

Controller AP 21

Technical documentation U-19



AP21 – Standard

APOELMOS
measurement & control
www.apoelmos.cz



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Controller AP 21 is 4 digit, two-line programmable device for universal use. Controller is equipped with digital signal processor with A/D transducer. Controller is operated with key-board placed on front panel or with control software that is used for setting of all parameters and archiving measured values. Controller has to be provided with communication line, variants of communication lines are in ordering code. Control software PAP is available on www.apoelmos.cz

Controller is equipped with two-line display. Upper large display allows to set three-color function of display. Visually interesting element is auxiliary vertical bargraph. Input section of controller is equipped with 16-bit A/D transducer with galvanic separation, which allows to connect the input connectors of resistance sensor Pt100, Pt1000, NI1000, thermocouple J, K, E, T, R, S, B and unified current signal 0/4 - 20 mA or voltage signal 0 - 10 V. Feedback is available for control of electric drive (resistance transmitter, current signal 4 - 20 mA or voltage signal 0 - 10 V). Controller is equipped with PID regulation. Can be regulated continuously with the analog output or with output three positions relays. There is a version with analog output in the ordering code of the controller. Analog output can be assigned to any input or action intervention. Controller is equipped with two limit switches, whose outputs are relay switching contacts.

Limit switches can be set for the safety function. Then it is necessary to do the manual deactivation after alarm switch occurs. For communication controller with the PC it possible to use any of the offered variants of communication lines.

In ordering code is the communication line RS232 or RS485. For premium applications it is possible to use both communication lines RS232 and RS485 simultaneously. Both communication lines work with MODBUS protocol.

Communication enables not only setting of parameters and data archiving, but regarding the possibility of addressing of individual controllers it can be also used for interconnection of bigger number of controllers and controlling of complete technological lines.

Controller features offers large possibilities of its usage, not only for PID regulation but also as signal transducers, galvanic separation, data collection for their processing on PC, as limit switches, simple two-state regulator, controllers for failure signalling.

1.1

Ordering code

This technical documentation refers to the following chart of ordering codes.

fig. 1

AP 21 - XX - X - X - X - X - X - XXX									
									Input
41									Input 1:universal with GS
									Input 2:feedback,external setting of required value
									Contact output
0									empty
1									2 x relay (switching contacts 250 VAC, 2A)
2									4 x relay (switching contacts 250 VAC, 2A)
									Analogue output
0									empty
1									current/voltage without GS
2									current/voltage with GS
									Comunnication
0									empty
1									RS232
3									RS485 with GS
6									RS485 with GS + RS232
									Power supply
1									80 - 253 VAC
2									18 - 36 V AC/DC
									Display
4									three-colour
									Software
001									standard
XXX									special requirement

Example of order:

AP 21 - 41 - 2 - 1 - 3 - 1 - 4 - 001

Input signal, accuracy				
Type	Input signal	Range of measurements	Measurement accuracy (%)	Standard
Input 1 with galvanic separation	Pt100	-100 ~ 800 °C	± 0,1%	IEC 751
	Pt1000	-100 ~ 600 °C	± 0,1%	IEC 751
	Ni1000/6180 ppm	-50 ~ 200 °C	± 0,1%	DIN 43760
	Ni1000/5000 ppm	-50 ~ 200 °C	± 0,1%	DIN 43760
	thermocouple J	-200 ~ 1200 °C	± 0,1%	IEC 584
	thermocouple K	-200 ~ 1300 °C	± 0,1%	IEC 584
	thermocouple E	-200 ~ 950 °C	± 0,1%	IEC 584
	thermocouple T	-200 ~ 400 °C	± 0,1%	IEC 584
	thermocouple R	-50 ~ 1550 °C	± 0,15%	IEC 584
	thermocouple S	-50 ~ 1700 °C	± 0,15%	IEC 584
	thermocouple B	-250 ~ 1800 °C with linearization by 400°C	± 0,15%	IEC 584
	current signal	4-20 mA, 0-20 mA	± 0,1%	
	voltage signal	0-10 V	± 0,1%	
	Compensation of comparative ends of thermocouples inside - accuracy 0,5 °C at temperature 20 °C, temperature coefficient 50 ppm/ °C outside - regulable 20 °C, 50 °C, 70 °C or without compensation			
Input 2	Potentiometer 1 (resistance transmitter)	up to 250 Ω	± 0,2%	
	Potentiometer 2 (resistance transmitter)	up to 1,3KΩ	± 0,2%	
	Potentiometer 3 (resistance transmitter)	up to 10KΩ	± 0,2%	
	Current signal (active)	4-20mA,0-20mA	± 0,1%	
	Voltage signal	0-10V	± 0,1%	

Power supply	
Power supply voltage	80 - 253 VAC, 50 Hz 18 - 36 VDC / 18 - 36 VAC, 50 Hz
Input	max. 12 VA
Display	
Display	-999 ~ 0 ~ 9999 (two-line, 4 digit LED)
Display color	Top display: green, yellow, red; bottom display: green
Height of digits	Top display 14 mm, bottom display 10 mm
Decimal point	Adjustable with program
Bargraph	16 LED
Resolution	According to position of decimal point
Auxiliary power supply	>18 VDC @25 mA for feeding of sensors
Outputs	
Contact	2x relay (switching contact 250 VAC, 2 A, 30 VDC, 2A) or 4x relay (switching contact 250 VAC, 2 A, 30 VDC, 2A)
Analogue	13.5 bit D/A transducer without galvanic separation or with galvanic separation current 0 (4) – 20 mA, loading resistance max. 400 Ω voltage 0 – 10 V, loading resistance min. 10 k Ω
Communication	
RS485, MODBUS	with galvanic separation, two way communication
RS232, MODBUS	without galvanic separation
Operating conditions	
Working temperature	0 - 60 °C
Temperature coefficient	25 ppm/°C
Stabilizing time	to 10 min. after switching
Shielding	IP 54 (front panel) IP 20 (terminal board)
Calibration	25 °C a 40% r.v.
Data back-up	electrically (EEPROM)
Connection	
Connector terminal board	
Max. section of conductor	2.5 mm ² for power supply and contact outputs 1 mm ² for other connectors
Safety class	I

Electromagnetic compatibility ČSN EN 61326	
Seismic resistibility ČSN IEC 980: 1993, art. 6	
Electric safety ČSN EN 61010-1: 2003 including changes	
Mechanical properties	
Type	panel controller
Dimensions	96 x 48 x 119 mm for power supply 80 - 253 VAC, 50 Hz 96 x 48 x 125 mm for power supply 18 - 36 VDC / 18 - 36 VAC, 50 Hz
Opening in panel	90,5 x 43,5 (openings in corners ø 3 mm with pitch 89,5 x 42,5 mm)
Keyboard	4 keys, foil
Weight	400 g with full installation

3.1

Front panel

fig. 2

**1 - Big display**

Four-digit display for indication of measured value. With parameter programming display shows clear reports.

2 - Small display

Four-digit display for indication of required value. With parameter programming display shows clear reports.

3 - Bargraph

Bargraph relates to measured value that is determined with pre-set range of BSTR and BEND.

E.g. if start of range (BSTR) is 0 and end (BEND) 200 and measured value shall be on level 100, bargraph shall indicate half of the scale. Bargraphs is formed with column of LED diodes.

4 - Output „OUT” indicators

Indicators OUT 1 to OUT 4 indicates state of individual outputs in the following manner: indicator flashing – output switched, indicator is not flashing – output is off.

5 - Key „UP”

Key „UP” is used for browsing parameters and setting of numeric data when programming. Pushing and keeping down of the key speeds up browsing and setting procedure.

6 - Key „MENU”

Key „MENU” is used to enter configuration menu, end of programming , write data to EEPROM and return to working mode. In working mode allows short push switch display of measured values of inputs.

7 - Key „DOWN”

Key „DOWN” is used for browsing parameters and setting of numeric data when programming. Pushing and keeping down of the key speeds up browsing and setting procedure.

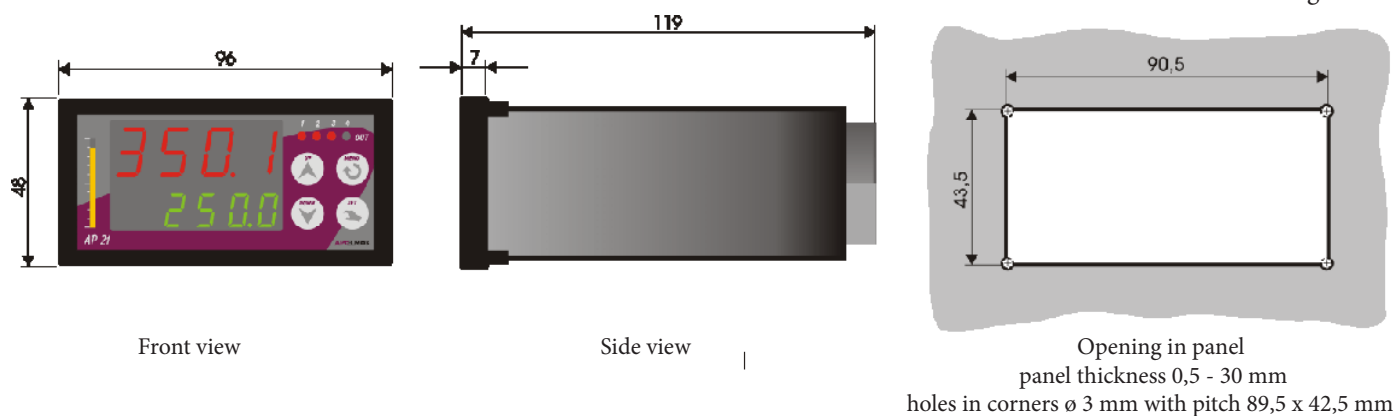
8 - Key „SET”

Key „SET” is used for setting data, programming termination, data uploading into EEPROM and return to operating mode.

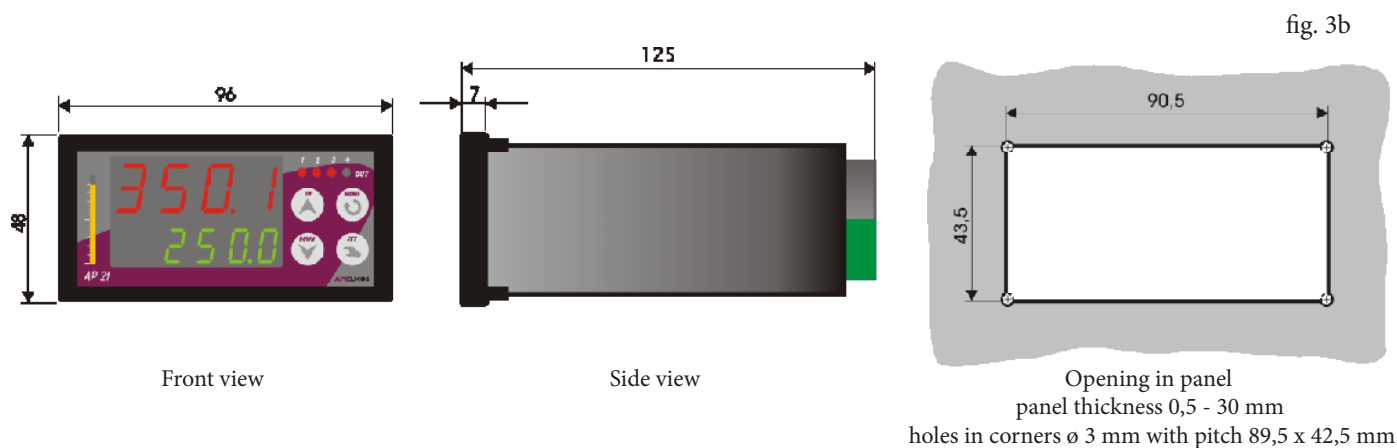
DIMENSIONS OF CONTROLLER AND ASSEMBLY OPENING

3.2

Dimensions for power supply 80 - 253 VAC, 50 Hz (fig. 3a)



Dimensions for power supply 18 - 36 VDC / 18 - 36 VAC, 50 Hz (fig. 3b)



4.1

Description of back panel

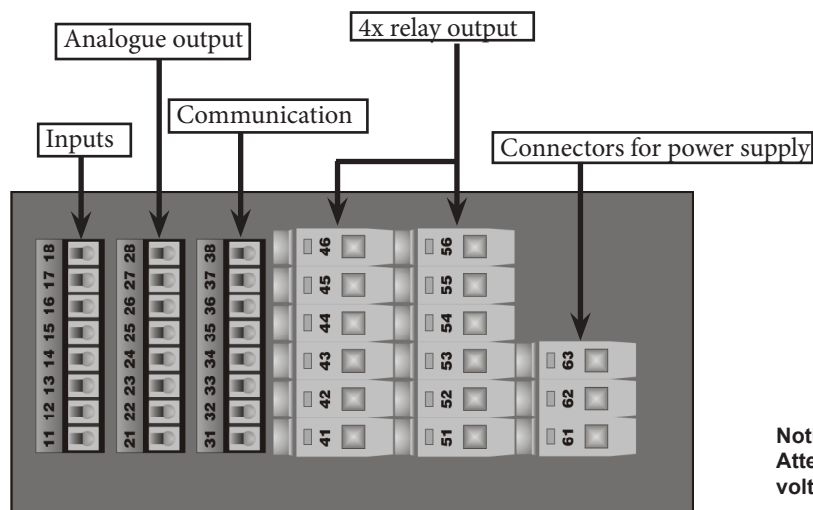


fig. 4



Notice risk danger!
Attention to the supply
voltage!

4.2

Instructions for assembly into panel and connection

Fix panelmeter into panel with two clamps (included in delivery).

Connect conductors into screw connectors on the back panel of AP21 controller. Connectors are designed as separately detachable constructions blocks as follows:

- connectors 11 to 18 – universal inputs
- connectors 21 to 28 – analogue output
- connectors 31 to 38 – communication
- connectors 41 to 46 – relay output
- connectors 51 to 56 – relay output
- connectors 61 to 63 – power supply

Pull each block with connectors out from AP21 controller (locking force has to be surpassed) in backward direction. Then connect conductors to released blocks with connectors and then insert blocks back to panelmeter. Max. cross section of conductors on relay connectors and power supply is 2,5 mm², on other connectors 1 mm².

4.2.1

Reducing of interference influence

Following rules should be observed with designing of the system:

- a) All power supply conductors and power lines has to be led separately from signal lines (e.g. thermocouple, communication). Min. gap between these types of lines shouldn't be less than 30 cm.
- b) If signal line crosses power line they should intersect in right angle.
- c) Lead the lines out of the potential source of interference.
- d) Don't install relay and contactors too close to panelmeter.
- e) Use twisted and screened conductor for signal line.

Connection to feeding voltage

4.3



Caution!

Danger: Don't connect controller to power supply until all inputs are connected. Wrong connection of panelmeter can cause injury!

Controller connection

During connecting of panelmeter main switch or safety circuit breaker has to be:

- part of building installation
- in the close vicinity of equipment
- easy to reach for operating personnel
- marked as equipment disconnecting element

If the equipment is used in different manner than specified by producer, protection provided with equipment can be disturbed.

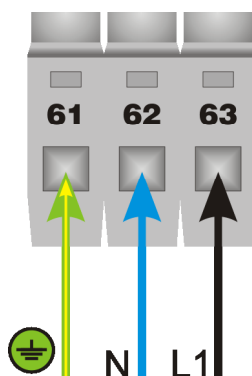
Recommended safety fuse for power supply 230 V is 1 A / 250 VAC

Recommended safety fuse for power supply 24 V is T 3,15 A / 250 V

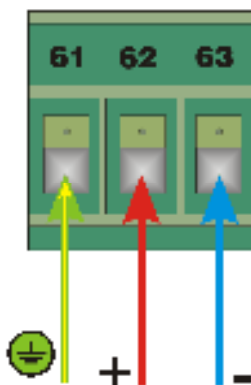
Connection of power supply conductors in terminal board

4.3.1

Alternating feeding voltage
80 - 253 VAC, 50 Hz



Feeding voltage
18 - 36 VDC



Feeding voltage
18 - 36 VAC

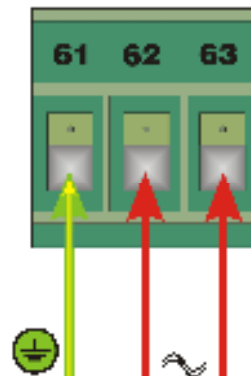


fig. 5

Connecting of input signals

Connection of universal input

Following diagrams show the possibilities of sensors and process signal connections the universal input with galvanic separation. Select input signal in the function menu SEN1.

Variants of input signals

Input 1 SEN1		
Signal type	Symbol on display	Figure no.
Resistance sensor		
PT100	<i>PT-1</i>	fig.6
PT1000	<i>PT-2</i>	
Ni1000/6180 ppm	<i>NI-6</i>	
Ni1000/5000 ppm	<i>NI-5</i>	
Thermocouple		
J	<i>TC-J</i>	fig.7
K	<i>TC-C</i>	
E	<i>TC-E</i>	
T	<i>TC-T</i>	
R	<i>TC-R</i>	
S	<i>TC-S</i>	
B	<i>TC-B</i>	
Current signal		
4 to 20 mA (passive double-conductor transducer)	<i>4-20</i>	fig.8
0/4 to 20 mA (active current signal)	<i>0-20</i> <i>4-20</i>	fig.9
Voltage signal		
0 to 10 V	<i>0-10</i>	fig.10

Input 2 SEN2		
Resistance sensor		
Potentiometer 1 (up to 250Ω) (resistance transmitter)	PT-1	11
Potentiometer 2 (up to 1,3KΩ) (resistance transmitter)	PT-2	
Potentiometer 3 (up to 10KΩ) (resistance transmitter)	PT-3	
Current signal		
4 - 20 mA (active current signal)	4-20	12
0 - 20 mA (active current signal)	0-20	
Voltage signal		
0 - 10 V	0-10	13
NO SENSOR	- N D-	Disabled sensor,not diplayed

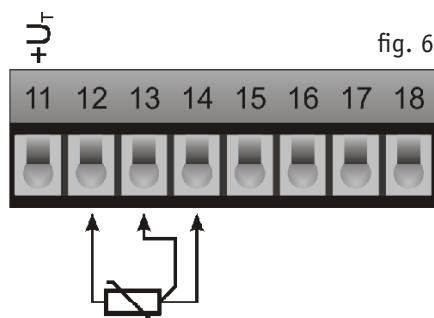


Requirement of right measuring is necessary to set type of signal input in menu SEN1 and SENS 2 during device configuration.

