INSTRUCTION MANUAL

PROGRAMMING DEVICE FOR ANALOGUE SIGNALS
AR904

Thank you for choosing our products.
This manual will aid you with a correct and safe
use and full utilisation of the programming device.
Before installation and use
please read and understand this manual.
If you have any further questions, please contact your technical advisor.

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⚠️ Particular attention shall be paid to the texts bearing this symbol

The manufacturer reserves the right to make changes in the design and software of the device without decreasing its technical parameters.

1. *SAFETY RULES* ⚠

- Before using the device, please carefully read this instruction manual.
- in order to avoid electric shock or damage to the device, mechanical
  and electrical installation shall be carried out by qualified personnel
- before turning on the power supply, make sure that all cables are connected correctly
- before making any modifications to the wiring connections, turn off the power supply
  to the device
- ensure proper working conditions in accordance with the technical data of the device (power supply voltage,
  humidity, temperature, chapter 5)

2. *INSTALLATION GUIDELINES* ⚠

The device is designed to provide an adequate level of resistance to most disturbances that may occur in the industrial environment. In environments with unknown levels of interference, the following preventive measures are recommended to prevent possible interference with the device:
- Do not operate the unit from the same lines as high-power units without using appropriate
  network filters
- use shielding of power and signal cables, whereby the screen should be grounded
  single-point, as close to the device as possible
- avoid routing the signal cables in the immediate vicinity of and parallel to
  power cables
- it is advisable to twist the signal cables in pairs
- avoid proximity to remote-controlled equipment, electromagnetic meters, high-power loads
  phase-controlled or grouped loads and other equipment which generates
  high impulse disturbances
- ground or reset the metal rails on which the rail-mounted devices are installed

Remove the protective foil from the LED display screen before starting to operate the unit.

3. *GENERAL CHARACTERISTICS OF THE PROGRAMMING DEVICE*

- The device enables controlling or testing devices with current or voltage input.
  (proportional valves, actuators, inverters, motors, etc.)
- 2 analogue outputs (simultaneous operation):
  - current 4÷20mA or 0÷20mA (active, cannot be supplied in a two-wire current loop)
    voltage from 0÷10V
- soft start/stop (ramp) or triangular wave generator manually or automatically triggered when power
  is applied.
- programmable setpoint, output signal step change, display range, initial setpoint after power supply
  start, soft start/stop, communication, access and other configuration parameters
- 7-segment LED display with brightness control
- optional RS485/RS232 serial interface (galvanically isolated, MODBUS-RTU protocol)
- parameter configuration methods:
  - using an IP65 foil keypad located on the front panel of the device
  - using an AR955 programmer or the RS485/RS232 interface and a free computer program
    ARSOFT- WZ1 (Windows 2000/XP/Vista/7/8)
- software and programmer which allow to preview the setpoint and quickly configure individual or
  predefined sets of parameters previously saved on a PC for re-use, for example for other referencing
  units of the same type (configuration duplication), access to configuration parameters is protected

by a user password.
- High accuracy and immunity to interference
- available accessories:
  - programmer AR955
  - RS485 to USB converter

CAUTION ⚠️
Before commencing operation of the programming device, please read this instruction manual and correctly perform electrical and mechanical installation and configuration of parameters.

4. CONTENTS OF THE KIT

- programming device
- Instruction manual
- warranty card

5. TECHNICAL SPECIFICATIONS

Number of analogue outputs		2
- current(active) standard 0/4÷20mA **(1)**	- full range of changes	3.8÷21mA / 0÷21mA / 21÷3.8mA / 21÷0mA
	- load resistance	$R_0 \leq 1$ kΩ
	- resolution (maximum)	1,7 µA
- voltage in standard 0/2÷10V	- full range of changes	0÷10.5V / 10.5÷0V
	- load resistance	$R_0 > 2.3$ kΩ (load current $I_0 < 4.5$mA)
	- resolution (maximum)	0.84 mV
Processing errors(at ambient temperature 25˚C):		
- basic		0.1 % of full output range ±1 digit
- additional for ambient temperature changes		< 0,005 % inut range /˚C
Output response time(10÷90%)		200 ms
RS485 Communication interface	- protocol	MODBUS-RTU
	- speed	2.4 ÷ 38.4 kb/s
	- symbol format	8N1 (without parity bit, 1 stop bit)
	- galvanic separation	500V, 50Hz, 1min
Display 7-segment LED (1 line, 4 digits)	- height and colour	20mm, red (adjustable brightness)
	- range of indications	-1999 ÷ 9999, programmable
	- decimal point position	Programmable, 0 ÷ 0.000
Power supply	- 230Vac	85 ÷ 260 Vac/ 4VA
	- 24Vac/dc (optional)	20 ÷ 50 Vac/ 4VA, 20 ÷ 72 Vdc/ 4W
Nominal conditions of use		0 ÷ 50˚C, <90 %RH (w/ out condensation)
Working conditions		air and neutral gases
Protection level		IP65 from the front panel, IP20 from the connectors side
Weight		~160g
Electromagnetic compatibility (EMC)		resistance: according to EN 61000-6-2 standard
		emissivity: according to the standard PN-EN 61000-6-4

