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USER MANUAL

AR604

AR614

TEMPERATURE CONTROLLER

Version 2.0.0
13.08. 2018

Thank you for choosing our product.
This manual will help you use your controller correctly, safely and to its full potential.
Read this manual carefully before installing and putting your controller to use.
In case of additional questions, please contact the technical advisor.

CONTENTS

⚠ Please pay particular attention to fragments marked with this sign.

The manufacturer reserves its rights to modify the design and software of the device without deteriorating its technical parameters.
(some functions may not be available in older versions).

1. SAFETY RULES

- before you start to use the device, become familiar with the present instructions;
- in order to avoid electrocution or damage to the device, its mechanical and electrical installation must be performed by qualified workers;
- before switching on the power supply, make sure that all cables and wires are properly connected;
- before making any modifications to the wire and cable connections, switch off the voltage supplied to the device;
- ensure proper operating conditions compliant with the technical specification of the device (chapter 5, power supply voltage, humidity, temperature).

2. INSTALLATION GUIDELINES

The device is designed so as to ensure an appropriate level of immunity to most interferences that may occur in industrial and household environments. In environments of unknown level of interferences, it is recommended to implement the following measures so as to prevent potential interference with the operation of the device:
a) do not supply the device from the same lines as high-power equipment without using appropriate power line filters;
b) use shielded supply, sensor, and signal cables, whereby the earthing of the shield should be single-point and located as close to the device as possible;
c) avoid running measurement (signal) cables in the direct vicinity of and parallel to power and supply cables;
d) it is recommended to twist the signal wires in pairs or to use a finished twisted-pair cable;
e) avoid proximity of remotely controlled devices, electromagnetic meters, high power loads, loads with phase or group power control, and other devices that cause high impulse disturbances;
f) ground or zero metal rails on which rail-mounted devices are installed.

Make sure to remove the protective film from the display before the first use of the device.

3. GENERAL CHARACTERISTICS OF THE CONTROLLER

- 1 universal measuring input (thermoresistive, thermocouple or digital temperature sensors AR182 and AR183);
- a programmable BIN input for changing the operating mode of the controller: start/stop regulation, setpoint interlock;
- 1 control output, relay or SSR control output, ON-OFF with hysteresis, PID; AUTOTUNING PID
- automatic selection of PID parameters;
- LED display with adjustable brightness control;
- compensation of line resistance for resistance sensors
- compensation of temperature of cold thermocouple ends
- programmable input type, control options, access options and other configuration parameters;
- access to configuration parameters protected with a user password;
- parameter configuration methods:
  - from the keypad and the knob located on the front panel of the device;
  - through the PRG port (AR955 programmer) and the free ARSOFT-CFG software (Windows 7/8/10);
- software and a programmer that enable viewing the measured value and quick configuration of single or ready sets of parameters that were saved earlier on the computer for future use, e.g. in other controllers of the same type (copying of configuration);
- a panel housing, IP40 on the front, IP20 on the connector side;
- high accuracy, long-term stability, and immunity to interferences;
- wide range of supply voltages: 15 ÷ 250 V AC (AC voltage 50/60 Hz), 20 ÷ 350 V DC (DC voltage)

- available accessories:
  - AR955 programmer
  - digital temperature probes AR182, AR183

NOTE:

- before you start working with the controller, make sure to become familiar with this operating instruction and perform proper electrical and mechanical installation, as well as configuration of the parameters;
- by default the controller is configured for measurement from the Pt100 sensor and ON-OFF control type.

4. CONTENTS OF THE PACKAGE

- a controller with fastening holders to installation in a panel window;
- a user manual;
- a warranty card.