Connection of input signals IN-1

4.4.2

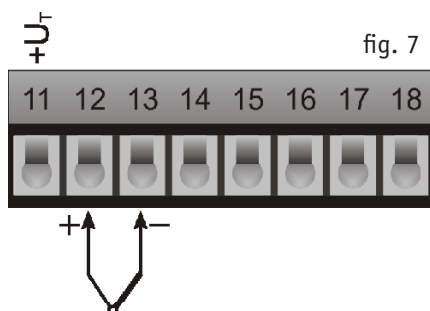
Resistance sensor Pt100, Pt1000, Ni 1000



Resistance sensor Pt100,
Pt1000, Ni 1000

Connect sensor to connectors 12, 13, 14 according to schema. Long press key MENU to enter into configuration menu of device. Press key SET to enter into options mode of parameter SEN1. With keys UP and DOWN find parameter TYP and press key SET to enter into options mode of sensor type. With keys UP and DOWN set the type of resistance indicator PT-1, PT-2, NI-5 or NI-6. Confirm the option with pressing key MENU. Press twice key MENU to enter into working mode of controller.

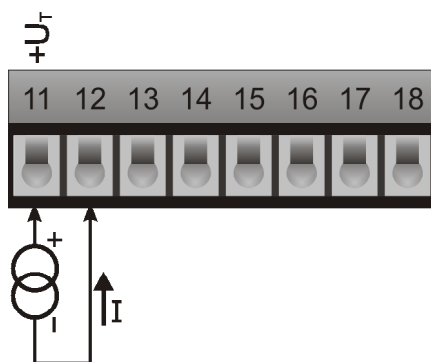
Thermocouple J, K, E, T, R, S, B



Thermocouple
J, K, E, T, R, S, B

Connect conductor thermocouple to connectors 12,13 according to schema. Long press key MENU to enter into device's configuration menu, find function for option type of sensor SEN1. Press SET to enter into submenu for options. Press key SET to enter into option type TYP of sensor. With keys UP and DOWN set the type of thermocouple TC-J, TC-C, TC-E, TC-T, TC-R, TC-S or TC-B. Confirm the option with pressing key MENU. At thermocouple is necessary to set compensation of cold end connectors COMP. See. configuration compensation of thermocouple on page 42.

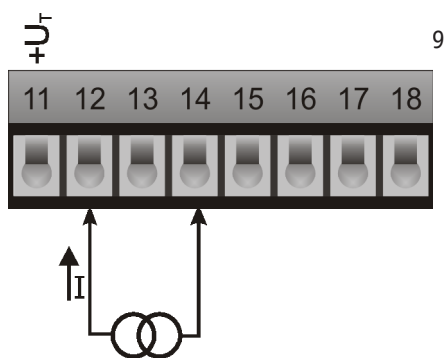
Current signal 4 - 20 mA (passive double-conductor transducer)



Current signal 4 - 20 mA
(passive double-conductor
transducer)

Connect double-conductor transducer to connector 11 (power supply) and to connector 12 according to schema. Long press key MENU to enter into device's configuration menu, find function for sensor type setting SEN-1. Press SET to enter into submenu. Find option type of sensor TYP. Press key SET to enter into options of type of sensor. With keys UP and DOWN set for passive double-conductor transducer 4 - 20 mA option 4 - 20. Confirm the option with pressing key MENU. Next there is necessary to set range of measuring here. Define the start of range in MENU with function STRS, the end of range with function ENDS. Confirm changes by leaving Menu

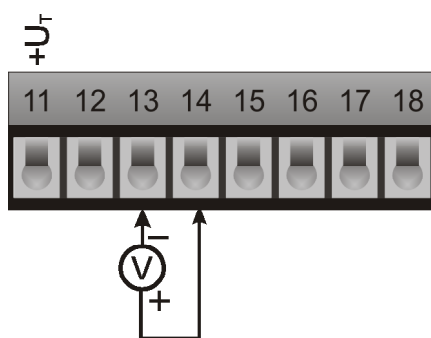
Current signal 0 - 20 mA (active), 4 - 20 mA (active)



Current signal
0 - 20 mA (active)
4 - 20 mA (active)

Connect supply of current signal with connectors 12, 14 according to schema. Long press key MENU to enter into device's configuration menu, find function for sensor type setting SEN-1. Press SET to enter into submenu. Find option type of sensor TYP. Press key SET to enter into options of type of sensor. With keys UP and DOWN set for active current signal option 0 - 20 mA or option 4 - 20. Confirm the option with pressing key MENU. Next there is necessary to set range of measuring here. Define the start of range in MENU with function STRS, the end of range with function ENDS. Confirm changes by leaving Menu

Voltage signal 0 - 10 V



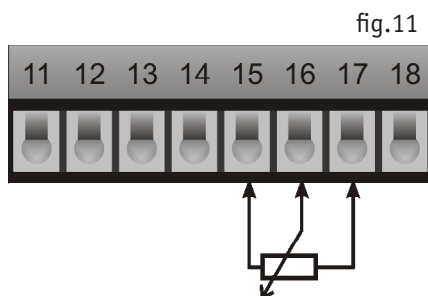
Voltage signal
0 - 10 V

Connect supply of voltage signal with connectors 13, 14 according to schema. Long press key MENU to enter into device's configuration menu, find function for sensor type setting SEN-1. Press SET to enter into submenu. Find option type of sensor TYP. Press key SET to enter into options of type of sensor. With keys UP and DOWN set for voltage signal 0 - 10 V option 0 - 10. Confirm the option with pressing key MENU. Next there is necessary to set range of measuring here. Define the start of range in MENU with function STRS, the end of range with function ENDS. Confirm changes

Connection of input signals IN-2

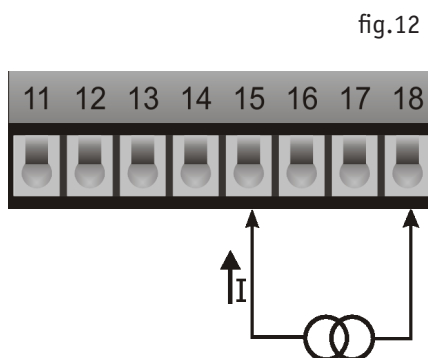
4.4.3

Potentiometer Pt-1, Pt-2, Pt-3



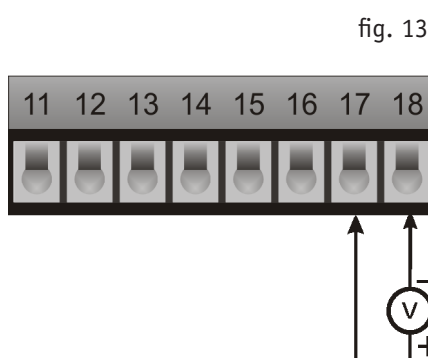
Connect resistance signal to connectors 15,16,17 according to schema. Long press key MENU to enter into device's configuration menu, find function for option type of sensor **SEN-2**. Press SET to enter into submenu for options sensor find item **TYP**. Press key SET to enter into options type of sensor. With keys UP and DOWN set resistance sensor PT-1,PT-2,PT3. Confirm the option with pressing key SET.

Current signal 0/4 - 20 mA (active)



Connect supply of current signal with connectors 15, 18 according to schema. Long press key MENU to enter into device's configuration menu, find function for sensor type setting SEN-2. Press SET to enter into submenu. Find option type of sensor TYP. Press key SET to enter into options of type of sensor. With keys UP and DOWN set for active current signal option 0 - 20 mA or option 4 - 20. Confirm the option with pressing key MENU. Next there is necessary to set range of measuring. Define the start of range in MENU with function STRS, the end of range with function ENDS *.Confirm changes by leaving Menu.

Voltage signal 0 - 10 V



Connect supply of voltage signal with connectors 17, 18 according to schema. Long press key MENU to enter into device's configuration menu, find function for sensor type setting SEN-2. Press SET to enter into submenu. Find option type of sensor TYP. Press key SET to enter into options of type of sensor. With keys UP and DOWN set for voltage signal option 0 - 10 V or option 0-10. Confirm the option with pressing key MENU. Next there is necessary to set range of measuring. Define the start of range in MENU with function STRS, the end of range with function ENDS*.Confirm changes by leaving Menu.

* By setting input 2 to function feedback (position of servo drive) setting of decimal point position DP and STR,END is solid (0.0-100.0).

Options of analogue output connections with or without galvanic separation are shown on the fig. 14. Type of output signal is selected in menu with parameter DACO and in its submenu by function AOUT.

5.1 Connection of analogue output



Analogue output is connected to connectors 21 - 28 (fig. 14).

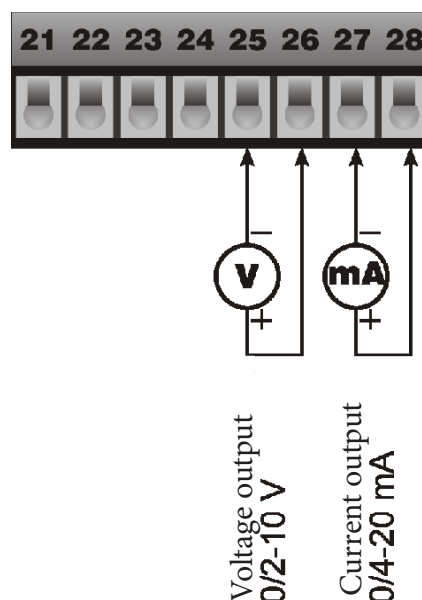
Long press key MENU and enter into configuration menu. Press keys UP and DOWN to get to the DACO option. Press SET key to enter into setup level. Press keys UP and DOWN to select required type of analogue output 0-20, 4-20, 20-0, 20-4. Press key MENU to confirm selected parameter.

In MENU of device is necessary to select type of analogue output in menu DACO ->AOUT and set parameters DACO -> ASTR and AEND

Features of analogue output

Type of analogue output	Symbol on display
Current	
0-20 mA	0-20
4-20 mA	4-20
20-0 mA	20-0
20-4 mA	20-4
Voltage	
0-10 V	0-20
2-10 V	4-20
10-0 V	20-0
10-2 V	20-4

fig. 14



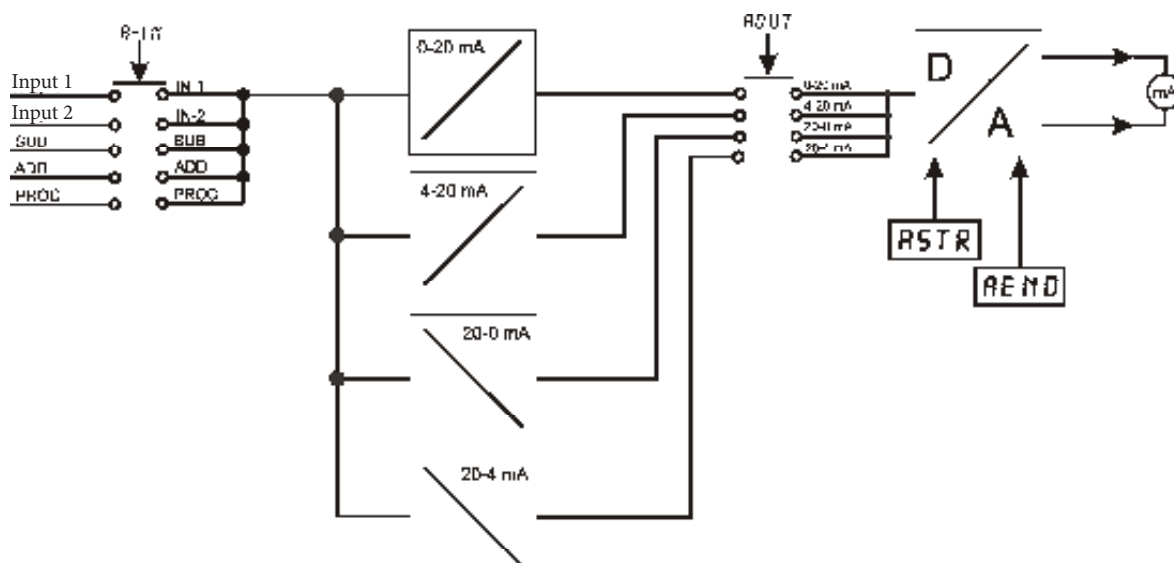
Block diagram of analogue output function

5.2

Principle of analogue output is shown on block diagrams Fig. 15 and 16. Diagrams of voltage and current output are separated for better orientation. In real connection are inputs and setup AOUT, ASTR and END common. For correct function of panelmeter set range of analogue output ASTR (start of range), AEND (end of range), that relates to input signal – see configuration of start and end of analogue output.

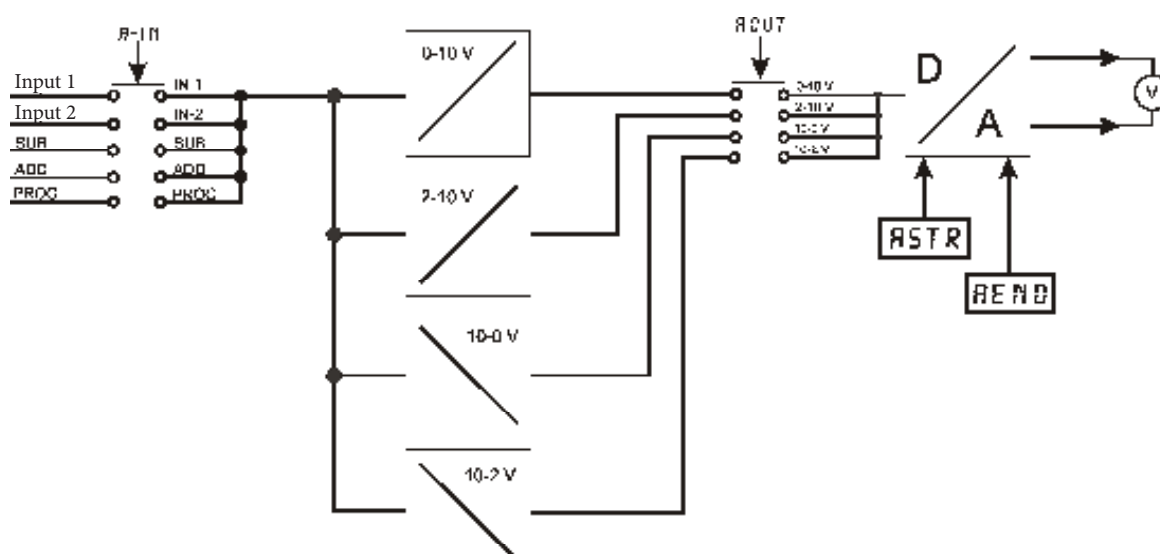
Current output

fig. 15



Voltage output

fig. 16



Controller AP21 can be equipped with communication line with protocol MODBUS, that is selected with order of AP21 according to ordering code. Following options of communication lines are available: RS232, RS485 with galvanic separation or both simultaneously.

Diagram of communication lines RS232 and RS485 connections

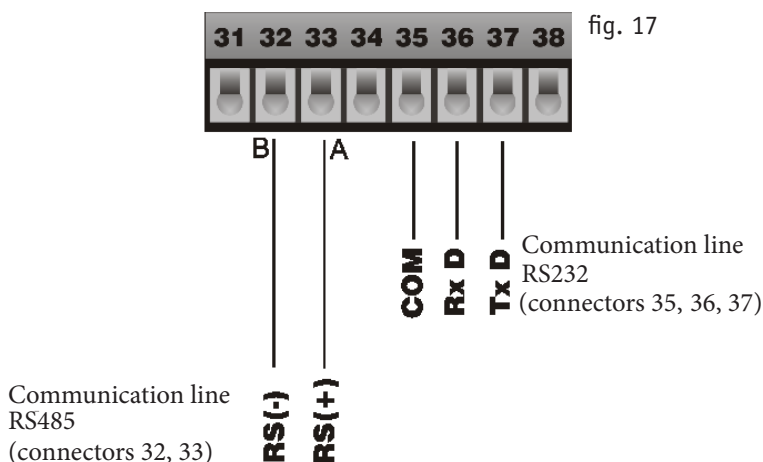
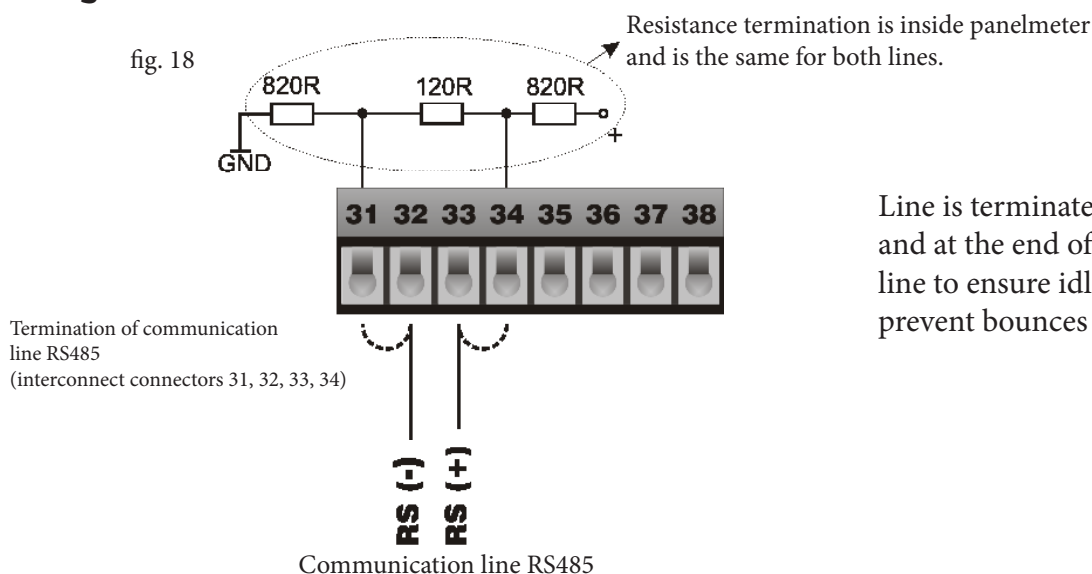


Diagram of communication line RS485 connection



Line is terminated at the beginning and at the end of communication line to ensure idle conditions and to prevent bounces in line.

