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COMECO
CONTROL & MEASUREMENT

UNIVERSAL PID CONTROLLER

RT1800

Operation Manual

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

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CONTENTS

1. APPLICATION

RT1800 is a compact, multifunctional all-purpose microprocessor controller. Its user-configurable analog input allows on-site adaptation to various thermocouple and RTD sensors as well as current and voltage output transducers for pressure, relative humidity, flow, etc. The RT1800 controller may be ordered with a second analog input for cascaded operation or remote set-point setting.

A set-point profile control is an additional option.

The device may be equipped with up to 4 relay and/or analog outputs that may serve as control outputs, limit comparators, alarm outputs, etc. The built-in timer may be programmed to fully control one of the output relays providing convenient delay at start-up.

The controller offers all standard PID features including bumpless auto/manual changeover. The two displays — one for the process variable and another for the set point — plus the control-action bar-graph allow all necessary information to be read at a glance.

The optional digital interface, either RS232 or RS485, provides connection to an operator station driven network as well as hierarchical control.

The switch-mode power supply provides for trouble-free operation under heavy mains voltage variations (from 85 to 265 VAC).

The unit is specially designed to sustain the heavy electromagnetic disturbances that often arouse in industrial environment by the means of optical decoupling of all inputs and outputs and special noise suppression circuits.

2. TECHNICAL SPECIFICATIONS

2.1. Indication: LED, IP56

<table>
<tr><th rowspan="2">Case</th><th colspan="4">Indication</th></tr>
<tr><th>PV Display</th><th>SV Display</th><th>Bar-graph</th><th>LEDs</th></tr>
<tr><td>'B'</td><td rowspan="2">4 red digits,
14 mm high
"MEASURED value"</td><td rowspan="2">4 green digits,
10 mm high
"SET POINT value"</td><td rowspan="3">10-point,
yellow,
0...100%
OUT1 control</td><td rowspan="3">8 LEDs for:
outputs OUT1 and OUT2 (green);
alarms AL1, AL2, AL3 (red);
auto-tuning AT (yellow);
manual control MAN (yellow);
profile control PRO (yellow)</td></tr>
<tr><td>'Q'</td></tr>
<tr><td>'H' / 'V'</td><td rowspan="2">4 red digits,
8 mm high
"MEASURED value"</td><td rowspan="2">4 green digits,
8 mm high
"SET POINT value"</td></tr>
<tr><td>'S'</td><td>none</td><td>6 LEDs (no LEDs for AL3 and MAN)</td></tr>
</table>

2.2. Keyboard: membrane, IP56

<table>
<tr><th rowspan="2">Case</th><th colspan="5">Keys and functions</th></tr>
<tr><th>SET</th><th>◄</th><th>▲</th><th>▼</th><th>A/M</th></tr>
<tr><td>'B'</td><td rowspan="4">setting
parameter value;
displaying
next parameter;
level switching</td><td rowspan="4">starting parameter value
adjustment;
selecting digit</td><td rowspan="4">increasing value</td><td rowspan="4">decreasing value</td><td rowspan="3">Manual/
Auto</td></tr>
<tr><td>'H' / 'V'</td></tr>
<tr><td>'Q'</td></tr>
<tr><td>'S'</td><td>no manual
control</td></tr>
</table>

2.3. **Power supply:** switch-mode

Supply voltage: 85...265 VAC
Consumption: less than 4 VA

2.4. **Inputs:**

2-wire - for voltage and current signals; 3-wire - for resistive signals.

2.4.1. **Main input:** universal, programmable

For available sensor types and input ranges — see Appendix 4.1.

2.4.2. **Auxiliary input (option):** linear current, 0(4)...20 mA

Serves for remote set point or for valve position control feedback. For cases 'B', 'H', and 'V' is feasible only with absence of interface. For case 'S' — feasible only with absence of retransmission analog output and interface. For case 'Q' — mounted instead of output AL2.

2.5. **Outputs:** max. 4 (3 for case 'Q')

2.5.1. **Relay outputs:** 2 control and 2 alarm or 1 control and 3 alarm (2 control and 1 alarm or 1 control and 2 alarm for case 'Q')

Description	Parameters	Location
electromechanical relay	max. 3 A / 250 VAC	OUT1, OUT2, AL1, AL2
solid state relay (SSR)	max. 1 A / 250 VAC	
MOS gate	max. 0.1 A / 60 V	
output for external SSR	24 V, 20 mA	

2.5.2. **Analog outputs:** max. 3 (2 control + 1 retransmission)

Description	Parameters	Location
control	(0)4…20 mA, 0...10 V	instead of OUT1 or OUT2
retransmission	(0)4…20 mA, 0...10 V	instead of AL2

For case 'S', the retransmission output is feasible only with absence of interface or instead of AL1.

2.5.3. **Serial interface (option):** RS232 or RS485

For cases 'B', 'H', and 'V' — feasible only with absence of auxiliary input.
For case 'S' — only with absence of retransmission analog output or instead of AL1.

2.6. **Operating conditions**

Operating temperature / humidity	0...50 °C / 20...85% RH
Protection, front / rear	IP56 / IP20
Maximum temperature drift	0.01% from span for 1 °C
Maximum warm-up time	15 min

2.7. **Storage conditions**

Temperature / humidity	-20...65 °C / 0...95% RH

3. OPERATION

3.1. General programming sequence

Controller parameters are grouped in 4 levels (parameter groups) according to their frequency of use. The following order of parameter programming is recommended:

1. Enter level 2 and set the parameter LCK = 1111 to get access to level 4.
2. Enter level 4 to configure basic controller settings (input and output number and use, which parameters of the other levels will be available for adjustment and which will be hidden ...).
3. Switch back to level 2 and set the parameter LCK = 0000 to get access to level 3.
4. Enter level 3 and set its parameters (input type, alarm type, output action direction ...).
5. Enter level 2 and set preliminary values for the PID (ON/OFF) parameters (proportional gain, hysteresis …).
6. Enter level 1 and adjust the set point, alarm limits, etc.
7. When the controller is already mounted in place and the system starts functioning, readjust PID (ON/OFF) control parameters to achieve satisfactory system performance.
8. Switch over to level 2 and set the parameter LCK = 0001 or 0101 to prevent unauthorized personnel from changing vital controller parameters (level access locking).

