Microprocessor regulator
APOSYS 10-1xxx

TECHNICAL DOCUMENTATION

Producer:

APOELMOS
measurement & control

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ISO 9001

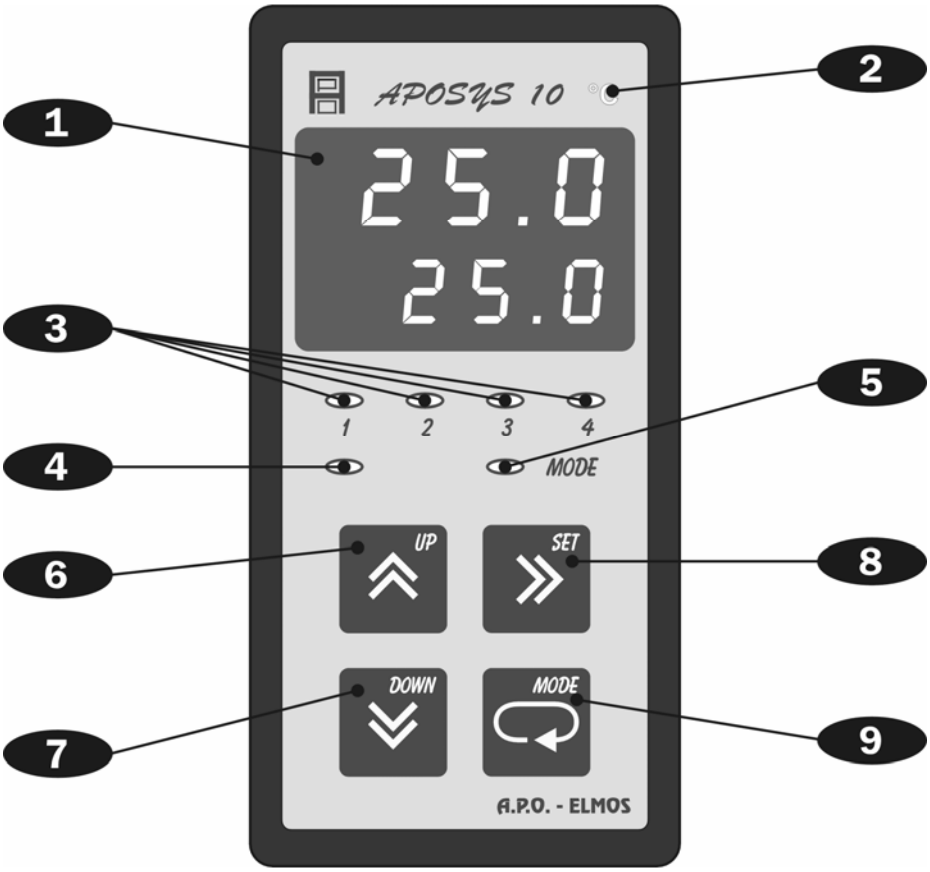
Februar 2005, TD-R-09-01

1 Introduction

The Controller APOSYS 10 is a universal compact controlled system for the monitoring and controlling of technology processes. For example: for the control of processes in freeze-dryers furnaces, cooling plants, smoking chambers, bakery's, farming premises, exchanger stations, or for control of air conditioning in residential and industrial spaces.

2 Description

2.1 Front panel



1 - Display

The double display represents a measuring and a demanding value of the controlled variable. The measuring value is on the upper line and the demanding value is on the bottom line. At measure and control programming the display offers tabular report.

2 - Check light „°C“

If is by operator set the any temperature sensor (Pt 100,Ni 1000,termocouples J, K, T, E, R, S, B), is the check light „°C“ lighting. For other ranges the check light do not lighting.
When the check light will be to twinkle is necessity to let the controller to calibrate by the producer.

3 - Check lights of outputs state

Check lights 1 – 4 indicate the state of single outputs by this way: the check light is lighting – output is switch-on, the check light don't lights – output is switch-off.

4 - Check light „TUNE"

The check light „TUNE" indicate switching-on a function of automatic adaptive tuning PID constants.

5 - Check light „MODE"

The check light „MODE" indicate presence in the programming menu.

6 - Key „UP"

Is for listing in the menu and for a numbers date setting at programming. At the key keeping the listing or setting run faster. In the basic mode is possible to set a requred value SP (see description LOC_ on a page 31) directly.

7 - Key „DOWN"

Is for listing in the menu and for a numbers date setting at programming. At the key keeping the listing or setting run faster. In the basic mode is possible to set a requred value SP (see description LOC_ on a page 31) directly.

8 - Key „SET"

Is for resetting at parameters setting. For return back in parameters programming and for switchover to the manual control.

9 - Key „MODE"

Is for input to programming of parameters and for confirmation of setting dates.

2.2 Input part

APOSYS 10 is one-loop PID controler. In the input part is a universal sixteen bit converter with galvanic isolation. It's allowed to connect the sensor Pt 100, sensor Ni1000/5000ppm, Ni1000/6180ppm, thermocouple (J, K, E, T, S, B), or unificate current (4 - 20 mA, 0 - 20 mA) or voltage (0 - 10 V, 0 - 50 mV) signal. Changing of input signal type is possible by reprogramming by keypad and by jumpers position changing (see page 8).

2.3 Output part

Output elements are four miniature relays with max. loading 250 VAC, 2 A. The relay out1 and out2 are united with the control. The relay out3 and out4 signal the alarm. Relay contacts are protected by varistors. For switching of inductive loading is recommended ,for increase of reliability and decrease of interference, to corresponding contacts to connects anti-jamming RC networks (for example 0,1 uF + 220 Ω).

Warning: *Connected varistors are defined for max. working voltage 250 Vef. At switching some motors in a single-phase connecting with a capacitor, for phase shift, can make it on winding connected through the capacitor permanent increasing the working voltage over setting of value allowable varistors voltage. Therefore we recommend to connect electric drive per protective relays (see page 13)*

Coherent analog output (16 bit) is possible to set as a control or as measured value output. Control coherent analog output work duplicitly with relay outputs out1 and out2.

Adjustable ranges of analog output are 0 - 20 mA, 4 - 20 mA, 20 - 0 mA, 20 - 4 mA for current signal and 0 - 10 V, 2 - 10 V, 10 - 0 V, 10 - 2 V for voltage signal.

Dates output is realised by serial communication line RS 232 or RS 485. The type of communication is Master-Slave. The controler is Slave.

2.4 Apparatus function

The controller APOSYS 10 – 1xxx makes a regulation to the constant value. Required value is setting in the menu COMP.

A type of regulation is possible to set in the menu REGO. Possibilities are:

ONOF two-state regulation
PROI proportional impulse regulation
PIDI PID impulse regulation
PID3 PID three-state regulation

At setting of regulation ONOF is the analogue output controlled by PID algorithm. The same is for setting of regulations PIDI or PID3. At the setting of regulation PROI is the analogue output controlled by proportional algorithm.

2.5 Technical dates

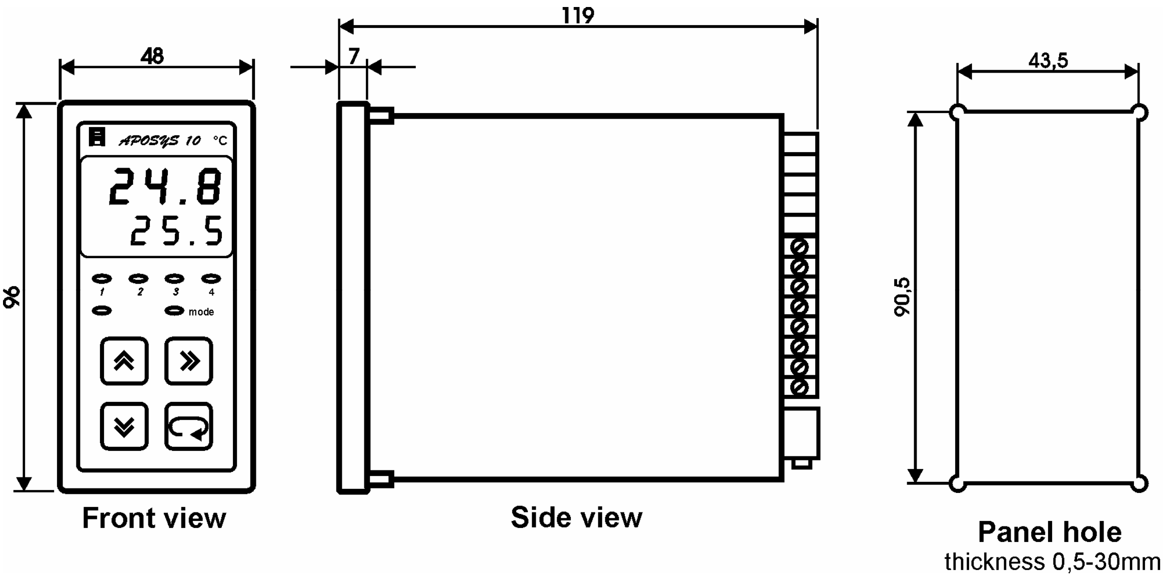
Power supply	APOSYS 10-xxx1=1/N/PE - 230 VAC (+10 -15%) 50Hz
	APOSYS 10-xxx2= 24 VDC (+10 -15%)
	APOSYS 10-xxx3= 24 VAC (+10 -15%) 50Hz
Power input	max. 6 VA
Fuse	for power supply 230VAC - 0,05A (T 50 mA)
	for power supply 24VAC, 24VDC - 0,63A (T 630 mA)
Display	-999 ~ 9999
	red double four point LED
	height of mark 10 mm and 7,62 mm
Decimal point	setting by program
Input signals:	
Number of inputs	1
Possibility of inputs signals	
thermocouple „J“	-200 ~ 1200 °C
thermocouple „K“	-200 ~ 1300 °C
thermocouple „E“	-200 ~ 1000 °C
thermocouple „T“	-200 ~ 400 °C
thermocouple „R“	-50 ~ 1700 °C
thermocouple „S“	-50 ~ 1700 °C
thermocouple „B“	-250 ~ 1800 °C with linearization from 400°C
sensor Pt100 by DIN IEC 751/A2	-80 ~ 800 °C
sensor Ni1000/6180ppm	-50 ~ 200 °C
sensor Ni1000/5000 ppm	-50 ~ 200 °C
current	4 ~ 20 mA, 0 ~ 20 mA
voltage	0 ~ 10 V, 0 ~ 50 mV

Compensation of thermocouples comparison ends :

inner	accuracy 0,5°C at temp. 20°C
	temperature coefficient 50 ppm / °C
outer	20°C, 50°C or 70°C setting by program
Outputs:	
switching-on	2x relay 250 VAC, 2 A
	2x relay 250 VAC, 2 A for alarm
analogue	16 bit D/A converter, isolated or bare
	current range 0 ~ 20 mA, 4 ~ 20 mA, 20 ~ 0 mA, 20 ~ 4 mA - loading resistance max. 500 Ω
	voltage range 0 ~ 10 V, 2 ~ 10 V, 10 ~ 0 V, 10 ~ 2 V - loading resistance min. 10 kΩ
dates	communication line RS 232/RS 485
	speed 9600 Baud
	11 bits, communication master-slave
Temperature coefficient	25 ppm / °C
Measuring accuracy	±0,1 % from range ±1 digit
Speed	5 measurements / s
Resolution	by decimal point state, max. 0,01
Calibration	at 25°C and 40 % r.h.
Processor	SAB 80C535N

Data redundancy	electrically EEPROM
Auxiliary voltage	20 VDC, max. 25 mA (electronic fuse)
Type of apparatus	panel
Dimensions	48 x 96 x 119 mm
Mounting hole in panel	43,5 x 90,5 mm (with holes ∅ 3 mm in corners)
Keyboard	4 foil keys
Operating temperature	0 ~ 60 °C
Weight	0,5 kg
Steady time	to 5 min after switch-on
Coverage	IP 54 (front panel)
Safety rate	I
Bonding	terminal block (max. 2,5 mm^2)
Data communication connector	Canon 9V

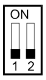
2.6 Dimensions



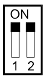
2.7 Mounting instruction

The controller handle in the mounting hole with help two holders. Wires are connected to screw connectors on rear panel of the controller. Connectors are as 4 single taking down construction blocks: connectors 1 - 5 - block of inputs, connectors 6 - 9 – block of analog output, connectors 10 - 17 – block of relays outputs, connectors 18, 19, 20 - block of power supply. Every block of connectors is possible to eject in the direction back after lock force overcoming. Wires are possible to connect to taking down blocks and then connect all blocks to the controller.Connector Cannon is for connecting of serial communication line RS 232 or RS 485.

Double switch DIP is like a hardware protection of setting dates.

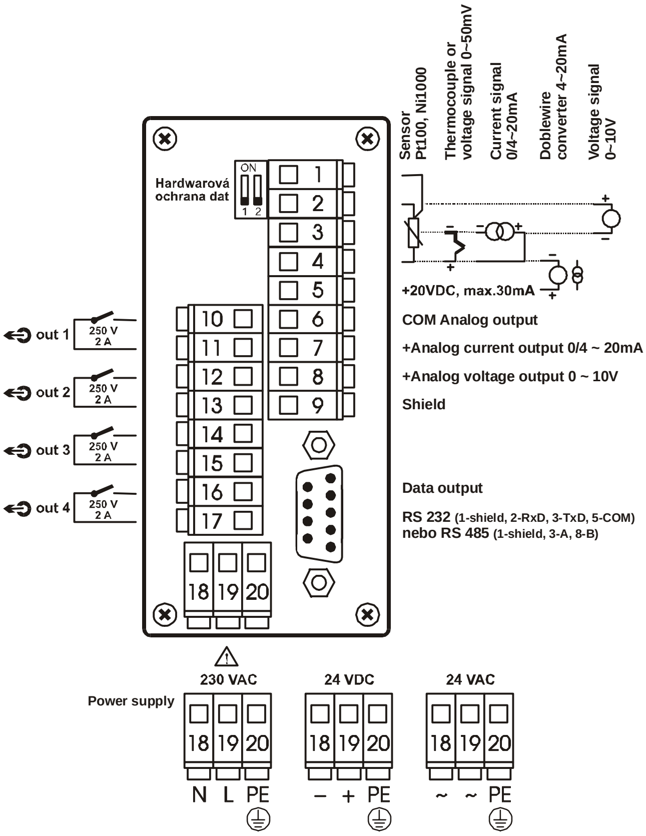


data transcription permit



data transcription forbid – in this position of DIP switches is possible parameters arbitrary to change. But after switch-on and switch-off of power supply is setting parameters shown before of data transcription forbid.