Diagram of communication line RS232 connection to PC (connector Canon 9 pin)

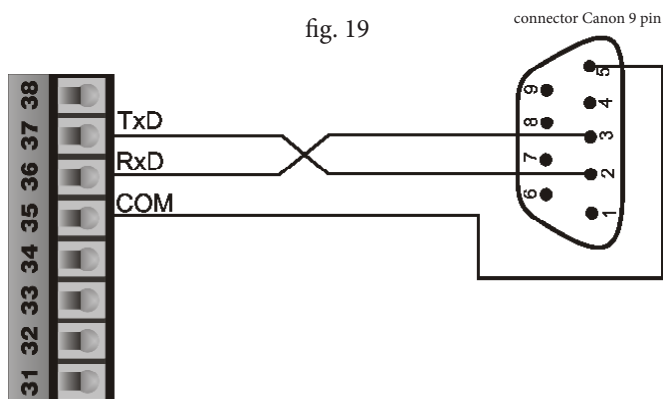
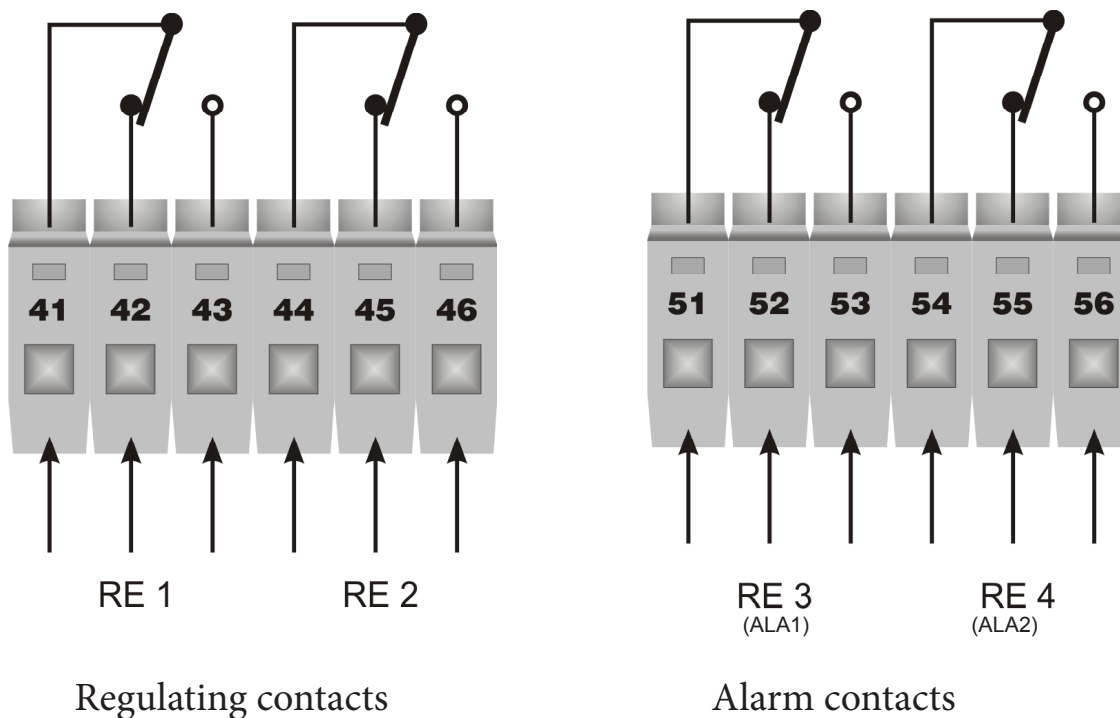


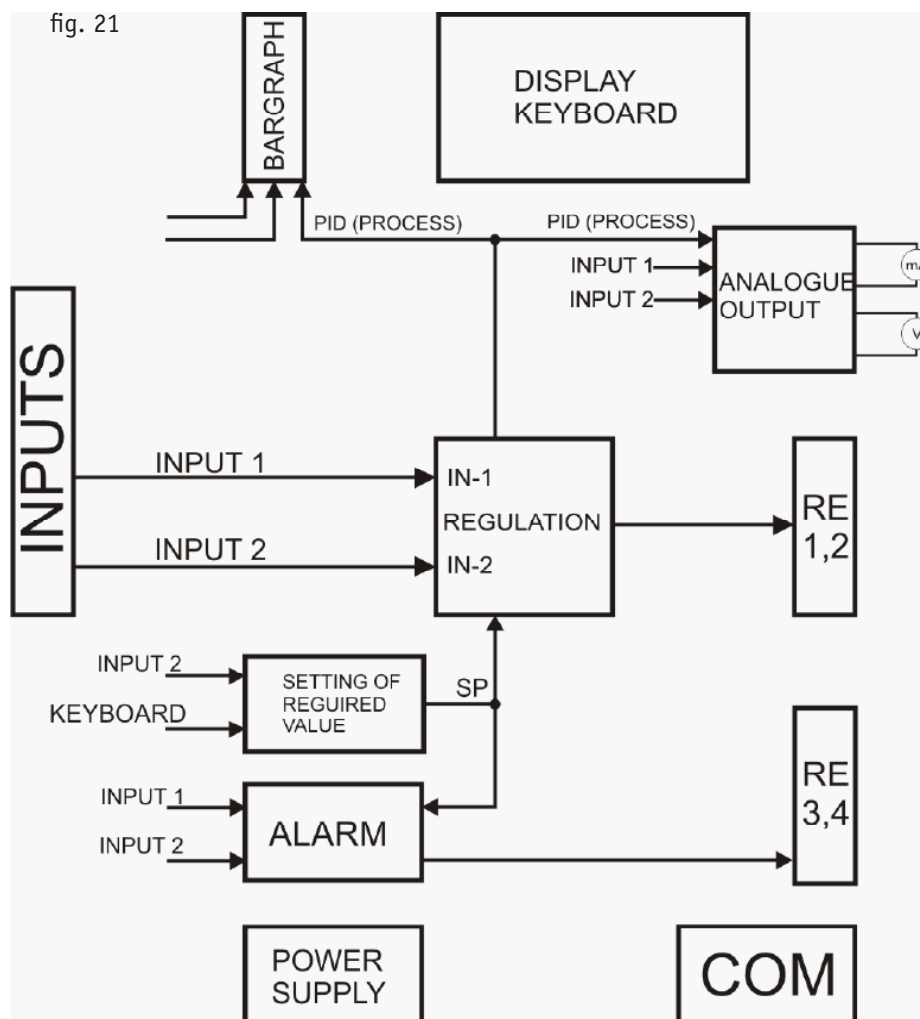
Figure 20 shows options of connections of output relay contacts. Max. load of relay contacts is 250 VAC, 2 A. It is advisable to connect antijamming RC cells (e.g. 220 ohm and 0,1 μ F) to respective contacts to increase reliability and to reduce jamming. State of output relays 1, 2 is selected in menu of panelmeter REGO. The state of relay 3,4 is selected in submenu parameter ALA1,ALA2.

fig. 20



8.1

Block diagram of controller



8.2

Switching on

Main switch is not included in regulator therefore it activates immediately after connection to power supply. The inscription AP 21 will be displayed for a while on device display. During this time is performed initialization and test of inner parameters. After completion of test regulator switches to working mode.

**Caution!**

If flashes key SET AP21 Controller needs to be recalibrated.

**Showing ERROR on Display**

Error of sensor on input 1 displays ER-1 (not connected, wrong sensor)

Error of sensor on input 2 displays ER-2 (not connected, wrong sensor)

8.3

Reset

Unplug regulator from power supply. Keep key SET pressed and connect the panelmeter to power supply. Keep the key pressed until sign RST appears on display.



Default parameters are restored after reset!

Display setting

8.4

Panelmeter AP 21 is equipped with three-colour display with possibility to set permanent colour changes or changes with relation to the amount of measured value. You will appreciate this function namely with instant visual check of limits, within which measured value oscillates. E.g. if measured value oscillates within the correct range it flashes in green (G). If the value is lower it flashes in yellow (Y). If maximum allowed limit is exceeded it flashes in red (R). Display colours in dependence on measured value can be modified as needed. Colour and display parameters can be set in AP21 controller menu (key MENU) and scrolling to parameter.

Figure 22 schematically shows principle of colour change in dependence on measured value.

In regulator Menu it is necessary to set to which sector (SEC-0, SEC-1 and SEC-2) the particular colour is assigned (R, G, Y). Then it is necessary to set limits within which the measured value should oscillate. Bottom limit is defined with parameter S-LO and top limit with S-HI. With this setting we suppose that required value is located in sector 1 (SEC-1) and if it oscillates within set limits, display flashes in green. If the value falls

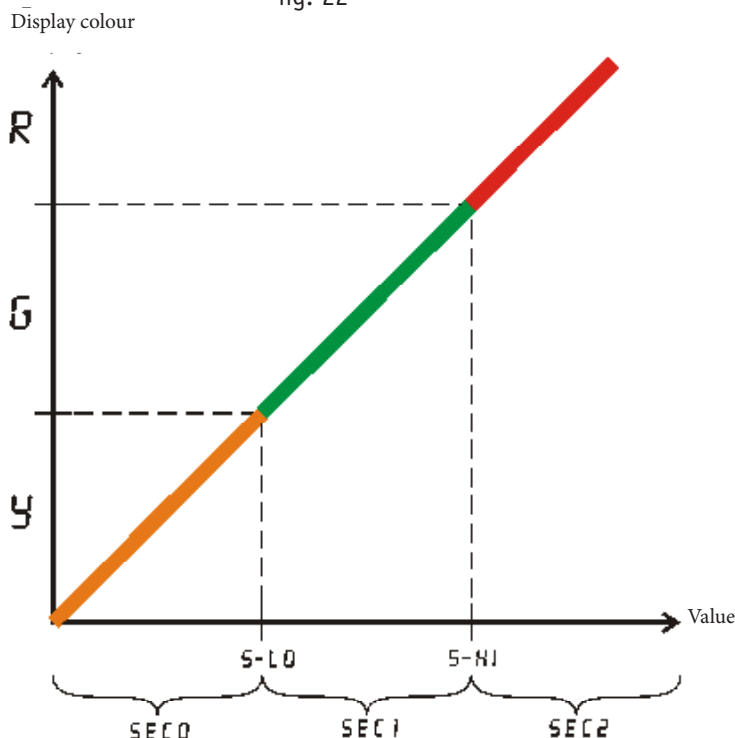
below S-LO (sector 0) it starts flashing in yellow and on contrary if measured value rises on the top limit S-HI display starts flashing in red. Colours assigned to individual sectors SEC-0, SEC-1, SEC-2 can be changed in

regulator menu as needed. If you want to change display colour permanently without any relation to measured value set the same colour to all parameters SEC0, SEC1, SEC2 .

With requirement for two colour display set only one of two limit parameters S-LO or S-HI separating two neighbouring sectors and set for one sector e.g. red colour (R) and for remaining two sectors green (G).

Example:

fig. 22



In menu for display properties setting DISP, intensity of display light can be set. Scroll to parameter LIGHT in menu. In setting mode display light intensity can be set to 25%, 50%, 75% and 100% with keys UP and DOWN.



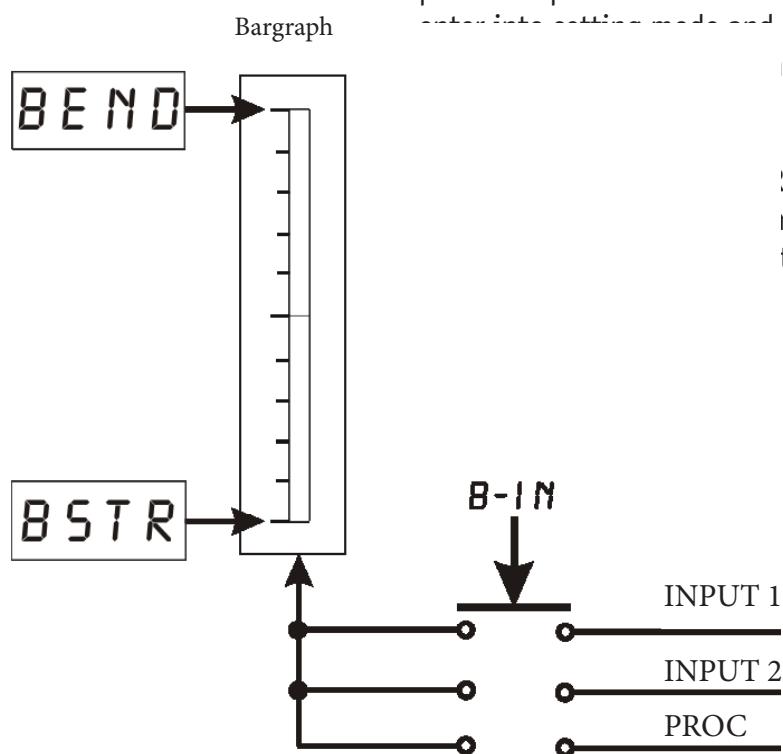
Change of display colour according to measured value is always related to first input (IN-1)!

Bargraph

Bargraph relates to input value, which is determined by parameter B-IN. It roughly indicates amount of measured value within limits set by a user. Thanks to these properties of bargraph it is possible to find out immediately the limits of measured value oscillation.

Press key MENU long to enter into configuration menu, find function for options of bargraph BARG. Press key SET to enter into submenu where confirm parameter BSTR for option the start of bargraph range with pressing key SET. Set required value with keys UP and DOWN. Press MENU key to confirm changes. To set the end of bargraph range find in submenu BARG parameter BEND. Setting procedure is identical with BSTR. Choose as the last item for which input are required values set. Find in submenu parameter B-IN. Press key SET to enter into setting mode and set required input IN-1, IN-2 and PROC. To save all you must leave config menu to working mode by

fig. 23



is 0 and the end (BEND) 200 and measured value of the scale. Bargraph is formed with column 16. of

Regulation

Type of regulations

Controller AP 21 for regulation systems is setting simply parameter REGO in device MENU.

In its submenu it is possible to set three types of regulations (parameter TYP):

1. ON/OFF - two-state regulation based on the setting of limit switches.
2. PID1 - PID regulation realized on a single relay output. It is used especially for control of heating elements. It allows more accurate control of the process than the two-state regulation. Precise control can be achieved only when the device is properly configured according to the characteristics of the regulated system. This is called PID parameters
3. PID3 - three position PID regulation.

Two-state regulation - ON / OFF

8.6.2

Characteristics two-position regulation

- Is used for less complex applications
- Zero regulation deviation cannot be achieved
- Measured value oscillates in characteristic manner around required value.