3.2. Switching among parameter levels

Normally, the controller operates at level 1 and shows the set-point value on its lower display and the measured value ─ on the upper display.

Switching over to level 1 may be done in either of the following ways:

- Automatically, when no key has been pressed for 1 minute, regardless of the level.
- By using the **A/M** key, regardless of the level.
- Automatically, after power-on. At start-up, the input type and range appear consecutively on the display, followed by the measured value and the set point from level 1.
- Automatically, after exiting level 2, 3, or 4.

Entering level 2:

- While the device operates at level 1, press and hold **SET** for 5 seconds.

Exiting level 2 may be done in either of the following ways:

- By holding **SET** depressed for 5 seconds.
- By pressing **A/M**. Mind that this also toggles between AUTO and MANUAL modes. Does not function while parameter value is being adjusted (finish parameter adjustment first by pressing **SET**).

To get access to level 3, set LCK = 0000 from level 2 beforehand.
To get access to level 4, set LCK = 1111 from level 2 beforehand.

Switching over to level 3 or 4:

- While the device operates at level 1 or 2, press and hold **SET** and ◀ for 5 seconds.

Exiting level 3 or 4 may be done in either of the following ways:

- By holding **SET** and ◀ depressed for 5 seconds.
- By pressing **A/M**. Mind that this also toggles between AUTO and MANUAL modes. Does not function while parameter value is being adjusted (finish parameter adjustment first by pressing **SET**).

If, after parameter adjustment at level 4, the device expects readjustment at levels 2 and 3, the value of the parameter LCK automatically changes to 0000.

3.3. Parameter adjustment

- Display the parameter symbol on the upper (red) display and the current value on the lower (green) display.
- Press ◀ to enter parameter value adjustment mode. The rightmost digit starts blinking. To select another digit, use ◀. To increase or decrease the blinking digit value, use respectively ▲ or ▼.

- Press **SET** to confirm the adjusted value and exit parameter value adjustment mode.
- To display the next parameter in the row, press **SET**.

3.4. Controller programming

Automatic PID control parameter tuning (Auto-tune)

Before starting the Auto-tune function, ensure the controller is properly installed, the system is functional, and the main parameters from levels 3 and 4 are already adjusted. The auto-tuning function automatically sets the values of the following parameters: P1, i1, db1, GAP1, P2, i2, d2. The operator must set manually the duration of the on/off output relay cycle CYt1, CYt2. For current output — set to 0, for relay output — try with 10.

a) Set the parameter At to YES.
b) Set a temporary automatic decrease of the set point during auto tuning via the AtVL parameter. With AtVL = 0, the tuning process will be performed around the set point. With AtVL = 5 °C and set point SV = 200 °C, the auto-tuning will be performed around 195 °C (this avoids overheating due to the process variable cycling during the auto-tuning process). If in doubt, set AtVL = 0.
c) Unsuccessful auto-tuning. Possible reasons are:
   - Too high AtVL value (if in doubt, set to 0).
   - Great system inertia. Set PID parameters manually.

3.4.1. Programming at LEVEL 1

Normally, the controller is at level 1 and displays the measured value. To view the next parameter from this level, press **SET**.

Display	Description
95	**PV** Measured value
100	**SV** Set point
↓ **SET**	
OUtL	In manual mode: output value in percents from 0 to 100%
100	In auto mode scales down control output; it is recommended to keep the value = 100%
↓ **SET**	
At	Enable/disable auto-tuning
YES / nO	See "Automatic PID control parameter tuning (Auto-tune)" above
↓ **SET**	
AL1	Alarm 1 limit
0	
↓ **SET**	
AL2	Alarm 2 limit
0	
↓ **SET**	
AL3	Alarm 3 limit (Ramp slope)
0	
↓ **SET** over again	

! With OUtL = 0 during PID control, the output is switched off.
To achieve proper output operation in AUTO mode, set OUtL = 100.

3.4.2. Programming at LEVEL 2

Normally, the controller is at level 1 and displays the measured value. To switch over to level 2, press and hold **SET** for 5 seconds. To switch back to level 1, depress **SET** again.

Display	Description
P1	Proportional band for main control output OUT1
3	Range: 0 to 200%.
↓ **SET**	Great values correspond to small proportional gain; value 0 sets ON/OFF control
i1	Integration time (reset time) for main control output
240	Range: 0 to 3600 s
↓ **SET**	value 0 turns integration off
d1	Derivative time for main control output
60	Range: 0 to 900 s
↓ **SET**	value 0 turns differentiation off
db1	Dead-band time for main output
0	Range: 0 to 1000 s
↓ **SET**	If in doubt, set to 0
AtVL	Set-point shift during auto-tuning
0	Range: 0 to USPL
↓ **SET**	If in doubt, set to 0
CYt1	output ON / OFF period duration for the main output OUT1 (total time of both ON and OFF periods during PID control)
10	Range: 0 to 150 s
↓ **SET**	In case of SSR — set to 0, with mechanical relay— try with 10
HYS1	Hysteresis for main output (visible only if P1 = 0, i.e. ON/OFF control)
1	Range: 0 to 1000
↓ **SET**	Small values result in lower cycling range, but much frequent output switching
P2	Proportional band for second control output OUT2
3	Range: 0 to 200%
↓ **SET**	As for P1
i2	Integration time (reset time) for second control output
240	Range: 0 to 3600 s
↓ **SET**	As for i1