2.8 Connecting of terminal blocks

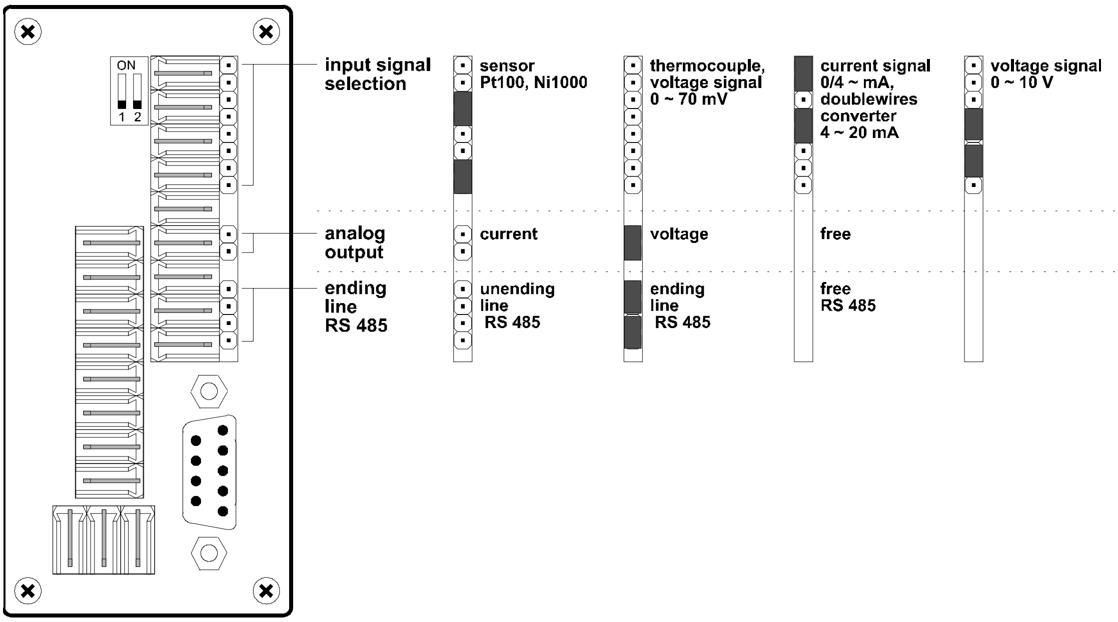


Measure ranges of inputs quantities

Type	range
thermocouple J	-200 ~ 1200°C
thermocouple K	-200 ~ 1300°C
thermocouple E	-200 ~ 1000°C
thermocouple T	-200 ~ 400°C
thermocouple R	-50 ~ 1700°C
thermocouple S	-50 ~ 1700°C
thermocouple B	-250 ~ 1800°C with linearization from 400°C
sensor Pt100	-80 ~ 800°C
sensor Ni1000/6180 ppm	-50 ~ 200°C
sensor Ni1000/5000 ppm	-50 ~ 200°C
current signal 4 ~ 20 mA	optional
current signal 0 ~ 20 mA	optional
voltage signal 0 ~ 10 V	optional
voltage signal 0 ~ 50 mV	optional

2.9 Connecting of main distribution frame

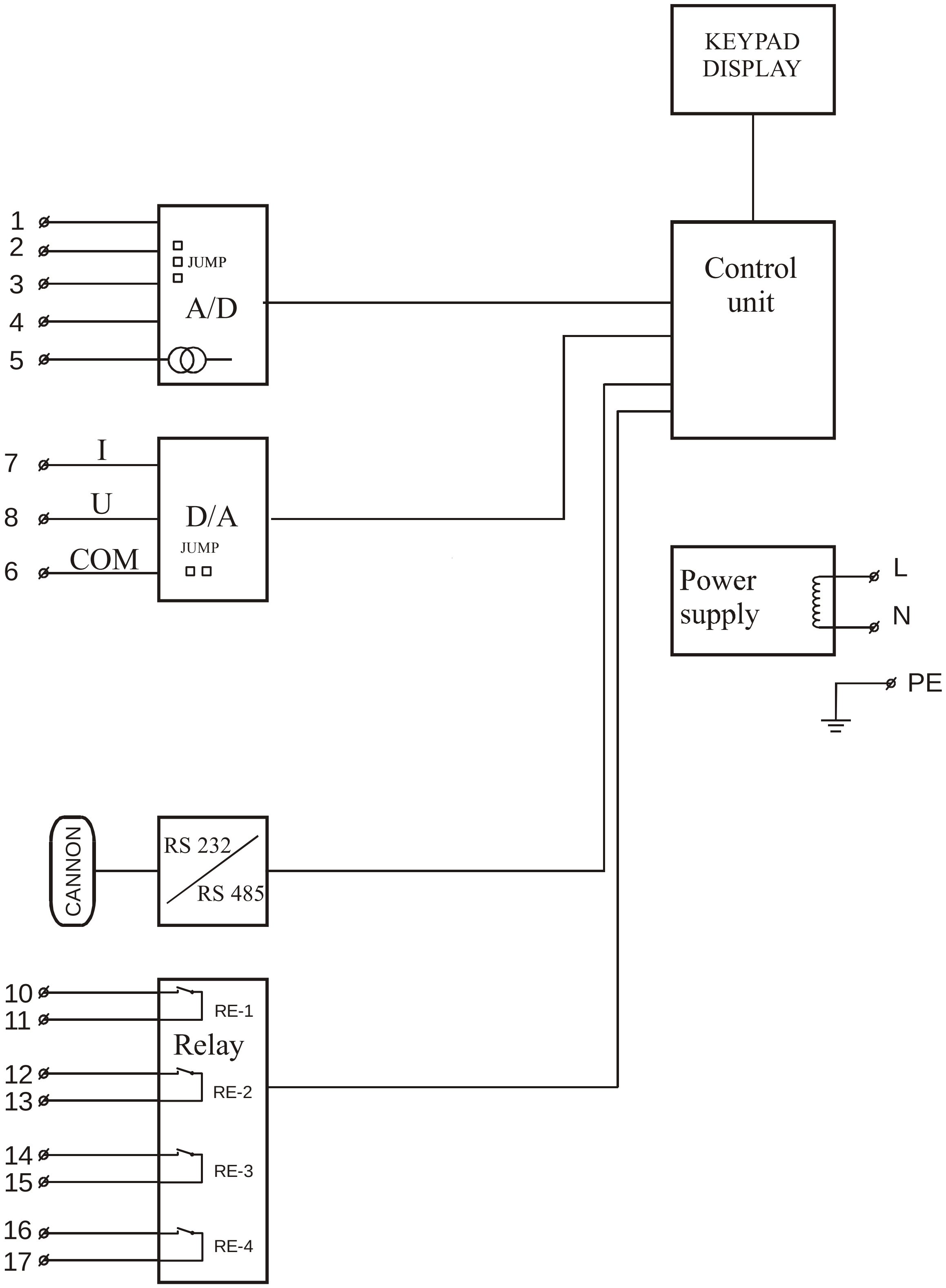
In the main distribution frame is necessary to set with delivered bonds a type of elect input signal, optionally a analog output type. The main distribution frame is allowable after taking down of connectors 1 - 5 and 6 - 9. Possibilities: see the picture. On the picture is demonstrate the rear side of apparatus after taking down of connectors.



At a selection of the type of input signal and the type of analogue signal is necessity to respect the bonds setting for parameters setting in the programming mode.

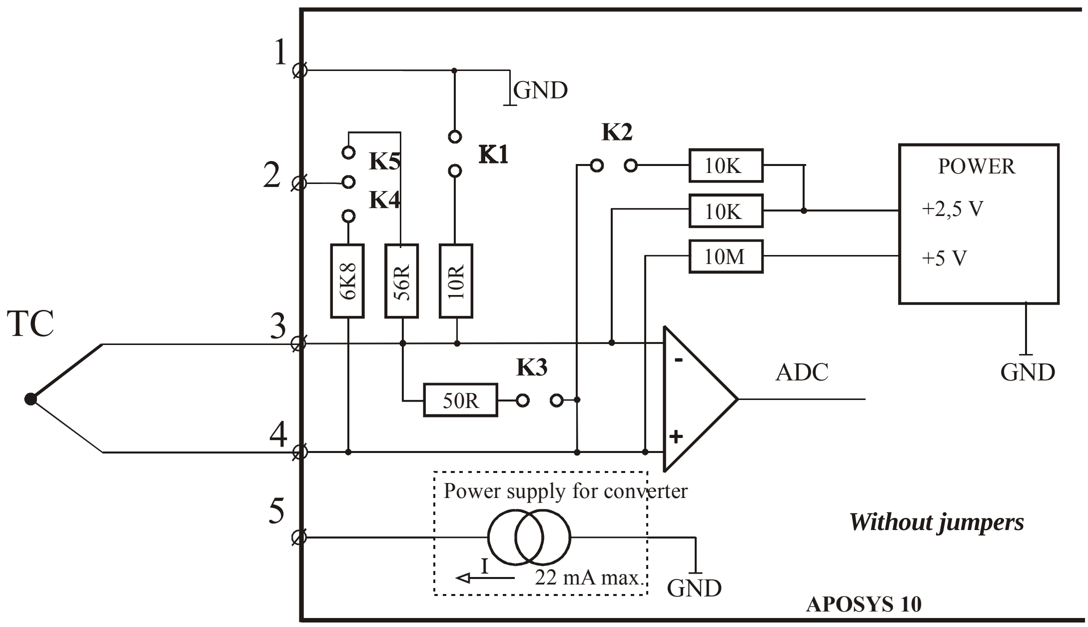
2.10 Block diagram of inner connexion

Block diagram

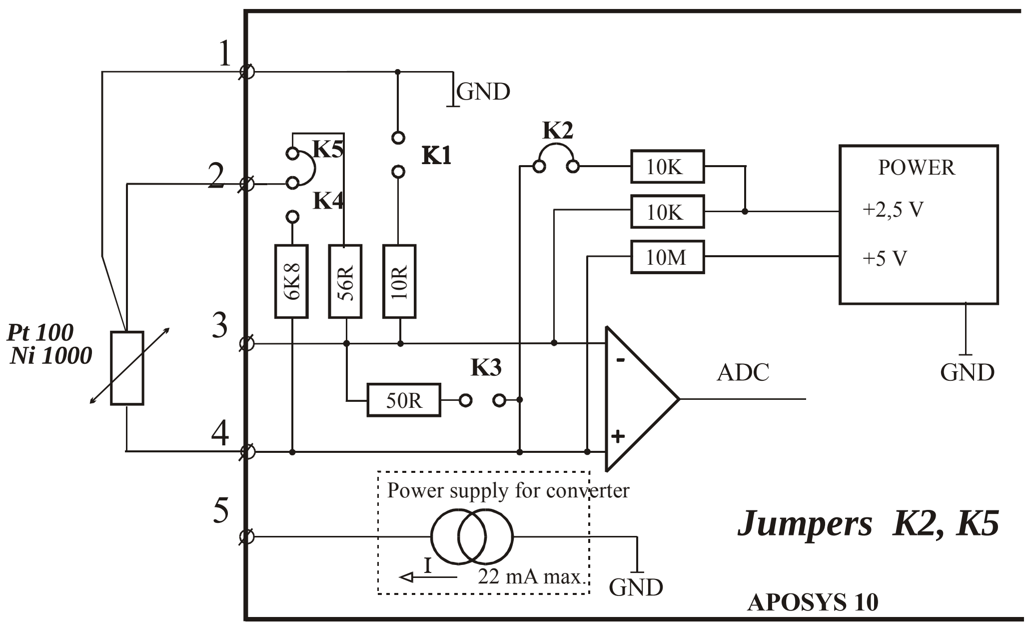


2.11 *Input signals connection*

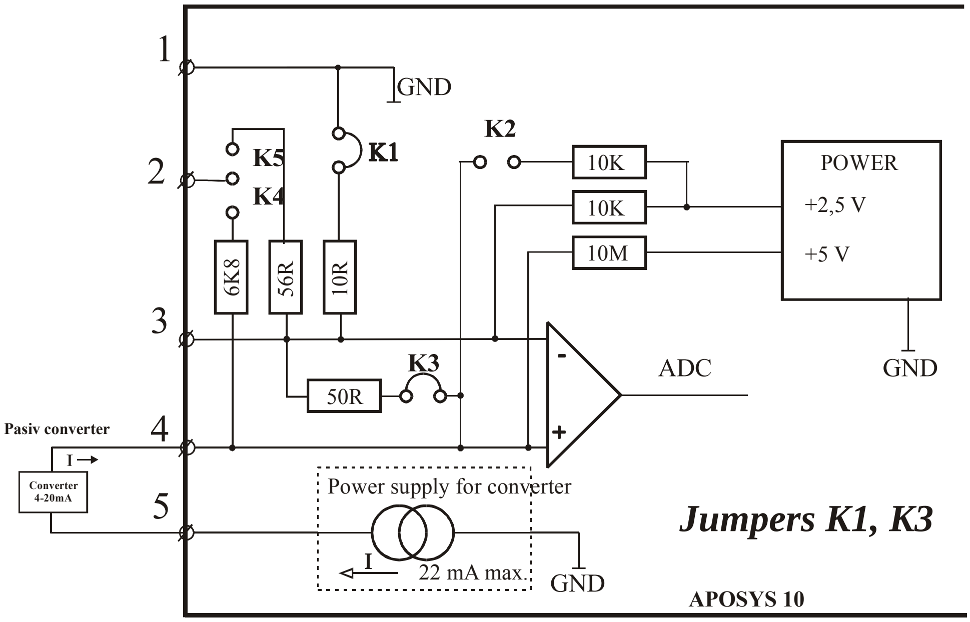
2.11.1 Thermocouple connection



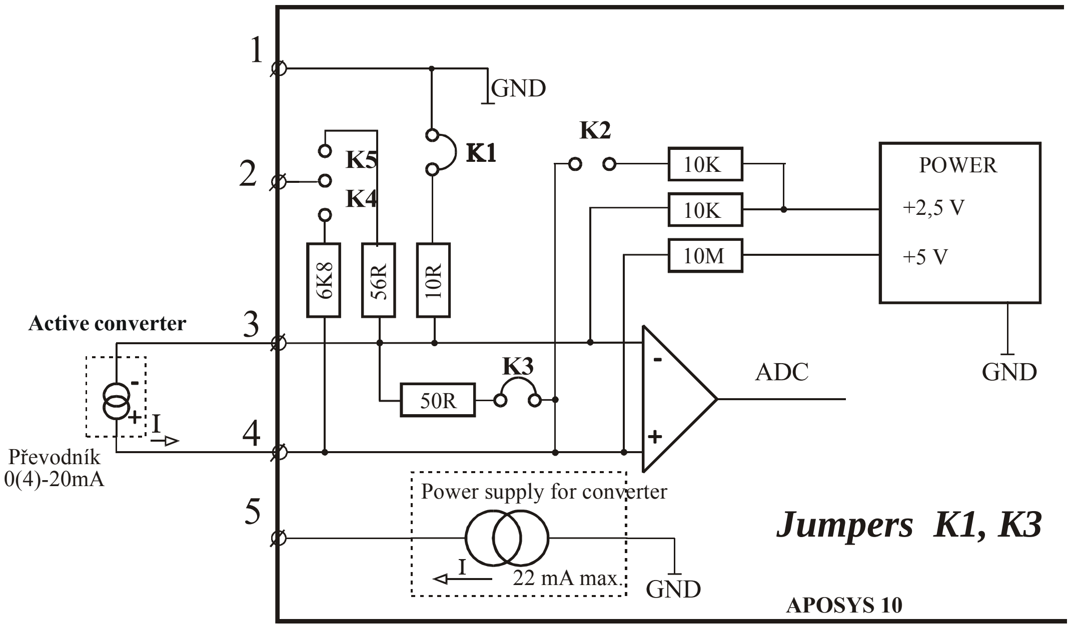
2.11.2 Resistive sensor Pt100 or Ni1000 connection