Regulation ONOF is realized on the first and the second output. Regulation compares input signal with required value and by setting shift in menu REGO evaluation its deviation of required value. After exceeding activate output(relay 1,2). Simultaneously with regulation ONOF is calculation PID. Action interference from PID can be send on analog output.

fig. 24

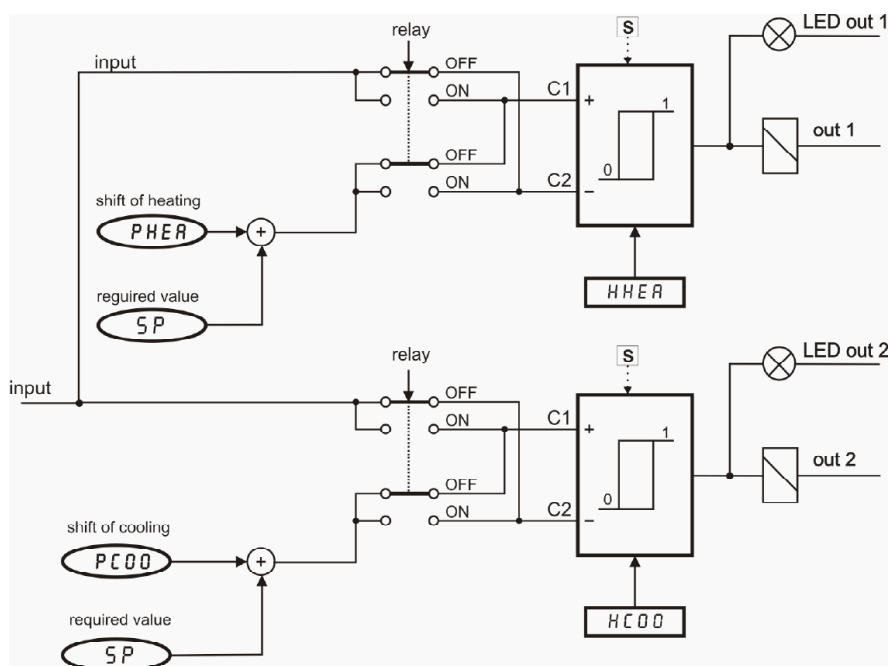
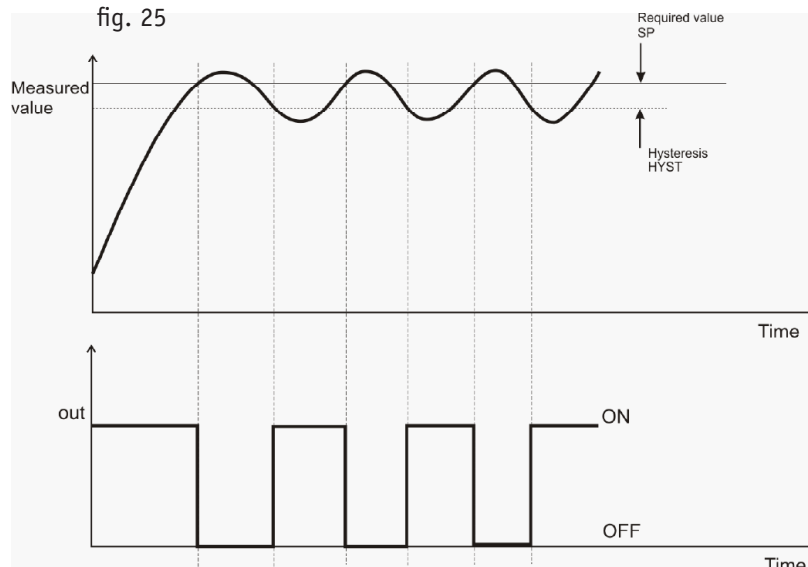


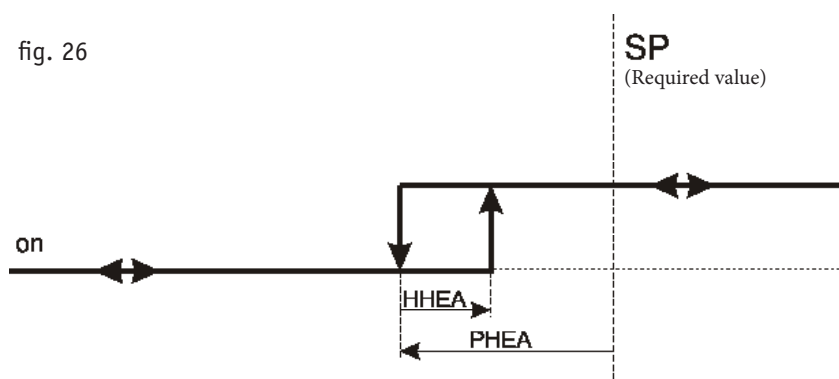
fig. 25



Regulation ONOF - first circuit

fig. 26

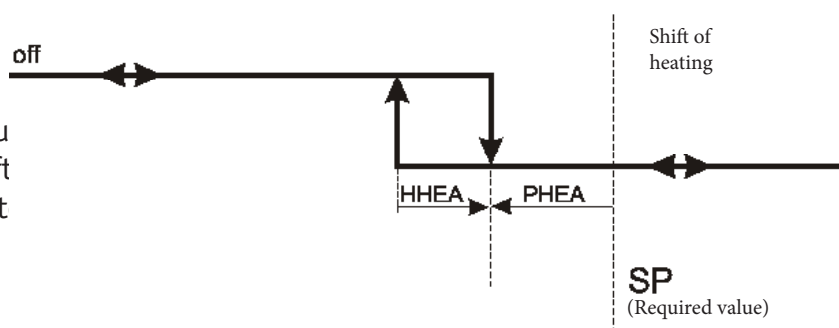
Relay ON



Relay OFF

SP
PHEA
HHEA

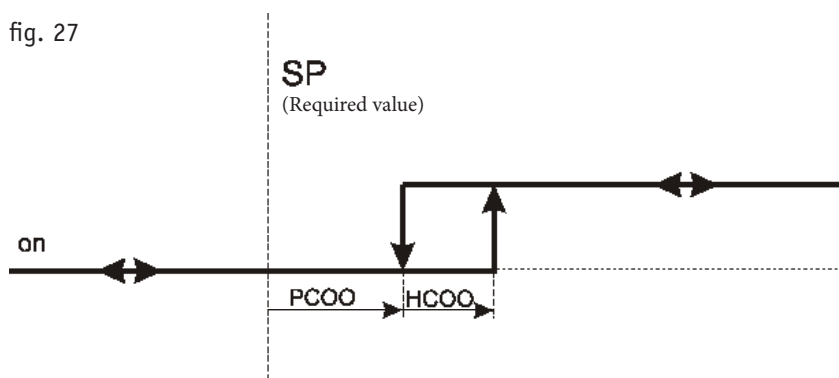
requ
shift
hyst



Regulation ONOF - second circuit

fig. 27

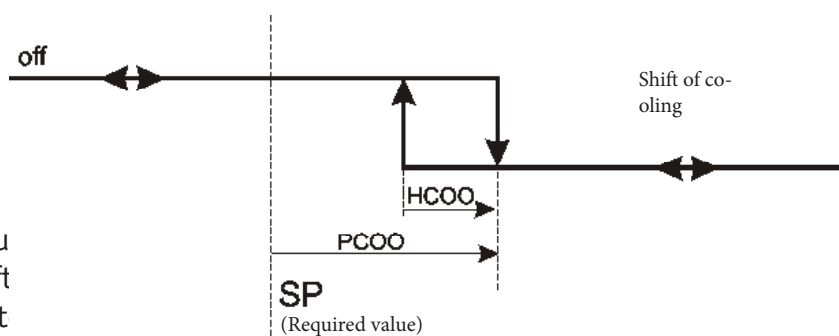
Relay ON



Relay OFF

SP
PCOO
HCOO

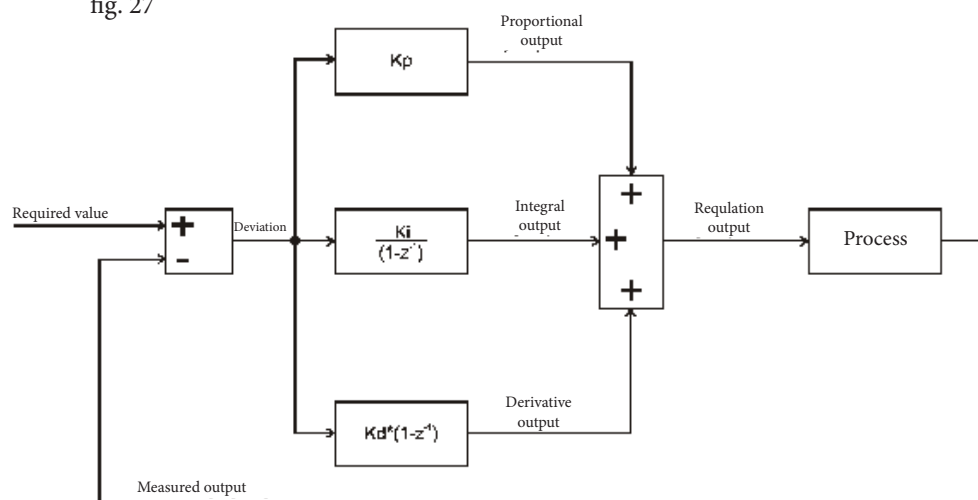
requ
shift
hyst



Characteristics of PID regulation

Allows more accurate control of the process than the two-state regulation. Precise control can be achieved only when the device is correctly configured according to the characteristics of regulated system. This is called PID parameters.

fig. 27



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

$u(k)$ action interference in the k -th moment

K reinforcement $((1/PB)*100)$

$e(k)$ deviation from the required value in the k -th moment

T time sampling (TPID)

T_i integral constant (TI)

T_d derivative constant (TD)

Basic regulative function of regulator P-I-D

- Proportional component (P regulator) creates action interference proportional to the actual regulative deviation e .
- Integration component (I regulator) creates action interference proportional to the integral value of the regulative deviation e .
Eliminates the loss of the regulated system.
- Differential component (D regulator) creates action interference proportional to the value of the derivation (or its discreet difference approximation) from the regulative deviation e . Applies at the changes required, or measured value.
- Sampling affects regulation quality, shorter cycle increases quality regulation, but then decreases vitality of mechanical switches.

Basic setting of constants can be set as follows:

Panelmeter is set as proportional, ie. eliminate the derivative and integration constant. After that find critical gain K_{kr} - i.e. such value K (Proportional band), where is Panelmeter on limit stability: First set smaller K (e.g. 0,01), and after previous activate to stable condition with change required value bring regulation process. After that, what is system gets to steady state, scale up K and change required value. This procedure repeat until to system vibrated. This value complies P_{kr} , length of period oscillates is T_{kr} .

According to these values, we calculate the basic system parameters as follows:

$$K = 0,5 * K_{kr}$$

$$T_i = 0,8 * T_{kr}$$

$$T_d = 0,12 * T_{kr}$$

Set value of sampling period so, during transition was going to remove 6 to 10 patterns.

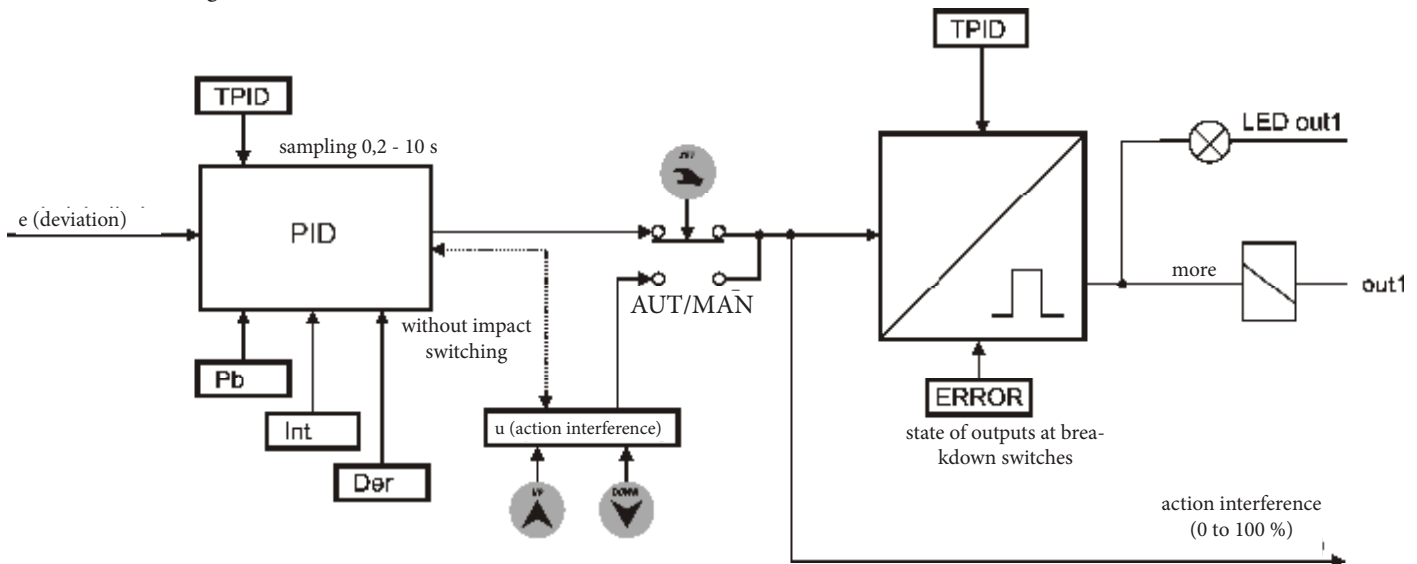
Manual control

Pressing key SET in working mode regulator switches to manual control. On bottom row is alternately shows RUC. With arrows UP and DOWN can be manually set size of action interference. Actual size of action interference is on bottom row of display. To return to automatic control press key SET.

Block of regulation PIDI

Block of regulation processes with PID algorithm calculated deviation e , which is transferred to the action interference. Action interference signal is transferred in the pulse module on output relay. In working mode, you can press key SET to go to manual setting of drive.

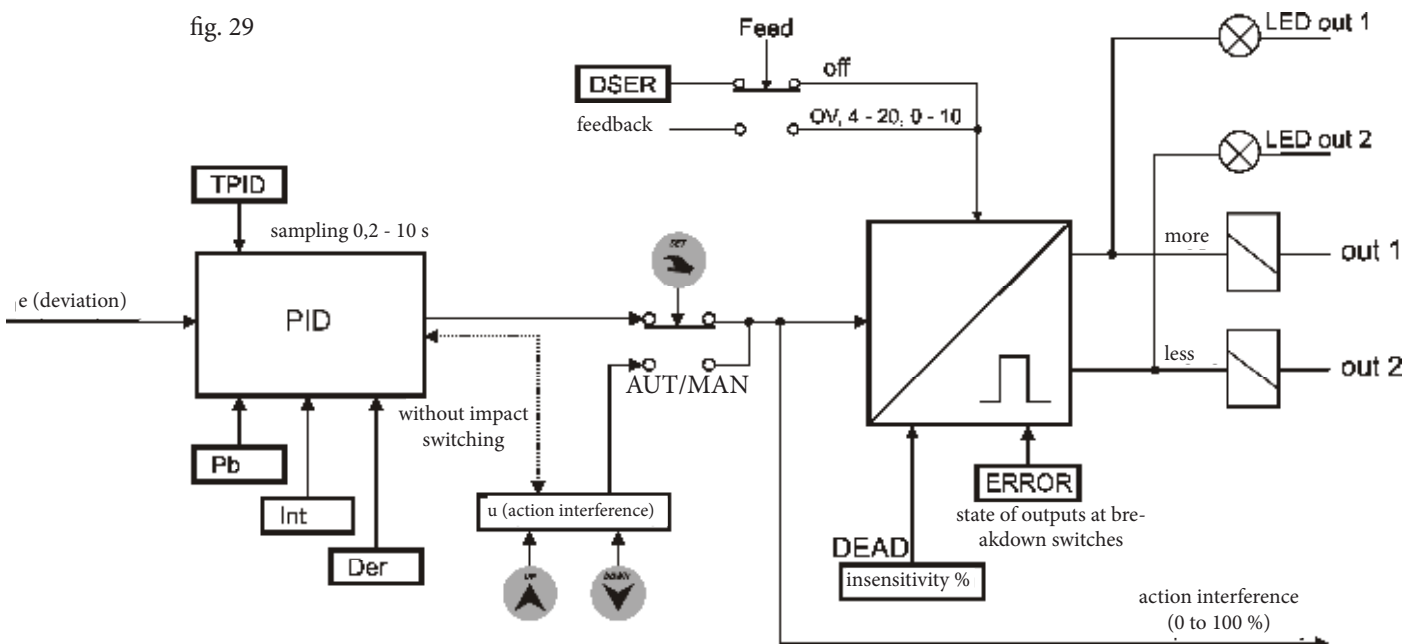
fig. 28



Block of regulation PID3

Block of regulation processes with PID algorithm calculated deviation e , which is transferred to the action interference. Action interference signal is transferred in the pulse module on servo with log. states MORE and LESS on output relay. They are used in two variants, with feedback or without feedback.

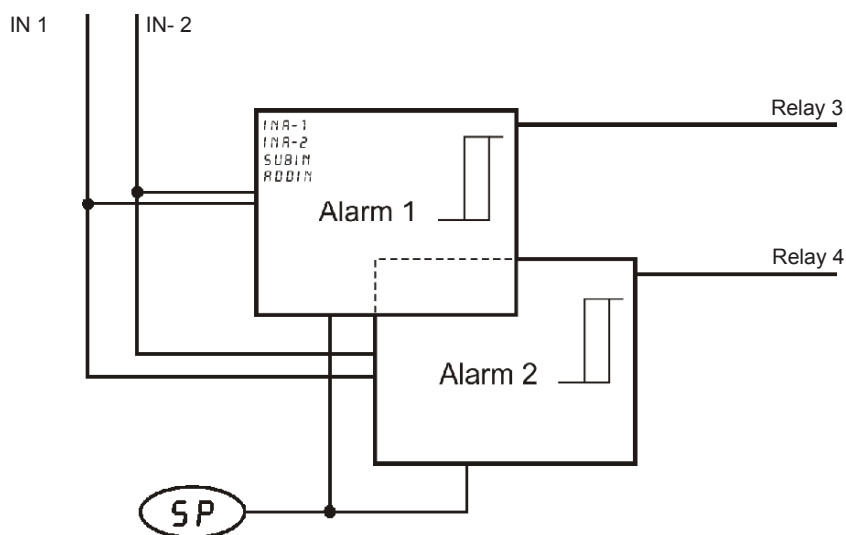
fig. 29



Functions of limit switches

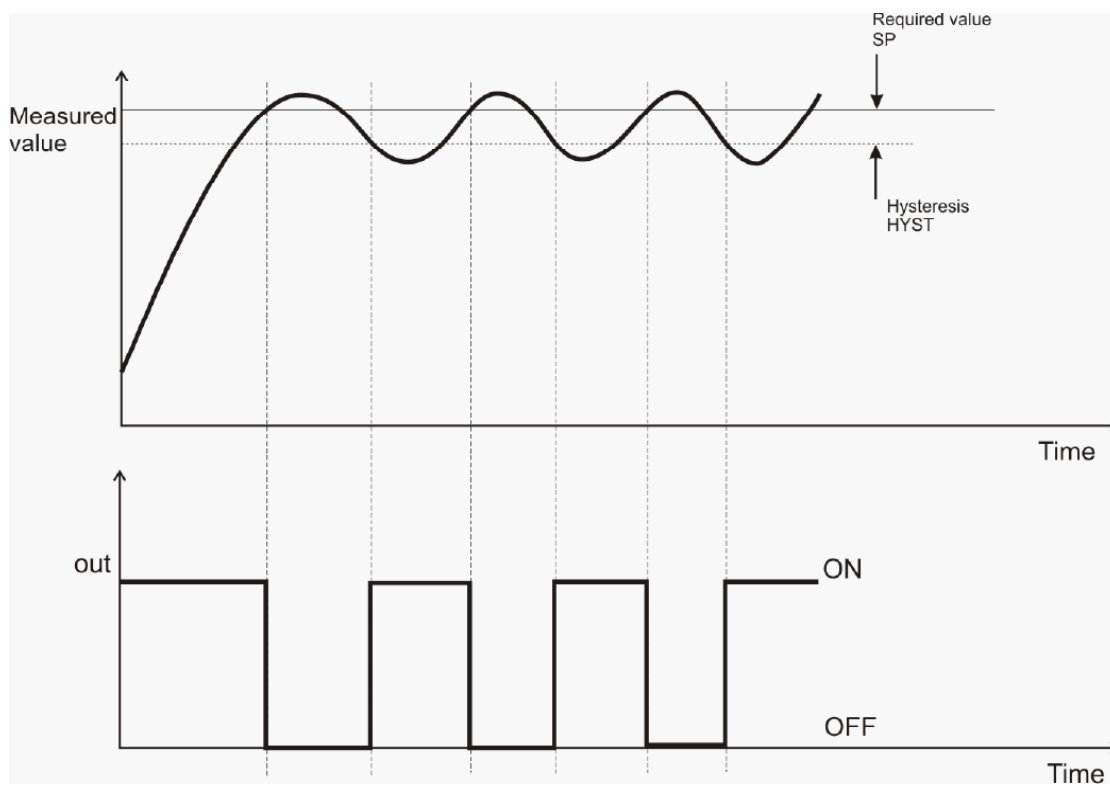
Figure 31. shows connection of input signals to limit switches (alarm 1, alarm 2).

fig. 31



Schematic of limit switch

fig. 32



Controller functions and limit switch setting

8.7.1

Any input value that can be compared with value for limit switch and can be selected for signalling of emergency condition. Value for limit switch can be selected with shift from required value SP or from value of limit switch ALSP. Select value in menu ALA1 and ALA2->MODE. Set state of output relay (whether it should switch on or switch off after exceeding of required value) in menu ALA1(ALA2) -> RELE. Limit switch alarm is delayed by hysteresis set with command ALA1(ALA2) ->HYST.