(1) the output cannot be powered by a two-wire current loop

6. ENCLOSURE MEASUREMENTS AND INSTALLATION DATA

Type of enclosure	array, Incabox XT L57
Material	self-extinguishing NORYL 94V-0, polycarbonate
Dimensions of the enclosure	96 x 48 x 79 mm
Array window	92 x 46 mm
Attachment	handles on the side of the enclosure

VIEW FROM THE SIDE OF MOUNTING HANDLE
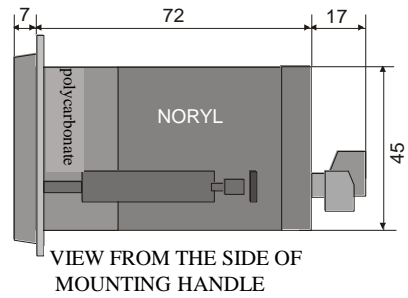
7. DESCRIPTION OF TERMINALS AND ELECTRICAL CONNECTIONS

Terminals	Description
1-2	current output 0/4÷20mA
3-4	voltage output 0÷10V
5-6-7	RS485/RS232 serial interface (MODBUS-RTU transmission protocol)
8-9	230Vac or 24Vac/dc power input
PRG	programming interface compatible with the AR955 programmer (do not use simultaneously with the RS485/RS232 interface)

a) numbering of connectors and signal output methods
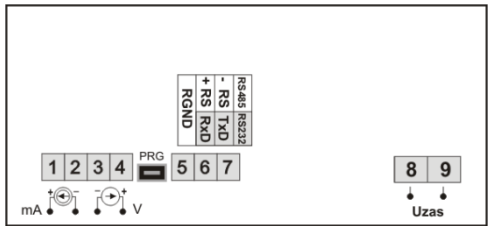
CAUTION ⚠️
Connecting devices other than the AR955 programmer to the PRG socket may damage the connected device and the AR904 programming device

8. BUTTON FUNCTIONS

7-segment LED display

programming buttons

a) button functions in setpoint display mode (normal mode)

Button	Description[and the corresponding symbol in the manual].
▲ lub ▼	**[UP]** or **[DOWN]:** Increase or decrease the setpoint of the output signal by the set change value (parameter 6:`StEP`, chapter 10)
SET + ▲	**[SET]** + **[UP]:** - incremental (extreme) change of the setpoint value of the output signal - highest value of the indication range (parameter 3:`rtoP`) or limiting the setting (5:`LtoP`)
SET + ▼	**[SET]** + **[DOWN]:** - incremental (extreme) change of the setpoint value of the output signal - lowest value of the indication range (parameter 2:`rbot`) or limiting the setting (4:`Lbot`)
▲ + ▼	**[UP]** and **[DOWN]** (simultaneously): entering the parameter configuration menu (hold pressed for more than 1 sec.) If parameter 13:`PPro=on`(password protection is enabled) enter the password (chapter 10)

SET [SET]	Start/stop the soft start/stop function
	  (hold pressed for more than 1.5 seconds). If parameter 8:`riSE` and 9:`FALL` = `oFF`
	  the function is inactive (chapter 11)

(b) button functions in the parameter configuration menu (Chapter 10)

Button	Description
SET [SET]	- editing the current parameter - confirm and save the edited parameter value
▲ lub ▼	**[UP]** or **[DOWN]:** - move to the next or previous parameter name - change the value of the edited parameter
▲ + ▼	**[UP]** and **[DOWN]** (simultaneously): - cancelling changes in the edited value (return to parameter name) Return to the setpoint display mode (hold pressed for > 0.5s).

