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

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

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

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

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

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

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

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

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

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

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

EP card 3U3I without DI/DO

EP card 4U4I with 8DI 4DO

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

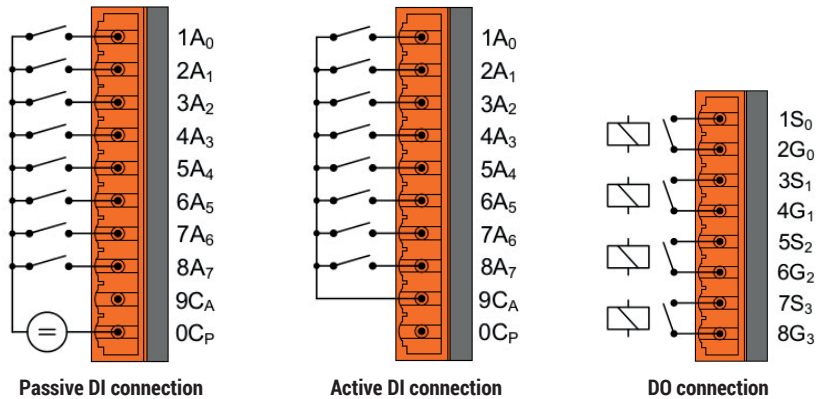## EP cards with special combinations of inputs

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

Typical applications with special EP cards

- Fault passage indicators,
- sensors FSI 36 and FSU 36,
- capacitive sensors VSO 25,
- GVR reclosers,
- Tavrida reclosers (including the solution with Rogowski coils for current measurements),
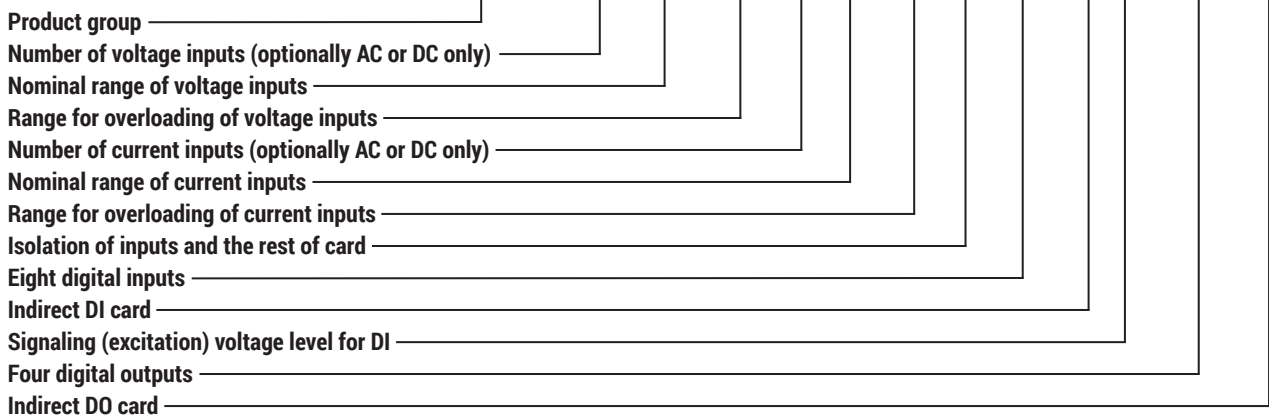- transducers VPIS V3 VO,
- sensors Zelisko,
- sensors TE.

Examples of front panels of EP cards in 1-slot, 2-slot and 3-slot version

Passive DI connection

Active DI connection

DO connection

Product Code Description of EP Cards

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

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

General Parameters of EP Cards

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

Voltage Inputs Specification

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

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

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

Current Inputs Specification

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

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

Modular RTU

Modular RTU

Technical Specification of Digital Inputs and Outputs of EP Cards

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

Power Consumption of EP Cards

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

Available Combinations of EP Cards – Supported Sensors and Transformers

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

There are typically supported the following sensors and transformers:

Voltage Measurement

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

Current Measurement

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