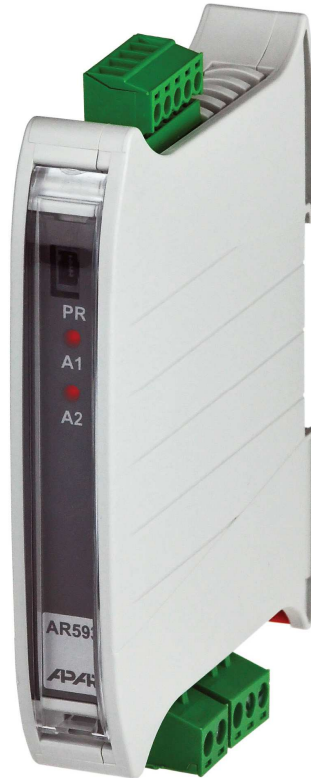


USER INSTRUCTION



UNIVERSAL TRANSDUCER AR593



Thank you for choosing our product.

These instructions will facilitate operating the device and enable safe use of the device at its full capacity.

Prior to the installation and startup of the device, please become familiar with these instructions.

In the event of any additional questions, please contact our technical adviser.

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Please pay particular attention to the text marked with this sign.

The manufacturer reserves the right to make changes to the design and the programming of the device without any deterioration of the technical parameters (some functions may not be available in older versions).

1. SAFETY PRINCIPLES



- 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 staff;
- 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 device's power supply;
- ensure proper operating conditions compliant with the technical specification of the device (power supply voltage, humidity, temperature - see chapter 5).

2. INSTALLATION GUIDELINES



The device is designed so as to ensure an appropriate level of immunity to most interferences that may occur in industrial 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:

- do not supply the device from the same lines as high-power equipment without using appropriate power line filters;
- use cable shields on power supply cables, sensor cables, and signal cables, whereby the earthing of the shield should be single-point and located as close to the device as possible;
- avoid running instrument (signal) cables in the direct vicinity of and parallel to power distribution and power supply cables;
- it is recommended to use twisted pair signal cables;
- in the case of sensing resistors in 3-wire connections, use identical wires;
- avoid locating remotely controlled, electromagnetic meters, and high-power loads, loads with phase or group power control, and other devices producing large impulse interferences close to one another;
- ground or zero metal rails on which rail-mounted devices are installed.

3. GENERAL CHARACTERISTICS OF THE TRANSDUCER

- linear processing of measured temperature or another physical value transformed into a standard current, voltage, or resistance signal.
- high accuracy, long-term stability, and immunity to interferences;
- universal input:
 - thermoresistance... Pt100, Ni100, Pt500, Pt1000
 - thermocouple J, K, S, B, R, T, E, N
 - analog 0/4÷20mA, 0÷10V, 0÷60mV, resistance 0÷2500ohm
- two independent outputs (current 0/4÷20mA and voltage 0/2÷10V, retransmission of measurement or programmable alarm)
- triple galvanic isolation (input/output/supply)
- narrow enclosure for installation on the TS35 rail (DIN rail)
- scope of processing, input type, and other parameters configured with an AR950 programmer or an AR956 programming set
- programmable exceeded set value alarms with hysteresis
- LED signaling of exceeded processing range, sensor error, or alarm output status (on/off type)
- high accuracy and immunity to interferences;

NOTE:

- before starting to work with the meter, you must become familiar with this using instruction, properly prepare the electrical system and the mechanical system, and correctly configure the parameters.
- if the characteristics of the transducer are configured with the AR956 programmer, the transmission parameters that can be set in the options of the ARSOFT-CFG software are the following:
 - COM port number: assigned by the Windows system after installation of the AR956 controller, available in the "Device Manager" in the "Ports (COM and LPT)" group; see "Quick start programmer AR956"
 - transmission speed: 2,400 bit/s
 - MODBUS address = 1

A detailed description of the configuration parameters of the transducer can be found in chapter 9.

4. CONTENTS OF THE SET

- a transducer with a set of connections;
- operating instructions;
- a warranty card.