Besides SP parameter (required value) are all parameters in submenu function of ALA1 and ALA2. Parameter SP is in submenu COMP.

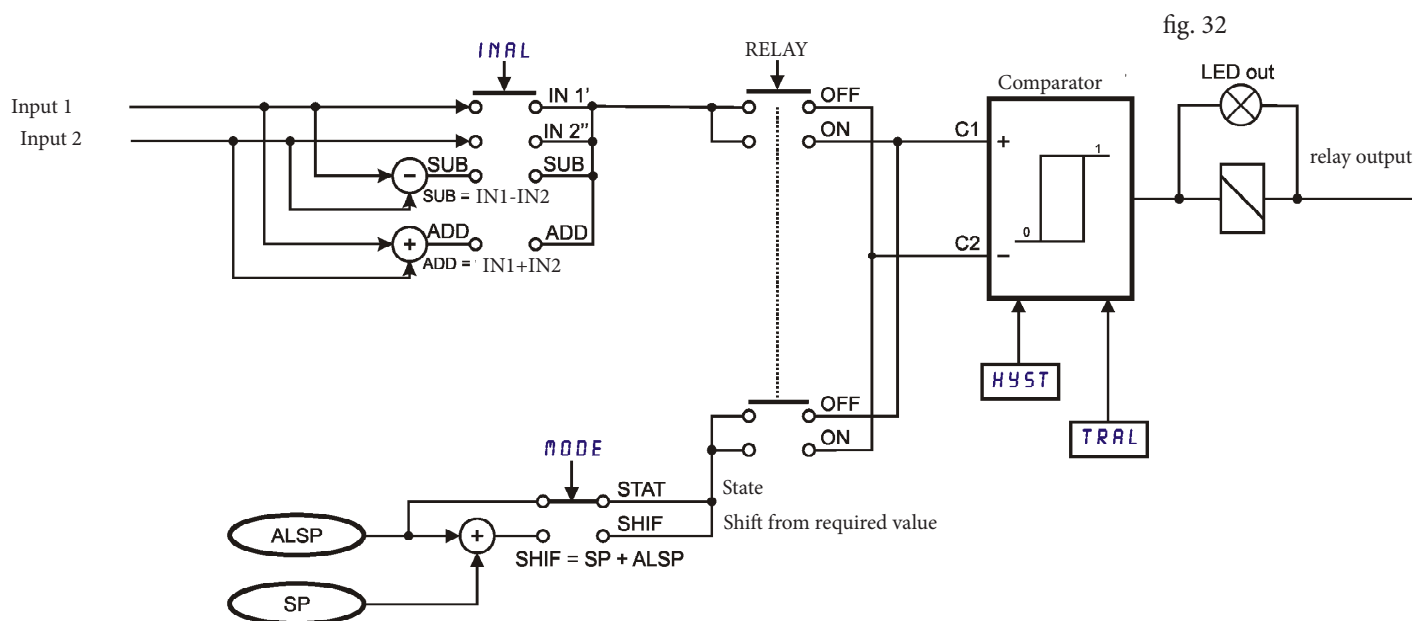
Function name	Configuration menu	Meaning
State of relay	<i>RELE</i>	Setup of output relay positing at exceeding of limit switch values. OFF switches off with exceeding the value. ON switches on.
Value of limit switch	<i>ALSP</i>	Setup of limit switch alarm value.
Input value	<i>INRL</i>	Option mode, which set limit switch. (IN-1, IN-2,SUB,ADD)
Mode	<i>MODE</i>	Assigning of limit switch value for evaluation. STAT value of alarm ALSP is directly connected to limit switch. SHIF value SP shifted by the value of alarm ALSP is connected to limit switch.
Hysteresis	<i>HYST</i>	Setup of switching hysteresis of output relays.
Output signalling	<i>TRAL</i>	Alarm for limit switch can be temporary TRAL = OFF or permanent TRAL = ON. a) Temporary limit switch alarm goes off after elapsing of alarm conditions. b) Permanent limit switch alarm is on even after elapsing of alarm conditions. Alarm can be switched off after elapsing of alarm conditions disconnecting regulator from power supply voltage or in submenu ALA1(ALA2) with parameter CLR.
Required value	<i>SP</i>	Setup of required value. Required value is common for all limit switches (see. mode MODE).



Caution:

- 1) Limits of limit switches in mode STAT are set in absolute values .
- 2) Limits of limit switches in mode SHIF are set as deviations from required value SP.

Diagram of limit switch



Setting of the limit sensor is realized with parameters ALA1 and ALA2 in menu of panelmeter AP 21. For setting enter into configuration menu of panelmeter long press key MENU. With keys UP and DOWN select ALA1(ALA2*).

Press key SET to enter into parameter setting mode. First set parameter ALSP (alarm set point) i.e. value that arrive to alarm. Press key SET to enter into the setting mode of parameter. Set required value with UP and DOWN keys and confirm with pressing key MENU. Next parameter is alarm hysteresis. In menu of the setting parameter ALA1 find parameter HYST. Press SET to enter into setting mode and confirm with key MENU.

With function INAL define for which input will alarm set. After press SET is possible in setting mode select input 1 (IN-1) or input 2 (IN-2), subtraction of inputs (IN1-IN2) with parameter SUB or sum of inputs (IN1+IN2) with parameter ADD. Press MENU to confirm your setting.

RELE parameter set in the state, the alarm relay output is located in the alarm ON or OFF. To ALA1, ALA2 is assigned relay 3 (ALA1) and relay 4 (ALA2).

Next define mode of limit switches. In menu find function MODE, where select process mode, assigned to measured value (function STAT) or relative derived by required value SP as its tolerance deviation (function SHIF, shift by required value), see. characteristics fig. 33, 34, 35, 36..

The last item for a full set of limit switches is function TRAL. It defines whether after deactivating of alarm condition, the limit switch off automatically (function TRAL is set to OFF), or whether is after overrange of alarm condition the limit switch permanently switch on/switch off and if is possible to switch it off after deactivating of alarm state with pressing key SET (function TRAL is set to ON).

Constant alarm is also switch off after power voltage failure. Then in menu find the function TRAL, press key SET to enter into setting mode, where assign the state ON or OFF to the input. Confirm with pressing key MENU. Function of limit switch is shown with characteristics on fig. 33, 34, 35, 36.

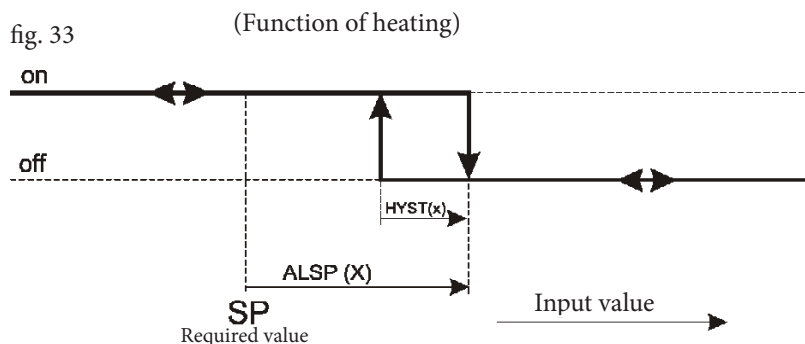
*Identical setting as ALA1

Functional characteristics of limit switches

8.7.2

Limit switch mode with MODE set to STATE SHIF
(limit shift mode derived from required value of SP)

After limit switch value is achieved relay state set to OFF



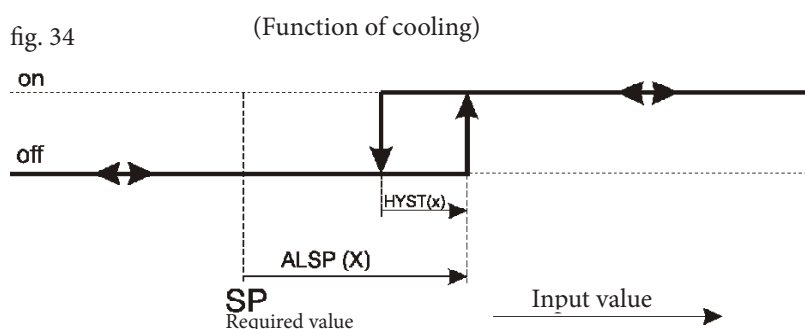
Example:

Switching off of the limit switch when temperature increases by 10 °C from required value. Required value shall be set to 50 °C. Deactivating of limit switch alarm clock is required at 55 °C.

Panelmeter setting:

Set SP value to 50 in configuration menu COMP. In configuration menu ALA1(ALA2) set value of limit switch ALSP to the value 10 (50 + 10 = switch off limit). To alarm assign the required input in INAL parameter to value IN-1 or IN-2 and MODE parameter to value SHIF. State of output relay set with RELE parameter to value OFF. Set deactivating of limit switch alarm with HYST parameter to the value 5. Confirm the setting by pressing the key MENU.

After limit switch value is achieved relay state set to ON



Example:

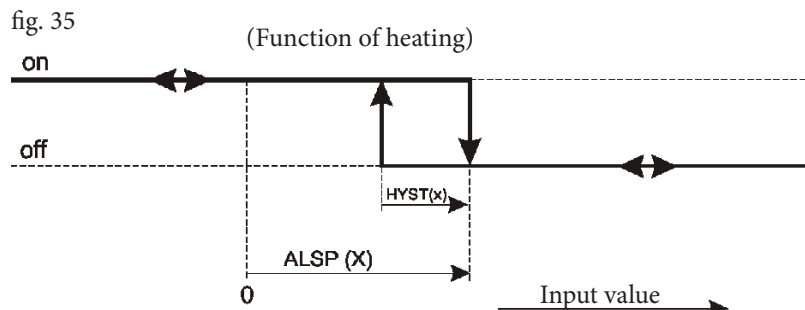
Switching of limit switch when temperature increases by 10 °C from required value. Required value shall be set to 50 °C. Deactivating of limit switch is required at 58 °C.

Panelmeter setting:

Set value SP to 50 in configuration menu COMP. In configuration menu ALA1(ALA2) set value of limit switch ALSP to the value 10 (50 + 10 = switching limit). To alarm assign the required input in INAL parameter to value IN-1 or IN-2 and MODE parameter to value SHIF. State of output relay set with RELE parameter to value ON. Set deactivating of limit switch with HYST parameter to the value 2. Confirm the setting by pressing the key MENU.

Limit switch mode with function **MODE** set to state **STAT** (limit switch mode related to measured value)

After limit switch value is achieved relay state set to OFF



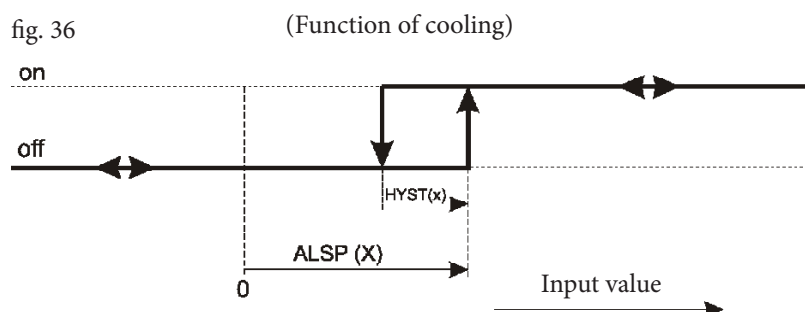
Example:

Switching off of the limit switch with temperature increase over 60 °C. Required value will not be used. Alarm shall be set to the value of limit switch. Deactivating of limit switch alarm is required at 55 °C.

Panelmeter setting:

In configuration menu ALA1(ALA2) set value of limit switch ALSP to the value 60. To alarm assign the required input in INAL parameter to value IN-1 and MODE parameter to value stat. State of output relay set with RELE parameter to value OFF. Set deactivating of limit switch with HYST parameter to the value 5. Confirm and leave the setting by pressing key MENU.

After limit switch value is achieved relay state set to ON



Example:

Switching of the limit switch with temperature increase over 60 °C. Required value will not be used. Deactivating of limit switch alarm is required at 58 °C.

Panelmeter setting:

In configuration menu ALA1(ALA2) set value of limit switch ALSP to 60. To alarm assign the required input in INAL parameter to value IN-1 and MODE parameter to value STAT(state). State of output relay set with RELE parameter to value ON. Set deactivating of limit switch with HYST parameter to the value 2. Confirm and leave the setting by pressing key MENU.

Functions of buttons in setting mode

9.1



Key „MENU“ is used to enter into configuration menu, end of programming, write data to EEPROM and return to working mode. In working mode allows short push switch display of measured values of inputs and long push enter to configuration menu.



Key „UP“ is used to scroll and set the value in configuration mode.
Keep the key pressed for approx. 3 s to speed up scrolling and setting.



Key „DOWN“ is used to scroll and set the value in configuration mode.
Keep the key pressed for approx. 3 s to speed up scrolling and setting.



Key „SET “ to enter parameter setting.



Caution:

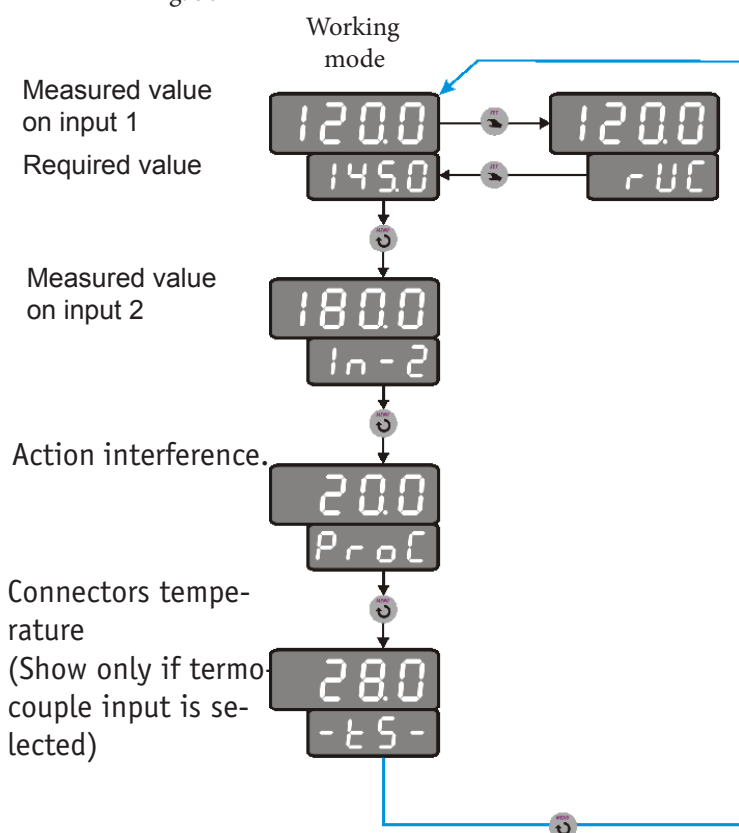
TIME OUT function.

If any key is not pressed in configuration mode during the period of 1 minute controller switches by means of TIME OUT function to working mode without saving parameters!

