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Electronics Co. Ltd

EuroProt

complex protection

hardware library

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Version information

Version	Date	Modification	Compiled by
00	28.11.2005	First issue, based on the EuroProt user's guide and the configuration CAD software	Petri
01	27.06.2006	Correction in relay data	Petri
02	22.11.2007	Introduction of new modules	Petri
03	30.05.2008	Introduction of new modules	Petri

CONTENTS

The hardware modules of the EuroProt devices

The *EuroProt* multifunctional devices are assembled of modules, which can be selected and configured according to the needed tasks. The principal scheme is as follows:

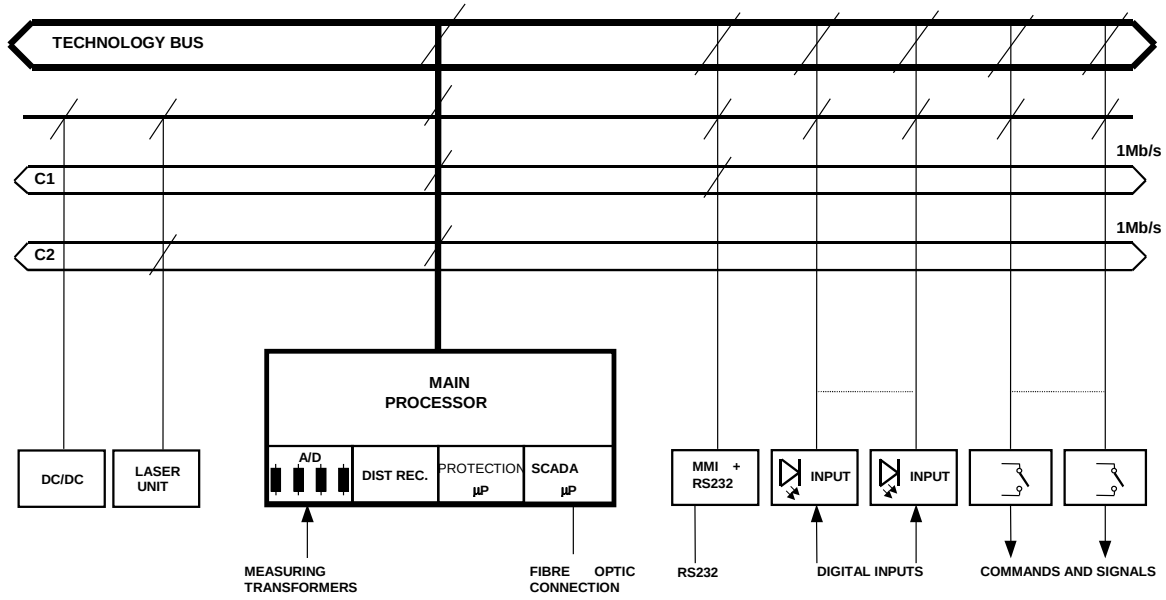


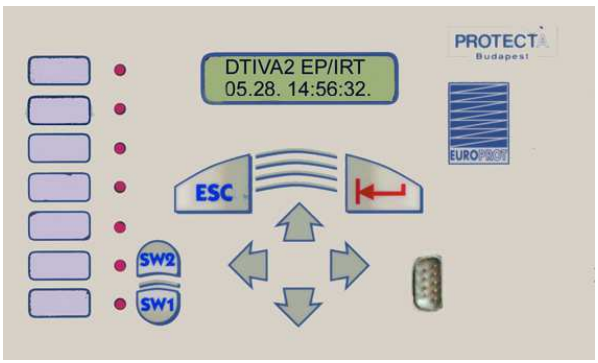
Fig. 1 The principal scheme of the EuroProt devices

The modules can be identified by code values. The first characters of the code are the main identifiers; the subsequent characters identify the different versions. This chapter describes the most important modules of the system.

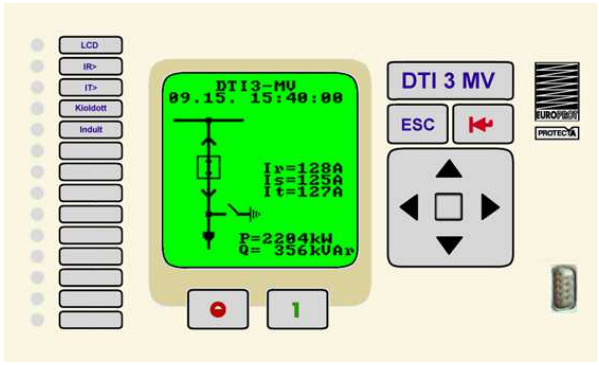
The front panels and the bus modules

- **The front panels**

The front panel of the device can contain three kinds of displays and operation panels. Figures a. b and c show these versions.



a)



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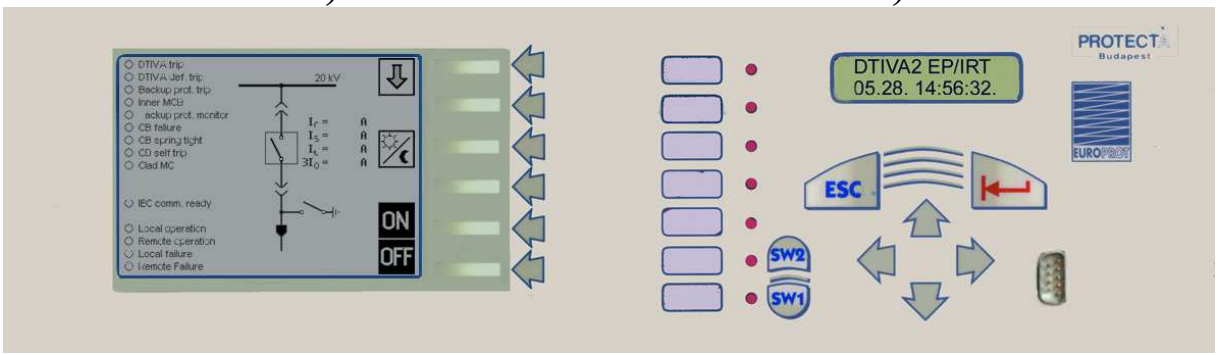


c)

Fig. Versions of the front panel

Code	Version
TAS/01	a)
TAS/02	a)
TAS/03	c)
TAS/04	c)
TAS/05	b)
TAS/06	b) (with bicolour LEDs)
TAS/07	b) (with additional LED panel)

- **The „BUS" modules**

This base module cannot be seen if the housing of the device is closed, this is a printed circuit board parallel behind the front cover. The role of this module is to serve the front panel, and contains the bus system consisting of the parallel technological bus, two serial CAN data communication busses C1 and C2 and the serial interface and driver to operate the serial I/O ports and for addressing all other modules.

The modules are connected to the base module from the backside of the device. The design of the modules assures the strict separation of the high power circuits connected to the secondary of the measuring transformers and to the technological circuits of the substation from the internal circuits connected to the bus system of the device.

Code	Width	Specialities
BUS/4003	42TE	-
BUS/6002	63TE	-
BUS/8001	84TE	-
BUS/8002	84TE	Applied in the OGYD central unit factory configuration
BUS/8003	84TE	Applied in the DTVA-ENEL simple factory configuration
BUS/8004	84TE	
BUS/8005	84TE	Applied in the OGYD-DTI factory configuration
BUS/8006	84TE	Only A,G,H,I,K,L,M,O,R,T,U slots can be used for cards
BUS/8007	84TE	Applied in the OGYD central unit configuration with Ethernet based communication

Table 0 The most important bus module versions

„PS" power supply modules

The versions of the DC/DC power supply modules are designed for different power needs and for different DC voltage levels. The standard module (PS2) can be connected without any modification to the 220 V or 110 V substation battery, as the voltage is acceptable in a very broad range between 88 V and 325 V DC. This standard module can be connected independently of the polarity.

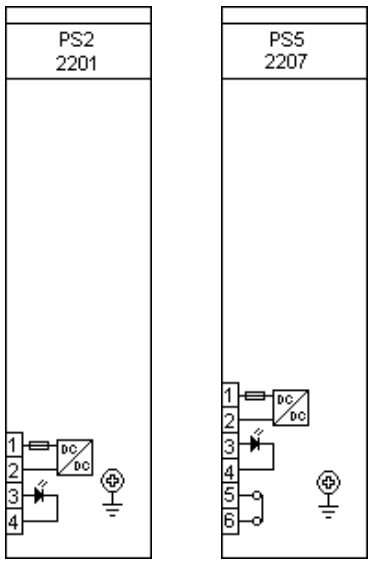
The power supply modules are selected according to the power needs of the configuration and the available power source. The module „PS2" e.g. can supply 2 A current (measured at the 220 V DC substation battery voltage level, the current value is 80 mA), the „PS4" module can supply 4 A current.

Some versions have a special protection circuit, which disconnects the device from the battery power supply system in case of undervoltage (e.g. in the rated 220 V DC system the voltage limit is 176 V).

In some versions there is an additional NC relay contact available, which opens if the power supply is down. This feature can be exploited if two power supply modules are connected parallel, and the supervisory system needs information about the availability of the individual power supply modules. (See Fig. 2)

To satisfy the requirements some power supply modules have additional power storage capacity to over-bridge the sags in the supply voltage.

