NZM-XATS-C... Automatic Transfer Switch-Controller Modbus® Communication Protocol

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The German-language edition of this document is the original operating manual.

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Content

0 About this Manual

This manual describes the installation, programming and commissioning of communication protocols Modbus RTU® and Modbus ASCII® for NZM-XATS-C96 and NZM-XATS-C144.

The current edition of this manual in other languages can be obtained from the Internet: www.moeller.net/support.

0.1 Target group

An NZM-XATS-C… must be installed and connected only by qualified electricians or other persons familiar with the installation of electrical equipment.

0.2 Exclusion of liability

In the event of improper use the manufacturer accepts no liability for the device's electrical safety.

The products described in this document are subject to change. The descriptions and data in the catalog are therefore not binding.

0.3 Device designations and abbreviations

The following terms are used for device models if the description applies to all of these models: NZM-XATS-C… for NZM-XATS-C96 and NZM-XATS-C144

The following abbreviations are used:
LSB = Least Significant Byte
MSB = Most Significant Byte

0.4 Writing conventions

The symbols used in this manual have the following meanings:

▶ indicates actions to be taken.

NOTICE

Warns about the possibility of material damage.

CAUTION

Warns of the possibility of hazardous situations that can cause injury.

WARNING

Warns of the possibility of hazardous situations that could result in serious injury or even death.

DANGER

Warns of hazardous situations that result in serious injury or death.

Draws your attention to useful or additional information.

For clarity, the name of the current chapter is shown in the first headline and the name of the current section in the second headline.

1 General

1.1 The Modbus® protocol

NZM-XATS-C… Automatic Transfer Switch-Controllers support communication protocols Modbus® RTU and Modbus® ASCII through serial RS-232 and – in the case of NZM-XATS-C144 – RS-485 interfaces.

In conjunction with application-specific software NZM-XATS-CSOFT, this function allows the use of a third-party standard control and monitoring application (SCADA) or of devices with Modbus® interface – such as PLCs and intelligent terminals – for reading device states and monitoring and controlling NZM-XATS-C….

1.2 Setting parameters

To configure the Modbus® protocol, call up menu P7 – serial interface as follows:

1.2.1 Setting parameters for NZM-XATS-C144

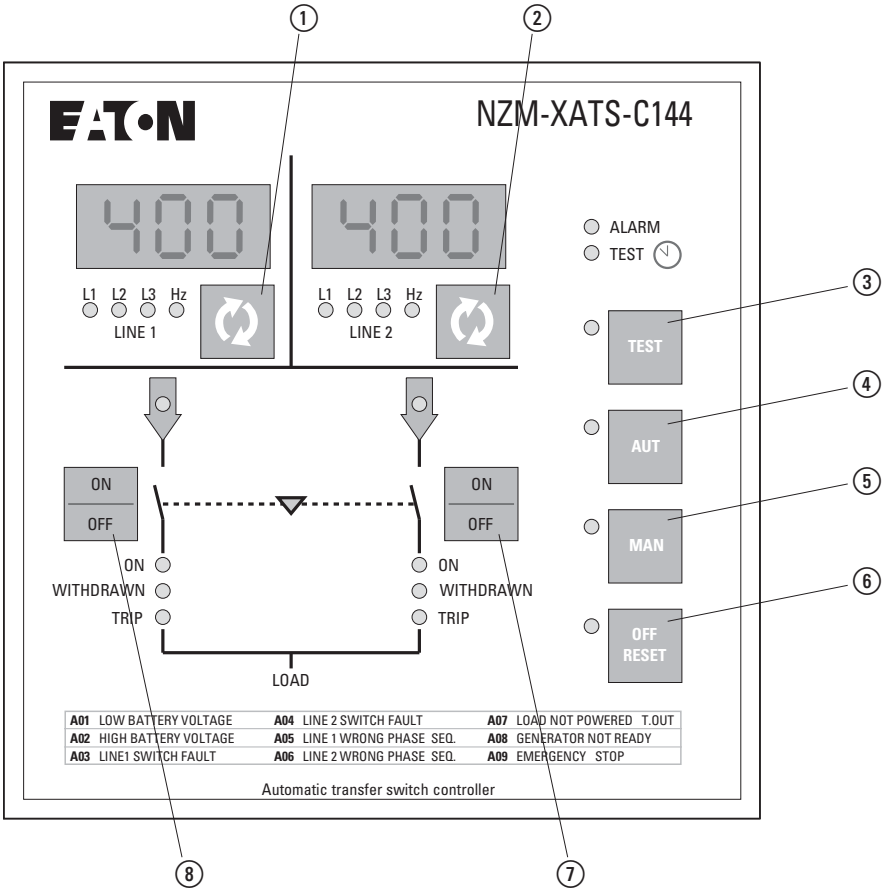

Figure 1: Operator panel of the NZM-XATS-C144

When the NZM-XATS-C144 is in OFF–Reset mode, press and hold keys ① and ⑥ at the same time for five seconds.

The display shows the code of the first parameter, P1.01, i.e. menu P1, parameter 01.

To move between the parameters within a menu, use keys ① and ⑧.

The parameter designation is shown in the display for LINE 1 and the current setting on the display for LINE 2.

To change the value of the selected parameter, use keys ② and ⑦.

The setting is saved automatically when you select another parameter or exit the menu.

To exit the parameter setup menu, press key ⑥.

If you do not press a key for more than two minutes, the device automatically exits the setup menu without saving your changes.

