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DOUBLE PROGRAMMABLE CONTROLLER

RT228U

OPERATION MANUAL



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



'RT28U' mark will be further used in this manual to describe specs and parameters identical for both channels!

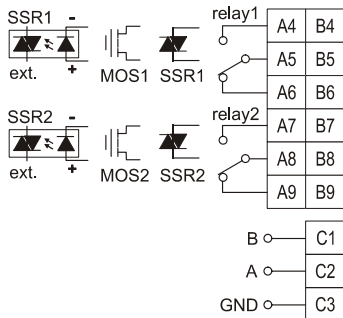
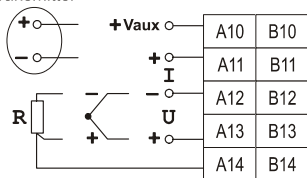
RT228U combines 2 programmable controllers RT28U in one case. Both universal inputs accept the most common RTDs, thermocouples, and linear signals. The device can be equipped with up to 2 relay outputs per channel, which can control various actuators using ON/OFF control algorithm, as well as with isolated serial interface RS485 for networking. RT228U allows adjusting of the built-in digital filters and the programmable output delay, resulting in increased operation reliability in case of industrial EMI.

Mounting

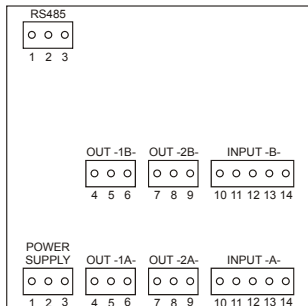
Place the device into a 90x90 mm panel cut-out, and tighten into place using the enclosed mounting brackets.

Electro-Magnetic Interference (EMI) Issues

- ◆ All signal wires must be shielded. They must not be packaged together with power cables!
- ◆ Never lay the signal wires close to inductive or capacitive sources, such as relays, motors, etc.!
- ◆ All shields have to be grounded **ONLY** at one end, as closer as possible to the controller terminals!
- ◆ Avoid sharing supply lines with powerful consumers, especially with inductive loads, switched on and off.
- ◆ To stop unwelcome interference signals entering through the power supply lines, use shielded 1:1 isolation transformer!
- ◆ Shunt all switched (not only those switched by the controller) inductive consumers with special suppression networks: RC group and varistor - for AC loads, or diode - for DC loads.
- ◆ If the controller operates in a very powerful EMI area, it has to be mounted inside a grounded metal shielding box!
- ◆ To protect the interface from EMI disturbances, follow the RS485 standard guidelines.

2-wire
transmitter

Note:
See device rear panel
for terminals location below:



Input signal wiring

- ◆ Connect the input of channel 'A' with regard to its type (see '**Specifications**') through the respective terminals from row 'A' on the device back.
- ◆ Connect the input of channel 'B' with regard to its type (see '**Specifications**') through the respective terminals from row 'B'



*To connect a 3-wire transmitter, use the auxiliary supply output **Vaux**.*

Output wiring

Connect the outputs with regard to their types (see '**Specifications**') via the respective terminals.

RS485 wiring

Connect the RS485 network line via the respective terminals.

Power supply wiring

Connect the right power supply voltage for your device (see '**Specifications**') via terminals A1 and A3.



- ◆ With DC power supply, the polarity does not matter.
- ◆ In case of 90...250 V power supply, grounding the device through terminal A2 is mandatory for covering safety standards.

Parameter	Symbol	Description
Configuration Parameters (These parameters are part of Configuration level)		
Input Type	inp	Type of signal that can be connected to the device input
Unit	$Unit$	Temperature measurement unit
Point	Pnt	Display decimal point position
Input Low	ILo	Display value at low limit of the linear input range
Input High	IHi	Display value at high limit of the linear input range
Input	ICr	Constant to be added to the measured input value
Address	Adr	Device address
Baud Rate	bRu	Serial interface rate
Gradient	Grd	Maximum input signal change during the sampling period (120 ms)
Filter Time	Ft	Relative time constant of the input filter
Filter Band	Fb	Zone around the measured value, within which the filter is active
SP limit Low	SPL	Set-point Low limit
SP limit High	SPH	Set-point High limit
Direction1	$dir.1$	Control action direction of output K1
Direction2	$dir.2$	Control action direction of output K2
Parameters of the control algorithm (These parameters are part of Parametric level)		
+Differential	$Pd.1$	Positive Differential of output K1
- Differential	$nd.1$	Negative Differential of output K1
Time On 1	$ton.1$	ON duration of output K1
Time Off 1	$tfo.1$	OFF duration of output K1
Hold1	$HL.1$	Holds the output reaction of output K1
The same 5 parameters, but with index 2 - for output K2		
Parameters of Basic (operating) level		
Set Point 1	$SP.1$	Set-point value of output K1
Set Point 2	$SP.2$	Set-point value of output K2