The parameters of the most important power supply modules are summarised in the following table:



a) *b)*

Fig. 2 The connection of the power supply modules

Code	Input voltage	Max. sec. current	Protection circuit	Power storage	Schema on Fig. 2
PS2/2201	220 V=, 230V~	2A	yes		a)
PS2/1101	110 V=, 100V~	2A	yes		a)
PS4/2202	220 V=	4A	no		a)
PS4/2208	220 V=	4A	no		a)
PS4/1103	110 V=	4A	no	200 ms	a)
PS4/1102	110 V=	4A	no		a)
PS4/4805	48 V=	4A	no		a)
PS4/2406	24 V=	4A	no		a)
PS5/2301	230V~	4A	yes		a)
PS5/1002	100V~	4A	yes		a)
PS5/2203	220V=	4A	no	20 ms	a)
PS5/1104	110V=	4A	yes	10 ms	a)
PS5/2207	220V=	4A	yes	20 ms	b)error signal
PS5/2208	220V= (88-264V=)	4A	yes	60 ms	a)
PS5/1109	110V=	4A	yes	10 ms	b)error signal
PS5/1110	110V=	4A	no	60 ms	a)
PS5/2211	220V=	4A	no	60ms	a)
PS5/4805	48V=	2A	no		a)
PS5/2406	24V=	2A	no		a)

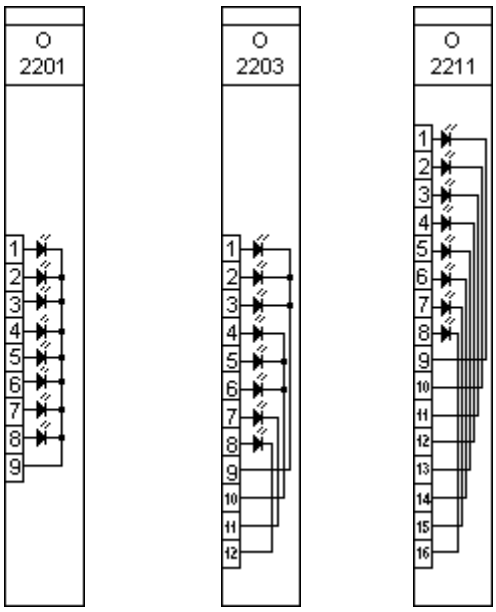
Table 1 The most important power supply module versions

Each power supply module contains an optically isolated digital input port for internal clock synchronisation. At the falling edge of the impulse, the clock is set to 30 s. The impulse must be high for 800-1200 ms (rated duration is 1000 ms). The synchronising impulse is accepted only if the clock is between 25 and 35 s at the falling edge of the impulse. The approximate time setting is possible using the „**Protect for Windows**" operation program. If the rated voltage of this digital impulse is not 220 V but 110 V then a jumper must be replaced according to the input voltage. In other types of power supply units, the rated input voltage is the same as the rated power supply voltage.

The fuse located on the power supply unit may be replaced by the same type of the fuse only. Before replacing the melted fuse, the cause of the melting must be identified and repaired.

„O" optically isolated digital input modules

These modules receive 8 digital input signals. The inputs are galvanically isolated, and the module converts the high voltage signals to the voltage level and to the format of the internal circuits. The most important data of the module is the rated signal voltage level, which must be same, as the voltage level of the substation DC system.



a) *b)* *c)*

Fig. 3 External connection of the digital input module versions

The basic versions of this module are the version with common negative polarity and the version with grouped negative pole.

Rated voltage	Un	110V DC
Operating voltage at rated temperature	0.65*Un±5%	71.5V ±5%DC
Operating voltage in the temperature range of –25°C+55°C	0.65*Un±20%	71.5V ±20%DC
Minimal drop-off difference of the input voltage in the temperature range of –25°C+55°C	0.04*Un	4.4V
RMS value of the power frequency voltage on the input, not generating operation	-	50V AC
Main characteristics of the power supply system O1102	-	Grounded negative pole
Main characteristics of the power supply system O1104 and O1112		Isolated negative pole
Steady state impedance on operating voltage (min.)		60kΩ
Steady state impedance on drop-off voltage (max)		2kΩ
Insulation tests	2kV RMS 50 Hz 1 min	5 kV 1,2/50 μs

Rated voltage	Un	220V DC
Operating voltage at rated temperature	0.7*Un±5%	154V ±5%DC
Operating voltage in the temperature range of –20°C+50°C	0.7*Un±20%	154V ±20%DC
Minimal drop-off difference of the input voltage in the temperature range of –20°C+50°C	0.04*Un	8.8V
RMS value of the power frequency voltage on the input, not generating operation	-	100V AC
Main characteristics of the power supply system O2201	-	Grounded negative pole
Main characteristics of the power supply system O2203 and O2211		Isolated negative pole
Steady state impedance on operating voltage (min.)		150kΩ
Steady state impedance on drop-off voltage (max.)		4kΩ
Insulation tests	2kV RMS 50 Hz 1 min	5 kV 1,2/50 μs

Table 2 Characteristics of the 220 V DC digital input modules

The most important versions are summarised in the following table:

Code	Input voltage	Scheme on Fig. 3
O/2201	220 V=	a)
O/2211	220 V=	c)
O/2203	220 V=	b)
O/1102	110 V=	a)
O/1112	110 V=	c)
O/1104	110 V=	b)
O/4813	48 V=	c)
O/4810	48 V=	a)
O/2414	24 V=	c)
O/2407	24 V=	a)
O/2409	24 V=	b)
O/1208	12 V=	a)

Table 3 Versions of the digital input modules

„R4" and „R4I" relay output modules

These modules contain four output relays.

Characteristics of the output relays:

Rated coil voltage	Un	18V DC
Operating voltage in the temperature range of –20°C+50°C	0,5 - 0,83Un	9V-15V DC
Minimal drop-off difference of the input voltage in the temperature range of –20°C+50°C	0,27Un	5V
Output contact rated voltage	Uk	250V DC
Output contact rated continuous load current	Ik	8A DC
Output contact making current		16A DC
Output contact breaking current L/R= 40ms load, at 220V		0,2A DC
Output contact breaking current conductive load, at 220V		0,25A DC
Insulation test surge voltage		5 kV 1,2/50 μs
50 Hz power frequency insulation test		2kV RMS. 1 min

Table 4a Main technical data of relays

As the technical data suggest, in the DC circuits switched by the relays the arc extinction must be solved (See Appendix 10). If this is not possible, the relay output modules provided with arc extinction circuit produced by Protecta Co. Ltd. must be applied. This module has a version with relay control circuits as well.

Rated coil voltage	Un	18V DC
Operating voltage in the temperature range of –20°C+50°C	0,5 - 0,83Un	9V-15V DC
Minimal drop-off difference of the input voltage in the temperature range of –20°C+50°C	0,27Un	5V
Output contact rated voltage	Uk	250V DC
Output contact rated continuous load current	Ik	8A DC
Output contact making current		16A DC
Output contact breaking current L/R= 40ms load, at 220V		4A DC
Output contact breaking current conductive load, at 220V		4A DC
Insulation test surge voltage		5 kV 1,2/50 μs
50 Hz power frequency insulation test		2kV RMS 1 min

Table 4b Main technical data of relays with arc extinction (increased breaking capacity)

The connection of the modules is drawn in Fig. 4.

The most important versions of the relay modules are summarised in table 5. (This table includes the versions R4E, R4EI and R8, described in the subsequent chapters).

Code	No. of contacts	Contact type	Max. breaking current	Control circuit
R4E/01	4	N.O. and N.C. contacts (*Fig.4. a*)	0.25A	yes
R4/02	4	N.O. and N.C. contacts (*Fig.4. a*)	0.25A	no
R4EI/05	4	N.O. contacts (*Fig.4. c*)	4A	yes
R4I/06	4	N.O. contacts (*Fig.4. c*)	4A	no
R4EU/07	4	1-3: NO contacts, 4. N.C. contact (*Fig.4. b*)	1-3: 4A, 4: 0.25A	yes
R4U/12	4	1-3: NO contacts, 4. N.C. contact (*Fig.4. b*)	1-3: 4A, 4: 0.25A	no
R4I/17	4	N.O. contacts (*Fig.4. c*)	1,2,4: 0.25A, 3: 4A	no
R8/03	8	N.O contacts (*Fig.5. a*)	0.25A	yes
R8B/04	8	1-7: NO contacts, 8. N.C. contact (*Fig.5. b*)	0.25A	yes
R81/08	8	NO contacts (*Fig.5. a*)	0.25A	no
R81B/09	8	1-7: NO contacts, 8. N.C. contact (*Fig.5. b*)	0.25A	no
R8/8000	8	NO contacts (*Fig.5. c*)	0.25A	yes
R8/8128	8	1-7: NO contacts, 8. N.C. contact (*Fig.5. d*)	0.25A	yes
R8/8224	8	1-5: NO contacts, 6-8: N.C. contacts (*Fig.5. e*)	0.25A	yes

Table 5 Summary of the relay output modules

„R4E", „R4EI" relay output modules with relay control circuits

These are output modules containing four relays and control circuits, which control the relays of modules "R4" and "R4I". The technical specification of the relays is the same as that of the relays in module R4 , the connection is shown on Fig. 4.

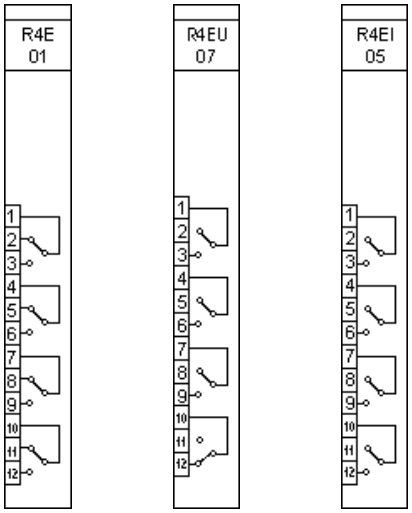


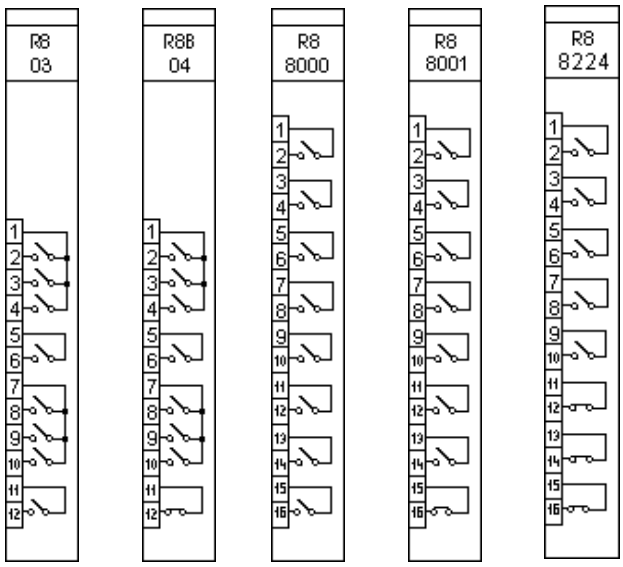
Fig. 4. Connection of the relay output modules

The versions are described in Table 5, in connection with modules R4 and R4I modules.

