

USER MANUAL



AR201



AR211

DATA RECORDERS



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.

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 Pay special attention to the texts marked with this sign

The manufacturer reserves the right to introduce changes to the design and the software (firmware) of the device without any deterioration of technical parameters.

1. SAFETY

- before using the device, please read this manual
- in order to avoid electrocution or damage to the device, its mechanical and electrical installation must be performed by qualified workers;
- before turning on the power supply, make sure that all cables are connected properly
- 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 (power supply voltage, humidity, temperature, chapter 5)

2. INSTALLATION RECOMMENDATIONS

The device has been designed to provide adequate levels of immunity to most of the disturbances that may occur in industrial environments. In environments with an unknown level of interference, the following measures are recommended to prevent possible interference of the device operation:

- do not supply the device with the same line as the high-power devices without the appropriate network filters
- use the shielding of power supply, sensor and signal wires, whereas grounding of the screening should be a single-point, made as close as possible to the device,
- avoid arranging the measurement (signal) wires in the immediate vicinity and in parallel to the high voltage cables and power supply cables
- It is advisable to twist signal cables in pairs
- use identical cables for resistance sensors in a 3-wire connection
- 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;
- ground or neutralize metal rails used for mounting terminal devices

Before starting the work on the device, remove the protective film securing the LED display window.

3. GENERAL CHARACTERISTICS OF ONE-CHANNEL RECORDER

- recording data from the measurement input 1 universal measuring input (thermoreistance, thermocouple and analogue)
- 1 alarm/control output with signalling operational status
- USB and RS485 serial interface (galvanically isolated, MODBUS-RTU)
- saving data in a standard text file stored in the recorder's internal memory, SD/MMC card or USB stick \ in FAT system
- option of transferring archive and configuration data on SD card, USB memory or using the USB port of a computer
- 7-segment LED display with adjustable brightness
- internal real time clock with a battery backup power supply
- built-in 24Vdc power supply for supplying on-site transducers
- line resistance compensation for resistive sensors (automatic or fixed)
- temperature compensation of thermocouple cold ends (automatic or fixed)
- free software provided for displaying recorded results as graphics or text and for configuring the parameters
- programmable input, range of indications, options for recording, alarm, communication, access and other configuration parameters
- access to configuration parameters is protected by the user's password

- methods for configuring parameters:
 - via membrane keyboard (IP65) located on the front panel of the device;
 - via USB or RS485 interface and a computer program (Windows XP/7/8/10) from the configuration files saved on SD/MMC card or USB memory
 - available data protection against unauthorized copying and modification (checksum, authorization request for SD card and USB memory)
 - possibility to differentiate archives from many recorders of the same or similar type by assigning individual identification numbers (ID);
- signalling the presence of SD/MMC memory and USB, and file operations
- saving data until the memory is full, signalling full memory
- option of manual updating the recorder firmware
- high accuracy and immunity to interference
- available accessories:
 - SD memory card (1GB)
 - SD/MMC card
 - USB memory (2GB)

CAUTION:

Before you start working with the recorder, make sure to read this manual and perform proper electrical and mechanical installation, as well as configuration of the parameters.

4. PACKAGE CONTENT

- recorder
- USB cable for a connection with a PC, length: 2m
- a CD with the drivers and the software (Windows XP/7/8/10)
- user manual
- guarantee card

5. TECHNICAL SPECIFICATIONS

Universal input (programmable):	measurement range
- Pt100 (RTD, 3- or 2-wire)	-200 ÷ 850 °C
- Ni100 (RTD, 3- or 2-wire)	-50 ÷ 170 °C
- thermocouple J (Fe-CuNi)	-40 ÷ 800 °C
- thermocouple K (NiCr-NiAl)	-40 ÷ 1200 °C
- thermocouple S (PtRh 10-Pt)	-40 ÷ 1600 °C
- thermocouple B (PtRh30PtRh6)	300 ÷ 1800 °C
- thermocouple R (PtRh13-Pt)	-40 ÷ 1600 °C
- thermocouple T (Cu-CuNi)	-25 ÷ 350 °C
- thermocouple E (NiCr-CuNi)	-25 ÷ 680 °C
- thermocouple N (NiCrSi-NiSi)	-35 ÷ 1300 °C
- current ($R_{we} = 110 \Omega$)	0/4 ÷ 20 mA
- voltage ($R_{we} = 250 \text{ k}\Omega$)	0 ÷ 10 V
- voltage ($R_{we} > 2 \text{ M}\Omega$)	0 ÷ 60 mV
- resistance (3- or 2-wire)	0 ÷ 1000 Ω
Number of measuring inputs	1
Response time (10÷90%)	1 ÷ 6 s (programmable)