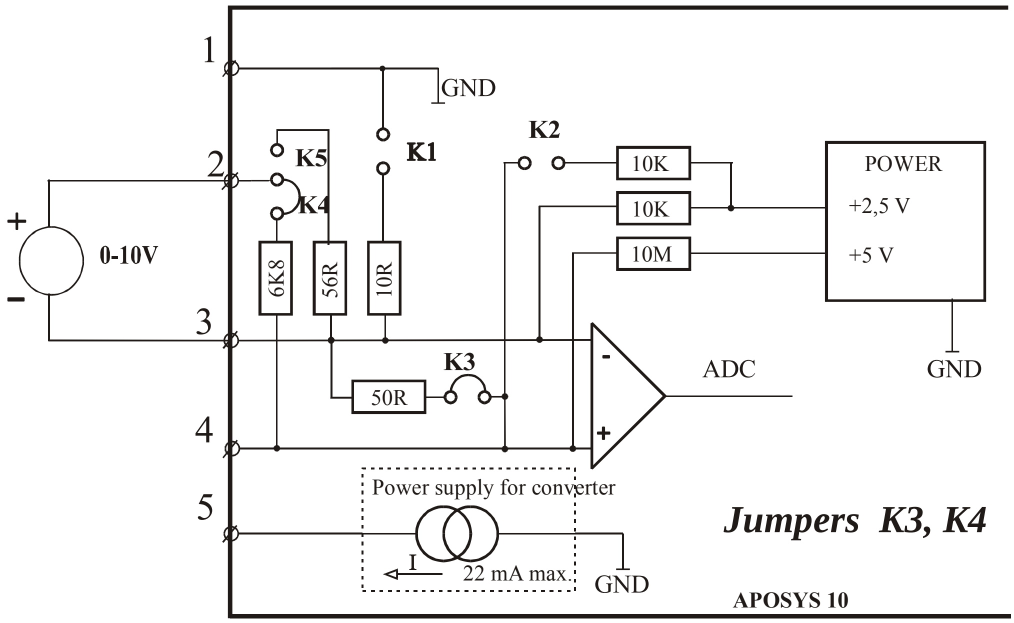
2.11.3 Passive converter 4~20 mA connection



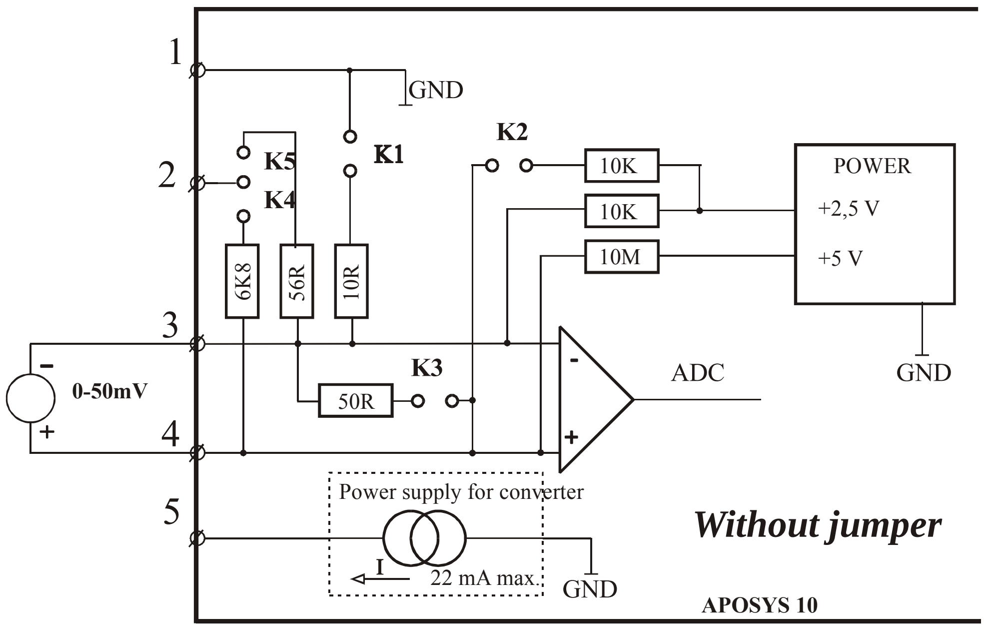
2.11.4 Active signal 0(4)~20 mA connection



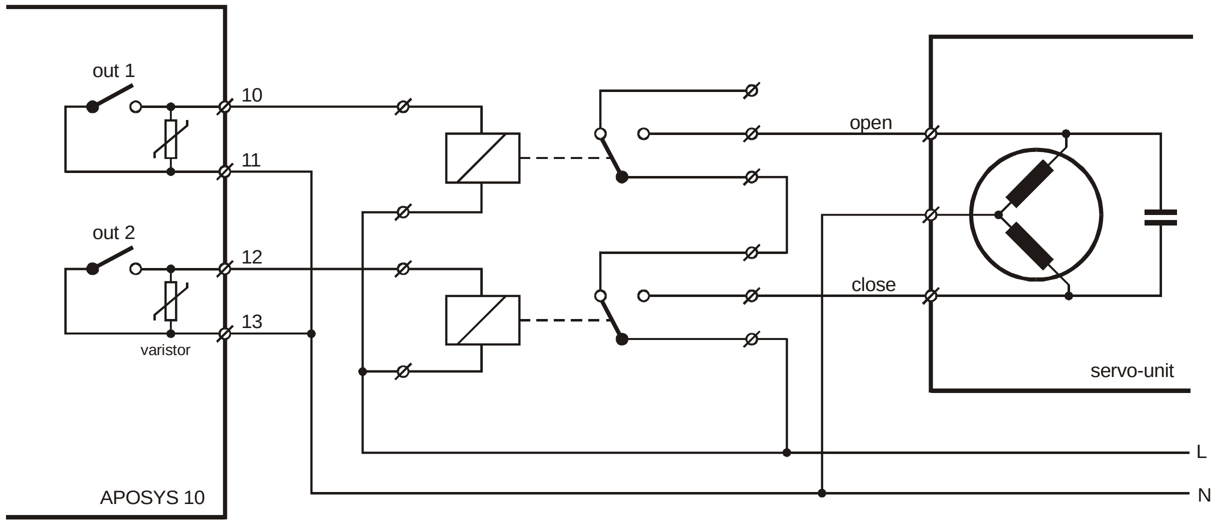
2.11.5 Voltage signal 0~10 V connection



2.11.6 Voltage signal 0~50 mV connection



2.11.7 Electric drive with pulse control recommended connection

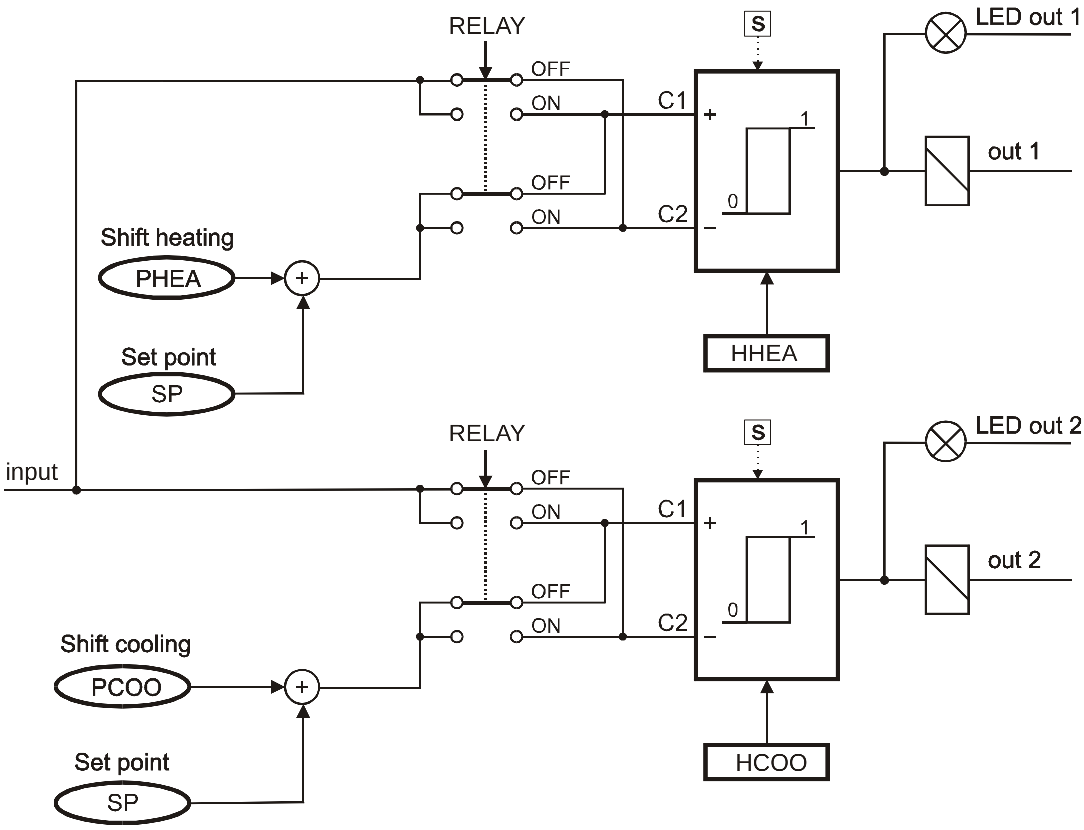


3 Control

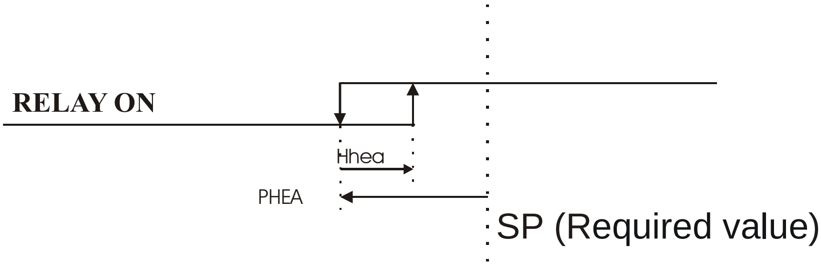
3.1 Control characteristic ONOF

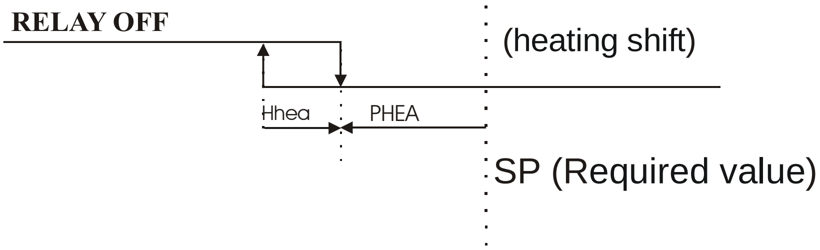
The control ONOF is realize on the first and second output. The control compare input signal with required value and by shift in the menu REGO setting evaluate its variation from required value. At overrun set the output. Concurrently with the ONOF control run PID calculation. Of action intervention from PID we have send to analog output.

3.1.1 Block ONOF control



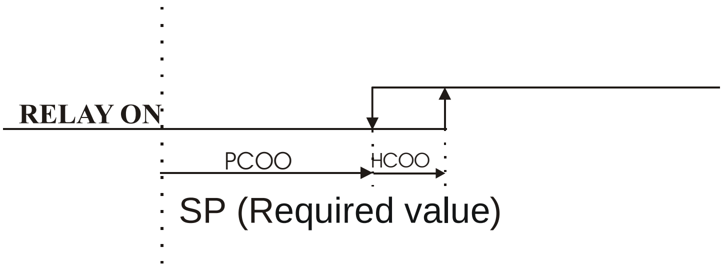
3.1.2 ONOF control – first circle

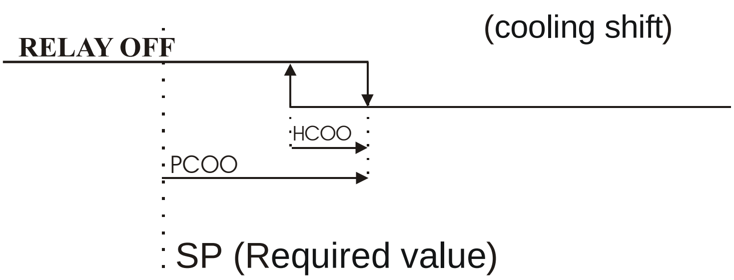




SP	required value
PHEA	shift
HHEA	hysteresis

3.1.3 ONOF control - second circle





SP	required value
PCOO	shift
HCOO	hysteresis

3.2 Characteristic PID control PIDI, PID3, automatic control

The control is drive by algorithm PID from formula:

$$u(k) = K * \{ e(k) + \frac{T}{Ti} * \sum_{i=0}^{k} e(i-1) + \frac{Td}{T} * [e(k) - e(k-1)] \}$$

u (k) the action intervention in the k-moment
K the amplification (_PB_)
e (k) the deviation from the required value in the k-moment
T sampling time (TPID)
Ti integration constant (INT)
Td derivative constant (DER)

The PID controller adjustment compile in suitable setting its constants. The method AUTO-TUNE (starting in the TUNE menu) lead to the basic calculation of setting constants. Is necessary to allow for that count settings are starting oriental values only. In the practice is always necessary the controller at the putting into operation to tune up.

At the average regulation action has controlled value even two-four times overswing after the required value reaching and then to fix.

Basic setting of constants is possible to do next way.

The controller is to set as proportional ,it is mean that derivative and integrating constant are eliminated. After that is find out a critical amplification K_r – it is mean such value K, when is the controller on a stability limit. Is to set smaller K (for exam.1) at first , and after previous initiation to stable state with changing of the required value is done a control run. After system fixation to steady state increase K and change the required value. This action repeat to the time until the system is amplitude. This value correspond to P_{kr}, length of vibration period is T_{kr}. According these values is calculated the basic system parameters setting:

$K = 0,5 * K_{kr}$ $Ti = 0,8 * T_{kr}$ $Td = 0,12 * T_{kr}$

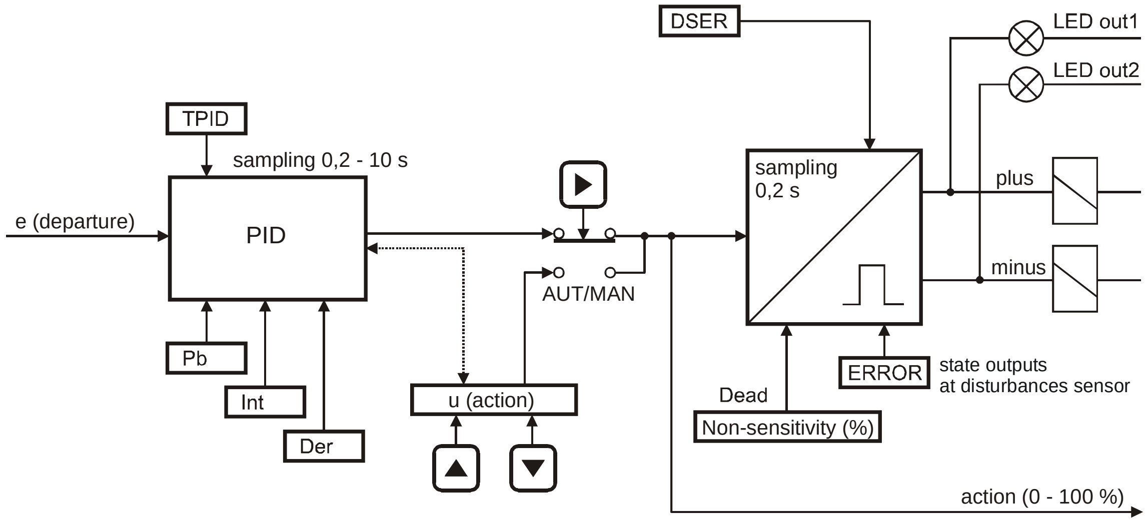
The value of the sampling period is to set so as during transition action come to 6-10 sampling.