5. TECHNICAL DATA

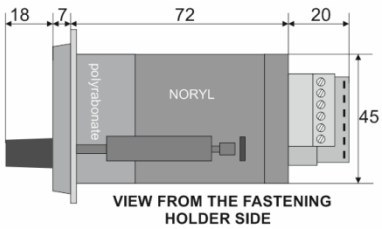
1 universal input (set with parameter 0: inP)		**measurement range**
- Pt100 (3- or 2-wire)		-100 ÷ 850 °C
- thermocouple J (Fe-CuNi)		0 ÷ 880 °C
- thermocouple K (NiCr-NiAl)		0 ÷ 1,200 °C
- thermocouple S (PtRh 10-Pt)		0 ÷ 1,750 °C
- thermocouple B (PtRh30PtRh6)		300 ÷ 1,800 °C
- thermocouple R (PtRh13-Pt)		0 ÷ 1,600 °C
- thermocouple T (Cu-CuNi)		0 ÷ 380 °C
- thermocouple E (NiCr-CuNi)		0 ÷ 700 °C
- thermocouple N (NiCrSi-NiSi)		0 ÷ 1,300 °C
- digital temperature probe AR182		-50 ÷ 120 °C
- digital temperature probe AR183		-50 ÷ 80 °C
Response time (10 ÷ 90%)		0.5 ÷ 2 s (programmable with parameter 1: FiLt)
Resistance of leads (Pt100)		Rd < 30 Ω (for each line)
Resistance input current (Pt100)		~250 µA
Processing errors (at ambient temperature of 25 °C):		
- basic	- for Pt100	0.2% of the measurement range ±1 digit
	- for thermocouples	0.3% of the measurement range ±1 digit
- additional for thermocouples		<2 °C (temperature of cold tips)
Resolution of measured temperature		programmable, 0.1 °C or 1 °C
Binary input (contact or voltage <24 V)		bistable, active level: short circuit or <0.8 V
Communication interfaces	- PRG programming connection (no isolation), standard	- bitrate 2.4 kb/s; - character format 8N1 (8 data bits, 1 stop bit, no parity bit) - MODBUS-RTU protocol (SLAVE)
Bi-state output (relay or for SSR control)	- relay (P1), standard	8 A / 250 VAC; for resistance loads
	- SSR (SSR1), option **Marked on the sticker of the device.**	transistor type NPN OC, 10.5 ÷ 11 V, with current limitation to ~25 mA

A 7-segment LED display (with brightness adjustment)		red, 4 digits 9 mm
Signaling	- relay activity	LED diode, red
	- messages and errors	LED display
Power supply (Usup)	universal, compliant with 24 V and 230 V standards	15 ÷ 250 V AC, <2 VA (AC voltage, 50/60 Hz)
		20 ÷ 350 V DC, <2 W (DC voltage)
Rated operating conditions		0 ÷ 50 °C, <90% RH (no condensation)
Operating environment		air and neutral gases
Protection rating	IP40 from the front, IP20 from the side of the connections	
Weight	approx. 125 g	
Electromagnetic compatibility (EMC)		immunity: according to the PN-EN 61000-6-2 standard
		emission: according to the PN-EN 61000-6-4 standard
Safety requirements according to EN 61010-1		installation category - II
		degree of pollution - 2
		voltage in relation to ground for the supply circuit, outputs - 300 V
		voltage in relation to ground for the input circuits - 50 V
		insulation resistance >20 MΩ
		height a.s.l. <2,000 m

6. ENCLOSURE DIMENSIONS AND INSTALLATION DATA

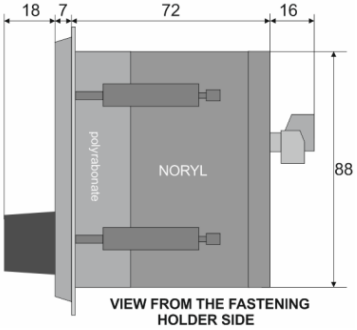
a) AR604

Enclosure type	panel, Incabox TX
Material	self-extinguishing NORYL 94V-0, polycarbonate
Enclosure dimensions (W x H x D)	48x48x79 mm
Panel window (W x H)	46 x 46 mm
Fixing methods	grips on the side of the enclosure
Conductor cross-section (for disconnectable connectors)	2.5 mm^2 (supply and outputs); 1.5 mm^2 (other)



a) AR614

Enclosure type	panel, Incabox TX
Material	self-extinguishing NORYL 94V-0, polycarbonate
Enclosure dimensions (W x H x D)	96x96x79 mm
Panel window (W x H)	92 x 89 mm
Fixing methods	grips on the side of the enclosure
Conductor cross-section (for disconnectable connectors)	2.5 mm^2 (supply and outputs); 1.5 mm^2 (other)