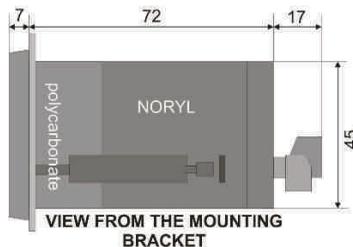
Resistance of leads (RTD, Ω)		$R_d < 25 \Omega$ (for each line)	
Resistance input current (RTD, Ω)		$\sim 480 \mu A$	
Processing errors (at ambient temperature of 25°C):			
- basic	- for RTD, mA, V, mV, Ω	0.1% of the measurement range ± 1 digit	
	- for thermocouples	0.2% of the measurement range ± 1 digit	
- additional for thermocouples		$< 2^\circ C$ (temperature of cold ends)	
- additional from ambient temperature changes		$< 0.005\%$ of input range $^\circ C$	
Resolution of the measured temperature		$0.1^\circ C$	
Communication interfaces	- USB	- slave mode	drivers compatible with Windows XP/7/8/10
		- master mode	USB memory operation (pendrive)
	- RS485, MODBUS-RTU, SLAVE	- AR201	speed $2.4 \div 115.2$ kbit/s, galvanic separation
		- AR211	speed $2.4 \div 115.2$ kbit/s, without separation
Period of data recording		programmable from 1s to 2 hours 45 min (1)	
Data storage memory (non-volatile, recording up to 19 million of measurements in 1GB memory):			
- internal		4MB FLASH, FAT12 file system, saving a minimum of 95 thousand measurements	
- external SD/MMC card (socket with ejector)		FAT16, FAT32, maximum size 2GB, recommended size ≤ 1 GB and FAT16	
- external USB memory (pendrive, A4 type socket)		FAT16, FAT32, maximum size: 4GB, maximum size ≤ 1 GB and FAT16	
Real-time clock (RTC) (sustain: lithium battery CR1220)		quartz, date, time, including leap years	
Alarm output	- relay	5A / 250V~ (for resistance loads), SPST-NO	
	- SSR (transistor, type NPN OC, optional)	11V, internal resistance 440 Ω	
Display		7-segments, LEDs, 4 digits, red, height 20 mm, adjustable brightness	
Power supply:	- 230Vac	$85 \div 260$ Vac/ 4VA	
	- 24 VAC/DC (option)	$20 \div 50$ Vac/ 4VA, $20 \div 72$ Vdc/ 4W	
Power supply of field transducers		24Vdc / 30mA	
Rated operating conditions		$0 \div 50^\circ C$, $< 100\%$ RH (no condensation)	
Operating environment		air and neutral gases	
Protection rating	- AR201	IP65 from the front, IP20 from the connectors	
	- AR211	IP20	
Weight	- AR201	~ 195 g	
	- AR211	~ 165 g	
Electromagnetic compatibility (EMC)		immunity: according to PN-EN 61000-6-2 standard emissivity: according to PN-EN 61000-6-4 standard	

(1) – minimum recording period equal to 1s is always possible for the internal memory. For USB memory (pendrive) and SD card, the minimum guaranteed (uniform) recording period may be up to several seconds and depends on the size of available memory, file system, archive file size and the manufacturer (e.g. for SD card size ≤ 256 MB, FAT16 and USB memory ≤ 1 GB, FAT16, it is possible to record for a period of 1s, tested memory devices: SanDisk, GOODRAM, Kingston and others)

6. ENCLOSURE DIMENSIONS AND INSTALLATION DATA

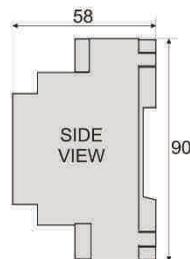
AR201

Enclosure type	panel, Incabox XT L57
Material	self-extinguishing NORYL 94V-0, polycarbonate
Enclosure dimensions	96 x 48 x 79 mm
Panel window	92 x 46 mm
Mounting	grips on the side of the enclosure



AR211

Enclosure type	rail-type, MODULBOX 4MH53
Material	self-extinguishing material PRO
Enclosure dimensions	71 x 90 x 58 mm
Mounting	mounted on TS35 rail DIN EN 50022-35

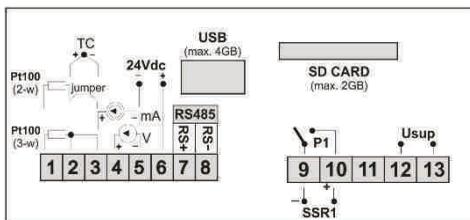


7. DESCRIPTION OF TERMINAL STRIPS AND ELECTRICAL CONNECTIONS

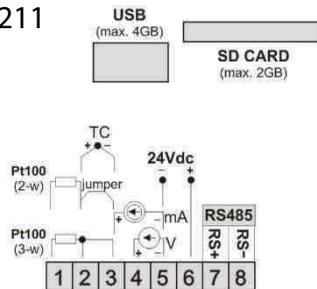
Terminals	Description
1-2-3	Input Pt100, Ni100, resistive, (2- and 3-wire)
2-3	thermocouple input TC (J, K, S, B, R, T, E, N) and voltage input 0÷60 mV
3-5	current input 0/4÷20 mA
4-5	voltage input 0÷10 V
7-8	RS485 serial interface (MODBUS-RTU transmission protocol)
6	output +24 V (in relation to the GND) of the integrated power supply of field transducers
9-10	relay output P1 or SSR1
12-13	power supply input 230 VAC or 24 VAC/DC

a) numbering of the connectors and the method of connecting sensors and measuring signals

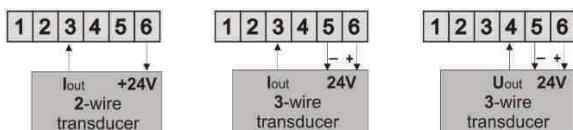
AR201



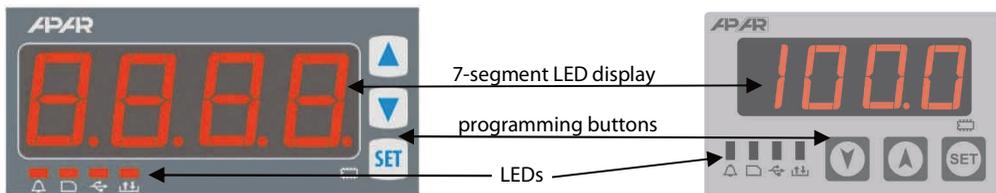
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b) connection of transducers (I_{out} - current, U_{out} - output voltage)



8. FUNCTIONS OF BUTTONS AND LEDs



a) button functions in the measurement display mode

Button	Description [and marking in the contents of the instruction]
	[SET] : entering the menu of file operations (after hold time longer than 1sec) If Parameter 19: PP-ro = on (password protection is enabled) you must enter the password (chapter 12) - acknowledging messages on the status of file operations (chapter 15, point c)
+	[UP] and [DOWN] (simultaneously): entering the menu of parameters (after hold time longer than 1sec). If Parameter 19: PP-ro = on (password protection is enabled) you must enter the password (chapter 11)

b) functions of the buttons in the parameter configuration or file operations mode (chapters 11 and 12)