9. CHANGING THE OUTPUT SETPOINT

Pressing the [**UP**] or [**DOWN**] button in the setpoint value display mode causes to change the value by a step (parameter 6:`StEP`, chapter 10, Table 10). Changes in the output signal are proportional to the changes in the displayed value. Using a combination of buttons**[SET]**+**[DOWN]** instantly sets the output level to the lowest possible value (2:`rbot` or 4:`Lbot`) while **[SET]**+**[UP]** sets it to the highest possible value (3:`rtoP` or 5:`LtoP`). In addition, the output signal can be also set in the parameter programming mode (parameter 7:`SEt`) and via the serial interface RS485/RS232 or AR955 programmer (Chapter 15, Table 15). Additionally, it is possible to set the value to a level which exceeds the range of parameters 2:`rbot` and 3:`rtoP`. The value of the overdrive for buttons is ±5% for the 4÷20mA (2÷10V) output and +6.2% for the remaining outputs.

10. SETTING CONFIGURATION PARAMETERS

All configuration parameters of the device are contained in EEPROM internal memory.
There are two ways to configure the parameters:

1. With IP65 foil keypad on the front panel of the device:
- enter the configuration menu from the setpoint display mode (by simultaneously pressing
   [UP] and **[DOWN]** for a time greater than 1 sec.) If parameter 13:**PPro** = **on** (password protection is

   on) the following message will appear on the display **CodE**, followed by **0000** with the first digit
   blinking, using the **[UP]** or **[DOWN]** button, enter the access password (by default, parameter
   12:**PASS** = **1111**), moving across positions and entering the code can be done with the **[SET]** button.

- after entering the configuration menu, the mnemonic names of the parameters are displayed (**outP** <->

   dot <-> **rbot** <-> itd.), pressing the **[UP]** button allows to move to the next parameter, while pressing the **[DOWN]** button moves to
   the previous parameter (for a consolidated list of configuration parameters, see Table 10)

   - in order to change or preview the value of the current parameter press the **[SET]** button
   - by pressing **[UP]** or**[DOWN]** you can change the value of the edited parameter
   - the modified value of a parameter can be confirmed by pressing the **[SET]** button or cancelled by pressing **[UP]** and **[DOWN]**
   (simultaneously), which will in turn display the name of the parameter

2. Via RS485/RS232 port**or** the AR955 programming set and the ARSOFT-WZ1 computer software:
   - connect the referencing-unit to the computer port and start the ARSOFT-WZ1 application
   - after the connection has been established, the current setpoint is displayed in the program window.
   - setting and previewing the parameters of the device is available in the parameter configuration window.
   the new parameter values must be confirmed by pressing *Approve changes*
   - the current configuration can be saved to a file, values can be also loaded from a file

   CAUTION: ⚠
   Do not use both the RS485/RS232 port and the AR955 programming set at the same time, because
    this will cause communication errors.

To restore the factory settings when turning the device on simultaneously press**[UP]**and **[DOWN]** buttons until the password entry menu appears (**CodE**), and then enter the code **0112**. Alternatively, you can use the default configuration file in ARSOFT-WZ1.

Table 10. Configuration parameters

Parameter	Range of parameter variation and description		Factory settings
0:**outP** type of current and voltage output	**4-20**	standard 4..20 mA (0..10V)	**4-20**
	0-20	standard 0..20 mA (0..10V)	
1:**dot** dot position	**0**	no dot	**1** (0.0)
	1	**00**	