Table 1

Value	Unit	Notes
P_{t100} or P_{t1000}	-	Pt100: -100...850 °C or Pt1000: -100...600 °C
P_{c1} or P_{c2}	-	PTC 1k or 2k: -50...150 °C
$r_{0.1}$	-	resistive linear: 0...1 kΩ
t_{cB}	-	T/C "B": 200...1000 °C
t_{cJ}	-	T/C "J": -20...1000 °C
t_{cK}	-	T/C "K": -20...1000 °C
t_{cR}	-	T/C "R": 0...1000 °C
t_{cS}	-	T/C "S": 0...1000 °C
t_{cT}	-	T/C "T": -40...400 °C
u	-	voltage linear: 0...100 mV
$i_{.0}$ or $i_{.4}$	-	current linear: 0...20 mA or 4...20 mA
$u_{.10}$	-	not available
$^{\circ}C$ or $^{\circ}F$	-	°C or °F
x1, x0.1, x0.01	-	when indicating values with the input-signal measurement unit (ISU)
-199 ... 999	ISU	These parameters make sense ONLY in case of a linear input signal!
-199 ... 999	ISU	OFFSET
1...254	-	
12, 24, 48, 96	bps	1200, 2400, 4800 (factory-set), or 9600 bps
0 ... 999	ISU	used for input peak filtration; Value '0' cancels the filtration.
0 ... 999	-	This parameter and the following one define a low-pass input filter.
0 ... M	ISU	temperature: whole part of $M \leq 100$; linear: $M = 25\%$ of input range
within input range	ISU	These parameters keep the Set-point in safe limits, preserving it from random changes.
c_{oo}, h_{ER}	-	('cooling', 'heating')
These parameters are accessible in the presence of the corresponding relay.		
0 ... 999	ISU	lower than (High input range - Set Point 1)!
0 ... 999	ISU	lower than (Set Point 1 - Low input range)!
0 ... 999	sec.	Value '0' disables Pulse mode.
0 ... 999	sec.	
These parameters are accessible in the presence of the corresponding relay.		
within input range	ISU	



Some parameters are accessible only when the respective functionality is installed. (see 'Specifications').











●* - *Changing Point Position value reflects the real value of all parameters with ISU!*

E.g.: changing Point Position value from (x1) to (x0.1) would change a Set-point value of 100 to 10.0!!!







Controller parameters

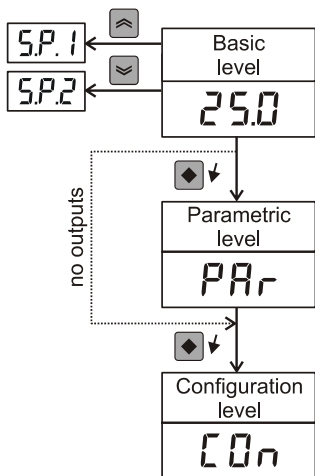
RT28U is a programmable device whose service behavior is determined by a set of parameters. All the parameters, along with their names, symbols, and value ranges, are given in Table 1.

Setting numerical parameter value

- ◆ Enter parameter value adjustment mode (see 'Program Levels').
- ◆ The whole part of the value together with the left zeroes appears on the display, and the rightmost digit blinks.
- ◆ To select another digit, press .
- ◆ The 2 rightmost digits can accept values from  to , and the leftmost digit can also accept the values - and .
- ◆ To increase or decrease the blinking digit value, use respectively  or .
- ◆ Confirm the adjusted value by pressing simultaneously  +  or  + .
- ◆ If the new value has not been confirmed and no key has been pressed for a certain period of time, value adjustment automatically ceases, and the parameter retains its initial value.

Setting symbolic parameter value

- ◆ Enter parameter value adjustment mode (see 'Program Levels').
- ◆ Read the blinking parameter value.
- ◆ To change the value, use  or , and to confirm, press  +  or  + .
- ◆ If the new value has not been confirmed and no key has been pressed for a certain period of time, value adjustment automatically ceases, and the parameter retains its initial value.



Basic level

At Basic level, RT28U indicates the measured input value (PV) with a resolution, according to the **Point Position** parameter.

