COMECO
CONTROL & MEASUREMENT

BS EN ISO 9001
Reg.No FM 40344

USER PROGRAMABLE STRUCTURE CONTROLLER

RT390

Instruction manual

Based on Bulgarian version 1.1

Edition1 / November '98

READ THIS MANUAL BEFORE INSTALLATION!

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CONTENTS

1. APPLICATION

RT390 is a true programmable controller for diverse process control applications. It is compact in size and may be programmed entirely using only front panel keyboard. The device may be fitted with up to three analog inputs, two discrete volt free contact inputs, three relay and two analog outputs. Among its many applications RT390 is succesfully used for control of temperature, humidity, pressure, flow etc. The user programmable internal structure plus the two inputs allow easy implementation of cascaded control, feedback + feed forward control, pH + temperature, RH% + temperature, nonlinear control, or special types of feedback. User defined functions may be ordered. Available are all types of industry applicable signal outputs: electromagnetic relays, solid-state relays and analog current or voltage outputs. They may be used for control, limit signaling, alarms etc. Each relay output may be programmed to act not only as simple ON-OFF, but also as time proportional (pulse width modulation), or apply various frequency modulation types.

The entirely user programmable internal structure plus specific custom functions allows realizing of any conceivable control algorithm.

Bumpless manual change over is a standard control feature.

The RS-485 (RS-232) digital interface provides connection to operator station for process monitoring and hierarchical control.

The controller has a DC voltage output for power supply of transmitters (12V/30 mA non-stabilized).

All parameters are securely stored into nonvolatile memory. Special care is taken to protect device from electromagnetic disturbances.

An option allows keyboard lock by external key connected to discrete input.

2.TECHNICAL SPECIFICATIONS

The configuration and custom user specified options of this particular device are listed in the configuration card at the end of this manual.

2.1. Display

Description	Front panel
4-digit LCD	Polystyrene (up to 60 °C)
4-digit LED	Ploycarbonate (up to 120 °C)

2.2. Power supply

Supply voltage	Consumption
220 V ± 10% AC	max. 20 mA
18 ... 24 V AC	max. 200 mA
9 ... 12 V AC	max. 300 mA
22 ... 26 V DC	max. 200 mA
12 ... 16 V DC	max. 300 mA

2.3. Inputs

2.3.1. Analog inputs

Type	Range	Resolution
According to customer tables□	□	□
RTD Pt 100	-199.9 ÷ 200.0 °C	0.1°C□
RTD Pt 500	-199.9 ÷ 200.0 °C	0.1°C□
RTD Pt 1000	-199.9 ÷ 200.0 °C	0.1°C□
RTD Cu 53	0 ÷ 180.0 °C	0.1°C□
RTD Cu 100	-199.9 ÷ 200.0 °C	0.1°C□
RTD Ni 100	-60.0 ÷ 200.0 °C	0.1°C□
RTD Pt 100	- 200 ÷ 850 °C	1°C□
RTD Pt 500	- 200 ÷ 850 °C	1°C□
RTD Pt 1000	- 200 ÷ 850 °C	1°C□
RTD Cu 53	0 ÷ 180 °C	1°C□
RTD Cu 100	-200 ÷ 200 °C	1°C□
RTD Ni 100	-60 ÷ 200 °C	1°C□
TC Fe-CuNi, type “J”	-210 ÷ 1200 °C	1°C□
TC NiCr-Ni, type “K	-270 ÷ 1370 °C	1°C□
TC Pt13%Rh-Pt, type “R”	-50 ÷ 1700 °C	1°C□
TC Pt10%Rh-Pt, type “S”	-50 ÷ 1700 °C	1°C□
TC Pt30%Rh-Pt-6% Rh, type “B”	200 ÷ 1820 °C	1°C□
TC Cu-CuNi, type “T”	-270 ÷ 400 °C	1°C□
TC NiCrSl-NiSl, type “N”	-270 ÷ 1300 °C	1°C□
TC Fe-CuNi, type “L”	-200 ÷ 900 °C	1°C□
TC NiCr-CuNi, type “E”	-270 ÷ 1000 °C	1°C□
TC Wo3%Re-Wo25%Re, type “D”	400 ÷ 2300 °C	1°C□
TC Cu-CuNi, type “U”	-200 ÷ 600 °C	1°C□
Linear current (Rin ≤ 10 Ω)	0 ÷ 20 mA	4000 points□
Linear current (Rin ≤ 10 Ω)	4 ÷ 20 mA	4000 points□
Linear current custom ranges(Rin ≤ 10 Ω)	range limits 0 ÷ 50 mA	4000 points□
Linear voltage (Rin ≥ 1 GΩ)	0 ÷ 2 V	4000 points□
Linear voltage (Rin ≥ 1 GΩ)	0 ÷ 5 V	4000 points□
Linear voltage	0 ÷ 10 V	4000 points□
Linear voltage custom ranges	range limits 0 ÷ 10 V	4000 points□
pH input (Rin >10^4 GΩ) *	0,00 ÷ 14.00	0.01□
Slide wire (potentiometer) (Rp ≥ 5 KΩ)	0 ÷ 100 %	4000 points□
Slide wire (potentiometer) (Rp ≥ 500 Ω)	0 ÷ 100 %	200 points

* By using a preamplifier COMECO model PHA-100.

2.3.2 Discrete inputs

“0” state	0 ÷ 1 V
“1” state	3 ÷ 20 V

2.4. Outputs

2.4.1. Relay outputs

Description	Parameters
Electromechanical relay	250 V, 3 A, N.O.
Solid State Relay (SSR)	250 V AC, 1 A
TTL - output (open collector)	36 V DC, 30 mA

2.4.2. Analog outputs

Description	Parameters
Current 0 ÷ 20 mA	load 400 Ω or less
Current 4 ÷ 20 mA	load 400 Ω or less
Voltage 0 ÷ 2 V	load 2 kΩ or more
Custom ranges: current output: 0 ÷ 20 mA voltage output: 0 ÷ 10 V	 load 400 Ω or less load 2 kΩ or more

2.5. Operating conditions

Operating temperature	0..+50°C
Operating humidity	0..80% RH
Front panel protection class	IP54
Rear panel protection class	IP40
Maximum temperature drift	0.01%/°C
Maximum settling time	15 min

2.6. Storage conditions

Temperature	-10..+50°C
Humidity	0..95% RH

3. INSTALLATION

3.1. Mounting

The controller is intended for panel mounting into a 45x93 cut-out (fig.3-1) and is tightened into place by two diagonally placed mounting brackets (Fig.3.2).

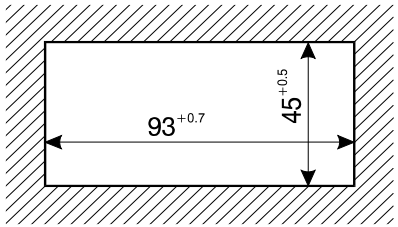
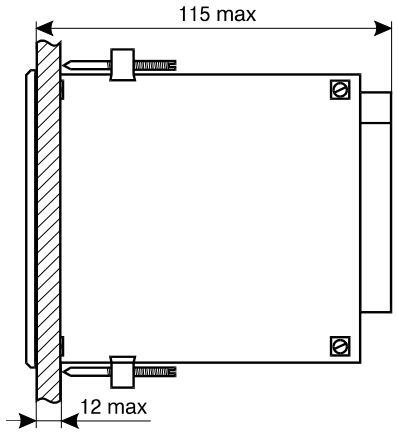


Fig.3.1



View from above

Fig.3.2

3.2. Wiring

All wires are connected to clamp screw terminals on the rear panel as shown on the circuit on controller case as well as Fig.3.3, Fig.3.4, Fig.3.5 and configuration card.

BACK PANEL TERMINAL USAGE FOR 1 or 2 ANALOG INPUTS

* In case of pH input type, analog output 1 is used for 15 V dc supply of the PHA-100 transmitter

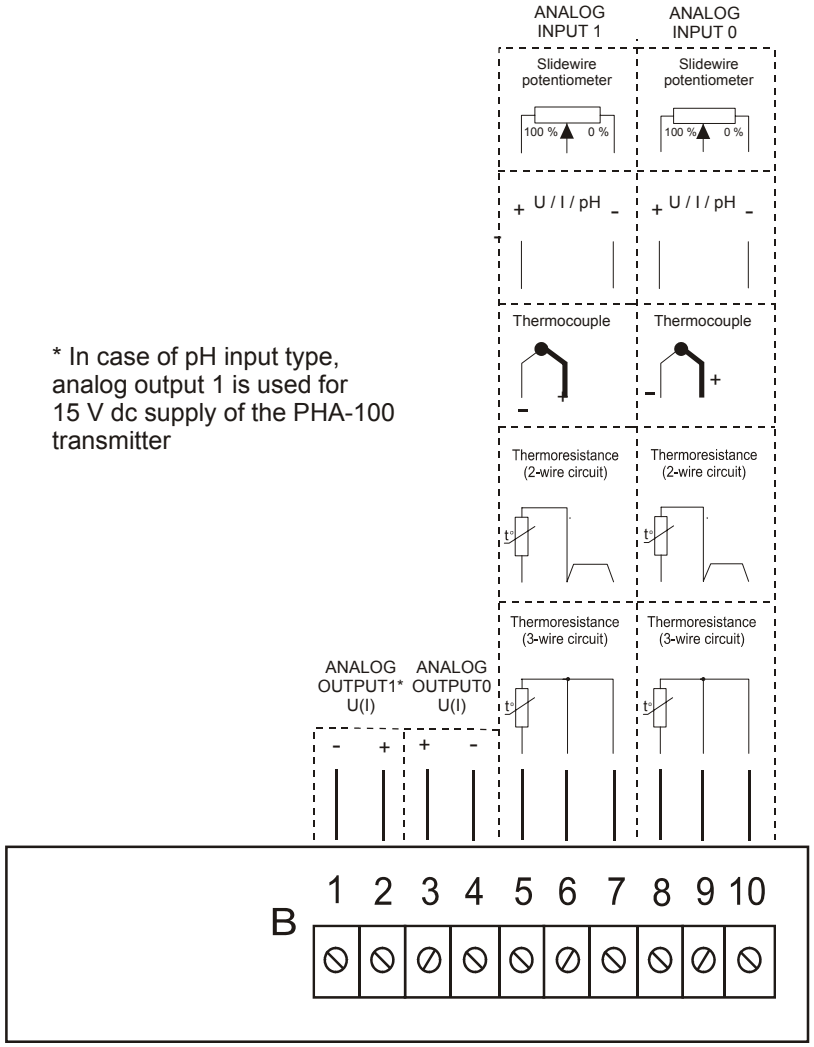


Fig.3.3

BACK PANEL TERMINAL USAGE FOR 3 ANALOG INPUTS

In case of pH input type, analog output 0 is used for 15 V dc supply of the PHA-100 transmitter