		2	**000**				
		3	**0000**				
2:**rbot** the bottom of the display range		**-1999** ÷ **9999** units - display for 0mA, 4mA, 0V - beginning of output scale					**0.0**
3:**rtoP** upper range of indications		**-1999** ÷ **9999** units - display for 20mA, 10V - end of output scale					**100.0**
4:**Lbot** set lower limit		**-1999** ÷ **9999** units, lower setpoint limit (Parameter 7:**SEt**) when setting up using the buttons on the device					**-1999**
5:**LtoP** upper limit		**-1999** ÷ **9999** units, upper setpoint limit (Parameter 7:**SEt**) when setting up using the buttons on the device					**9999**
6:**StEP** step change		**0** ÷ **5000** units, step change for the setpoint (parameter 7:**SEt**) when setting up using the buttons on the device					**10**
7:**SEt** setpoint		Lower limit: parameter 2:**rbot** or 4:**Lbot**, upper limit: parameter 3:**rtoP** or 5:**LtoP**, change step: 6:**StEP**, when setting up using the buttons on the device					**0.0**
8:**rISE** soft start time		**oFF** **1** ÷ **8160** s	the duration of the rising slope (ramp), for the value of **oFF** function switched off, description in chapter 11				**oFF** deactivated
9:**FALL** soft stop time		**oFF** **1** ÷ **8160** s	duration of descending slope (ramp), for values **oFF** function switched off, description in chapter 11				**oFF** deactivated
10:**trIG** ramp release mode		**Auto** automatic	soft start/stop (ramp) trigger after each power-on (chapter 11)				**MAnu** Manual operation
		MAnu manual	soft start/stop (ramp) triggering by means of a manual push-button **[SET]** (Chapter 11)				
11:**bLSE** Setpoint setting lock		**oFF** deactivated	setpoint change inhibition disabled by pushbuttons				**oFF** deactivated
		on activated	button lock activated				
12:**PASS** access password		**0000** ÷ **9999**	password for accessing the setup menu				**1111**
13:**PPro** password protected configuration		**oFF**	access to configuration menu **is not** password-protected				**oFF** deactivated
		on	Entering the configuration menu is protected by an access password.				
14:**brIG** display brightness		**10** ÷ **100** %, change by 10%					**100** %
15: **Addr** MODBUS-RTU address		**1** ÷ **247**	the individual address of the device in the RS485 network (chapter 13) or for the AR955 programming unit				**1**
16: **br** RS485/232 or AR955 programmer transmission speed		**2.4** kbit/s	**4.8** kbit/s	**9.6** kbit/s	**19.2** kbit/s	**38.4** kbit /s	**19.2** kbit/s
17: **Sin** start setpoint (7:**SEt**) after powering on **(1)**		**LASt**	last stored setpoint (7:**SEt**)				**LASt**
		bot	range start (2:**rbot**) or set lower limit (4:**Lbot**)				
		toP	range end (3:**rtoP**) or set upper limit (5:**LtoP**)				

Remarks: (1) – parameter available since version **u-22** (device firmware can visible after powering on)

11. SOFT START / STOP AND TRIANGLE WAVE GENERATOR

The device is equipped with the function of a ramp (soft start and stop) operating according to the diagrams below (Figures 11.1, 11.2, 11.3). In order to start the function, the soft start time (ascending slope, parameter 8) must be configured: r.SE Chapter 10) or of the soft stop (falling slope, 9:FALL) and the method of triggering (triggering, 10:tr.iG). If both times are non-zero (8:r.SE and 9:FALL) a periodical triangle wave is generated at the outputs. The limit values (amplitudes) of the output signals are defined by the following parameters 2:rbot, 3:rtoP, 4:Lbot and 5:LtoP.

This function is activated automatically after the power supply is switched on (when parameter 10:tr.iG = Auto) or manually (10:tr.iG = MAnu) with the **[SET]** button (hold pressed for longer than 1.5 sec). In addition, the ramp can be stopped and restarted at any time by pressing the **[SET]** button (a momentary message StAr appears for start or StoP - for stop)**.**

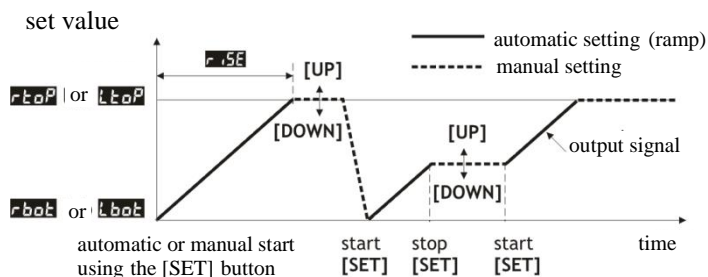Output status in this mode is automatically updated 4 times per second.

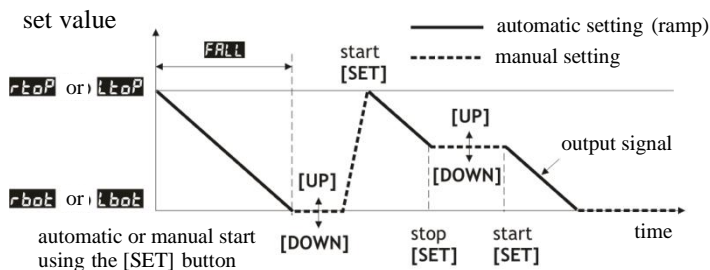Fig.11.1 Principle of operation of outputs in the **soft start** mode (parameter r.SE > 0, FALL = oFF).

