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COMECO Inc., P.O.Box 378, Plovdiv 4000, BULGARIA, tel: +359 32 646523, 646524, fax: 634089
e-mail: info@comeco.org, WWW.COMECOGROUP.COM

PROGRAMMABLE BARGRAPH INDICATOR

TC600

OPERATION MANUAL

TC600 is a microprocessor-based process indicator, designed for displaying and controlling various process variables. Besides its excellent displaying capabilities, it can serve as limit comparator, 2- or 3-state ON/OFF controller, or motorized-valve ON/OFF duplex controller.

Please read this Operation Manual before mounting and operating!
Save the Manual for future references!

TECHNICAL SPECIFICATIONS

For the features of this particular device, see 'Factory configuration card'

Table 1

INPUT	**one of the following:**
- RTD Pt50...1000 (1.385) or (1.391)	-99.9 °C...+199.9 °C; -200 °C...+800 °C
- RTD Cu50, Cu100 (1.426) or (1.428)	-50.0 °C...+199.9 °C
- other thermoresistive	min. -200...max. +1000 °C
- T/C type "J" (Fe-CuNi)	-100 °C...+900 °C
- T/C type "K" (NiCr-Ni)	0 °C...+1200 °C
- T/C type "S" (PtRh10-Pt)	0 °C...+1600 °C
- other thermocouple	min. -200...max. +2400 °C
- DC current linear	0(4)...20 mA or other (min. 0...max. 50 mA); programmable input-to-display correspondence, min. -1999...max. 9999)
- DC voltage linear	0...10 V or other (min. 0...max. 40 V); programmable input-to-display correspondence, min. -1999...max. 9999)
Decimal point position	programmable
OUTPUTS	max. 2 relay and 1 analog
Analog retransmission output	0(4)...20 mA, 0...2 V, 0...5 V, 0...10 V, or other on request
Relay output:	**one of the following:**
- electromechanical relay (EMR)	5A/250VAC with NO/NC contact
- SSR	1A/250VAC
- MOS gate	0.1A/60VDC, optically isolated
- for external SSR	5...24 VDC, 50 mA, non-isolated form the device ground
CONTROLS	
Digital display	4-digit bright red LED with 9 mm (for variant 'B') or 14 mm (for variant 'D') digit height
Digital-display range	-1999...9999 (x10^{-1}, 10^{-2}, or 10^{-3})
Bargraph display	linear ('D') or arc-shaped ('B'), 50-dot LED with custom 10-point color zones
Bargraph-display range	0...100%, programmable
Display refresh rate	programmable
LED indicators	for signaling relay output activation
Keyboard	flexible foil-type keyboard with 4 membrane switch keys
METROLOGICAL SPECIFICATIONS	
Measurement error	0.4% from span
Temperature drift	0.01% from span for 1 °C
POWER SUPPLY	
Supply voltage	230 VAC, 115 VAC, 90…250 VAC/DC, 12…24 VAC/DC, or 24 VAC
Consumption	less than 4 VA
CONSTRUCTION	
Dimensions	96x96(front)x107 mm ('B'), 144x72(front)x100 mm ('D')
Weight	max. 650 g
Protection	IP54 (front), IP20 (terminals)
Wiring	SEE 'WIRING'
Mounting	SEE 'MOUNTING'
Case material	plastic
OPERATING CONDITIONS	
Operating temperature	-10...65 °C
Operating humidity	0...85 %RH
Storage temperature	-10...75 °C
Storage humidity	0...95 %RH

MOUNTING

Place the device into a 136x66 mm (for variant 'D') or 90x90 mm (for variant 'B') panel cut-out and tighten into place using the enclosed mounting brackets.

WIRING

To wire, use the plug-in terminals on the back of the unit observing the numbering printed on its rear panel.

Power supply wiring

The power supply wiring diagram for both variants is shown on Fig. 1.

Notes:

1. See **'Factory configuration card'** for power supply specifications!
2. Earthing is necessary ONLY if the power supply voltage is 90...250 VAC/DC!

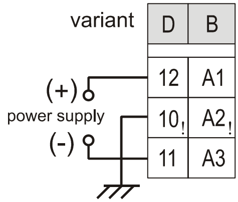


Fig. 1

Input signal wiring

Wire the input with regard to its type as shown on Fig. 2.