Button	Description
	- edition of the current parameter or selection of file operation - approving and recording the edited parameter (when the computer's USB port is connected, recording in non-volatile FLASH memory is performed after disconnecting the port) - activating the selected action of the current file operation (e.g. copy the archive to the SD card, download the configuration from the USB memory, etc., chapter 12) - acknowledging messages on the status of file operations (chapter 15, point c)
	[UP] or [DOWN] : - moves to the next or previous item in the menu - changing the value of the edited parameter or action selected in the file operation
+	[UP] and [DOWN] (simultaneously): - cancelling changes in the edited value (return to the parameter name) - return to the measurement view mode (with holding time > 0.5 s)

c) functions of signal LEDs

LED [marking]	Description
[Alarm]	signalling the activation of alarm output (chapter 11.4)
[SD]	signalling the presence of SD/MMC card and recording
[USB]	signalling the presence of USB memory stick, recording and connection to the USB port of the computer (chapter 11.7)
[R/W]	signalling of writing to or reading from the internal memory, SD card or USB memory
[Memory]	signalling of ongoing recording in the internal memory

9. CONNECTING TO A COMPUTER AND INSTALLATION OF DRIVERS

Before connecting to a computer's USB port, make sure that Parameter 24: **USB = COM** (USB mode set as available for PC, chapter 11.7). After first connection, Windows system (XP/7/8/10) detects the recorder as "**APAR USB DEVICE**" and asks for installing drivers. In "Found New Device" Wizard, **manually** specify the location of drivers from the supplied CD (directory **DRIVERS**).

In Windows XP, the installation is as follows:

1. select option "**No, not this time**", press "**Next**" button,
2. select "**Install from a list or specific location (advanced)**", click "**Next**"
3. select "**Search for the best driver in these locations**" and "**Include this location in the search:**", press "**Browse**", and select file **DRIVERS**, press "**Next**", when "**Hardware Installation**" is shown – press "**Continue anyway**"
4. a virtual COM port "**CDC USB to UART**" is installed, press "**Finish**"
5. the system detects and installs a "**Mass Storage Device**" -> "**ATMEL MASS STORAGE USB Device**"-> "**Disk**"

After installation is complete, the recorder is shown in the system as a virtual port COMx (x- port number 1.2 ..) and two removable disks: internal memory 4MB labelled as AR201 and SD/MMC (available after the card is inserted to the "SD/MMC CARD" slot). In the internal memory you can see a text configuration file: *AR201.cfg* (chapter 11).



Do not disconnect the device from the computer before completing the installation of the drivers and later when USB drives are detected after connecting them (LED **[R/W]** is on, chapter 8)

10. INSTALLATION OF SOFTWARE

The supplied CD-ROM contains "**SOFTWARE**" folder with a free software installation set for the operation of the recorder. The installation set includes the following applications:

- **ARSOFT-CFG-WZ1** - displaying current measurement data, date and time,
 - configuration of the real-time clock (**RTC**) and other parameters such as the type of measurement input, display range, recording options, alarms, display, communication, access, etc. (chapter 11), the program requires communication with the recorder via USB or RS485 - **on-line configuration**
- **ARSOFT-LOG-WZ3** - graphic or text presentation of recorded results with the possibility to print, input data is taken once from a ".csv" text file created in the recorder in the internal memory or in USB memory (chapter 14)

The **latest** versions of the aforementioned software are also available at the website (www.apar.pl). The detailed descriptions of the aforementioned applications can be found in the installation folders.

11. SETTING THE CONFIGURATION PARAMETERS

All configuration parameters of the recorder are stored in the non-volatile internal FLASH memory

- in text file: *AR201.cfg*.

When the device is switched on for the first time, an error message may be shown in the display 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 proper sensor or analogue signal must be connected and the configuration must be programmed.

There are three methods for configuring parameters:

1. Via membrane keyboard (IP65) located on the front panel of the device:

- from the measurement display mode enter the configuration menu (simultaneously press **[UP]** and **[DOWN]** for more than 1 sec.). If Parameter 19: **PRPRo** = **on** (password protection is enabled) the display will show message **Code**, and then **0000** with flashing first digit, use **[UP]** or **[DOWN]** button to enter the password access (default Parameter 20: **PASS** = **1111**), to move to the next position and to approve the code use **[SET]** button
- after entering the configuration menu, mnemonic parameter names are displayed (**rPER** <-> **rLSP** <-> **rTh** <-> etc.), pressing **[UP]** button moves you to the next parameter, whereas pressing **[DOWN]** button moves you to the previous parameter (list of configuration parameters is shown in Table 11)
- to change or preview current parameter values press **[SET]** button
- use **[UP]** or **[DOWN]** buttons to change the value of the edited parameter
- approve the changed value of the parameter by pressing **[SET]** button or cancel it by pressing **[UP]** and **[DOWN]** (simultaneously), the parameter's name is displayed again

2. Use the USB or RS485 port and ARSOFT-CFG-WZ1 software (on-line configuration):

- connect the recorder to a computer port and start ARSOFT-CFG-WZ1 application
- when the connection is made, the program window displays current measured values and the internal time and date of the recorder
- 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 software enables synchronization of the time and the date with the computer
- the current configuration can be saved in a file or set using values read from a file
- the recorder updates the configuration file when disconnected from the computer's USB port
- on-line configuration via USB is possible only when Parameter 24: **USBA** = **onPA** (USB mode set to available for PC, chapter 11.7)

CAUTION: 

- before disconnecting the device from a computer, press the **"Disconnect device"** button
- in the absence of response:
 - in **"Program options"** check the configuration of the port and **MODBUS address of the device**
 - make sure that the serial port drivers have been installed correctly (chapter 9)
 - disconnect for a few seconds and then reconnect the recorder to the USB port
 - restart the computer

When indications differ from the actual value of the input signal, it is possible to adjust the zero and sensitivity of a given input: parameters 14: **ARLo** (zero) and 15: **ARLs** (sensitivity).

CAUTION: 

Do not shut down the power supply during the on-line configuration (via the computer's USB port) because the changed parameter values are saved in the non-volatile FLASH memory after disconnecting from the USB port.