Working mode of Panelmeter

9.2

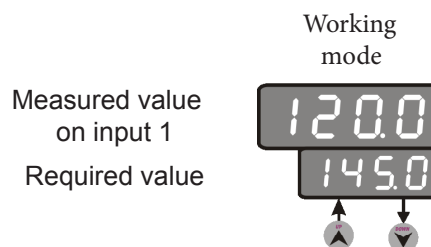
fig. 38



If other value is shown then first input(different input), is backlighted key MENU.If SENS-2 is set to -NO-, then item IN-2 is not displayed.Item TS is only shown when termocouple sensor is set in menu SENS-1->TYP

In working mode by pressing key MENU controller shows on the display measured values on both inputs. At first input is on the bottom display shows required value. Input 2 is shown when pressed Menu key,the bottom display shows name. For setting mode of manual action interference.Press key SET .

Configuration of required value SP from working mode

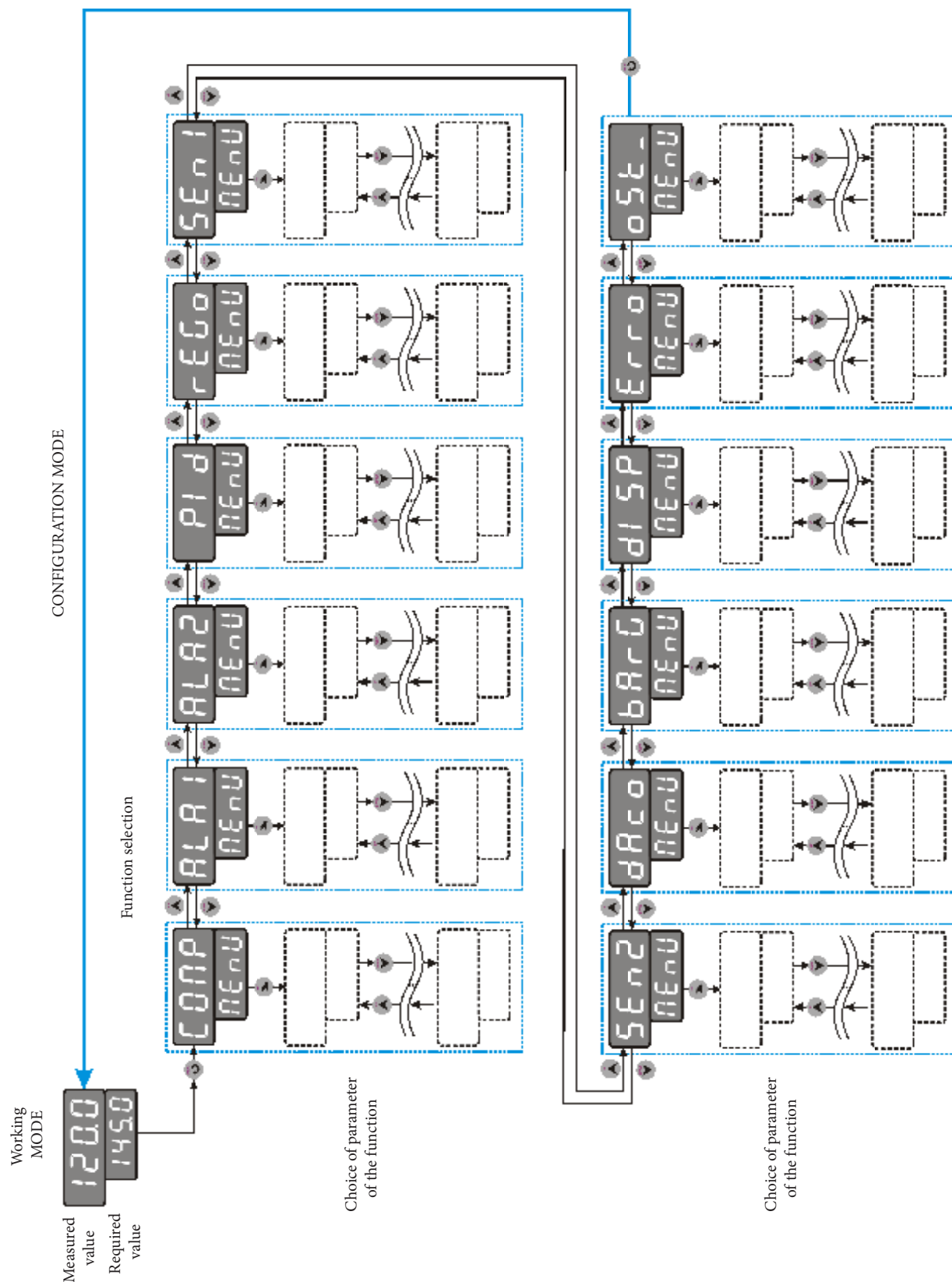


In working mode can be with pressing keys UP and DOWN set size of required value SP. After 1 minute inactivity is setting automatically saved to the device memory EEPROM.

Configuration mode

Block diagram of regulator menu

fig. 39

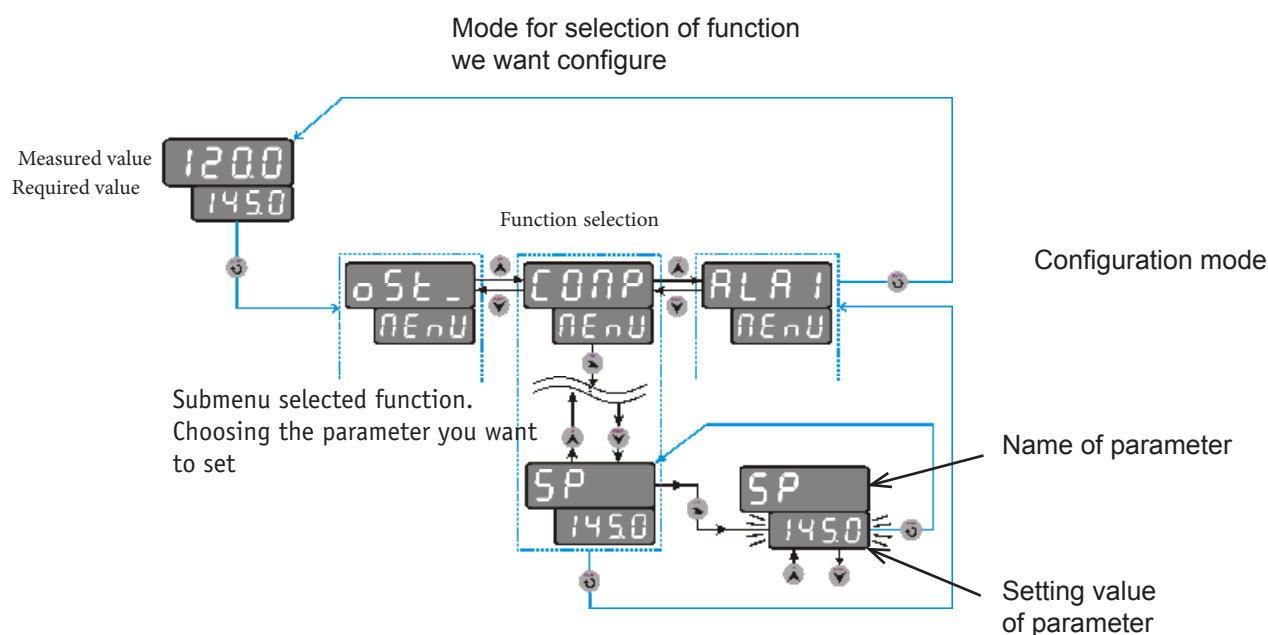


If alarm relays (relay 3,4) are not ordered, **alarm menu (ALA-1,ALA-2)** is not displayed.
 If analogue output is not ordered, **menu (DACO)** is not displayed.

Here below configuration diagrams of individual parameters in configuration menu of panelmeter are shown. For the first diagram is described configuration of parameters in menu. Configuration of other parameters is identical. Only function name and description are modified. Button functions remain the same.

Configuration of required value and length regulation - COMP

9.3.2



COMP function parameters

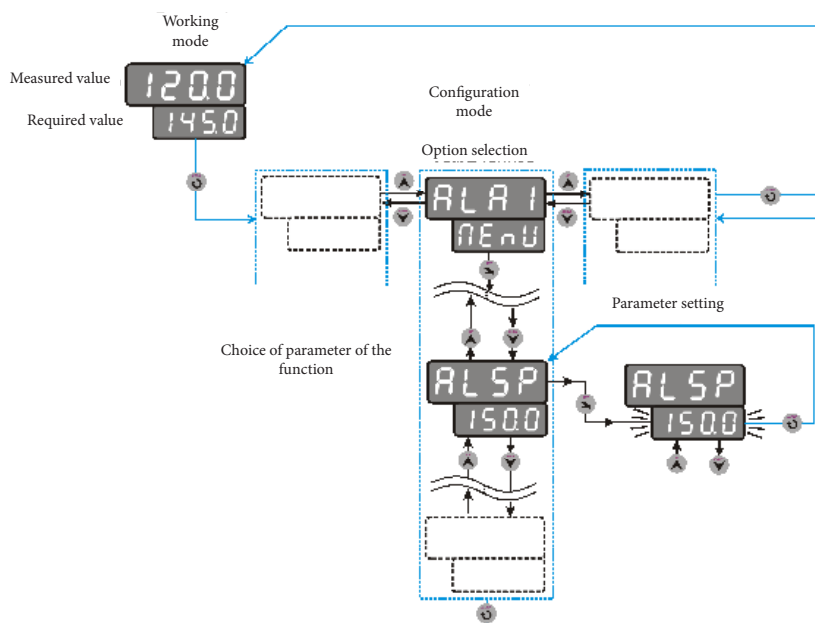
SP required value (set point)

Long press MENU key to enter configuration menu. The upper line shows the selected function, the bottom line the inscription menu. Scroll to required function (e.g. COMP) with keys UP and DOWN. With key SET enter into submenu of the function. With keys UP and DOWN scroll required parameter. With key SET enter into configuration mode of parameter (bottom display flashes). With keys UP and DOWN set the required value. Press key MENU to return into submenu of the function. By pressing key MENU you return into configuration menu. Press key MENU again to return into working mode to save selected parameters.

Attention of TIME OUT function in configuration mode!

9.3.3

Configuration of limit switches - ALA1



Function parameters - ALA1

ALSP - setting of alarm value

HYST - setting of alarm hysteresis

INAL - setting of inputs (IN-1 , IN-2 , SUB,ADD)

Options:

IN-1 - input 1

IN-2 - input 2

SUB - difference between IN-1 and IN-2

ADD - sum of IN-1 and IN-2

RELE - state of output relay when limit switch value is achieved (relay 3)

Options:

Off - relay switches off when set value for limit switch is exceeded

On - relay switches on when set value for limit switch is exceeded

MODE - assignment of limit switch mode (absolute or as a deviation from required menu)

Options:

STAT - limit switch value ALSP is directly connected to comparator

SHIF - value SP (required) is directly connected to comparator, shifted by limit switch value ALSP (see limit switch functional characteristics)

TRAL - state of relay contacts after alarm conditions subside

Options:

Off - temporary switching of limit switch – after limit switch alarm conditions subside, limit switch returns to original state

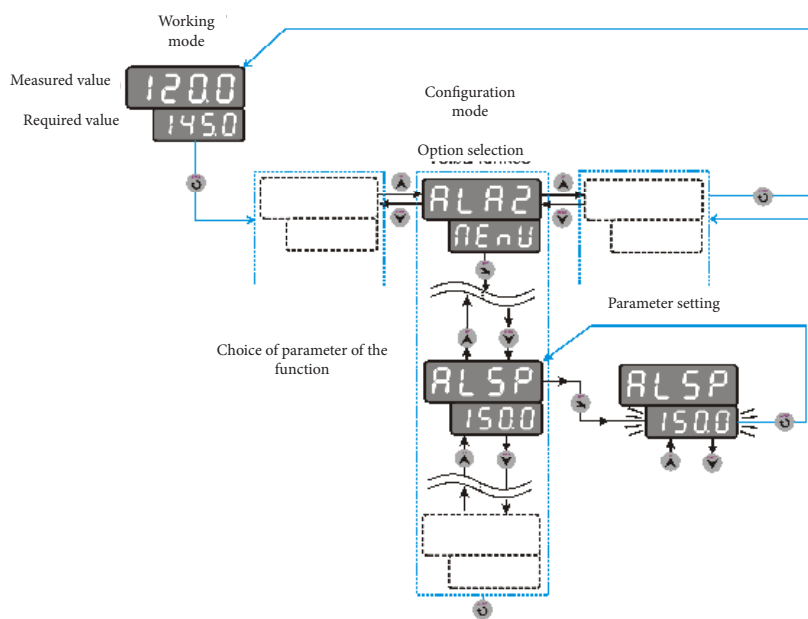
On - permanent switching of limit switch – after limit switch alarm conditions subside, limit switch remains permanently switched. It can be switched off only after subsiding of alarm conditions and disconnecting of regulator from supply voltage

clr - resetting limit switches set in function tral (set on)

If alarm relays (relay 3,4) are not connected, alarm menu (ALA-1,ALA-2) is not displayed.

Configuration of limit switches - ALA2

9.3.4



Function parameters - ALA2*

ALSP - setting of alarm value

HYST - setting of alarm hysteresis

INAL - setting of inputs (IN-1 , IN-2 , SUB,ADD)

Options:

IN-1 - input 1

IN-2 - input 2

SUB - difference between IN-1 and IN-2

ADD - sum of IN-1 and IN-2

RELE - state of output relay when limit switch value is achieved (relay 4)

Options:

Off - relay switches off when set value for limit switch is exceeded

On - relay switches on when set value for limit switch is exceeded

MODE - assignment of limit switch mode (absolute or as a deviation from required menu)

Options:

STAT - limit switch value ALSP is directly connected to comparator

SHIF - value SP (required) is directly connected to comparator, shifted by limit switch value ALSP (see limit switch functional characteristics)

TRAL - state of relay contacts after alarm conditions subside

Options:

Off - temporary switching of limit switch – after limit switch alarm conditions subside, limit switch returns to original state

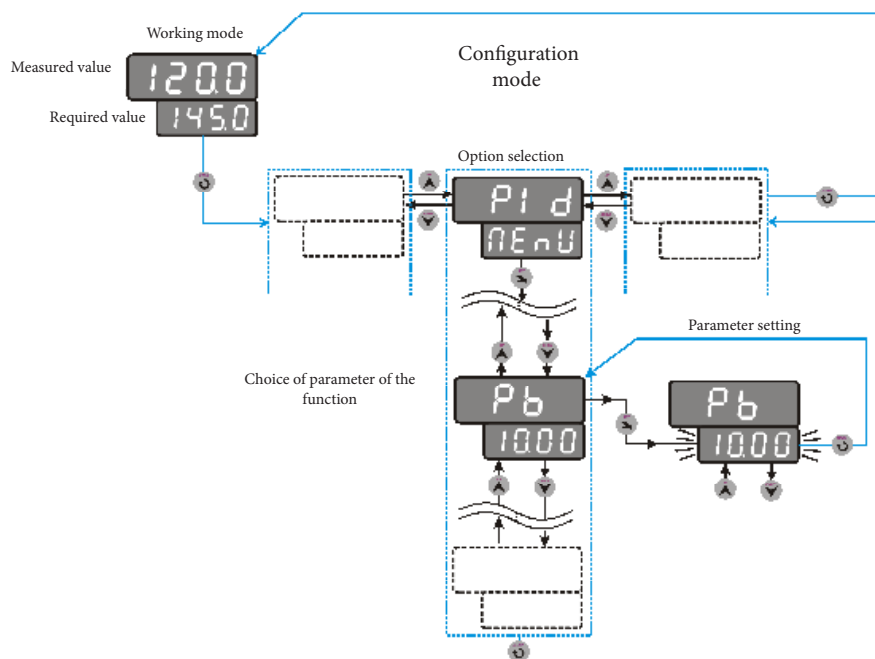
On - permanent switching of limit switch – after limit switch alarm conditions subside, limit switch remains permanently switched. It can be switched off only after subsiding of alarm conditions and disconnecting of regulator from supply voltage

clr - resetting limit switches set in function tral (set on)

If alarm relays (relay 3,4) are not connected, alarm menu (ALA-1,ALA-2) is not displayed.