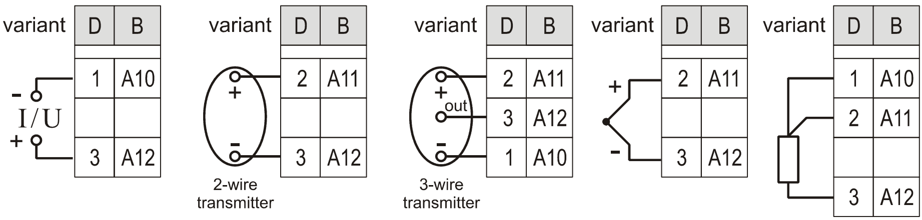


Fig. 2

Output wiring

The inner connection of the relay outputs and the analog output (if installed) wiring diagram for both variants are shown respectively on Fig. 3a and Fig. 3b.

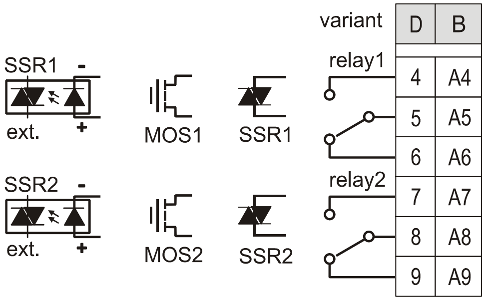


Fig. 3a

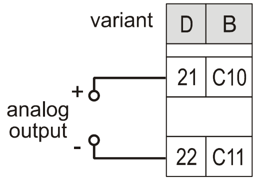


Fig. 3b

Note:

For the load capabilities of the outputs, see **'Technical specifications'**!

ELECTRO-MAGNETIC INTERFERENCE (EMI) ISSUES

For proper device functioning, 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 4 ways:

- Galvanic coupling – direct cable connection, common supply or common ground wire. Be careful. Grounding your device through 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 V.
- Inductive coupling – cables leading to your device are laid in parallel with cables whose current changes too abruptly, or your device is placed near a coil.
- Electromagnetic wave coupling – cables connected to your device are 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, and 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 2 general approaches:

- to suppress noise at the source - this is the best approach but 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.

Protecting the cables leading to your device

- Use cables in compliance with the particular device application.
- 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...15 cm between long parallel signal and power cables.
- Only similar signals may be run close together. Package input signal wires into twisted couples and shield (Table 2).

Table 2

Cable purpose	Use of twisted couple	Shield
HIGH VOLTAGE Supply, grounding, and relay outputs	NO	NO
Measurement-variable input signal	YES	YES

- Arrange power and signal cables crossing at right angle and at the maximum possible distance.
- Signal cable branching and terminals are susceptible to noise and should be arranged away from noise sources.
- Connect reliably the ground at measurement point and controller ground with thick stranded wire.
- All shields must be reliably grounded at one end, preferably at your device end. An ungrounded shield may be worse than no shield at all.

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 (e.g. 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.

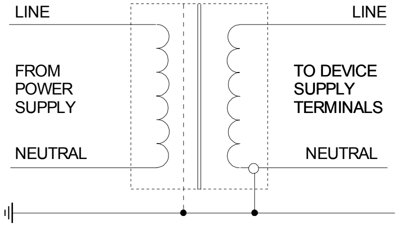


Fig. 4

Suppressing major noise sources

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.

Inductive loads

To suppress high-voltage spikes, connect a metal-oxide varistor (MOV) in parallel with and as closer as possible to the inductance (Fig. 5). An RC network in parallel with the varistor is highly recommended. It should constitute of a 220 Ω resistor in series with a 0.5 μF / 1000 V capacitor. Select resistor power in relation to the inductance voltage (Table 3). Always use wire wound resistor. Keep RC network leads short.

Table 3

Inductance voltage, V	Resistor power, W
115	0.25
230	1
460	3
550	4

A current flows through the RC network. In this case, given the above values and at U = 230 V / 50 Hz, the current flowing through the network, calculated by the formula $I = \dfrac{U}{\sqrt{R^2 + \left(\dfrac{1}{2\pi\ f\ C}\right)^2}}$, is 35 mA.