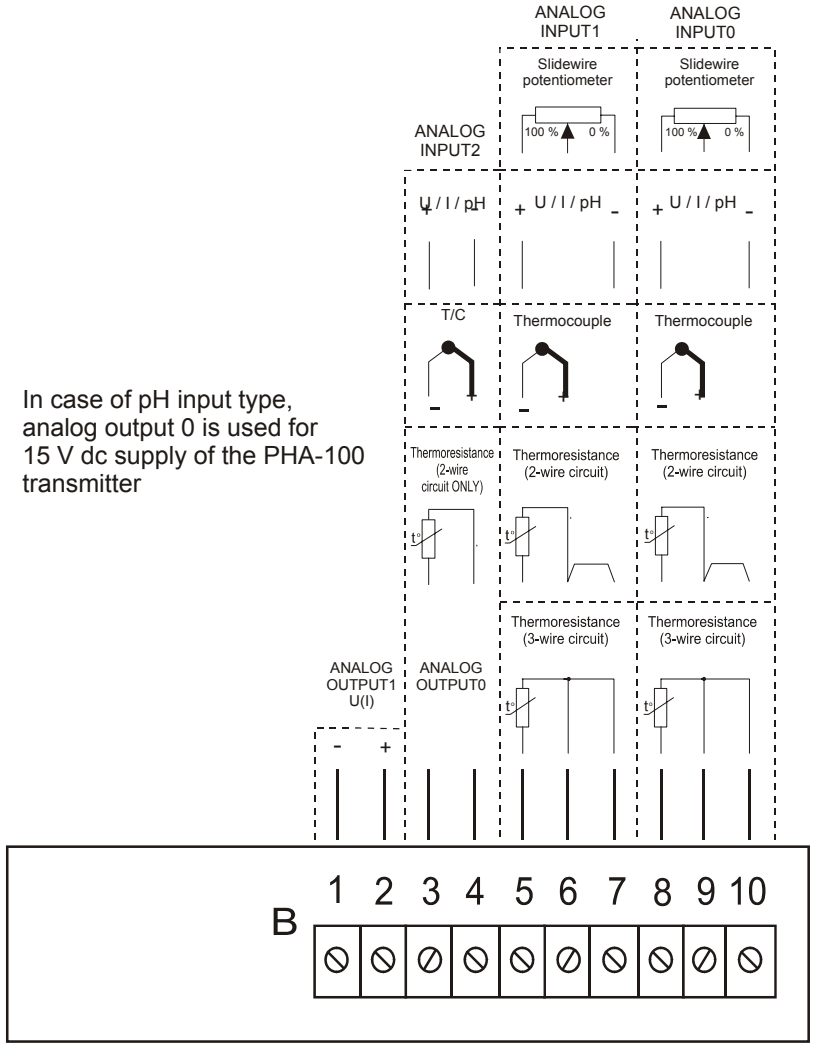


Fig.3.4

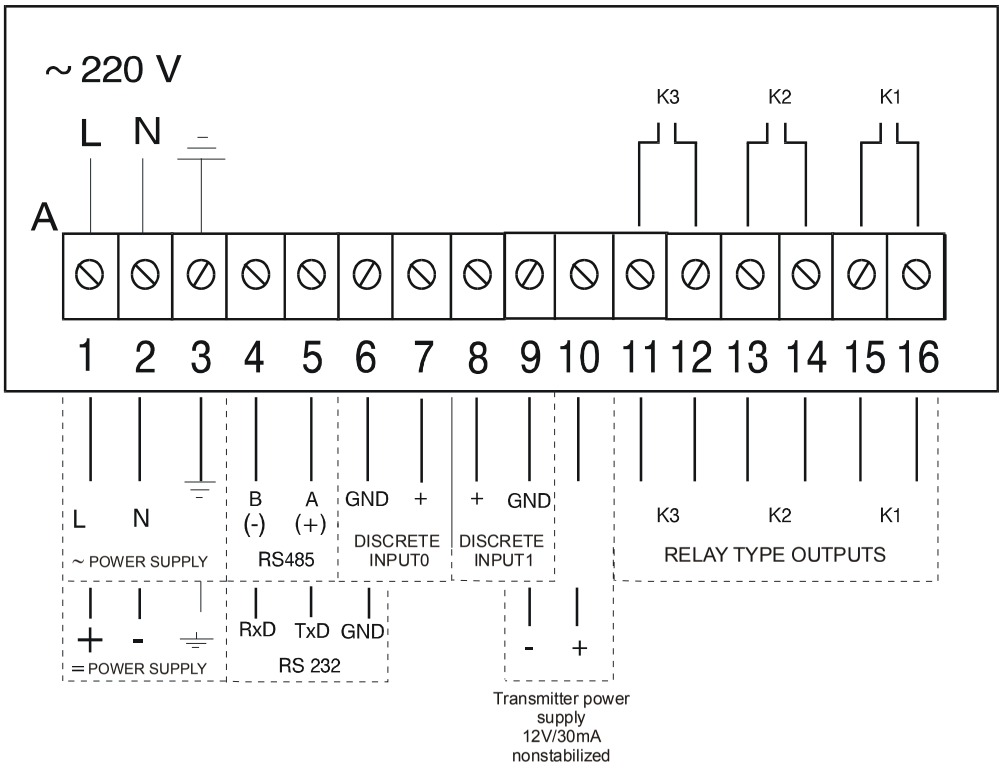

~ 220 V
L N
A
K3 K2 K1
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16
L N
~ POWER SUPPLY
B (-) A (+)
RS485
GND +
DISCRETE INPUT0
+ GND
DISCRETE INPUT1
K3 K2 K1
RELAY TYPE OUTPUTS
+ -
= POWER SUPPLY
RxD TxD GND
RS 232
- +
Transmitter power supply 12V/30mA nonstabilized

Fig.3.5

3.3. Electromagnetic compatibility issues

For proper functioning of the device some mounting and wiring requirements must be observed. The aim is to reduce undesirable electromagnetic interference. If high-energy electric spikes are allowed to get into device circuitry, the microprocessor may be misled and unpredictable erroneous functioning may result.

The noise may get into device circuitry by four ways:

- Galvanic coupling - direct cable connection, common supply or common ground wire. Be careful - grounding your device by using the ground wire of a powerful consumer may sometimes lead to unpleasant surprises.
- Capacitive coupling - your device or cables connected to it are too close to a cable whose voltage changes abruptly or is higher than 100 Volt.
- Inductive coupling - cables leading to your device are laid in parallel with cables whose current changes too abruptly. Your device is placed near a coil.
- Electromagnetic wave coupling - cables connected to your device is acting as antenna in relatively strong electromagnetic field or your device is placed in a metal housing near frequency inverter.

Devices that may cause all the types of noise coupling described above, especially when switched ON and OFF are:

- big electromechanical relays,
- contactors
- electrical motors,
- gas discharge lamps,
- welding equipment,
- solid state inverters and light dimmers,
- the cables leading to such devices.

As a summary - the cause of interference in most cases above is generally the abrupt current switching.

Avoiding electromagnetic interference

There are two general approaches:

- To suppress noise at the source. This is the best approach but it is applicable only to major noise sources.
- To protect your device and especially the signal and power lines connected to it from unwelcome electromagnetic interference.

3.3.1.Protecting your device from existing noise sources

How to protect the cables leading to your device.

Signal cables

- Always use twisted couples, preferably shielded. The shield must be reliably grounded at one end, preferably at your device end. An ungrounded shield may be worse than no shield at all.
- Never lay signal wires close in parallel with power supply or actuator wires. If this happens you will never get a steady measurement. Leave 10 to 15 cm between long parallel signal and power cables. The rule is that only similar signals may be run close together.
- Arrange power and signal cables crossing at right angle.
- Connect reliably the ground at measurement point and controller ground with thick stranded wire.
- Signal cable branching and terminals are susceptible to noise and should be arranged away from noise sources.

Supply circuit recommendations.

The AC supply voltage and frequency must be kept within the stated limits. Use stabilizer if necessary. Avoid sharing supply lines with powerful consumers, especially inductive loads switched on and off (like motors, lighting, etc.). To provide current supply for your device and at the same time stop unwelcome interference signals use shielded 1:1 isolation transformer (there are special designs of anti-interference transformers). A high quality anti-interference filter may also prove useful.

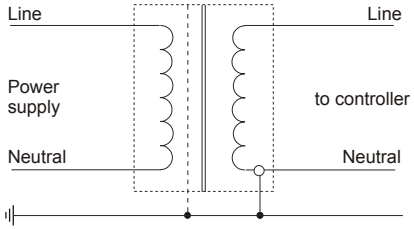


Fig. 3.5

3.3.2. Major noise sources suppression

Major noise sources are usually inductive loads switched on and off (motors, solenoids, relays, etc). A voltage surge suppressor should be connected in parallel with the inductance or if this is not possible, in parallel with the switching contacts. A metal-oxide varistor (MOV) and high quality, high power RC network should be used. The two cases mentioned will be explained in detail below.

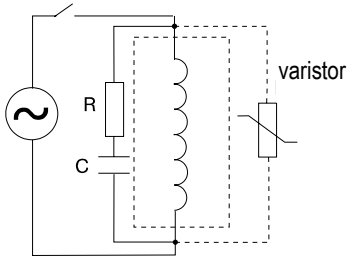


Fig. 3.6

Inductive loads.

To suppress high voltage spikes a Metal Oxide Varistor (MOV) is connected in parallel with inductance as closer as possible using short leads. A RC network in parallel with the varistor is highly suggested. It constitutes of 220 Ω/5W resistor in series with 0.5μF/1000V capacitor. Always use wire wound resistor. Keep RC network leads short.

Contacts.