When you get at the basic setting of the controller parameters (AUTO-TUNE) the unit step response with the right fast growth but with the big overshoot or with next big overswings you could let the proportional constant _PB_ and to change of time constants - integration constant (INT) to increase and derivative constant (DER) to decrease. It will be the basic unit step response the other way round has character of the system with the big damping (the so-called with the long time of control and non over control) is the necessity to reduce the integration constant (INT) and to increase the derivative constant (DER).

The magnitude of the action intervention at moment is possible to subtract in the PROC menu.

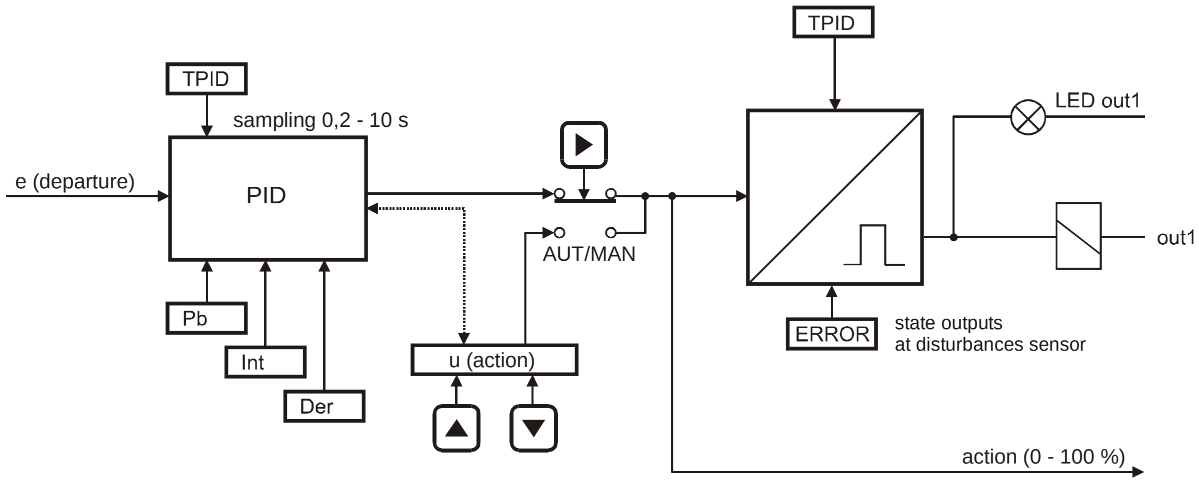
3.2.1 Block PID3 control

Block of control process by the help of PID algorithm the rated diversion e, which is converted to the action intervention. Signal of the action intervention is converted in the impulse module to the output relay. By key arrow to right we come over to manual drive setting. By the parameter DSER we set the servo-unit overtravel time. If we increase DSER, then at the action intervention change about 1% is the impuls run time lengthened.



3.2.2 Block PIDI control

Block of control process by the help of PID algorithm the rated diversion e, which is converted to the action intervention. Signal of the action intervention is converted in the impulse module to the output relay. By key arrow to right we come over to manual drive setting. By the parameter TPID is define impuls period.



3.2.3 Manual control

By the key „arrow to right" in the main menu the controller switch over to manual driving. On the upper line is in turns display RUC_ and the measured value. On the bottom line is possible by arrows up and down manually to set the servo-unit position. The magnitude of the action intervention at moment is on the bottom line of the display. For return to the automatic control is necessity to depress the key MODE. Switchover from the manual control to the automatic control is non- impulse.
When is the control in STOP state, is not possible manually to set the action intervention (the servo-unit position).

3.3 Characteristic of the proportional control PROI

u (k) = K * e (k) + Ps

u (k) the action intervention in the k-moment
K the amplification (proportional constant _PB_)
e (k) the deviation from the required value in the k-moment
Ps power shift (PS)

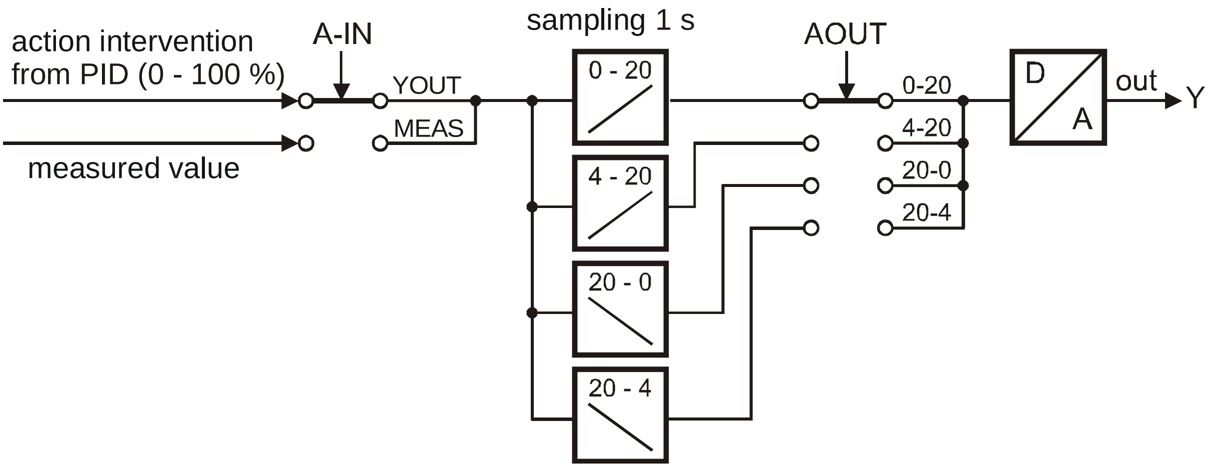
For example:
There are set values: required value SP = 100°C
the amplification _PB_ = 5
power shift PS = 10 %
The measured temperature in k-moment is 90°C. The magnitude of action intervention is calculated from the previous formula:

u (k) = 5 * 10 + 10 = 60 % of action intervention

This value is possible to subtraction in the PROC menu.
At seting control proportional impulse PROI this information demonstrate the time of the switching-on of the output in the setting period PER. For example there is the period time set 10 s, is at 60 % of the action intervention the control output 6 s switch-on and 4 s switch-off.
As long as you use the proportional regulation for the heating you set in the amplification menu _PB_ the positive value. The function heating is achieve on the control output **out1**, output **out2** work inverse against output **out1**.
As long as you use the proportional regulation for the cooling you set in the amplification menu_PB_ the negative value.

3.4 Block of analog output

Analog output is possible to set as the control (typical) output or as the measured value output by the help of the parameter A-IN. Analog output is possible to set as increasing or decreasing in the menu AOUT. By the help of jumpers under rear terminal block we set voltage or current output (see page 8).



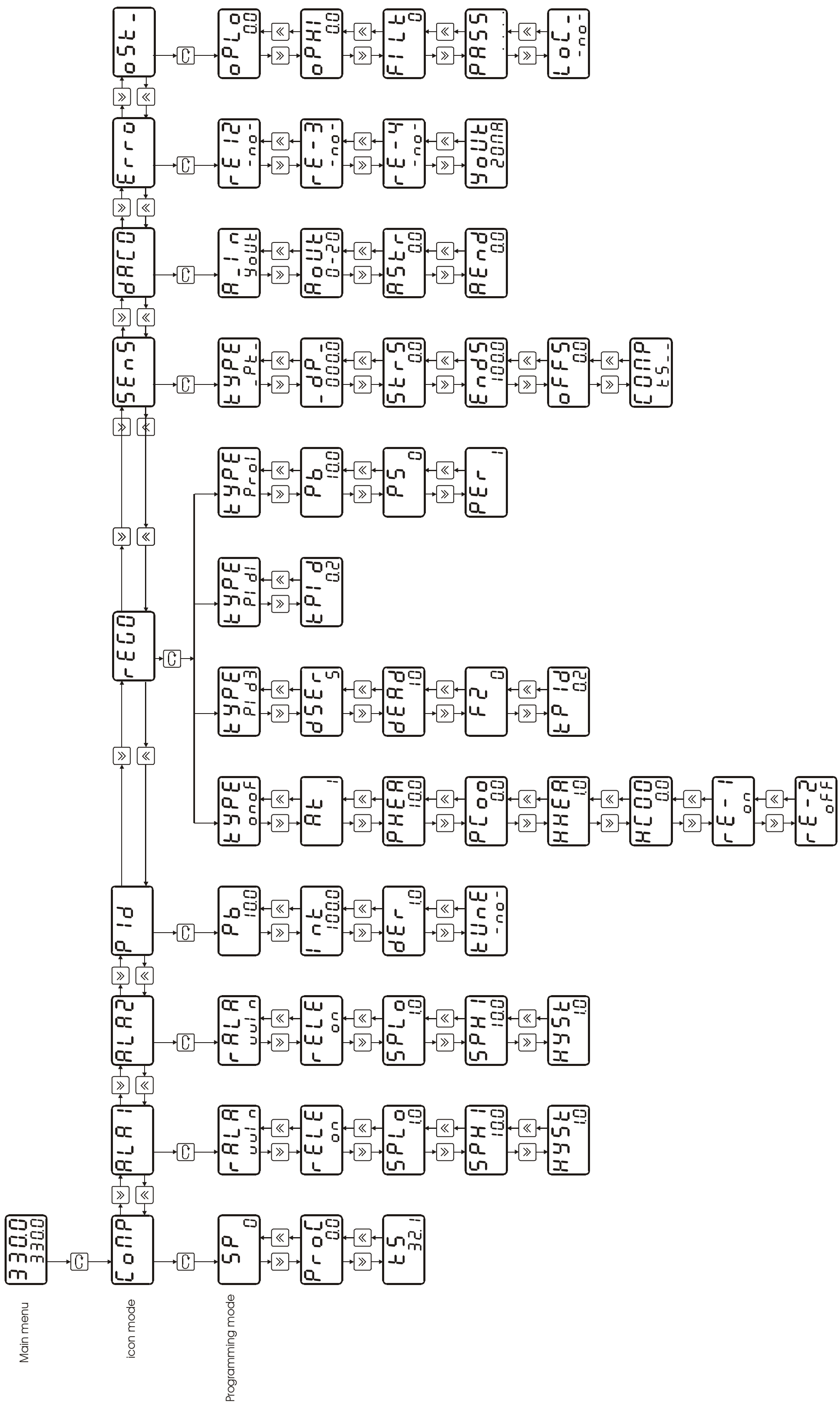
4 Programming manual

In the programming manual is a detail transcription of electing parameters setting of controller. For using of the controller is necessity to adapt the controller to concrete user application by setting of the required parameters. Standard values are in the programming mode setting by producer. And they are show in a limit values chart (page 33). Before the programming is necessity to control if the switch for data hardware protection is in the position off. After the programming is possible to protect parameters against data transcription by change-over of both poles of switch to position ON. It's mean that parameters is possible to change but after switch-off and switch-on of power supply are show parameters set before of data transcription forbid.

At new parameters setting in the menu MODE the controller work with original parameters. After the menu MODE exit by „arrow to right“ run the up-dating and record new setting dates.

As long as in the programming course do not be pressed the arbitrary key during 1 minute the controller automatically come over to main menu without setting parameters record (function TIME OUT).

4.1 Block diagram for operating



By the key » you achieve return about level above always.
Parameters programming in arbitrary menu is possible after the key C depress
Required value you set by keys » « . By the key » is possible the set value reset.

4.2 Parameters meaning

Level MODE

Icon COMP – required value setting and action intervention view and drive position

SP — required value for the control

PROC — magnitude of action intervention view (%)
When is the control in the STOP state is not possible the action intervention set manually (servo-unit position). Relay 1 and 2 are switch-off.

TS — temperature of binding clips view (°C)

Icon ALAx – alarm setting for outputs 3 and 4. For alarm is possible to set switching logic (output switch is active if is not the alarm, if need be a converse action) and alarm mode.

RALA — alarm mode:
- CONS — processed, belong to measured value only (see graph page 23)
- DRIF — relative, deduce from the required value as the allowed deviation (see graph page 24)
- WIN — processed with allowed deviation zone, belong to measured value only (see graph page 25)
- DWI — relative with allowed deviation zone, deduce from the required value, as allowed deviation (see graph page 26)

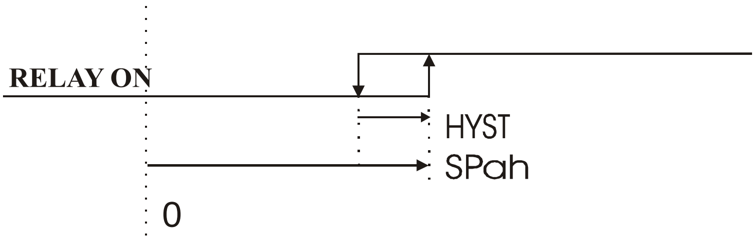
RELE — output relay state at alarm limit overstepping
Possibilities:
- OFF — at alarm limit overstepping the relay switch-off
- _ON_ — at alarm limit overstepping the relay switch-on

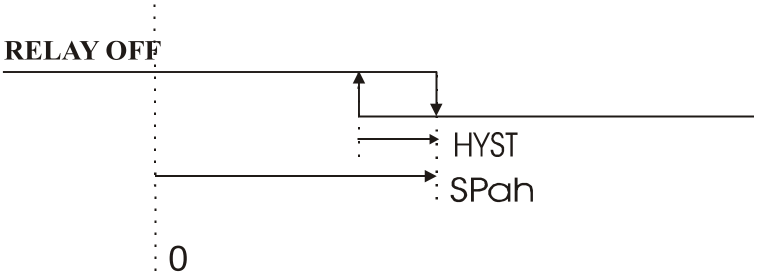
SPLO — bottom alarm limit (this parameter at CONS and DRIF setting have not importance)

SPHI — upper alarm limit

HYST — alarm hysteresis

4.2.1 Alarm mode, processed, belong to measured value (CONS)

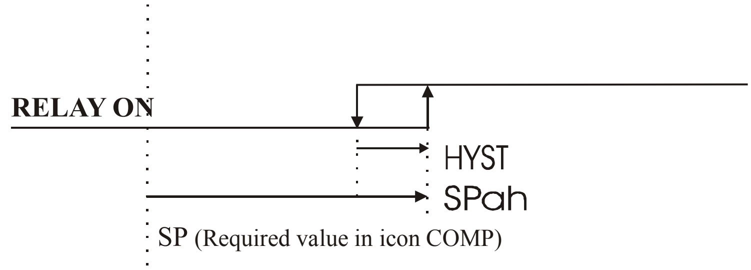


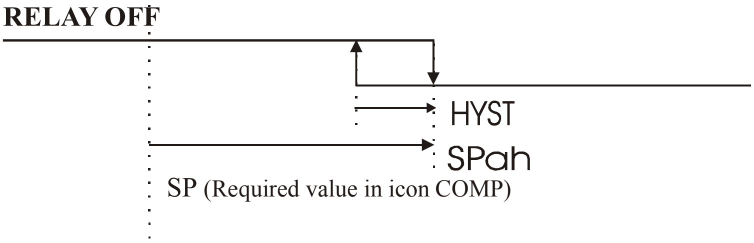


Example:

1) At relay setting ON and SPAH=130 °C, HYST=2 °C. If will be the measured temperature greater than 130 °C, output relay switch-on. If the measured temperature fall below 128 °C, output relay switch-off.
2) At relay setting OFF and SPHI=130 °C, HYST=2 °C. If will be the measured temperature greater than 130 °C, output relay switch-off. If the measured temperature fall below 128 °C, output relay switch-on.