Display	Description
d2	Derivative time for second control output
60	Range: 0 to 900 s
↓ **SET**	As for d1
CYt2	output ON / OFF period duration for the second output OUT2 (total time of both ON and OFF periods during PID control)
10	Range: 0 to 150 s
↓ **SET**	As for CYt1
HYS2	Hysteresis for second output
1	Range: 0 to 1000
↓ **SET**	As for HYS1
GAP1	Dead band for main output OUT1 (only for two-output controllers)
0	Sets a gap before the set point, in which the output is inactive
↓ **SET**	If in doubt, set to 0
GAP2	Dead band for second output OUT2 (only for two-output controllers)
0	As for GAP1
↓ **SET**	If in doubt, set to 0
LCK	Level access control (parameter locking)
0000	See explanation below
↓ **SET** over again	

Level access control (parameter LCK)

LCK = 0100 - levels 1 and 2 are accessible, and their parameters may be adjusted;
LCK = 0110 - levels 1 and 2 are accessible, but only the parameters from level 1 may be adjusted;
LCK = 0001 - levels 1 and 2 are accessible, but their parameters (except for set point) may not be
adjusted;
LCK = 0101 - only level access control parameter may be adjusted.

The level access control parameter may always be adjusted.

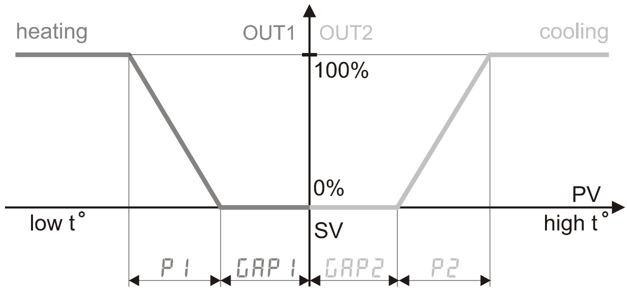
LCK = 0000 allows access to level 3 (from level 2, press and hold **SET и ◀** for 5 s)
LCK = 1111 allows access to level 4 (from level 2, press and hold **SET и ◀** for 5 s)

Proportional band (parameters P1 and P2)

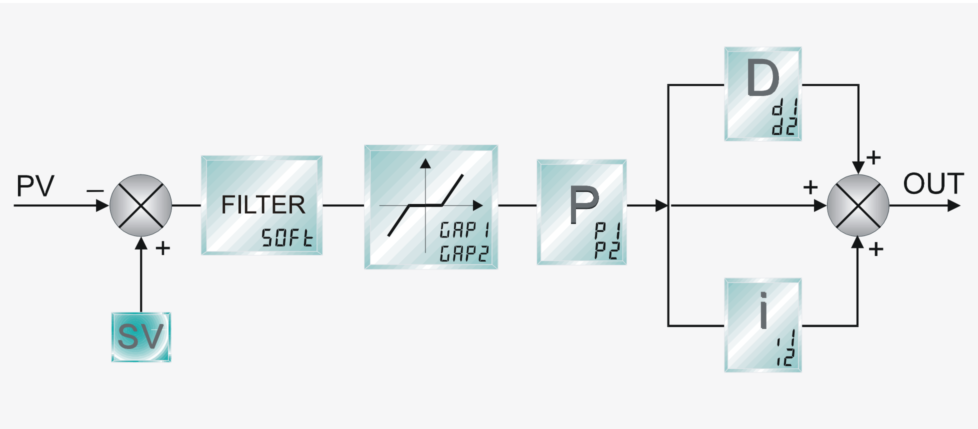
The relation between the proportional band P and the proportional gain K_P is as follows:

K_P = 10 000 / (P * INPUT_RANGE),

K_P [%/°C] is the proportional gain, P[%] is the proportional band,
INPUT_RANGE [°C] is the input range high limit (e.g. with input range -200...400 °C,
INPUT_RANGE = 400)



Relationship between PID input and output
when both integration and differentiation are switched off



PID control internal structure

3.4.3. Programming at LEVEL 3

To access level 3, first set LCK = 0000 from level 2. To enter level 3, press and hold **SET** and ◀ for 5 seconds. To switch back to level 1, depress **SET** and ◀ again.

inP1	Input type selection – sensor type and range
K2	select input range and type
↓ **SET**	*See Appendix 4.1. Input type and range codes. Switching from T/C (voltage) to RTD input type or vice-versa requires hardware adjustment (see 5.3).*
AnL1	Zero adjustment of the analog input for the main output
0	Range: LSPL to USPL
↓ **SET**	*Makes sense only when the selected input type code is among An1 ... An5* *See Appendix 4.4. Linear input adjustment*
AnH1	Span adjustment of the analog input for the main output
5000	As for AnL1
↓ **SET**	*See Appendix 4.4. Linear input adjustment*
dP	Measured value decimal point position (display accuracy)
0000	Sets decimal point position
↓ **SET**	
LSPL	Low limit for measured value and set point
0.0	Sets low limit for measured value and set point (narrows input range)
↓ **SET**	*With linear input, sets display value at low limit of the input range (e.g. 2 Bar for 4 mA)*
USPL	Higher limit for measured value and set point
400.0	Sets higher limit for measured value and set point (narrows input range)
↓ **SET**	*With linear input, sets display value at high limit of the input range (e.g. 16 Bar for 20 mA)*
AnL2	Zero adjustment of the analog input for the second output
0	Range: LSPL to USPL
↓ **SET**	*Makes sense only when the selected input type code is among An1 ... An5*
AnH2	Span adjustment of the analog input for the second output
5000	As for AnL2
↓ **SET**	