„R8"and „R8B" relay output modules

These module versions contain eight output relays. The technical specification of the applied relays is the same as that of the relays in module R4 with the exception that these modules have no version with arc suppression circuits. The NC or NO contact types can be ordered optionally. The connection diagram is shown in Fig. 5.

These versions are summarised in Table 5.



a) *b)* *c)* *d)* *e)*

Fig. 5. Output relays module with 8 relays

„M_A" module for checking the CB operating circuits

This module supervises the CB operating circuits, and contains additional four digital input ports as well. The main characteristics of this module is the maximum resistance value of the supervised CB operating circuits, and the rated voltage of the input interface, which must be the same as the rated DC voltage of the auxiliary power supply battery. For the technical data of the digital inputs see those of the "O" digital input modules.

If the CB circuit supervision option is applied, then the CB circuits are checked continuously. The principle of the supervision is as follows. The module generates a voltage through a high R resistance (see Fig. 6. *a*), which is connected to the phases of the the trip coils of the circuit breaker individually. If the circuit is healthy, which means that the resistance is below 5 kΩ, the fibre optic input detects healthy operating circuit. If the circuit is broken, and the resistance is above 5 kΩ, then error is detected, and at the same time the "Z" surge arrester keeps the voltage on a low level. This method can detect error additionally in case of broken trip circuits, if there is no voltage available. If the protection generates trip signal individually for the three phases, the all operating circuits can be involved in the supervision.

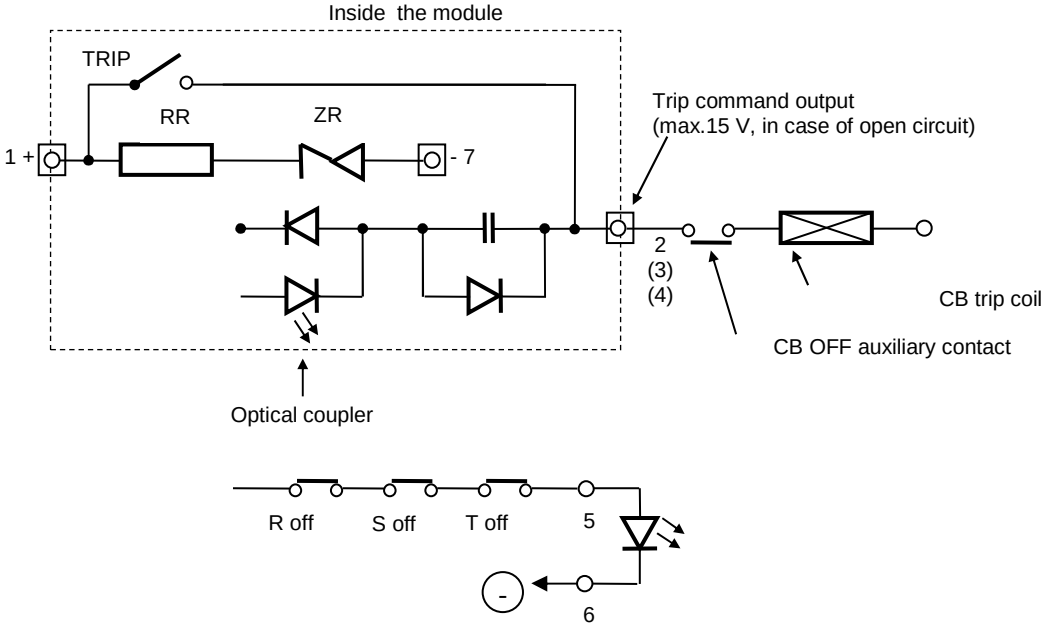
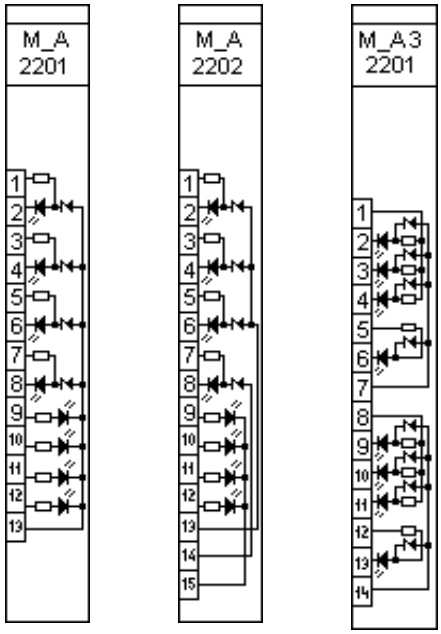


Fig. 6. Supervision of the CB command circuits (version c on Fig. 7)

The auxiliary contact of the CB trip circuit opens in the open state of the circuit breaker in order to interrupt the high current of the trip command. In this open state, the supervision could detect error. At the same time however, the close command circuit would be closed, or the fouth circuit, indicating the open state of the CB-s in all three phases should be closed and the supervision would show a healthy state. Normally either the trip, or the close command circuit must be healthy, so the supervision detects error only, if both circuits are broken (or all circuits are closed).

The connection of the modules for checking the CB circuits is shown on Fig. 7.



a) *b)* *c)*

Fig. 7. Modules for CB circuit supervision

The most frequent versions are summarised in the following table:

Code	Input voltage	Schema on Fig.7
M_A/2201	220 V=	a)
M_A /2202	220 V=	b)
M_A/2205*	220 V=	a)
M_A/2210**	220 V=	b)
M_A /1103	110 V=	a)
M_A /1107	110 V=	b)
M_A /1109	110 V=	b)
M_A /4804	48 V=	a)
M_A /4808	48 V=	b)
M_A /2406	24 V=	a)
M_A /2412	24 V=	a)
M_A 3/2201	220 V=	c)
M_A 3/1101	110 V=	c)

Table 6. Summary of the CB circuit supervision modules

If the factory configuration of the program in the device does not cover circuit supervision, then this task can be solved by simple logic equations. For example, in a system consisting of one trip and one close circuit the trip circuit should be connected according to the scheme of Fig. 6. to the first input of the module (*1.CB circuit OK* signal), the close circuit should be connected to the next input (*2. CB circuit OK* signal), and edit the PROTLOG equation according to Fig. 8. According to this equation if the supervision detects error, the timer starts. If during running time the healthy state does not recover, the device generates alarm signal.

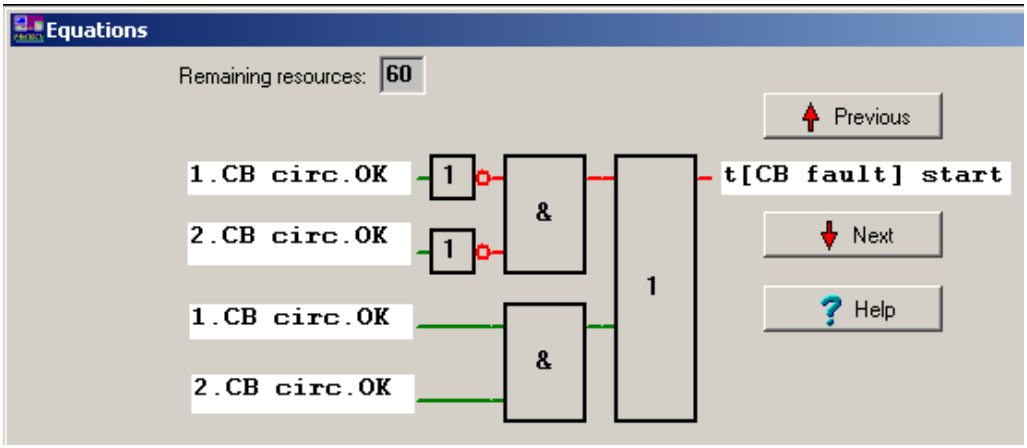


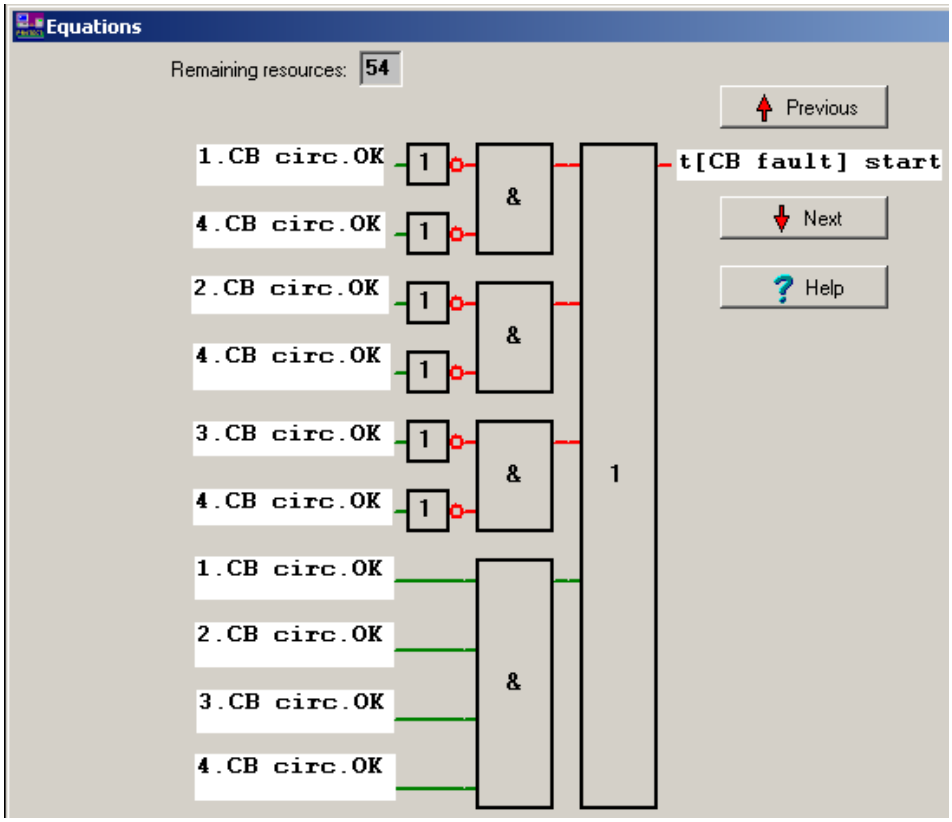
Fig. 8. A simple CB circuit supervision system

In case of a system containing three trip circuit and a single close circuit, the equation can be edited for example according to Fig. 9.