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 'quiet' the arc, connect an RC network in parallel with the contact (Fig. 6). For circuits up to 3A / 300 V, the RC network should be made up of a 47 Ω resistor in series with a 0.1 μF / 1000 V capacitor. To provide extra circuit protection in cases of voltages higher than 200 V, add MOV in parallel. Please note that at 230 V, 50 Hz supply, up to 7 mA current may flow through the network. It may cause slight vibration of the rotor of miniature electrical motors. For example, there is a 68 Ω / 22 nF RC network in parallel with the contacts of your device. A varistor may be added, but the RC network should already be present. Always use wire wound resistors for noise suppression RC networks.

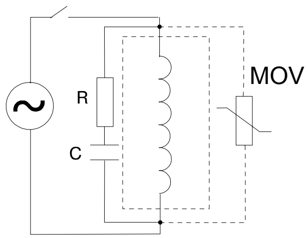


Fig. 5

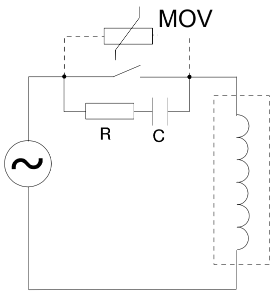


Fig. 6

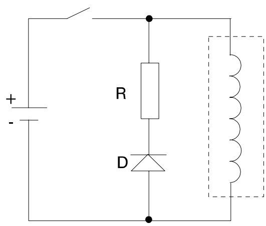


Fig. 7

Direct current (DC) circuits
In parallel with the inductive load, connect a network consisting of a diode in series with a resistor. Mind that the resistance should be less than that of the inductive load (Fig. 7).

OPERATION

Start-up

After power-on, the unit performs a series of self-tests. Their visible effect is as follows:

- the bargraph and all the display segments light up;
- the time remaining before end of tests is indicated in percents;
- init shows on digital display as parameters are read from the non-volatile memory;
- finally, the device enters either failure state or normal mode of operation.

Normal mode

In this mode, front panel keys and indicators function as follows:

- the bargraph indicates the measured value in percents of selected input range;
- the digital display indicates measured value except when key is pressed;
- pressed and held shows on the digital display the measured value corresponding to 100% bargraph indication;
- pressed and held shows on the digital display the measured value corresponding to 0% bargraph indication;
- pressed and held lights up both displays;
- pressed and held shows on the digital display the analog bargraph value (a digit from 0% to 100%) with a 0.1% accuracy.

While the device is in normal mode of operation, relay state is determined by measured value and relay output parameters (see 'Outputs').

DEVICE PROGRAMMING

This chapter explains how to adjust device parameters and so determine device functions.

Parameter tree

For easier and more convenient to memorize access, device parameters are organized in groups according to their function (Fig. 8). This arrangement is called 'parameter tree' or just 'tree'. The parameters are arranged in groups. Sometimes, 2 or more groups are themselves arranged in a larger group. All groups, along with their parameters or subgroups, form the tree. To select a parameter for adjustment, the user has to specify first –the group, then – the subgroup if any, and finally – the parameter. This sequence resembles movement from the 'root' of the tree to its 'leaves' (the parameters).
The path to a certain parameter from here on will be coded as:

Group1 ⇒ Subgroup2 ⇒ ... ⇒ Parameter3

Please note that when the values of some parameters are changed, other parameters or whole groups may accordingly appear or disappear. These appearing / disappearing parameters are shown in dotted lines.
Parameter adjustment mode does not stop bargraph or relay functioning; they continue operation as in normal mode.