Display	Value	Description
	01	Alarm AL 1 type Range: 00 to 19 *(See Appendix 4.2. Alarm type and function)*
↓ **SET**		
ALt1	0	Delay of alarm AL 1 activation in profile control mode Range: 0 to 99.59 min *0 = flicker alarm, 99.59 = continued, other values = on-delay time*
↓ **SET**		
ALd2	01	Alarm AL 2 type Range: 00 to 19
↓ **SET**		
ALt2	0	Delay of alarm AL 2 activation in profile control mode Range: 0 to 99.59 min *0 = flicker alarm, 99.59 = continued, other values = on-delay time*
↓ **SET**		
ALd3	01	Alarm AL 3 type Range: 00 to 19
↓ **SET**		
ALt3	0	Delay of alarm AL 3 activation in profile control mode Range: 0 to 99.59 min *0 = flicker alarm, 99.59 = continued, other values = on-delay time*
↓ **SET**		
HYSA	0	Alarm hysteresis Range: 0 to 1000
↓ **SET**		
CLO1	150	Calibration of the low limit of the main control output (in case of analog output) Range: LSPL to USPL *See Appendix 4.5. Analog output adjustment*
↓ **SET**		
CHO1	3500	Calibration of the high limit of the main control output (in case of analog output) Range: 0 to 9999 *See Appendix 4.5. Analog output adjustment*
↓ **SET**		

CLO2	Calibration of the low limit of the second control output (in case of analog output)
150	Range: LSPL to USPL

↓ **SET**

CHO2	Calibration of the high limit of the second control output (in case of analog output)
3500	Range: 0 to 9999

↓ **SET**

CLO3	Calibration of the low limit of the retransmission output (in case of analog output)
	As for CLO1

↓ **SET**

CHO3	Calibration of the high limit of the retransmission output (in case of analog output)
	As for CHO1

↓ **SET**

rUCY	Full travel time of motor valve (w/o slide-wire position feedback)
00	Range: 0 to 150 s

↓ **SET**

WAit	WAIT - Waiting for the current segment to end after the time is up in profile control mode
0	*0 = no waiting; other values = max. admissible diversion of PV from the set point, at reaching which the segment may end*

↓ **SET**

SEtA	Additional settings
0000	SETA.1/2/3=1 changes the relays AL1/2/3 action to reverse (NC) SETA4.4=0 or 1 sets profile program RUN ALARM or END ALARM

↓ **SET**

idnO	ID number for serial communication

↓ **SET**

bAUd	Serial communication baud rate
2400	Range: 110 to 9600 bps

↓ **SET**

SVOS	Set-point shift
0	Range: -1000 to 1000
↓ **SET**	*Unless there is a particular reason, it is recommended to set SVOS = 0*
PVOS	Measured-value shift
0	Range: LSPL to USPL
↓ **SET**	*Convenient for calibration*
Unit	Measurement unit for measured value and set point
C	Range: C = °C, F = °F, A = analog input
↓ **SET**	
PVFt	PV filter
1000	Smaller values result in faster reaction, greater values – in better filtering
↓ **SET**	*Adjust the filtering to avoid flickering of input measurement*
CASC	*(reserved)*
↓ **SET**	
OUd	Output action direction
HEAt	HEAt = heating action of output OUT1 , cool = cooling action of output OUT1
↓ **SET**	*Correspond respectively to direct and reverse action.* *The action of OUT2 is always the opposite of that of OUT1*
OPAd	Control algorithm
Pid	Range: PID, Fuzzy
↓ **SET**	*PID control incorporates PID Auto-tune and ON/OFF*
Hz	Power supply frequency
50	Range: 50 Hz or 60 Hz
↓ **SET** over again	*Match local mains frequency!*

3.4.4. Programming at LEVEL 4

To access level 4, first set LCK = 1111 from level 2. To enter level 4, press and hold **SET** and ◀ for 5 seconds. To switch back to level 1, depress **SET** and ◀ again.

The parameters from level 4 grant (1) and deny (0) access to parameters from levels 1, 2, and 3.

Other parameters from level 4 enable (1) and disable (0) certain controller functions.

Parameter symbols — SEt0 ... SEt9 — appear on the upper (red) display. To browse among the parameters, use **SET**.

Each of the four digits of the lower (green) display grants/denies parameter access or enables/disables function. Thereby, a single parameter (e.g. SEt1) with its four digits controls four parameters or functions.

0 = denies access to parameter / disables function, 1 = grants access to parameter / enables function

SEt1			
0/1 for AL2	0/1 for AL1	0/1 for At	0/1 for OUtL

denies/grants access to parameters: OUtL, At, AL1, AL2

↓ **SET**

SEt2			
0/1 for AnL2, AnH2	0/1 for LSPL, USPL	0/1 for AnL1, AnH1, dP	0/1 for AL3

denies/grants access to parameters: AL3, AnL1, AnH1, AnH1, dP, LSPL, USPL, AnL2, AnH2

↓ **SET**

SEt3			
0/1 for ALt2	0/1 for ALd2	0/1 for ALt1	0/1 for ALd1

denies/grants access to parameters: ALd1, ALt1, ALd2, ALt2

↓ **SET**

SEt4			
0/1 for CLO1, CHO1	0/1 for HYSA	0/1 for ALt3	0/1 for ALd3

denies/grants access to parameters: ALd3, ALt3, HYSA, CLO1, CHO1

↓ **SET**

SEt5			
0/1 for idnO, bAUd	0/1 for rUCY, wAit, HYSM	0/1 for CLO3, CHO3	0/1 for CLO2, CHO2

denies/grants access to parameters: CLO2, CHO2, CLO3, CHO3, rUCY, wAit, HYSM, idnO, bAUd

↓ **SET**

SEt6			
0/1 for SOFt	0/1 for Unit	0/1 for P''_OS	0/1 for S''_OS

denies/grants access to parameters:
S''_OS, P''_OS, Unit, SOFt

↓ **SET**

SEt7			
0/1 for H=	0/1 for OPAd	0/1 for OUd	0/1 for CASC

denies/grants access to parameters:
CASC, OUd, OPAd, H=

↓ **SET**

SEt8			
0 do not change	0 do not change	0 do not change	0/1 for INVERT
0 do not change	0/1 for START	0/1 for RESUME	0/1 for REPEAT

sets transmit function in case of linear input
INVERT: 0 = direct (e.g. 4...20 mA → 0...100 °C);
1 = reverse (e.g. 4...20 mA → 100...0 °C)

defines controller operation in profile mode (if available)
REPAEAT: 0 = single execution of profile control program;
1 = set point profile program repeats cyclically
RESUME: 0 = program execution ceases at power dropout;
1 = program execution resumes at power restore
START: 0 = program starts from zero;
1 = program starts from currently measured value