The necessary setting:

LCD display	Min	Max	Step	Remark
t[CB test]= ms	0	60000	10	Delay time setting
M_A module applied ? /+=yes/	-	+		Permission for CB circuit supervision

In case of detected error, the display shows „`CB circuit error !`” message.
In the software matrix, the internal error signal is to be directed to a normally closed contact. So in case of power supply failure the contact opens, and this way the general operability of the device can be checked as well.



*The signal "*4.CB circ.OK*" means input(5-6) according to Fig. 6., indicating 3-phase off state of the CB*

Fig. 9. Three phase trip circuit supervision

`t[CB test]=`
The setting should be at least 300 ms.
This setting on the PC screen:

```
Delay for CB circuit supervision error (0-60000/10) = 12340       ms
```

`M_A module applied?`
For enabling CB circuit supervision the setting should be „+". If the module is enabled, there is possibility for free usage of the four additional digital inputs on the supervision module as well.

„CPU" central processing unit

- **Tasks of the central processing unit**

The elements of the central processing unit are:

- "main processor" (80C196NU), for organising the cooperation of the system elements, with clock, "watch-dog" circuits, 2 CAN controllers, drivers, interface elements,
- signal processor (ADSP2189M), for performing protection functions of the device,
- signal processor (ADSP2189M), for performing communication and supervisory functions,
- flash memory for storing the programs of the processors,
- flash memory for storing the integrated disturbance records,
- EEPROM memory for storing the parameter values,
- battery supported RAM for storing recorded events and clock information,
- 2 pieces of 8 channel multiplexer and A/D converter,
- 4 fibre optic interface (dual loop possibility for protection engineering workstation, and dual loop for the supervisory control system (these interfaces are included only according to the ordering),
- RS232 port on the front panel to connect the protection engineer's computer.

The "intelligent" modules, modules containing microprocessor, are connected to the CPU module via two CAN busses; the communication speed is here 1 Mbit/s.

The size of the flash memory for program storage is sufficient to store programs for all usual protection functions for a power system element. The used functions are selected by configuration and parameter setting.

The 2 pieces of 14-bit A/D converters receive 16 analogue channels. The sampling frequency is 2 kHz, but the program interpolates the sampled values to a common time base. This procedure assures 1 kHz effective sampling frequency for the protection functions and for the disturbance recording.

In some applications a dual sampling is applied to increase resolution accuracy and for a broader scale. This method results an effective sampling of 16 bits, but in this case, the number of the sampled channels decreases.

The versions of the CPU modules are summarised in Table 7:

Code	Protection communication	SCADA communication	CAN channels	Internal I/O channels (1,2,3)	An. channels	Samp-ling
CPU/0203	Dual plastic fibre optic	-	1, 2	X	-	-
CPU/0204	-	Dual plastic fibre optic	1	X	-	-
CPU/0402**	Plastic fibre optic	-	-	-	-	-
CPU/2101	Plastic fibre optic	-	1, 2	X	0	-
CPU/2206	Plastic fibre optic	-	1	X	3	dual
CPU/0101*	Dual plastic fibre optic	Dual plastic fibre optic	1, 2	I, O, -	16	single
CPU/0501	Dual plastic fibre optic	Dual plastic fibre optic	1, 2	I, O, -	16	single
CPU/0202	Dual plastic fibre optic	Dual plastic fibre optic	1	I, I, -	16	single
CPU/0211	Plastic fibre optic	Dual plastic fibre optic	1, 2	I, I, -	16	single
CPU/0112*	Plastic fibre optic	Dual plastic fibre optic	1	I, I, -	16	single
CPU/2112*	Plastic fibre optic	Dual plastic fibre optic	1	I, O, -	16	single
CPU/3112*	Plastic fibre optic	Dual plastic fibre optic	1	I, I, I	16	single
CPU/0212	Plastic fibre optic	Dual plastic fibre optic	1	I, I, -	16	single
CPU/2212	Plastic fibre optic	Dual plastic fibre optic	1	I, O, -	16	single
CPU/3212	Plastic fibre optic	Dual plastic fibre optic	1	I, I, I	16	single
CPU/0117*	Plastic fibre optic	Dual plastic fibre optic	1, 2	I, I, -	0	-
CPU/0142*	Plastic fibre optic	Plastic fibre optic	1, 2	I, I, -	16	single
CPU/0242	Plastic fibre optic	Plastic fibre optic	1, 2	I, I, -	16	single
CPU/0143*	Plastic fibre optic	Plastic fibre optic	1	I, I, -	16	single
CPU/2143*	Plastic fibre optic	Plastic fibre optic	1	I, O, -	16	single
CPU/3143*	Plastic fibre optic	Plastic fibre optic	1	I, I, I	16	single
CPU/0243	Plastic fibre optic	Plastic fibre optic	1	I, I, -	16	single
CPU/2243	Plastic fibre optic	Plastic fibre optic	1	I, O, -	16	single
CPU/3243	Plastic fibre optic	Plastic fibre optic	1	I, I, I	16	single

CPU/0148 *	Plastic fibre optic	Plastic fibre optic	1, 2	I, I, -	0	-
CPU/0158 *	Plastic fibre optic	-	1, 2	I, I, -	0	-
CPU/0258	Plastic fibre optic	-	1, 2	I, I, -	0	-
CPU/4510	Plastic fibre optic	Glass fibre optic	0	I, I, -	4+8	dual+ single
CPU/4610	Plastic fibre optic	Glass fibre optic	1, 2	I, I, -	4+8	dual+ single
CPU/6701 *	Plastic fibre optic	Dual plastic fibre optic	1, 2	I, I, -	7	dual
CPU/6704 *	Plastic fibre optic	Dual plastic fibre optic	1, 2	I, I, -	7	dual
CPU/7601 *	Plastic fibre optic	Plastic fibre optic	1, 2	I, I, -	7	dual
CPU/7604 *	Plastic fibre optic	Plastic fibre optic	1, 2	I, I, -	7	dual
CPU/7606 *	Plastic fibre optic	Plastic fibre optic	1, 2	I, I, -	6	dual
CPU/8202	Dual plastic fibre optic	Dual plastic fibre optic	1, 2	I, O, -	6	dual
CPU/8410	Dual plastic fibre optic	Dual plastic fibre optic	0	I, I, -	4+8	dual+ single
CPU/8501	Plastic fibre optic	Dual plastic fibre optic	1, 2	I, I, -	7	dual
CPU/8504	Plastic fibre optic	Dual plastic fibre optic	1, 2	I, I, -	7	dual
CPU/9401	Plastic fibre optic	Plastic fibre optic	1, 2	I, I, -	7	dual
CPU/9404	Plastic fibre optic	Plastic fibre optic	1, 2	I, I, -	7	dual
CPU6/0001	RJ45		1, 2	I, O, -	16	single
CPU6/0002	RJ45		0	I, I, -	4+8	dual+ single
CPU6/0003	RJ45		1, 2	I, I, -	7	dual
CPU6/0004	RJ45		1	I, O, -	16	single
CPU6/0005	Plastic fibre optic	Glass fibre optic	1, 2	I, I, -	4+8	dual+ single
COM6/0005 ***	RJ45		1	I, I, -	0	-
CPU6/0006	RJ45		1	I,O,I	16	single

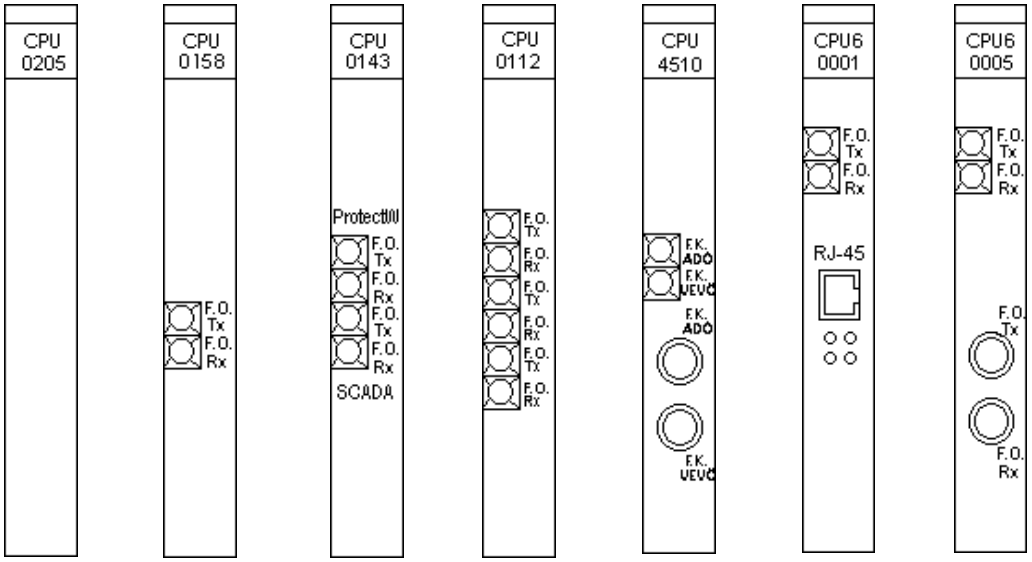
* different bus driving method

Table 7. Versions of the CPU unit

** applied in disturbance recorder factory configuration

*** must be without bus driving (it works only with a “main” CPU)

Fig. 10. shows the back side of the CPU modules.



a) *b)* *c)* *d)* *e)* *f)* *g)*

Fig. 10. Versions of the CPU module

The CPU module performs the full-scale hardware and software supervision of the system as well. The main processor is supervised continuously by the „watch –dog" circuit, the other supervision functions are assigned to the main processor. The continuous supervision covers the internal supply voltages, the A/D converter, and the correct operation of the two signal processors as well. In case of any changes, all kinds of memory chips are supervised using the stored check-sum values.