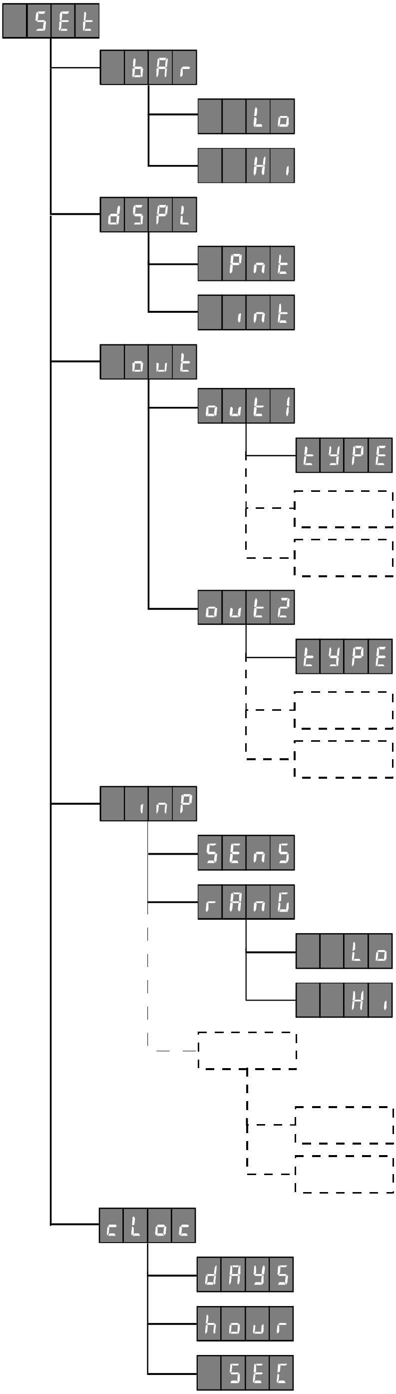


Fig. 8

Selecting parameters

To start parameter adjustment, press [▲] and [↻] simultaneously. While the two keys are depressed, SEt is displayed, indicating that parameter adjustment mode is entered. With key release, the name of the first group – bAr – shows up on the display. To move vertically along the tree and select any group or parameter, use [▲] and [▼]. To exit the current group, press [«].

In case there are no more groups to exit from, while [«] is depressed, SEt is displayed, and as the key is released, the device exits parameter adjustment mode and returns to normal mode. Upon exiting parameter adjustment mode, TC600 automatically checks whether parameter value has been changed. If so, the relevant change is saved in the non-volatile memory as is indicated via LoAd.

The [↻] key action depends on whether the current element is a group or a parameter name. If it is a group, pressing [↻] would make current the first subgroup or parameter inside. If it is a parameter, pressing [↻] would start parameter value adjustment. When the adjustment has completed and the new value set via [↻], the device displays again the name of the adjusted parameter.

<u>Please note that for all changes to be memorized permanently, parameter adjustment mode must be exited before the controller is switched off.</u>

If no key has been pressed for 1 minute, the device returns automatically to normal mode.

Parameter adjustment

Input

The function of the input part of the device is to measure the physical quantity and transform it into engineering units. In order to perform its functions properly, the device needs the following parameters to be specified:

- <u>Sensor type</u>: SEt ⇒ inP ⇒ SEnS - specifies the type of sensor non-linearity.
  The possible values are:
  - Lin - linear input (or already externally linearized);
  - Pt0.1 - RTD Pt100;
  - tc K - thermocouple type "K" (NiCr-Ni);
  - SqrT - quadratic (the input value is square rooted);
  - CYL - cylindrical (the input value is the level of the fluid inside a lying cylindrical tank and serves as a basis for fluid volume calculation).

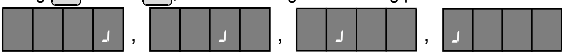
- Measured value range - programmed by 2 parameters, specifying display values at minimum and maximum input signal quantity. In case of a CYL sensor type, these parameters define display values at the extreme input signal quantities not of the fluid volume, but of its level inside the lying cylindrical vessel in regard to the cylinder diameter.
  The paths to these parameters are respectively SEt ⇒ inP ⇒ rAnG ⇒ Lo and SEt ⇒ inP ⇒ rAnG ⇒ Hi, and their values are subject to adjustment according to **'Setting parameter value'** within the following ranges:

Parameter	With all sensor types except CYL		With sensor type CYL	
	min. value	max. value	min. value	max. value
Lo	-1999	9999	0.000	1.000
Hi	-1999	9999	0.000	1.000

