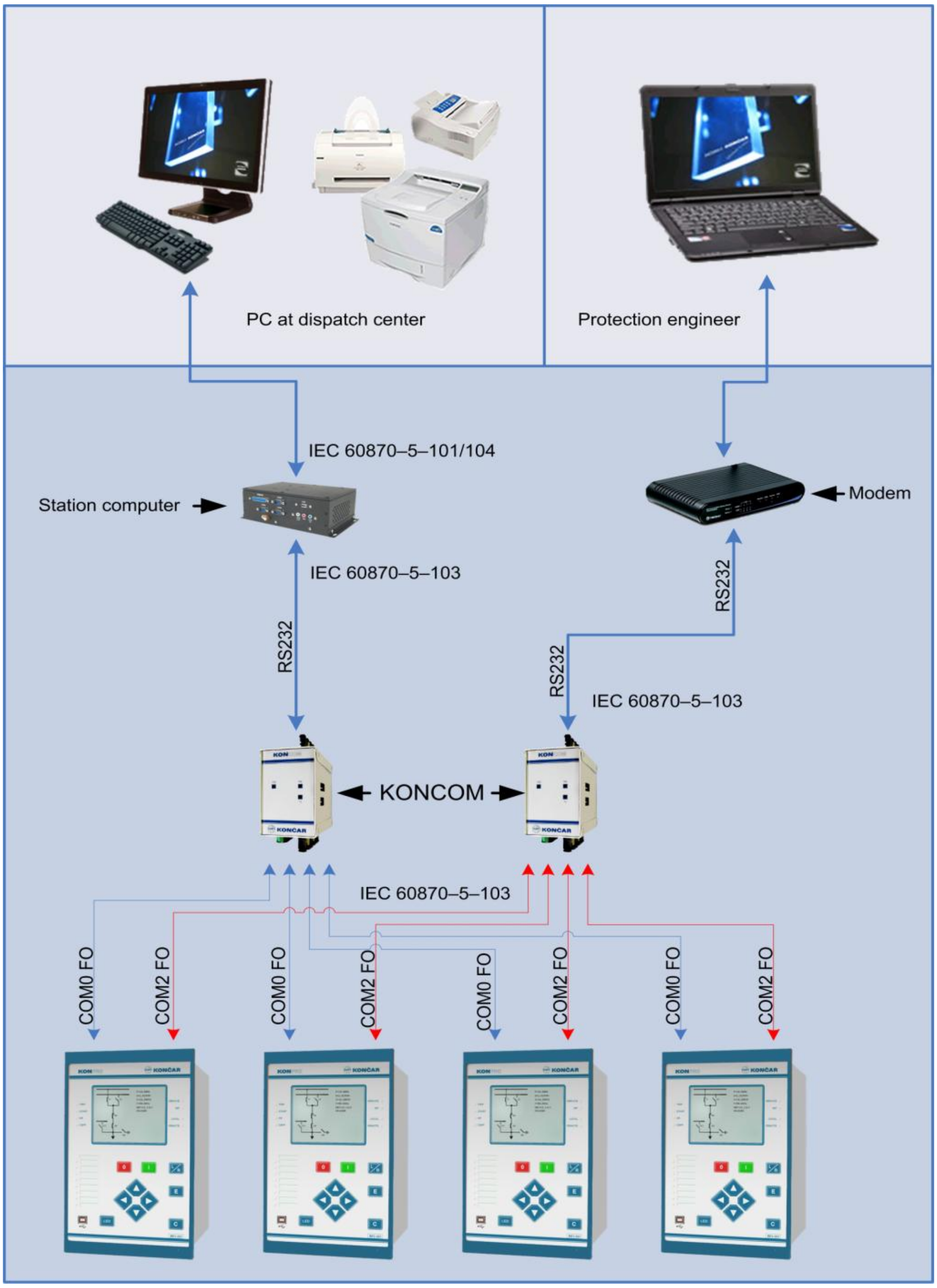


Fig. 13: Communications connection schematic for facilities

The figure 18 shows one kind of relay interconnection using the communications inverter. In order to achieve optimal characteristics, we recommend usage of communications converters from the KONCOM series. The image illustrates a relay, which is equipped with two optical ports (service and system port), allowing relays to be connected to the SCADA system and to a remote PC used by protection engineer.