Table 11. Cumulative list of configuration parameters

No.	Name	Parameter description	User settings
0	RTC (1)	internal real time clock (chapter 11.1)	
RECORDING OPTIONS (chapter 11.2)			
1	Start (2)	start of recording time limit	
2	Stop (2)	end of recording time limit	
3	rPEr	data recording period - seconds	
4	rTyP	recording type	
5	rthr	recording permission threshold value	
6	SAdE	selecting memory available to store archive files (data logging)	
CONFIGURATION OF MEASUREMENT INPUT (chapter 11.3)			
7	inp	type of the measurement input	
8	rRtd	total resistance of leads for 2-wire RTD sensors and 1000Ω	
9	cJtE	temperature of thermocouple cold ends	
10.	dot	position of the point/resolution	
11	rbot	bottom of display range (beginning of the scale) for 0mA, 4mA, 0V, 0mV, 0Ω	
12	rtop	top of display range (end of scale) for 20mA, 10V, 60mV, 1000Ω	
13	Filt	digital filtration of measurements	
14	cALo	zero calibration	
15	cALG	slope calibration	
CONFIGURATION OF ALARM OUTPUT (chapter 11.4)			
16	ALyP	alarm type	
17	ALyS	hysteresis	
18	ALvE	alarm value	
ACCESS OPTIONS (chapter 11.5)			
19	PPrO	password protection of configuration parameters, and file operations	
20	PASS	password to access the configuration parameters and file operations	
21	Auth	authorization of SD card and USB memory	
22	id	ID number (stored in an archive file - csv)	
DISPLAY OPTIONS (chapter 11.6)			
23	brIG	display brightness	
SERIAL RS485, AND USB COMMUNICATION SETTINGS (chapter 11.7)			
24	USbM	USB mode	
25	Addr	MODBUS-RTU address	
26	br	Baud rate for the RS485	

Notes: (1) - the parameter is available only from ARSOFT-CFG-WZ1 level (MODBUS-RTU, on-line configuration)
(2) - the parameter is available only from ARSOFT-CFG-WZ1

11.1. TIME AND DATE

Current time and date are used as timestamps for registration. Preview and modification is possible **only** from ARSOFT-CFG-WZ1 level (chapter 11, sec. 2) or MODBUS-RTU (chapter 18). In order to maintain operation of the internal clock (RTC), when the power supply is disconnected, the device uses **CR1220** lithium battery sufficient for a minimum five years in continuous operation.

Table 11.1. Parameters Real-Time Clock (RTC)

Parameter	Range of variability of the parameter
TIME (hh:mm:ss)	00:00:00 ÷ 23:59:59
DATE (dd:mm:yyyy)	01.06.2008 ÷ 31.12.2099

11.2. RECORDING SETTINGS

Data is archived in a text file with .csv extension in the internal memory or SD/MMC card or USB memory; a detailed description of the storage format is given in chapter 14. The recording is performed until the memory is full, then the recording is stopped and

message **E-Fu** is displayed cyclically. The recording must then be stopped (set Parameter 4: **REYP** to **OFF**, Table 11.2), the archive files must be copied for further analysis, and the memory space must be provided for further recording. The recording memory is selected by Parameter 6: **SRdE**, copying and deleting of existing archive files (csv) re available in the menu of file operations (chapter 12).Table 11.2. Configuration parameters for recording options

Parameter	Range of parameter variation and description	Factory settings	
1: Start : start of recording time limit(5)	date: 01.06.2008 ÷ 31.12.2099 , time: 00:00:00 ÷ 23:59:59 , parameter active if parameter 4: REYP = ENTL	2008.06.01 00:00:00	
2: Stop : end of the time limit (5)	date: 01.06.2008 ÷ 31.12.2099 , time: 00:00:00 ÷ 23:59:59 , parameter active if parameter 4: REYP = ENTL	2008.06.01 00:00:00	
3: PER data recording period (1)	1 ÷ 9999 s (2g 46m 39s) (note (1) in technical specifications, chapter 5)	60 s	
4: REYP recording type (2)	OFF	recording switched off permanently	OFF
	cont	recording switched on permanently	
	ENTL	recording is active within the time range defined by parameters: (1: Start) and (2: Stop) of the time limit	
	othr	recording is active when the measured value is greater from parameter 5: REhr (permission threshold value)	
	uthr	recording is active when the measured is smaller than the value of parameter 5: REhr (permission threshold value)	
5: REhr permission threshold value	1999 ÷ 1800 °C or 1999 ÷ 9999 units (3) Parameter active if parameter 4: REYP = othr or uthr	1800 °C	
6: SRdE memory to store archive files (csv) (4), (chapter 13)	intE	csv files are created only in the internal memory	Auto automatic selection
	SD.in	archive files (csv) are created only on SD/MMC card or in the internal memory when there is no card in the slot	
	Auto	archive files are created in the following order: USB memory, SD/MMC card or internal memory	

Notes: (1) - the recording period is counted from the moment the device is disconnected from the USB port
(2) - the device does not record data in a file when it is connected to the computer's USB port

(3) - applies to analogue inputs (mA, V, mV, Ω)

(4) - it is possible to request authorization of SD card and USB memory (chapter 11.5, Parameter 21: **RULH**)

(5) - available only from the level of ARSOFT-CFG-WZ1 (on-line configuration)