↓ **SET**

SEt9			
0/1 for RETRANSMIT PV	0/1 for RETRANSMIT SV	0/1 for TIME UNITS	X do not change

retransmission output function
TIME UNITS: hh:mm(0) or mm:ss (1) - with pattern set point ONLY
RETRANSMIT SV: retransmits set point
RETRANSMIT PV: retransmits measured value

↓ **SET**

SEt0			
	0/1 for REMOTE SV	X do not change	

REMOTE SV = 1 : set point is received from the second input and is no longer set through keyboard
X: for RT1800-S, X = 0; for the rest of the cases, X = 1
these values determine standard PID control

↓ **SET**

inP2
0 = none

second input

↓ **SET**

OUtY
0 = one, 1 = two

number of control outputs

fewer than the physically mounted control outputs may be set

↓ **SET**
over again

4. APPENDICES

4.1. Input type and range codes (inP1)

TYPE	CODE	RANGE
K	k1	0.0 ÷ 200.0 °C
	k2	0.0 ÷ 400.0 °C
	k3	0 ÷ 600 °C
	k4	0 ÷ 800 °C
	k5	0 ÷ 1000 °C
	k6	0 ÷ 1200 °C
J	J1	0.0 ÷ 200.0 °C
	J2	0.0 ÷ 400.0 °C
	J3	0 ÷ 600 °C
	J4	0 ÷ 800 °C
	J5	0 ÷ 1000 °C
	J6	0 ÷ 1200 °C
R	r1	0 ÷ 1600 °C
	r2	0 ÷ 1769 °C
S	S1	0 ÷ 1600 °C
	S2	0 ÷ 1769 °C
B	b1	0 ÷ 1820 °C
E	E1	0 ÷ 800 °C
	E2	0 ÷ 1000 °C
N	n1	0 ÷ 1200 °C
	n2	0 ÷ 1300 °C
T	t1	-199.9 ÷ 400 °C
	t2	-199.9 ÷ 200 °C
	t3	0.0 ÷ 350.0 °C
W	ū1	0 ÷ 2000 °C
	ū2	0 ÷ 2320 °C
PLII	PL1	0 ÷ 1300 °C
	PL2	0 ÷ 1390 °C
U	U1	-199.9 ÷ 600.0 °C
	U2	-199.9 ÷ 200.0 °C
	U3	0.0 ÷ 400.0 °C

TYPE	CODE	RANGE
L	L1	0 ÷ 400 °C
	L2	0 ÷ 800 °C
JIS Pt100	JP1	-199.9 ÷ 600.0 °C
	JP2	-199.9 ÷ 400.0 °C
	JP3	-199.9 ÷ 200.0 °C
	JP4	0 ÷ 200 °C
	JP5	0 ÷ 400 °C
	JP6	0 ÷ 600 °C
DIN Pt100	dP1	-199.9 ÷ 600.0 °C
	dP2	-199.9 ÷ 400.0 °C
	dP3	-199.9 ÷ 200.0 °C
	dP4	0 ÷ 200 °C
	dP5	0 ÷ 400 °C
	dP6	0 ÷ 600 °C
JIS Pt50	JP.1	-199.9 ÷ 600.0 °C
	JP.2	-199.9 ÷ 400.0 °C
	JP.3	-199.9 ÷ 200.0 °C
	JP.4	0 ÷ 200 °C
	JP.5	0 ÷ 400 °C
	JP.6	0 ÷ 600 °C
AN1	An1	-10 ÷ 10 mV 1999 ÷ 9999
AN2	An2	0 ÷ 10 mV 0 ÷ 20 mA w/ 0.5 Ω* 1999 ÷ 9999
AN3	An3	0 ÷ 20 mV 0 ÷ 20 mA w/ 1 Ω* 1999 ÷ 9999
AN4	An4	0 ÷ 50 mV 0 ÷ 20 mA w/ 2.5 Ω* 1999 ÷ 9999
AN5	An5	10 ÷ 50 mV 4 ÷ 20 mA w/ 2.5 Ω* 1999 ÷ 9999

* A 0.5% tolerance resistor should be connected in parallel with the input.

! If not specially requested, the input is factory configured to type K (k2).

! To change the input type from thermocouple to RTD or vice-versa, open / close respective jumper pads on the PCB (see detailed explanation bellow).

4.2. Alarm type and function

CODE	ALARM TYPE	SUPPRESSION
00/10	No alarm	
01	Deviation from set point - high limit	YES
11	Deviation from set point - high limit	NO
02	Deviation from set point - low limit	YES
12	Deviation from set point - low limit	NO
03	Deviation from set point – low and high limits	YES
13	Deviation from set point – low and high limits	NO
04/14	Deviation from set point INVERTED – low and high limits	NO
05	Exceeding absolute value	YES
15	Exceeding absolute value	NO
06	Falling below absolute value	YES
16	Falling below absolute value	NO
07	End of period (only for profile control)	-
17	End of program (only for profile control)	-
08	System error – alarm goes ON	-
18	System error – alarm goes OFF	-
09	Enables RAMP-SOAK function	-
19	Timer alarm activated after predefined time	-

* "suppression" means that after power-on, alarm action is suppressed until the alarm situation normalizes at least for a moment. In this way, alarm activation is avoided while the system is reaching steady state.

Detailed alarm function diagrams are given on the next page.