- ◆ If the whole part of PV cannot be entirely displayed, the unit generates blinking 'overflow' messages (OL or -OL, depending on PV sign).
- ◆ If PV is out of its operating range (the input range according to Table 1, extended by 5% on both sides), the device displays blinking symbolic messages:







$$\begin{matrix} \text{L} = \text{L} & \text{(under-range)} \\ \text{H} = \text{H} & \text{(over-range)} \end{matrix}$$

When PV is out of physical range, the unit displays - - - .

- ◆ Upon entering Basic level, RT28U may display the , n , message, indicating that some time is necessary for filter initialization.
- ◆ The n o , message may appear as a result of the peak filter operation (see 'Input filtration').
- ◆ To enter parameter value adjustment mode for **Set Point 1**, press and hold until SP. 1 appears on the display. To view the Set-point value, release the key.
- ◆ To enter parameter value adjustment mode for **Set Point 2**, follow the same procedure, but start with the key.


Parametric level

This level contains the control algorithm parameters. If no relay output is installed, this level does not show up.

- ◆ Enter from Basic level by pressing and holding  until *PAR* appears on the display. Release the key. If the key is not released on time, RT28U enters Configuration level.
- ◆ Choose a parameter using  and .
- ◆ To enter parameter value adjustment mode, press .
- ◆ If no key has been pressed for a while, the device automatically returns to Basic level, storing all confirmed changes.
- ◆ For quick exiting and saving, use key combination  + .

Configuration level

This level contains the configuration parameters of the device.

- ◆ Enter from Basic level by pressing and holding  until *CONF* appears on the display.
- ◆ To access and adjust the configuration parameters, follow the algorithm described in 'Parametric level'.

Control output operation

- ◆ The control outputs operate according to the control algorithm parameters.
- ◆ The outputs deactivate with the value change of one of the following configuration parameters - **Point Position, Input Low, Input High, and Input Correction** - and remain inactive till Basic level is entered.
- ◆ The outputs deactivate also when an error has been detected (see 'Error messaging').

ON/OFF control algorithm

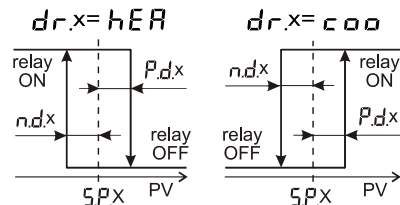
The static characteristic of a relay controlled by an ON/OFF algorithm is shown on the left drawing.

Output hold

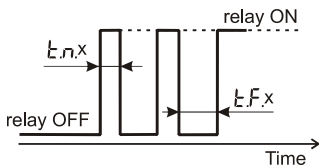
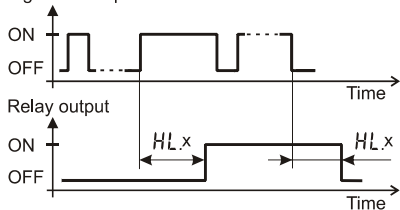
For eliminating undesirable switches of the relay output, additional parameter (**Hold**) is assigned to hold the output reaction for certain period of time.

Output pulse mode

When a relay is forced to ON by the control algorithm, it can either stay ON or pulse depending on **Time On** and **Time Off** parameter values. Setting any of these parameters to '0' disables the Pulse mode.



Algorithm output



Peak filter

This filter is intended for eliminating pulse spikes (peaks), which can appear in the input signal, in the following way:

- ◆ RT28U measures the input signal value every 120 ms (sample time).
- ◆ The measured values are compared subsequently. The filter checks the difference between the last two samples. If it does not exceed **Gradient** value, the device accepts the signal as *normal*.
- ◆ If the last measured value differs from the previous one by more than the **Gradient** value, the filter output is held until the device determines a presence of a *normal* signal. It is possible only if the input signal has not been changed with more than the **Gradient** value for four subsequent samples.
- ◆ If the device has not determined a *normal* signal for 20 subsequent samples, **no** appears on the display (see 'Basic level').

Low-pass filter

This first-order filter acts **ONLY** within a certain band around filter output value. This has been designed to cut periodic noises outside the communication signal spectrum.

- ◆ Filter operation is defined by two parameters:
Filter Time (defines filter time constant) and
Filter Band (defines filter active band around filter output value).
- ◆ If the newly measured value differs from the filter output by more than **Filter Band**, the filter resets with a new initial output value (newly measured value).