1.2.2 Setting parameters for NZM-XATS-C96

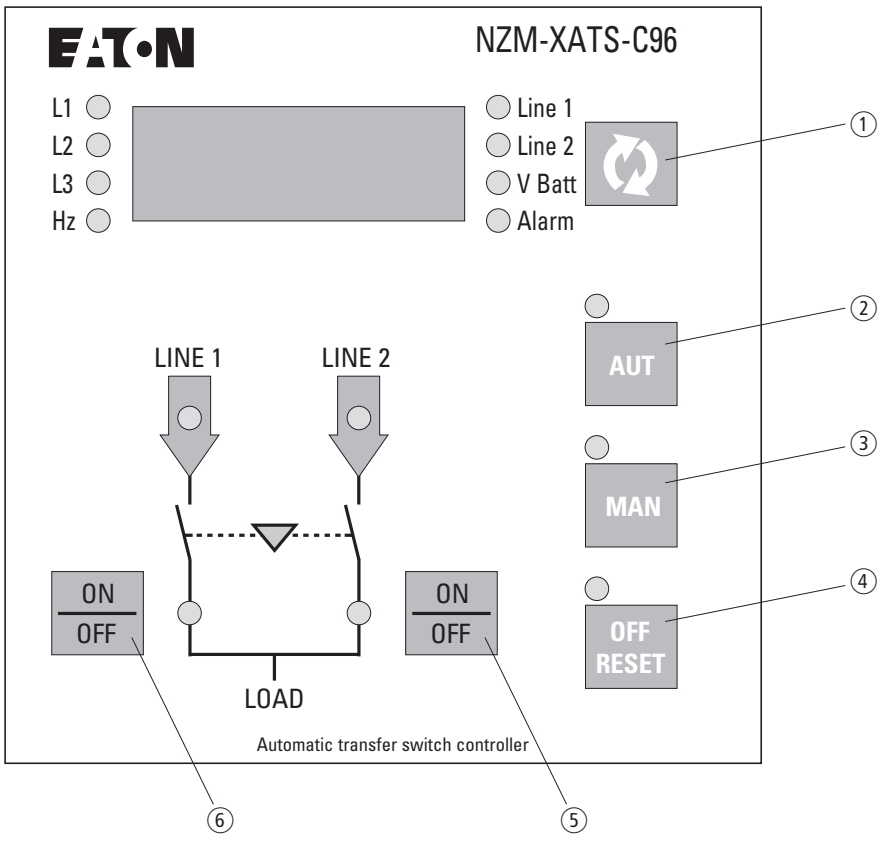

Figure 2: Operator panel of the NZM-XATS-C96

When the NZM-XATS-C96 is in OFF–Reset mode, press and hold keys ① and ④ at the same time for five seconds. The SETUP menu appears. Wait a few seconds or press key ④ to call up the menu.

The display shows the code of the first parameter, P1.01, i.e. menu P1, parameter 01.

To move between the parameters within a menu, use keys ① and ②.

To select the previous or next menu, use keys ⑤ and ⑥.

To switch from the parameter name display to the parameter's value, press key ③.

To change the value of the selected parameter, use keys ① and ②.

To exit the parameter setup menu, press key ④.

To return to the default setting, press keys ⑤ and ⑥ at the same time.

If you do not press a key for more than two minutes, the device automatically exits the setup menu without saving your changes.

1.3 Menu P7 – Serial connection

PAR	Function	Range	Default
P7.01	Address RS232	1 - 245	1
P7.02	Speed RS232 baud	2400 4800 9600 19200 38400	9600
P7.03	Protocol RS232	Rtu – RTU ASC – ASCII Mod – ASCII + ATL	rtu
P7.04	Parity RS232	Non – none Odd – odd EvE – even	non
P7.05[1)]	Address RS485	1 - 245	1
P7.06[1)]	Speed RS485 baud	2400 4800 9600 19200 38400	9600
P7.07[1)]	Protocol RS485	Rtu – RTU ASC – ASCII Mod – ASCII + ATL	rtu
P7.08[1)]	Parity RS485	Non – none Odd – odd EvE – even	non

[1)]Only for NZM-XATS-C144

2 Modbus® RTU protocol

In the Modbus® RTU protocol messages are referred to as frames and have the following structure:

T1 T2 T3	Address (8 bits)	Function (8 bits)	Data (n x 8 bits)	CRC (16 bits)	T1 T2 T3

- The Address field contains the address of the slave to which the message is sent.
- The Function field contains the code for the function that the slave is to perform.
- The Data field contains the data sent to the slave or sent by the slave in response to a command.
- On NZM-XATS-C... the Data field can have a length of up to 60 registers of 16 bits (120 bytes) each.
- The CRC field allows master and slave to check for transmission errors. Any frames containing errors are ignored to prevent problems on the master and slave side.
- Sequence T1 T2 T3 corresponds with the time during which no data can be transmitted through the communication bus to allow the connected devices to recognize the end of one frame and the start of the next. This pause in transmissions must have a duration corresponding with at least 3.5 characters.

NZM-XATS-C… measures the time between each two consecutively received characters. If this time exceeds the time required to send 3.5 characters – which depends on the set baud rate – the next character is regarded as the start of a new frame.

2.1 Modbus® functions

Available functions are:

04 = Read Input Register	Allows reading of the readings saved in the NZM-XATS-C…
06 = Write Single Register	Allows setting of parameters.
07 = Read Exception Status	Allows reading of the status of the NZM-XATS-C…
10 = Write Multiple Register	Allows setting of multiple parameters.
17 = Report station ID	Allows reading out device-related data.

For example, the battery voltage in register 30 ($1E_{hex}$) of the NZM-XATS-C… with address 01 is read out with the following frame:

01	04	00	1D	00	02	E1	CD

The codes have the following meanings:

B01	Station address
04	Function Read Input Register
00 1D	Address of register, **reduced by 1**, Table 2, page 19
00 02	Number of registers to be read out starting at address 30.
E1 CD	Checksum CRC

As defined by the Modbus® standard, the address given in the frame is reduced by 1 relative to the address in the table.

The response from the NZM-XATS-C… is:

01	04	04	00	00	00	7C	FA	65

The codes have the following meanings:

01	Address of the NZM-XATS-C… (slave 01).
04	Function requested by the master
04	Number of bytes sent by the NZM-XATS-C…
00 00 00 7C	Battery voltage as a hex value = 124 = 12.4 V
FA 65	Checksum CRC

2.2 Function 04: Read Input Register

Function 04 allows reading out of one or more consecutive variables in memory. The address of each variable is listed in the tables on the last page of these instructions (Table 2, page 19 ff.)

As defined by the Modbus® standard, the address given in the frame is reduced by 1 relative to the address in the table.

If the table does not contain the requested address or the number of polled registers exceeds 60, the NZM-XATS-C… returns an error message (Table 1, page 12).

2.2.1 Example request from the master:

08	04	00	0F	00	08	21	57	65

08	Station address
04	Function
00	MSB of register address
0F	LSB of register address
00	MSB, number of registers
08	LSB, number of registers
21	MSB CRC
57	LSB CRC

In the example slave number 8 requests 8 consecutive registers starting with address 10_{hex} ($0F_{hex}$ + 01_{hex}).

Accordingly, register 10_{hex} to 17_{hex} are read out. The command always ends with the CRC checksum.

2.2.2 Example response from slave:

08	04	10	00	00	…	00	00	5D	83

08	Station address
04	Function
10	Number of bytes
00	MSB, data 10_{hex}
00	LSB, data 10_{hex}
----	Data MSB 11_{hex} to LSB 16_{hex}
00	MSB, data 17_{hex}
00	LSB, data 17_{hex}
5D	MSB CRC
83	LSB CRC

The reply always consists of the slave's address, the function requested by the master and the data from the requested registers. The response always ends with the CRC checksum.

2.3 Function 06: Write Single Register

This function allows writing to registers with an address above 1000_{hex}. It can be used, for example, to set the setup parameters. If the set value does not lie between the min. and max. values in the table, the NZM-XATS-C… responds with an error message. If a parameter at a non-existent address is requested, an error message is also returned. The valid ranges for each parameter are listed in the tables below (Table 17, page 26 to Table 18, page 29).

Function 06 can also be used to execute commands, for example a switch from automatic to manual or vice versa. The addresses and values listed in the table below apply (Table 13, page 24).

2.3.1 Example request from the master:

08	06	16	03	00	1D	FD	13

08	Station address
06	Function
16	MSB of register address
03	LSB of register address
00	MSB of data
1D	LSB of data
FD	MSB CRC
13	LSB CRC

2.3.2 Example response from slave:

08	06	16	03	00	1D	FD	13

The response is an echo of the request, i.e. the slave transmits the address of the value to be changed or the parameter's new value.