The internal relays are controlled daily at a predefined time.

In case of CB circuit supervision module application (option), the external circuit can be supervised as well (see the description of this module, Chapter 0).

All detected error, which can influence the correct operation of the device, all functions are disabled, and the device generates alarm signal.

If the device co-operates with fibre optic connection with other devices, then this connection is supervised continuously.

- **Characteristics of the integrated disturbance recorder**

The integrated disturbance recorder is always available, but the usual disturbance recorder functions are realised only in a simplified way.

The recorded disturbances are stored in a flash memory chip, reserved for this function. This memory is divided into 64 kbyte memory pages. All disturbances start on a new page, and can not be longer than the page.

For the evaluation of the storage capacity, the following data must be considered: 1 analogue sampled value needs 1 word (2 byte) in the memory, and one word can store 16 digital channel signals. In a sampling step (1 ms) maximum 16 word can be handled, and the disturbance recorder has 10 pages, 64 kbyte each. Accordingly, using 1 kHz sampling frequency, 10 records of about 3.2 s can be stored, if a record has 8 analogue and 32 digital channel values.

The factory setting reserves 200 ms preliminary time span and 200 ms post fault time span. The starting of the disturbance recorder is performed by digital signal changes only, the starting state can be edge triggered or level triggered. In this case, the recorder keeps registering during the active state of the signal. With „Protlog" equations, the user can define the triggering.

The parameters of the integrated disturbance recorder functions have factory settings only, set by the user.

The data of the recorded disturbances can be transferred via fibre optic connection to a computer using the menus of the ***„Protect for Windows"*** software. There is a separate evaluation program ***"Zirert***", which can be started automatically by the ***„Protect for Windows"*** program as well.

Attention: the optional additional disturbance recorder module fulfils all requirements for the disturbance recording. The description of this optional module can be found in a separate chapter (See Chapter 0).

- **Tasks of the communication and control processor**

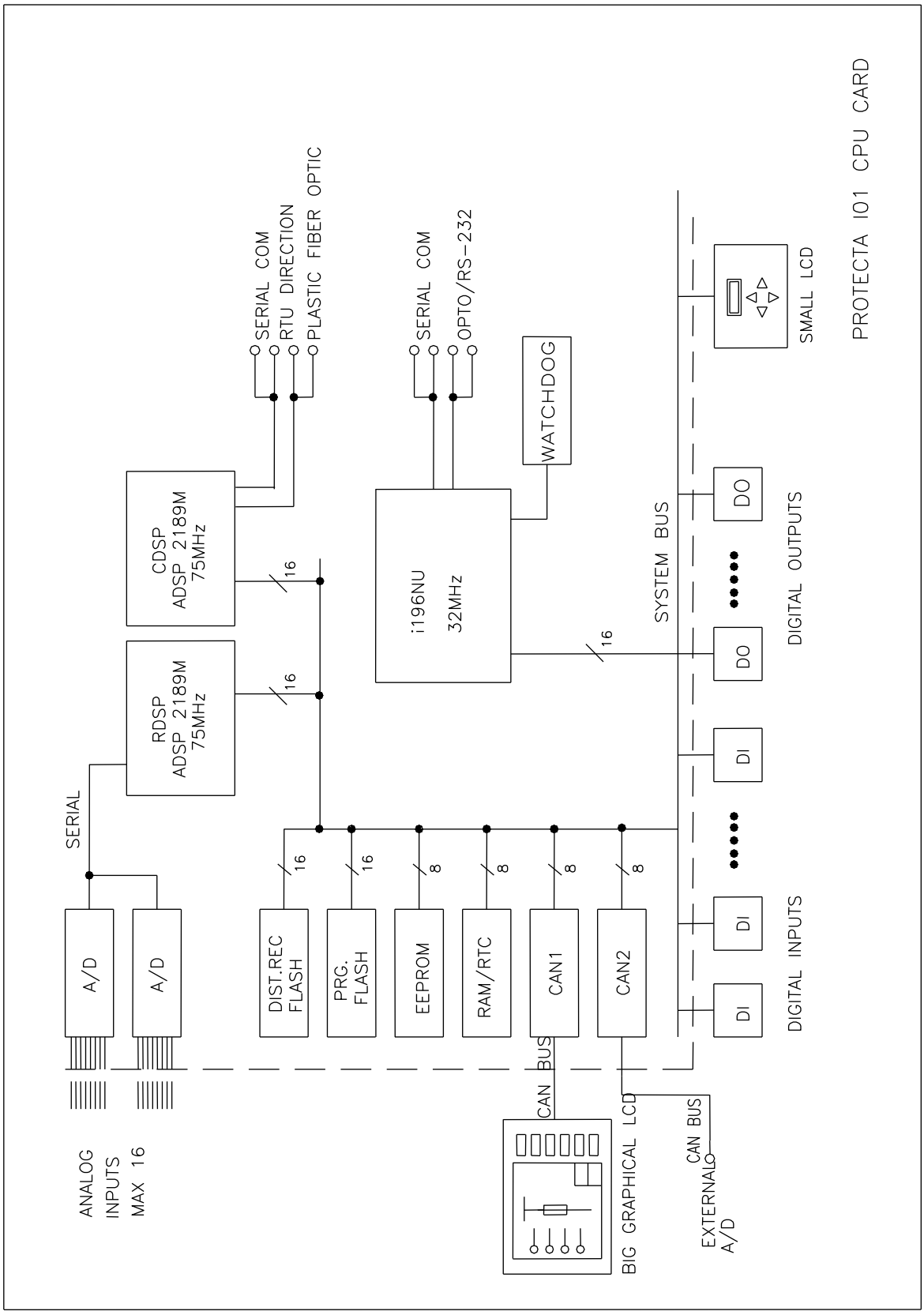
The signal processor dedicated for communication and control tasks is prepared to communicate in different directions:

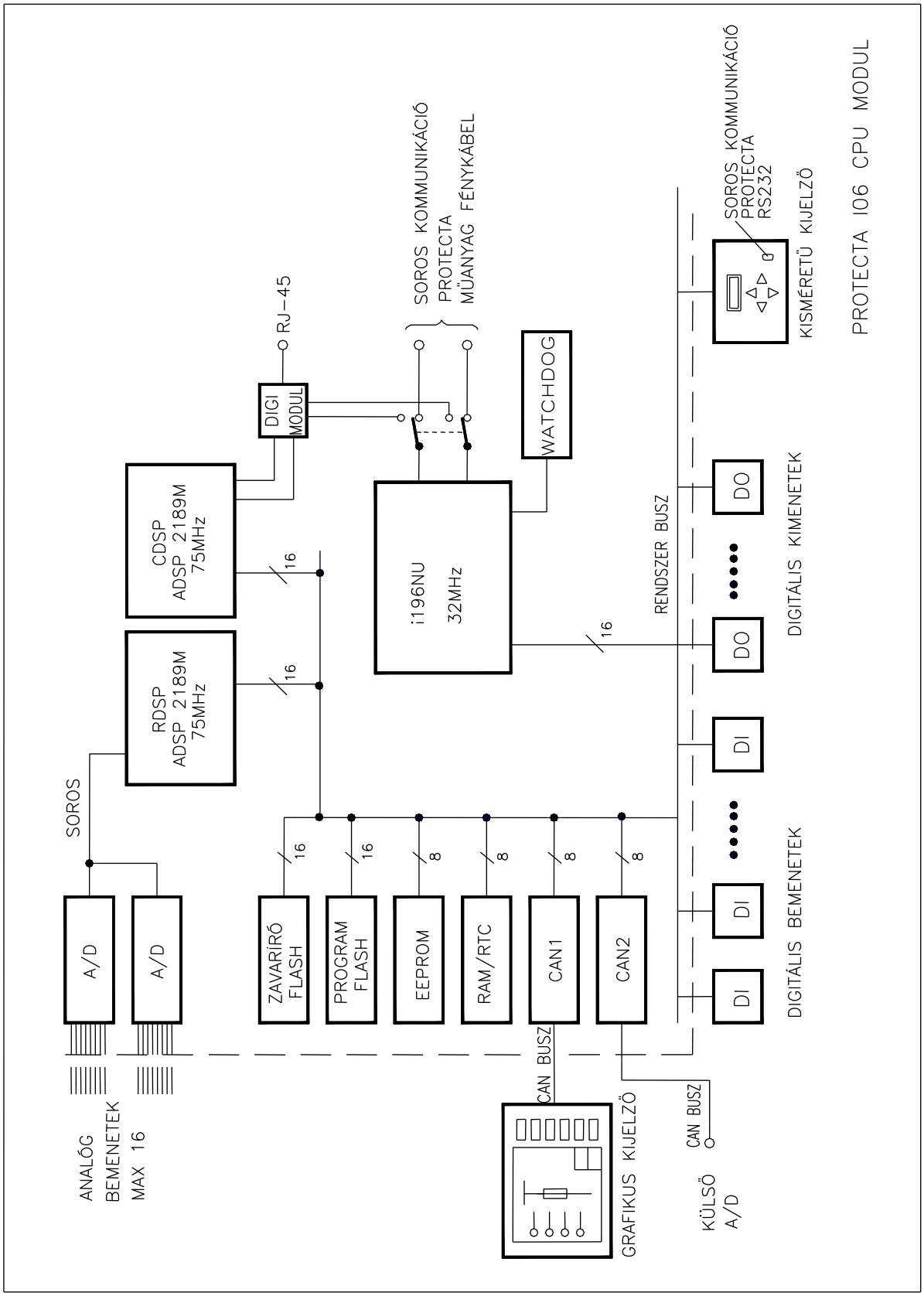
- the communication with the protection engineering workstation is organised with Protecta protocol. This direction gives possibility to set and check the parameters of the protection functions, the measured values and the status signals can be displayed, and the stored disturbance records can be downloaded from the device for analysis. This direction gives possibility to initiate some switching operations as well.
- using standard protocols (IEC 60870-5-101, IEC 60870-5-103, ABB SPA) the supervisory and control system can be connected this way.