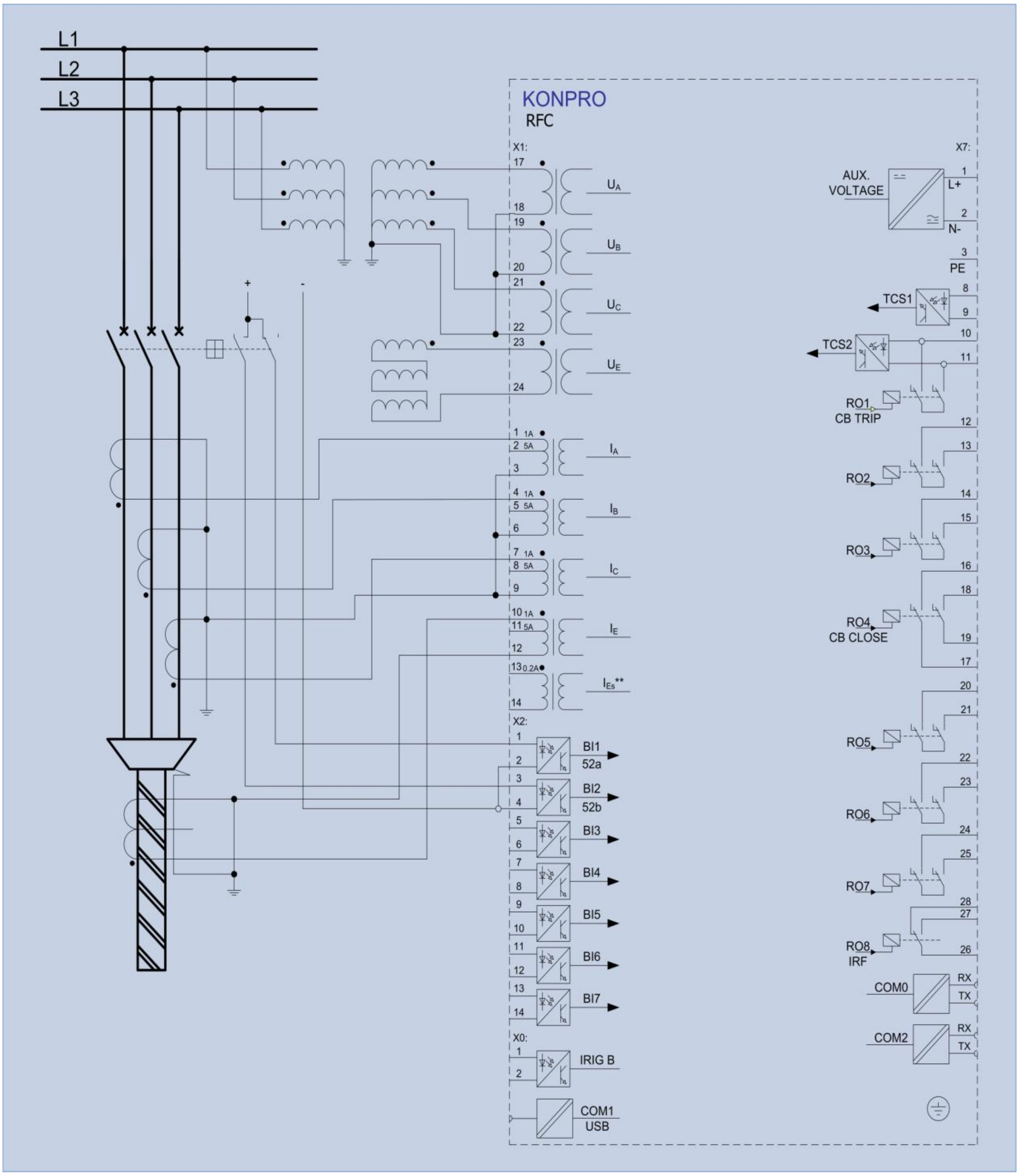


Fig. 14: Common connectivity schematic of basic relay types to measurement transformers, with breaker state monitoring

- **Expansion of binary input and relay output number**

The figure above shows the schematic of basic relay type, without additional expansion boards with binary inputs and outputs. Present-day power facilities demand relays to receive and compute a large number of signals, and send a lot of signals as well. In order to fulfil all potential demands, relays allow expansion of circuitry with additional binary input and relay output expansion boards.

We offer three types of units, as shown on figure 21. Basic circuit and software architecture are adapted to receive up to two additional expansion boards of same or different type, depending on demand shown on order description. The next two pictures show all the basic and additional relay modules.