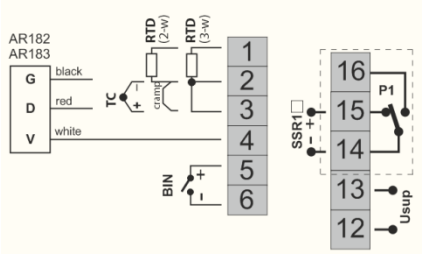


7. DESCRIPTION OF TERMINAL STRIPS AND ELECTRICAL CONNECTIONS

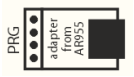
Table 7. Numbering and description of terminal strips

Terminals	Description
1-2-3	Pt100 input (2- and 3-wire)
2-3	thermocouple input (J, K, S, B, R, T, E, N)
2-3-4	input for digital temperature probes AR182, AR183
5-6	binary input (contact or voltage <24 V), chapter 9.1
PRG	programming connection for cooperation with the programmer **(only AR955 or AR956)**
12-13	supply input
14-15-16	relay output P1 or SSR1 control (transistor NPN OC)

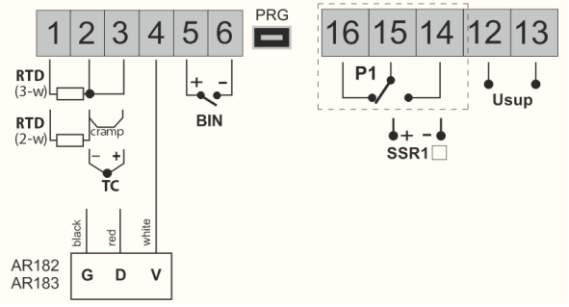
a.1) AR604 – terminals description Table 7



PRG socket is available from the top of the enclosure

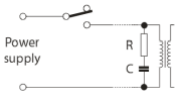


a.4) AR614 - terminals description Table 7

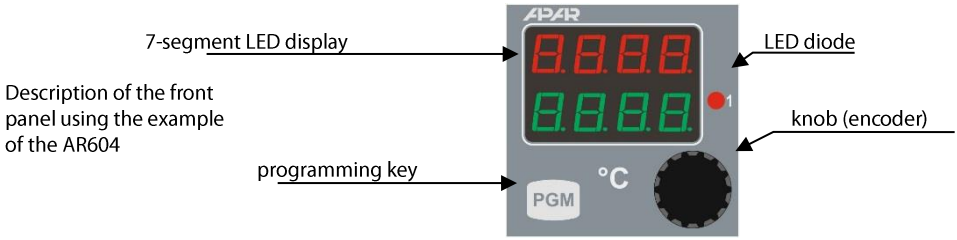


8. IMPORTANT TIPS - use of fire suppression systems

If an inductive load (e.g. contactor coil, transformer) is connected to the relay contacts, overvoltage and arc appear often during opening as a result of discharge of energy accumulated in the inductance. Particularly harmful effects of such overvoltage include reduced life of contactors and relays, destruction of semiconductors (diodes, thyristors, triacs), damage or disturbance of control and measurement systems, emission of electromagnetic fields causing interference with local devices. To avoid such effects, the overvoltage must be reduced to a safe level. The easiest method is connecting a suitable suppression module **directly** to the inductive load terminals. Generally, a suitable type of suppression system should be selected for each inductive load. Modern contactors usually have factory-installed suitable suppression systems. If they do not, a contactor with a built-in suppression system should be bought. Temporarily, you can shunt the load using the RC system, e.g. R=47Ω/1W and C=22nF/630V. Connect the suppression system to the inductive load terminals. This will limit burning of the relays contacts in the controller and reduce the probability that they will get stuck.