4.2.2 Relative alarm mode, deduce from the required value as the allowed deviation (DRIF)

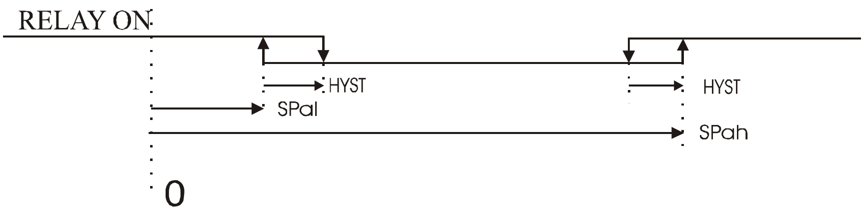


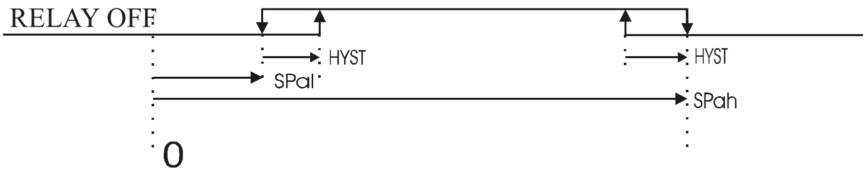


Example:

1) At relay setting ON and SP=120 °C, SPHI=10 °C, HYST=2 °C. If will be the measured temperature greater than 130 °C, output relay switch-on. If the measured temperature fall below 128 °C, output relay switch-off.
2) At relay setting OFF and SP=120 °C, SPHI=10 °C, HYST=2 °C. If will be the measured temperature greater than 130 °C, output relay switch-off. If the measured temperature fall below 128 °C, output relay switch-on.

4.2.3 Processed alarmu mode with allowed deviation zone, belong to measured value only (WIN)

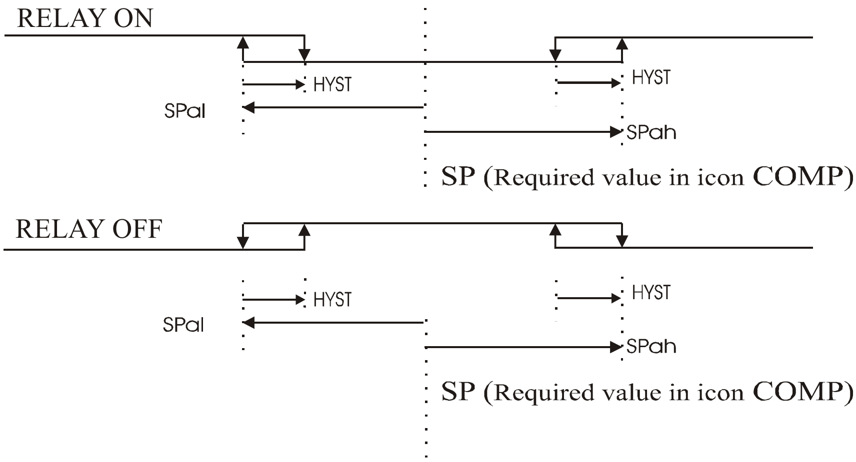




Example:

1) At relay setting ON and SPLO=120 °C, SPHI=150 °C, HYST=2 °C. If will be the measured temperature to move among 120 °C - 150 °C output relay will be switch-off. If the measured temperature fall below 120 °C or if overstep the value 150 °C, output relay will switch-on. To the relay reentry switching-off come at temperature increase above 122 °C or in the second case at decrease below 148 °C.
2) At relay setting OFF and SPLO=120 °C, SPHI=150 °C, HYST=2 °C. If will be the measured temperature to move among 120 °C - 150 °C output relay will be switch-on. If the measured temperature fall below 120 °C or if overstep the value 150 °C, output relay will switch-off. To the relay reentry switching-on come at temperature increase above 122 °C or in the second case at decrease below 148 °C.

4.2.4 Alarmu relative mode with allowed deviation zone, deduce from the required value, as allowed deviation (DWI)



Example:

1) At relay setting ON and SP=130 °C, SPLO= -20 °C, SPHI= 20 °C, HYST=2 °C. If will be the measured temperature to move among 110 °C - 150 °C output relay will be switch-off. If the measured temperature fall below 110 °C or if overstep the value 150 °C, output relay will switch-on. To the relay reentry switching-off come at temperature increase above 112 °C or in the second case at decrease below 148°C.
3) At relay setting OFF and SP=130 °C, SPLO= -20 °C, SPHI=20 °C, HYST=2 °C. If will be the measured temperature to move among 110 °C - 150 °C output relay will be switch-on. If the measured temperature fall below 110 °C or if overstep the value 150 °C, output relay will switch-off. To the relay reentry switching-on come at temperature increase above 112 °C or in the second case at decrease below 148 °C.

Icon PID - PID constant for control setting

PB	amplification (see characteristic PID control)
INT_	integration constant
DER_	derivative constant
TUNE	automatic tuning PID constants

Icon REGO – the others control parameters

TYPE in the menu we set the control required type:

- ONOF two-state control
  At set control ONOF run the calculation PID and the action intervention is possible to send on analog output.
- PROI a proportional impulse control
- PIDI PID impulse control
- PID3 PID three-state control

AT automatic output changes timer (s) for ONOF control

PHEA heating shift for ONOF control (see page 15)

PCOO cooling shift for ONOF control (see page 15)

HHEA heating hysteresis for ONOF control (see page 15)

HCOO cooling hysteresis for ONOF control (see page 15)

RE_1 output relay state at required value limit overstepping for ONOF control

RE_2 output relay state at required value limit overstepping for ONOF control
Possibilities:

- OFF at limit overstepping the relay switch-off
- ON at limit overstepping the relay switch-on

DSER drive overtravel time (in seconds) for three-state control. If we increase DSER, then at the action intervention change about 1% is the impuls lifetime extended.

DEAD non-sensitivity (%)
As long as is requirement for drive position change from PID controller less then set non-sensitivity, drive position is unchanged.

F2 control magnitude digital filter (FIR)
With setting of higher value the action intervention damping is increased and by this is slowed down the drive response.

TPID sampling time period (in seconds) in the setting interval is running the samples drain and the PID constant re-counting for regulation.

PB amplification setting for PROI control

PS power shift value setting for PROI control

PER period time setting PWM puls for PROI control

Icon SENS – input signal parameters setting

TYPE input sensor type

Possibilities:

_ _J_	thermocouple „J“
CRAL	thermocouple „K“
_ _E_	thermocouple „E“
_ _T_	thermocouple „T“
_ _R_	thermocouple „R“
_ _S_	thermocouple „S“
_ _B_	thermocouple „B“
_PT_	sensor Pt100
NI_6	sensor Ni1000/6180ppm
NI_5	sensor Ni1000/5000ppm
4_20	current signal 4 - 20 mA
0_20	current signal 0 - 20 mA
0_10	voltage signal 0 - 10 V
50MV	voltage signal 0 - 50 mV

If you set the temperature sensor (thermocouple, Pt100 or Ni1000), above the display light-on the red check light „°C“.
At input signal type change is necessary to check rightness of jumpers in the main distribution frame option (see connecting of main distribution frame page .8).

_DP_ decimal point position
Setting decimal point position is valid for most of numeric parameters set-up.

STRS input range beginning (start sensor)
You set the beginning of the measuring range the input value. The parameter have the importance at electing of current (4 - 20mA or 0 - 20 mA) or voltage (0 - 10 V or 0 - 50 mV) input signal only. If you set as the type of sensor the thermocouple Pt 100 or Ni 1000 it is not necessary to set the start of the sensor.
For example:
You want to connect the sensor with the 4 - 20 mA output and corresponding for the temperature -30 to +70°C. It is that the sensor starting STRS is necessity to set: -30. For the sensor type SENS is necessity to set 4 - 20 mA.

ENDS input range end (end sensor)
You set the end of the measuring range the input value. The parameter have the importance at electing of current (4 - 20mA or 0 - 20 mA) or voltage (0 - 10 V or 0 - 50 mV) input signal only. If you set as the type of sensor the thermocouple Pt 100 or Ni 1000 it is not necessary to set the end of the sensor.
For example:
You want to connect the sensor with the 4 - 20 mA output and corresponding for the temperature -30 to +70°C. It is that the sensor end ENDS is necessity to set: 70. For the sensor type SENS is necessity to set 4 - 20 mA.

OFFS offset (shift) of measure
Parameter is for setting for example: resistor compensation of inputs wires for Pt 100 at two-wires connection etc. Generally is possible by offset to compensate any measurement inaccuracy. As long as is not necessity to set the any shift or compensation set 0.
Example of inputs wires for Pt 100 compensation at two-wires connection:

The wire have definite resistor which make the failure of measurement. On the end of wires you connect instead the sensor Pt 100 the resistance decade and set the resistor 100,0 Ω (corresponding 0°C). You subtract the measured value on the display (for example 1,3°C). This is the failure of measurement made with resistor of inputs wires. For its compensation is necessary to set in the menu OFFS the value -1,3.

COMP thermocouple cold end compensation
Parameter have meaning at thermocouple choice only.
Compensation possibilities:

_NO_	without compensation
TS__	compensation to temperature of terminal boxes (compensation is ensure by inner resistive sensor Pt1000)
20°C	compensation to temperature 20 °C
50°C	compensation to temperature 50 °C
70°C	compensation to temperature 70 °C

Icon DACO – analog output parameters setting

A_IN input magnitude for the analog output
Possibilities:

YOUT	control magnitude – analog output behave as control
MEAS	measured value – analog output generate the output current (voltage) commensurate with the measured value

AOUT analog output election
Possibilities:

0-20	0 - 20 mA, 0 - 10 V
4-20	4 - 20 mA, 2 - 10 V
20-0	20 - 0 mA, 10 - 0 V
20-4	20 - 4 mA, 10 - 2 V

ASTR measured value analog output start
The parameter have importance in case only at the measured value MEAS election in the menu A_IN. The measured value is set and correspond to analog output start. Setting example:
If you need that analog output 0 - 10 V correspond to the measured value on the display in among 0 - 100 °C. This means that analog output ASTR start is necessary to set 0. Condition is the measured value MEAS setting in the menu A_IN and the analog output election 0-20mA in the menu AOUT and setting of main distribution frame (see page 8).

AEND measured value analog output end
The parameter have importance in case only at the measured value MEAS election in the menu A_IN. The measured value is set and correspond to analog output end. Setting example:
If you need that analog output 0 - 10 V correspond to the measured value on the display in among 0 - 100 °C. This means that analog output AEND end is necessary to set 100. Condition is the measured value MEAS setting in the menu A_IN and the analog output election 0 - 10 V in the menu AOUT and setting of main distribution frame (see page 8).

Icon ERRO – Outputs state at sensor trouble

The controller evaluate the input sensor trouble by sign ERRO on the bottom line of the display. At the input sensor trouble is possible to set arbitrary output relays state and analog output. The controller signal the input sensor trouble as long as the measured value is out of following limits:

Pt100	-80 - 802 °C
Ni1000/5000 ppm	-50 - 202 °C
Ni1000/6180 ppm	-50 - 202 °C
thermocouple J	-210 - 1200 °C
thermocouple K	-200 - 1372 °C
thermocouple E	-200 - 1000 °C
thermocouple T	-200 - 400 °C
thermocouple R	-50 - 1768 °C
thermocouple S	-50 - 1768 °C
thermocouple B	-250 - 1820 °C
0 - 20 mA	> 21 mA
4 - 20 mA	3,6 - 21 mA
0 - 10 V	> 10,5 V
0 - 50 mV	> 75 mV

RE12	outputs out 1 and out 2 state at the sensor trouble	
	_NO_	out 1 and out 2 without response to the sensor trouble (response by parameters in the icon PID)
	OPEN	out 1 switch-on and out 2 switch-off at the sensor trouble
	SHUT	out 1 switch-off and out 2 switch-on at the sensor trouble
	OFF	out 1 and out 2 switch-off at the sensor trouble
RE-3	output out 3 state at the sensor trouble	
	_NO_	out 3 without response to the sensor trouble (response by parameters in the icon ALA1)
	ON	out 3 switch-on at the sensor trouble
	OFF	out 3 switch-off at the sensor trouble
RE-4	output out 4 state at the sensor trouble	
	_NO_	out 4 without response to the sensor trouble (response by parameters in the icon ALA2)
	ON	out 4 switch-on at the sensor trouble
	OFF	out 4 switch-off at the sensor trouble
YOUT	analog output state at the sensor trouble	
	_NO_	analog output without response to the sensor trouble (response by parameters in the icon DACO)
	0-MA	analog output set to 0 mA (0 V) at the sensor trouble
	20MA	analog output set to 20 mA (10 V) at the sensor trouble

Icon OST_ – the others parameters setting

OPLO optic alarm bottom limit (at the measured value decrease under set value twinkle the value on the display).

OPHI optic alarm upper limit (at the measured value increase under set value twinkle the value on the display).

FILT input signal filter by the filter value increasing come to the controller response deceleration to the input magnitude change and respectively by the filter value decreasing come to the controller response acceleration to the input magnitude change. Filter have the effect for the measured value representation on the display and on the control.

PASS access password

With the access password setting is possible to prohibit for the unqualified intervention to control parameters. The PASS password serve for access to all parameters settings. From the production is set the 0 password. In this case is the controller behaviour as world be setting as the no password and the access to the setting is not limited. If you set the arbitrary number password is possible to enter to parameters setting after the password adjust only. If you want change the password you have to secure the access to the password adjusting with the knowledge a the old access password. As long as you will forget this password you set code 555 with its help you will get to the password adjusting.

The controller demand the password always one time in the each icon only. For example when you in the SENS icon set the _DP_ parameter (decimal point position) at the enter to the parameter setting the controller demand the access password. As long as you set the password right, you will have the free access to all the others parameters below the SENS icon (TYPE, STRS, ENDS, OFFS, CoMP).