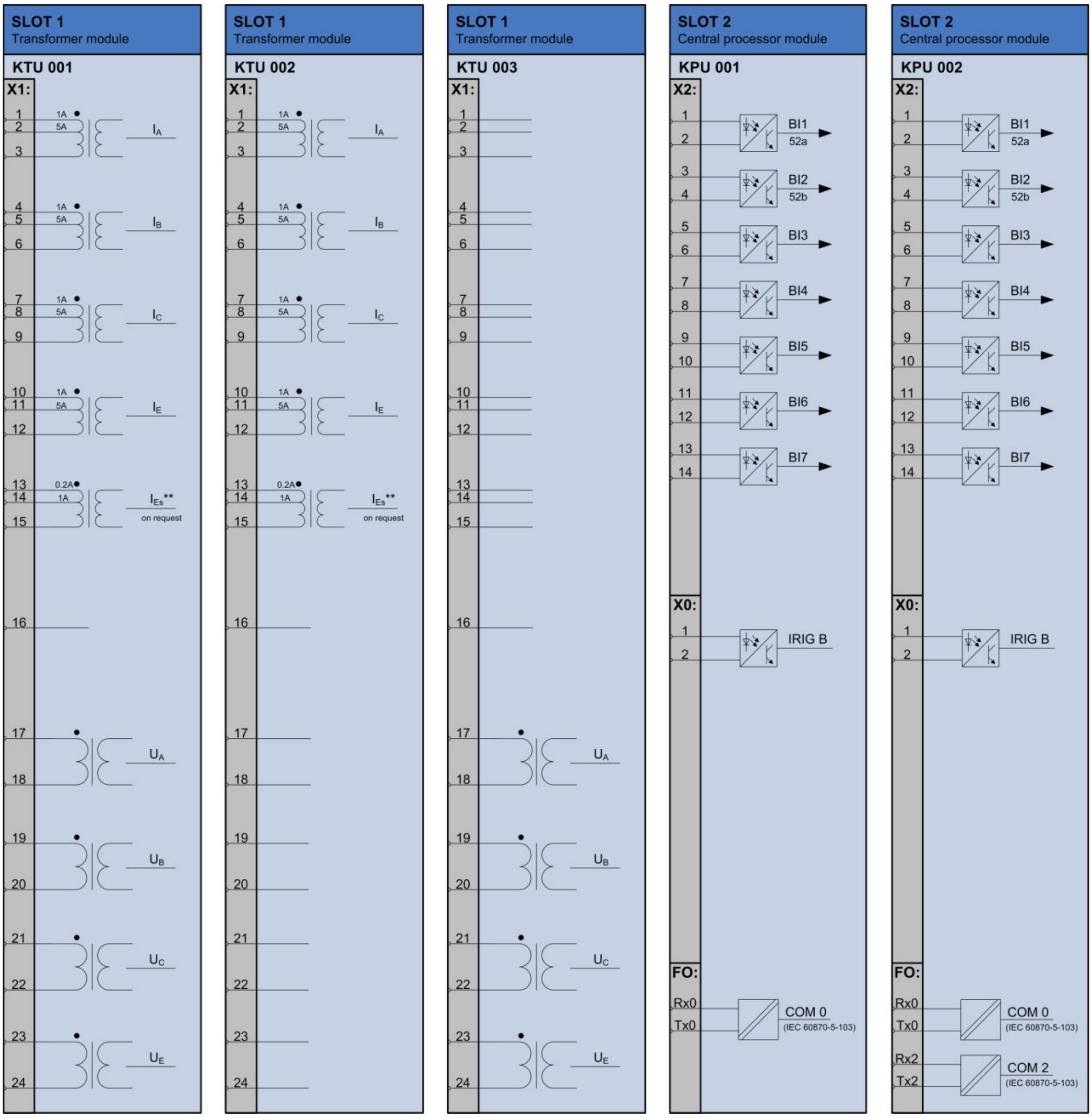


Fig. 15: Schematic of basic and additional relay modules

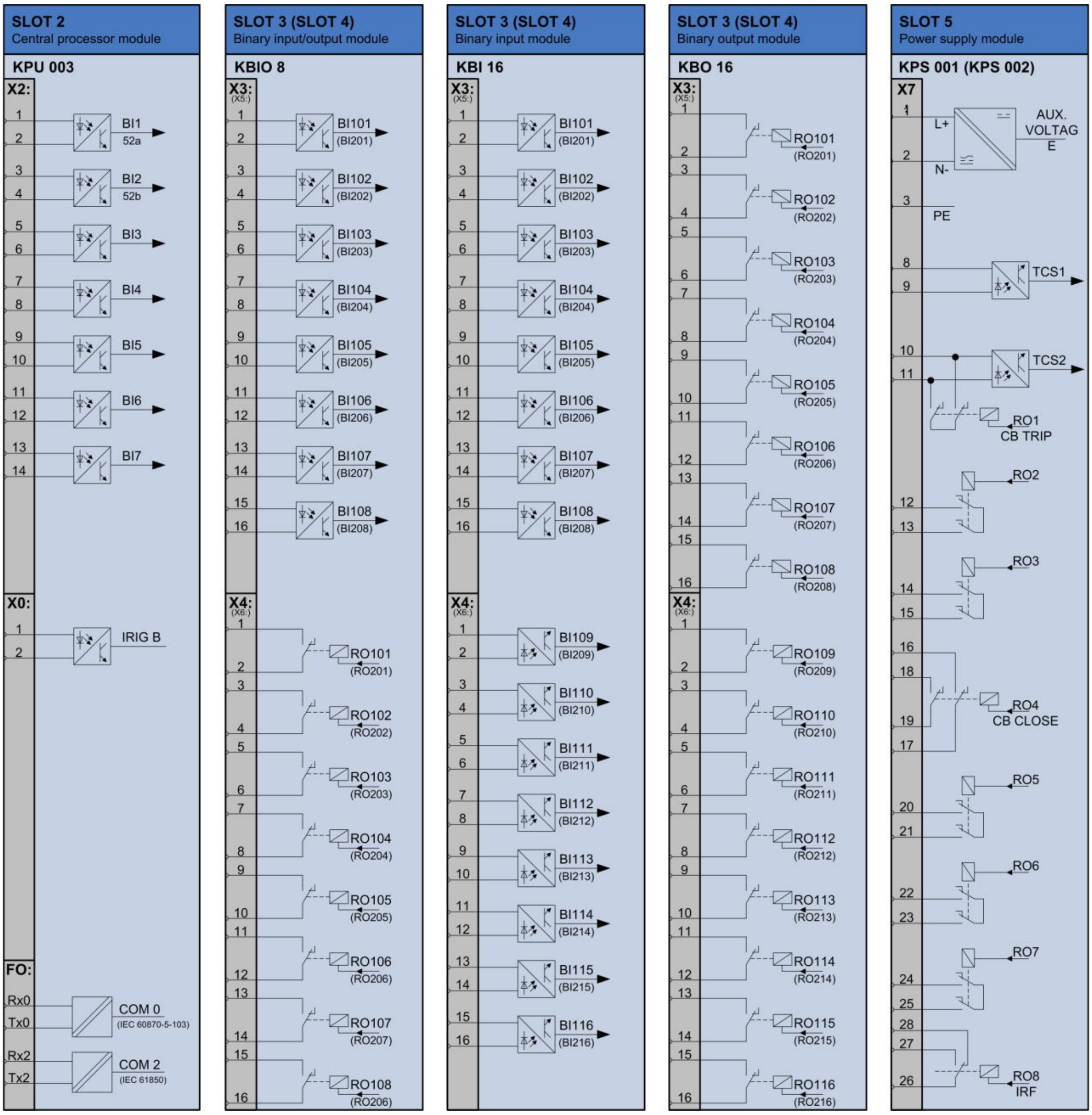


Fig. 16: Schematic of basic and additional relay modules

- **HMI interface**

HMI interface gives the user a visual overview of the state of the plant, quick and easy access to the parameters and control of devices in the field. The main display includes the following:

• Single line diagram with the current state of the field apparatus showing all devices in the field,
• Measured electrical values.

Single line schemes are predefined, and there is 2 factory predefined schemes available. If none of the predefined schemes satisfy the state in the installation it is possible to add a new scheme on request.

Since the switching devices change state during operation, there are four tags for each apparatus used to indicate the possible states: closed, open, intermediate, undefined.

With the single line diagram display fields are associated with certain measurement depending on the type of predefined schemes.

- **Predefined schemes**

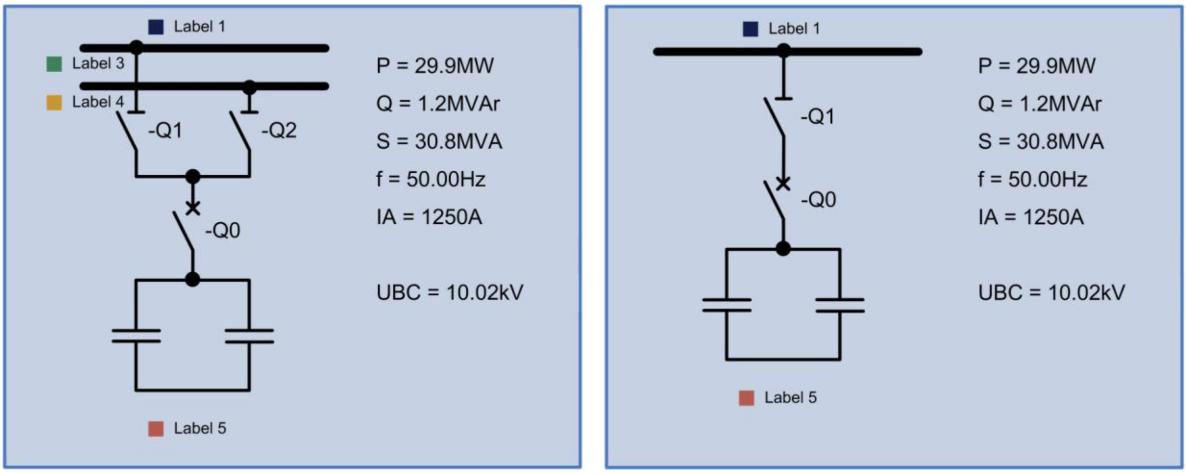


Fig. 17: Predefined schemes

Secondary equipment

RFC

TECHNICAL DATA

MEASUREMENT INPUTS

Current inputs

- Number of inputs	5
- Rated current	1A, 5A (0.2A)**
- Rated frequency	50/60 Hz
- Number of connectors per input	3 (1 A, 5 A and mutual)
- Consumption	< 0.5 VA
- Load Capacity	
- Thermal	4 In constant, 100 In per one second
- Dynamic	250 In for one half-period

Voltage inputs (RFX, RFU)

- Number of inputs	4
- Rated voltage	100 V (200V)**
- Rated frequency	50/60 Hz
- Number of connectors per input	2
- Consumption	< 0.5 VA
- Load Capacity	4 U_n constant

Binary inputs

	Number of binary inputs:
- Standard variant (on CPU unit)	8 (52a, 52b, IRIG, 5 programmable)
- Additional card A-type O/I units	8 (programmable)
- Additional card B-type O/I units	16 (programmable)
- Additional card C-type O/I units	0
Voltage setting for binary inputs	18-80 Vdc
	80-265 Vdc