9. FUNCTIONS OF BUTTONS AND LED INDICATORS



a) button functions in the measurement display mode

Button	**Description** [and marking in the contents of the instructions]
	**[ENCODER KNOB]** By pressing: - access the quick access menu (chapter 11) - edit the setpoint SEt 1
	**[PGM]** - enter the parameter configuration menu (after holding for more than 2 seconds) If parameter 16: PPro = on (password protection is activated) enter the access code (chapter 10) - enter the quick access menu (chapter 11) - edit the parameter t-St

b) button functions in the parameter configuration menu and the quick access menu (chapters 10 and 11)

Button	**Description** [and marking in the contents of the instructions]
	**[ENCODER KNOB]** By pressing: - edit the current parameter (the value being edited is blinking) - approve and save the edited parameter value; By turning the knob: - to the left - reduce or to the right - increase the preset value; (save the entered value by pressing the knob or cancelling the changes with the **PGM** button), viewing the parameters

PGM	**[PGM]** - cancel changes to the edited value (the blinking stops); - return to the measurement display mode (after hold time >1 s).

FUNCTIONS OF THE DISPLAYS:

- **UPPER** : displays the measured values, the parameter names, or messages and errors;
- **LOWER** : set values, parameter values

(c) signaling LED functions

Diode [marking]	**Description**
1	signaling of activation of the P1/SSR1 output

9.1. BINARY INPUT

Binary input **BIN** performs a function that is programmable with parameter 18: Func (chapter 10). The binary input works with the bi-stable signal i.e. the supplied signal (voltage or switch) must be permanent (on/off type). Activation or deactivation of the function is indicated by appropriate messages on the display (described in Table 9.1).

Table 9.1. Available **BIN** input functions

Source	**Description** (depending on the value of parameter 18: Func)		**Message**
BIN	Func = nonE	the **BIN** input is inactive (factory setting)	-
	Func = bLoc	set value interlock	bLoc / boFF
	Func = StSP	start/stop control and automatic PID parameter selection when parameter 13: tunE = AutO, chapter 12.4	StAr / StoP

10. SETTING OF THE CONFIGURATION PARAMETERS

All the controller's configuration parameters are saved in a non-volatile (permanent) internal memory.
When the device is switched on for the first time, an error message may be shown in the display (chapter 13) due to the lack of a sensor or the fact that the sensor that is connected is not one that is factory-programmed. In this case, connect the appropriate sensor or correct the configuration parameters.

There are two parameter configuration methods:

1.From the keypad located on the front panel of the device:

- from the mode where the input measurements are displayed in the configuration menu (press the **[PGM]** button for more than 2 seconds) If parameter 16: PPro = on (password protection is enabled) the display will show CodE, then 0000 with the first digit flashing, turn the knob to enter the access password (the factory setting of the parameter is 15): PASS = 0015), the encoder button is used to move to the next positions and to confirm the code.
- after entering the configuration menu (with the message conF) the display shows a mnemonic name of the parameter (dot <-> ch-1 <-> ch- <->, etc.)
- turn the knob to the right to move to the next parameter and turn the knob to the left to the previous parameter (see Table 10 for a list of configuration parameters)
- to change the value of the current parameter, press briefly the button of the encoder (blinking in the edition mode)
- by turning the knob, change the value of the edited parameter

– approve the changed value of the parameter by pressing the encoder button or cancel it by pressing **[PGM]** (briefly); then return to the parameter name display
– exit the configuration by pressing **[PGM]** for a long time or automatically after about 2 min of inactivity

2. Use the PRG port (AR955/956 programmer) and the ARSOFT-CFG software (chapter 14):
– to connect the controller to a computer port and to start and configure the ARSOFT-CFG application
– after the connection has been established, the current measured value is displayed in the window of the software
– the device can be set and viewed in the parameter configuration window
– new parameter values must be approved with the ***Approve changes*** button
– the current configuration can be saved in a file or set using values read from a file

NOTE:
– before disconnecting the device from a computer, press the ***Disconnect device*** button (ARSOFT-CFG)
– in the event of no response:
– in the ***Program options*** check the configuration of the port and the ***MODBUS address*** of the device (transmission speed 2,400 bit/s, address MODBUS=1)
– make sure that the serial port drivers in the computer have been properly installed for the AR955/AR956 programmer
– disconnect for a few seconds and then reconnect the AR955/AR956 programmer
– restart the computer

In the event of indications different than the actual value of the input signal, the zero and the sensitivity of a sensor can be tuned: parameters 19: **cALo** (zero) and 20: **cALG** (sensitivity).