LOC_ keyboard lock for the required value direct setting

Possibilities:

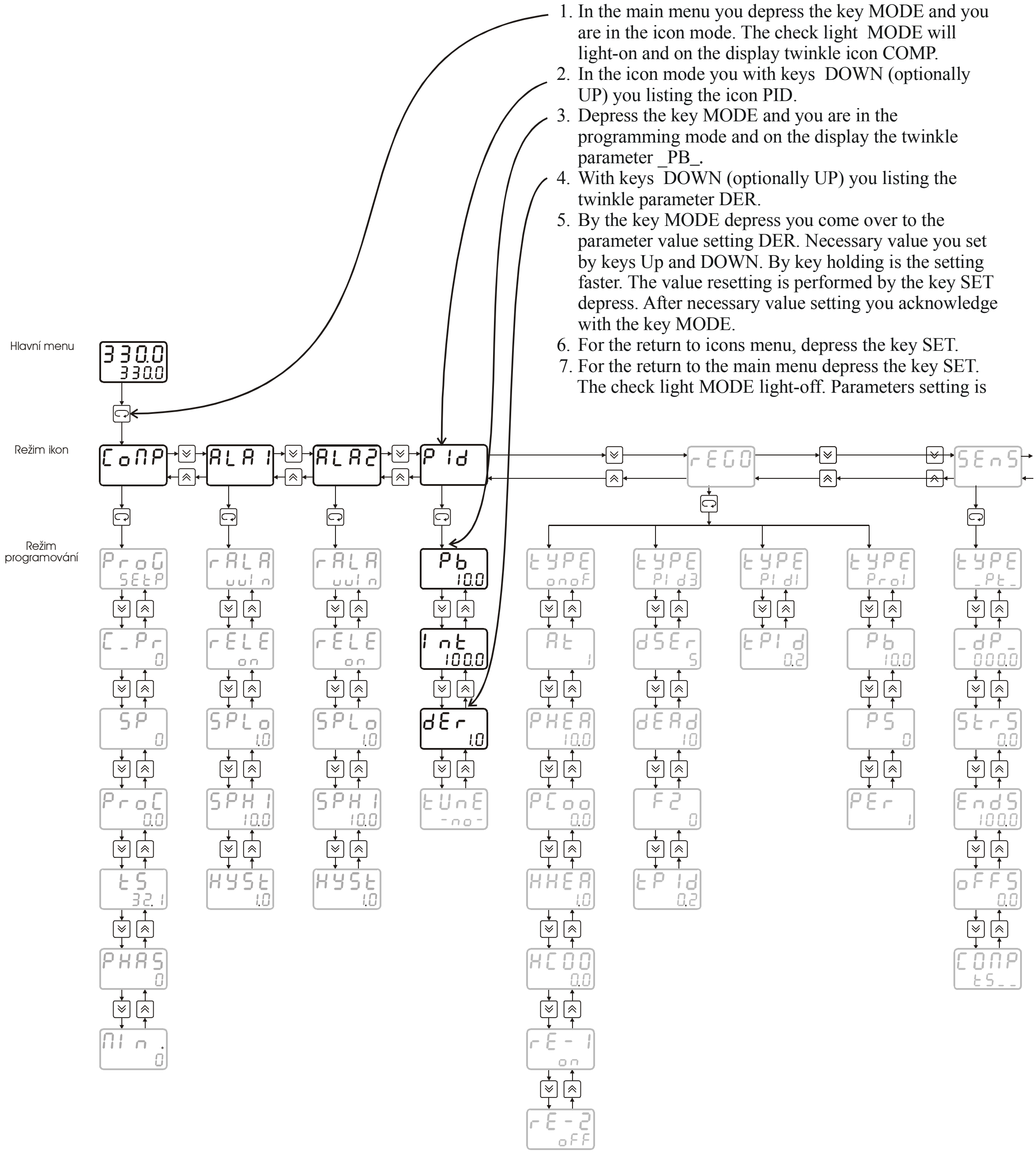
_NO_ keyboard unlocked

YES_ keyboard locked

If is the keyboard unlocked is possible in the main menu by keys UP and DOWN the required value SP direct to set. After keyboard lock is possible the required value set as much as after program mode entry.

At the programming control RAMP/JUMP keys "UP" and "DOWN" are not active.

4.3 Setting examples



With the same way is possible to set the next parameters by the block diagram of the operation.

As long as in the programming course do not take after 1 min to depress any key the controller automatically come over to the main menu without setting parameters record (so-called TIME OUT). After exit the menu MODE by key "SET" the set parameters are up-dated and PID parameters are re-counted and if is the hardware protection in position OFF, so to EEPROM parameters record will done too. The dates are for the data memorize after power supply failure.

4.4 Parameters limit values

Code	Importance	Limit values	From production	From operation
SP	required value	-999 - 9999	0.0	
PROC	magnitude of action intervention	0 - 100%	-	-
TS	binding clips temperature view °C	-	-	-
RALA	alarm mode	CONS, DRIFT, WIN, DWIN	CONS	
RELE	output alarm relay state	OFF/ON	ON	
SPLO	alarm value	-999 - 9999	0.0	
SPHI	alarm value	-999 - 9999	0.0	
HYST	alarm hysteresis	0 - 9999	1.0	
-PB-	amplification	-500 - 500		
INT-	integration constant	0,01 - 9999	100.0	
DER-	derivative constant	0.01 - 9999	10.0	
TUNE	automatic constants tuning	NO/ YES	-NO-	
AT	automatic output changes timer	0 - 10 s	1 s	
PHEA	heating shift	-999 - 9999	0.0	
PCOO	cooling shift	-999 - 9999	0.0	
HHEA	heating hysteresis	0 - 9999	0.0	
HCOO	cooling hysteresis	0 - 9999	0.0	
RE – 1	output relay state	OFF/ON	OFF	
RE – 2	output relay state	OFF/ON	ON	
DSER	drive overtravel time	5 - 1000 s	60	
DEAD	non-sensitivity	0 - 10 %	2 %	
F2	control magnitude filter	0 - 16	16	
TPID	sampling time period	0,2 - 10	1	
PS	static constant	0-100%	0	
PER	Period PWM	1-60s	10s	
TYPE	sensor type	thermocouple J, K, E, T, R, S, B Pt100 Ni1000/6180ppm Ni1000/5000ppm 4 - 20 mA 0 - 20 mA 0 - 10 V 0 - 50 mV	Pt100	
-DP-	decimal point	0., 0.0, 0.00	0.0	
STRS	start sensor	-999 - 9999	0.0	
ENDS	end sensor	-999 - 9999	100.0	
OFFS	Offset	-999 - 9999	0.0	
CoMP	thermocouple compensation	-NO-, binding clips	binding	

	type	temperature, 20°C, 50°C, 70°C	clips temperatur e	
A-IN	input magnitude for the analog output	control magnitude, measured value	control magnitude	
AOUT	analog output election	0 - 20 mA (0 - 10 V), 5-20 mA (2 - 10 V), 20 - 0 mA (10 - 0 V), 20 - 4 mA (10 - 2 V)	0 - 20 mA (0 - 10 V)	
ASTR	measured value analog output start range	-999 - 9999	0.0	
AEND	measured value analog output end range	-999 - 9999	100.0	
RE12	output relay 1 and 2 state at the sensor trouble	-NO-, OPEN, SHUT, OFF	-NO-	
RE-3	output relay 3 state at the sensor trouble	-NO-, ON, OFF	-NO-	
RE-4	output relay 1 and 2 state at the sensor trouble	-NO-, ON, OFF	-NO-	
YOUT	analog output state at the sensor trouble	-NO-, 0 mA, 20 mA	-NO-	
OPLO	optic alarm low	-999 - 9999	0.0	
OPHI	optic alarm high	-999 - 9999	100.0	
FILT	input signal filter	0 - 32	0	
PASS	access password	0 - 9999	0	
LOC_	keyboard lock	NO/YES	NO	
FILT	input signal filter	0 - 32	0	

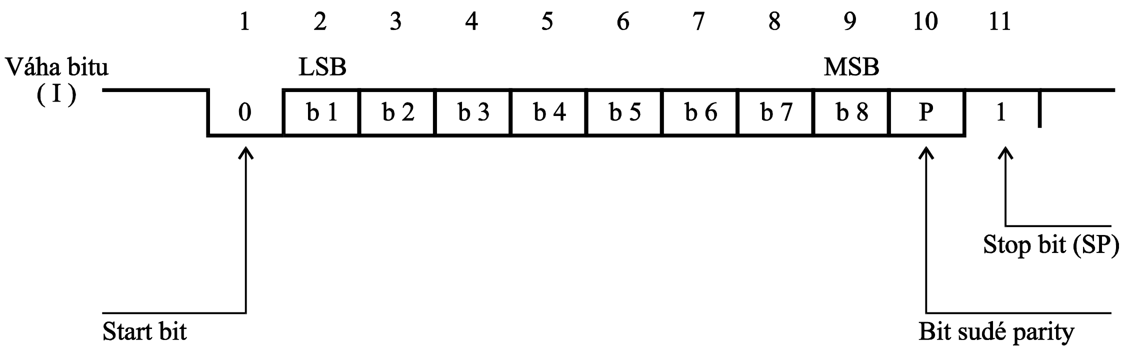
5 Communication protocol

5.1 Protocol description

Communication protocol is from protocol **PROFIBUS** layer 2. Data part (layer 7) implemented the protocol.
Communication is of the type **master - slave** and enable the two-ways communication between systems. The communication use the interface RS 232 or RS 485.

Telegram mark (UART - Character)

Protocol:



Every UART – have a character 11 bits, and so 1st start-bit (ST) with signal logic "0", 8th inform bits (I), 1st parity bit for even parity (P) with signal logic "1" and 1th stop-bit (SP) with signal logic "1". Transmit speed 9600 Bd.

Communication conditions:
Communications are invoked by superior communications participant on a principle request - answer. This principle allowed a addition of greater users number to superior system on the interface RS-485. Controlers and sensors behave as a slave user (slave).
From a time aspect is necessary to observe next conditions:

a) between single bytes transmited from superior system have to be a **shorter** delay than treble of a time necessary for one byte transmitting.
b) between received answer and transmited next report have to be a rest on the line **longer** than treble of a time necessary for one byte transmitting.
c) if come by receiving side to line protocol error detecting (frame error, parity, unpassing line, breaking above mentioned conditions), or at error in transmission protocol (start parity error, ended mark, telegram length), the receiving side the report do not work and do not answer for that. In case do not grant requirement for transmission or for dates writting (the apparatus do not contain dates), send the error report with SD1 and FC = 2 (negative confirmation).
d) between last byte of transmited report and first byte of receiving answer is delay at minimum identical as the time necessary for one byte transmitting.

5.2 LAYER 2

Format of telegrams with firm length without data pole:

a) question

SD1	DA	SA	FC	FCS	ED

b) answer

SD1	DA	SA	FC	FCS	ED

Format of telegram with constant length

Telegram start with SD1 and FC=0x69 and end ended mark ED.
Positive answer is telegram with constant lenght with FC=0. Negative answer FC=2.

Example of setting format of telegram with firm length without dates pole:

```
REQUEST                  Number of transmitting marks: 6
10 02 04 69 6F 16

ANSWER                   Number of receiving marks:    6
10 04 02 00 06 16
```

Format of telegrams with variable length of information pole:

a) question

SD2	LE	LEr	SD2	DA	SA	FC	DATA	FCS	ED

b) answer

SD2	LE	LEr	SD2	DA	SA	FC	DATA	FCS	ED

Importance of used symbols

SD1	frame start (Start Delimiter), code 10H
SD2	frame start (Start Delimiter), code 68H
LE	length of information pole (Length) start by bit DA and finished by bit before FCS. Length of pole 4 - 249.
LEr	repeating of bits length of the information pole (Lenght repeat)
DA	address of target station (Destination Address)
SA	address of supply station (Source Address)
FC	řídící byte drive bit (Frame Control)
DATA	pole of dates max 246 bits
FCS	control sum (Frame Check Sum)
ED	frame end (End Delimiter), code 16H

LE, LEr - Length of information pole

Both bits in the head of telegram with variable length of information pole contents numbers of bits of information pole. In this is count DA, SA, FC and DATA. Upset value LE is 4, highest 249. By this possible to transmit 1 - 246 bits of dates.

DA, SA – Address of the station (DA - target, SA - supply)

Addresses can be in the range 0 - 126, and the address 127 is use as global address for transmitting of messages for all stations. At setting of global address the apparatus receive only (do not transmitting). In the corresponding telegram is target address (DA) actually source address (SA) from appeal telegram.

Limitation: Maximal setting address is 126. Controllers and sensors can not increase the address by bits EXT, how is definite in PROFIBUS.

FC - Driving bit

Driving bit in the head of frame contents the transmit function and information to prevent for loss or doubling of message.

<table>
<tr><th>b8</th><th>b7</th><th>b6</th><th>b5</th><th>b4</th><th>b3</th><th>b2</th><th>b1</th></tr>
<tr><td rowspan="2">RES</td><td>1</td><td>FCB</td><td>FCV</td><td colspan="4" rowspan="2">FUNCTION</td></tr>
<tr><td>0</td><td colspan="2">Stn - Type</td></tr>
</table>

RES - reservation

b7 = 1 - **frame of call** (Send / Request)

FCB (Frame Count Bit): 0/1 - alternated bit of sequence of calls
FCV (Frame Count Bit Valid): 0 - function FCB invalid
1 - function FCB valid

Controllers and sensors unused alternating bite FCB at FCV = 1, these bites have to have a value FCB=1 and FCV=0.

FUNCTION: frame of call b7 = 1

code	function
0x03	Send Dat with Acknowledge Data sending with acknowledgement
0x09	Request FDL - Status With Reply Request for Status
0x0C	Send and Request Data Sending and request for dates

b7 = 0 - **frame of acknowledge or answer** (Acknowledgement/Response)

Stn - Type (Station type a FDL - STATUS) - characterised the type of customer.
Only passive customer ⇒ b 6 and b5 = 0.

FUNCTION: frame of answers b7 = 0

code	function
0x00	Acknowledgement positive Positive acknowledgement
0x02	Acknowledgement negative Negative acknowledgement
0x08	Response FDL / FMA - Date data transmitting

FCS - control sum

Control sum is done with arithmetic data sum of information frame DA, SA, FC and DATA modulo 256 (100h) with ignore of higher frames arised by transfer 256 (100h).
25h = (24h + 30h + 37h + 52h + 48h) MOD 100h

For SD1 $\sum_{DA}^{FC}$ mod 256 for SD2 $\sum_{DA}^{FCS-1}$ mod 256

Format of telegram with variable length of information pole:

Telegram start with SD2 and FC=0x6C and end ended mark ED.
Request is reading from chart nr. 3 two bytes with offset = 0.
Positive answer is telegram with constant lenght with FC=0. Negative answer FC=2.

```
REQUEST                 Number of transmitting marks:  14
68 08 08 68 02 04 6C 01 03 02 00 00 78 16

ANSWER                  Number of receiving marks:    11
68 05 05 68 04 02 08 06 01 15 16
```

Layer 7

Layer 7 (**data** part) implement the protocol. There are these services:

1) **Reading of apparatus identification**
2) **Reading of firmware version**
3) **Reading of value**
4) **Record of value**
5) **Reading of apparatus state**
6) **Reading and record of synchronizing dates**
7) **Record of dates to EEPROM**

1) Reading of apparatus identification - Identify

telegram SD2 data part

a) question

SD2	LE	LEr	SD2	DA	SA	FC	RI	FCS	ED

FC		0x6C
RI	REQ_IDENTIFY	0x00

b) answer

SD2	LE	LEr	SD2	DA	SA	FC	DATA	FCS	ED

FC		0x08
DATA	Apparatus type name	

2) Reading of firmware version - Version

telegram SD2 data part

a) question

SD2	LE	LEr	SD2	DA	SA	FC	RV	FCS	ED

FC		0x6C
RV	REQ_VERSION	0x04

b) answer

SD2	LE	LEr	SD2	DA	SA	FC	DATA	FCS	ED

FC		0x08
DATA	Apparatus version name	

3) <u>Reading of dates - Read</u>

Reading value is determinate by chart, bytes number and offset.

a) question

SD2	LE	LEr	SD2	DA	SA	FC	RR TC PB OFH OFL	FCS	ED

FC		0x6C
RR	REQ_READ	0x01
TC	TABULKA_ČÍSLO	used chart number
PB	POČET_BYTE	bytes number in char
OFH	OFFSET	shift in chart high byte
OFL	OFFSET	shift in chart low byte

b) answer

SD2	LE	LEr	SD2	DA	SA	FC	1 - n byte by chart	FCS	ED

Positive acknowledgement (SD2, FC = 08), in error case (SD1, FC = 2).