2.4 Function 07: Read Exception Status

This function allows reading of the current status of an NZM-XATS-C….

2.4.1 Example request from the master:

08	07	47	m2

08	Station address
07	Function
47	MSB CRC
m2	LSB CRC

The table below lists the meanings of the byte that the NZM-XATS-C… sends as its reply:

BIT	Meaning
0	Operating mode OFF–Reset
1	Operating mode MAN
2	Operating mode AUT
3	Operating mode TEST (NZM-XATS-C… only)
4	Failed
5	AC supply voltage applied (NZM-XATS-C… only)
6	DC supply voltage applied
7	Global alarm activated

2.5 Function 17: Report Slave ID

With this function the slave type can be determined.

2.5.1 Example request from the master:

08	11	C6	7C

08	Station address
11	Function
C6	MSB CRC
7C	LSB CRC

2.5.2 Example response from slave:

08	11	04	60	04	00	01	…	…

08	Station address
11	Function
04	Counter bytes
60	Value 1 (device model)
04	Value 2 (software version)
00[1)]	Value 3 (hardware version)
01	Value 4 (parameter version)
…	MSB CRC
…	LSB CRC

[1)] 60_{hex} = NZM-XATS-C96, 61_{hex} = NZM-XATS-C144

2.6 Error

If the slave receives a corrupt frame, it sends a message to the master consisting of the requested function in OR with 80_{hex}, followed by an error code.

The error codes the slave sends to the master are summarized in the table below.

Table 1: Error codes

COD	**Failed**
01	Function invalid
02	Invalid register address
03	Parameter value outside range
04	Function cannot be performed
06	Slave busy, function currently unavailable

2.7 Function 16: Write Multiple Registers

With this function several consecutive parameters or parameters consisting of more than two bytes can be changed. The address and valid range for each parameter are listed in the table below (→ Section "2.1 Modbus® functions", page 8).

2.7.1 Example request from the master:

08	10	20	01	00	02	01	F4	06	83	55	3A

08	Station address
10	Function
20	MSB of register address
01	LSB of register address
00	MSB, number of registers
02	LSB data register: 2
01	MSB data register: 1
F4	LSB data register: 1
06	MSB data register: 2
83	LSB data register: 2
55	MSB CRC
3A	LSB CRC

2.7.2 Example response from slave:

08	10	20	01	00	02	9C	53

08	Station address
10	Function
20	MSB of register address
01	LSB of register address
00	MSB number of bytes
02	LSB number of bytes
9C	MSB CRC
53	LSB CRC

2.8 Calculation of the CRC (CHECKSUM for RTU)

Calculation example:

Data transmission block = frame = 0207_{hex}

Initialization CRC	**1111**	**1111**	**1111**	**1111**
Load first byte			0000	0010
Execute XOR with the first byte of the frame	1111	1111	1111	1101
Execute first shift to right	0111	1111	1111	1110 **1**
Carry=1, load polynomial	1010	0000	0000	0001
Execute XOR with the polynomial	1101	1111	1111	1111
Execute second shift to right	0110	1111	1111	1111 **1**
Carry=1, load polynomial	1010	0000	0000	0001
Execute XOR with the polynomial	1100	1111	1111	1110
Execute third shift	0110	0111	1111	1111 **0**
Execute fourth shift	0011	0011	1111	1111 **1**
Carry=1, load polynomial	1010	0000	0000	0001
Execute XOR with the polynomial	1001	0011	1111	1110
Execute fifth shift to right	0100	1001	1111	1111 **0**
Execute sixth shift to right	0010	0100	1111	1111 **1**
Carry=1, load polynomial	1010	0000	0000	0001
Execute XOR with polynomial	1000	0100	1111	1110
Execute seventh shift to right	0100	0010	0111	1111 **0**
Execute eighth shift to right	0010	0001	0011	1111 **1**
Carry=1, load polynomial	1010	0000	0000	0001
Second byte of			0000	0111
Load frame				
Execute XOR with the second byte of the frame	1000	0001	0011	1001
Execute first shift to right	0100	0000	1001	1100 **1**

Initialization CRC	**1111**	**1111**	**1111**	**1111**
Carry=1, load polynomial	1010	0000	0000	0001
Execute XOR with the polynomial	1110	0000	1001	1101
Execute second shift to right	0111	0000	0100	1110 **1**
Carry=1, load polynomial	1010	0000	0000	0001
Execute XOR with the polynomial	1101	0000	0100	1111
Execute third shift to right	0110	1000	0010	0111 **1**
Carry=1, load polynomial	1010	0000	0000	0001
Execute XOR with the polynomial	1100	1000	0010	0110
Execute fourth shift to right	0110	0100	0001	0011 **0**
Execute fifth shift to right	0010	0100	0000	1001 **1**
Carry=1, load polynomial	1010	0000	0000	0001
Execute XOR with the polynomial	1001	0010	0000	1000
Execute sixth shift to right	0100	1001	0000	0100 **0**
Execute seventh shift to right	0010	0100	1000	0010 **0**
Execute eighth shift to right	0001	0010	0100	0001 **0**
Result CRC	**0001**	**0010**	**0100**	**0001**
		12_{hex}		**41_{hex}**

Byte 41_{hex} is transmitted first (even if it is the LSB); then 12_{hex} is sent.

3 Modbus® ASCII protocol

The Modbus® ASCII protocol is generally used for applications in which several modems are used for communications.

The available functions and addresses correspond with those of the RTU version except that the characters are transmitted as ASCII and the frame end is not defined by a transmission pause but by a CR LF (carriage return, line feed).

If parameter P7.04 and/or P7.07 is set to Modbus® ASCII protocol, the frames have the following structure:

:	Address 2 chars	Function 2 chars	Data (N chars)	LRC 2 chars	CR LF

- The Address field contains the address of the slave to which the message is sent.
- The Function field contains the code for the function that the slave is to perform.
- The Data field contains the data sent to the slave or sent by the slave in response to a command. The greatest permissible length is 60 consecutive registers.
- The LRC field allows master and slave to check for transmission errors. Any frames containing errors are ignored to prevent problems on the master and slave side.
- The message always ends with CR LF (carriage return, line feed) (0D 0A).