When a contact opens and breaks inductive load circuit a certain amount of energy, stored in the inductance has to be released. If there is no varistor or RC network to dissipate it, the voltage rises abruptly and an electric arc is formed between opening contacts. This causes both electromagnetic interference and contact life shortening. To “quieten” the arc an RC network must be connected in parallel with the contact. The RC network is made up of 47 Ω/5W resistor in series with 0.1μF/1000V capacitor. Please note that at 220V 50Hz supply up to 7mA current may flow through the network. It may cause slight vibration of the rotor of miniature electrical motors. For example, in parallel with the contacts of your device there is a 68Ω/22nF RC network. A varistor may be added, but the RC network should already be present. Always use wire wound resistors for noise suppression RC networks.

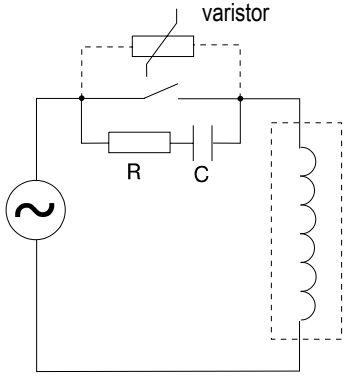


Fig. 3.7
Direct current (DC) circuits

A network consisting of a diode in series with resistor is connected in parallel with the inductive load. The resistance should be less than that of the inductive load (See Fig. 3.8).

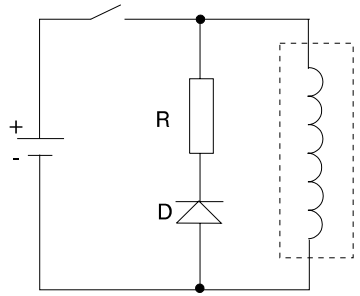


Fig. 3.8

4. FRONT PANEL

Front panel is shown on Fig. 4.1.

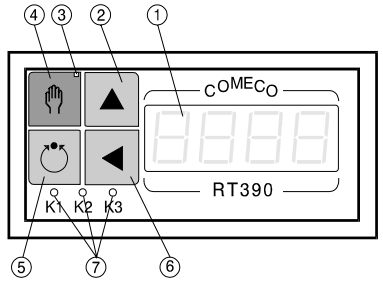


Fig.4.1

Front panel controls and indicators:

1 – four digit LSD (LED) display;
2, 4, 5, 6 – keyboard keys;
3 – Auto mode LED;
7 – Output relay state LEDs.

5. PRINCIPLE OF OPERATION

Each RT390 controller has some hardware inputs and outputs. In order to use the controller, the user must first define how the measured input values act on output state. In other words the internal controller structure must be defined.

The internal structure consists of input blocks, function calculating blocks and output blocks. A block has inputs and output. The information flows from input blocks, through a number of function blocks into output blocks. The interconnections are entirely user defined; if necessary an input may be directed directly to output block (see fig.5.1).

The signals from sensors and transmitters are fed to controller inputs. In internal controller structure these inputs are represented as input blocks (in0 ... inx). If input type is thermocouple or thermo-resistive sensor (Pt100), the output signal of this

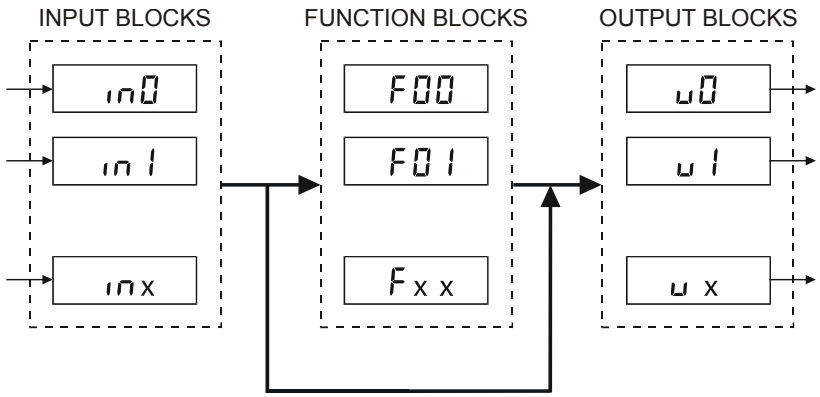


Fig.5.1

input block is temperature in degrees Celsius. The input temperature range is fixed. If the exact input value type is not known (analog current or voltage input) the user must define the values corresponding to minimum and maximum input current (input voltage). The output of this input block will be proportional to input current or voltage (see chapter 8.3.2).

Information from input blocks can be directly fed to output block. In this case the output will act as retransmission output. In most cases the information from input blocks first passes through several function blocks. Available are a number of function block types. Each of them performs a specific function on input data (see chapter 9). Internal structure loops are not allowed (the output of a block can not be connected to its input either directly or through other blocks. The output blocks may be relay type or analog (current or voltage). Relay type outputs may provide simple ON-OFF action or if desired time proportional (pulse width modulation) or frequency proportional output. In auto mode first the output of input blocks is evaluated, then this output values are used to calculate the outputs of following function blocks until the input value of output blocks is calculated. This action is performed frequently at regular short intervals. In manual mode this order of calculation is stopped and the user can manually set output values.

The controller has three programming levels:

- configuration level for most general settings - which inputs to use, how many function blocks are needed etc. This is level should be configured first. (see chapter 8.1).

- Parameter level for setting of controller internal structure and parameters - block types and interconnection, block parameters, relay output action type etc. (see chapter 8.3).

- Normal operation level - values of controller inputs, outputs and selected function blocks may be viewed on controller display (see chapter 8.2).

See APPENDIX 3. ‘GENERAL PROGRAMMING ORDER, USEFULL TIPS’ for general plan of action.

6. ENTERING DATA INTO CONTROLLER

6.1. Entering numerical values

Values are entered through keyboard and viewed on the display. Different number of digits is used depending on value range. Decimal point position may be selected for some parameters. Value digits are changed one at a time. The digit to change is selected by the ◄ key. By consecutively pressing this key all digit positions are traversed. The selected digit position is flashing - indicating that change is possible. The flashing symbol - either digit or character may be changed by pressing the ▲ key (see Fig. 6.1). The new value is entered by pressing the ☜ key.

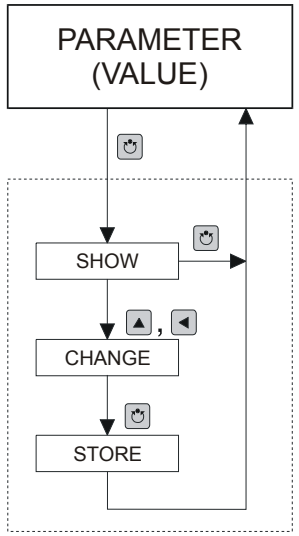


Fig. 6.1

If decimal point position may be changed - after selecting the leftmost digit and pressing the ◄ key again, the sign 888. is displayed indicating the point position. By pressing the ◄ key this position is moved left. The positions allowed are shown on Fig 6.2.

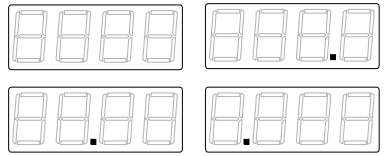


Fig.6.2

The selected position is entered by pressing the ☜ key.

If there are no special limits imposed on the value, the ranges for each of the four decimal point positions are:

- 1999 to 9999
- 199.9 to 999.9
- 19.99 to 99.99
- 1.999 to 9.999

The permissible range for some parameters is narrower. If the user tries to enter a value outside the range it is rejected and a the value of the nearest range limit is displayed instead.

To abandon the current new value and revert to the old value the ✋ key may be pressed instead of the ☜ key.

Some parameters can not be changed while in AUTO mode. In this case they can only be viewed. When the user selects the parameter and presses ☜ in order to change the parameter, the value is displayed but no digit is flashing indicating that the value can not be altered. The way back is by pressing the ☜ key again - the same as when entering new parameter value.

EXAMPLE 6.1

The value -200 should be entered.

The old value is 0000 and the rightmost digit is flashing.

1. ◄ key is pressed twice in order to select the second digit from left to right .

2. ▲ key is pressed twice to increase the digit. As a result 0200 is displayed.

3. ◄ key is pressed to select the leftmost digit.

4. ▲ key is pressed ten times in order to increase the digit from 0 to 9 and then to the "-" sign.

5. Now when the desired -200 value is displayed it is entered by pressing the ☺ key.

EXAMPLE 6.2

The value 000.1 should be entered.

0000 is shown on the display and the rightmost digit is flashing.

1. ▲ key is pressed once to increase the digit. As a result 0001 is displayed.

2. ◄ key is pressed four times (three times to select the leftmost digit and once more to display decimal point position sign). As a result the decimal point position sign 888. is displayed. It is moved to the left by pressing ◄ key 88.8. Now the decimal point is between third and fourth digit.

3. The selected decimal point position is entered by pressing ☺ key. Now the value with the new decimal point is displayed 000.1.

4. The displayed value is entered by pressing ☺.

6.2 Entering name of internal structure block name

Internal structure blocks are input blocks named I00, I01, ... and function blocks named F00, F01, ... The names of these blocks are entered when internal structure is being defined. The block type, its number and the sign of input signals are included in the name. If no block name is entered not is displayed with n letter flashing. At pressing ▲ key the flashing letter is changed and I00 is displayed. After pressing once more ▲ F00 is displayed and finally again not. In this way the type of internal block is chosen.

To define block number the rightmost two digits are changed appropriately. The corresponding digit is selected by pressing ◄. When the leftmost digit is selected the controller offers the user to change the sign of the input signal by displaying "-". If no signal negation is required, the user must hide the "-" sign by pressing ▲ this also moves the selection to the rightmost digit.

Block name is entered by pressing ☺. If the user is not certain and wants to keep the old name ✋ must be pressed instead.

Entering or changing of block names is impossible in AUTO mode. Switch to MANUAL mode first.

EXAMPLE 6.3

Enter -F13 if the display shows not.

1. Press ▲ twice to display F00. The F digit is flashing.

2. Press ◄. The leftmost digit displays a flashing "-" sign. Press ◄ once more, the rightmost digit is selected and flashing.

3. Press ▲ three times. This changes the rightmost digit to 3.

4. Select the next digit by pressing ◄.

5. Change the 0 to 1 by pressing ▲. Now the display shows the desired value -F 13.

6. Enter the value by pressing ↺.

7. OPERATING MODES

RT390 has two operating modes AUTO and MANUAL.