  Example: How to reach parameter Hi :
  - From normal mode, enter parameter adjustment mode by pressing ▲ and ↺ simultaneously.
  - Release the keys. Selected is the first group of the tree next to SEt.
  - Browse with ▼ until inP is displayed.
  - Press ↺ to select the first subgroup within the inP group – SEnS.
  - Using ▼ select the second subgroup within the same group – rAnG.
  - To select the first parameter of the rAnG subgroup – Lo, press ↺.
  - Use ▼ to display the second parameter of the subgroup – Hi .
  - To start parameter adjustment procedure, press ↺.
- Input calibration: SEt ⇒ inP ⇒ cLbr - allows improving measurement accuracy by eliminating constant errors.
  Different sets of calibration parameters appear depending on the value of the parameter SEt ⇒ inP ⇒ SEnS:
  1. There are no calibration parameters for linear, quadratic, and cylindrical sensor types.
  2. When RTD (Pt100) is selected, the following parameters appear:
  SEt ⇒ inP ⇒ cLbr ⇒ rLin - total resistance of the sensor connection wires when 2-wire circuit is used; enter '0' for 3-wire circuits.
  SEt ⇒ inP ⇒ cLbr ⇒ oFFS - corrects the offset at 0 °C.
  SEt ⇒ inP ⇒ cLbr ⇒ GAin - corrects the rate of increase of temperature above 0 °C with the increase of resistance.
  The values of these parameters are subject to adjustment according to **'Setting parameter value'**.
  3. For thermocouple sensor types, accessible are only the parameters SEt ⇒ inP ⇒ cLbr ⇒ oFFS and SEt ⇒ inP ⇒ cLbr ⇒ GAin, which have the same interpretation as those for a RTD sensor.
- Volume of the surrounding parallelepiped: SEt ⇒ inP ⇒ d2L . This parameter is accessible only when the value of the parameter SEt ⇒ inP ⇒ SEnS is CYL . The value assigned to d2L may vary from 0.001 to 9999, and should be calculated by the formula $d^2 \times L$, where d is the diameter, and L – the length of the lying cylindrical vessel.

Display

The digital display shows the measured variable value. Its function is determined by 2 parameters:

- Decimal point position: SEt ⇒ dSPL ⇒ Pnt - determines how many digits of the fractional part would be displayed.
  Using ▲ and/or ▼, choose among the following possible values –
   , and Auto – and set with ↺.
  The first 4 values specify decimal point position exactly. When Auto is assigned, the position is determined automatically so that more digits of the fractional part could be shown. Please note that if the measured value is too big to be properly indicated, the message ==== appears on the display instead.
- Display refresh: SEt ⇒ dSPL ⇒ int - determines the time interval of display refresh within 1 to 9 seconds.
  To choose relevant value, use ▲ and/or ▼; set with ↺. If value '0' is assigned, display is refreshed as frequently as possible.

Bargraph
The bargraph displays graphically the measured variable value. The lit-up stripe/arc length is proportional to the measured value. It shows 0% at measured value equal to the SEt ⇒ bAr ⇒ Lo parameter value and 100% at measured value equal to the SEt ⇒ bAr ⇒ Hi parameter value. In case of an analog output installed (see **'Factory configuration card'**), bargraph higher and lower limits (Hi and Lo) also define respectively the higher and lower limits of the analog output.
It is advisable to set these parameters equal to those printed on the front panel tag, in order to avoid ambiguities. If, for some reason, it is necessary to assign different values, update the tag.
The values of these parameters are subject to adjustment according to **'Setting parameter value'**.

Outputs
The device may have up to 2 output relays – K1 and K2 – each of which may be programmed to operate independently in various modes. Two corresponding branches of the parameter tree are assigned to the 2 relays:
SEt ⇒ out ⇒ out1 ⇒ … and SEt ⇒ out ⇒ out2 ⇒ …
For simplicity, only the programming for K1 will be explained:

- Output type: SEt ⇒ out ⇒ out1 ⇒ tYPE. The possible values of this parameter are: SYS, 1AbS, 2AbS, 1rEL, and 2rEL. Each value is composed of 2 parts. The right 3 digit positions may be SYS, AbS, or rEL. For AbS and rEL, the leftmost digit may be 1 or 2, and for SYS, it is always dark.
  The meaning of this coding is:
  SYS - the relay is activated on device failure, probe failure, or other similar emergency;
  AbS - from this point forward, relay parameters will be entered in engineering units;
  rEL - from this point forward, relay parameters will be entered in percents from span (0...100%);
  1 - relay state is determined by 1 limit;
  2 - relay state is determined by 2 limits.
  The adjustment of this parameter goes off as follows:
  1. At the beginning of the parameter adjustment, the display indicates the current parameter value with its 3 rightmost digits blinking (i.e. are selected).
  2. To select the other part of the value, use «, and to change the blinking part value – ︽ and/or ︾.
  3. After composing the desired value, set it by pressing ↻.
  Depending on the particular value assigned to this parameter, the corresponding branch of the tree comprises of different parameters (Fig. 9).

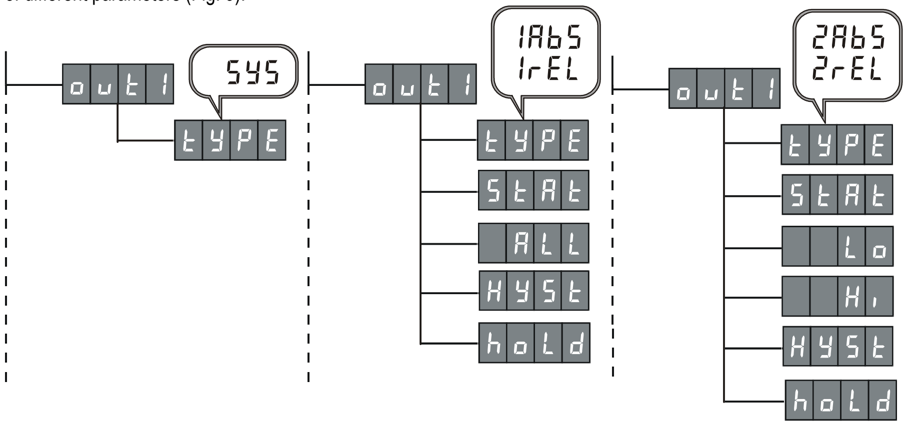


Fig. 9
Different variations of parameter tree output branch

- Relay static characteristic: SEt ⇒ out ⇒ out1 ⇒ StAt. When output state is determined by 1 limit, this parameter may accept either of the values _|¯ and ¯|_, and when the state is determined by 2 limits – _Π_ and ¯U¯. The symbols representing the value of the parameter depict relay activation function (see Fig.10 and Fig. 11). To confirm value change, press ↻.

Relay activation function in case of 1 limit (Fig. 10) is further specified by the parameters SEt ⇒ out ⇒ out1 ⇒ ALL and SEt ⇒ out ⇒ out1 ⇒ HYSt, and in case of 2 limits (Fig. 11) – by the parameters SEt ⇒ out ⇒ out1 ⇒ Lo, SEt ⇒ out ⇒ out1 ⇒ Hi, and SEt ⇒ out ⇒ out1 ⇒ HYSt.
The values of these parameters are subject to adjustment according to **<u>'Setting parameter value'</u>** within the following ranges:

Parameter	Minimum value	Maximum value
ALL	-1999	9999
Lo	-1999	Hi value
Hi	Lo value	9999
HYSt	0	9999