3.1 Data query example

For example, the phase-to-phase voltage from register 04 (04_{hex}) of the NZM-XATS-C… with address 8 is read out with the following frame:

:	08	04	00	03	00	02	EF	CRLF

The codes have the following meanings:

:	ASCII $3A_{hex}$ = frame start marker
08	Station address
04	Function Read Input Register
00 03	Register address, **reduced by 1**. 04 contains voltage of line 1 L2-N, Table 2, page 19
00 02	Number of registers to be read out starting at address 04 (03 + 1).
EF	Checksum LRC
CRLF	ASCII $0D_{hex}$ $0A_{hex}$ = frame end marker

The response from the NZM-XATS-C… is:

:	08	04	04	00	00	01	A0	4F	CRLF

The codes have the following meanings:

:	ASCII $3A_{hex}$ = frame start marker
08	Address of the NZM-XATS-C… (slave 08).
04	Function requested by the master
04	Number of bytes sent by the slave
00 00 01 A0	Voltage of line L2-N = 416 V as hexadecimal value
4F	Checksum LRC
CRLF	ASCII $0D_{hex}$ $0A_{hex}$ = frame end marker

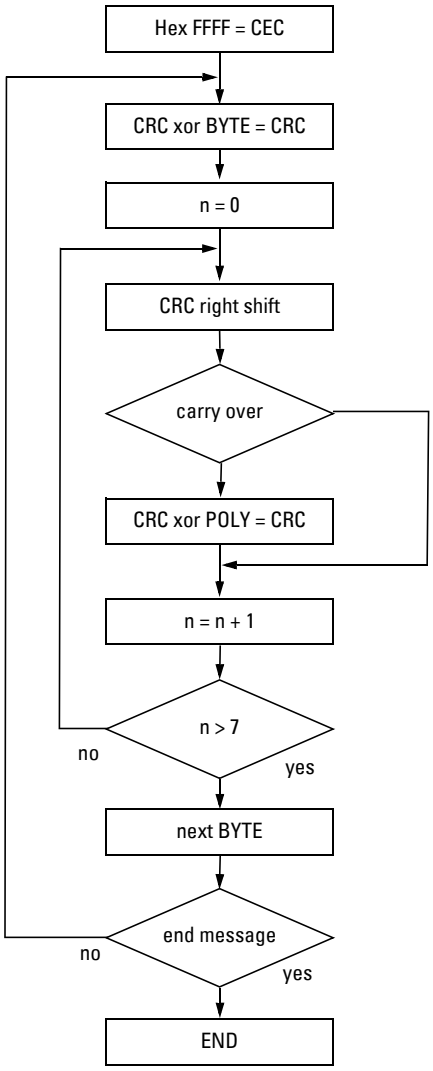

Figure 3: Algorithm for calculating the CRC

3.2 Calculation of the LRC (CHECKSUM for ASCII)

Calculation example:

Address	01	00000010
Function	04	00000100
Start address hi.	00	00000000
Start address lo.	00	00000000
Number of registers	08	00001000
	Total	00001100
	Ones' complement	11110011
	+ 1	00000001
	Two's complement	11110100
Result LRC		**F4**

4 Data content

4.1 Content of message register

Table 2: Readings transmitted with the communication protocol (used with function 04)

Address [hex]	Words	Measurement	Unit	Format
02	2	Voltage Line 1 L1-N	V	Unsigned long
04	2	Voltage Line 1 L2-N	V	Unsigned long
06	2	Voltage Line 1 L3-N	V	Unsigned long
08	2	Voltage Line 1 L1-L2	V	Unsigned long
0A	2	Voltage Line 1 L2-L3	V	Unsigned long
0C	2	Voltage Line 1 L3-L1	V	Unsigned long
0D	2	Voltage Line 2 L1-N	V	Unsigned long
10	2	Voltage Line 2 L2-N	V	Unsigned long
12	2	Voltage Line 2 L3-N	V	Unsigned long
14	2	Voltage Line 2 L1-L2	V	Unsigned long
16	2	Voltage Line 2 L2-L3	V	Unsigned long
18	2	Voltage Line 2 L3-L1	V	Unsigned long
1 A	2	Frequency Line 1	Hz/10	Unsigned long
1C	2	Frequency Line 2	Hz/10	Unsigned long
1D	2	Battery voltage (DC power supply)	VDC/10	Unsigned long
20	2	Total operating time	s	Unsigned long
22	2	Total time line 1 OK	s	Unsigned long
24	2	Total time line 2 OK	s	Unsigned long
26	2	Total time line 1 not OK	s	Unsigned long
28	2	Total time line 2 not OK	s	Unsigned long
2A	2	Total time circuit-breaker line 1 closed	s	Unsigned long
2C	2	Total time circuit-breaker line 2 closed	s	Unsigned long
2D	2	Total time circuit-breaker open	s	Unsigned long
30	2	(not used)	–	Unsigned long
32	2	Number of transfers circuit-breaker 1 in AUT	No.	Unsigned long
34	2	Number of transfers circuit-breaker 2 in AUT	No.	Unsigned long
36	2	Number of transfers circuit-breaker 1 in MAN	No.	Unsigned long
38	2	Number of transfers circuit-breaker 2 in MAN	No.	Unsigned long
3A	2	Number of alarms transfer circuit-breaker 1	No.	Unsigned long
3C	2	Number of alarms transfer circuit-breaker 2	No.	Unsigned long

Address [hex]	Words	Measurement	Unit	Format
3D	2	(not used)	–	Unsigned long
40	2	Error bit[1)]	Bits	Unsigned long

1) When the words at address 40_{hex} are read out, 32 bits with the following meaning are output (Table 3, page 20).

Table 3: Meaning of error bits of address 40_{hex}

Bit	Code	Alarm
0	A01	Battery voltage too low
1	A02	Battery voltage too high
2	A03	Timeout, transfer device line 1
3	A04	Timeout, transfer device line 2
4	A05	Incorrect phase sequence, line 1
5	A06	Incorrect phase sequence, line 2
6	A07	Timeout, consumer without power
7	A08	Generator not available
8	A09	Emergency
9	–	(not used)
10	–	Circuit-breaker line 1 tripped (trip)
11	–	Circuit-breaker 1 withdrawn (NZM-XATS-C144 only)
12	–	Circuit-breaker line 2 tripped (trip)
13	–	Circuit-breaker 2 withdrawn (NZM-XATS-C144 only)
14 - 31	–	(not used)

4.2 Status bits

Table 4: Status bits (used with function 04)

Address [hex]	Words	Function	Format	Bit assignment
2070	1	Status of operator panel	Unsigned integer	→ Table 5
2071	1	Status of digital inputs (per pin)	Unsigned integer	→ Table 6
2072	1	Status of digital outputs (per pin)	Unsigned integer	→ Table 7
-	-	-	-	
2074	1	Status of voltage, line 1	Unsigned integer	→ Table 8
2075	1	Line 1 circuit-breaker status	Unsigned integer	→ Table 9
2076	1	Status of voltage, line 2	Unsigned integer	→ Table 8
2077	1	Line 2 circuit-breaker status	Unsigned integer	→ Table 9
2078	1	Status of input functions	Unsigned integer	→ Table 10
207A	1	Status of output functions	Unsigned integer	→ Table 11
207C	1	General status of controller	Unsigned integer	→ Table 12

Table 5: Meaning of bits from address 2070_{hex}

Bit	Button
0	ON-OFF line 2
1	Operating mode OFF
2	Operating mode MAN
3	Operating mode AUT
4	Operating mode TEST (NZM-XATS-C144 only)
5	ON-OFF line 1
6	Measurement selection, line 2
7	Measurement selection, line 1
8 - 15	Not Used