7.1 MANUAL mode

In this mode the LED on the ✋ key is darkened.

In MANUAL mode the user may set output values manually or simply turn all output relays OFF.

7.2 AUTO mode

Auto mode is easily recognized by the lit up LED on the ✋ key.

In auto mode output state is determined by the internal structure, parameters and input signal values.

At entering AUTO mode the message tESt is displayed for a moment while the controller tests internal structure consistency. If a loop or unconnected block is found the messages LooP or nc are displayed respectively (see chapter 8.3.4).

7.3 Switching between AUTO and MANUAL modes

Switching between AUTO and MANUAL mode is achieved by pressing shortly ✋ key. After switching ON power supply the last operating mode is restored except in the rare case when configuration level is entered.

7.4 Bumpless auto-manual changeover

Bumpless auto manual changeover is available for the PID function block. The initial auto mode PID control is equal to the last manual mode control (see chapter 9.2). A necessary condition for bumpless manual-to-auto changeover is a zero control error. The operator should have provided that the controlled variable is equal to the set point.

It is also possible that the manual control is equal to the last control in auto mode (so that output remains the same as in auto mode).

7.5 Stop command (output reset)

If at any moment there is a need to reset outputs to zero (all relays inactive) just press ✋ key for more than two seconds. The controller goes to (or remains in) MANUAL mode.

8. CONTROLLER PROGRAMMING LEVELS

There are three programming levels: normal operation level, parameter level, and configuration level. The way each level is entered is shown on Fig. 8.1.

See also APPENDIX 3. 'GENERAL PROGRAMMING ORDER, USEFULL TIPS' for general plan of action.

8.1 Configuration level

This is the first level to be programmed. Here is specified which inputs will be used (enabled), the number of function blocks and display necessary.

Configuration level is intentionally made difficult to enter. Switch the controller off and then press the ✋ key. After that without releasing the key, switch the power on. Release the key when conF is displayed. Configuration has three menus: inP, bLc and dSP.

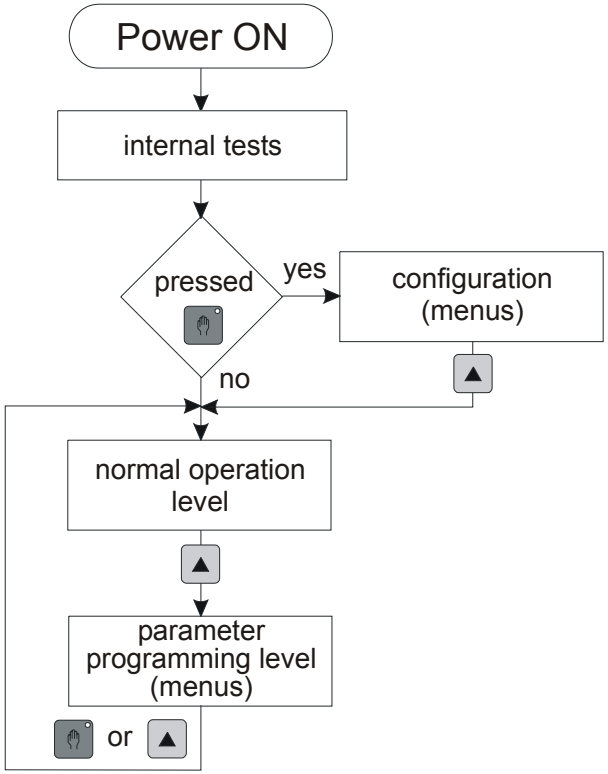


Fig.8.1

When a menu name is on the display other menus may be selected by ◄. Each menu is entered by ↺, Return from a menu back to configuration is done by ▲.

Menu ,nP is used for enabling/disabling of separate inputs. After ,nP is shown on display the menu is entered by ↺. The menu contains a list of controller inputs. For example if the controller has two analog inputs the display will show ,n0. The other input ,n1 inside the menu will be displayed by ◄. The input enable/disable is started with ↺. For enabled input the display shows USE , for disabled it is not. The input is enabled/disabled by ▲. The choice is entered into controller memory with ↺.

Please note that inputs not used should be disabled. Otherwise if no signal is fed to the input the flashing message ,nPx will be displayed where **x** is input number. This is the result of sensor functionality test, which is performed for all enabled inputs. The operator is notified that an input signal is outside permissible range.

After entering bLc menu with the number of necessary function blocks is displayed. You could always increase necessary function block number without disrupting existing structure (see chapter 6.1). The number may be set bigger than the actually necessary number of blocks. Please note that if the necessary number is decreased all existing structure is DELETED.

The dSP menu is similar to bLc, but specifies the number of display blocks – that is the number of values (controller inputs or function block outputs) that can be circulated on the display in normal operation mode (see chapter 8.2).

If the number of display blocks is decreased and the currently active display block is deleted the value of display d00 will be shown.

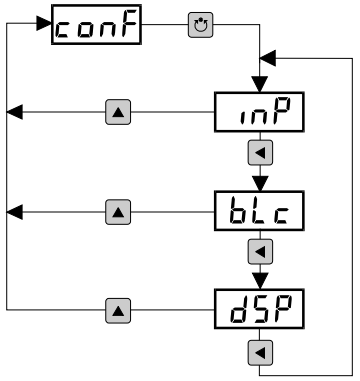


Fig.8.2

8.2. Normal operation level

After switching on the power the controller enters normal operation mode as shown on Fig.8.1 (if key is not depressed at that moment). The last auto/manual operating mode is restored. In normal operation mode the pre-selected display block values are circulated on controller display by pressing (see chapter 8.3.6). The name of the viewed value (the name of the input or function block) may be seen by depressing and holding down

If an input signal goes outside input range the operator is notified in a way depending of whether the 'bad' value was already on the display or not.

- **if the 'out of range' input was already on display** - for several seconds the closest input range limit is displayed flashing (in a hope that things will recover). After that the flashing message ,nPx, where **x** is the 'out of range' input number.
- **if a function block connected to the 'out of range' input is viewed** - for several seconds the displayed function block output value is displayed and then it is replaced by the flashing message ,nPx, where **x** is the 'out of range' input number.
- **If another input or a function block not connected to the 'out of range' input is displayed** – after several seconds the flashing message ,nPx is displayed, where **x** is the 'out of range' input number.

If a key is pressed the flashing message ,nPx is inhibited for several seconds allowing entering other levels and menus.

The outputs logically connected to the 'out of range' input are deactivated (relays are OFF, analog output values are 0 in the corresponding Lo-Hi range - see chapter 8.3.3).

8.3. Parameter programming level

If ▲ is pressed in normal operation mode Parameter Programming Level is entered (Fig. 8.3). This level contains several menus some with submenus.

The navigation in these menus is done in the following way: Parameter programming level is entered by pressing ▲ and exited again by ▲ or directly by ✋. Menus are circulated (selected) by ◄ and then entered by ☺. Submenus are also selected by ◄ entered by ☺. The return to parent menu is similarly with ▲. There is a quick way out of the 'web' of the parameter level – by pressing ✋ normal operation level is reentered. After going deeper and deeper into the submenus finally the user is offered to enter or read a parameter value.

The ctr menu is used for entering control output values in manual mode or monitoring of function block outputs in auto mode.

The inP menu deals with input ranges. For analog inputs the user defines numerical values for lower and higher input range. For temperature inputs (THC or RTD) input ranges are fixed and can only be viewed (see chapter 8.3.2).

The out menu is used for setting output type and parameters (see chapter 8.3.3).

Internal structure is entered in the Str menu (see chapter 8.3.4). Here are entered block connections and function block types.

The PAr menu is used for setting function block parameters (see chapter 8.3.5).

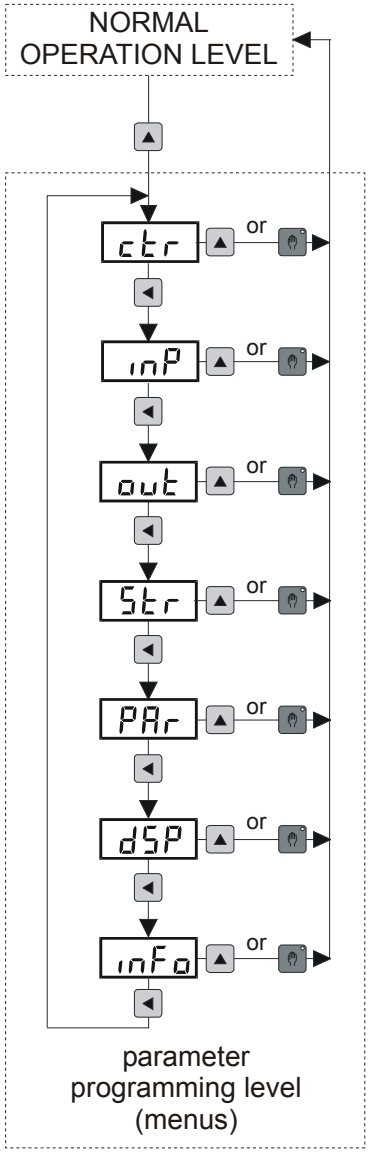


Fig.8.3

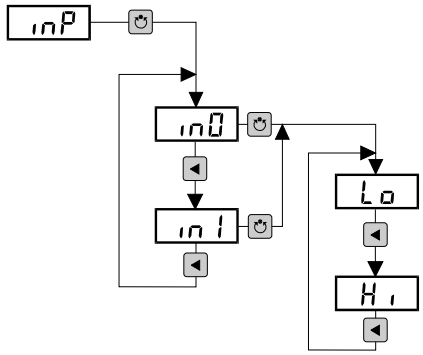


Fig.8.4

The dSP menu is used for selecting which inputs and function block outputs to display (see chapter 8.3.6).

Information about software version, maximum number of function blocks, display blocks and the unique software serial number can be found in the inFo (see chapter 8.3.7).

If no key is pressed for a long time normal operation level is reentered automatically.

8.3.1. Menu ctr

The ctr menu has a different application depending on the mode (auto or manual).

When the ctr sign is already displayed the menu is entered by ⏲.