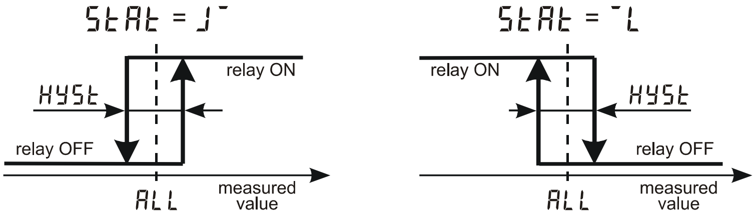


Fig. 10
1-limit relay activation function

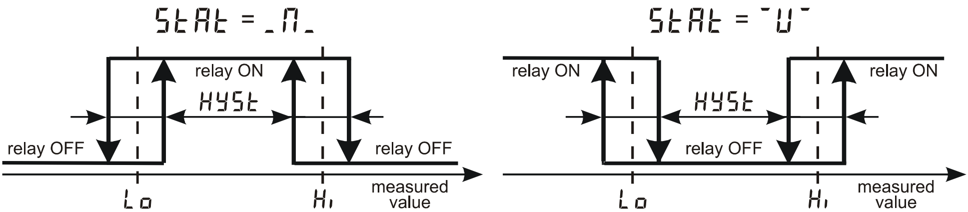


Fig. 11
2-limit relay activation function

- <u>Output hold</u>: SEt ⇒ out ⇒ out1 ⇒ hoLd - time interval between 0 and 9 seconds, allowing avoidance of undesirable frequent on-off switching of output relay as a result of unsteady measurement. With output hold, relay state is changed only if a limit is exceeded for a time longer than the time interval defined by the parameter. To choose relevant value, use and/or ; set with . If value '0' is assigned, relay state is updated immediately.

System timer

The system timer is an additional feature, which may be found useful though not necessary for standard applications. Actually, the system timer does not need programming. It can only be viewed and serves as additional operator information source.
The system timer counts the time from the last system RESET. Its full capacity is 48 days, after which, if no RESET condition has occurred, counting restarts from zero. An additional sign is available showing whether these are the first 48 days of operation without a RESET condition or the timer has started counting from zero after 48 days of uninterrupted operation. This, in fact, extends the period to 96 days. Timer parameters may only be read, not changed.

- <u>Days</u>: SEt ⇒ cLoc ⇒ dAYS;
- <u>Hours and minutes</u>: SEt ⇒ cLoc ⇒ hour - shows the hours and minutes, separated by a point;
- <u>Seconds</u>: SEt ⇒ cLoc ⇒ SEC - shows the seconds and tenths of a second.

If the rightmost-digit point is lit up while the value of any of the 3 parameters is displayed, the timer has started over from zero after 48 days of operation without RESET occurring. To cease displaying parameter value, press .

Setting parameter value

Parameter value adjustment procedure starts with the current parameter value shown on the display with its rightmost digit blinking. If all 4 digits are blinking, an unexpected situation has occurred, i.e. the value is out of range. To solve the problem, press ︽ to display the maximum admissible value or ︾ to display the minimum admissible one. In both cases, only the rightmost digit remains blinking. To select another digit, use «. To increase or decrease the blinking digit value, use respectively ︽ or ︾. The 3 rightmost digits may accept values from 0 to 9. The leftmost digit may also accept the values - and -1 if negative values are allowed for this parameter. After composing the desired value, set it by pressing ↻. If the new value is within the range limits for the parameter being adjusted, value adjustment completes. Otherwise, all 4 digits of the new, out-of-range value start blinking.

Example: How to enter a numerical parameter value of -5.47:

- Enter parameter value adjustment mode by pressing ↻ while the parameter is displayed.
- Using ︾ , change the flashing rightmost digit to 7.
- Press « to select the next digit.
- Adjust its value via ︽ and/or ︾.
- Select the third digit on the row via «.
- Change its value to 5 using ︽ and/or ︾.
- Select the leftmost digit and set its value to - .
- Press « to display the decimal point.
- Move the point to the desired position via ︾.

DEVICE FAILURE STATE

If the input signal increases or decreases too much so that it exceeds the stated input range limits, the device saturates it to the limits. TC600 reports about this emergency situation by activating the system relay output if such output is assigned.
At start-up and later, during operation, the device performs routine self-tests. If any sign of incorrect operation is detected, the device takes the following actions: activates the system outputs, darkens the bargraph, displays an error message, and, in a half a second, generates a RESET and initiates the series of actions that follows turning device power supply on.
If the emergency situation has been caused by a temporary event (e.g. power supply surge), the device continues normal operation. If the emergency state has been caused by permanent damage to device circuit, the problem will be discovered again and another RESET will be generated after a short time. In such case, please pay attention to the error message on the display. If it starts with Er or ic, i.e. Er88 or ic88, where 8 is any digit, the device should be repaired by authorized personnel. If the message is FAIL, then the problem can be relatively easily fixed by the user. This message appears when the testing routine discovers a parameter value that is outside allowed limits. This may happen, though rarely, after heavy power surges that may not be able to damage permanently the device, but may succeed in altering non-volatile memory, where parameter values are kept. To fix the problem, reenter the altered values. Start parameter adjustment by pressing and holding the ↻ key until SEt appears on the display. Check all parameters to ensure that their values are proper. If, after parameter readjustment, FAIL appears again, there is still a parameter with forbidden value. Enter parameter adjustment mode again and recheck the parameters.
If parameters are altered in this way more often than once a year, please refer to **'Avoiding electromagnetic interference'** for a permanent solution.