To restore the factory settings, when the device is switched on press the **[PGM]** button and hold it until the password menu appears (**CodE**), and then enter the following code **1112**. As an alternative, a file with default configuration can be used in the ARSOFT-CFG software.

NOTE:
Do not perform configuration of the device with the keypad and via the serial interface (AR955/AR956) at the same time.

Table 10. List of configuration parameters

Parameter	**Range of variability of the parameter and description**		Default settings
0: **inP** type of measurement input	**Pt**	thermoresistance sensor Pt100 (-100 - 850 °C)	**Pt**
	tc-J	thermoelectric sensor (thermocouple) type J (0 - 880 °C)	
	tc-K	thermoelectric sensor (thermocouple) type K (0 - 1,200 °C)	
	tc-S	thermoelectric sensor (thermocouple) type S (0 - 1,750 °C)	
	tc-b	thermoelectric sensor (thermocouple) type B (300 - 1,800 °C)	
	tc-r	thermoelectric sensor (thermocouple) type R (0 - 1,600 °C)	
	tc-t	thermoelectric sensor (thermocouple) type T (0 - 380 °C)	
	tc-E	thermoelectric sensor (thermocouple) type E (0 - 700 °C)	
	tc-n	thermoelectric sensor (thermocouple) type R (0 - 1,300 °C)	
	Ar 18	digital temperature probe AR182 or AR183	
1: **FiLt** filtration **(1)**	**3÷15**	digital filtration of measurements (response time)	**3**
2: **dot** point position/resolution	**0**	resolution 1 °C	**1** (0.1 °C)
	1	resolution 0.1 °C	

3: Lo2 lower limit 1	-99.9 ÷ 1800	lower setting limit for the preset value 7: SEt 7	-99.9 °C
4: H 1 upper limit 1	-99.9 ÷ 1800	upper setting limit for the preset value 7: SEt 7	850.0 °C
OUTPUT CONFIGURATION (P1/SSR1) - chapter 12.2			
5: Fto 1 failure status of output 1 **(2)**	status ourpur when the sensor (signal) absent or damaged: noCh = no changed, oFF = off, on = on		oFF
6: out 1 function output 1	oFF = off, inv = heating, dir = cooling		inv
7: SEt 1 preset value 1	applies to output 1, changes in scope 3: Lo 1 ÷ 4: H 1		100.0 °C
8: H 1 hysteresis output 1	hysteresis 0.0 ÷ 99.9 °C		1.0 °C
CONFIGURATION OF PID ALGORITHM			
9: Pb range of PID proportionality	0.0 ÷ 2000, 0 - switches off the PID's action, a description of the PID algorithm and associated topics can be found in chapters 12.3 ÷ 12.6		0.0 °C
10: t i PID integration time constant	0 ÷ 3600 sec.	PID algorithm doubling time 0 switches off the integrating component of the PID algorithm	0 s
10: t d PID differentiation time constant	0 ÷ 999 sec.	PID algorithm lead time 0 switches off the differentiating component of the PID algorithm	0 s
12: t c impulse period	4 ÷ 250 sec.	switching period for the binary output	4 s
13: tunE PID autotuning mode (chapter 12.4)	oFF = off, mAnu = manual start, Auto = after each power on and after adjustment (when input **BIN** in start/stop mode Func = StSP)		oFF
ACCESS OPTIONS AND OTHER CONFIGURATION PARAMETERS			
14: bSEt value change block SEt 1	oFF = no blocks, SEt 1 = block of parameter 7: SEt 1		oFF
15: PASS password	0000 ÷ 9999	password for the parameter configuration menu	1111
16: PPro protection of the configuration with a password	oFF	entry into the configuration menu is not password-protected	on
	on	entry into the configuration menu is password-protected	
17: br id illumination brightness	50 ÷ 100 %	brightness of the display, a 10 % increase	100 %
18: Func **BIN** input function (chapter 9.1)	nonE	the **BIN** input is inactive	nonE
	bLoc	set value setting interlock	
	StSP	start/stop of control or autotuning	
19: cALo calibration of the zero	zero offset for measurements: -5.0 ÷ 5.0 °C		0.0 °C
20: cALG gain	850 ÷ 1150 %	calibration of inclination (sensitivity) for measurements	1000 %

Notes: **(1)** - for Filt = 3 response time is about 0.5 seconds, for Filt = 15 at least 2 seconds.
Higher degree of filtration means a "smoother" measured value and a longer response time, which is recommended in the case turbulent measurements (e.g. water temperature in the boiler).