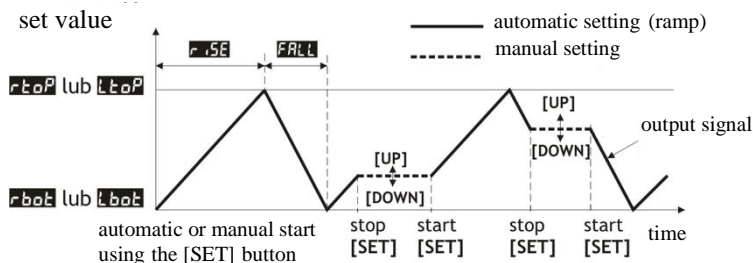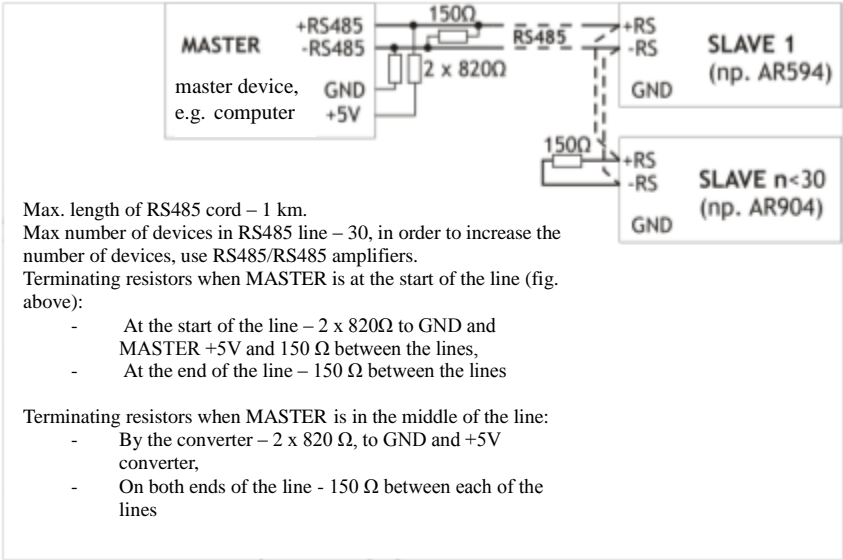Fig.11.2 Principle of operation of outputs in the **soft stop** mode (parameter r.SE = oFF, FALL > 0).

Fig.11.3 Zasada działania outputs in the **triangle wave generator** mode (parameter r.SE > 0, FALL > 0).

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12. MESSAGES AND ERRORS

The following instantaneous messages may appear while the unit is operating:

Code	Message description
CodE	Entering the password mode for accessing configuration parameters (chapter 10).
Err	an incorrect password has been entered
ConF	Entering the parameter configuration menu.
bLoc	setpoint setting lock on (11: bLSE = on, Chapter 10)
rRMP	Setpoints lock due to activating ramp function (Chapter 11)
StRr	Manual starting of the soft start or stop function (**[SET] button**)
StoP	Manual stopping of the soft start or stop function (**[SET] button**)

13. COMMUNICATION INTERFACE RS485 (in accordance with EIA RS-485)

Max. length of RS485 cord – 1 km.
Max number of devices in RS485 line – 30, in order to increase the number of devices, use RS485/RS485 amplifiers.
Terminating resistors when MASTER is at the start of the line (fig. above):
-    At the start of the line – 2 x 820Ω to GND and MASTER +5V and 150 Ω between the lines,
-    At the end of the line – 150 Ω between the lines

Terminating resistors when MASTER is in the middle of the line:
-    By the converter – 2 x 820 Ω, to GND and +5V converter,
-    On both ends of the line - 150 Ω between each of the lines

Devices of different manufacturers that form RS485 network (e.g. RS485/USB converters) can have built-in polarizing and terminating resistors, and then there is no need to use external elements.

14. COMMUNICATION INTERFACE RS232C (in accordance with EIA RS-232C)
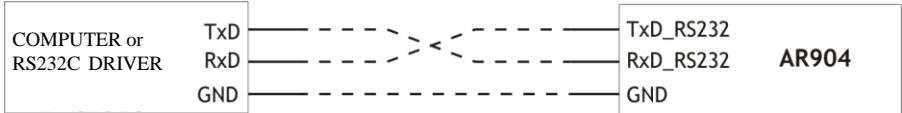
Maximum cable length – 10 m.
Maximum number of devices connected to a computer – 1.