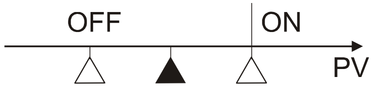
4.3. Error Messages

in1E	sensor open
AdCF	* DAC failure
CJCE	* input measurement circuit failure or loose / missing cold junction temperature compensation sensor on controller back
in2E	additional input open
UUU1	measured value above high set-point limit (parameter USPL)
nnn1	measured value below low set-point limit (parameter LSPL)
UUU2	additional input signal above high range limit
nnn2	additional input signal below low range limit
rAMF	* RAM failure
intF	interface problem
AUtF	unsuccessful auto-tuning

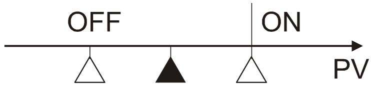
! When a message marked with " * " appears and stays, send the controller for repair.

00 / 10 no alarm

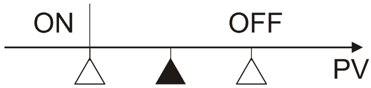
01 deviation from set-point high limit w/ suppression



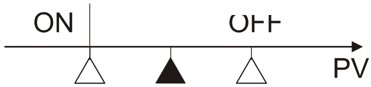
11 deviation from set-point high limit w/o suppression



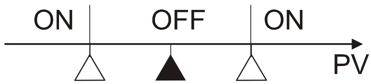
02 deviation from set-point low limit w/ suppression



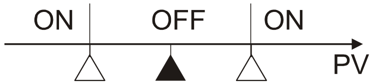
12 deviation from set-point low limit w/o suppression



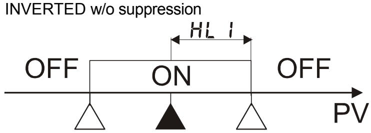
03 deviation from set-point high and low limit w/ suppression



13 deviation from set-point high and low limit w/o suppression



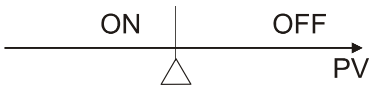
04 / 14 deviation from set-point high and low limit INVERTED w/o suppression



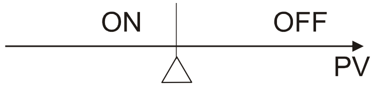
05 exceeding absolute value w/ suppression

15 exceeding absolute value w/o suppression

06 falling below absolute value w/ suppression

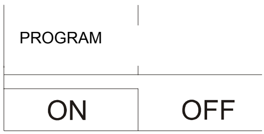


16 falling below absolute value w/o suppression

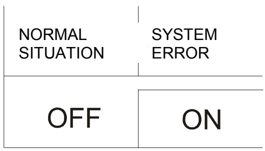


07 end of period (only for profile control)
a) set AL.d1, AL.d2, or AL.d3 = 07
b) set AL.1, AL.2, or AL.3 = period number
c) set AL.t1, AL.t2, or AL.t3 =
0 - momentary action alarm
99:59 - constantly activated alarm (retentive)
other value = time of activation

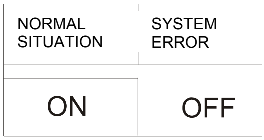
17 started program (only for profile control)



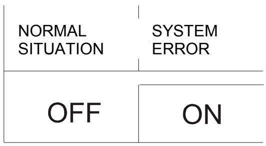
08 alarm activated at system error



18 alarm deactivated at system error



09 heater break alarm (only one line is monitored)



19 When PV=SV(soak), the timer begins to count. When time is up, the relay of alarm module will activate.
Range from 00:00 to 99:59 (hours:minutes)

▲ SV (set point)

△ Alarm limit

4.4. Linear input adjustment

When the device input is programmed as analog linear input, the correspondence between input voltage (current) and displayed value may be specified. For instance, the correspondence may be from 10 mV input → 0 °C to 50 mV input → 1000 °C. For this purpose, the following parameters are used: AnL1, AnH1, and dP. The displayed range defined by AnL1, AnH1 should be within the allowed input range defined by parameters LSPL and USPL. Sometimes the allowed input range needs to be extended first.

- Connect a calibrator to the controller analog input.
- From level 4, grant access to parameters AnL1, AnH1, and dP by setting SEt2 = XX1X.
- Enter level 3 and select the desired range of the analog input by setting inP1 = AnX (see Appendix 4.1).
- Set the calibrator to generate a signal (voltage or current) corresponding to the lower end of the input range.
- From level 3, enter parameter value adjustment mode for AnL1 for the displayed value at the lower end of the input range. Values appear on both displays. The value on the upper display is the measured value that the device would display with the current input value. To make the adjustment, increase or decrease the value on the lower display until the upper display shows the desired measured value to be displayed in normal operation at lower input range.
- Set the calibrator to generate a signal (voltage or current) corresponding to the higher end of the input range.
- From level 3, enter parameter value adjustment mode for AnH1 for the displayed value at the higher end of the input range. Values appear on both displays. Increase or decrease the value on the lower display until the upper display shows the desired measured value to be displayed in normal operation at higher input range.
- Repeat the last four steps until satisfactory correspondence is achieved at both input range ends.
- If necessary, from level 3, adjust the position of the display decimal point via dP.

4.5. Analog output adjustment

When the device has a linear output, it is factory tuned by default. If readjustment is necessary, follow this procedure:

- For easier adjustment, switch to manual mode by pressing the **A/M** key (The **MAN** LED should light up).
- Connect a mA-meter to the controller analog output.
- From level 4, grant access to parameters CLO1 and CHO1 by setting SEt4 = 1XXX.
- From level 2, set to the parameter P1 a value other than zero. Set also CYt1 = 0.
- From level 1, set OUtL = 0 (minimum output value). At this moment, if factory setting is correct, the output current should be 4 mA.
- If adjustment of the output setting is needed, from level 3, change the value of parameter CLO1 for low control range limit. Increased / decreased the value, until the miliammeter reads 4 mA.
  Try with CLO1 = 0192.
  ATTENTION: At an attempt to achieve currents lower than 2-3 mA, considerable nonlinearity appears, since the device is designed for output 4...20 mA, and not for 0...20 mA.
- Set OUtL = 100. At this moment, if factory setting is correct, the output current should be 20 mA.
- If adjustment is needed, from level 3, change the value of parameter CHO1 for high control range limit. Increased / decreased the value, until the miliammeter reads 20 mA.
  Try with CHO1 = 3096.
- Repeat the last four steps until satisfactory correspondence is achieved at both range ends.