***identical setting as ALA1**

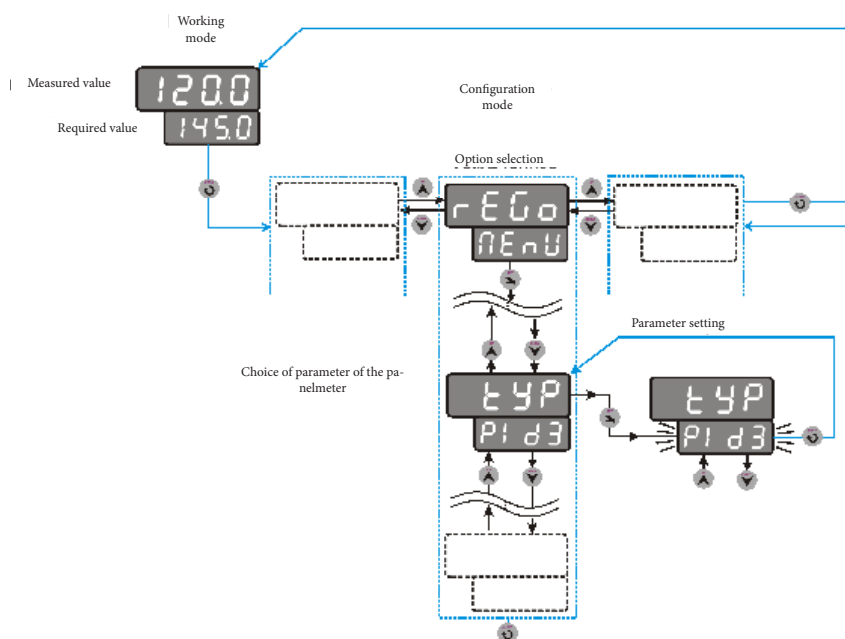
Configuration of regulation - PID



Function parameters - PID

PB	proportional constant
TI	integral constant (eliminates the loss of the regulation system)
TD	derived constant (applies to changes required or measured value)
TPID	period of sampling -at a specified interval are withdrawals of samples and reduction PID constants for regulation

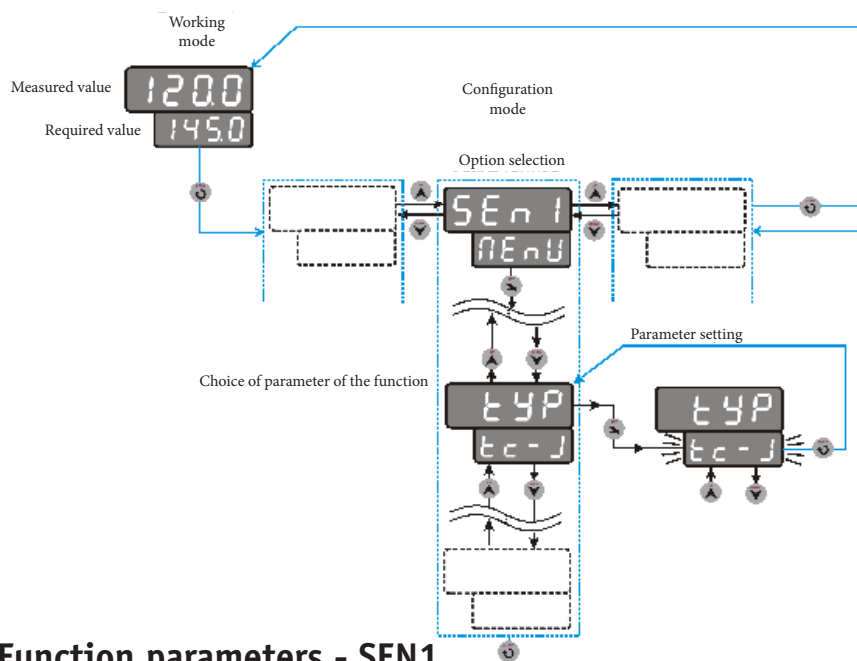
Configuration type of regulation - REGO



Function parameters - REGO

TYP	type of regulation (ON/OFF, PID1, PID3) Options: ONOF - two-state regulation PID1 - PID regulation for heaters controlling PID3 - three positions PID regulation (servo)
PHEA	heating shift (see. chapter two-state regulation ON/OFF)
PCOO	cooling shift (see. chapter two-state regulation ON/OFF)
HHEA	Hysteresis of heating (see. chapter two-state regulation ON/OFF)
HCOO	Hysteresis of cooling (see. chapter two-state regulation ON/OFF)
RE-1	state of output relay at exceeding required value for regulation ON/OFF Options: OFF - relay switch off at exceeding ON - relay switch on at exceeding
RE-2	state of output relay at exceeding required value for regulation ON/OFF Options: OFF - relay switches off at exceeding ON - relay switches on at exceeding
FEED	feedback Options: OFF - without feedback ON - with feedback - feedback is from input 2, if not used for external setting of required value see. configuration SEN2
DEAD	Setting of insensitivity in [%] for three positional regulation - if the request to change the position of drive from PID regulator smaller than set insensitivity, position of drive is unchanged
DSEK	Time of overrun drive in [s]. Parameter is meaningful only if the drive is not controlled by feedback (in menu FEED is set OFF or input 2 is used for external setting of required value)
F2	digital filter of action interference (ON/OFF)

Configuration type of sensor - SEN1



Function parameters - SEN1

TYP option of input sensor type - see. table input 1 (see page 14)
DP setting of decimal point position – refers to most numerically input parameters.

Options:

0000. units are displayed
 000.0 tenths are displayed
 00.00 hundredths are displayed
 0.000 thousandths are displayed

STRS Setting of start of measurement range
 The function sets start of range of input value measurement. Parameter is important only with selection of current (4 to 20 mA or 0 to 20 mA) or voltage (0 to 10 V) input signal. If you set the thermocouple, Pt100 or Ni1000 like the sensor type, it isn't necessary to set the start of sensor.

ENDS setting of ending of measurement range.
 The function sets the ending of range of input value measurement. Parameter is important only with selection of current (4 to 20 mA or 0 to 20 mA) or voltage (0 to 10 V) input signal. If you set the thermocouple, Pt100 or Ni1000 like the sensor type, it isn't necessary to set the end of sensor (ends).

OFFS Setting of measured value range offset.
 Parameter sets for example compensation of resistance the incoming conductors for Pt100 the double-conductor connection etc.involvement, etc. Generally it is possible to compensate any inaccuracy of measurement with offset. If it is not necessary to set any offset or compensation, set the value to 0.

Example: OFFS compensation of incoming conductors for Pt100 on the double-conductor connection: Conduct specific resistance, which causes error of measuring. At the end of conductor connect resistance decade instead of sensor Pt100 and set resistance 100,0 Ω (it conform 0 °C). Subtract measured statement on the display (for example 1,3 °C). This is error of measuring, which is caused by resistance of incoming conductors. For compensation of measuring error is necessary to set in menu OFFS value -1,3.

COMP

compensation setting of thermocouple's cold end
parameter is meaningful only at choice of thermocouple

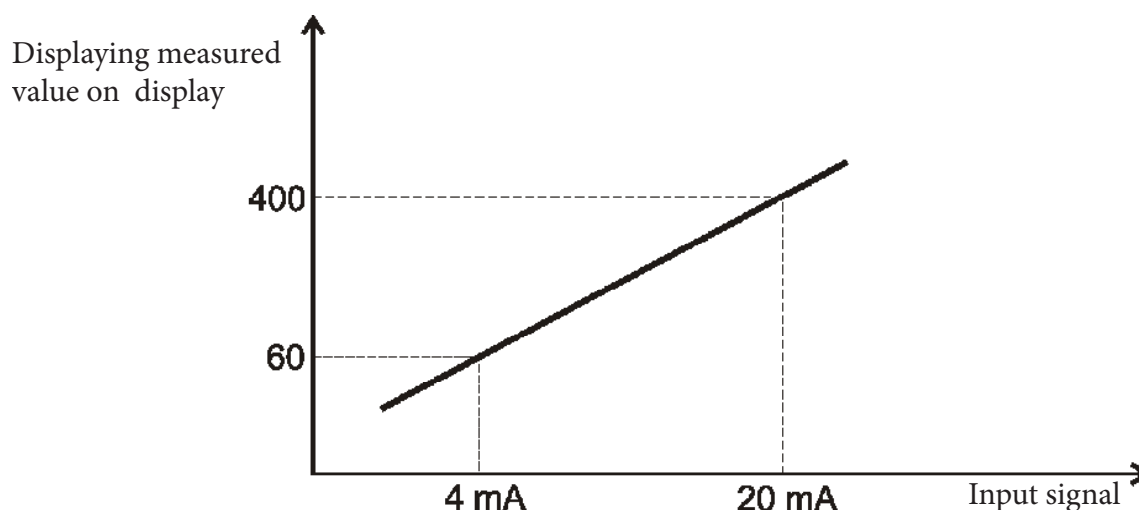
Options:

- no- without compensation
- ts compensation for temperature of connectors (compensation is ensured by an inside sensor resistance Pt100)
- 20°C compensation for temperature 20°C
- 50°C compensation for temperature 50°C
- 70°C compensation for temperature 70°C

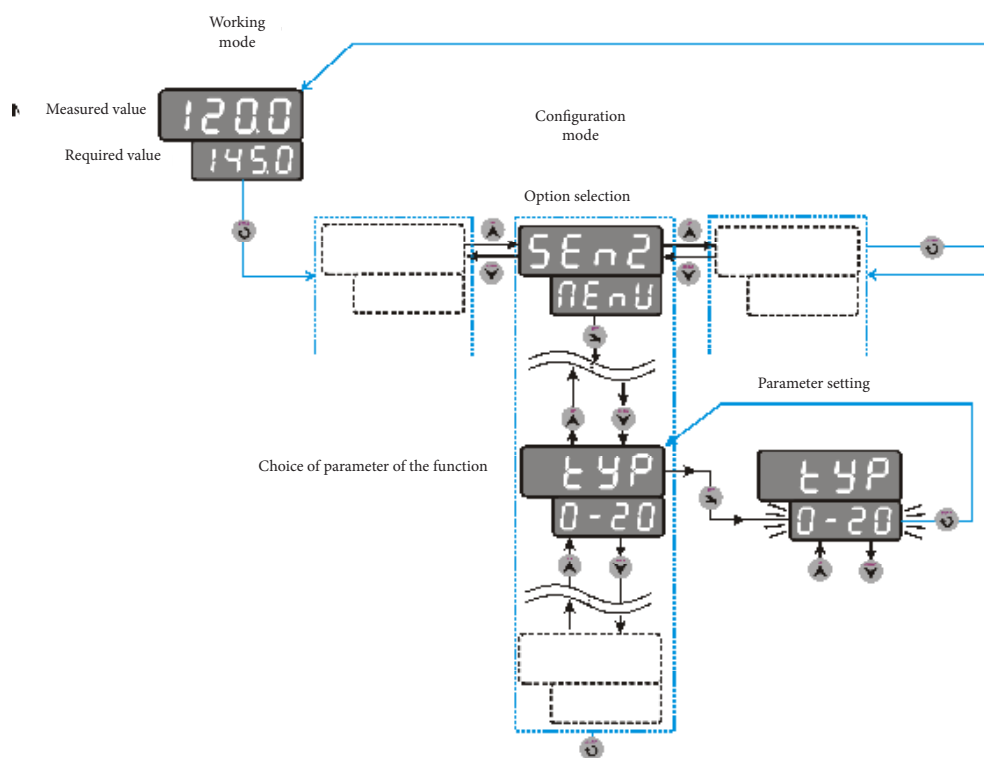
Example of configuration:

If you want to display the input signal 4 to 20 mA on display in the range 60 to 400

Set type of sensor type = 4-20, the start of range STRS = 60, the end of range ENDS = 400 and shift OFFS = 0. Resolution between values 60 and 400 will be linear.



Configuration type of sensor - SEN2



Function parameters - SEN2

TYP option of input sensor type - see table input 2 (see page 15)

SETS Sensor 2 functions

Options:

SP - external setting of required value

FEED - input 2 used for feedback (position of servo)

MERS - input 2 used for measuring, with possibility of further evaluation e.g (ALARMx)

DP setting of decimal point position – refers to most numerically input parameters.

Options:

0000. units are displayed

000.0 tenths are displayed

00.00 hundredths are displayed

0.000 thousandths are displayed

STRS configuration of start range of external setting of required value SP. Parameter is active only if in item SETS option SP is chosen.

ENDS configuration of ending range of external setting of required value SP. Parameter is active only if in item SETS option SP is chosen.

OFFS sets offset of measured value



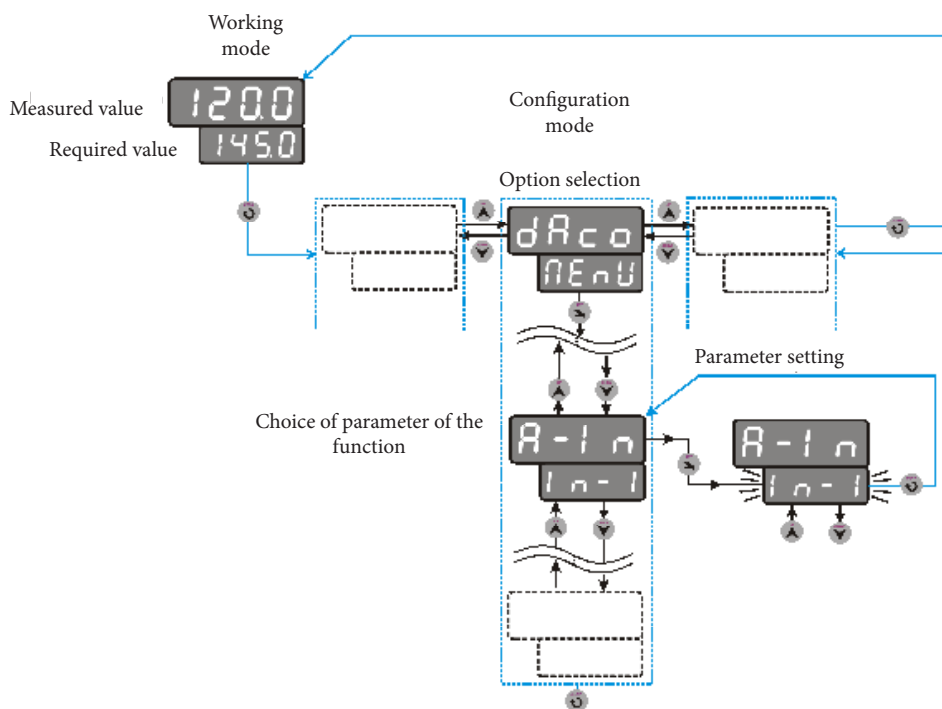
Automatical calibration of resistance transmitter (potentiometer - PT-1, PT-2, PT-3) is made on startup of device and every 2 minutes.



By setting input 2 to function feedback with parameter SETS->FEED (position of servo drive) setting of decimal point position DP and STR,END is solid (0.0-100.0).

Configuration of analogue output - DACO

9.3.9



Function parameters - DACO

A-IN option of input signal - see. block diagram of the analog output (chapter 5)

AOUT option type of analogue output

Options:

0-20 0 to 20 mA, 0 to 10 V

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

20-0 20 to 0 mA, 10 to 0 V

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

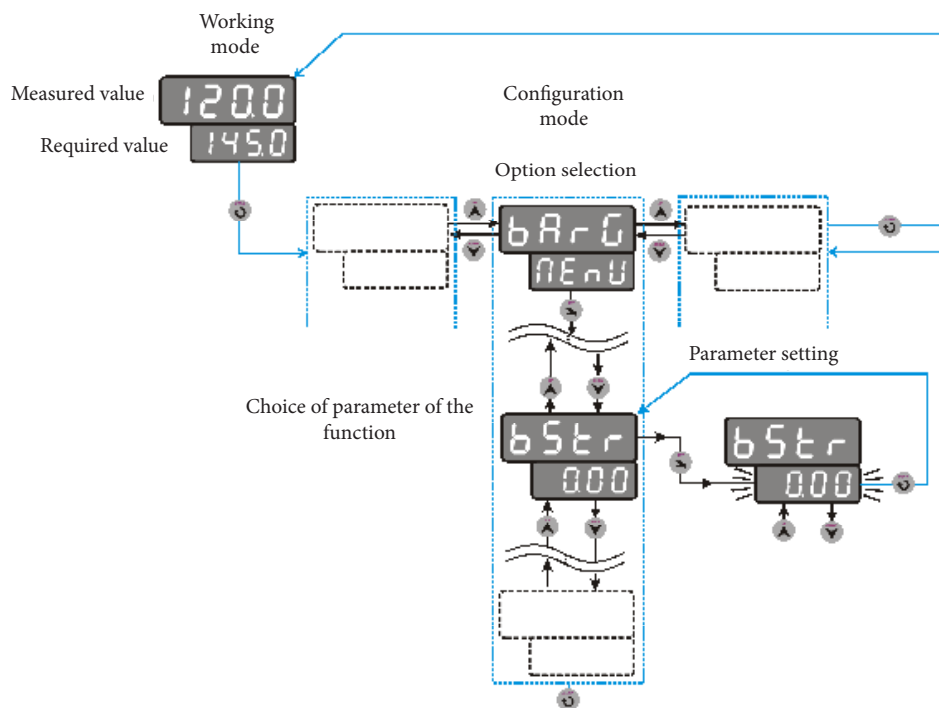
ASTR setting start of analogue output range relative to the chosen value in the A-IN submenu.

AEND setting end of analogue output range relative to the chosen value in the A-IN submenu.

Example of configuration:

Range of analogue output should be 100°C to 200°C. That means that the start ASTR has to be set to 100, AEND has to be set to 200.

Configuration of bargraph - BARG



Function parameters - BARG

BSTR

Setting of bargraph range start.

This parameter is used for setting the bottom limit of bargraph range. When measured value drops to bottom limit of set range, all bargraph LEDs stop flashing.

BEND

Setting of bargraph range end.