Table 6: Meaning of bits from address 2071_{hex}

Bit	Input NZM-XATS-C96	input NZM-XATS-C144
0	Input terminal 2.1	Input terminal 4.1
1	Input terminal 2.2	Input terminal 4.2
2	Input terminal 2.3	Input terminal 4.3
3	Input terminal 2.4	Input terminal 4.4
4	Input terminal 2.5	Input terminal 4.5
5	Input terminal 2.6	Input terminal 4.6
6	Not Used	Input terminal 4.7
7	Not Used	Input terminal 4.8
8 - 15	Not Used	Not Used

Table 7: Meaning of bits from address 2072_{hex}

Bit	Output NZM-XATS-C96	Output NZM-XATS-C144
0	Status of output terminal 4.1	Status of output terminal 1.1
1	Status of output terminal 4.3	Status of output terminal 1.3
2	Status of output terminal 5.1	Status of output terminal 2.1
3	Status of output terminal 5.3	Status of output terminal 2.3
4	Status of output terminal 3.1	Status of output terminal 3.2
5	Status of output terminal 3.4	Status of output terminal 3.4
6	Not Used	Status of output terminal 3.7
7 - 15	Not Used	Not Used

Table 8: Meaning of bits from address 2074_{hex} (line 1) or 2076_{hex} (line 2)

Bit	Line status
0	Line within limit values
1	Line within limit values + delay
2	Voltage within limit values
3	Voltage OK
4	Frequency within limit values
5	Frequency OK
6	Voltage < minimum value
7	Voltage > maximum value
8	Voltages outside asymmetry threshold value
9	Voltage < phase failure threshold value
10	Frequency < minimum value
11	Frequency > maximum value
12	Incorrect phase sequence
13	All line parameters OK
14 - 15	Not Used

Table 9: Meaning of bits from address 2075_{hex} (line 1) or 2077_{hex} (line 2)

Bit	Circuit-breaker status
0	Circuit-breaker closed
1	Alarm triggered
2	Withdrawn alarm (NZM-XATS-C144 only)
3	Status actuated (1 = closed)
4	Output actuation close
5	Output actuation open
6 - 15	Not Used

Table 10: Meaning of bits from address 2078_{hex}

Bit	Status of input functions
0	Line 1 switching device closed
1	Circuit-breaker line 1 tripped (trip)
2	Circuit-breaker line 1 withdrawn (NZM-XATS-C144 only)
3	Line 2 switching device closed
4	Circuit-breaker line 2 tripped (trip)
5	Circuit-breaker line 2 withdrawn (NZM-XATS-C144 only)
6	Forced transfer to standby line
7	Automatic transfer to main supply inhibited
8	Emergency-Stop actuators
9	Start generator
10	Generator 1 ready
11	Generator 2 ready
12	Keypad lock
13	Programming lock
14	Standby (as of SW version 08)
15	Not Used

Table 11: Meaning of bits from address $207A_{hex}$

Bit	Status of output functions
0	Open line 1
1	Open line 2
2	Close line 1
3	Close line 2
4	Global alarm
5	Start generator 1
6	Start generator 2
7	NZM-XATS-C… ready
8	Load shedding (NZM-XATS-C144 only)
9	Time before transfer
10	Time after transfer
11 - 15	Not Used

Table 12: Meaning of bits from address $207C_{hex}$

Bit	Status of output functions
0	Operating mode OFF–Reset
1	Operating mode MAN
2	Operating mode AUT
3	Operating mode TEST (NZM-XATS-C144 only)
4	Failed
5	AC supply voltage applied (NZM-XATS-C144 only)
6	DC supply voltage applied
7	Global alarm activated
8 - 15	Not Used

4.3 Commands

Table 13: Commands of function 06

Address [hex]	Words	Function	Format	Value
2F00	1	Change operating mode	Unsigned integer	→ Table 14
2F01	1	Reset device (warm boot)	Unsigned integer	01
2F02	1	Reset all setup parameters to default values	Unsigned integer	01
2F03	1	Save parameters to EEPROM	Unsigned integer	AA
2F04	1	Reset counter	Unsigned integer	FF
2F05	1	Reset operations counter	Unsigned integer	FF
2F06	1	Reset event memory	Unsigned integer	01
2F07	1	Save calendar clock settings	Unsigned integer	01
2F08	1	Keypad lock ON/OFF	Unsigned integer	→ Table 15
2F0D	1	Simulation of operator panel key actuation	Unsigned integer	→ Table 16

Table 14: Values to be written to address $2F00_{hex}$ to receive the required functions.

Value	Function
0	Switch to operating mode OFF
1	Switch to operating mode MAN
2	Switch to operating mode AUT
3	Switch to operating mode TEST (NZM-XATS-C144 only)

Table 15: Values to be written to address $2F08_{hex}$ to receive the required functions.

Value	Function
0	Unlock keypad
1	Keypad lock

Table 16: Positions of bits of the value to be written to address $2F0D_{hex}$ to receive the required functions.

Bit	Keystroke simulation
0	Transfer line 2
1	Operating mode OFF
2	Operating mode MAN
3	Operating mode AUT
4	Operating mode TEST (NZM-XATS-C144 only)
5	Transfer line 1
6	Measurement selection, line 2
7	Measurement selection, line 1
8 - 15	Not Used

4.4 Setting parameters

With the Modbus® protocol the parameters available through the menus can be accessed. The tables below list the setting ranges in numerical form. To help you correctly interpret the correspondence the numerical value and the selected function and/or unit of measurement, please use the manuals for the NZM-XATS-C….

Changes in the Setup menu take effect when the changed values are saved to EEPROM with command $2F03_{hex}$ (Table 13, page 24).

Table 17: Parameter Setup (used with functions 04 and 06)

Address [hex]	Words	Parameter	Range	Format
3000	1	P1.01 Rated operating voltage	100 - 690	Unsigned integer
3001	1	P1.02 Voltage ratio TV	100 - 999	Unsigned integer
3002	1	P1.03 Connection type	0 - 3[1)]	Unsigned integer
3003	1	P1.04 Monitoring voltage	0 - 2[1)]	Unsigned integer
3004	1	P1.05 Rated frequency	0 - 1[1)]	Unsigned integer
3005	1	P1.06 Rated operational battery voltage	0 - 3[1)]	Unsigned integer
3100	1	P2.01 Transfer type	0 - 2[1)]	Unsigned integer
3101	1	P2.02 Phase sequence measurement	0 - 2[1)]	Unsigned integer
3102	1	P2.03 Main line selection	0 - 1[1)]	Unsigned integer
3103	1	P2.04 Interlock time line1-->line2	1 - 900	Unsigned integer
3104	1	P2.05 Interlock time line2-->line1	1 - 900	Unsigned integer
3105	1	P2.06 Transfer behavior	0 - 1[1)]	Unsigned integer
3106	1	P2.07 Actuation type	0 - 2[1)]	Unsigned integer
3107	1	P2.08 Maximum time for circuit-breaker actuation	1 - 900	Unsigned integer
3108	1	P2.09 Open pulse duration	1 - 600	Unsigned integer
3109	1	P2.01 Close pulse duration	1 - 600	Unsigned integer
310A	1	P2.11 Maximum time with consumer at zero volts	0 - 3600[2)]	Unsigned integer
310C	1	P2.12 Automatic back-transfer inhibit	0 - 1[1)]	Unsigned integer
310C	1	P.2.13 Delay before transfer	0 - 300[2)]	Unsigned integer
310D	1	P2.14 Delay time after transfer	0 - 300[2)]	Unsigned integer
310D	1	P2.15 Generator start delay	0 - 900	Unsigned integer
310F	1	P.16 Generator cooling time	1 - 3600	Unsigned integer
3110	1	P2.17 Generator start interval	0 - 14[1)]	Unsigned integer
3111	1	P2.18 Generator start hour	0 - 23	Unsigned integer

1) Numerical value and executed function are linked sequentially taking into account the functions listed in the manual. The first function is obtained with value 0, the last with the highest value within the range.