11.3. CONFIGURATION OF MEASUREMENT INPUTS

Table 11.3. Configuration parameters of the measurement input

Parameter	Range of parameter variation and description		Factory settings
7: mP Measurement input type	PE	thermoresistance sensor (RTD) Pt100 (-200 ÷ 850°C)	PE
	nI	thermoresistance sensor (RTD) Ni100 (-50 ÷ 170°C)	
	tc-J	thermoelectric sensor (thermocouple) type J (-40 ÷ 800°C)	
	tc-K	thermoelectric sensor (thermocouple) type K (-40 ÷ 1200°C)	
	tc-S	thermoelectric sensor (thermocouple) type S (-40 ÷ 1600°C)	
	tc-B	thermoelectric sensor (thermocouple) type B (300 ÷ 1800°C)	
	tc-R	thermoelectric sensor (thermocouple) type R (-40 ÷ 1600°C)	
	tc-T	thermoelectric sensor (thermocouple) type T (-25 ÷ 350°C)	
	tc-E	thermoelectric sensor (thermocouple) type E (-25 ÷ 850°C)	
	tc-N	thermoelectric sensor (thermocouple) type N (-35 ÷ 1300°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..1000 Ω		
8: rLEd Line resistance (1)	000 ÷ 5000 Ω	total resistance of leads for 2-wire RTD sensors and 1000Ω	000 Ω
9: cJtE temp. of cold ends of thermocouples	RULd 0.1 ÷ 500 °C	automatic or constant compensation of temperature of the cold junction of thermocouples	RULd
10: dob position dot /resolution	0	no dot (2) or resolution 1°C for temperature	1 (0.0/0.1°C)
	1	0.0 (2) or resolution 0.1°C for temperature	
	2	0.00 (2)	
	3	0.000 (2)	
11: bbot bottom of display range	-999 ÷ 9999 units (2) – indication for 0mA, 4mA, 0V, 0mV, 0Ω - start of the input scale		0.0 °C
12: ttop top of the indication range	-999 ÷ 9999 units (2) – indication for 20mA, 10V, 60mV, 1000Ω - end of the input scale		100.0 °C
13: FILt filtration (3)	1 ÷ 12	digital filtration of measurements (response time)	1
14: ARLd zero calibration	zero offset: -500 ÷ 500 °C or -500 ÷ 500 units (2)		0.0 °C
15: ARLd slope calibration	sensitivity (gain): 0.50 ÷ 1.150 %		100.0 %

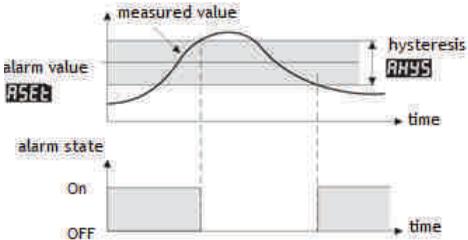
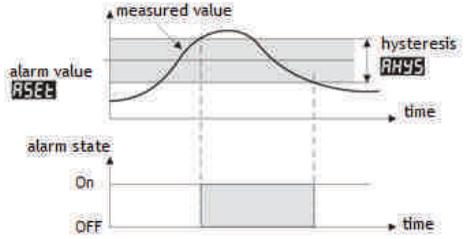
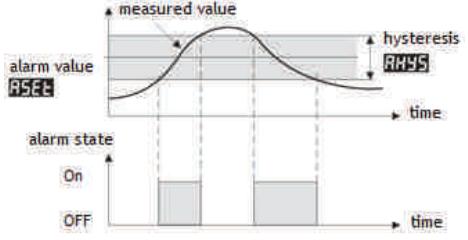
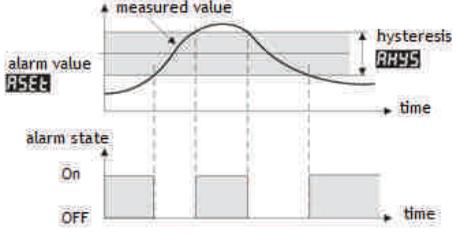
Notes: (1) – for 3-wire sensors, the line resistance is automatic and Parameter 8: **rLEd** must be equal to **000** Ω

(2) – applies to analogue inputs (mA, V, mV, Ω)

(3) – for **FILt** = **1** the response time is equal to 1s, for **FILt** = **12** it is equal to at least 6s. 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).

11.4. CONFIGURATION OF ALARM OUTPUT

Table 11.4. Configuration parameters of the alarm output

Parameter	Range of parameter variation and description		Factory settings
16: ALYP alarm type	off	constantly switched off alarm output	off disabled
	inv inverted / heating	 <p>Fig. 12.4.1. Characteristics of a heating alarm</p>	
	dir direct / cooling	 <p>Fig. 12.4.2. Characteristics of a cooling alarm</p>	
	bron in the band	 <p>Fig. 12.4.3. Characteristics of an "In the band" alarm</p>	
	brorf outside the band	 <p>Fig. 12.4.4. Characteristics of an "Outside the band" alarm</p>	
17: RHYS hysteresis	0 ÷ 5000 °C or 0 ÷ 5000 units (1)		00 °C
18: ASET alarm value	+99.9 ÷ 1800 °C or +999 ÷ 9999 units (1)		1000 °C

Notes: (1) – applies to analogue inputs (mA, V, mV, Ω)

11.5. ACCESS AND IDENTIFICATION OPTIONS

Table 11.5. Configuration parameters for identification and access options

Parameter	Range of parameter variation and description		Factory settings
19: PPr0 Data protected by access password	off disabled	access to the parameter configuration menu and file operation menu is not password-protected	off disabled
	on enabled	access to the parameter configuration menu and file operation menu is password-protected	
20: PASS access password	0000 ÷ 9999	password to access the menu of configuration and file operations	1111
21: Auth authorization of SD and USB (1)	off disabled	disabled authorization request for SD card and USB memory to save archive files	off disabled
	on enabled	recording in the archive is only possible on SD card or USB memory containing the configuration file (AR201.cfg) with a relevant access password (20:PASS)	
22: ID (Identification number - ID)	0 ÷ 9999	an individual device number entered into the initial records in the archive file (csv) in order to distinguish archives from different recorders of the same type;	0

Notes: (1) – the function prevents unintentional creation of archives in SD and USB memory, placed in the recorder accidentally during an off-line configuration or by unauthorized personnel. Not recommended for recording with the data recording period (Parameter 3: **PER**) shorter than 3 sec., as it introduces an additional delay of access to the archive causing uneven recording.