(2) - this parameter also defines the status of the output outside the measurement range and when there is no communication with digital temperature probes AR182, AR183

11. QUICK ACCESS MENU

In the measurement mode (when the measured value is displayed), it is possible to immediately access certain configuration parameters and functions without the need to enter a password. This can be done in the quick menu, which can be accessed by turning the encoder knob (for SEt 1) or the **[PMG]** button (for t-St). The parameter is selected and edited in the same way as described above (in chapter 10).

Table 11. Complete list of elements accessible in the quick configuration menu.

Element	Description
SEt 1	preset value 1 (parameter 7: SEt 1)
t-St	start/stop of PID tuning (chapter 12.4), optional element - unavailable when parameter 13: tunE = oFF

12. OUTPUT OPERATION CONFIGURATION

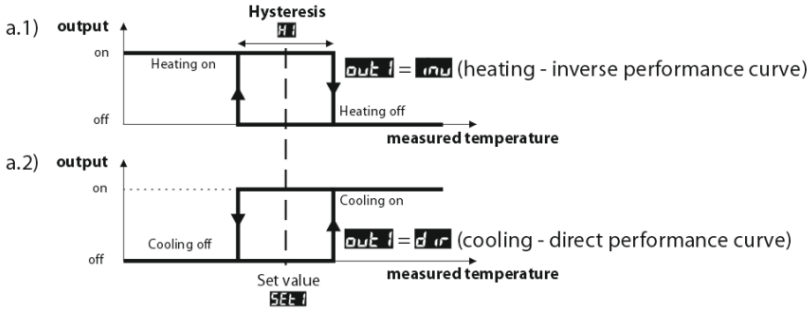
The programmable architecture of the controller enables using it in many fields and applications. Before the operation of the device starts, it is necessary to set the parameters according to specific requirements (chapter 10). A detailed description of configuration of the operation of outputs is given in chapters 12.1÷ 12.6. The default (factory) configuration is the following: outputs 1 is in the ON/OFF configuration mode with hysteresis (Table 10, *Factory settings* column).

12.1. CHANGE OF THE SET OUTPUT VALUE

In the measurement mode, the upper display shows the value being measured and the lower display shows the set value. The easiest way to change the set value for output 1 is to enter the quick menu (chapter 11). As an alternative, it is possible to change the preset value in the parameter configuration mode (using the methods described in chapter 10).

12.2. TYPES OF OUTPUT CHARACTERISTICS

The operating mode of the output is programmed by parameter 6: out 1, chapter 10, Table 10.
Basic operating characteristics of the outputs:



12.3. PID CONTROL

The PID algorithm enables achieving smaller temperature control errors than the ON-OFF method with hysteresis. However, the algorithm requires selecting the characteristic parameters for the specific controlled object (e.g. a furnace). In order to simplify the operation, the controller is provided with the PID parameter selection function described in chapter 12.4. Also, it is always possible to manually correct the settings (chapter 12.6).

The controller works in the PID mode when the proportionality range (parameter 9: Pb) is not equal to zero. The location of the proportionality range 9: Pb in relation to the preset value 7: SEt 1 is shown in drawings 12.3 a) and b). The impact of the integrating and differentiating components of PID control is determined by parameters 10: t i and 11: td. Parameter 12: tc determines the impulse period for output 1 (P1/SSR1). Correction of its state always takes place every 1 s. The principle of P-type control (proportional control) for output 1 is shown in figures c) and d).