In manual mode the value (or state) for each output may be set manually (see chapter 8.3.3). In this way manual plant control is performed or certain value sent through retransmission analog output. The names of all outputs are displayed consecutively by pressing ◄. For example if the controller has three outputs - the signs will be u0, u1 and u2. The manual control of displayed output is entered by ⏲ (for output value adjustment see chapter 6.1).

In auto mode calculated output values of all blocks may be monitored. The block names are displayed consecutively by pressing ◄. For example if there are 5 function blocks the display will show - F00, F01, ..., F04. Block output value is displayed by ⏲ and exited by ▲.

If the viewed block is logically connected to an 'out of range' input, displayed value will start flashing.

Please note that output block value is not refreshed while viewing. If new values are constantly needed - viewing of block output value must be frequently exited and reentered.

8.3.2. Menu inP

The inP menu is used for calibration of linear analog inputs (current or voltage). For each analog input the numerical values corresponding to lower and higher range limit are entered. The ranges for the temperature inputs (RTD and THC) can only be viewed. In this case the output value of input block is temperature in degrees Celsius. On Fig.8.4 is shown inP menu with its submenus and parameters in the case of two inputs.

The ◄ key selects the input.

Table 8.1

Output type	Varying parameter	Range	Constant user selected parameters	Range
1 (Time proportional)	Duty factor	0 ... 100 %	Period- cE Minimum pulse width - PULS Minimum pause width - PAUS	0,5 ... 128 s 0 ... 10 s 0 ... 10 s
2 (Frequency proportional type 1)	Frequency	0 ... f_{max}	Constant duty factor coEF Maximum frequency (f_{max})- FrEq dead band - db	0 ... 100 % 0 ... 240 Hz 0 ... 1 Hz
3 (Frequency proportional type 2)	Frequency	0 ... f_{max}	Constant pulse width PULS Maximum frequency (f_{max}) - FrEq dead band db	0 ... 134 s 0 ... 240 Hz 0 ... 1 Hz
4 (Frequency proportional type 3)	Frequency	0 ... f_{max}	Constant pause width PAUS Maximum frequency (f_{max}) - FrEq dead band - db	0 ... 134 s 0 ... 240 Hz 0 ... 1 Hz

For each analog input the numerical values corresponding to lower and higher range analog signal limit are entered. For example if analog input limits are 4 and 20 mA the user may set the following correspondence: Parameter Lo = 100 this means that at 4 mA the input will measure 100 (e.g. 100 kPa). Parameter Hi = 200 this means that at 20 mA the input will measure 200 (e.g. 200 kPa). In this way the internal structure functional blocks will operate with values ranging from 100 to 200.

For RTD or THC input types Lo и Hi are fixed at the input ranges. For example thermocouple type 'K' has Lo = -270 °C and Hi = 1370 °C.

8.3.3. Menu out

This menu deals with output configuration. It contains a list of hardware outputs (for number, type and order of outputs see device configuration card). For example in the case of three outputs the list of submenus will be: u0, u1 and u2. After the proper output name is displayed the submenu is entered by pressing .

Outputs can be linear analog or relay type.

For analog type outputs there are two parameters: Lo and Hi . The Lo parameter sets the calculated number corresponding to lower analog output limit. The Hi parameter sets the number corresponding to higher analog output limit.

Example: in case of 4 - 20 mA range current output and Lo = 0, Hi = 100, when the calculated output number is equal to 50 the output is 12 mA. Generally output number is in percents and so the parameters are Lo = 0%, Hi = 100% or more rarely Lo = -100%, Hi = 100%.

For relay output the tYPE parameter of relay action type is set first (simple on-off, time proportional, frequency proportional). It is chosen depending on the type of actuator used.

Output type can be changed only in MANUAL mode.

Type 0 is for on-off relay action. At calculated number less than or equal to 0 the relay is deactivated, at number greater than 0 the relay is activated.

Each relay output can be used for generating of pulse modulated signal with user specified parameters. The possible choices are: tYPE = 1 for time proportional output with fixed period time and varying pulse duration (used for heaters and standard motors), tYPE = 2, 3 for frequency proportional output (used for certain solenoid driven

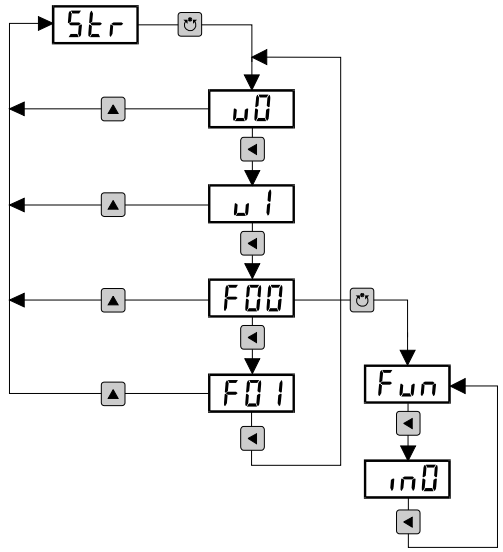


Fig.8.5

pumps etc.) for more information see Table 8.1.

Time proportional output period may be adjusted by 0.5 s increments. If output pulse shorter than PULS is calculated, the relay is not activated. Similarly if output pause shorter than PAUS is calculated the relay remains ON.

In case of frequency output type if calculated output frequency is less than db value, no relay switching is performed (frequency is assumed 0).

Example 8.1.

Configuring two relay outputs (oO and o1) in the following way:

oO - type 0 (on-off relay)

o1 - type 1 (time proportional output).

The actions necessary are:

The controller should be already in parameter programming mode and out menu should be displayed.

1. Enter out menu by pressing . The display then shows first output submenu oO.
2. Enter the submenu oO by pressing . The display then shows the tYPE parameter of this input.
3. To start tYPE parameter change press .
4. Enter 0 for on-off relay type (see chapter 6.1). Finish tYPE parameter adjustment by .
5. Press to exit oO (K1 relay output) submenu and then to move to the next output menu. The display shows o1 (K2 relay output). Enter the submenu by .
6. The display shows output type parameter name tYPE. To start parameter change press .
7. Enter 1 for time proportional type and finish adjustment with .
8. The choice of time proportional type requires three other parameters to be entered: Press to show next parameter. The display shows ct (time proportional sequence period).

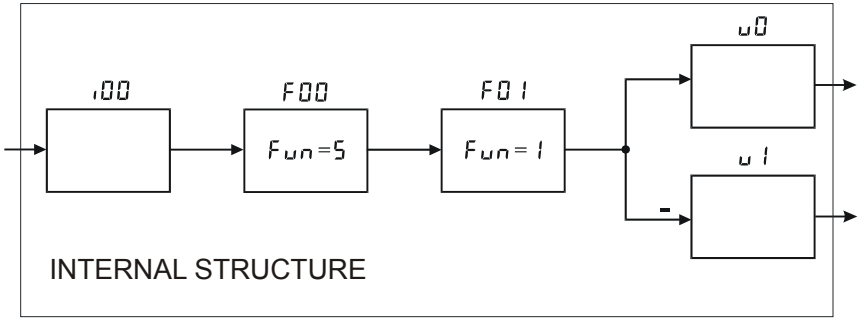


Fig.8.6

Press ☺ to start ct parameter adjustment. After adjusting the value press ☺ again to enter the new value.

9. to display the next parameter PULS (min. pulse duration) press ◄. Start PULS adjustment by ☺ and then finish it again with ☺.
10. to display the next parameter PAUS (min. pause duration) press ◄. Start PAUS adjustment by ☺ and then finish it again with ☺.

Press ▲ twice to exit out menu.

8.3.4. Menu Str

The Str menu deals with defining internal controller structure. The types of function blocks and the connections between them are set here. In this way the control algorithm is selected. It is expected that the maximum number of function blocks and the active inputs have already been specified in the configuration conF.

Fig.8.5 shows the submenus in the case of two outputs and three function blocks.

The user enters Str menu by ☺. The names of function and output blocks are circulated on the display by ◄. After a block name is displayed, the editing of its function type and connections is started by ☺.

For each output (u0, u 1, ...) after pressing ☺ the connection to a function or input block must be defined. See chapter 6.2 about how to enter block names. If an output is connected directly to input block, it becomes retransmission output. Outputs not used at the moment should be marked by not (not connected).

After connections of the outputs are entered, the connections of the function blocks must be defined. A function block inputs may be connected to other functional block or input block. After the name of the function block (e.g. F00) is displayed its function and connection parameters are shown by pressing ☺. First the Fun parameter is displayed (see chapter 9). It is used to define function block particular calculation function. There is a rich set of functions available – each function is identified by a code number. According to the function code entered - the number of input parameters will automatically change. For this reason the Fun parameter must be entered first. After finishing entering function parameter by ☺ the input parameters are

displayed by ◄. In the case of one input the parameter will be i n0. If the function selected has more inputs – more input parameters will appear: i n0, i n1 ...

It is an error to leave an input of an output or function block unconnected. At attempt to enter AUTO mode the flashing message nc will be displayed and the controller will remain in manual mode. In this situation pressing any key hides the message to allow structure reediting.

Internal feedbacks are not allowed (input of a function block to be connected to its output either directly or through other function blocks). If there is an internal feedback and the controller is switched to AUTO mode - the flashing message LooP is displayed and the controller remains in manual mode. Pressing any key hides the message to allow structure reediting.

If user defined structure is too complex the cycle time may not be enough for calculation of all blocks. In this case the error message Er00 is displayed and the controller microprocessor is reset. If the reason was intermittent electrical disturbance, the controller will continue its normal operation. Otherwise the user must simplify the internal structure. This is most easily done by removing function blocks and declaring them Fun = 0. If total function block number has to be decreased in configuration level please note that the entire structure will be deleted as the controller does not know which blocks you want to delete. Most time consuming are the functions Low pass filter (Fun=13) and PID (Fun=1).

Example 8.2

The structure shown on Fig.8.6 will be entered.

The submenus and parameters are shown on Fig.8.5. The structure is entered through the following sequence of actions.