Relay outputs

	Number of relay outputs:	
- Standard variant (on power supply unit)	8 (CBtrip, CBclose, IRF, 5 programmable)	
- Additional card A-type O/I units	8(programmable)	
- Additional card C-type O/I units	16(programmable)	
Number of rear relay outputs (for tripping/closing)	7 (2 predefined TRIP and CLOSE)	
Circuit voltage	≤ 400 Vac/dc	
Continuous current	8 A	
Admissible current (close and hold) – 0.5 s	28 A	
Admissible current per contact	Signal relays (I/O unit)	triping relays (on power unit)
- For 48 Vdc	2.5 A	8A
- For 110 Vdc	0.5 A	2A
- For 220 Vdc	0.25 A	0,6 A

*** on demand*

KONČAR inem

Local and remote communications

Local communication (on front panel)	
- Operating interface – COM 1	USB, IEC 60807-5-103
Remote communication (on rear panel)	
- System/Service interface – COM 0	V-Pin connector, IEC 60870-5-103
- System/Service interface – COM 2	V-Pin connector, IEC 60870-5-103 or 61850

Auxiliary power supply

Auxiliary voltage	80-265 Vdc ; 18-80 Vdc 220 -230V, 50Hz
Consumption	
- Stand-by	Approx. 10 W
- Operation	Approx. 15 W

Device enclosure

Installation	Using installation plate
Weight	Approx. 7.0 kg

Measurement accuracy

Currents	In range of 10-200% In 0,5% In or 1% current value
Voltages	In range of 10-120% Un 0,5% Un or 1% current value
Powers	In range of 10-120% rated power U>0,5Un, I>0,5In, f=50Hz, |cosf|>0,7 2% rated value
Energy	In range of 10-120% rated value U>0,5Un, I>0,5In, f=50Hz, |cosf|>0,7 2% rated value

GENERAL INFORMATION

C/CE Conformity

HRN EN 61000-6-2:2001.	EMC directive
HRN EN 61000-6-4:2003.	EMC directive
HRN EN 60950-1: 2005+A11:2005	LVD directive

Electrical testing

Insulation testing

- According to standard: IEC 60255-5	
- Measurement inputs, binary inputs, relay outputs	2.5kV rms, 50/60Hz
- Class III impact voltage test: Measurement inputs, binary inputs, relay outputs, auxiliary power supply	5kV peak value 1.2/50µs, 0.5J, 3 pos. and 3 neg. impulses in 5s interval

EMC testing

- According to standard: IEC 60255-22, IEC 61000-4, IEC 61000-6-2, IEC 61000-6-4	
- Resistance to short signals at frequency of 1MHz, IEC 60255-22-1, class III	2.5kV peak value1MHz 400 waves at sec, for 2s
- Electrostatic discharge, IEC 60255-22-2 IEC 61000-4-2 + A1 + A2	±6kV by contact, ±8kV through air ±4kV by contact, ±8kV through air
- Resistance to electromagnetic field radiation IEC 60255-22-3 IEC 61000-4-3 + A1 + A2	10V/m, 27-500MHz, 80-1000MHz 10V/m, 80-1000MHz
- Resistance to electric quick transient / brief signal, IEC 60255-22-4 IEC 61000-4-4	±4kV dc port, ±2kV sig. port, 5/50ns, 5kHz, 60s
- Resistance to high-energy wave signal, IEC 60255-22-5	1.2/50µs, DC clamps: ±1kV dif, ±2kV comm.
IEC 61000-4-5	1.2/50µs voltage OK, 8/20µs short circuit current, 0.5kV
- Resistance to disturbances induced by RF field IEC 60255-22-6 IEC 61000-4-6 + A1	150kHz-80MHz, Modulation 80%AM at 1KHz, 10Vef
- Resistance to PF magnetic field IEC 61000-4-8 + A1	30A/m, 50Hz, 60s, xyz axis
- Resistance to impulse magnetic field IEC 61000-4-9 + A1	300A/m, 50Hz, 60s, 5 pos. + 5 neg. imp. 10s
- Permanent voltage interference at main clamps IEC 61000-6-4, EN 55011 + A1 + A2	150kHz-30MHz
- Radio emission IEC 61000-6-4, EN 55011 + A1 + A2	30MHz-1000MHz

Mechanical testing

Resistance testing for vibration, shock, strikes and earthquakes

- According to standard: IEC 60255-21		
	- Resistance to vibration (sinusoidal) IEC 60255-21-1	10-60Hz, Amp. ±0.035mm 60-150Hz, acceleration 0.5g, class 1 xyz axis 20 cycles, 1octave/min.
	- Shock and strikes resistance IEC 60255-21-2	Shock test: acceleration 5g, duration11ms, Strike test: acceleration 10g, duration 16ms, class1
	- Earthquake resistance IEC 60255-21-3	8-35Hz 1g x axis, 0.5g y axis, class 1 1-8Hz, 3.5mm x axis, 1.5mm y axis 8-35Hz 1g x axis, 0.5g y axis, class 1

Ambient/climate testing

Thermal resilience testing

- According to standard: IEC 60068-2, IEC 60255-6		
	- Resilience to thermal influence in duration of 16 hrs IEC 60068-2-1, IEC 60068-2-2	-25°C to +70°C
	- Temporarily allowed installation temperature in duration of 96 hrs	-10°C to +55°C
	- Recommended constant installation temperature IEC 60255-6	-5°C to +55°C
	- Recommended constant storage temperature IEC 60255-6	-10°C to +55°C

Humidity resilience testing

- According to standard: IEC 60068-2-30		
	- Resilience to elevated temperature with elevated humidity IEC 60068-2-30	+55°C at 95%rel.humidity, duration of 96hrs

Degree of enclosure mechanical protection

- According to IEC 60529	Front: IP50 Rear: IP20

Additional testing

Testing of permissible thermal load of measurement current inputs

- Permanent	4In, effectively
- In interval of 5s	40In, effectively
- In interval of 1s	100In, effectively

Protection functions

Overcurrent protection with definite time characteristic (ANSI No. 50)

- Measurement inputs		IA, IB, IC	
- Function activation	Func.	OFF I> I>, I>> I>, I>>, I>>>	
- First/second/third stage			
- Pickup value	I>, I>>, I>>>	0.00 – 30.00 In	step: 0.01 In
- Pickup time characteristic			
Definite time	t>, t>>, t>>>	0.05 – 300.00 s	step: 0.01 s
- Allowed dropdown time	t-drop	0.00 – 60.00 s	step: 0.01 s
Cold Load Pickup			
- CLP first/second/third stage			
- Pickup value	Ic>, Ic>>, Ic>>>	0.00 – 30.00 In	step: 0.01 In
- Pickup time characteristic			
Definite time	tc>, tc>>, tc>>>	0.00 – 300.00 s	step: 0.01 s
- Start time		< 30 ms (at 2Ip)	
- Release time		< 35 ms (at 2Ip)	
- Pickup/release ratio		0.95 (Ip/In ≥ 0,5)	
- Time accuracy		2% pickup value or 10 ms	
- Pickup current accuracy		2% pickup value or 0.01 In	