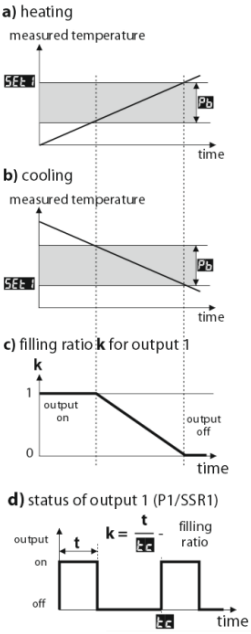


Fig. 12.3. Principle of the PID control:
a) location of the proportionality range Pb in relation to the preset value SEt for heating (Fun 1 = inv)
b) location of the proportionality range Pb in relation to the preset value SEt 1 for cooling (Fun 1 = dir)
c) filling coefficient for output 1 (P1/SSR1)
d) state of output 1 for the measured value within the proportionality range

12.4. AUTOMATIC SELECTION OF PID PARAMETERS

Autotuning automatically selects the PID parameters characteristic for a given control object (e.g. a furnace).

To start the autotuning algorithm, set parameter 15 accordingly: tunE (see chapter 10, Table 10), whereby the value tunE = MAnu enables manual start of the autotuning at any time, while tunE = Auto starts the tuning at each starts of control (when the power supply is switched on and with the **BIN** binary input, when parameter 20: Func = St.SP, chapter 9.1). In addition, the algorithm can be stopped manually or started at any time using the function t-St available in the quick menu (chapter 11). To do this, proceed as follows:

- press the **[PGM]** button for a moment; the upper display shows the name of the parameter t-St and the lower display shows the current parameter value (oFF = tuning off, on = on)
- by pressing the knob, enter the parameter value edition mode; the lower display starts flashing
- by turning the knob, select the value to be set and confirm it by pressing the knob.
- exit from the quick menu: press the **[PGM]** key for a longer time or wait approx. 5 sec.

During determination of the object's characteristics, the algorithm does not cause any additional delay in reaching the preset value 7: SEt 1. This method is intended specifically for objects of stabilized initial value of temperature (e.g. in a cold furnace). In order to avoid disturbing stabilized initial temperature, before the autotuning is switched on, the power supply of the operating element (e.g. a heater) should be switched off using an external switch or the control start/stop function should be used (**BIN** input). The power supply should be switched on immediately after the tuning is started, while the controller output is still off (for about 15 seconds). If the power supply is switched on later, an erroneous analysis of the object and improper selection of PID parameters will result.

During the tuning (when the display shows tunE alternately every 5 seconds with the measured value) the preset value SEt 1 must not be changed.

Autotuning consists of the following steps:

- delay in switching on the tuning (approx. 15 seconds - time to switch on the power supply of the operating element, i.e. the heating/cooling power, etc.);
- determination of the object's characteristics;
- calculation and saving in the controller's permanent memory parameters 9: Pb, 10: t_i, 11: t_d, and 12: t_c;
- switching on the control with new PID settings.

Programmed interruption of the autotuning (with the message Err t) can take place, if the conditions for proper operation of the algorithm are not met, such as:
- the initial temperature value is higher than the preset value for heating or lower than the preset value for cooling;
- the maximum tuning time (4 hours) has been exceeded;
- the measured temperature changes too quickly or too slowly.

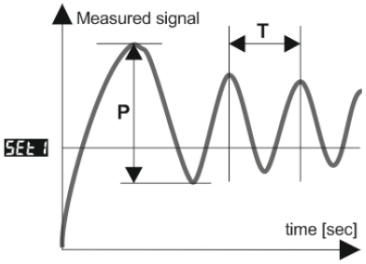
It is recommended to restart the autotuning after a significant change in the SEt 1 threshold or the controlled object's parameters (e.g. the heating/cooling power, the batch weight, the initial temperature, etc.).

12.5. ADJUSTMENT OF PID PARAMETERS

In a situation where there is an object with an unstable initial temperature value (e.g. in a heated furnace) or the measurement is turbulent (e.g. water temperature in a boiler) then the built-in autotuning algorithm may not work correctly. The PID control parameters must then be adjusted manually. The following algorithm using the oscillation method makes it possible to choose own PID action parameters: proportionality range 9: PP, integration time 10: PP, differentiation 11: PP, and pulse duration 12: PP.