1. The menu Str should be displayed first.
2. Enter the Str menu by pressing ☺. The display shows u0.
3. You are expected to enter from where will the u0 output block receive signal. Press ☺ and enter the name of the function block F01 (see chapter 6.2 about the way of entering function block names). Press ☺ to finish block name editing. Now output block U0 is connected to function block F01.
4. Press ◄ to move to output block u1.
5. Press ☺, enter -F01 and finish editing it by ☺.
6. Press ◄ to move to F00 function block.
7. Press ☺ to enter block function and input connections. The display shows the function code parameter Fun. Press ☺ to start editing and enter code 5. finish editing by ☺.
8. Press ◄ to show the first input parameter, i n0.
9. Press ☺, enter i 00 and finish editing by ☺.
10. Leave function block F00 submenu by ▲ and move to the next block (F01) by ◄.
11. Press ☺ to enter the block function and connection submenu. The display will show Fun. Press ☺ and enter function code 1. Finish by ☺.
12. Press ◄ to move to the input parameter, i n0.

13. Start parameter editing by [⏲], enter F00 and finish by [⏲].
14. Press [▲] twice to return to Str menu.

8.3.5. Menu PAr

The PAr menu is used for entering function block parameters (e.g. PID control coefficients etc.) It is expected that the structure ahs already been entered in the Str menu.

The change of parameter values may be done both in AUTO and MANUAL modes.

Each function block has a calculation function assigned in the Str menu. Some functions have parameters that allow to tune controller algorithms. In the PAr menu are shown only function blocks whose functions have parameters. (e.g. F00, F02 and F04). After displaying the desired function block name, [⏲] is pressed to show block parameter names. Parameter names are circulated on the display by [◄]. Parameter value editing is started by [⏲] (see chapter 6.1 about the way of changing parameter value).

Fig.8.7 shows the menu structure in the case of two function blocks with parameters – the first block function is PID (function code 1) with four parameters: Pr, ti, td and no.

8.3.6. Menu dSP

The dSP menu is used to select the blocks whose output values will be displayed in normal operation mode. The user has as many display blocks as he had entered in configuration (see chapter 8.1). Display blocks are named d00, d01 ... For each display block is defined where it gets its input signal from (, nP parameter) and what decimal point position is (Pnt parameter).

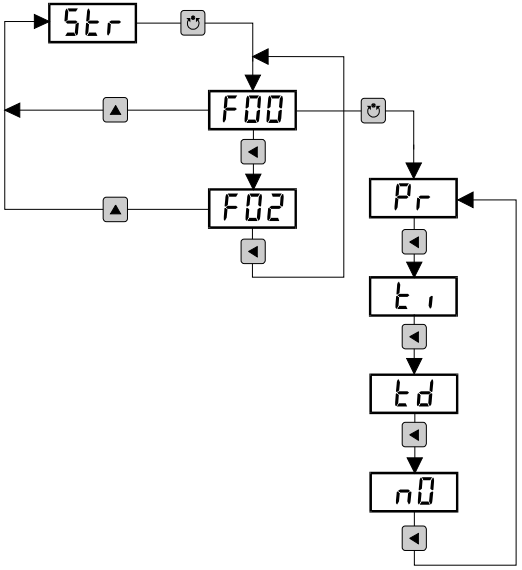


Fig.8.7

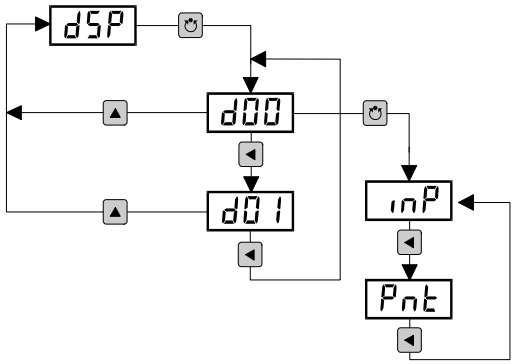


Fig.8.8

Fig.8.8 shows menu structure in the case of two display blocks.

If no input block is entered , nP = not , the sign "- - - -" will be displayed in normal operation mode. In normal operation mode the number of the display block whose input is currently displayed may be seen for a moment by pressing and holding down key.

8.3.7. Menu , nFo

This menu has no parameters that can be altered by the user. It contains information about the device. The , nFo menu has the following parameters:

- UEr software version. Omit the rightmost digit and compare to the number on the cover of your manual. The numbers must be the same.
- bLc The maximum number of function blocks hat may be used at one moment.
- dSP The maximum number of display blocks.
- Func The number of function types available (various function codes).
- nbrH left 4 digits of software device serial number.
- nbrL right 4 digits of software device serial number.

9. FUNCTIONS

Controller internal logical structure contains a number of function blocks each calculating one function.

Appendix 1 contains a table with function codes, short definitions, parameter and ranges.

The following functions come as a standard. The functions are arranged here according to their codes:

9.1. Function 0

Reserved. Empty function. Has no parameters or inputs. The output is always zero. When internal structure is deleted (the number of function blocks is decreased) all function blocks are given function code 0.

9.2. Function 1 - PID

PID control algorithm. It has one input. If input is named *e(t)*, then the output is *u(t)* will be:

$$u(t) = \mathrm{Pr}\left[e(t) + \frac{1}{ti}\int_0^t e(\tau)d\tau + td\frac{de(t)}{dt} \right] + n0$$

where derivative action is filtered. The first order derivative filter time constant is a fraction of derivative time.

Parameters:

1. Pr – proportional gain [% output value change/input value dimension]. Range - from 0 to 9999*[1)].
2. tI – Integral action time constant (reset time) [s]. Range from 0 to 9999*.
3. td – derivative time [s]. Range - from 0 to 9999*[1)].

nO – output reset (constant added to PID output) Range - from -100 to 100

PID integral action has built in anti windup function and bumpless auto-manual changeover

9.3. Function 2 – Two-state relay

This is a two state relay with hysteresis. Has one input. Hysteresis zone is symmetrical around the switching point. The switching point is fixed to zero. Input signal on Fig.9.1 is designated by *e*.

Parameters:

1. HYSt – hysteresis zone [input signal dimension]. Range - from 0 to 9999*.

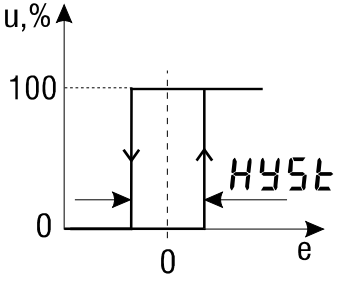


Fig.9.1

[1)] **This and all other values marked with * allow digital position to be freely moved as shown on Fig.6.2.**

9.4. Function 3 – three state relay

This is a three state relay with hysteresis and dead band (see Fig.9.2). It has one input.

Parameters:

1. db – dead band measured in input value dimension. Range - from 0 to 9999*.
2. HS1 - hysteresis 1 measured in input value dimension. Range - from 0 to 9999*.
3. HS2 - hysteresis 1 measured in input value dimension. Range - from 0 to 9999*.

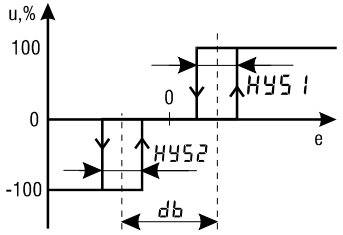


Fig.9.2

9.5. Function 4 – two speed position control of electric motor actuators with slidewire position feedback.

This is a function for position control of fixed speed electrical motors. It has one input where the difference between required and actual position is applied. The relation between current position and average motor speed is shown on Fig.9.3. Please note that if the staring position is within one of the low speed (SSPd) zones, the starting speed will not be equal to SSPd but to Forc (see parameters below).

The output signal range is from – 100% to 100%.

Parameters:

1. db - dead band - measured in input value dimension. Range - from 0 to 9999*.
2. StoP – low speed zone width - measured in input value dimension. Range - from 0 to 9999*.
3. SSPd – low speed value. Range - from 0 to 100%.
4. Forc – starting speed when initial position was in low speed zone but outside dead band. Range - from 0 to 100%.

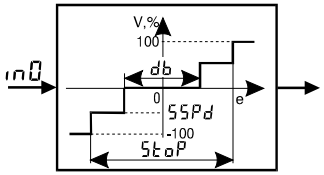


Fig.9.3

9.6. Function 5 – control error calculation

Calculates control error; has one input. The output signal is a difference between the set point (SP) parameter and input value (Fig.9.4).

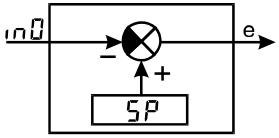


Fig.9.4

Parameters:

1. SP – set point measured in input value dimension. Range - from 1999* to 9999*.

9.7. Function 6 - constant

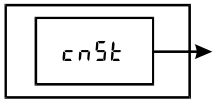


Fig.9.5

The output is equal to the constant value (cnSt parameter) (Fig.9.5).

Parameters:

1. cnSt - constant. Range - from -1999* to 9999*.

9.8. Function 7 - adder

Adds two input signals; has two inputs. (Fig.9.6).

Parameters:

None.

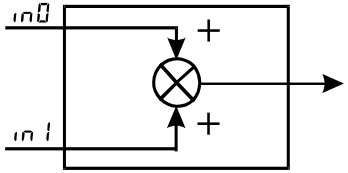


Fig.9.6

9.9 Function 8 - gain

Output is equal to the input signal multiplied by the GAin coefficient (Fig.9.7).

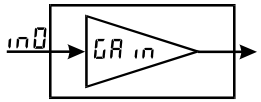


Fig.9.7

Parameters:

1. GAin – gain coefficient. Range - from -1999* to 9999*.

9.10. Function 9 - attenuator

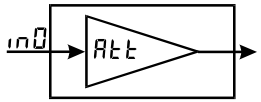


Fig.9.8

Output is equal to the input signal divided by the Att coefficient (Fig.9.8).

Parameters:

1. Att – attenuation coefficient. Range - from -1999* to 9999*.

9.11. Function 10 - multiplication

Output is equal to the product of the two input signals (Fig.9.9).

Parameters:

None.

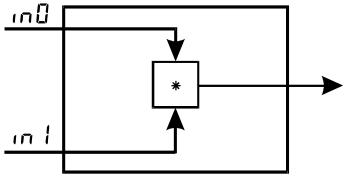


Fig.9.9

9.12. Function 11 - division

Output signal is equal to in0 signal divided by in1 signal (Fig.9.10)

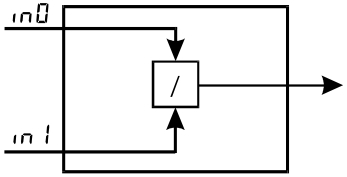


Fig.9.10

Parameters:

None.