Overcurrent protection with inverse time characteristic (ANSI No. 51)

- Measurement inputs		IA, IB, IC	
- Function activation	Func.	OFF ON	
- Pickup value	I>	0.10 – 5.00 In	step: 0.01 In
- Pickup time characteristic			
IEC-Normal inverse	k	0.05 – 1.00	step: 0.01
IEC-Very inverse			
IEC-Extremely inverse			
IEC-Long inverse			
ANSI-Inverse	TD	0.50 – 15.00	step: 0.01
ANSI-Short inverse			
ANSI-Long inverse			
ANSI-Moderately inverse			
ANSI-Very inverse			
ANSI-Extremely inverse			
ANSI-Definite inverse			
Cold Load Pickup			
- CLP pickup value	Ic>	0.10 – 5.00 In	step: 0.01 In
- CLP pickup time characteristic			
IEC-…	kc	0.05 – 1.00	step: 0.01
ANSI-…	TD	0.50 – 15.00	step: 0.01
- Drop-out characteristic	Drop-out	Instant	

- Working area		1.10 Ip	
- Release value		1.05 Ip (Ip/In ≥ 0,5)	
- Pickup current accuracy		2% set value or 0.01 In (1A)	
- Time accuracy		5% set value ± 2% curr tol, min 30 ms	

Directional overcurrent protection with definite time characteristic (ANSI No. 67-DT)

- Current inputs		IA, IB, IC	
- Voltage inputs		UA, UB, UC	
- Referred voltage		UAB, UBC, UCA *If the voltage is too small for measurement it is taken from memory (2P)*	
- Function activation	Func.	OFF Iφ> Iφ>, Iφ>> Iφ>, Iφ>>, Iφ>>>	
- Characteristic angle	RCA	± 90°	step: 1°
- Pickup direction	Dir>, Dir>>, Dir>>>	forward / reverse	
- Stabilization angle (pickup/release)		8^0 / 3^0	
- First/second/third stage			
- Pickup value	Iφ>, Iφ>>, Iφ>>>	0.10 – 30.00 In	step: 0.01 In
- Pickup time characteristic *Definite time*	tφ>, tφ>>, tφ>>>	0.05 – 300.00 s	step: 0.01 s
- Allowed dropdown time	t-drop	0.00 – 60.00 s	step: 0.01 s
Cold Load Pickup - CLP first/second/third stage			
- Pickup value	Iφc>, Iφc>>, Iφc>>>	0.10 – 30.00 In	step: 0.01 In
- Pickup time characteristic *Definite time*	tφc>, tφc>>, tφc>>>	0.05 – 300.00 s	step: 0.01 s
- Start time		< 45 ms	
- Release time		< 40 ms	
- Pickup/release ratio		0.95 (Ip/In ≥ 1)	
- Time accuracy		2% pickup value or 10 ms	
- Pickup current accuracy		2% pickup value or 0.01 In	
- Angle accuracy		±3°	

Directional overcurrent protection with inverse time characteristic (ANSI No. 67-IT)

- Current inputs		IA, IB, IC	
- Voltage inputs		UA, UB, UC	

- Referred voltage		UAB, UBC, UCA *If the voltage is too small for measurement it is taken from memory (2P)*	
- Function activation	Func.	OFF ON	
- Characteristic angle	RCA	± 90°	step: 1°
- Pickup direction	Dir>	forward / reverse	
- Stabilization angle (pickup/release)		8^0 / 3^0	
- Pickup value	Iφ>	0.10 – 5.00 In	step: 0.01 In
- Pickup time characteristic			
IEC-Normal inverse	kφ	0.05 – 1.00	step: 0.01
IEC-Very inverse			
IEC-Extremely inverse			
IEC-Long inverse			
ANSI-Inverse			
ANSI-Short inverse			
ANSI-Long inverse			
ANSI-Moderately inverse	TDφ	0.50 – 15.00	step: 0.01
ANSI-Very inverse			
ANSI-Extremely inverse			
ANSI-Definite inverse			
Cold Load Pickup			
- CLP pickup value	Iφc>	0.10 – 5.00 In	step: 0.01 In
- CLP pickup time characteristic			
IEC-…	kφc	0.05 – 1.00	step: 0.01
ANSI-…	TDφc	0.50 – 15.00	step: 0.01
- Drop-out characteristic	Drop-out	Instant	
- Working area		1.10 Ip	
- Pickup/release ratio		1.05 Ip (Ip/In ≥ 0,5)	
- Time accuracy		5% pickup value ± 2% current tolerance, 30 ms	
- Pickup current accuracy		2% pickup value or 0.01 In	
- Angle accuracy		±3°	

Overvoltage protection (ANSI No. 59)

- Voltage inputs		UA, UB, UC	
- Function activation	Func.	OFF U> U>, U>>	
- Measurement type	Meas.	Uph-ph U2	
- First/second stage			
- Pickup value	U>, U>>	0.10 – 2.00 Un	step: 0.01 Un
- Pickup time characteristic			
Definite time	t>, t>>	0.05 – 300.00 s	step: 0.01 s

- Pickup/release ratio	R-drop	0,90 – 0,99	step: 0.01
- Pickup time (Uph-ph)		< 40 ms	
- Pickup time (U_2)		< 45 ms	
- Release time(Uph-ph)		< 45 ms	
- Release time (U2)		< 50 ms	
- Voltage accuracy (Uph-ph)		2% pickup value or 1 V	
- Voltage accuracy (U2)		3% pickup value or 2 V	
- Time accuracy		2% pickup value or 10 ms	

Undervoltage protection (ANSI No. 27)

- Voltage inputs		UA, UB, UC	
- Function activation	Func.	OFF U< U<, U<<	
- Measurement type	Meas.	Uph-ph U1	
- First/second stage			
- Pickup value	U<, U<<	0.10 – 1.20 Un	step: 0.01 Un
- Pickup time characteristic			
Definite time	t<, t<<	0.05 – 300.00 s	step: 0.01 s
- Pickup/release ratio	R-drop	1,01 – 3,00	step: 0.01
- Current supervision block	CS-block	ON OFF	
- Current threshold	Current thresh.	0.01 – 1.00 In	step: 0.01 In
- Pickup time		< 40 ms	
- Release time		< 45 ms	
- Voltage accuracy (Uph-ph)		2% pickup value or 1 V	
- Voltage accuracy (U1)		3% pickup value or 2 V	
- Time accuracy		2% pickup value or 10 ms	