5. TECHNICAL DATA

1 universal programmable input	measurement range	
- Pt100 (RTD, 3- or 2-wire)	-200 ÷ 850 °C	
- Ni100 (RTD, 3- or 2-wire)	-50 ÷ 170 °C	
- Pt500 (RTD, 3- or 2-wire)	-200 ÷ 850 °C	
- Pt1000 (RTD, 3- or 2-wire)	-200 ÷ 850 °C	
- thermocouple J (Fe-CuNi)	-40 ÷ 800 °C	
- thermocouple K (NiCr-NiAl)	-40 ÷ 1200 °C	
- thermocouple S (PtRh 10-Pt)	-40 ÷ 1,600 °C	
- thermocouple B (PtRh30PtRh6)	300 ÷ 1,800 °C	
- thermocouple R (PtRh13-Pt)	-40 ÷ 1,600 °C	
- thermocouple T (Cu-CuNi)	-25 ÷ 350 °C	
- thermocouple E (NiCr-CuNi)	-25 ÷ 740 °C	
- thermocouple N (NiCrSi-NiSi)	-35 ÷ 1,300 °C	
- current ($R_{in} = 110 \Omega$)	0/4 ÷ 20 mA	
- voltage ($R_{in} = 100 \text{ k}\Omega$)	0 ÷ 10 V	
- voltage ($R_{in} > 5 \text{ M}\Omega$)	0 ÷ 60 mV	
- resistance (3- or 2-wire)	0 ÷ 2,500 Ω	
Permissible feed resistance (RTD, Ω)	$R_d < 30 \Omega$ (for each line)	
Resistance input current (RTD, Ω)	180 ÷ 250 μA	
Processing ranges for outputs (2 independent)	any (programmable in the measurement range of the input), factory 0 ÷ 500 °C	
Processing errors (at ambient temperature of 25 °C):		
- basic	- for RTD, mA, V, mV, Ω	0.1% of the measurement range ± 1 digit
	- for thermocouples	0.2% of the measurement range ± 1 digit

- additional for thermocouples	<2 °C (temperature of cold tips)	
- additional from ambient temperature changes	< 0.01% of the input range /°C	
Resolution of measured temperature	programmable, 0.1 °C or 1 °C	
Resolution of analog input (programmable)	-1999 ÷ 9999 (parameters 3: A_{b0L} , 4: A_{L0A})	
Analog output	- current 0/4 ÷ 20 mA	maximum resolution 1.3 mV load resistance R _o < 500 Ω
	- voltage 0/2 ÷ 10 V	maximum resolution 1.3 mV load resistance R _w > 2.5 kΩ
	- basic error of the output	< 0.1% of the output range
Response time (10 ÷ 90%)	240 ÷ 1,600 ms (programmable with parameter 1: F_{1L1}), factory 360 ms	
Signaling of alarms, messages, and errors	red LED diode (A1, A2) and output signals (3.8mA (1) , 21mA (1) , 21.25mA (2) , 10.625V (3))	
Power supply (U _{sup})	24 VAC/DC (18÷50 VDC, 14÷35 VAC), <850mW	
Operating temperature range	0 ÷ 65 °C	
Relative humidity range	0-90 °C (no condensation)	
Protection rating	IP20	
Operating position	any	
Weight	approx. 70 g	
Separation (in/out/sup)	1.5 kV, 50 Hz, 1 min.	
Electromagnetic compatibility (EMC)	immunity: according to the PN-EN 61000-6-2:2002(U) standard	
	emissivity: according to the PN-EN 61000-6-4:2002(U) standard	
Transmission parameters for the AR956 programmer	2,400 bit/s, MODBUS address = 1	

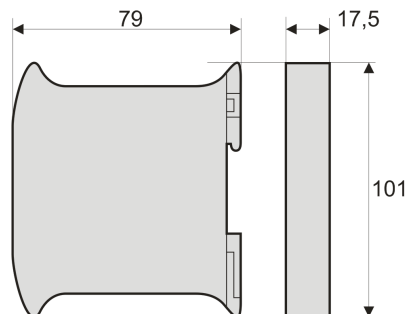
Notes: (1) - applies to the 4÷20 mA output
(2) - applies to the 0÷20 mA output
(3) - applies to the 0/2÷10 V output

NOTE: 

Measurements performed by the transducer when supplied from the AR956 programmer are not reliable. The AR956 programmer is intended only to supply the transducer during configuration of parameters using the ARSoft-CFG software. During normal operation, the transducer should be supplied in the standard manner.