Both serial interfaces are prepared to operate in radial, looped or dually looped communications systems with fibre optic, but the basic configuration has a single communication interface for the protection engineering workstation, and one interface towards the supervisory system.

Following page:

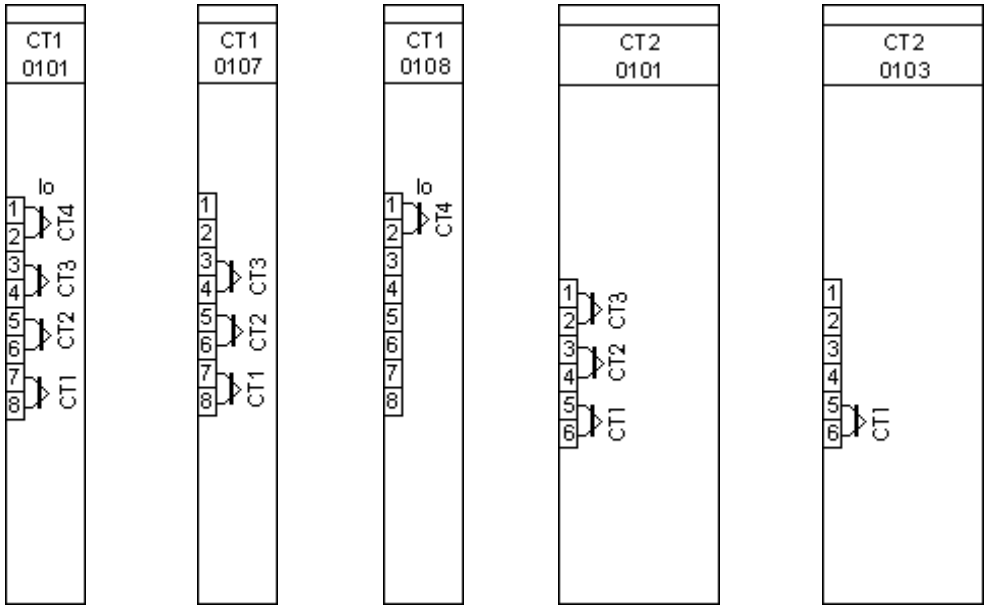
Fig. 11. Principal scheme of the CPU module


PROTECTA I01 CPU CARD
SERIAL COM
RTU DIRECTION
PLASTIC FIBER OPTIC
SERIAL COM
OPTO/RS-232
WATCHDOG
SMALL LCD
CDSP
ADSP 2189M
75MHz
i196NU
32MHz
SYSTEM BUS
DO
DO
DIGITAL OUTPUTS
RDSP
ADSP 2189M
75MHz
16
16
16
SERIAL
A/D
A/D
DIST.REC
FLASH
PRG.
FLASH
EEPROM
RAM/RTC
CAN1
CAN2
8
8
8
8
DI
DI
DI
DIGITAL INPUTS
CAN BUS
BIG GRAPHICAL LCD
CAN BUS
EXTERNAL
A/D
ANALOG
INPUTS
MAX 16


PROTECTA I06 CPU MODUL
SOROS KOMMUNIKÁCIÓ PROTECTA RS232
KISMÉRETŰ KIJELZŐ
SOROS KOMMUNIKÁCIÓ PROTECTA MŰANYAG FÉNYKÁBEL
RJ-45
DIGI MODUL
WATCHDOG
CDSP ADSP 2189M 75MHz
RDSP ADSP 2189M 75MHz
i196NU 32MHz
RENDSZER BUSZ
DO
DO
DIGITÁLIS KIMENETEK
DI
DI
DI
DIGITÁLIS BEMENETEK
SOROS
A/D
A/D
ZAVARÍRÓ FLASH
PROGRAM FLASH
EEPROM
RAM/RTC
CAN1
CAN2
16
8
CAN BUSZ
GRAFIKUS KIJELZŐ
CAN BUSZ
KÜLSŐ A/D
ANALÓG BEMENETEK MAX 16

„CT" the current transformer input module

This is an input module with intermediate current transformers to input the phase currents and the zero sequence current. The rated current for the phase current can be 1 A or 5 A. If the zero sequence current in not derived from the sum of the phase current transformers, but a summation current transformer is applied, then this rated current is 100 mA.



a) *b)* *c)* *d)* *e)*

Fig. 12 The current input modules

The most frequent versions of this module are summarised in Table 8.

Table 8. Versions of the current input modules

Technical data:

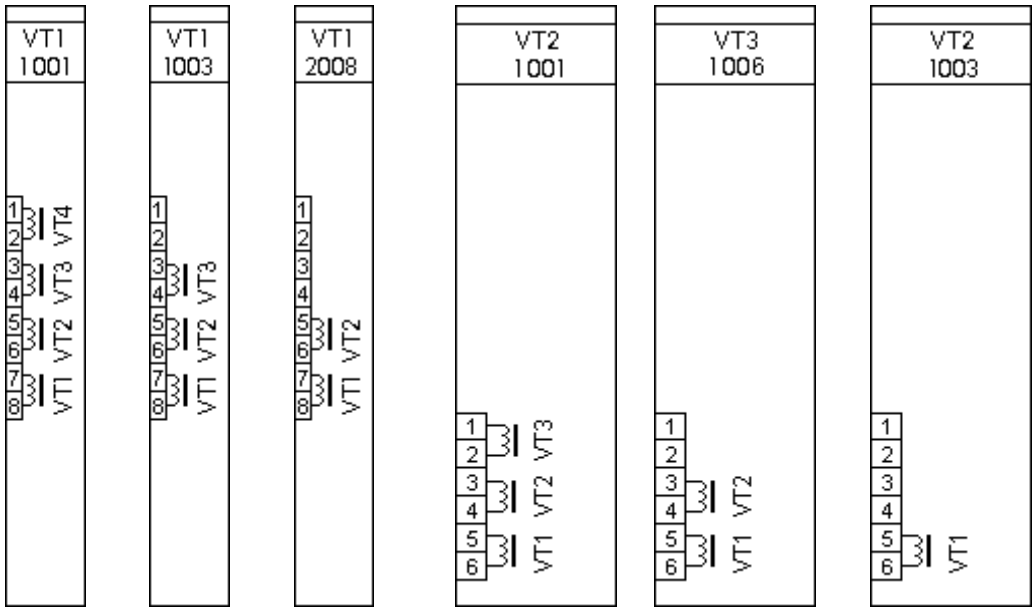
Information	Data
Rated current In (toroidal CT)	1 A or 5 A (100 mA)
Continuous current	4 * In
Short time overload (1s)	100 * In (if In = 1 A), and 50 * In (if In = 5 A)
Dynamic overload	100 * In
Power consumption Double size version Single size version	 < 1 W <0.2 W

Table 9 Technical data of the CT input modules

Code	Channel	Rated current	Sampling
CT1/0101	3 (8-7,6-5,4-3) + 1 (2-1)	1A (200mV) + 1A (1V)	simple
CT1/0112	3 (8-7,6-5,4-3)	1A (200mV)	simple
CT1/0118	4 (8-7,6-5,4-3)	1A (400mV)	simple
CT1/0501	3 (8-7,6-5,4-3) + 1 (2-1)	5A (200mV) + 5A (1V)	simple
CT1/0105	3 (8-7,6-5,4-3) + 1 (2-1)	1A (400mV) + 1A (1V)	simple
CT1/0505	3 (8-7,6-5,4-3) + 1 (2-1)	5A (400mV) + 5A (1V)	simple
CT1/0512	3 (8-7,6-5,4-3)	5A (200mV)	simple
CT1/0518	4 (8-7,6-5,4-3)	5A (400mV)	simple
CT1/1104	3 (8-7,6-5,4-3) + 1 (1-2)	1A (200mV) + 0.1A (1V)	simple
CT1/1110	3 (8-7,6-5,4-3) + 1 (2-1)	1A (400mV) + 0.1A (1V)	simple
CT1/1113	3 (8-7,6-5,4-3) + 1 (2-1)	1A (400mV) + 0.1A (1V)	simple
CT1/1502	3 (8-7,6-5,4-3) + 1 (2-1)	1A (200mV) + 0.5A (1V)	simple
CT1/5502	3 (8-7,6-5,4-3) + 1 (2-1)	5A (200mV) + 0.5A (1V)	simple
CT1/1514	3 (8-7,6-5,4-3)	1A,5A,5A (400mV)	simple
CT1/1515	3 (8-7,6-5,4-3)	1A,5A,1A (400mV)	simple
CT1/1516	3 (8-7,6-5,4-3)	1A,1A,5A (400mV)	simple
CT1/1517	3 (8-7,6-5,4-3) + 1 (2-1)	1A (200mV) + 5A (200mV)	simple
CT1/5104	3 (8-7,6-5,4-3) + 1 (2-1)	5A (200mV) + 0.1A (1V)	simple
CT1/5110	3 (8-7,6-5,4-3) + 1 (2-1)	5A (200mV) + 0.1A (1V)	simple
CT1/5113	3 (8-7,6-5,4-3) + 1 (2-1)	5A (400mV) + 0.1A (1V)	simple
CT1/0103	4	1A (200mV)	simple
CT1/0503	4	5A (200mV)	simple
CT1/0107	3	1A (400mV)	simple
CT1/0507	3	5A (400mV)	simple
CT2/0101	3	1A (10mA)	dual
CT2/0102	3	1A (5mA)	dual
CT2/1110	3	1A,1A,1A (10mA)	dual
CT2/1114	3	1A,1A,5A (10mA)	dual
CT2/1514	3	1A,5A,1A (10mA)	dual
CT2/0502	3	5A(5mA)	dual
CT10/1501	4	1A or 5A(100mV)	dual
CT10/1502	4	1A or 5A(200mV)	simple
CT10/1503	3	1A or 5A(400mV)	simple
CT10/1504	3	1A or 5A(100mV)	dual
CT10/1505	3 (8-7,6-5,4-3) + 1 (2-1)	1A or 5A(200mV) + 1A or 5A(1V)	simple
CT10/1506	3 (8-7,6-5,4-3) + 1 (2-1)	1A or 5A(200mV) + 0.1A or 0.5A(1V)	simple
CT10/1507	4	1A or 5A(400mV)	simple
CT10/1508	3 (8-7,6-5,4-3) + 1 (2-1)	1A or 5A(400mV) + 0.1A or 0.5A(1V)	simple
CT10/1509	4	1A or 5A(200mV)	simple
CT10/1510	3	1A or 5A(200mV)	simple
CT10/1511	4	0.025A(700mV)	simple
CT10/1512	3	1A or 5A(1V)	simple
CT10/1513	1 (2-1)	0.1A or 0.5A(1V)	simple
CT10/1514	1 (2-1)	0.025A or 0.05A(1V)	simple