Negative sequence overcurrent protection with *definite-time* characteristic (ANSI No. 46-DT)

- Measurement inputs		IA, IB, IC	
- Function activation	Func.	OFF I2> I2>, I2>>	
- First/second stage			
- Pickup value	I2>, I2>>	0.10 – 3.00 In	step: 0.01 In
- Pickup time characteristic			
Definite time	t2>, t2>>	0.05 – 300.00 s	step: 0.01 s
- Allowed dropdown time	t-drop	0.00 – 60.00 s	step: 0.01 s
- Pickup time		< 45 ms	

- Release time		< 45 ms	
- Pickup/release ratio		0.95 (Ip/In ≥ 0,5)	
- Time accuracy		2% pickup value or 10 ms	
- Current accuracy		3% pickup value or 0.02 In	
- Working area		- all phase currents less than 4 In	

Negative sequence overcurrent protection with *inverse-time* characteristic (ANSI No. 46-IT)

- Function activation	Func.	OFF ON	
- Measurement inputs		IA, IB, IC	
- Pickup value	I2>	0.10 – 3.00 In	step: 0.01 In
- Pickup time characteristic *IEC*	Tp2	0.05 – 1.00 s	step: 0.01 s
- Working area		1.10 Ip, phase currents less than 4 In	
- Pickup/release ratio		1.05 Ip (Ip/In ≥ 0,5)	
- Time accuracy		3% + 2% curr measurement error	
- Current accuracy		3% set value or 0.02 In	

Capacitator bank undercurrent protection (ANSI No. 37B)

- Measurement inputs		IA, IB, IC	
- Function activation	Func.	OFF ON	
- *task* interval		5 ms	
- Pickup value	Icn<	0.05 – 1.00 Icn	default: 0.70 Icn
- Trip time	tcn<	0.00 – 300.00	default: 5.0

Capacitator bank reconection inhibit function (RecInh)

- Measurement inputs		IA, IB, IC	
- Function activation	Func.	OFF ON	
- *task* interval		5 ms	
- Pickup value	RInh<	0.05 – 10.00 Icn	default: 0.10 Icn
- Trip time	tRInh	0.00 – 6000.00	default: 300.0

Current unbalance protection for capacitor bank (ANSI No. 51NC-1)

- Measurement inputs		IA, I0	
- Function activation	Func.	OFF ON	
- Time characteristic type	Type	Normal inverse Very inverse Extremely inverse Long-time inverse	
- Trip pickup value	∆Inc>	0.01 – 1.00 In	step: 0,01 In
- Time constant	k	0.05 – 2.00	step: 0,01
- Alarm pickup value	∆Inc-Al>	0.01 – 1.00 In	step: 0,01 In
- Alarm pickup time - Command for natural unbalance current measurement	tnc-Al> Measure ∆In	0.5 – 300.0 s NO YES	step: 0,1s
- Calculated natural unbalance current	∆In-meas	0.01 – 1.00 In	step: 0,01 In
- Compensation current for natural unbalance	∆In-comp	0.01 – 1.00 In	step: 0,01 In
- Task interval		10 ms	

Zero voltage unbalance protection for capacitor banks (ANSI No. 59NC)

- Measurement inputs		VA, VB, VC, VX	
- Function activation	Func.	OFF ON	
- Alarm pickup value	59NC-AL>	0.05 – 1.00 Un	step: 0,1 Un
- Alarm pickup time	t-AL>	0.5 – 300.0 s	step: 0,1s
- Trip pickup value	59NC>	0.05 – 1.00 Un	step: 0,1 Un
- Trip pickup time	t>	0.5 – 300.0 s	step: 0,1s
- ZA/ZB reactance proportion	kAB	0.80 – 1.20	step: 0,01
- ZA/ZC reactance proportion	kAC	0.80 – 1.20	step: 0,01
- Task interval		10 ms	

Circuit breaker failure protection (ANSI No. 50BF)

- Measurement inputs		IA, IB, IC	
- Function activation	Func.	OFF ON	
- Minimal current for CB being considered closed	Current thresh.	0.01 – 1.00 A	
- Function start		-internal trip signal - local/remote trip	
- Time delay	t-BF	0.05 – 60.00 s	step: 0.01 s
- Time accuracy		2% pickup value or 10 ms	
- Start criteria	CB contact	ON, OFF	

Trip circuit supervision (ANSI No. 74TCS)

- Function activation	Func.	OFF ON	
- Measurement type	Meas. mode	2 bin 1 bin	
- Control current of trip circuit		5 mA	
- Time delay	t>	0.10 – 3.00 s	step: 0.01 s
- Time accuracy		2% pickup value or 10 ms	
- Block manual close and AR	TC fail blk.	ON OFF	

Other functions and parameters

Time synchronization

- Date	Date	[01 - 31] . [01 - 12] . [2000 - 2100]	Day. Month. Year
- Time	Time	[00 - 23] . [00 - 59] . [00 - 59]	Hour. Minute. Second.
- Synchronization manner	Sync.	Internal IRIG-B Comm-103 Bin. input	
- Time after synchronization termination	T-sync.	1 - 65535	min

Energy measurement

- Measurement inputs		IA, IB, IC, UA, UB, UC	
- Function activation	Func.	OFF ON	
- Register reset	Resetreg	ON	
- Positive real energy register	Wp+	0 – 7999999kWh	
- Negative real energy register	Wp-	0 – 7999999kWh	
- Positive reactive energy register	Wq+	0 – 7999999kVArh	
- Negative reactive energy register	Wq-	0 – 7999999kVArh	
- Apparent energy register	Ws	0 – 7999999kVAh	
- Power factor	PF	-1.00 – 1.00	

Disturbance recorder

- Function activation	Func	OFF ON	
- Sampling frequency	Sampl.	1KHz 2KHz	
- *Prefault time*	t-pre	0.05 - 1.00 s	step: 0.01s
- *Postfault time*	t-post	0.05 - 1.00 s	step: 0.01s
- *Limit time*	t-limit	0.1 – 5.0 s	step: 0.1s
- Trigger	trigger:	TRIP PU	