1. Set the controller to the ON-OFF mode (parameter 11: Pb = 0), the required threshold value 7: SEt 1 and 8: PP = 0. If over-regulation is not recommended, set SEt 1 to a value lower than the required value.
   The controller should be connected to the measurement and control system used.

2. Observe and record the temperature oscillations. Note the difference **P** between the highest and lowest value of the first oscillation and the time **T** between the second and third oscillations.



3. Set the configuration parameters:
   - range of proportionality Pb = **P**
   - integration time t_i = **T** [s]
   - differentiation time t_d = **T** / 4 [s]
   - pulsation time t_c = **T** / 8 [s]

12.6. PID PARAMETER CORRECTION

The autotuning function correctly selects the PID control parameters for most processes; but sometimes the parameters need adjustment. Due to the strong correlation between those parameters, only one parameter should be changed and the impact of the change on the process should be observed:

a) <u>oscillations around the threshold</u> - increase the proportional range 9: PP, increase the integration time 10: PP, reduce the differentiation time 11: PP, (possibly reduce the pulse duration of output 1 by half, parameter 12: PP)
b) <u>slow response</u> – reduce the proportionality Pb, differentiation times t_d, and integration times t_i
c) <u>over-regulation</u> - increase the proportionality Pb, differentiation times t_d, and integration times t_i
d) <u>instability</u> - increase the integration time t_i.

13. MESSAGE AND ERROR SIGNALING

a) measurement errors:

Code	Possible causes of error
---- ____	- the measurement range of the sensor is exceeded from the top (----) or from the bottom (____) - damage or incorrect connection of the sensor - the sensor that is connected is different than the one that is set in the configuration (chapter 10, parameter 0: inP)
----	- no communication with the digital probe AR182, AR183 - damage or incorrect connection of the digital probe - the sensor that is connected is different than the one that is set in the configuration (chapter 10, parameter 0: inP)

b) temporary messages and errors (one-time and recurring):

Code	Description of message
CodE	mode of entering the password for access to the configuration parameters, chapter 10
Err	the password is invalid,
ConF	the parameter configuration menu was accessed,
tunE	implementation of the PID autotuning function, chapter 12.4
Errt	autotuning error, chapter 12.4, deleting the error by pressing the **[PGM]** key for a longer period of time
StAr / StoP	control start/stop, chapter 9.1
bLoc / boFF	keypad block on/off, chapter 9.1
SAvE	saving of factory parameter values (chapter 10)

14. CONNECTING THE CONTROLLER TO A COMPUTER AND AVAILABLE SOFTWARE

It may be useful to connect the controller to a computer in the following situations:
- quick configuration of parameters, to include copying of settings to other controllers of the same type
- monitoring and recording of the measured temperature and the state of the output.

As a standard, the controllers are equipped with a PRG port which enables connecting to a computer using an AR955/AR956 programmer (without galvanic isolation, cable length approx. 1.2 m). The programmer requires installation of the supplied serial port drivers on the computer. Note the port configuration in the ARSOFT-CFG options (baud rate = 2400 bit/s, MODBUS address = 1). Communication with devices is effected using a protocol compatible with MODBUS-RTU. The ARSOFT-CFG application is available on the website ***www.apar.pl*** in the *Download* tab or on a CD-ROM bundled with the AR955/AR956 programmer (for Windows 7/8/10). The main features of the software are as follows:.

Name	Software description
ARSOFT-CFG (free)	- display of current measurement data from the connected device - quick configuration of controller parameters, measurement input type, control options, access, etc. (Chapter 10) - creation on the disk of a "cfg" file with the current configuration of the parameters for future use (e.g. for copying of the configuration) - the software requires communication with the controller via the PRG port (AR955/AR956)

A detailed description of the aforementioned application can be found in the installation folder.

NOTE: 

Before a connection is established, make sure that the MODBUS address and the transmission speed in the options of the ARSOFT software are the same as the settings of the device. Moreover, in the ARSOFT software options, set the number of the COM serial port in use (in the case of the RS956 or AR955 programmer it is the number assigned by the operating system during installation of the drivers).

15. USER'S NOTES