9.13. Function 12 – linear transformation

linearly maps input range into output range (Fig.9.11). Input to output relation is given by a straight line defined by two points with coordinates (iL, oL) and (iH, oH).

Parameters:

1. iL – input value that is transformed into output value equal to oL. iL is measured in input value dimension. Range - from -1999* to 9999*.

2. iH - input value that is transformed into output value equal to oH. iH is measured in input value dimension. Range - from -1999* to 9999*.

3. oL – output value corresponding to input value equal to iL. oL is measured in output value dimension. Range - from -1999* to 9999*.

4. oH - output value corresponding to input value equal to iH. oH is measured in output value dimension. Range - from -1999* to 9999*.

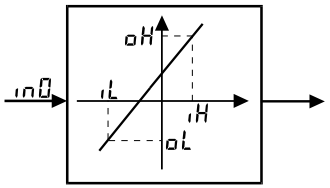


Fig.9.11

9.14. Function 13 – third order low pass filter

The filter consists of three consecutive first order time delay elements. It may be related to three consecutive RC circuits. The time constants of the three first order time delay elements are entered separately. If output to input difference becomes too big (bigger than no.5 parameter) the filter may be switched off for a moment and output made equal to the input. This was intended for fast step response to big input changes but should be applied cautiously. We suggest to try first with a big value for the no.5 parameter.

Parameters:

1. t1 –time constant 1 [s]. Range - from 0 to 9999*.

2. t2 - time constant 2 [s]. Range - from 0 to 9999*.

3. t3 - time constant 3 [s]. Range - from 0 to 9999*.

4. no.5 – maximum difference between input and output value (see above) - measured in input value dimension. Range - from 0 to 9999*.

9.15. Function 14 - saturation

Output may not exceed certain limits (Fig.9.12). output is saturated at input value , nO<SAtL or , nO>SAtH . If input is within the limits the output is equal to the input.

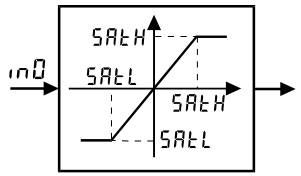


Fig.9.12

Parameters:

1. SAtL - low saturation limit - measured in input value dimension. Range - from -1999* to 9999*;

2. SAtH – high saturation limit - measured in input value dimension. Range - from -1999* to 9999*.

9.16. Function 15 - dead band

When input is smaller than certain value it is considered zero. Output signal is 0 if input signal is within db zone (Fig.9.13).

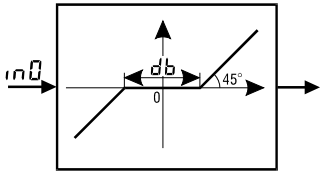


Fig.9.13

Parameters:

1. db - dead band measured in input value dimension. Range - from 0 to 9999*.

9.17. Function 16 – alarm activated outside limits

Output is equal to 100% if input value is outside alarm limit range LoL to Hi L, otherwise output is zero (Fig.9.14).

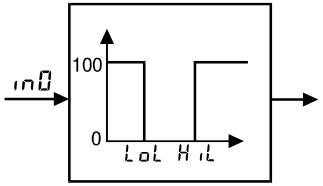


Fig.9.14

Parameters:

1. LoL – low alarm limit - measured in input value dimension. Range - from -1999* to 9999*.

2. Hi L – high alarm limit - measured in input value dimension. Range - from -1999* to 9999*.

9.18. Function 17 – alarm activated within limits

output is deactivated (zero) at input outside alarm range LoL to Hi L, otherwise output is activated (100%) (Fig.9.15).

Parameters:

1. LoL – low alarm limit measured in input value dimension. Range - from -1999* to 9999*.

2. Hi L - high alarm limit measured in input value dimension. Range - from -1999* to 9999*.

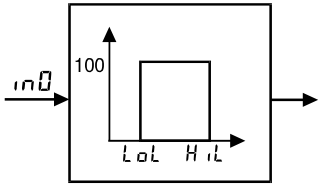


Fig.9.15

9.19. Function 18 – high level alarm

Output is activated (100%) if input value is bigger than alarm limit HiL, otherwise output is deactivated (0%) (Fig.9.16).

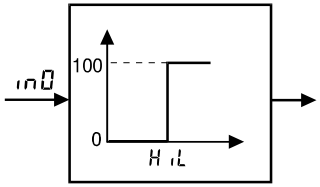


Fig.9.16

Parameters:

1. HiL – high alarm limit - measured in input value dimension. Range - from -1999* to 9999*.

9.20. Function 19 – low level alarm

Output is activated (100%) if input value is lower than alarm limit LoL, otherwise output is deactivated (0%) (Fig.9.17).

Parameters:

1. LoL – low alarm limit measured in input value dimension. Range - from -1999* to 9999*.

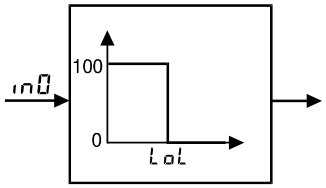


Fig.9.17

10. ERROR MESSAGES

During normal operation the controller constantly tests hardware and data entered by operator. If a probable hardware failure is detected a system error message is displayed. If operator entered data is inconsistent – a message for erroneous operator action is displayed.

10.1 Operator error messages

Message	Meaning	Correction
nc	An input of internal block was left unconnected (, nx = not).	Check and reedit structure (see chapter 8.3.4).
LooP	An internal logical loop exists. The order of block calculation can not be resolved.	Check and reedit structure (see chapter 8.3.4).

10.2 System errors

Message	Meaning	Correction
, nPx[1]	Input signal for input number 'x' is outside range. No normal link with external input device.	check wiring and transducer power supply. Disable unused inputs (see chapter 8.1).
Er00	Too complex structure. Total block calculation time is too big. This error may be an intermittent result of powerful electromagnetic disturbance.	Simplify internal structure by using fewer and simple function blocks (see chapter 7.2).
FAiL	Parameters in nonvolatile memory were lost.	Press to acknowledge the message. Whole structure and all parameters must be reentered.
Er xx[2]	Hardware failure.	Switch power supply off for 4 seconds and turn on again. If the message reappears send the controller for repair.

[1] - x is input number
[2] - xx is error number (xx>0).

APPENDIX 1. FUNCTIONS AND PARAMETERS

№	Function	input No	Parameters name	Parameters Meaning	Range [1]
1	PID	1	Pr	proportional gain	0 ... 9999 [2]
			ti	integral action constant (reset time)	0 ... 9999 s
			td	derivative time constant	0 ... 9999 s
			n0	manual reset	-100 ... 100 %
2	Two state relay	1	HYSt	hysteresis	0 ... 9999 [3]
3	Three state relay	1	db	dead band	0 ... 9999 [3]
			HS1	hysteresis 1	0 ... 9999 [3]
			HS2	hysteresis 2	0 ... 9999 [3]
4	Position control of electric motors	1	db	dead band	0 ... 9999 [3]
			StoP	low speed zone width	0 ... 9999 [3]
			SSPd	low speed value	0 ... 100 %
			Forc	starting speed when staring position is in low speed zone but outside dead band	0 ... 100 %
5	Control error calculation	1	SP	set point	-1999 ... 9999 [3]
6	Constant	0	cnSt	constant	-1999 ... 9999
7	Adder	2	¦	¦	¦
8	Gain	1	GAin	proportional gain	-1999 ... 9999
9	Attenuator	1	Att	attenuation	-1999 ... 9999
10	Multiplication	2	¦	¦	¦
11	Division	2	¦	¦	¦
12	Linear transformation	1	iL	low input point	-1999 ... 9999 [3]
			iH	high input point	-1999 ... 9999 [3]
			oL	output point corresponding to low input point	-1999 ... 9999 [3]
			oH	output point corresponding to high input point	-1999 ... 9999 [3]
13	Low pass filter	1	t1	time constant 1	0 ... 9999 s
			t2	time constant 2	0 ... 9999 s
			t3	time constant 3	0 ... 9999 s
			noiS	maximum input to output difference	0 ... 9999 [3]
14	Saturation	1	SAtL	High saturation level	-1999 ... 9999 [3]
			SAtH	Low saturation level	-1999 ... 9999 [3]
15	Dead band	1	db	Dead band	0 ... 9999 [3]
16	Alarm activated outside limits	1	LoL	high limit	-1999 ... 9999 [3]
			Hi L	low limit	-1999 ... 9999 [3]
17	Alarm activated within limits	1	LoL	High limit	-1999 ... 9999 [3]
			Hi L	Low limit	-1999 ... 9999 [3]
18	High level alarm	1	Hi L	High limit	-1999 ... 9999 [3]
19	Low level alarm	1	LoL	Low limit	-1999 ... 9999 [3]

[1] values may have up to four digits.
[2] the dimension is [%/ input signal dimension].
[3] input signal dimension.

APPENDIX 2. SAMPLE INTERNAL STRUCTURES

This appendix contains three commonly used sample internal structures.

Fig. A2.1 shows single loop controller with one Pt100 input and three relay type outputs.

Measured temperature is displayed in normal operation mode - (input, 00) shown by display block d00. Measured temperature is compared to set point in block F00 (Function 5 – control error calculation). Control error is fed to the input of block F01 (Function 1 - PID). Control output is fed to outputs u0 (heating action) and u1 (cooling action). These inputs are of type 1 – time proportional. The structure includes alarm activated outside alarm limits (Fo2) acting on output u2 (type 0 – on-off relay).

Fig. A.2.2 shows a structure of two independent loops in one controller. One of the inputs is Pt100 and the other is thermocouple type “K”. There are three relay outputs.

First loop is formed by , 00, F00, F01 and u0 the loop control realizes heating action. Second loop is made up of , 01, F02, F03 and u1 and realizes cooling action. The two inputs can be observed on the display in normal operation mode. Only first input is checked by alarm limits.

Fig.A3.3 shows cascaded control system in one controller. It could be temperature control of saturated steam heat exchanger. The main feedback is performed by measuring output product temperature. The auxiliary feedback is steam pressure inside heat exchanger. The outer loop measures temperature and calculates necessary steam pressure inside heat exchanger (pressure is related to steam temperature). The inner loop keeps steam pressure at the level required by the outer loop.

a) Outer loop: The first input (, 00) measures current temperature. It is compared to set point in F00 and the calculated control error is fed to the input of F01 block (PID). The output of this PID block is the set point of the inner loop. b) Inner loop: stream pressure is the output of , 01. The set point is compared to measured steam pressure in F02. Inner loop control error I fed to F03 input (PID). It calculates inner loop control output. The inner loop opens the motorized valve through u0 (heating) and closes it by u1 (cooling).