„VT" voltage transformer input modules

If the device performs voltage related functions (over/undervoltage, directionality, distance protection) or the voltage is to be sampled for the disturbance recorder, then this module is needed. The rated voltage of this module is 100 V or 200 V line-to line value.



a) *b)* *c)* *d)* *e)* *f)*

Fig. 13. The voltage transformer input modules

The most frequent versions of this module are summarised in Table 10.

Code	Channels	Rated line voltage	Sampling	Frequency signal
VT1/1001	3+1	100V/5V	single	No
VT1/2001	3+1	200V/5V	single	No
VT1/1002	4	100V/5V	single	Yes
VT1/1003	3	100V/5V	single	No
VT1/1007	4	100V/5V	single	No
VT1/1008	2	100V/5V	single	No
VT1/2002	4	200V/5V	single	Yes
VT1/2003	3	200V/5V	single	No
VT1/2007	4	200V/5V	single	No
VT1/2008	2	200V/5V	single	No
VT2/1001	3	100V/15.3V	dual	-
VT2/2001	3	200V/15.3V	dual	-
VT4/1003	3	100V(20mA)/5V	single	No
VT4/1004	4	100V(10mA)/5V	single	No
VT4/1005	3	100V(20mA)/5V	single	Yes
VT4/1006	3	100V(20mA)/5V	single	No
VT4/1007	4	100V(20mA)/5V	single	No
VT4/1008	2	100V(10mA)/5V	single	No
VT4/1009	3+1	100V(20mA)/5V + 100V(10mA)/5V	single	Yes
VT4/1010	3+1	100V(20mA)/5V + 100V(10mA)/5V	single	No
VT4/1011*	3	100V(20mA)/5V	dual	No
VT4/1012*	3+1	100V(20mA)/5V + 100V(10mA)/5V	dual	No
VT4/1013*	1	100V(20mA)/5V	dual	No

** reduced inductance*

Table 10 Versions of the voltage transformer modules

Technical data:

Information	Data
Rated voltage Un	100 V, 200 V, 100 V/$\sqrt{3}$, 200 V/$\sqrt{3}$
Continuous voltage Double size version Single size version	 2 * Un 1.5 * Un
Power consumption	< 1.5 W

Table 1. Technical data of the VT input modules

The system has combined modules (VTCT) as well. The combined module versions are summarised in Table 12:

Code	Channels	Rated current	Rated voltage	Sampling
CTVT/0111	2 currents (8-7,6-5) + 1 voltage (2-1)	1A (200mV)	100V (5V)	single
CTVT/0511	2 currents (8-7,6-5) + 1 voltage (2-1)	5A (200mV)	100V (5V)	single
CTVT/0508	2 currents (8-7,6-5) + 1 voltage (2-1)	5A (5mA)	100V (5V)	dual
CTVT/0112	2 currents (8-7,6-5) + 1 voltage (2-1)	1A (200mV) 1A (400mV)	100V (5V)	single
CTVT/0512	2 currents (8-7,6-5) + 1 voltage (2-1)	5A (200mV) 5A (400mV)	100V (5V)	single
CTVT/5122	2 currents (8-7,6-5) + 1 voltage (2-1)	5A (5mA) 1A(5mA)	220V (5V)	dual
CTVT/0520	2 currents (8-7,6-5) + 1 voltage (2-1)	5A (200mV)	200V (5V)	single

Table 12. Combined analogue input modules

„OX" Optically isolated communication modules

The task of the optically isolated communication module is to transmit sampled analogue or digital signals to higher distances via fibre optic cables. The main application is longitudinal line differential protection and bus-bar protection. For evaluation of the communication capacity, the following information must be considered: in each sampling period (1 ms) 4 word sampled data (four channels) and additionally 4 word digital information can be transmitted.

Technical data of OX module:

Information	Data
Optical code	Manchester
Optical frequency	10 MHz
Communication speed	1.2 Mbit/s
Optical sending element	Laser diode
"Single" mode (SM) cable application	
Wave length	1300 or 1550 nm
Optical power	> -7 dBm
Optical receiver	InGaAs diode
Receiver sensitivity	< -35 dBm
Optical connector	FC PC
Fibre optic cable internal diameter	9 nm
Maximal distance	>100 km
"Multi" mode (MM) cable application	
Wave length	850 nm
Optical power	> -7 dBm
Optical receiver	InGaAs diode
Receiver sensitivity	< -35 dBm
Optical connector	FC PC
Fibre optic cable internal diameter	50 or 62.5 nm
Maximal distance	2-4 km

Table 13. Technical data of the OX module

Disconnection of the glass fibre optic cables maybe performed in inactive state, by qualified personnel only. Not proper handling can cause serious damages of the optical elements.

The most important versions of the OX modules are summarised in Table 14.

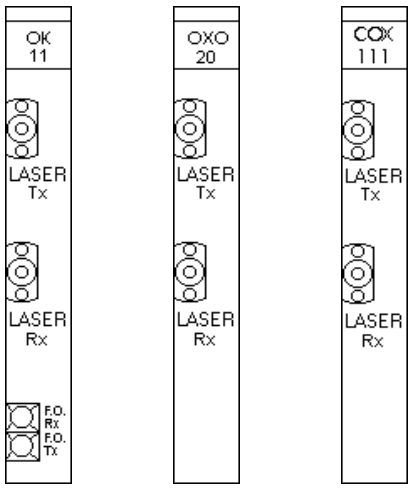


Fig. 14. Versions of the OX module

Code	Channels	Master/slave	Modus	Wave length
COX/111	1	master	mono	1310nm
COX/112	1	master	mono	1550nm
COX/120	1	master	multi	-
COX/211	1	slave	mono	1310nm
COX/212	1	slave	mono	1550nm
COX/220	1	slave	multi	-
COX/312	1	selectable	mono	1550nm
COX/320	1	selectable	multi	-
OX/11	1	-	mono	1310nm
OX/12	1	-	mono	1550nm
OX/20	1	-	multi	-
OXR/11	1	-	mono	1310nm
OXR/12	1	-	mono	1550nm
OK/11	1	-	mono	1310nm
OK/12	1	-	mono	1550nm
OK/20	1	-	multi	-
OK/21*	1	-	multi	-
OXO/20	1	-	multi	-
OXO1/20	1	-	multi	-
COM3/20	3	-	multi	-

** not coded*

Table 14. Versions of the OX modules

„ZI" Independent disturbance recorder module

The EuroProt system can contain as an option an "independent" disturbance recorder module as well. This disturbance recorder can fulfil all usual requirements for a modern disturbance recorder. This module can be configured to select the analogue channels (up to 16) and digital channels (up to 64). These channels can be measured or derived channels too, generally, all information can be recorded, which is available in the protection functions.

The disturbance recorder module has no own man-machine interface. The parameter setting and the uploading of the recorded disturbances are performed with the help of ***Protect for Windows software*** via fibre optic channel. This module has an independent device code, it can be connected to the fibre optic communication network, as any other Protecta devices.

The storage of the recorded disturbances is performed by a battery protected static RAM, optionally with 1, 2 or 4 Mbyte capacity. The duration of the recording is determined by the memory capacity. For example in case of 15 analogue and 32 digital signal channels a 4 Mbyte SRAM can store about 100 s recordings. If the memory is full, the oldest record is overwritten, but the time stamps of the deleted record remain available. The time information of up to 100 records can be stored, the oldest ones can be overwritten.

The triggering of the recording can be set by parameters: this can be an analogue signal level violation, a rising or falling edge of a digital signal or any changes of the levels. The maximum duration of a record, the pre-fault and the pos-fault time can be defined as well. The scaling is a parameter too.

The disturbance recorder parameters in the „**Protect for Windows"** software are displayed according to Fig. 15.