11.6. DISPLAY SETTINGS

Table 11.6. Configuration parameters for displaying options

Parameter	Range of parameter variation and description	Factory settings
23: Br0 display brightness	10 ÷ 100 %, in 10% steps	100 %

11.7. SERIAL RS485, AND USB COMMUNICATION SETTINGS

Table 11.7. Configuration parameters serial communication of RS485 and USB

Parameter	Range of parameter variation and description				Factory settings
24: USBn USB mode	comp accessible for computer	in order to establish communication with the computer, drivers must be installed (chapter 9), the USB connection is indicated by LED [USB] (chapter 8)			comp accessible for computer
	pend operation of USB memory	the presence of the memory is indicated by LED [USB] (chapter 8)			
25: br MODBUS-RTU address	1 ÷ 247	individual address of the device in the RS485 network (chapter 18)			1
26: add Baud rate for the RS485	24 kbit/s 384 kbit /s	48 kbit/s 576 kbit /s	96 kbit/s 1152 kbit /s	192 kbit/s	192 kbit/s

CAUTION: 

Do not connect the device in the USB Memory mode (24: **USBn** = **pend**) to the USB port of the computer, as it may damage the ports.

12. FILE OPERATION MENU

All available measurement data (csv archive files) and configuration data (*AR201.cfg*) are saved as text files in the memory formatted in standard FAT system. Access to files and to the memory (copying, deleting, checking the available free space, formatting the memory, etc.) is possible in two ways:

1. Via USB port of the computer (required installation of drivers, chapter 9)
2. From the recorder menu (with IP65 membrane keyboard on the front panel):
 - in the measurement display mode, press **[SET]** button for more than 1sec. If Parameter 19: **PPPrn = on** (password protection is enabled) the display will show message **cod6**, then **0000** with flashing first digit, press **[UP]** or **[DOWN]** button to enter the password (default Parameter 20: **PRSS = 1110**), in order to move to next positions and to confirm code use **[SET]** button
 - after entering the menu of file operations, the mnemonic names of operations are displayed (**SEAr** <-> **DEAr** <-> **SEcF** <-> etc.), press **[UP]** button to move to the next item, or **[DOWN]** to the previous one (the list of available operations is shown in Table 12)
 - to select the current operation, press **[SET]** button
 - Use **[UP]** or **[DOWN]** buttons to select the desired action of the current file operation (e.g. copy the archive to the SD card, download the configuration from the USB memory, etc.).
 - start the selected action by pressing **[SET]** button or cancel it by pressing **[UP]** and **[DOWN]** (simultaneously), the name of the operation will be shown again

Table 12. List of available disk and file operations

File operation	Description of the operation	
1: FRFr memory size	the number of free records in the internal memory (in thousands)	
2: SEAr send the archive (1), (memory operation - chapter 13)	cRnc	return to the previous menu (higher level)
	SD	copy the archive (csv files) from the internal memory to the SD/MMC card
	USB	copy the archive (csv files) from the internal memory to USB memory
	SEcF	copy the archive (csv files) from the SD/MMC card to USB memory
3: DEAr delete archive	cRnc	return to the previous menu (higher level)
	intE	delete the archive (files with the csv extension) in the internal memory
	SD	delete the archive (csv files) from the SD/MMC card
	USB	delete the archive (files with the csv extension) in the USB memory
4: SEcF send the configuration (chapter 13)	cRnc	return to the previous menu (higher level)
	SD	copy the current settings (<i>AR201.cfg</i>) to the SD card
	USB	copy the current settings (<i>AR201.cfg</i>) to the USB memory
	cRnc	return to the previous menu (higher level)
5: DEcF configure from file (chapter 13)	cRnc	return to the previous menu (higher level)
	SD	copy the current settings (<i>AR201.cfg</i>) from the SD card
	USB	copy the current settings (<i>AR201.cfg</i>) from the USB memory
	cRnc	return to the previous menu (higher level)
6: DEFc return the default	cRnc	return to the previous menu (higher level)
	rESt	set the default configuration parameters (<i>AR201.cfg</i>) in the recorder
7: FORr format memory (2)	cRnc	return to the previous menu (higher level)
	intE	format the internal memory in FAT12 system, preserving the current settings (parameters in <i>AR201.cfg</i> file)
	SD	format the SD/MMC card in FAT16 or FAT32 system (when the size > 2GB)
	USB	format the USB memory in FAT16 or FAT32 system (when the size > 2GB)

Notes: (1) – for an archive file of 4MB, the copying time is approx. ~2 min, for 250MB ~30 min

(2) – formatting deletes all data from the memory (except the configuration file in the internal memory)

Until the completion of file operations or formatting the memory, recording is suspended.



During file operations or formatting of memory, **do not shut down the power supply** and **do not connect the device to the USB port of the computer and do not remove external memory devices**, as this may cause a loss of recorded data or the current configuration (parameters).

13. USE AND FUNCTIONS OF SD/MMC CARDS AND USB MEMORY (PENDRIVE)

Due to the stationary (panel) installation of the recorder, it may be useful to use a SD/MMC card and USB memory to transfer archive data or configuration data and when the size of internal memory is insufficient to record the required number of measurements.

To access the USB storage device, make sure that parameter 24: **USB = Pend** (USB operation set for USB memory, chapter 11.7), access to SD/MMC C memory does not require configuration.

All file and disk operations are available in the file operation menu, chapter 12. They allow the user, among others, to copy and delete archive files, check the available space, and format the selected memory.

In addition, you can select a memory to store the archive by configuring parameters 6: **SRG** (memory for recording, chapter 11.2) and 21: **RUSH** (authorization of SD and USB, chapter 11.5).

A properly installed SD/MMC card or USB memory has the following functions:

- storage of files with saved data in the course of recording
- off-line configuration of device parameters (with configuration file *AR201.cfg*, chapter 11, sec. 3)
- copying archive files with *csv* extension from the internal memory or SD/MMC card (action performed in the menu of file operations, chapter 12.).

14. VIEWING RECORDED MEASUREMENTS AND EVENTS

In order to archive the data, the recorder creates a text file with "csv" extension in one of the memories: internal, SD/MMC or USB. The file name contains the device type (AR201), the identification number **ID** (chapter 11.5, parameter 22: **ID**) and the date and time of its creation e.g. "AR201_1_2009-08-09_10-57-16.csv".

The format of a single data record is the following:

"successive number of the event;date;time;identifier of the event;argument1;check sum".