The alarm (F04) is relative to set point. The absolute alarm activation input values change when set point is changed. The alarm acts on output u2 (type 0 – on-off relay). The analog output u3 retransmits input , 01 measurement in range set by the Lo and Hi parameters in ranges set by Parameters. The two input measurements may be shown on display in normal operation mode.

Internal structure for single loop controller

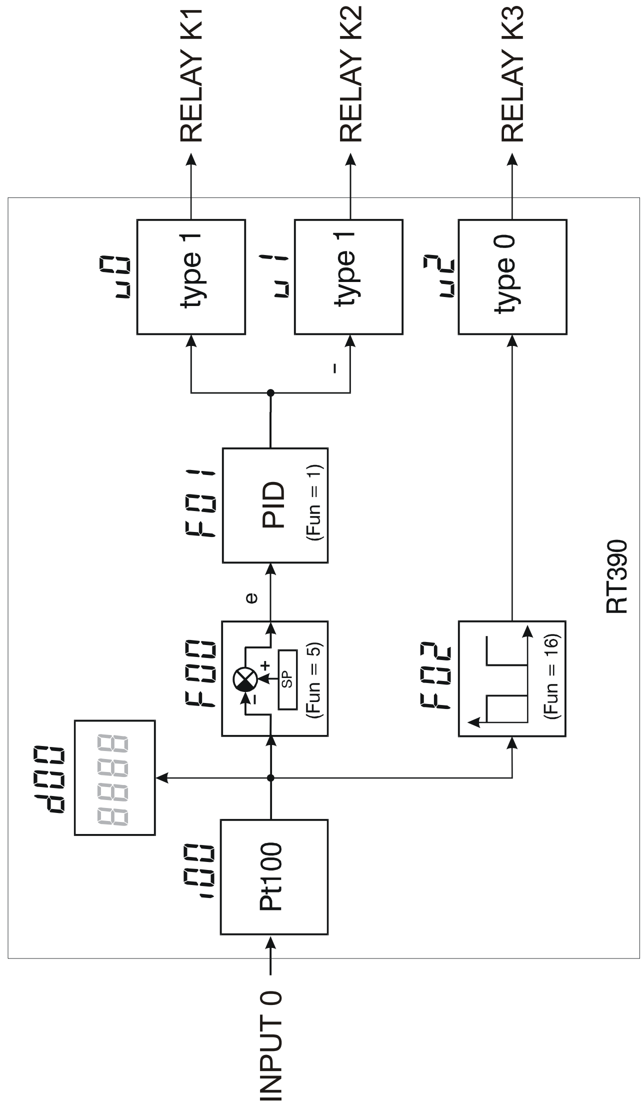


Fig. A2.1

Internal structure for two independent loops in one controller

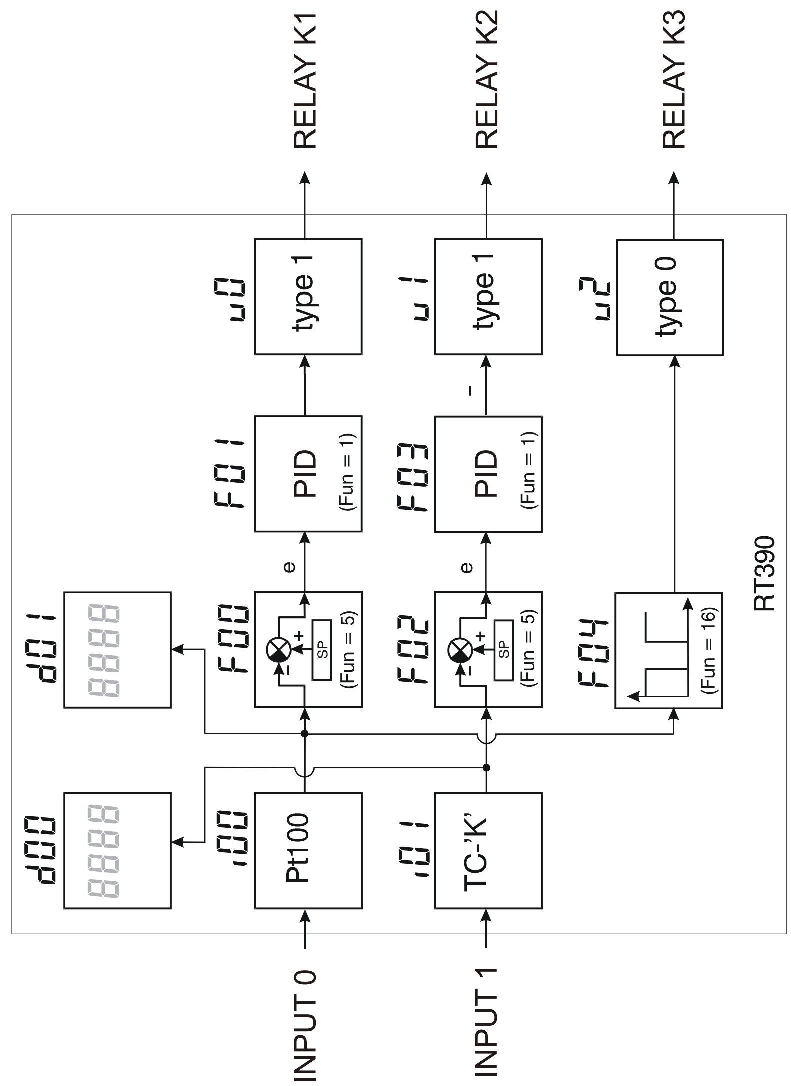


Fig. A2.2

Internal structure for cascaded operation of two regulators

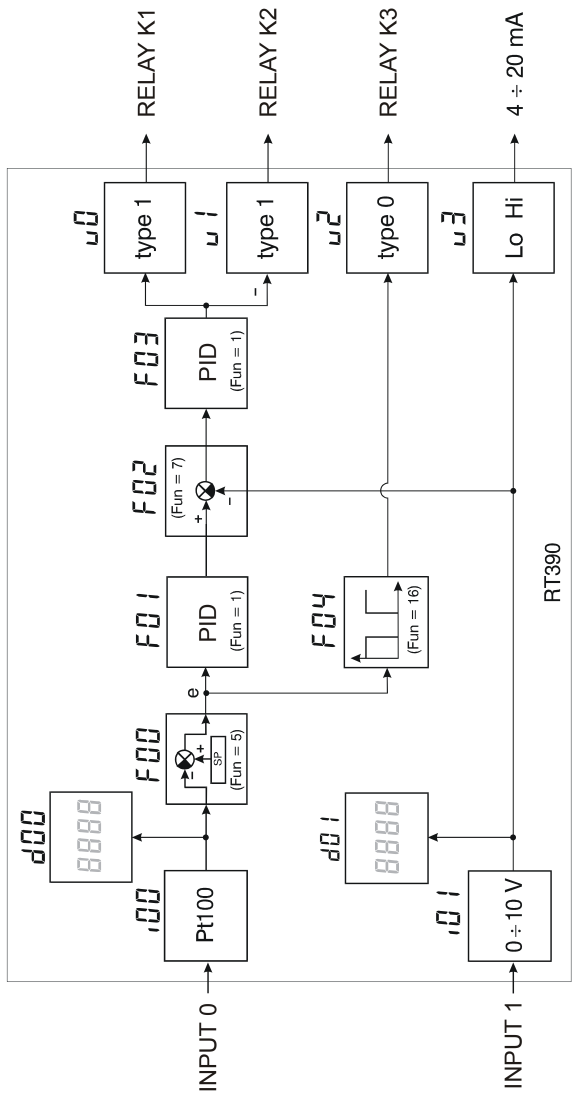


Fig. A2.3

APPENDIX 3. GENERAL PROGRAMMING ORDER, USEFULL TIPS

General order of programming

1. Check device configuration card to see hardware input numbering (which input is i 00, i 01...). Also check hardware output numbering (which output is u00, u01...). Check back panel terminal numbering for each input and output.
2. Draw your structure on a sheet of paper. Number input blocks (i 00, i 01, …), function blocks (F00, F01, …) and output blocks (u00, u01, …). Write down function block function codes (Fun = ?). Check feedback polarity to avoid positive feedbacks.
3. Enter configuration by pressing at switching power on. Enable inputs in use and disable all others in inP menu. Count your function blocks and enter the number in blc menu. Note that if your function blocks are numbered from F00 to F09 you will need 10 blocks, not 9. Do not enter much more blocks than necessary – if the number exceeds 9 there is always a risk that time will not be enough for all block calculation. Then total block number blc will have to be reduced which will result in deleting of whole structure and all parameters. Enter in dSP the number of display blocks needed. Exit configuration. The controller will go into normal operation and will be in manual mode.
4. Go to parameter programming level. If your controller has inputs other than temperature type, enter inP menu parameters for input ranges.
5. In programming level enter out menu parameters. During initial tests you are suggested to use small ct parameter times and zero PULS and PAUS times. If motorized valve is used always enter equal values for heating and cooling output parameters.
6. Enter controller structure in Str menu. Always enter function block function Fun first and input connections in x after that.
7. Enter function blocks parameters.
8. Check parameters in inP, out, Str and PAr menus.
9. Enter display block connection in dSP menu. Use decimal point position to distinguish between display blocks. Assign display blocks to all inputs to check that measurement is OK.
10. While still in manual mode use ctr menu to test actuator action.
11. Test the structure by going into auto mode. Fix input signals at constant values and use ctr menu to check block outputs.
12. Tune the controller and when finished write down the final structure and parameters.

CONFIGURATION CARD

Display: ☐ **LCD** ☐ **LED**

Power supply: ☐ **220 V AC** ☐ **Other voltage:** _____

	Type	Range
Input 0 , 00		
Input 1 , 01		
Input 2 , 02		
Output 0 u0		
Output 1 u1		
Output 2 u2		
Output 3 u3		
Output 4 u4		

Discrete inputs: ☐ **Discr. input 0** ☐ **Discr. input 1**

Interface: ☐ **RS232** ☐ **RS485**

Serial №: _____