6. ENCLOSURE DIMENSIONS AND INSTALLATION DATA

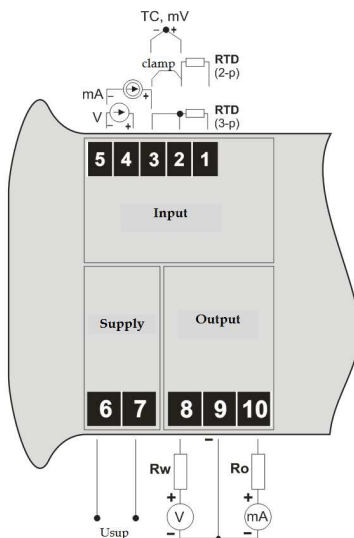
Enclosure type	rail-mounted
Material	polycarbonate, ABS UL94V-0
Enclosure dimensions	79 x 101 x 17.5 mm
Fixing methods	on a 35 mm DIN rail
Conductor cross-sections	2.5 mm ² (supply, outputs), 1.5 mm ² (inputs)



7. DESCRIPTION OF TERMINAL STRIPS AND ELECTRICAL CONNECTIONS

Table 7. Numbering and description of terminal strips.

Terminals	Description
1-2-3	input Pt100, Ni100, Pt500, Pt1000, resistance (2- and 3-wire)
2-3	thermocouple input TC (J, K, S, B, R, T, E, N) and voltage input 0÷60 mV
3-5	current input 0/4÷20 mA
4-5	voltage input 0÷10 V
6-7	power supply input 24 VAC/DC
8-9	analog output 1 (0/2÷10 V)
9-10	analog output 2 (0/4÷20 mA)



U_{sus} - power supply voltage

R_o, R_w - load resistance (int.) of the measuring device

- measuring device (milliammeter)

- measuring device (volt meter)

8. LOCATION AND DESCRIPTION OF ELEMENTS OF THE FRONT PANEL

Table 8. Description of the elements of the front panel.

Symbol	Description
PR	programming outlet (for AR956 and AR950)
A1	LED signaling of exceeded processing range, sensor error or alarm output status (on/off type) of output 1 (0/2÷10 V)
A2	LED signaling of exceeded processing range, sensor error or alarm output status (on/off type) of output 2 (0/4÷20 mA)



NOTE:



Connecting other devices than the AR950 or AR956 programmer to the PR socket may result in damage to the connected device and the AR593 transducer.

9. SETTING OF THE CONFIGURATION PARAMETERS

All the configuration parameters of the device are stored in the non-volatile internal memory.

When the device is switched on for the first time, an error may occur due to the lack of a sensor or the fact that the sensor that is connected is not one that is factory-programmed. In such a situation, the appropriate sensor or analog signal should be connected

or the parameter configuration must be performed.

Methods of parameter configuration via the PR socket (accessible by opening the transparent front cover):

1. Use the AR956 programmer and the ARSOFT-CFG software to:

- connect the device 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
- setting and viewing of the device parameters is possible 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, MODBUS address=1)
 - make sure that the serial port drivers in the computer have been properly installed for the AR956 programmer
 - disconnect for a few seconds and then reconnect the AR956 programmer
 - restart the computer
 - - if the AR955 programmer is used instead of the AR956 programmer, connect the power supply voltage to the transducer

2. Use the autonomous AR950 programmer to:

- connect the power supply voltage to the transducer;
- use the cable included in the set to connect the AR950 programmer to the device being configured (an AR5xx series transducer);
- the programmer can be connected both before the power supply is switched on and during operation of the device;
- enter the configuration parameters programming mode by pressing (for about 2 s) the **CONF** button until the **CONF** message briefly appears on the display and then the mnemonic name of the first parameter is displayed (**CONF**); by pressing the **▲** button, you can move to the next parameter, and by pressing the **▼** button - to the previous parameter (**CONF** ↔ **FILE** ↔ **DATE** ↔ ...); a list of configuration parameters can be found in the user instruction of the device being configured;
- in order to change or view the value of the current parameter, press SET (edition of the parameter);
- by using **▲** or **▼**, you can change the value of the current parameter;
- by pressing SET again, you can save the edited value and return to the parameter name display (e.g. **FILE**);
- in the parameter edition mode, by pressing **ESC** for a short time, you can cancel the changes and return to the parameter name display mode;
- you can exit the configuration parameters programming mode by pressing the **ESC** button for a long time (approx. 1 s); otherwise, the mode is switched off after approx. 2 minutes;
- in the normal mode, the measured value is displayed;

Detailed information can be found in the user instruction of the AR950 programmer.

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 17: **RL0** (zero) and 18: **RL1** (sensitivity).