Example of a record:

"30;2009-08-09;16:34:58;5;49,5;;8BE2" (measured value : "49.5").

The types and the identifiers of the recorded events are:

- measurement (identifier of event **5**)
- connection to the USB port (**0**, "USB;CONNECTED")
- disconnection from the USB port (**1**, "USB;DISCONNEC")
- loading of a new configuration (identifier of event **3**), values of arguments:
 - "NEW;ON-LINE" - parameter configuration via the USB port or RS485 port (on-line)
 - "NEW;OFF-LINE" - parameter configuration by way of modification of *AR201.cfg* file (off-line)
 - "NEW;USER" - parameter configuration from the keypad (user) level
- creation of a new "csv" file (**4**, "ID;xxxx", where xxxx - value of parameter 22: **ID** - Identification number of the device, chapter 11.5, Table 11.5)

In order to present graphics or text and to print the recorded results, use ARSOFT-LOG-WZ3 software, which also allows you to detect unauthorized modifications in the archive. As an alternative, csv files can be edited in spreadsheet software (e.g. OpenOffice Calc, Microsoft Excel

- with large files in Excel2007 version) and text editors (Windows WordPad, Notepad ++).

CAUTION: 

If SD/MMC or USB memory is installed or removed in the course of recording, a new "csv" file is created where the successive numbers of events are continued from the previous file.

15. MESSAGE AND ERROR SIGNALLING

a) measurement errors:

Code	Possible causes of the error
----	- exceeding the measuring range of the sensor from above - sensor damage
----	- attached sensor is different than the one set in configuration (chapter 11.3, parameter 7: rnP)
----	- exceeding the measuring range of the sensor from below - sensor damage
----	- attached sensor is different than the one set in configuration (chapter 11.3, parameter 7: rnP)

b) instantaneous messages (not requiring user intervention):

Code	Description of the message
Code	entering the access password for the configuration parameters and file operations
Err	incorrect password
Conf	input in the parameter configuration
File	entering the file operation menu

c) signalling the status of performed file and disk operations (the message shown in the display must be acknowledged by pressing **[SET]** button):

Code	Description of the message or error
r-u	operation in progress (copying or deleting files, formatting the memory)
r-d	operation completed successfully (copying or deleting files, formatting the memory)
E-nR	operation not allowed in USB mode (disconnect the USB cable from the computer)
E-Fu	memory full, recording rejected (recording suspended until space is available)
E-SR	SD/MMC card is not available (no memory in SD slot)
E-UR	Memory (pendrive) is not available (no memory in the USB port)
E-nF	lack of archive files (csv) in the memory
E-cR	no configuration file (<i>AR201.cfg</i>) to copy (from SD or USB)
r-cl	new configuration set (file <i>AR201.cfg</i> copied or the default file restored)

16. IMPORTANT OPERATION REMARKS



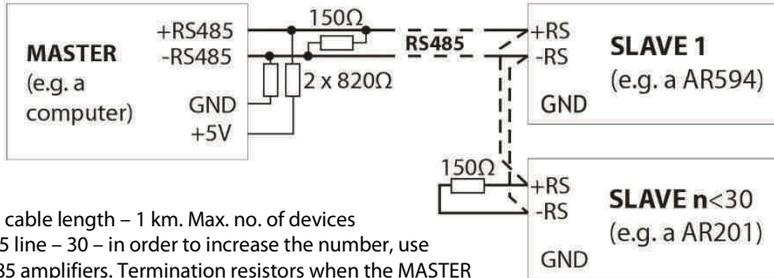
In order to ensure problem-free and optimum operation of the recorder, please observe the following guidelines:

- do not disconnect the device from the computer in the course of communication via the USB interface, which is indicated by LED **[R/W]** and in ARSOFT-CFG-WZ1 software. USB communication is in place when the mass memory is operated (internal or SD/MMC card) and during the operation of ARSOFT-CFG-WZ1.
- delete unnecessary files from the internal memory, SD or the USB memory before new recording starts
- store the copy of the current configuration file (*AR201.cfg*) in an external memory (SD/MMC, USB, computer drives, etc.)
- **do not allow power supply loss during data saving**, particularly in the

internal memory, as this may lead to the risk of errors in the FAT file system and, consequently, to problems with recording of data and loss of the current controller configuration and reverting to the default configuration. If this happens, perform the following actions from the level of file operation menu of the device or using a computer connected via the USB port:

1. copy the existing archive files to an external memory (SD, USB memory or the computer's disk)
2. format the internal memory
3. configure the recorder (manually, on-line or off-line by restoring the copy of configuration file if previously made by the user)

17. RS485 COMMUNICATION INTERFACE (acc. to EIA RS-485)



Max. RS485 cable length – 1 km. Max. no. of devices in the RS485 line – 30 – in order to increase the number, use RS485/RS485 amplifiers. Termination resistors when the MASTER is at the start of the line (fig. above):

- at the start of the line - 2 x 820 Ω to the ground and +5 V MASTER and 150 Ω between the lines;
- at the end of the line - 150 Ω between the lines.

Termination resistors when the MASTER is in the middle of the line:

- at the converter - 2 x 820 Ω to the ground and +5 V converter;
- at both ends of the line - 150 Ω each between the lines.