Message	Parameters	Error type
<i>FAL</i>	all	Incorrect memory
<i>brE</i>	-	Service required!
<i>EO1</i>	<i>Grd</i>	Out of range
<i>EO2</i>	<i>Ft</i>	Out of range
<i>EO3</i>	<i>Fb</i>	Out of range
<i>EO4</i>	<i>SPL</i>	Out of range
<i>EO5</i>	<i>SPH</i>	Out of range
<i>EO6</i>	<i>SPL, SPH</i>	$SPL > SPH$
<i>E.11, E.21</i>	<i>En.1, En.2</i>	Out of range
<i>E.12, E.22</i>	<i>EF.1, EF.2</i>	Out of range
<i>E.13, E.23</i>	<i>HL.1, HL.2</i>	Out of range
<i>E.14, E.24</i>	<i>Pd.1, Pd.2</i>	Out of range
<i>E.15, E.25</i>	<i>nd.1, nd.2</i>	Out of range
<i>E.16, E.26</i>	<i>SP.1, SP.2</i>	Out of range ($SPL \dots SPH$)
<i>E.17, E.27</i>	<i>SP.x - nd.x</i>	Lower than Input Low Range Limit
<i>E.18, E.28</i>	<i>SP.x + Pd.x</i>	Exceeds Input High Range Limit
<i>E.29</i>	<i>Adr</i>	Out of range


- ◆ In some cases, RT28U finds non-conformities in parameter values that must be corrected before operating at Basic level.
- ◆ The device indicates such kind of problems by displaying error messages as given on the left.
- ◆ If *FAL* appears on the display, try debugging by turning the power off/on.
- ◆ If the problem persists, press and hold  or send command `error 0` via the communication interface to restore the default (factory) settings.

Table 2

Parameter	Symbol	Value
Input Type	inp	pt100, pt1000, ptc1, ptc2, r.0.1k, t.c.b, t.c.j, t.c.k, t.c.r, t.c.s, t.c.t, u, u.0.10, i.0.20, i.4.20
Unit	unit	c, f
Point Position	pnt	0, 1, 2
Input Low	i.hi	-199...999
Input High	i.lo	-199...999
Input Correction	i.cor	-199...999
Address	addr	1...254
Baud Rate	baud	1200, 2400, 4800, 9600
Gradient	grad	0...999
Filter Time	f.t	0...999
Filter Band	f.b	0...M
Input Value	p.v	*
Error Info	error	**

*** Input Value** (read-only)

numerical value with ISU - measured input value

sat.lo - ADC under-range

sat.hi - ADC over-range

inp.br - sensor break

break - device failure

noise - noisy measurement

**** Error Info**

0 - initializes non-volatile memory

-1 - error **FRL** (read-only)1...29 - errors **E0 1... E29** (read-only)**Protocol architecture**

- ◆ The protocol is based on UART protocol with:
 - Baud Rate - as defined by parameter **Baud Rate**;
 - Data bits - 8;
 - Parity Control - Even;
 - Stop bit - 1.
- ◆ ASCII protocol is used for communicating, and the information is exchanged in frames.
- ◆ Each frame consists of 1, or 2 words separated by byte 32 (SPACE), and ends with bytes 13 (CR) and 10 (LF). The first word in the frame denotes a parameter 'Symbol' as taken from Table 2 and the second word (if needed) is the parameter 'Value', both spelled with only small Latin letters, digits, dots, and/or the '-' sign.

Device activating

- ◆ To respond to commands, the device should be active.
- ◆ For a device to be activated, it must receive a Ux command, where 'x' is the value of the parameter **Address** or the value '255' (if device address is unknown), and respond to it with ok..
- ◆ If a device does not respond even to U255, check the UART protocol settings, chiefly **Baud Rate** value.



RT228U contains 2 separate devices RT28U with different network addresses!

**Notes:**

- ◆ RT28U adds 3 spaces in the beginning of the response.
- ◆ RT28U returns decimal point even when the value is integer.
- ◆ #13 (CR) is byte 0x0D;
#10 (LF) is byte 0x0A.
- ◆ The U255 command should be used only in case just one slave is presented.

**Protocol examples:**

PC or other device: RT28U response:

activating device number 10

U10#13#10 ok.#13#10

reading filter time

f.t.#13#10 f.t. 0015.#13#10

writing filter time of 30

f.t. 30#13#10 f.t. 0030.#13#10

reading input value of 27.5

p.v.#13#10 p.v. 027.5#13#10

invalid command.	command not recognized
parity error.	parity error detected
not a number.	attempt to write symbols for numerical parameter
point error.	value resolution greater than parameter's one
out of range.	value out of range
unit is busy.	writing is allowed only to device at Basic level
read only.	parameter is read-only
can't save.	problem with writing in non-volatile memory

- ◆ The device remains active until it receives another Ux command, but with different device address, a FRL error, or with reset.
- ◆ Any Baud Rate value change through the communication interface also deactivates the device.