Note: In the case of such configuration — first control output - analog, second control output - relay type — for better operation of the analog output, is advisable to disable the relay control output by setting, from level 4, OUtY = 0.

4.6. RAMP-SOAK adjustment

The Ramp-Soak function is available ONLY for models with standard PID-Fuzzy algorithm (not with pattern set point)! To program the RAMP function, follow the procedure below:

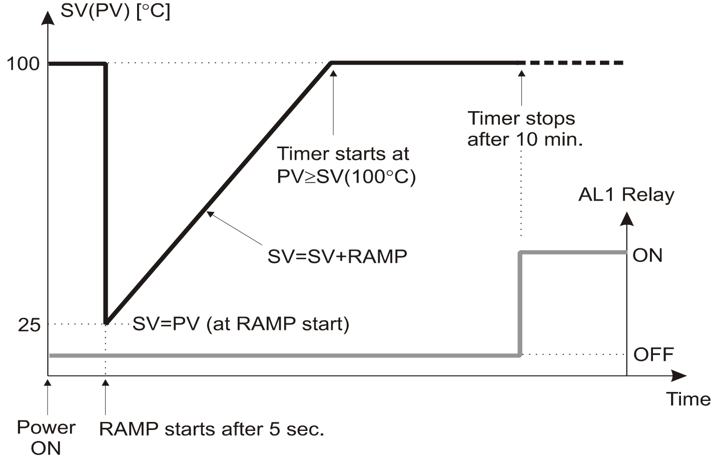
- From level 4, set SEt2 = XXX 1 to enable AL3 access
- From level 4, set SEt4 = XXX 1 to access ALd3
- From level 3, set ALd3 = 9 to enable RAMP function - it will replace AL3 by rAMP
- From level 1, adjust the rAMP slope from 00.00 to 99.99 [°C/min]

To program the SOAK function, follow the procedure below:

- From level 3, set ALd1 (ALd2) = 19 to use SOAK timer function
- From level 1, adjust the AL1 (AL2) Soak time from 00.00 to 99.59 [h.min]

The following example illustrates RAMP-SOAK function:

- Let SV = 100 °C, rAMP = 10.00 °C/min, AL1 = 00.10 min, PV = 25 °C



4.7. Profile (pattern) control programming

The profile control with is available ONLY for models with PID-Fuzzy algorithm with pattern set point!
To program the profile control, follow the procedure below:

- From level 4, set SEt8 to adjust profile program *repeat, start and power failure* options
- From level 4, set SEt9 to adjust *time units*
- From level 3, set SEtA to adjust profile program *run or end alarm*
- From level 3, set wAit to adjust WAIT option
- Set the alarm type "07" and alarm functions as described in 4.2
- From level 1 follow the steps below to create a pattern, consisting of RAMP and SOAK segments (up to 2 patterns with 8 segments or 1 pattern with 16 segments can be created)

Note: If you want the program to stop before the 8th or 16th segment just set the last segment OUt to '0'.

4.7.1. Keyboard operating commands

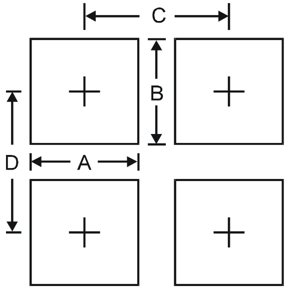
- Program starts by pressing ▲. PRO front panel LED starts to blink
- Program holds by pressing ▼ (pause). PRO stops blinking but lights
- To jump to previous segment press ▲+**SET**
- To continue a stopped program at segment end (wAit message) press ▲+**SET**
- Program stops (RESET) by pressing ▼+**SET**. PRO front panel LED will be off.

LEVEL 1	
↓ **SET**	
PtN	Set-point patterns (profile programs)
1	Range: 1 - for 1 pattern with 8 segments, 2 - for 2 patterns with 8 segments each, 0 - links 2 patterns together (16 segments)
↓ **SET**	
SEG	Displays the current pattern segment
1_1	Range: 1_1 (1st pattern_1st segment) to 2_8, 1_0 means program stopped
↓ **SET**	
tiMr	Program countdown timer - displays the rest segment time
00.00	Range: 0 to 99:59 (hours or minutes, depending on SET9.2)
↓ **SET**	
SV_1	Set-point value at the end of segment 1
	Range: LSPL to USPL
↓ **SET**	
tM_1	Time duration of segment 1
00.00	Range: 0 to 99:59 (hours or minutes, depending on SET9.2)
↓ **SET**	
OUt1	Output limit of segment 1
100.0	Range: 0 to 100% (100 - no limit, 0 - cancels the segment and ends the program)
…	
SV_8	Set-point value at the end of segment 8
	Range: LSPL to USPL
↓ **SET**	
tM_8	Time duration of segment 8
00.00	Range: 0 to 99:59 (hours or minutes, depending on SET9.2)
↓ **SET**	
Out8	Output limit of segment 8
100.0	Range: 0 to 100% (100 - no limit, 0 - cancels the segment and ends the program)
↓ **SET**	Returns to LEVEL 1

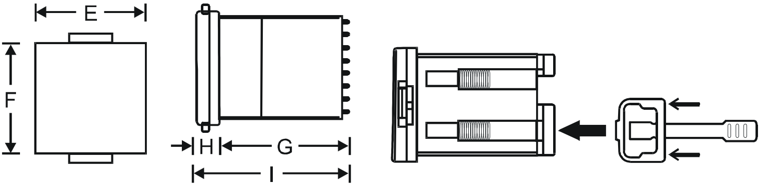
5. MOUNTING AND WIRING

5.1. Mounting

The controller overall dimensions, recommended panel cut-outs and controller-to-controller minimum clearance for the different case types are given in the table below.