DEVICE APPLICATION

Depending on the type and action of outputs, as well as on the external connections, TC600 may be used for alarm level signaling, ON/OFF control, heating / cooling ON/OFF duplex control, motorized-valve open / close duplex control.

TC600 use for alarm signaling

The 2 alarm relay outputs of TC600 allow it to be used in applications for controlling the limits of measured variables (Fig. 12) as well as in various discrete automation schemes.

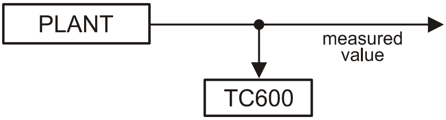


Fig. 12

TC600 use for ON/OFF control

A major application of TC600, along with indicating measured variable, is ON/OFF control. The unit has all the features of a standard ON/OFF controller. It may be used for controlling a single actuator, e.g.: heater, cooler, solenoid operated valve, etc. In such case, only 1 relay is needed, and respectively, the parameters to be programmed are: tYPE, StAt, ALL, and HYSt. The relay, and consequently the actuator, will have only 2 states - activated and inactivated. Depending on the tYPE value, the relay will be switched ON or OFF when the measured variable exceeds the limit ALL a little or falls down below it a little. This exceeding / falling bellow by a certain margin delays the switching action a bit, but avoids undesirable frequent relay switching when the measured variable slowly crosses the limit. The 2 switching points around the limit form the hysteresis zone HYSt (see Fig. 10). Please note that the measured (controlled) variable continually cycles around the limit. Therefore, ON/OFF control is not considered precise, but it is very simple to use and implement.

TC600 use for ON/OFF duplex control

When the actuator is a combination of a heater and a cooler or a motorized valve with separate open and close commands, both output relays have to be used. Then TC600 acts as an ON/OFF duplex controller (3-state controller).
TC600's application as an ON/OFF duplex controller for heater / cooler applications is a standard use of a 2-relay ON/OFF controller. One of the relays controls the heater, and the other one controls the cooler. When the temperature is too low, the heater is ON; when temperature is too high, the cooler is ON; when the temperature is close to the desired value, both heater and cooler are OFF.
In case TC600 is used to control a motorized valve, when one of the relays is activated, the motor opens the valve; when the other relay is activated, the motor closes the valve; and finally, when none of the relays is activated, the valve remains at its last position (Fig. 13).

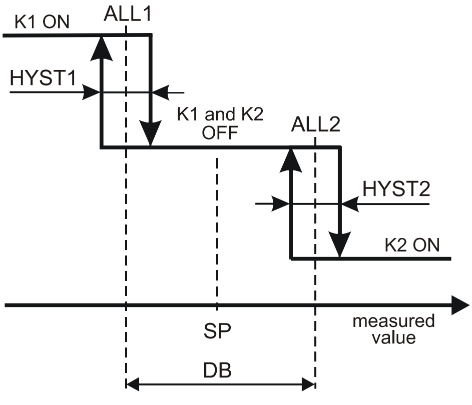


Fig. 13
Relay activation function of ON/OFF duplex control

The dead band (DB) is the zone around the desired value (SP), in which the motor is stopped. This allows at the cost of some inaccuracy for a valve continual open / close cycling to be put to an end. DB is actually not a parameter. It is the difference between the limits of the relays.
To use TC600 as a duplex controller, specify the parameters for both relays, keeping in mind that to achieve a certain DB, the activation limits for each relay must be derived from the formulas ALL1 = SP - DB/2 and ALL2 = SP+ DB/2.
Take care to adjust the StAt parameter for each relay accordingly. The StAt parameter values for the 2 relays should be opposite, i.e. when the measured value is within the limits, both relays should be de-energized.