Reading from a device

- ◆ If the frame consists of only one word, it is recognized as a command for reading.
- ◆ The device responds to it by returning the same word and its value, according to Table 2.

Writing in a device

- ◆ If the frame consists of two words, it is recognized as a command for writing.
- ◆ With writing, transferred are the same two words that would have been received at the respective command for reading from the device.
- ◆ After successful writing, the device responds with the respective command for reading, except for the baud command.

Other device responses

- ◆ When Error Info value is -1, the device substitutes any command for error reading.
- ◆ RT28U responses in case of incorrect protocol use are given on the left.

Reset

To reset the device, send command **reset**.



The undersigned hereby declares,
on behalf of COMECO Inc.,
that this device has been manufactured
in compliance with standards
EN 61000 and EN 61010,
and meets the requirements
of Directives 73/23/EEC and 89/336/EEC.

A handwritten signature in black ink, appearing to read 'Viz'.

Vladimir Sakaliyski
CEO
COMECO Inc.

Waste Disposal

*Do not dispose of
electronic devices
together with
household waste
material!*

If disposed of within European Union,
this product should be treated
and recycled in accordance with the laws
of your jurisdiction implementing
the WEEE Directive 2002/96
on the Waste Electrical and Electronic
Equipment.

Input	programmable
Outputs:	up to 2 per channel
Electromechanical relay	5A/250VAC with NO/NC contact
SSR	1A/250VAC
MOS gate	0.1A/60V, optically isolated
Output for external SSR	5...24 VDC, 30 mA
- K1 (channel 'A')	<input type="checkbox"/> relay, <input type="checkbox"/> SSR, <input type="checkbox"/> MOS gate, <input type="checkbox"/> for ext. SSR
- K2 (channel 'A')	<input type="checkbox"/> relay, <input type="checkbox"/> SSR, <input type="checkbox"/> MOS gate, <input type="checkbox"/> for ext. SSR
- K1 (channel 'B')	<input type="checkbox"/> relay, <input type="checkbox"/> SSR, <input type="checkbox"/> MOS gate, <input type="checkbox"/> for ext. SSR
- K2 (channel 'B')	<input type="checkbox"/> relay, <input type="checkbox"/> SSR, <input type="checkbox"/> MOS gate, <input type="checkbox"/> for ext. SSR
Serial Interface (channel 'A')	<input type="checkbox"/> RS485, isolated,
	<input type="checkbox"/> RS485 for "PolyMonitor", isolated
Serial Interface (channel 'B')	<input type="checkbox"/> RS485, isolated,
	<input type="checkbox"/> RS485 for "PolyMonitor", isolated
Power Supply	<input type="checkbox"/> 230 VAC, <input type="checkbox"/> 90...250 VAC/DC,
	<input type="checkbox"/> 24 VDC, <input type="checkbox"/> 12...24 VAC/DC,
	<input type="checkbox"/>
Auxiliary Supply Output	<input type="checkbox"/> $\leq U_p$ (DC); $\leq 1.2 \cdot U_p$ (AC), <input type="checkbox"/> 24 VDC, 30 mA
Consumption	less than 3 VA per channel
Measurement Error	$\leq \pm 0.3\%$ from span
Temperature Drift	$\leq 0.02\%$ from span for 1 °C
RTD Line Error	$\leq \pm 0.001\%/\Omega$ at $R_{lin} \leq 50 \Omega$
Cold-junction Error	$\leq \pm 1^\circ\text{C}$ at air temperature -10...80 °C
Operating Temperature / Humidity	-10...65 °C / 0...85% RH
Protection Class: front / terminals	<input type="checkbox"/> IP65, <input type="checkbox"/> IP54 / IP20

.....
serial number

.....
manufacturing date

QC check mark(passed)
(stamp)

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Warranty

COMECO warrants this product to be free from defects in materials and workmanship for 2 years. If your unit is found to be defective within that time, we will promptly repair or replace it. This warranty does not cover accidental damage, wear or tear, or consequential or incidental loss. This warranty does not cover any defects caused by wrong transportation, storage, installation, or operating (see '**Specifications**').

Technical support

In the unlikely event that you encounter a problem with your COMECO device, please call your local dealer or contact directly our support team.