Secondary equipment

RFC

CB Wear Monitoring

- Measurement inputs		IA, IB, IC	
- Function activation	Func.	OFF ON	
- Square current limit	SumI^2	0-1000000000 kA	step: 1
- Breaker opening time	T-opening	0,001-0,5 s	step: 0,001s
- Breaker breaking time	T-breaking	0,001-0,6 s	step: 0,001s
- Current threshold	Curr.thresh.	0,04-1,00 In	step: 0,01In
- Measurement values			
Accumulated current value in phase A	Σ IA	0-2000000000 kA	step: 1
Accumulated current value in phase B	Σ IB	0-2000000000 kA	step: 1
Accumulated current value in phase C	Σ IC	0-2000000000 kA	step: 1
Accumulated square current value in phase A	Σ IA^2	0-2000000000	step: 1
Accumulated square current value in phase B	Σ IB^2	0-2000000000	step: 1
Accumulated square current value in phase C	Σ IC^2	0-2000000000	step: 1
Breaker trip counter	Num of TRIPs	0-2000000000	step: 1
Manipulation counter 1A	Oper.Count. 1A	0-2000000000	step: 1
Manipulation counter 1B	Oper.Count. 1B	0-2000000000	step: 1
Manipulation counter 2A	Oper.Count. 2A	0-2000000000	step: 1
Manipulation counter 2B	Oper.Count. 2B	0-2000000000	step: 1
Manipulation counter 3A	Oper.Count. 3A	0-2000000000	step: 1
Manipulation counter 3B	Oper.Count. 3B	0-2000000000	step: 1
Manipulation counter 4A	Oper.Count. 4A	0-2000000000	step: 1
Manipulation counter 4B	Oper.Count. 4B	0-2000000000	step: 1
Manipulation counter 5A	Oper.Count. 5A	0-2000000000	step: 1
Manipulation counter 5B	Oper.Count. 5B	0-2000000000	step: 1
Manipulation counter 6A	Oper.Count. 6A	0-2000000000	step: 1
Manipulation counter 6B	Oper.Count. 6B	0-2000000000	step: 1
Manipulation counter 7A	Oper.Count. 7A	0-2000000000	step: 1
Manipulation counter 7B	Oper.Count. 7B	0-2000000000	step: 1
Manipulation counter 8A	Oper.Count. 8A	0-2000000000	step: 1
Manipulation counter 8B	Oper.Count. 8B	0-2000000000	step: 1
Manipulation counter 9A	Oper.Count. 9A	0-2000000000	step: 1
Manipulation counter 9B	Oper.Count. 9B	0-2000000000	step: 1
Manipulation counter 10A	Oper.Count. 10A	0-2000000000	step: 1
Manipulation counter 10B	Oper.Count. 10B	0-2000000000	step: 1
Operation time	Oper. time	0-10000000 hours	step 1h

Relay characteristic angle

- Characteristic angle for 67DT and 67 IT	RCA 67	-90 – 90°	step: 1°
- Characteristic angle for 67NDT and 67N IT	RCA 67N	-90 – 90°	step: 1°

Change group

- Active group selection	Active group	1 – 3	step: 1

Circuit Breaker control

Control type LOCAL/REMOTE:	Control	Front pl. Bin.in.

Records and event logs

Event records and disturbance logging			
Event log	Log of all events		500
Trip log	Log of all events related to trip		500
Disturbance log	log of disturbance recordings	2kHz	12s / 8
		1kHz	24s / 8
Reset Event log	Delete event log	password	
Reset Trip log	Delete trip log	password	
Reset Disturbance log	Delete disturbance log	password	

System parameters

Transformer ratios

Current transformer primary	CT prim	1 – 2000 A	step: 1 A
Current transformer secondary	CT sec	1 A or 5 A	
Earth current transformer primary	CTE prim	1 – 2000 A	step: 1 A
Earth current transformer secondary	CTE sec	1 A or 5 A	
Voltage transformer primary	VT prim	0,1 - 99,99 kV	step: 0,01 kV
Voltage transformer secondary	VT sec	50,0 – 130,0 V	step: 0,1 V
Earth voltage transformer primary	VTE prim	0,1 - 99,99 kV	step: 0,01 kV
Earth Voltage transformer secondary	VTE sec	50,0 – 130,0 V	step: 0,1 V

Means of voltage connection

Choosing means of voltage connection	VT conn.	3L- UE-m (UE measured) 3P- UE-m (UE measured) 3P- UE-c (UE calculated)	

Circuit breaker

Minimal current to consider CB closed	Curr. thresh	0,04 – 1,00 A	step: 0,01 A

DISPLAY OF MEASUREMENTS ON FRONT PANEL SCREEN

PRIMARY VALUES

A:	Primary value of current IA (A)
B:	Primary value of current IB (A)
C:	Primary value of current IC (A)
bal:	Primary value of current Ibal (A)
AB:	Primary value of line voltage UAB (kV)
BC:	Primary value of line voltage UBC (kV)
CA:	Primary value of line voltage UCA (kV)
bal:	Primary value of voltage Ubal (kV)

SECONDARY VALUES

A:	Secondary value of current IA (A)
B:	Secondary value of current IB (A)
C:	Secondary value of current IC (A)
bal:	Secondary value of current Ibal (A)
AB:	Secondary value of line voltage UAB (V)
BC:	Secondary value of line voltage UBC (V)
CA:	Secondary value of line voltage UCA (V)
bal:	Secondary value of voltage Ubal (V)

NOMINAL VALUES

A x In:	Nominal value of current IA
B x In:	Nominal value of current IB
C x In:	Nominal value of current IC
A x Un (Uph):	Nominal value of phase voltage UA
B x Un (Uph):	Nominal value of phase voltage UB
C x Un (Uph):	Nominal value of phase voltage UC
A x Un (Ulin):	Nominal value of line voltage UAB
B x Un (Ulin):	Nominal value of line voltage UBC
C x Un (Ulin):	Nominal value of line voltage UCA
Ubal x Un:	Nominal value of balans voltage Ubal
Ibal x In:	Nominal value of balans current Ibal
Ibalc x In:	Nominal value of compensated balans current Ibalc
I2 x In:	Nominal value of inverse current
U2 x Un:	Nominal value of inverse voltage
I1 x In:	Nominal value of direct current
U1 x Un:	Nominal value of direct voltage

GENERAL VALUES

UBC:	Primary value of line voltage UAB (kV)
IA:	Primary current of current IA (A)
P:	Primary value of real power(MW)
Q:	Primary value of reactive power (MVar)
S:	Primary value of apparent power (MVA)
f:	Frequency (Hz)
cosφ :	Power factor

ENERGY

Wp+	Value of positive real energy
Wp-	Value of negative real energy
Wq+	Value of positive reactive energy
Wq-	Value of negative reactive energy
Ws	Value of positive apparent energy

TYPE CODE

When ordering the relay it is necessary to specify the type code. Detailed description of type capabilities is shown in the following table:

RFC 6 3 1 - 0 0 A 1 E - 2 0

Function
C – capacitator bank protection

Series

Variant
3 – Large display

Hardware package
1 – 1x FO (IEC 60870-5-103)
2 – 2x FO (IEC 60870-5-103)
3 – 1x FO (IEC 60870-5-103)
1x FO (IEC 61850)

BI/R0 units 1. slot
0 - No additional units
A - Binary unit A-type (8BI+8RO)
B - Binary unit B-type (16BI)
C - Binary unit C-type (16RO)