In order to restore the default settings, use the file with the default configuration in the ARSOFT-CFG software.

NOTE:

The transmission parameters for the AR956 programmer in the ARSOFT-CFG software are the following: 2400 bit/s, MODBUS address = 1

Table 10. List of configuration parameters

Parameter	Range of variability of the parameter and description		Default settings
0: mP Type of measurement input	Pt-100	thermoresistance sensor (RTD) Pt100 (-200 ÷ 850°C)	Pt-100
	Ni-100	thermoresistance sensor (RTD) Ni100 (-50 ÷ 170°C)	
	Pt-500	thermoresistance sensor (RTD) Pt500 (-200 ÷ 850°C)	
	Pt-1000	thermoresistance sensor (RTD) Pt1000 (-200 ÷ 850°C)	
	Ec-J	thermoelectric sensor (thermocouple) type J (-40 ÷ 800°C)	
	Ec-K	thermoelectric sensor (thermocouple) type K (-40 ÷ 1,200°C)	
	Ec-S	thermoelectric sensor (thermocouple) type S (-40 ÷ 1,600°C)	
	Ec-B	thermoelectric sensor (thermocouple) type B (-300 ÷ 1,800°C)	
	Ec-R	thermoelectric sensor (thermocouple) type R (-40 ÷ 1,600°C)	
	Ec-T	thermoelectric sensor (thermocouple) type T (-25 ÷ 350°C)	
	Ec-E	thermoelectric sensor (thermocouple) type E (-25 ÷ 740°C)	
	Ec-N	thermoelectric sensor (thermocouple) type N (-35 ÷ 1,300°C)	
	4-20	current signal 4 ÷ 20 mA	
	0-20	current signal 0 ÷ 20 mA	
0-10	voltage signal 0 ÷ 10 V		
0-60	voltage signal 0 ÷ 60 mV		
rES	resistance signal 0 ÷ 2,500 Ω		
1: Filt filtration (3)	1 ÷ 10	digital filtration of measurements (response time)	1
2: dot position of the point/resolution(2)	0	no point or 1°C resolution for temperature	1 (0.1 °C)
	1	0.0 or resolution 0.1 °C for temperature	
3: Abot start of input scale (1)	4999 ÷ 9999	indication for 0/4mA, 0V, 0Ω on the input - start of input scale	00 °C
4: Abop end of input scale (1)	4999 ÷ 9999	indication for 20 mA, 10 V, 60 mV, 2,500 Ω on the input - end of the input scale	5000 °C
5: type type of output 1 (0/2÷10 V)	2-10	voltage signal 2 ÷ 10 V	0-10 V
	0-10	voltage signal 0 ÷ 10 V	
6: out characteristics of output 1 (0/2÷10 V), (see chapter 10)	retr	retransmission of measurement	retr
	inv	inversion (heating)	
	dir	direct (cooling)	
7: Set alarm value of output 1 (0/2÷10 V)	in the measurement range of the specific input type		500 °C
8: Hz hysteresis of output 1	0.0-999.9 °C or 0-9999 units (1)		1.0 °C
9: bot start of scale of output 1	in the measurement range of the specific input		0.0 °C
10: top end of scale of output 1	in the measurement range of the specific input		500.0 °C

11: 4-20 type of output 2 (0/4÷20 mA)	4-20 = 4÷20 mA, 0-20 = 0÷20 mA	4-20 mA	
12: out2 characteristics of output 2 (4÷20 mA), (see chapter 10)	retr	retransmission of measurement	retr
	inv	inversion (heating)	
	dir	direct (cooling)	
13: SE2 alarm value of output 2 (0/4÷20 mA)	in the measurement range of the specific input type	500 °C	
14: H2 hysteresis of output 2	00-9999 °C or 0-9999 units (1)	10 °C	
15: bot start of scale of output 2	in the measurement range of the specific input	00 °C	
16: top end of scale of output 2	in the measurement range of the specific input	5000 °C	
17: ARL0 calibration of the zero	zero offset for measurements: -1000 ÷ 1000 °C or -1000 ÷ 1000 units (1)	0.0 °C	
18: ARL0 gain	-050 ÷ 1150 %	calibration of inclination (sensitivity) for measurements 1000 %	

- Notes:**
- (1) – applies to analog inputs (mA, V, mV, Ω),
 - (2) – applies only to display of data in the connected programmer (AR950, AR956),
 - (3) – for **Filt=1**, the response time is approx. 0.135 s; for **Filt=10** - approx. 1.5 s. Higher degree of filtration means a more smooth measured value and a longer response time, which is recommended in the case of turbulent measurements (e.g. water temperature in a boiler).