2) To set OFF, program the lowest value of the range.

3) To set OFF, program the highest value of the range.

4) Numerical value and executed function are linked sequentially taking into account the functions listed in the manual. The first function is obtained with value 0, the last with the highest value within the range.

Address [hex]	Words	Parameter	Range	Format
3112	1	P2.19 Generator start minute	0 - 59	Unsigned integer
3113	1	P2.20 Minimum battery voltage	69 - 100[2)]	Unsigned integer
3114	1	P2.21 Maximum battery voltage	100 - 141[3)]	Unsigned integer
3115	1	P2.22 Battery alarm delay	0 - 60	Unsigned integer
3116	1	P2.23 Set clock on startup	0 - 1[4)]	Unsigned integer
3117	1	P2.24 Activate voltage measurement in MAN mode	0 - 1[1)]	Unsigned integer
3118	1	P2.25 Continuous command signal in RESET–OFF mode	0 - 1[4)]	Unsigned integer
3119	1	P2.26 EJB start delay	0 - 3600[2)]	Unsigned integer
3200	1	P3.01 Trip, minimum voltage threshold	70 - 98	Unsigned integer
3201	1	P3.02 Recovery, minimum voltage threshold	75 - 100	Unsigned integer
3202	1	P3.03 Delay, minimum voltage threshold	1 - 9000	Unsigned integer
3203	1	P3.04 Trip, maximum voltage threshold	102 - 121[3)]	Unsigned integer
3204	1	P3.05 Recovery, maximum voltage threshold	100 - 115	Unsigned integer
3205	1	P.06 Delay, maximum voltage threshold	1 - 9000	Unsigned integer
3206	1	P3.07 Phase failure threshold	59 - 85[2)]	Unsigned integer
3207	1	P3.08 Delay, phase failure	1 - 300	Unsigned integer
3208	1	P3.09 Asymmetry threshold	2 - 21[3)]	Unsigned integer
3209	1	P3.10 Asymmetry, delay	1 - 9000	Unsigned integer
320A	1	P3.11 Minimum frequency threshold	79 - 100[2)]	Unsigned integer
320C	1	P3.12 Minimum frequency delay	1 - 9000	Unsigned integer
320C	1	P3.13 Maximum frequency threshold	100 - 121[3)]	Unsigned integer
320D	1	P3.14 Maximum frequency delay	1 - 9000	Unsigned integer
320D	1	P3.15 Delay, restore line 1 if within limit value (if line 2 not OK)	1 - 3600	Unsigned integer
320F	1	P3.16 Delay, restore line 1 if within limit value (if line 2 OK)	1 - 3600	Unsigned integer
3300	1	P4.01 Trip, minimum voltage threshold	70 - 98	Unsigned integer
3301	1	P4.02 Recovery, minimum voltage threshold	75 - 100	Unsigned integer
3302	1	P4.03 Minimum voltage delay	1 - 9000	Unsigned integer
3303	1	P4.04 Trip, maximum voltage threshold	102 - 121[3)]	Unsigned integer
3304	1	P4.05 Recovery, maximum voltage threshold	100 - 115	Unsigned integer
3305	1	P4.06 Maximum voltage delay	1 - 9000	Unsigned integer
3306	1	P4.07 Phase failure threshold	59 - 85[2)]	Unsigned integer
3307	1	P4.08 Delay, phase failure	1 - 300	Unsigned integer
3308	1	P4.09 Asymmetry threshold	2 - 21[3)]	Unsigned integer

1) Numerical value and executed function are linked sequentially taking into account the functions listed in the manual. The first function is obtained with value 0, the last with the highest value within the range.

2) To set OFF, program the lowest value of the range.

3) To set OFF, program the highest value of the range.

4) Numerical value and executed function are linked sequentially taking into account the functions listed in the manual. The first function is obtained with value 0, the last with the highest value within the range.

Address [hex]	Words	Parameter	Range	Format
3309	1	P4.10 Asymmetry delay	1 - 9000	Unsigned integer
330A	1	P4.11 Minimum frequency threshold	79 - 100[2)]	Unsigned integer
330C	1	P4.12 Minimum frequency delay	1 - 9000	Unsigned integer
330C	1	P4.13 Maximum frequency threshold	100 - 121[3)]	Unsigned integer
330D	1	P4.14 Maximum frequency threshold	1 - 9000	Unsigned integer
330D	1	P4.15 Delay, restore line 1 (if line 1 not OK)	1 - 3600	Unsigned integer
330F	1	P4.16 Delay, restore line 1 (if line 1 OK)	1 - 3600	Unsigned integer
3400	1	P5.01 Programmable input function 1	0 - 20[1)]	Unsigned integer
3401	1	P5.02 Programmable input function 2	0 - 20[1)]	Unsigned integer
3402	1	P5.03 Programmable input function 3	0 - 20[1)]	Unsigned integer
3403	1	P5.04 Programmable input function 4	0 - 20[1)]	Unsigned integer
3404	1	P5.05 Programmable input function 5	0 - 20[1)]	Unsigned integer
3405	1	P5.06 Programmable input function 6	0 - 20[1)]	Unsigned integer
3406	1	P5.07 Programmable input function 7	0 - 20[1)]	Unsigned integer
3407	1	P5.08 Programmable input function 8	0 - 20[1)]	Unsigned integer
3500	1	P6.01 Programmable output function 1	0 - 14[1)]	Unsigned integer
3501	1	P6.02 Programmable output function 2	0 - 14[1)]	Unsigned integer
3502	1	P6.03 Programmable output function 3	0 - 14[1)]	Unsigned integer
3503	1	P6.04 Programmable output function 4	0 - 14[1)]	Unsigned integer
3504	1	P6.05 Programmable output function 5	0 - 14[1)]	Unsigned integer
3505	1	P6.06 Programmable output function 6	0 - 14[1)]	Unsigned integer
3506	1	P6.07 Programmable output function 7	0 - 14[1)]	Unsigned integer
3600	1	P7.01 Serial address RS232	1 - 245	Unsigned integer
3601	1	P7.02 Speed RS232	0 - 4[1)]	Unsigned integer
3602	1	P7.03 RS232 Protocol	0 - 4[1)]	Unsigned integer
3603	1	P7.04 RS232 Parity	0 - 4[1)]	Unsigned integer
3604	1	P7.05 Serial address RS485	1 - 245	Unsigned integer
3605	1	P7.06 Speed RS485	0 - 4[1)]	Unsigned integer
3606	1	P7.07 RS485 Protocol	0 - 4[1)]	Unsigned integer
3607	1	P7.08 RS485 Parity	0 - 4[1)]	Unsigned integer
3700	1	P8.01 Automatic test active	0 - 1[1)]	Unsigned integer
3701	1	P8.02 Automatic test interval (days)	1 - 60	Unsigned integer
3702	1	P8.03 Activate test on Monday	0 - 1[1)]	Unsigned integer

1) Numerical value and executed function are linked sequentially taking into account the functions listed in the manual. The first function is obtained with value 0, the last with the highest value within the range.