18. MODBUS–RTU SERIAL TRANSMISSION PROTOCOL (SLAVE)

Format of characters : 8 bits, 1 stop bit, no parity bit. Available

functions : READ - 3 or 4, WRITE - 6

Table 18.1. Request frame format for the READ function (frame length - 8 bytes):

address of the device	function n 3 or 4	register address to read: 0 ÷ 53 (0x0035)	number of read registers: 1 ÷ 54 (0x0036)	CRC check sum
1 byte	1 byte	2 bytes (HB-LB)	2 bytes (HB-LB)	2 bytes (LB-HB)

Example 18.1. Read-out of the register with address 0: 0x01 - 0x04 - 0x0000 - 0x0001 - 0x31CA

Table 18.2. Request frame format for the WRITE function (frame length - 8 bytes):

address of the device	function 6	register address to write: 0 ÷ 53 (0x0035)	write register value	CRC check sum
1 byte	1 byte	2 bytes (HB-LB)	2 bytes (HB-LB)	2 bytes (LB-HB)

Example 18.2. Recording the register with address 10 (0xA) with value 0: 0x01 - 0x06 - 0x000A - 0x0000 - 0xA9C8

Table 18.3. Response frame format for the READ function ((minimum frame length - 7 bytes):

address of the device	function 3 or 4	number of bytes in the data field (max. 54*2=108 bytes)	data field - register value	CRC check sum
1 byte	1 byte	1 byte	2 ÷ 108 bytes (HB-LB)	2 bytes (LB-HB)

Example 18.3. Response frame for register value equal to 0: 0x01 - 0x04 - 0x02 - 0x0000 - 0xB930

Table 18.4. Response frame format for the WRITE function (frame length - 8 bytes):

copy of the request frame for the WRITE function (Table 18.2)

Table 18.5. Special answer (errors: function field = 0x84 or 0x83 in the case of READ function and 0x86 in the case of WRITE function):

Error code (HB-LB in the data field)	Description of error
0x0001	non-existing register address
0x0002	wrong write register value
0x0003	improper function number

Example 18.5. Error frame for a non-existing register address to read: 0x01 - 0x84 - 0x02 - 0x0001 - 0x5130**Table 18.6. Map of registers for MODBUS-RTU**

Register address HEX (DEC)	Value (HEX or DEC)	Description of register and access type (R- read only register, R/W - read and write register)	
0x00 (0)	0	not used	R
0x01 (1)	201	ID of the device type	R
0x02 (2)	100 ÷ 999	recorder's software (firmware) version	R
0x03 (3)	-100 ÷ 700	internal device temperature (resolution 0.1°C)	R
0x04 ÷ 0x0B	0	not used or reserved	R
0x0C (12)	-1999 ÷ 19999	measurement value	R
0x0D ÷ 0x13	0	not used	R
0x14 (20)	0 ÷ 6	day of the week in the internal RTC clock (counted based on the date)	R
0x15 (21)	0x0101 ÷ 0x630C	years (HB) and months (LB)	R/W
0x16 (22)	0x0100 ÷ 0x1F17	days (HB) and hours (LB)	Internal Real-Time-Clock (RTC, chapter 11.1)
0x17 (23)	0x0000 ÷ 0x3B3B	minutes (HB) and seconds (LB)	
0x18 (24)	0x0101 ÷ 0x630C	years (HB) and months (LB)	
0x19 (25)	0x0100 ÷ 0x1F17	days (HB) and hours (LB)	Parameter 1: Start : start of the time limit (chapter 11.2)
0x1A (26)	0x0000 ÷ 0x3B3B	minutes (HB) and seconds (LB)	
0x1B (27)	0x0101 ÷ 0x630C	years (HB) and months (LB)	Parameter 2: Stop : end of the time limit (chapter 11.2)
0x1C (28)	0x0100 ÷ 0x1F17	days (HB) and hours (LB)	
0x1D (29)	0x0000 ÷ 0x3B3B	minutes (HB) and seconds (LB)	
0x1E (30)	1 ÷ 9999	Parameter 3: rPER data recording interval (chapter 11.2) – number of seconds	R/W
0x1F (31)	0 ÷ 4	Parameter 4: rTRP recording type (chapter 11.2)	R/W
0x20 (32)	-1999 ÷ 18000	Parameter 5: rTHR release threshold (chapter 11.2)	R/W
0x21 (33)	0 ÷ 2	Parameter 6: SRdE storage memory (chapter 11.2)	R/W
0x22 (34)	0 ÷ 14	Parameter 7: inp input type (chapter 11.3)	R/W
0x23 (35)	0 ÷ 5000	Parameter 8: rREd line resistance (chapter 11.3)	R/W
0x24 (36)	0 ÷ 600	Parameter 9: CTE temperature of thermocouple cold ends (chapter 11.3)	R/W
0x25 (37)	0 ÷ 3	Parameter 10: Dot position of the dot/resolution (chapter 11.3)	R/W
0x26 (38)	-1999 ÷ 18000	Parameter 11: rBot bottom of the display range (chapter 11.3)	R/W
0x27 (39)	-1999 ÷ 18000	Parameter 12: rTop top of the display range (chapter 11.3)	R/W
0x28 (40)	0 ÷ 10	Parameter 13: rLH filtration (chapter 11.3)	R/W
0x29 (41)	-500 ÷ 500	Parameter 14: rRL zero calibration (chapter 11.3)	R/W
0x2A (42)	850 ÷ 1150	Parameter 15: rRL slope calibration (chapter 11.3)	R/W
0x2B (43)	0 ÷ 4	Parameter 16: rEYP alarm type (chapter 11.4)	R/W

0x2C (44)	0 ÷ 5000	Parameter 17: RHYS hysteresis(chapter 11.4)	R/W
0x2D (45)	-1999 ÷ 18000	Parameter 18: RSRH alarm value (chapter 11.4)	R/W
0x2E (46)	0 ÷ 2	Parameter 19: PPrd password protection (chapter 11.5)	R/W
0x2F (47)	0 ÷ 9999	Parameter 20: PRSS access password (chapter 11.5)	R/W
0x30 (48)	0 ÷ 2	Parameter 21: RUEH authorization of SD and USB (chapter 11.5)	R/W
0x31 (49)	0 ÷ 9999	Parameter 22: Id ID number (chapter 11.5)	R/W
0x32 (50)	10 ÷ 100	Parameter 23: br id display brightness (chapter 11.6)	R/W
0x33 (51)	0 ÷ 2	Parameter 24: USbR USB mode (chapter 11.7)	R/W
0x34 (52)	1 ÷ 247	Parameter 25: RRRr MODBUS-RTU address (chapter 11.7)	R/W
0x35 (53)	0 ÷ 6	Parameter 26: br speed for RS485 (chapter 11.7)	R/W

19. USER'S NOTES