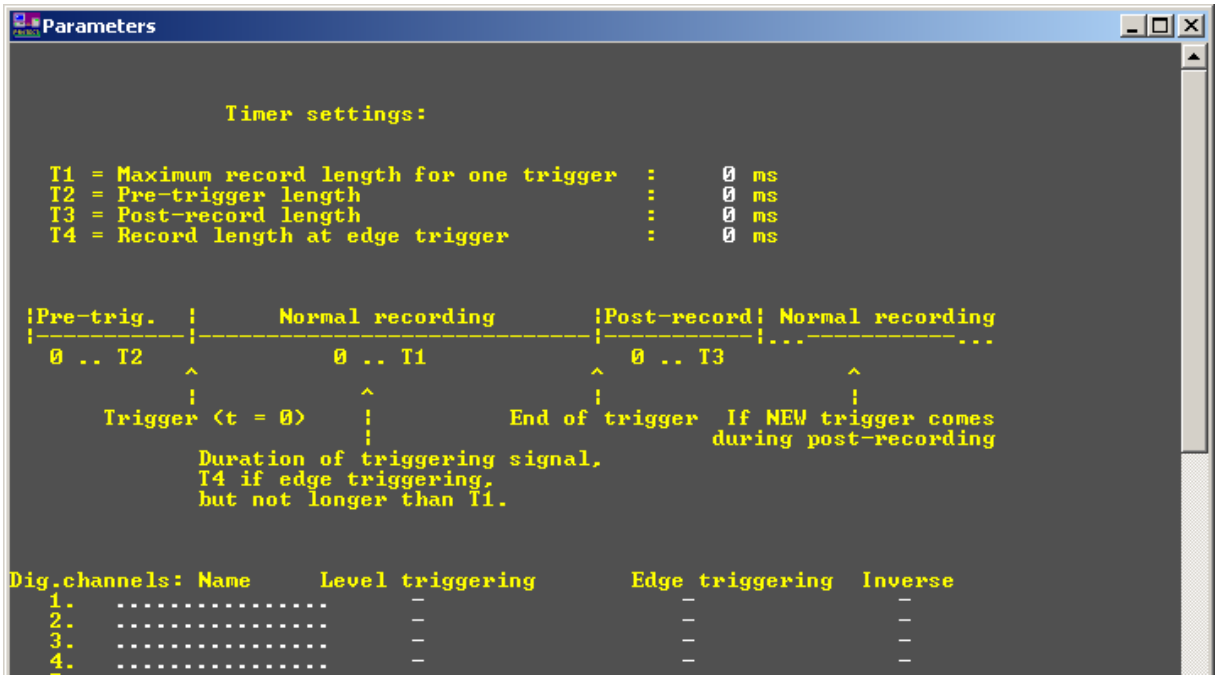


Fig. 15. Setting of the disturbance recorder

The text on the screen explains the meaning of T1, T2, T3 and T4 time parameters. The meaning of "Normal recording" on the screen needs some additional remark: if for the triggering by a digital channel "Edge" triggering" is selected, which means that the recording is started by a change in the selected digital signal, then the duration of the recording is T4+T2+T3. When however Level triggering is selected, then the duration of the "Normal recording" is the duration of the selected signal state. In any cases, the duration is limited by T1.

The parameters of the channels can be selected according to the following figures:
One page on the screen contains 32 digital channels, page down, if there are more of them. The names of the digital channels can be freely edited; this name will be shown on the replayed records.

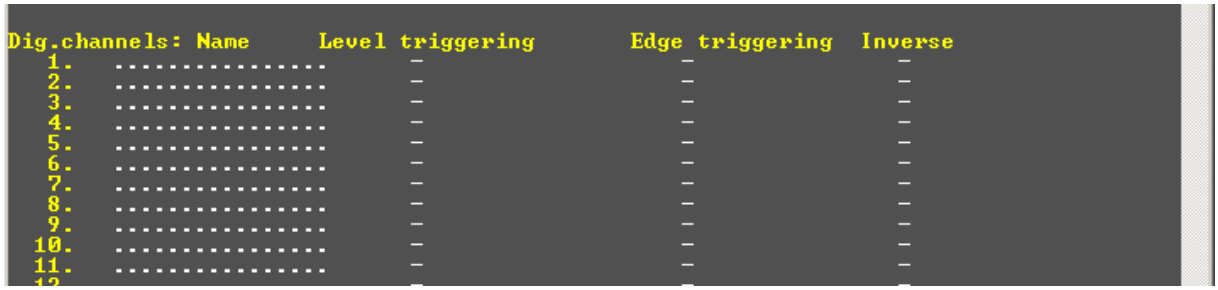


Fig. 16. Recorder settings for digital channels

If the "Level triggering" column contains a "+" mark, then the triggered state is valid during the duration of 1 state of this signal. If at the same time the "Inverse" column contains the "+" mark as well, then the triggered state is the 0 state of the selected signal.

The "+" mark in the "Edge triggering" means triggering by a 0 -> 1 transition of the selected signal. The "Inverse" column can invert the triggering for a 1 - > 0 transition. Each transition restarts the measuring T4 time.

The triggering is performed using "OR" connection of all trigger settings. This signal is the internal trigger signal, the duration of which determines the duration of the recording. This means, that new triggering can prolong duration of the recording, but this is limited by T1.

If the triggering signal falls back, during the "Post-recording" period a new triggering state will restart recording, and the total duration will be longer by the "Normal recording" time and by T3.

When the triggered state is too long, the disturbance recorder gets in disabled state until reset of the internal trigger signal. The new recording is triggered by the rising edge of the internal trigger signal.

Because of the triggering explained above the inverted level triggering is advised to be applied if the disturbance recorder is supervised (e.g. in a laboratory), because a continuous reset state of the selected signal disables new recording.

The parameters for analogue channels are shown in Fig. 17.

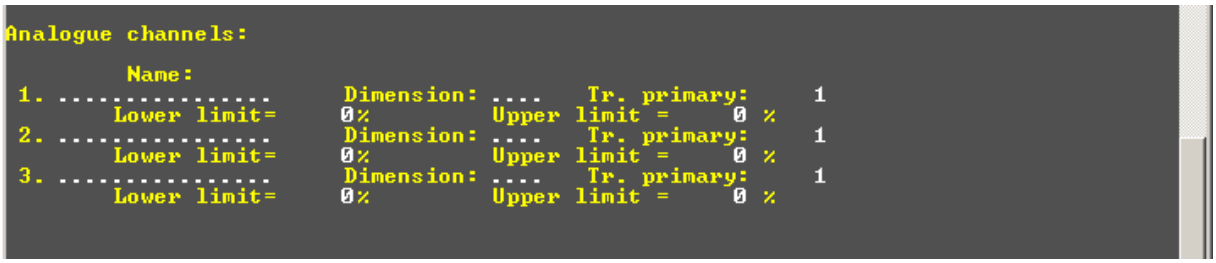


Fig. 17. Recorder settings for analogue channels

The parameters to be set are:

- the name of the channel with maximum 16 characters, according to the real signal application, (this name will identify the signal on the replayed records),
- the dimension of the signal,
- the primary rated value of the signal (the rated secondary value of the measuring transformer must be identical to the rated input value of the device),
- lower limit means triggering, if the signal falls below this level; be careful with this setting. Setting to 0 means no triggering.
- Upper limit means triggering, if the signal rises above this limit. Setting for current to 2500 %, for voltage to 200 % means no triggering).

The "On-line" window of the **Protect for Windows** software shows continuously the measured signals and the triggering conditions.

“TA” analogue signal transmitter modules

These modules can transmit any analogue measured value of the device coded into the 4-20 mA range current loop. This module needs independent power supply input.

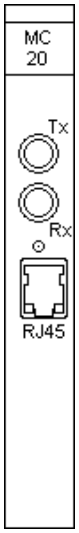
Code	External power	Channel 1	Channel 2
TA2/2420	220V=	4-20mA	4-20mA
TA2/1420	110V=	4-20mA	4-20mA
TA2/4420	48V=	4-20mA	4-20mA
TA2/206	220V=	0-6mA	0-6mA
TA2/106	110V=	±6mA	0-6mA
TA2/406	48V=	0-6mA	0-6mA

Technical specification:

Rated voltage	Un	220/110/48 V DC
Output current range	I	4-20/0-6mA±2%
Output current resolution		12 bits, 1 in 4096
Max load resistance	Ri	1kΩ
Settling time to 0,5%	ts	<10ms
Power supply voltage range	Ut	Un±10%
Insulation tests	2kV RMS 50 Hz. 1 min	5 kV 1,2/50 μs
Signal transmission time	tt	100 ms

MC media converter module

This module is designed to convert the electric signals of the CPU modules with RJ-45 connector to light signals of mono- or multi-mode fibre optic cables. This way the module provides possibility to connect the devices with Ethernet connector for twisted metal cables to Ethernet networks using fibre optic media. The distance for data transmission can be up to 2-4 km(50μm) or 80-100km(9μm) depending on the applied fibre optic cable. The operation of the MC media converter module is independent of the hosting device, which provides power supply voltage only. This module can be applied in EuroProt operating with CPU6 unit extended with RJ-45 Ethernet connection.



MC20	MC12
Tx 62,5/50/9 μm	
Rx 62,5/50/9 μm	
Ethernet connector	

Type of patch cable needed for connection: UTP crossover cable.

FO connector type	ST connector
Connection	Rear side of the device, on the MC20 module
Optical wavelength	820 nm
Laser Class 1 (EN 60825-1/-2)	Glass fibre 50/125 μm or 62.5/125 μm
Permissible optical link signal attenuation	Max 8 dB with glass fibre 62.5/125 μm
Maximum distance of transmission	1.5 km
Character idle state	Configurable: factory setting “Light off”

Additional modules

There are some modules (4...20 mA signal input module, Pt100 signal input module, etc.) designed for special applications. Please contact Protecta Co. Ltd., if you need these options.

The sequence of the modules in the device and the number of the modules depend on the applications. Please find these drawings in the configuration manuals.

Exchange of the modules is permitted only, if their codes are identical. In case of any doubts, please contact Protecta Co. Ltd.