2) To set OFF, program the lowest value of the range.

3) To set OFF, program the highest value of the range.

4) Numerical value and executed function are linked sequentially taking into account the functions listed in the manual. The first function is obtained with value 0, the last with the highest value within the range.

Address [hex]	Words	Parameter	Range	Format
3703	1	P8.04 Activate test on Tuesday	0 - 1[1)]	Unsigned integer
3704	1	P8.05 Activate test on Wednesday	0 - 1[1)]	Unsigned integer
3705	1	P8.06 Activate test on Thursday	0 - 1[1)]	Unsigned integer
3706	1	P8.07 Activate test on Friday	0 - 1[1)]	Unsigned integer
3707	1	P8.08 Activate test on Saturday	0 - 1[1)]	Unsigned integer
3708	1	P8.09 Activate test on Sunday	0 - 1[1)]	Unsigned integer
3709	1	P8.10 Start automatic test - hour	0 - 23	Unsigned integer
370A	1	P8.11 Start automatic test - minutes	0 - 59	Unsigned integer
370C	1	P8.12 Automatic test - duration	0 - 600	Unsigned integer
370C	1	P8.13 Load transfer	0 - 1[1)]	Unsigned integer

1) Numerical value and executed function are linked sequentially taking into account the functions listed in the manual. The first function is obtained with value 0, the last with the highest value within the range.

2) To set OFF, program the lowest value of the range.

3) To set OFF, program the highest value of the range.

4) Numerical value and executed function are linked sequentially taking into account the functions listed in the manual. The first function is obtained with value 0, the last with the highest value within the range.

4.5 Setting the real-time clock (NZM-XTAS-C144 only)

Table 18: Calendar clock (used with functions 04 and 06)

Address [hex]	Words	Parameter	Range	Format
2F20	1	Seconds	0 - 59	Unsigned integer
2F21	1	Minute	0 - 59	Unsigned integer
2F22	1	Hour	0 - 23	Unsigned integer
2F23	1	Weekdays	1 - 7	Unsigned integer
2F24	1	Day	0 - 31	Unsigned integer
2F25	1	Month	1 - 12	Unsigned integer
2F26	1	Year (2000 ≙ 00)	0 - 99	Unsigned integer

The changes take effect when the settings are saved with the command described in the table below (Table 13, page 24).

4.6 Reading out the events list

The events list is stored in a ring buffer. To restore the correct chronology, the pointer at the position of the most recent event must be read out and, starting at this position, retracting by as many positions as the events counter indicates.

When the start (pos. 1) of the ring buffer is reached, counting is continued at the last position (pos. 100, end) until the position of the most recent event is reached again.

The date and time values are compressed in pairs into three registers to reduce frame length. Register 2100_{hex}, for example, contains the hour in its MSB and the minutes in its LSB. The same goes for seconds and days, and for month and year (Table 20, page 30).

4.7 Events list table

Table 19: Events list pointer (used with function 04)

Address [hex]	Words	Parameter	Range	Format
2510	1	Pointer indicating position of most recent event	0 - 99	Unsigned integer
2511	1	Saved events counter	0 - 99	Unsigned integer

Table 20: Events list (used with function 04)

Address [hex]	Words	Parameter	Range	Format
2100	1	Hour/minutes event pos. 1	0 - 23/0 - 59	Unsigned integer
2101	1	Seconds/day event pos. 1	0 - 59/0 - 31	Unsigned integer
2102	1	Month/year event pos. 1	1 - 12/0 - 99	Unsigned integer
2103	1	Code event pos. 1 → Table 21	1 - 225	Unsigned integer
2104	1	Hour/minutes event pos. 2	0 - 23/0 - 59	Unsigned integer
2105	1	Seconds/day event pos. 2	0 - 59/0 - 31	Unsigned integer
2106	1	Month/year event pos. 2	1 - 12/0 - 99	Unsigned integer
2107	1	Code event pos. 2 → Table 21	1 - 225	Unsigned integer
…	…	…	…	…
228C	1	Hour/minutes event pos. 100	0 - 23/0 - 59	Unsigned integer
228D	1	Seconds/day event pos. 100	0 - 59/0 - 31	Unsigned integer
228D	1	Month/year event pos. 100	1 - 12/0 - 99	Unsigned integer
228F	1	Code event pos. 100 → Table 21	1 - 225	Unsigned integer

Table 21: Events list correspondence numerical value/event type

Code	Event
1	Switch on NZM-XATS-C…
2	Switch off NZM-XATS-C…
3	Restart NZM-XATS-C…
5	Selected operating mode RESET-OFF
6	Selected operating mode MAN
7	Selected operating mode AUT
8	Selected operating mode TEST (NZM-XATS-C144 only)
10	External start signal generator (start)
11	External start signal generator (end)
12	External transfer signal (start)
13	External transfer signal (end)
20	Automatic test active
21	Automatic test deactivated
22	Start automatic test
23	End automatic test
26	Start command to generator 1
27	Stop command to generator 1
28	Start command to generator 2
29	Stop command to generator 2
30	Manual start command
31	Stop command to generator
32	Manual transfer, line 1
33	Manual transfer, line 2
34	Start line failure simulation
35	End line failure simulation
36	Start test under load
37	End test under load
40	Line 1 within limit values
41	Line 1 outside limit values
42	Line 1 present
43	Line 1 not present
44	Line 1 voltage within limit values
45	Line 1 voltage outside limit values
46	Line 1 frequency within limit values
47	Line 1 frequency outside limit values
48	Line 1 phase sequence OK
49	Line 1 phase sequence incorrect
50	Line 1 asymmetry within limit values