BI/R0 units 2. slot
0 - No additional units
A - Binary unit A-type (8BI+8RO)
B - Binary unit B-type (16BI)
C - Binary unit C-type (16RO)

Aux. power supply
A - 80-265Vdc, 230Vac
B - 18-80Vdc

Nominal voltage
1 - 100Vac
2 - 200Vac

Nominal frequency
E - 50Hz
F - 60Hz

Software package
1..9

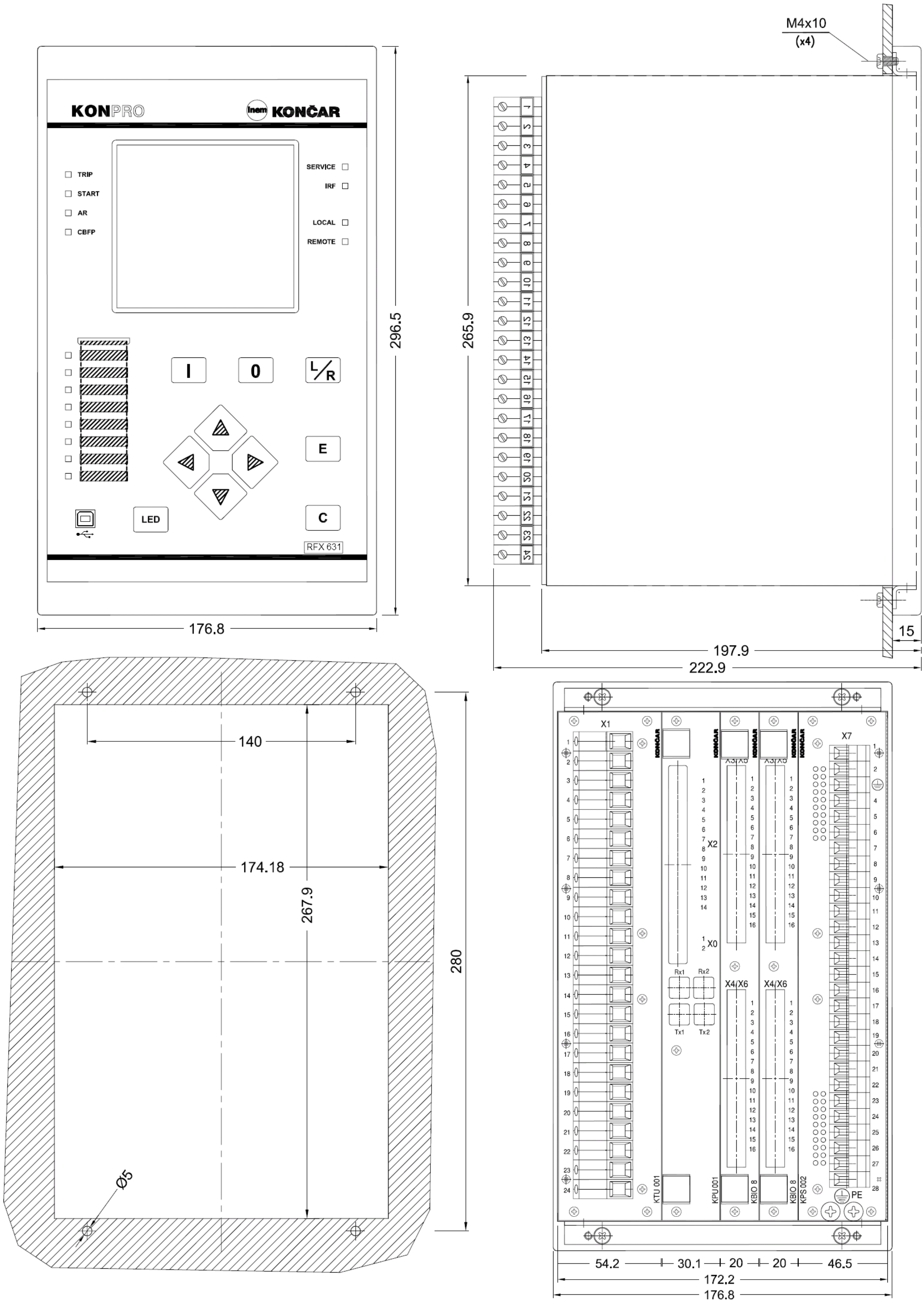
Rear optical port
0 - Plastic
1 - Glass

LIST OF STANDARD FUNCTIONS FOR INDIVIDUAL RELAY TYPE

RFC SW package 2

IEC	ANSI	FUNCTION DESCRIPTION/RELAY TYPE	RFC 631	RFC 632	RFC 633
		Protection functions - current			
I>,>>	**50**	Overcurrent protection with DT characteristic	●	●	●
I>>>	**50**	Overcurrent protection with DT characteristic	●	●	●
I>	**51**	Overcurrent protection with IDMT characteristic	●	●	●
I_{dir}>,>>	**67DT**	Directional overcurrent protection with DT characteristic	●	●	●
I_{dir}>>>	**67DT**	Directional overcurrent protection with DT characteristic	●	●	●
I_{Edir}>	**67IT**	Directional overcurrent protection with IDMT characteristic	●	●	●
I_2>,>>	**46DT**	Negative sequence overcurrent protection with DT characteristic	●	●	●
I_2>	**46IT**	Negative sequence overcurrent protection with IDMT characteristic	●	●	●
I<	**37B**	Capacitator bank undecurrent protection	•	•	•
dI>C	**51NC-1**	Capacitator bank unbalans current protection	•	•	•
RecInh	**RecInh**	Capacitator bank reconection inhibit function	•	•	•
		Protection functions - voltage			
U>,>>	**59**	Overvoltage protection	●	●	●
U<,<<	**27**	Undervoltage protection	●	●	●
dU>C	**59NC**	Capacitator bank unbalans voltage protection	•	•	•
		Supervisory functions			
	50BF	Breaker faliure protection	●	●	●
	74TC	Trip circuit supervision(TCS1, TCS2)	●	●	●
		Time sincronization	●	●	●
		Event logger(event recorder + trip logger)	●	●	●
		Disturbance recorder	●	●	●
		Managment level (local/remote)	●	●	●
		Circuit breaker wear monitor	●	●	●
		Measurment			
		3xI, Ibal, 3xUf, 3xUL, Ubal, sim. comp., I1, U1, I2, U2, P, Q, S, cos φ, f	●	●	●
		Energy (Wp+, Wp-, Wq+, Wq-, Ws)	●	●	●
		Control			
		Breaker control	●	●	●
		Apparatus control according to the selected scheme	●	●	●

MEASURMENT SCHEMATIC AND RELAY DIMENSIONS



Secondary equipment

RFC

KONČAR

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