15. SERIAL TRANSMISSION PROTOCOL MODBUS – RTU

Character Format: 8 bits, 1 stop bit, without parity
Available functions: READ - 3 or 4, WRITE - 6

Table 15.1. Frame format request for READ function (frame length - 8 bytes):

device address	function 4 or 3	Registry address to be read: 0 ÷ 23 (0x0017)	number of registers to be read: 1 24 (0x0018)	CRC checksum
1 byte	1 byte	2 bytes (HB-LB)	2 bytes (HB-LB)	2 bytes (LB-HB)

Example 15.1. Registry readout with address 0: 0x01 - 0x04 - 0x0000 - 0x0001 - 0x31CA

Table 15.2. Frame format request for WRITE function(Frame length - 8 Bytes):

device address	function 6	registry address for recording: 0 ÷ 23 (0x0017)	value of the registry to be recorded	CRC checksum
1 byte	1 byte	2 bytes (HB-LB)	2 bytes (HB-LB)	2 bytes (LB-HB)

Example 15.2. Saving registry with address 10 (0xA) with value 0: 0x01 - 0x06 - 0x000A - 0x0000 - 0xA9C8

Table 15.3. Frame format for READ output (minimum frame length - 7 bytes):

device address	function 4 or 3	number of bytes in the data field, (maximum 24*2=48 bytes)	data field - value of the register	CRC checksum
1 byte	1 byte	1 byte	2 ÷ 48 bytes (HB-LB)	2 bytes (LB-HB)

Example 15.3. The response frame for a registry value of 0: 0x01 - 0x04 - 0x02 - 0x0000 - 0xB930

Table 15.4. Frame format for WRITE output (frame length - 8 bytes):

a copy of the request frame for the WRITE function (Table 15.2)

Table 15.5. The specific answer is (Errors: field function = 0x84 or 0x83 when READ function was performed and 0x86 when WRITE function was performed):

Error code (HB-LB in the data field)	Error description
0x0001	non-existent registry address
0x0002	incorrect value of registry to be saved
0x0003	Incorrect function number

Example 15.5. Error frame for a non-existent readable registry address:

0x01 - 0x84 - 0x02 - 0x0001 −0x5130

Table 15.6. Map of registers for the MODBUS-RTU protocol

Registry address hex (dec)	Value DEC	Register description and type of access (Read-only R-register, read-only R/W-write-only)	
0x00 (0)	-1999 ÷ 9999	current setpoint (register in RAM)	R/W
0x01 (1)	904	device type identifier	R
0x02 (2)	20 ÷ 99	firmware version of the recorder	R
0x03 ÷ 0x05	0	not used or reserved	R

0x06 (6)	0 ÷ 1	Parameter 0: **outP** output type (Chapter 10, Table 10)	R/W
0x07 (7)	0 ÷ 3	Parameter 1: **dot** decimal point position	R/W
0x08 (8)	-1999 ÷ 9999	Parameter 2: **rbot** lower range of indications	R/W
0x09 (9)	-1999 ÷ 9999	Parameter 3: **rtoP uPPEr** upper range of indications	R/W
0x0A (10)	-1999 ÷ 9999	Parameter 4: **Lbot LoUEr** lower adjustment limit	R/W
0x0B (11)	-1999 ÷ 9999	Parameter 5: **LtoP** upper adjustment limit	R/W
0x0C (12)	1 ÷ 5000	Parameter 6: **StEP** change step	R/W
0x0D (13)	-1999 ÷ 9999	Parameter 7: **SEt** setpoint	R/W
0x0E (14)	0 ÷ 8160	Parameter 8: **riSE** soft start time	R/W
0x0F (15)	0 ÷ 8160	Parameter 9: **FALL** soft stop time	R/W
0x10 (16)	0 ÷ 1	Parameter 10: **tr_ro** ramp release mode	R/W
0x11 (17)	0 ÷ 1	Parameter 11: **bLSE** setpoint setting lock	R/W
0x12 (18)	0 ÷ 9999	Parameter 12: **PASS** password	R/W
0x13 (19)	0 ÷ 1	Parameter 13: **PPro** password data protection	R/W
0x14 (20)	10 ÷ 100	Parameter 14: **br_ro** display brightness	R/W
0x15 (21)	1 ÷ 247	Parameter 15: **Rddr** MODBUS-RTU address	R/W
0x16 (22)	0 ÷ 4	Parameter 16: **br** data transfer speed for RS485/RS232 or the AR955 programmer	R/W
0x17 (23)	0 ÷ 2	Parameter 17: the initial setpoint after the power supply has started	R/W

16. NOTES