FC	0x08
Dates	1 - n byte by chart

4) <u>Record of one value - Write</u>

Record value is determinate by chart, bytes number and offset.

a) question

SD2	LE	LEr	SD2	DA	SA	FC	RW TC PB OFH OFL DT	FCS	ED

FC		0x63
RW	REQ_WRITE	0x02
TC	TABULKA_ČÍSLO	used chart number
PB	POČET_BYTE	bytes number in chart
OFH	OFFSET	shift in chart high byte
OFL	OFFSET	shift in chart low byte
DT	DATA	sended dates n byte (PB byte)

b) answer

Positive acknowledgement (SD1, FC = 0), in error case FC = 2.

SD1	DA	SA	FC	FCS	ED

5) <u>Reading of apparatus state</u>

telegram SD2 data part

a) question

SD2	LE	Ler	SD2	DA	SA	FC	RU	FCS	ED

FC 0x6C
RU REQ_Unit_Status 0x03

b) answer

SD2	LE	Ler	SD2	DA	SA	FC	DATA	FCS	ED

FC 0x08
DATA controller state 5 byte

4 byte	1 byte
measured value (float)	**OUT** (char)

OUT bit =0 output relay is switch-off
OUT bit =1 output relay is switch-on
measured value = float format
OUT bit D0 represent output 1
bit D1 represent output 2
bit D2 represent output 3
bit D3 represent output 4

6) Reading and record of synchronizing dates

Telegram SD2 data part.

a) question

SD2	LE	Ler	SD2	DA	SA	FC	RSS	FCS	ED

FC 0x63
RSS REQ_SYNCHRO_SAMPLING 0x05

b) answer after instruction REQ_SYNCHRO_SAMPLING with FC=0x63 achieve the measured value draft to memory. Positive acknowledgement (SD1, FC = 0), in error case (FC = 2). At using a global address DA=127 there is not any answer, the apparatus achieve the measured value draft only.

c) answer after instruction REQ_SYNCHRO_SAMPLING with FC=0x6C

SD2	LE	Ler	SD2	DA	SA	FC	RES Measured value	FCS	ED

1 byte	4 - byte
RES	**measured value** (float)

define FC 0x08
#define RES 0x01 indicate first draft
#define RES 0x00 indicate, that one at least are dates read

7) Record of dates to EEPROM

The apparatus activity at record to EEPROM: the apparatus relocate setting dates from RAM to buffer. Compound and send answer. And then create the request for record to EEPROM.
The record is performed from buffer after 1 byte in free time of processor.
The time needful for record is 2 sec. At next reading or recording next dates on communication line may the time needful for record to EEPROM rather elongate.
Record immunity to EEPROM is 100.000 cycles.

a) question

SD2	LE	Ler	SD2	DA	SA	FC	RWE	FCS	ED

FC 0x63
RWE REQ_WRITE_EEPROM 0x06

b) answer
Positive acknowledgement (SD1, FC = 0), in error case FC = 2.

SD1	DA	SA	FC	FCS	ED

Importance of use symbols

The first data layer 7 part byte at request.

# define REQ_IDENTIFY	0x00	request on the identification
# define REQ_READ	0x01	request for data sending
# define REQ_WRITE	0x02	request for data record
# define REQ_Unit Status	0x03	request on the apparatus state
# define REQ_VERSION	0x04	request on firmware version
# define REQ_SYNCRO_SAMPLING	0x05	request on synchronous draft
# define REQ_WRITE_EEPROM	0x06	request on record of dates to EEPROM

Importance of charts and dates structures

Chart 0 for APOSYS 10-1xxx required value

Tabulka_číslo TC = 0				
Importance	**Code**	**range**	**type**	**bytes number**
Required value	**SP**	**-999 - 9999**	**float**	**4**

Chart 0 for APOSYS 10-2xxx , APOSYS 10-3xxx

Tabulka_číslo TC = 0				
Importance	**Code**	**range**	**type**	**bytes number**
Required value SP	**SP[10]**	**-999 - 9999**	**float**	**40**

Chart 1 and 2 ALARM alarm setting

Tabulka_číslo TC = 1 a 2				
Importance	**Code**	**range**	**type**	**bytes number**
Alarm value Low	**SPLo**	**-999 - 9999**	**float**	**4**
Alarm value High	**SPHi**	**-999 - 9999**	**float**	**4**
Hysteresis	**HYST**	**0 - 9999**	**float**	**4**
Mode	**RALA**	**0 - 3**	**char**	**1**
Output state at overrun	**RELE**	**0 / 1**	**char**	**1**

Mode 0 = alarm value is SPHI (CONS)
1 = alarm value is sum SPHI and SP (required value) (DRIF)
2 = alarm value is define two alarm limits (WIN)
3 = alarm value is define two alarm limits with shift from SP-required value (DWI)

Output state 0 = OFF at alarm limit overrun relay switch-off
1 = ON at alarm limit overrun relay switch-on

Chart 3 SENS input setting

Tabulka_číslo TC = 3				
Importance	**Code**	**range**	**type**	**bytes number**
Sensor type	**TYPE**	**0 - 13**	**char**	**1**
Decimal point	**_DP_**	**0 - 2**	**char**	**1**
Range beginning	**STRS**	**-999 - 9999**	**float**	**4**
Range end	**ENDS**	**-999 - 9999**	**float**	**4**
Offset	**OFFS**	**-999 - 9999**	**float**	**4**
Compensation	**COMP**	**0 - 4**	**char**	**1**

Sensor type
0 = thermocouple "J"
1 = thermocouple "K"
2 = thermocouple "E"
3 = thermocouple "T"
4 = thermocouple "R"
5 = thermocouple "S"
6 = thermocouple "B"
7 = Pt100
8 = Ni1000/6180ppm
9 = Ni1000/5000ppm
10 = 4 - 20 mA
11 = 0 - 20 mA
12 = 0 - 10 V
13 = 0 - 50mV

Decimal point
0 = number
1 = one decimal point
2 = two decimal points

Compensation
0 = without compensation
1 = clamps temperature
2 = temperature 20°C
3 = temperature 50°C
4 = temperature 70°C

Chart 4 PID

Tabulka_číslo TC = 4				
Importance	**Code**	**range**	**type**	**bytes number**
Amplification	**PB**	**-500 - 500**	**float**	**4**
Integrate constant	**INT**	**0,01 - 9999**	**float**	**4**
Derivative constant	**DER**	**0,01 - 9999**	**float**	**4**
Automatical PID tuning	**TUNE**	**0/1**	**char**	**1**

Automatical tuning
0 = NO (NO)
1 = YES (YES)

Chart 5 REGO

Tabulka_číslo TC = 5				
Importance	**Code**	**range**	**type**	**bytes number**
Control type	**TYPE**	**0 - 3**	**char**	**1**
Drive overtravel time	**DSER**	**5 - 1000**	**int**	**2**
On change non-sensitivity Yout	**DEAD**	**0 - 10**	**int**	**2**
Filter F2	**F2**	**0 - 16**	**int**	**2**
Sampling	**TPID**	**1 - 50**	**int**	**2**
Shift static constant	**PS**	**0 - 100**	**int**	**2**
Sampling period	**PER**	**1 - 50**	**int**	**2**

Control type 0 = ONOF 2 = PIDI
1 = PROI 3 = PID3

Sampling TPID x 0,2 = sampling period

Chart 6 Control ONOF

Tabulka_číslo TC = 6				
Importance	**Code**	**range**	**type**	**bytes number**
heating shift	**PHEA**	**-999 - 9999**	**float**	**4**
cooling shift	**PCOO**	**-999 - 9999**	**float**	**4**
Heating hysteresis	**HHEA**	**0 - 9999**	**float**	**4**
cooling hysteresis	**HCOO**	**0 - 9999**	**float**	**4**
Sample draft for evaluation [s]	**AT**	**0-10**	**int**	**2**
Relay 1	**RE-1**	**0/1**	**char**	**1**
Relay 2	**RE-2**	**0/1**	**char**	**1**

Relay 0 = at overrun switch-off (OFF)
1 = at overrun switch-on (ON)

Chart 7 Analog output

Tabulka_číslo TC = 7				
Importance	**Code**	**range**	**type**	**bytes number**
Input value to analog output	**A_IN**	**0/1**	**char**	**1**
Analog output	**AOUT**	**0 - 3**	**char**	**1**
Range beginning for measured value	**ASTR**	**-999 - 9999**	**float**	**4**
Range end for measured value	**AEND**	**-999 - 9999**	**float**	**4**

A_IN 0 = connected control value
1 = connected measured value

AOUT 0 = 0 - 20mA 2 = 20 - 0mA
1 = 4 - 20mA 3 = 20 - 4mA

Chart 8 controller error

Tabulka_číslo TC = 8				
Importance	**Code**	**range**	**type**	**bytes number**
Output relay 1 and 2 state at the sensor trouble (erro)	**RE12**	**0-3**	**char**	**1**
Output relay 3 state at the sensor trouble (erro)	**RE_3**	**0-2**	**char**	**1**
Output relay 3 state at the sensor trouble (erro)	**RE_4**	**0-2**	**char**	**1**
Analog output state at the sensor trouble (erro)	**YOUT**	**0-2**	**char**	**1**

RE12

0 = _NO_ without response
1 = OPEN relay 1 switch-on relay 2 switch-off
2 = SHUT relay 1 switch-off relay 2 switch-on
3 = OFF relay 1 switch-off relay 2 vypne

RE_3, 4

0 = _NO_ without response
1 = ON relay 3 switch-on
2 = OFF relay 3 switch-off

YOUT

0 = _NO_ without response
1 = 0mA
2 = 20mA

Chart 9

Tabulka_číslo TC = 9				
Importance	**Code**	**range**	**type**	**bytes number**
optic alarm	**OPLO**	**-999 - 9999**	**float**	**4**
optic alarm	**OPHI**	**-999 - 9999**	**float**	**4**
Password	**PASS**	**0 - 9999**	**int**	**2**
Filter	**FILT**	**0 - 32**	**int**	**2**
Keyboard lock	**LOC_**	**0/1**	**char**	**1**
Level (unused)	**LEVL**	**0/1**	**char**	**1**

Keyboard lock

0 = keyboard unlocked
1 = keyboard locked

Chart 10

Tabulka_číslo TC = 10				
Importance	**Code**	**range**	**type**	**bytes number**
Apparatus address	**-**	**0 - 126**	**char**	**1**
Record speed in seconds	**-**	**1 - 32000**	**int**	**2**

From the production is set the communication address 0. For more instruments communication on line is necessary to assign every instrument another address. After apparatus address setting is answer with new address SA.

Parameters intended for diagnostic of controller

Chart 11 (FOR READING ONLY)

Tabulka_číslo TC = 11				
Importance	**inner code**	**range**	**type**	**bytes number**
Measured value state	**NAMERENA**	**-999 - 9999**	**float**	**4**
Relay state	**RELE**	**D0-D4**	**char**	**1**
Required value state	**SP**	**-999 - 9999**	**float**	**4**
Action intervention state	**PID**	**0 - 1000**	**int**	**2**
Clamps temperature state	**TS**	**0 - 60°C**	**float**	**4**
Relay 1 and 2 actual position	**SERVO**	**D0, D1**	**char**	**1**
Input sensor trouble state	**PORUCHA_SNIMACE**	**0x00, 0xFF**	**char**	**1**

Some controllers states are not in physical units.

Chart 12 (FOR READING ONLY)
Measured values to memory RAM about 1K size data stored record (256 measured values). At set record speed 900 s (15min) is record length 64 hour then last measured value rewrite to new one. Min. record count is 32000s and max. record count is 1s (setting in chart 12).
Measured values from record is not possible read at once (for one rading is possible to read max. 61 measured values). After power suplly to controller connecting or in case restart is on pointer position insert the null value.

Tabulka_číslo TC = 12				
Importance	**Code**	**range**	**type**	**bytes number**
Pointer to last measured value	**-**	**0 - 255**	**char**	**1**
RAM[0]	**-**	**-999 - 9999**	**float**	**4**
…	**…**	**…**	**…**	**…**
…	**…**	**…**	**…**	**…**
RAM[255]	**-**	**-999 - 9999**	**float**	**4**

Chart 14 for APOSYS 10-2xxx, APOSYS 10-3xxx

Tabulka_číslo TC = 14				
Importance	**Code**	**range**	**type**	**bytes number**
Progam start	**GO**	**0/1**	**char**	**1**
Program end possibilities	**PEND**	**0-2**	**char**	**1**
Required values security achievement	**HOLD**	**0/1**	**char**	**1**
Power supply failure security	**PCUT**	**0-4**	**char**	**1**
Startup date (APOSYS 10-3xxx only)	**DATE**	**1-31**	**char**	**1**
Startup hour (APOSYS 10-3xxx only)	**HOUR**	**0-23**	**char**	**1**
Startup minute (APOSYS 10-3xxx only)	**MIN**	**0-59**	**char**	**1**

Program end possibilities:

0 = OFF control switch-off
1 = SBY keep the last attained required value
2 = RST time resetting and crossing to program loop start

Required values security achievement

0 = NO do not wait to attained required values
1 = YES wait to attained required values

Power supply failure security

Is possible to set apparatus reaction to power suplly failure at program run. For controllers APOSYS 10-2xxx and APOSYS 10-3xxx are these power supply failure security possibilities:

APOSYS 10-2xxx

0 = program end
1 = new program start
2 = required value achievement engaged in section with null interval (SBY)

APOSYS 10-3xxx

0 = program end with control outputs switch-off
1 = new program start
2 = required value achievement engaged in section with null interval (SBY)
3 = program continue
4 = keep the last attained required value

Chart 15 TIME for APOSYS 10-3xxx

Tabulka_číslo TC = 15				
Importance	**Code**	**range**	**type**	**bytes number**
real time – second	**SEC**	**0-59**	**char**	**1**
real time – minutes	**MIN**	**0-59**	**char**	**1**
real time – hours	**HOUR**	**0-23**	**char**	**1**
real time – week	**DAY**	**1-7**	**char**	**1**
real time – date	**DATE**	**1-31**	**char**	**1**
real time – month	**MONT**	**1-12**	**char**	**1**
real time – year	**YEAR**	**0-99**	**char**	**1**

Chart 16 for APOSYS 10-2xxx , APOSYS 10-3xxx

Tabulka_číslo TC = 16				
Importance	**Code**	**range**	**type**	**bytes number**
Program type	**PROG**	**0 - 2**	**char**	**1**
Programu number	**C_PR**	**0 - 9**	**char**	**1**

Program type 0 = to constant value (SP)
1 = ramping program (RAMP)
2 = jumping program (JUMP)

Chart 17 for APOSYS 10-2xxx , APOSYS 10-3xxx

Tabulka_číslo TC = 17				
Importance	**Code**	**range**	**type**	**bytes number**
Required value RAMP/JUMP	**SP[10][20]**	**-999 - 9999**	**float**	**10x20x4=800**

Chart 18 for APOSYS 10-2xxx , APOSYS 10-3xxx

Tabulka_číslo TC = 18				
Importance	**Code**	**range**	**type**	**bytes number**
Time interval RAMP/JUMP	**TI[10][20]**	**0 - 1000**	**int**	**10x20x2=400**

Matrix RAMP/JUMP [10][20] importance [program number][sectors number]
location in memory: TI[0][0], TI[0][1], TI[0][2], . . . TI[0][19]
TI[1][0], TI[1][1], TI[1][2], . . . TI[1][19]

Warning!
Values in charts 17 and 18 is not possible to read on one reading because in protocol in date part is possible transfer 246 bytes only (see layer 2).