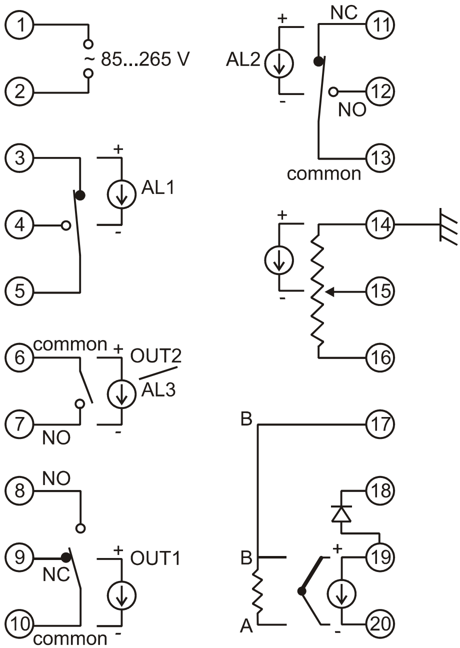


Case	A	B	C	D	E	F	G	H	I
'S'	$44.5^{+0.5}$	$44.5^{+0.5}$	65	70	50	50	81	14	95
'V'	$44.5^{+0.5}$	$90.5^{+0.5}$	65	116	50	96	81	14	95
'H'	$90.5^{+0.5}$	$44.5^{+0.5}$	111	70	96	50	81	14	95
'B'	$90.5^{+0.5}$	$90.5^{+0.5}$	111	116	96	96	81	14	95
'Q'	$68.5^{+0.5}$	$68.5^{+0.5}$	89	94	74	74	81	14	95

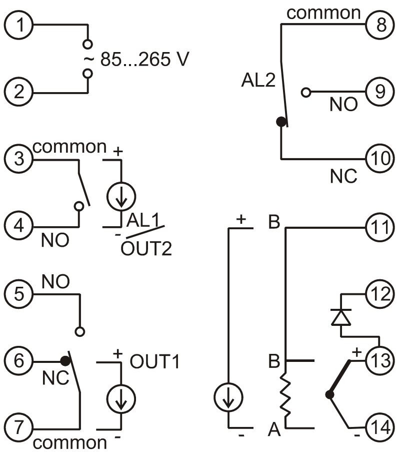


5.2. Wiring

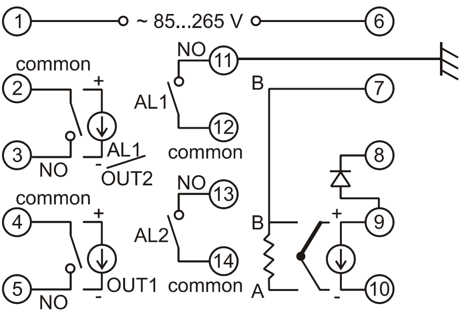
The wiring diagrams showing input, output, and power supply connections for the different case types are given below. The cold junction temperature compensation sensor is represented by diode symbol.



RT1800-H/V/B



RT1800-Q



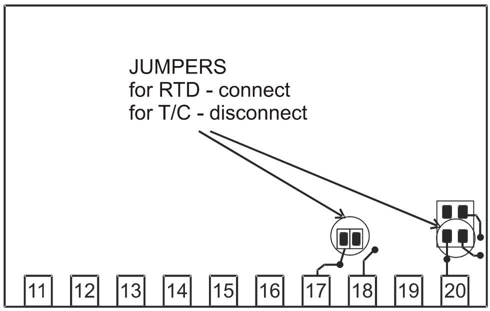
RT1800-S

⚠ **Important note:**
If serial interface is installed, see the device label for wiring changes!

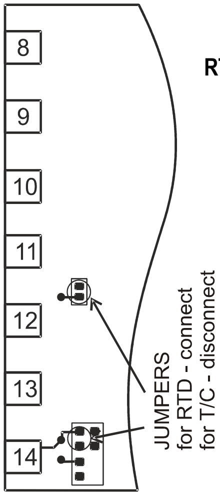
5.3. Input type selection

If the input type has to be changed from thermocouple (voltage) to RTD (resistance) or vice-versa, two couples of pads on controller circuit board have to be connected or disconnected respectively.

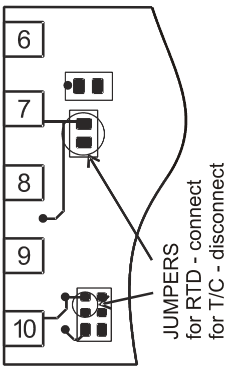
RT1800-H/V/B



RT1800-Q



RT1800-S



5.4. Electro-magnetic interference (EMI) issues

If high-energy electric spikes are allowed to get into device circuitry, the microprocessor may be misled and unpredictable erroneous functioning may result.

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-filled lamps (tubes), 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.

There are two general approaches to avoiding electromagnetic interference:

- 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 EMI.

5.4.1. 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.
- 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.

5.4.2. 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.

5.4.3. 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 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. An RC network in parallel with the varistor is highly recommended. It should constitute of a wire-wound or carbon resistor in series with a X/Y-type AC high-voltage capacitor. Select resistor power in relation to the inductance voltage. Keep RC network leads as short as possible.

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, connect an RC network in parallel with the contact. 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. A varistor may be added, but the RC network should already be present.

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.

6. SERIAL INTERFACE

If serial interface is installed, follow the additional requirements given in the supplemental COMMUNICATION MANUAL (CD or printed version) or download it from http://www.comeco.org/downloads.