Code	Event
51	Line 1 asymmetry outside limit values
52	Line 1 switching device closed
53	Line 1 switching device open
54	Line 1 voltage below minimum value
55	Line 1 voltage above maximum value
56	Phase failure line 1
57	Line 1 frequency below minimum value
58	Line 1 frequency above maximum value
60	Line 2 within limit values
61	Line 2 outside limit values
62	Line 2 present
63	Line 2 not present
64	Line 2 voltage within limit values
65	Line 2 voltage outside limit values
66	Line 2 frequency within limit values
67	Line 2 frequency outside limit values
68	Line 2 phase sequence OK
69	Line 2 phase sequence incorrect
70	Line 2 asymmetry within limit values
71	Line 2 asymmetry outside limit values
72	Line 2 switching device closed
73	Line 2 switching device open
74	Line 2 voltage below minimum value
75	Line 2 voltage above maximum value
76	Phase failure line 2
77	Line 2 frequency below minimum value
78	Line 2 frequency above maximum value
80	Manual alarms reset
81	Start alarm A01 – Low battery voltage
82	Start alarm A02 – High battery voltage
83	Start alarm A03 – Line 1 transfer switch fault
84	Start alarm A04 – Line 2 transfer switch fault
85	Start alarm A05 – Wrong phase sequence, line 1
86	Start alarm A06 – Wrong phase sequence, line 2
87	Start alarm A07 – Timeout, consumer without power
88	Start alarm A08 – Generator not ready
89	Start alarm A09 – Emergency Off
90	Start alarm A10
91	Start alarm – Line 1 circuit-breaker trip

Code	Event
92	Start alarm – Line 2 circuit-breaker trip
93	Start alarm – Line 1 circuit-breaker withdrawn
94	Start alarm – Line 2 circuit-breaker withdrawn
95	Start alarm A15
96	Start alarm A16
97	Start alarm A17
98	Start alarm A18
99	Start alarm A19
100	Start alarm A20
101	End alarm A01 – Low battery voltage
102	End alarm A02 – High battery voltage
103	End alarm A03 – Line 1 transfer switch fault
104	End alarm A04 – Line 2 transfer switch fault
105	End alarm A05 – Wrong phase sequence, line 1
106	End alarm A06 – Wrong phase sequence, line 2
107	End alarm A07 – Timeout, consumer without power
108	End alarm A08 – Generator not ready
109	End alarm A09 – Emergency Off
110	End alarm A10
111	End alarm – Line 1 circuit-breaker trip
112	End alarm – Line 2 circuit-breaker trip
113	End alarm – Line 1 circuit-breaker withdrawn
114	End alarm – Line 2 circuit-breaker withdrawn
115	End alarm A15
116	End alarm A16
117	End alarm A17
118	End alarm A18
119	End alarm A19
120	End alarm A20
130	Menu P1 changed
131	Menu P2 changed
132	Menu P3 changed
133	Menu P4 changed
134	Menu P5 changed
135	Menu P6 changed
136	Menu P7 changed
137	Menu P8 changed
138	Menu P9 changed
139	Menu P10 changed

Code	Event
140	Calendar clock set
141	All setup parameters reset to default values
142	Keypad unlocked
143	Keypad blocked
150	Events list set to zero
151	Operating time counter set to zero
152	Operations counter set to zero
210	Start remote control
211	End remote control
212	Incoming call through modem
213	Modem line closed
214	Call, modem to PC
215	Connection with PC OK
216	Connection to PC failed
217	SMS sent to user 1
218	SMS sent to user 2
219	SMS sent to user 3
220	SMS transmission OK
221	SMS transmission failed
222	Send e-mail
223	E-mail sent OK
224	Sending of e-mail failed
225	Commands received by SMS

5 Connection diagrams

5.1 Connecting a PC to NZM-XATS-C144 through RS-485

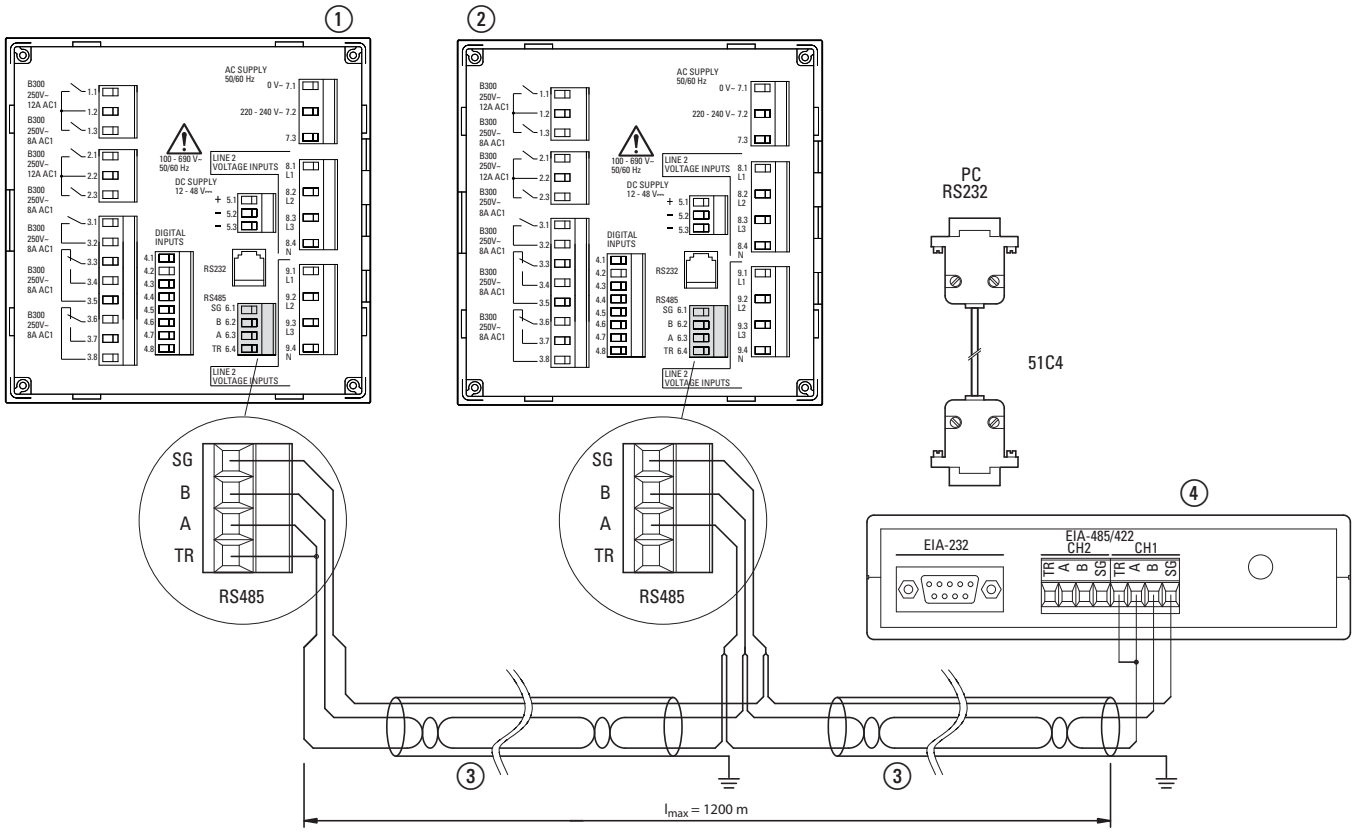

Figure 4: Connection RS485 interface

① NZM-XATS-C96 number n, maximum 30
② NZM-XATS-C96 number 1
③ "Twisted-pair" connection cable, max. 1200 m long
④ Controlling unit, e.g. computer

5 Connection diagrams

5.1 Connecting a PC to NZM-XATS-C144 through RS-485