5.3 Stored dates format in APOSYS 10

Signed and Unsigned Characters

Range of char type is 1 byte (8 bites). For example value 0x12

Address	+0
Contents	0x12

Signed and Unsigned Integers

Range of int type is 2 byte (16 bites). For example value 0x1234

Address	+0	+1
Contents	0x12	0x34

Signed and Unsigned Long Integers

Range of long type is 4 byte (32 bites). For example value 0x12345678

Address	+0	+1	+2	+3
Contents	0x12	0x34	0x56	0x78

Floating-point Numbers

Range of float type is 4 byte (32 bites) by standard IEEE-754

Address	+0	+1	+2	+3
Contents	SEEE EEEE	EMMM MMMM	MMMM MMMM	MMMM MMMM

S represent sign (1 negative value and 0 is positive value)
E "Two's complement exponent" with offset 127
M 23-bit nominal mantise

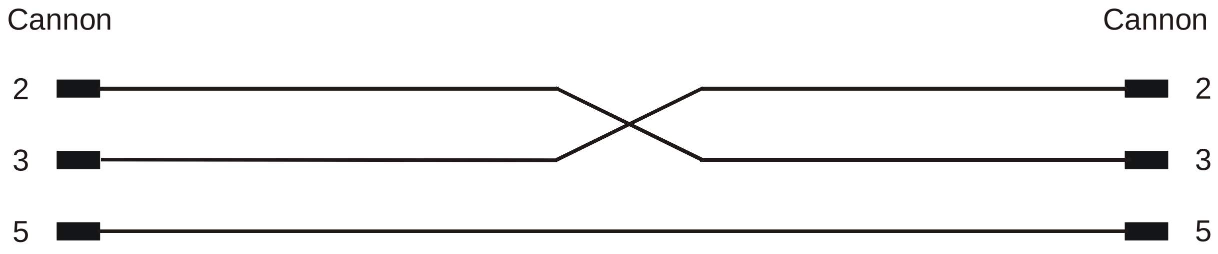
Example: value -12,5 is given hexadecimally 0xC1480000

Address	+0	+1	+2	+3
Contents	0xC1	0x48	0x00	0x00

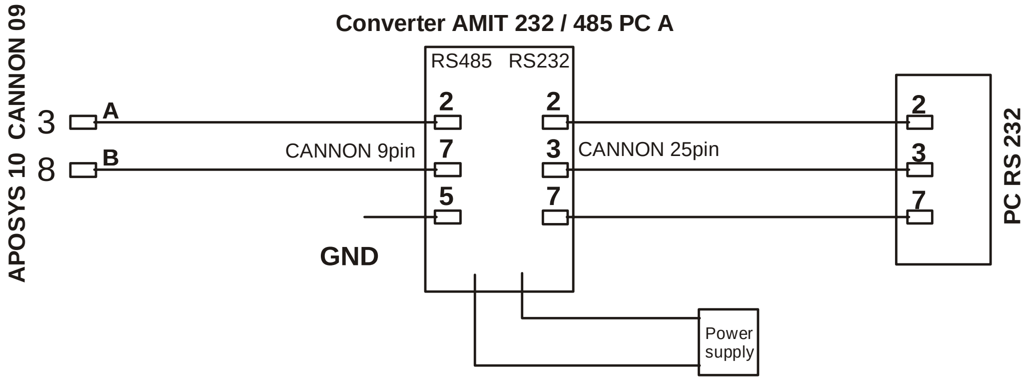
Note:
At first is sended the mark with the address (address+0) and last is sended the mark with the address (address+n).

6 Controller connecting with PC

6.1 Cable connexion for communication RS 232



6.2 Cable connexion for communication RS 485 with converter or card



7 Software

7.1 Application of software APOELMOS

Request on hardware:

PC: Pentium 100
graphic card: VGA
CD ROM drive

Request on software:

operation system MS Windows 95/98/ME and higher versions

Installation of software suppose the basic knowledge for working with PC and selected instructions MS Windows.

7.2 Installation

1) Enter CD ROM to CD ROM drive. As long as the CD ROM after enter to CD ROM drive will run Internet Explorer (autorun), you set from concrete menu „Service software“ and use a program for the controller APOSYS 10.
2) Copy software to HDD.
3) Create shortcut and move shortcut to Start Programs.
4) Now you can run the software (PA-10.exe).

7.3 Program PA-10 description

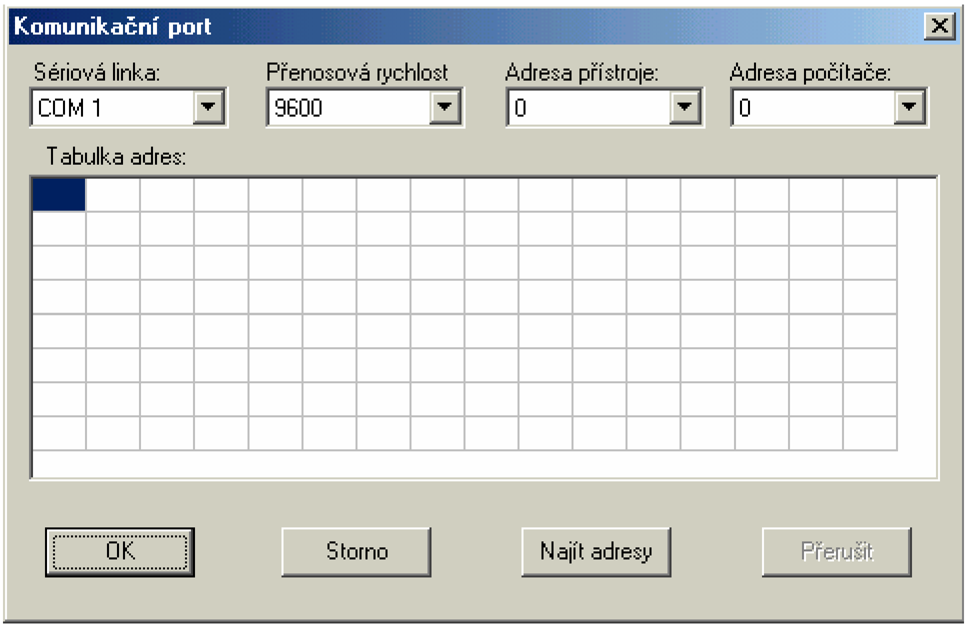
1) Introduction
2) Communication line setting
3) Graph setting
4) Data record speed setting
5) Controllers parameters setting
6) Controller set parameters save
7) Automatical record start
8) Record from controller reading

7.3.1 Introduction

The software is for the controller parameters setting and for measured values monitoring.

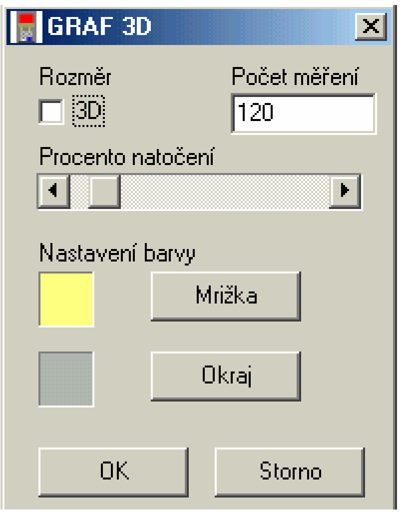
7.3.2 First start

After the software start at first you have to set the communication line and the controller address.
In the menu setting you click on a button communication port. There is open a window the communication port. At first you set a serial line and a communication speed 9600Bd. After that you click on a button find addresses. In the address chart is detected the controller address which you set to apparatus address. The PC address have to be arbitrary in the range 0 - 126. After setting you acknowledge by button OK.



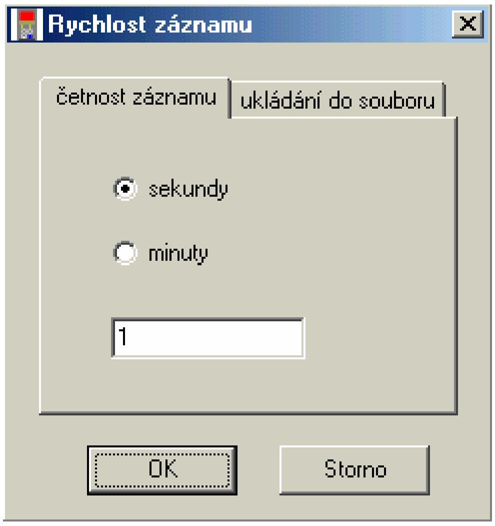
7.3.3 Graph setting

In the menu setting you click on the button graph setting. There is open the window graph 3D. Here you set required graph view.



7.3.4 Data record speed setting

In the menu setting you click on the button record speed. There is open the window record speed. Here you set required speed of save to form and automatical form save to file time.



7.3.5 Controllers parameters setting

In the menu setting you click on the button controller setting. There is open the window APOSYS 10 dates. By button reading you can read parameters from the controller namely always those parameters only which active card contain. By button record you can record parameters from active card to the controller. After the controllers parametars setting you click on the button EEPROM for parameters storage in the controller in case of the controller power supply failure.

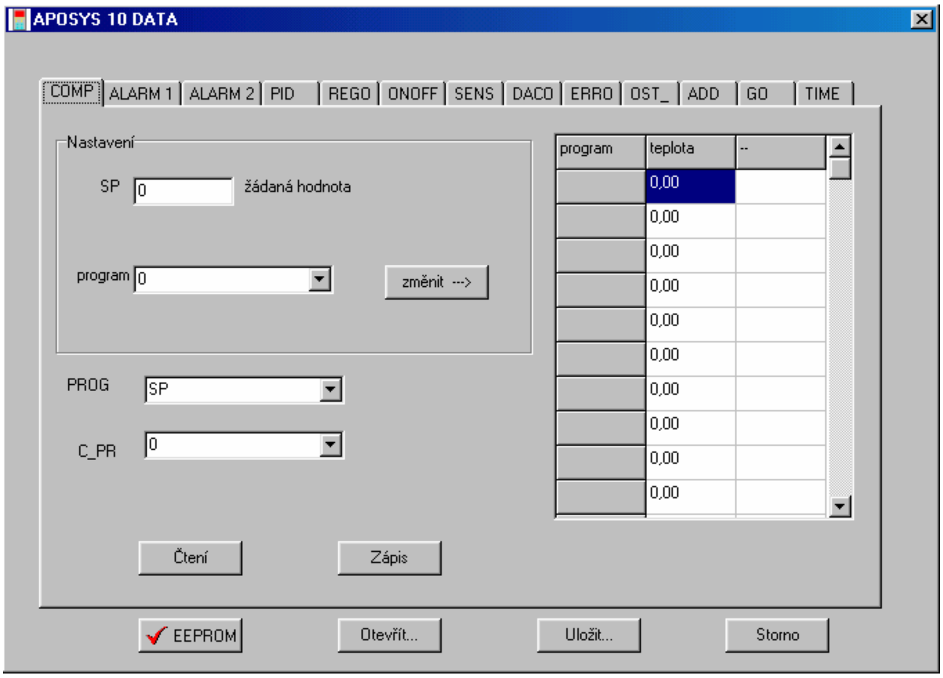
Warning!

If we have on the rear panel of controller the switch in position ON the parameter record to EEPROM will not achieve.

7.3.6 Controller set parameters save

In the window APOSYS 10 dates (see previous setting). By the button save (open) you can set parameters save to file (refresh from file). File have a suffix ini.

At dates refresh from file are parameters projection on the controller parameters cards only. Parameters record to the controller you have to do from every card extra. One exception is card COMP for controller version APOSYS 10-2xxx and APOSYS 10-3xxx. At first we set the program (PROG) and program number (C_PR) and after that we achieve the parameters refresh by the key open. By the key record we record parameters to controller. This is recommended process. Because at program change or program number are every time retrieved parameters from controller to card.

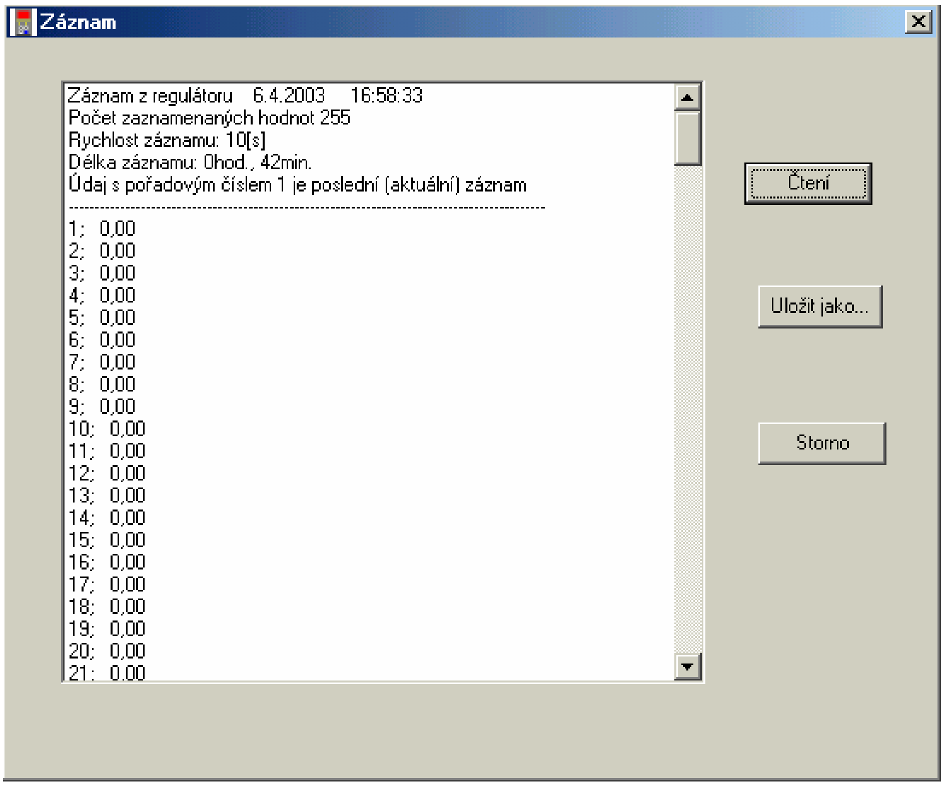


7.3.7 Automatical record start

In the main window you check off automatical reading and record to file.

7.3.8 Record reading from the controller

In the menu setting we click on the key record from the controller. The window record is open. By the key reading we can retrieve 255 saved measured values in the controller. Record frequency we can affect on card ADD in window APOSYS 10 dates.



8 Certificate about the product assembly and quality

Microprocessor controller APOSYS 10

product nr. 88-09-08888

We acknowledge that the above mentioned product is complete. And the product answers to technical conditions and it is well inspected and tested.

9 Guarantee conditions

The producer is responsible that his product has and will have characters appointed by technical norms for appointed time, that it is complete and without defect. The producer is also responsible for defects, which a customer will find out in the guarantee time and which he will claim in time. The basic condition of guarantee is using the controller this way as the above mentioned in the using handbook.

The guarantee time is 36 months from the day of sale.

The guarantee is possible to apply at material defects or at bad function of product. Guarantee repairs are achieved with exchange way.

The guarantee is dissolved as long as on the product there were made arrangements or guarantee labels were broken down and as long as the product was violently mechanically damaged or it was used the wrong way.

Guarantee and afterguarantee service perform entirely A.P.O. – ELMOS.

stamp

Date of sale: ....

Signature: ....

Substance