10. OUTPUT CONFIGURATION

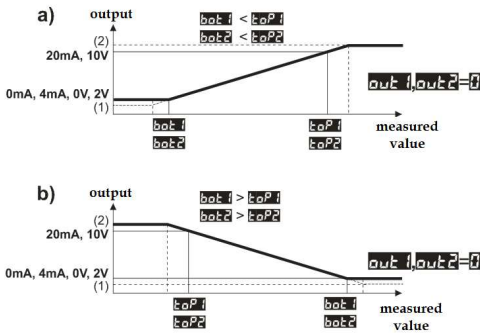
The types of output characteristics are determined by parameters 6: out_1 (for the 0/2÷10 V output) and 12: out_2 (for output 0/4÷20 mA), see chapter 8, Table 1. In the measurement retransmission mode ret_n , the output signal is proportional to the signal measured in the range set by parameters 9: bot_1 and 10: top_1 , as well as 15: bot_2 and 16: top_2 .

When parameter 6: out_1 , 12: out_2 is equal to inv or dir its corresponding output switches to the alarm mode of the ON-OFF type. In the alarm mode, the following parameters apply: 7: set_1 , 8: H and 13: set_2 , 14: HP , the status of the outputs is indicated by diodes **A1**, **A2**.

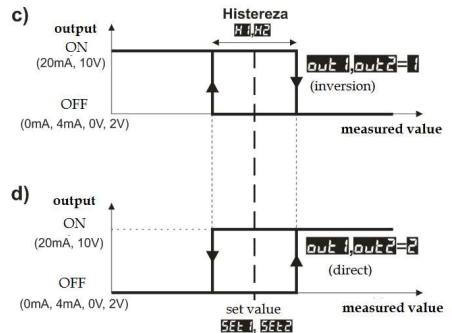
Thus, independent operation of each of the outputs enables configuration of two different processing ranges, operating modes, alarm values, and hystereses.

The principle of operation of the analog outputs in the individual operating modes is shown in the figures below.

Measurement retransmission



Alarm characteristics (ON-OFF)



- Notes:** (1) - 3.8 mA - expansion from the bottom of the proportionality range for the 4÷20 mA output
 (2) - 21 mA, 21.25 mA, 10.625 V - expansion from the top of the proportionality range for the 4÷20 mA, 0÷20 mA, and 0/2÷10V outputs

Fig. 10. Characteristics of operation of analog outputs: a) measurement retransmission - direct; b) measurement retransmission - reverse; c) alarm output - inversion; d) alarm output - direct.

11. SIGNALING OF MEASUREMENT ERRORS

The transducer detects the following measurement errors:

- exceeded processing range, from the bottom or from the top;
- connected sensor or input signal other than the one set in the configuration parameters;
- defective sensor circuit.

Methods of signalization of measurement errors:

- blinking LED **A1** or **A2** (works only in the measurement retransmission mode).

12. CONNECTING THE CONTROLLER TO A COMPUTER AND AVAILABLE SOFTWARE


It may be useful (or necessary) to connect the transducer to a computer in order to configure parameters, which also enables copying the setting to other transducers of the same type.

As a standard, the transducers are equipped with a **PR** port, which enables connecting to a computer using an AR956 programmer. Attention should be paid to the configuration of transmission parameters in the options of the ARSOFT-CFG software. The transmission parameters should be of the following values: Speed = 2,400 bit/s, MODBUS address = 1.

The following applications are available (on a CD supplied with the AR956 programmer or to be downloaded from the Internet at www.apar.pl, *Download* section, for operating systems Windows Vista/7/8/10):

Name	Software description
ARSOFT-CFG (free)	<ul style="list-style-type: none">- display of current measurement data from the connected device- configuration of the type of measurement input, the indication range, the alarm options, the display, etc.- creation of a disk with a "cfg" extension, containing the current configuration of the parameters to be used again (duplication of configuration)- the software requires communication with the device via the PR port (AR956 or AR955)

The detailed descriptions of the aforementioned applications can be found in the installation folders.

NOTE: 

Before a connection is established, make sure that the MODBUS address and the transmission speed in the options of the ARSOFT-CFG 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).

13. USER'S NOTES