This parameter is used for setting the top limit of bargraph range. When measured value reaches top limit of set range, all bargraph LEDs start flashing

B-IN

setting the input to which it is expressed bargraph

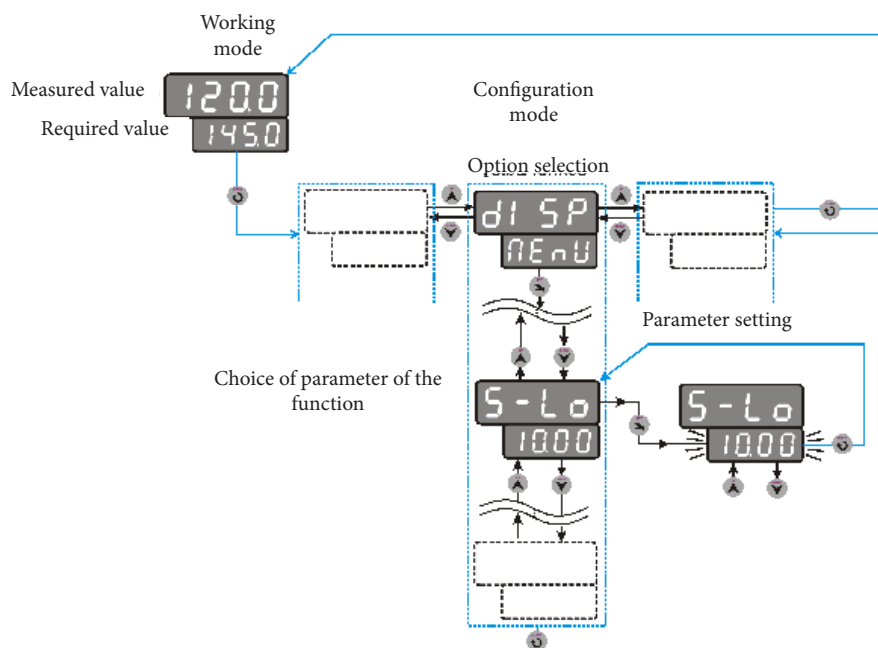
Options:

IN - 1 - input 1

IN - 2 - input 2

PROC - action interference from PID regulation (range of bargraph 0 - 100 %)

Configuration parameters of display - DISP



Function parameters - DISP

- S-Lo** Setting of value bottom limit when display changes its colour
- S-Hi** Setting of value top limit when display changes its colour
- SEC0** Setting of colour for sector 0
- SEC1** Setting of colour for sector 1
- SEC2** Setting of colour for sector 2
- LIGH** Setting of display brightness
- MODE** Setting of display range

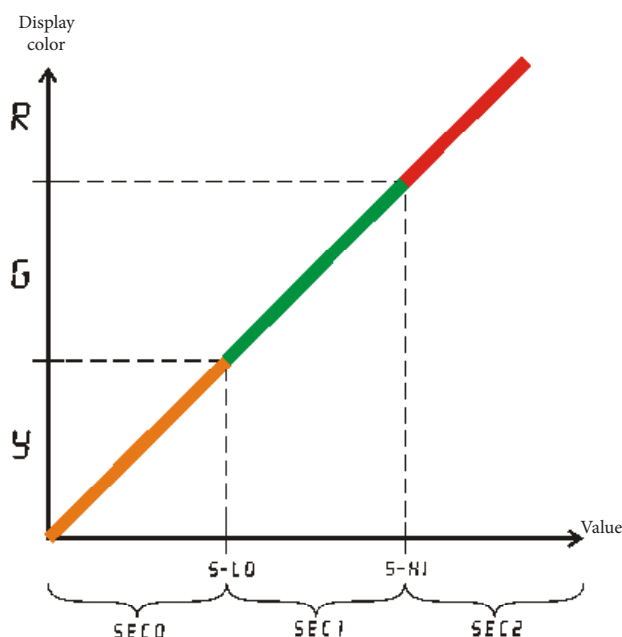
Options:

stat - Absolute value of limits s-lo and s-hi

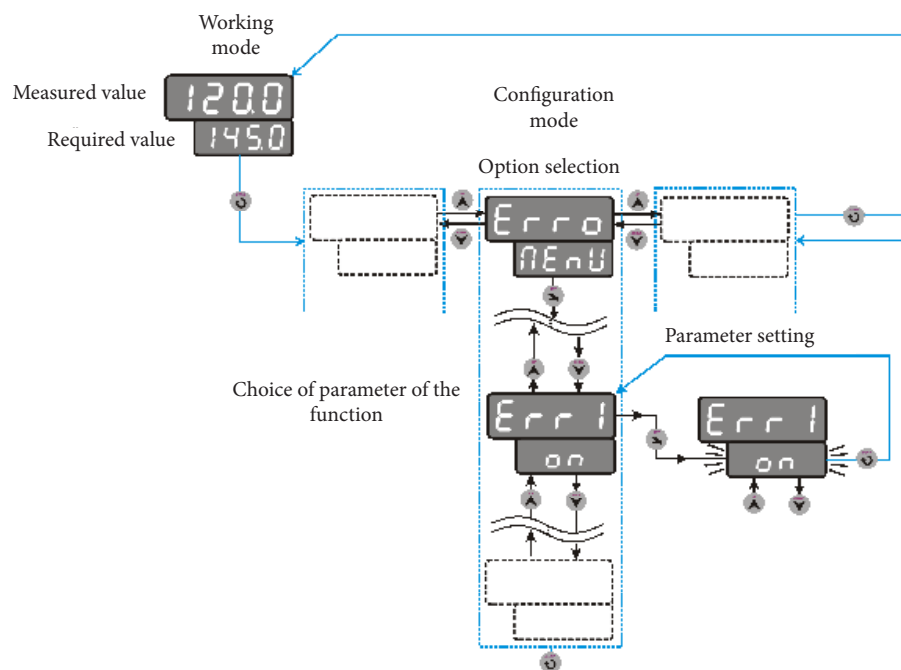
shif - Value of limits s-lo and s-hi derived from required value SP

Detailed description can be found on page 23, Chapter Display settings.

Example:



Configuration of output state in case of breakdown - ERRO



Function parameters - ERRO

ERR1	Setting of output relay at breakdown of any sensor
ERR2	Setting of output relay at breakdown of any sensor
ERR3	Setting of output relay at breakdown of any sensor
ERR4	Setting of output relay at breakdown of any sensor
ERRA	Setting of analogue output at breakdown of sensor

ERR(X) Assignment device parameters at breakdown of sensor. Panelmeter evaluates the breakdown of input sensor with tittle ERRO on the display. At breakdown of input sensor it is possible to set any state of output relay and analogue output. Panelmeter signals breakdown of sensor, if is the measured value outside the limits of individual sensors.

Options:

setting ERR1 to ERR4 state of output relay (x) at breakdown input sensor

-no-	without response to sensor breakdown
Off	at breakdown switch off the output
On	at breakdown switch on the output

setting of ERRA state analogue output at breakdown input sensor

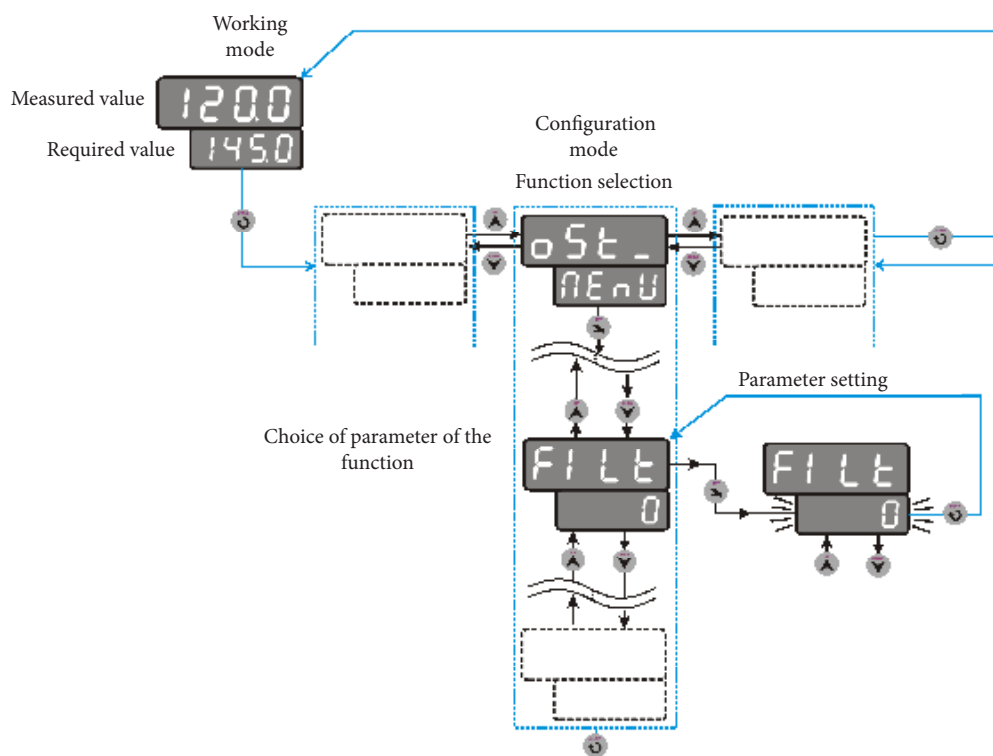
-no-	without response to sensor breakdown
0-ma	at breakdown output current 0 mA (output voltage 0 V)
20-ma	at breakdown output current 20 mA (output voltage 10 V)

Note:

When using regulation PID3 and the setting of output relays 1 and 2 to state ON the priority at breakdown of sensor assigned state of relay 1 to ON and the relay 2 OFF because of protection of servo drive

Configuration filter of input signal and password - FILT, PASS

9.3.13



Function parameters - OST_

FILT

Configuration of input signal filter

Increase of filter value slows down regulator response to change of input value, on contrary reduction of filter value accelerates regulator response to change of input value. Filter affects displaying of measured value and also regulation.

PASS

Setting of access password

Setting of access password can prevent unauthorized interference in regulation parameters. Password PASS enables access to set all panelmeter parameters. Default password is 0. In this case regulator operates as if no password was set and access into setting mode is not restricted. If any numerical password is set, parameters can be configured only after this password is entered. For changing the password you have to enter old access password first. In case you forget the old password enter code 555 instead, to get to new password setting mode. Regulator requires password only once in configuration menu. If you enter correct password you have free access to all parameters in configuration mode.

ADR

Setting of panelmeter address for communication with PC.

PAR

Setting of parity

Options:

- NO - no parity
- EVEN even parity (default value)
- ODD odd parity

9.4

Limit values of parameters

Function parameters - COMP

Parameters	Function	Limit values	Default value	Operation
SP	Required value	-999 to 9999	0.0	

Alarm parameters - ALA- 1

Parameters	Function	Limit values	Default value	Operation
RLSP	Limit value of switch 1	-999 to 9999	0	
HYST	Hysteresis	-999 to 9999	1	
INRL	Input selection	IN-1, IN-2, SUB, ADD	0	
RELE	State of output relay	ON, OFF	OFF	
MODE	Limit switch mode	STATE,SHIFT	STATE	
TRAL	Signalling of output	ON, OFF	OFF	

Alarm parameters - ALA- 2

Parameters	Function	Limit values	Default value	Operation
RLSP	Limit value of switch 1	-999 to 9999	0	
HYST	Hysteresis	-999 to 9999	1	
INRL	Input selection	IN-1, IN-2, SUB, ADD	0	
RELE	State of output relay	ON, OFF	OFF	
MODE	Limit switch mode	STATE,SHIFT	STATE	
TRAL	Signalling of output	ON, OFF	OFF	

Regulation parameters - PID

Parameters	Function	Limit values	Default value	Operation
PB	Proportional constant	-1000 to 1000	1	
TI	Integral constant	0,01 to 1000	100	
TD	Derivative constant	0 to 1000	1	
TPID	Sampling period	1 to 10	1	

Function parameters - REGO

Parameters	Function	Limit values	Default value	Operation
TYP	Type of regulation	ON/OFF, PID1, PID3	ON/OFF	
PHER	Heating shift	-999 to 9999	0	
PCOO	Cooling shift	-999 to 9999	0	
HHER	Hysteresis of heating	-999 to 9999	1	
HCOO	Hysteresis of cooling	-999 to 9999	1	
RE-1	State of output relay	ON, OFF	ON	
RE-2	State of output relay	ON, OFF	ON	
FEED	Feedback allow	ON, OFF	OFF	
DEAD	Insensitivity setting	0 to 20	0	
DSEK	Servo time setting	10 to 500	100	
F2	Filter of action interference	ON, OFF	OFF	

Function parameters - SEN1

Parameters	Function	Limit values	Default value	Operation
<i>TYP</i>	Type of sensor	Pt 100, P1000, Ni-6, Ni-5, J, K, E, T, R, S, B, 4-20, 0-20, 0-10	Pt 100	
<i>DP</i>	Decimal point	0., 0.0, 0.00, 0.000	0.0	
<i>STRS</i>	Start (start) of range	-999 to 9999	0.0	
<i>ENDS</i>	End (end) of range	-999 to 9999	100.0	
<i>OFFS</i>	Offset (shift) of range	-999 to 9999	0	
<i>COMP</i>	Compensation of thermocouple	-no-, Ts, 20°C, 50°C, 70°C	Ts	

Function parameters - SEN2

Parameters	Function	Limit values	Default value	Operation
<i>TYP</i>	Type of sensor	Pt-1, Pt-2, Pt-3, 4-20, 0-20, 0-10, -no-	Pt-1	
<i>SETS</i>	Input function	FEED, SP, MEAS	FEED	
<i>DP</i>	Decimal point	0., 0.0, 0.00, 0.000	0.0	
<i>STRS</i>	Start (start) of range	-999 to 9999	0.0	
<i>ENDS</i>	End (end) of range	-999 to 9999	100.0	
<i>OFFS</i>	Offset (shift) of range	-999 to 9999	0	

Analogue output parameters - DAC0

Parameters	Function	Limit values	Default value	Operation
<i>R-IN</i>	Setting of input signal	IN-1, IN-2, SUB, ADD, PROC	IN-1	
<i>ROUT</i>	Type of analogue output	0-20, 4-20, 20-0, 20-4	0-20	
<i>RSTR</i>	Start of analogue output	-999 to 9999	0.0	
<i>REND</i>	End of analogue output	-999 to 9999	100.0	

Bargraph parameters - BAR - (x)

Parameters	Function	Limit values	Default value	Operation
<i>STR</i>	Start of bargraph range	-999 to 9999	0	
<i>END</i>	End of bargraph range	-999 to 9999	100	
<i>B-IN</i>	Setting of bargraph input	IN-1, IN-2, PROC,	IN-1	

Display parameters - DIS - (x)

Parameters	Function	Limit values	Default value	Operation
S-L0	Setting of bottom limit	-999 to 9999	0	
S-H1	Setting of top limit	-999 to 9999	100	
SEC0	Setting of colour for sector 0	-G-, -R-, -Y-	-Y-	
SEC1	Setting of colour for sector 1	-G-, -R-, -Y-	-G-	
SEC2	Setting of colour for sector 2	-G-, -R-, -Y-	-R-	
LIGH	Setting of display brightness	25, 50, 75, 100	75	
MODE	Setting of display range	STAT, SHIF	STAT	

Function parameters - ERRO

Parameters	Function	Limit Values	Default value	Operation
ERR1	State of outputs at breakdown	-no-, off, on	-no-	
ERR2	State of outputs at breakdown	-no-, off, on	-no-	
ERR3	State of outputs at breakdown	-no-, off, on	-no-	
ERR4	State of outputs at breakdown	-no-, off, on	-no-	
ERRA	State of analogue output at breakdown	-no-, 0 mA, 20 mA	-no-	

Function parameters - OST_

Parameters	Function	Limit values	Default value	Operation
filt	Filter of input signal	0 to 32	0	
pass	Access password	-999 to 1000	0	
adr	Setting of address regulator	1 to 126	1	
par	Setting of parity	-no-, even, odd	even	

Application software

Software PAP is intended for setting of AP21 controller parameters and monitoring of measured values.
Software available on www.apoelmos.cz.

Software / Hardware requirements and installation:

-> TD-U-19-19 (PAP Software)

Communication protocol

-> TD-U-19-20 (Communication protocol)

We,

A.P.O. - ELMOS v.o.s., Pražská 90, 509 01 Nová Paka, Česká republika
IČO: 60111615

declare under our sole responsibility that the below specified product meets requirements of technical directives and regulations, under specified conditions is safe to use and we adopted all measures to guarantee the compliance of all products of below specified type introduced on market with technical documentation and requirements of relating government and European directives.

Product: Panelmeter AP 21

Type: AP 21

Manufacturer: A.P.O. - ELMOS v.o.s.
Pražská 90
509 01 Nová Paka
The Czech Republic

The product is intended for measuring and regulation temperature or analog signals.

Assessment of product compliance was performed within the frame of assessment of production quality system by authorised person (no. A0 201, Electro-technical Testing Institute, Pod lisem 129, Prague 8 – Troja) and monitoring of proper maintaining of the system.

Above mention product is in compliance with the following standards:

ČSN EN 61010-1 ed.2:2011 including amendment	EN 61010-1:2010 including amendment
ČSN EN 61326-1:2013 including amendment	EN 61326-1:2013 including amendment

and government directives (European directives)

NV 17/2003 Sb. including amendment	2006/95/EC including amendment
NV 616/2006 Sb. including amendment	2004/108/EC including amendment
NV 481/2012 Sb, including amendment	2011/65/EU including amendment

Sample was examined by accredited testing laboratory no. 1103, VOP-026 Šternberk, s.p., division VTÚPV Vyškov, that issued for the product Protocol of safety type test no. 6450-20/2006 dated 28/3/2006, Protocol of EMC test no. 6440-68/2006 dated 2/3/2006 and no. 6440-129/2006 dated 20/3/2006.
The last two digits of the year when the product was certified with mark CE: 08

Place of issue: Nová Paka
Date of issue : 22.7.2014

Name: Ing. Libor Lukeš
Position: company director

AP ELMOS

A.P.O. - ELMOS v.o.s.
Pražská 90, 509 01 Nová Paka
DIČ: CZ60111615

Stamp:

Signature:



Product: Panelmeter AP 21

Specification acc. to code: **AP 21** - **41** - - - - - - - - - -

Serial number: **88-1921-08888**

Hereby we confirm that above mentioned product is complete, complies with technical conditions and is fully inspected and tested.

GUARANTEE CONDITIONS

13

Manufacturer is responsible for the product to have properties specified by technical standards for stipulated period of time, to be complete and without any defects. Manufacturer is also liable for the defects found by customer within guarantee period and that are timely claimed. The basic condition to be entitled to claim any defect is that the panelmeter is used in the manner specified by technical documentation. Guarantee period is 36 months since the date of purchase.

Complaint can be claimed on material defects or product malfunction. Guarantee repairs are performed in accordance with internal regulations of A.P.O.-ELMOS in company's workshop. Faulty product has to be properly protected not to be damage during transport.

Guarantee expires if any modifications are performed on product or guarantee tags are broken and if the product was damaged mechanically or by improper use.

Guarantee and after guarantee service is provided exclusively by A.P.O. – ELMOS.

Date of purchase:

Signature:

