Limited Liability Company
“NPK Morsvyazavtomatica”

SUMMATOR-COMBINER OF NMEA SIGNAL (SENTENCES)

NC-117

Operating manual

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INTRODUCTION

This operating manual (hereinafter – OM) is intended to familiarize service personnel with the design, structure, operation and technical service of summator-combiner of NMEA signal (sentences) NC-117 type (hereinafter – the Product).

In addition to the instructions given in this document, the safety regulations and rules applicable in the field shall be observed.

Only those who have read and understood this document and those who have had special training shall be permitted to operate the Product according to the applicable regulations.

The full list of documents referred to in this OM is given in Appendix A.

TERMS AND ABBREVIATIONS:

CL – check list;

LCD – liquid crystal display;

NC-117 – summator-combiner of NMEA signal (sentences), type NC-117;

OM – operating manual;

PC – personal computer;

TS – technical service

1 DESCRIPTION AND OPERATION OF THE PRODUCT

1.1 DESCRIPTION

The Product is designed to receive messages from NMEA 0183 signal sources (via eight RS-232 and RS-422/485 input ports and one USB port), combine them in different combinations into one packet according to user settings, and output them to consumers of NMEA 0183 signal (via four RS-232 and RS-422/485 output ports and one USB port).

Note – Along with the standard NMEA signals, the Product recognizes sentences beginning with a $ or ! or # and ending with CR and LF; it also receives and combines messages of other serial data standards provided that they are separated by symbols “Carriage Return” and/or “Line Feed” (CR and LF, respectively).

1.2 TECHNICAL SPECIFICATIONS

1.2.1 The Product, when working with NMEA data, ensures the following functionality for each output port:

a) select of input ports to be polled;

b) editing NMEA sentence headlines for the corresponding port;

c) addition of NMEA sentences to the corresponding port;

d) switching to the backup input port with an option to configure an interval of switching delay;

e) defining the priority of input ports polling;

f) setting a rule that the input data are combined into one packet and forwarded to the corresponding ports;

g) data transmission checksum test (check CRC)

1.2.2 Table 1 describes technical specifications of the Product.

Table 1 – Main technical specifications

Parameter	Value
Input voltage, V DC	24 (9 to 36)*
Max. power consumption, W	7
Galvanic isolation from the mains	yes
Protection	overvoltage; reverse polarity
Number of inputs, pcs.	8xRS-232 and RS-422/485; 1xUSB
Number of outputs, pcs.	4xRS-232 and RS-422/485; 1xUSB
Baud rate (receive/send), bit/s	2400 - 115200**
Signal format	NMEA 0183 versions 1-3 (IEC 61162-1, 61162-2) or other serial data transmission signals

Parameter	Value
Opto-isolation (inputs)	yes
Galvanic isolation (outputs)	yes
Nominal power, W	7
Message combining	selectable for each output port
Input ports polling priority	selectable for each output port
Delay of input port polling	selectable for each output port
NMEA addition	selectable for each output port
NMEA headlines editing	for each output port
Number of polled input ports	selectable for each output port
Weight, kg	0.63
Protection degree	IP22
Operating temperature, °C	–15 to +55
Storage temperature, °C	–60 to +70
Mounting	wall
* The supply voltage range is shown in brackets. ** Baud rate (receive/send) is configurable for each port within the specified range.	

1.3 Structure and operation of the Product

1.3.1 The Product has a metal casing where the functional elements and connectors are located, see figure 1, 2. Description of the functional elements is given in table 2.

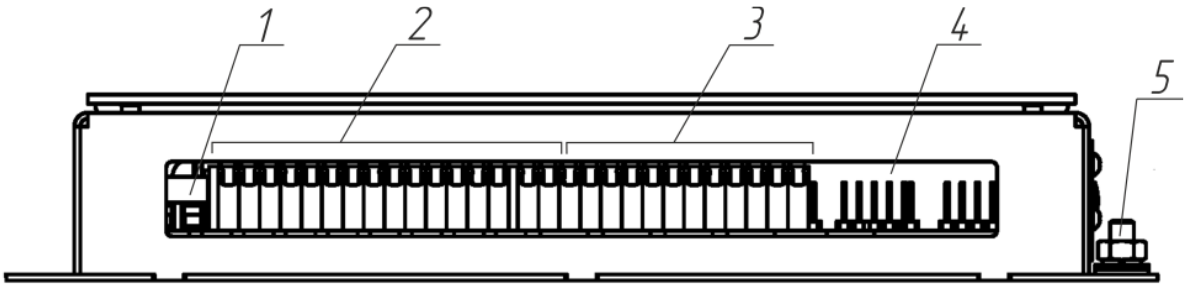

Figure 1 – The Product

Table 2 – Description of the functional elements

№	Element	Type, size, identifier	Description
1	“Power”	+	To connect power supply
		E	
		–	
2	“IN1” to “IN8”	A	To connect a data source
		B	
3	“OUT1” to “OUT4”	A	To connect a data receiver
		B	
		0	

№	Element	Type, size, identifier	Description
4	Mini-USB port	–	To connect a data receiver
5	Grounding stud	M4x10	Main grounding element
6	LCD display	“LCD1”	To display information
7	Keys	“MENU”	To call the user menu
		“UP”	To scroll through menu items
		“DOWN”	To scroll through menu items
		“ENTER”	To confirm the select
Note – See positions (№) in figure 1, 2			

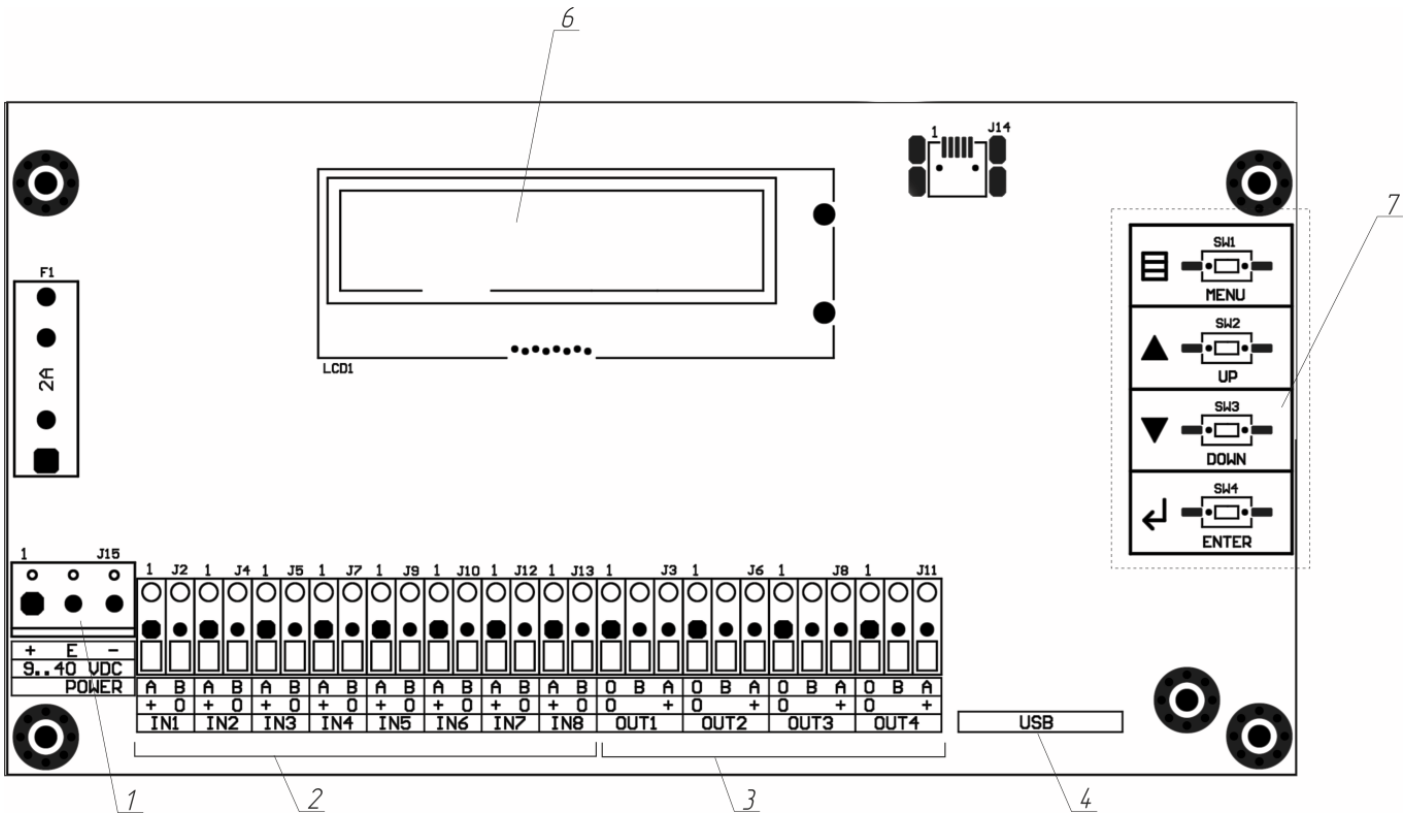

Figure 2 – Layout of the terminals and functional elements on the printed circuit board

1.3.2 The Product receives NMEA messages on “IN1” to “IN8” inputs and USB, then combines them according to user settings and outputs through “OUT1” to “OUT4” ports and USB-port. A user may provide baudrate settings and message combining settings on the built-in keyboard and LCD display “LCD1”.

1.3.3 Signal sources with both RS-232 output interface and RS-422/485 may be connected to each input port. The connection for each interface is shown in figure 3.

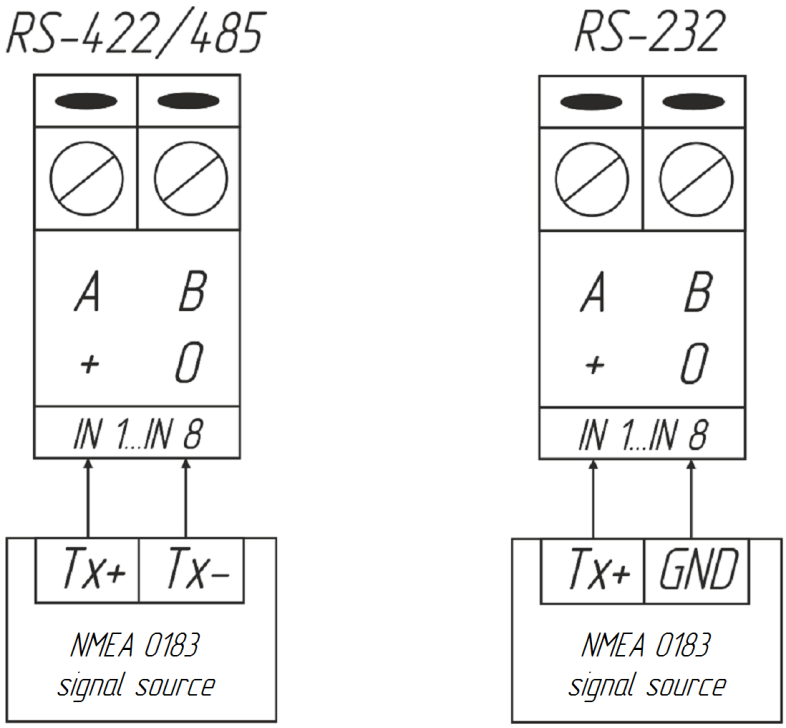

Figure 3 – Connection of NMEA data sources to input ports

1.3.4 NMEA 0183 signal receivers may be connected to output ports via RS-232 input interface and RS-422/485. Connection for each of the interfaces is shown in figure 4.

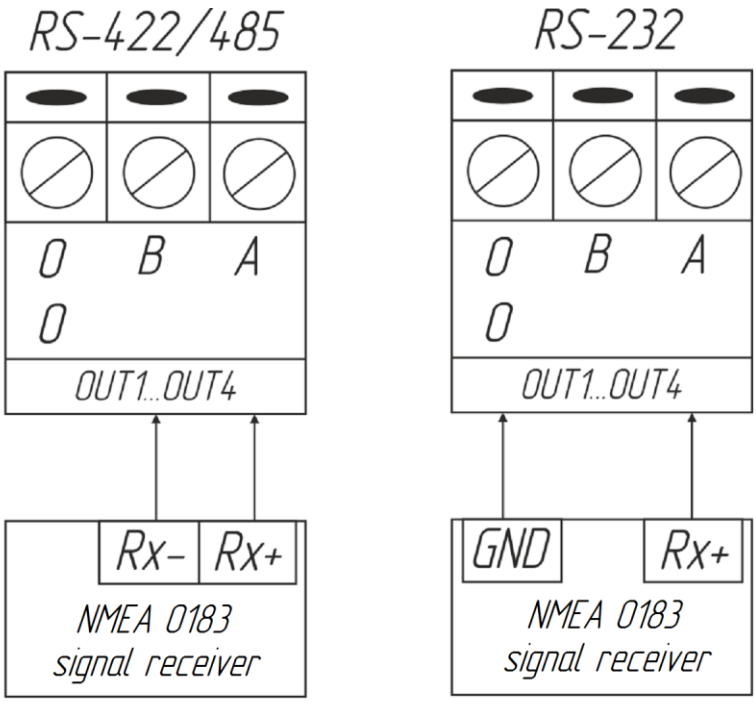

Figure 4 – Connection of NMEA data sources to output ports

1.3.5 The Product can be connected to the PC via USB interface using a standard USB type A cable. There is a USB mini B connector on the Product's board for cable connection.

When the Product is connected to the PC's USB port, the operating system supporting Plug-n-Play will automatically detect the new device. For correct operation of the interface, install the drivers delivered with the Product on a CD-ROM. Once the drivers are installed, the Virtual COM port will appear in the device list of the operating system; it can be used as a regular PC COM port.

1.4 MEASUREMENT INSTRUMENTS, TOOLS AND APPLIANCES

Table below describes consumables required for the TS.

Table 3 – Consumables required for the TS

Name and identifier of consumables	Amount of consumables	Note
Cleaning cloth	0.10 kg	1 To clean the Product surfaces – use clean cloth. 2 To remove severe contamination – use cloth soaked in alcohol
Rectified hydrolytic technical ethyl alcohol	0.05 l	To soak cloth when removing contamination from a screen
Varnish	0.05 kg	To cover surfaces of the Product in case of paint coating damage
Abrasive cloth	0.06 x 0.06 m	To polish surfaces of the Product in case of paint coating damage

1.5 MARKING AND SEALING

The Product has a nameplate displaying a name, input voltage, power consumption, protection degree, weight, serial number and date of manufacturing.

Sealing of the Product is not provided.

1.6 PACKAGING

When delivered, the Product is packed in a corrugated board box and inner packaging (air bubble film) ensuring its transportation and storage at the warehouse.

Transport packaging is also used as a returnable packaging for transportation of the Product to the repair location and back.

Sealing of packaging is not provided.

2 INTENDED USE OF THE PRODUCT

2.1 OPERATIONAL LIMITATIONS

Select an installation place in compliance with operational limitations (operating temperature and protection degree – IP).

Caution! Distance between the place of installation and magnetic compass shall not be less than 1 m!

2.2 USAGE PREPARATIONS

2.2.1 Safety features

While preparing the Product for operation, check it visually and make sure there is no mechanical damage.

Connect the Product to power mains only in compliance with input power requirements.

Before connection, the Product shall be switched off and grounded.

While using the Product the staff shall follow “The technical rules for operation of electric installation” and “Safety rules for operation of electric installation” while testing electrical circuits and insulation resistance.

2.2.2 Scope and sequence of external inspection

Before switching the Product on, act as follows:

a) check visually the integrity and initial position of the controls;

b) check the absence of dirt and dust on the Product’s surfaces, wipe it, if necessary, with a soft cloth, see table 3;

c) check that cable connectors are securely connected to the Product and proper grounding.

2.2.3 Switching on instructions

While connecting the Product and bringing it into operation, follow the steps below:

a) transfer the circuit breaker of the main power switchboard to the “OFF” position;

b) connect the de-energized power cable to the input terminals;

c) switch the circuit breaker of the main power switchboard to the “ON” position.

2.2.4 Disconnect the Product in the following order:

a) switch the circuit breaker of the main power switchboard to the “OFF” position;

b) disconnect the de-energized power cable from the Product.

2.3 INTENDED USE

2.3.1 Before configuring the ports, take off the top cover to provide access to the LCD display and buttons located on the printed circuit board of the Product.

2.3.2 Configure input and output ports in the user menu (“INPUTs” – settings of input ports, “OUTPUTs” – output ports), see figure 5. To enter the menu, press the “MENU” button in the active channel display mode, see figure 2. After that, the Product will transfer to the input/output port select mode.

Figure 5 – User menu

To select the input port “INPUTs”, press “MENU” and then “ENTER”, see figure 2 and 6.

Figure 6 – Selecting input ports for configuration

2.3.3 Select the port to configure using “UP” and “DOWN” buttons, see figure 2 and 7. To confirm the select, press “ENTER” button.

Figure 7 – Selecting a port to configure

Use buttons “UP” and “DOWN” to select the parameter:

– “BAUDRATE” – data baud rate (receive/transmit), see figure 8;

– “STOP Bit” – number of stop bits, see figure 9;

– “PARITY” – parity, see figure 10;

– “CHECK SUM” – checksum test, see figure 11;

– “PRIORITY” – port polling priority, see figure 12;

– “DELAY” – delay of port polling priority, see figure 13;

– “GET FROM” – settings of data combining parameters, see figure 14;

– “FILTER” – data filtering, see figure 15;

– “ADD NEW SENTENCE” – adding NMEA data, see figure 16;

– “MOD MENU”, see figure 18.

Note – To return to the port select menu, press “MENU” button. To enter the input (output) port display mode, press “MENU” button.

2.3.4 Data baud rate select. Use buttons “UP” and “DOWN” to select the necessary data baud rate from the list: 2400; 4800; 9600; 14400; 19200; 28800; 38400; 76800; 115200 bps. Press “ENTER” to confirm the select. The Product will save the set value in the non-volatile memory; to return to the parameter select menu, press “MENU” button.

Figure 8 – Select of the data baud rate

Note – If you do not press the “ENTER” button after the select, the input value will not be saved once you exit the parameter menu.

2.3.5 Stop bits select. Use buttons “UP” and “DOWN” to select the number of stop bits (one or two) and press “ENTER”. The Product will save the set value in the non-volatile memory; to return to the parameter select menu, press “MENU” button.

Figure 9 – Select of stop bits

Note – If you do not press the “ENTER” button after the select, the set value will not be saved once you exit the parameter menu.

2.3.6 Parity select. Use buttons “UP” and “DOWN” to select the parity mode (“NONE”, “EVEN”, “ODD”) and press “ENTER”. The Product will save the set value in the non-volatile memory; to return to the parameter select menu, press “MENU” button.

Figure 10 – Select of the parity check mode

Note – If you do not press “ENTER” button after the select, the set value will not be saved once you exit the parameter menu.

2.3.7 Checksum test mode. Use buttons “UP” and “DOWN” to select the mode (“ON” – checksum test is enabled, “OFF” – disabled) and press “ENTER”. The Product will save the set value in the non-volatile memory; press “MENU” button to return to the parameter select menu.

Figure 11 – Select of the checksum test mode

Attention! The checksum test enables to remove invalid NMEA messages with errors. However, when the Product operates with NMEA 0183 messages version 1 or other messages with a format different from NMEA 0183 version 2, and checksum test is enabled, the Product will disregard any received messages.

Note – If you do not press the “ENTER” button after the select, the set value will not be saved once you exit the parameter menu.

2.3.8 Priority select mode. Use buttons “UP” and “DOWN” to select the priority and press “ENTER” button. The Product will save the set value in the non-volatile memory; press “MENU” button to return to the parameter select menu.

Figure 12 – Select of the priority mode

Note – If you do not press the “ENTER” button after the select, the set value will not be saved once you exit the parameter menu.

2.3.9 Port polling delay mode by priority. Use buttons “UP” and “DOWN” to select the delay time and press “ENTER”. The Product will save the set value in the non-volatile memory; press “MENU” button to return to the parameter select menu.

Figure 13 – Select of the delay time

Note – If you do not press the “ENTER” button after the select, the set value will not be saved once you exit the parameter menu.

2.3.10 The Product enables flexible configuration of data acquisition parameters from the input ports for forwarding to the output ports. Each port “OUT1” to “OUT4” and USB may be configured individually.

Note – This setting is only available for the output ports.

Data Acquisition Setup mode. The bottom line of the LCD displays the numbers of input ports, see figure 14; the Product receives data from these ports and outputs to the current output port. When the Product receives no data (inactive input ports), LCD shows “_”.

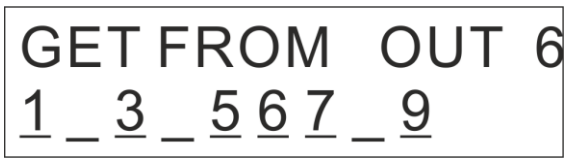

Figure 14 – Select of the data combining parameters

2.3.11 Data filtering mode. Use buttons “UP” and “DOWN” to select “ON” – enable or “OFF” – disable the port filter. When “OFF” is selected, further settings are inactive. To return to the parameter select menu, press the “MENU” button.

Figure 15 – Select of the port filter settings

2.3.12 To enter the mode of NMEA data addition, press “ENTER” button, and LCD will take the following view, see figure 17. Add a headline of NMEA sentences by means of “UP” and “DOWN” buttons; output port will receive (or not) these headlines depending on the “FILTER” settings, see. 2.3.11.

Figure 16 – Select of NMEA Data Addition Mode

Figure 17 – NMEA data addition

2.3.13 “MOD MENU” mode. Use “UP" and “DOWN” buttons to enable or disable the “MOD MENU” mode.

Figure 18 – “MOD MENU” mode

Having “MOD MENU” enabled or disabled, enter the NMEA checksum mode, enable or disable checksum to the output NMEA data, see figure 19.

Figure 19 – Checksum addition to NMEA

If this setting is not relevant, switch to “MOD HEAD” mode by pressing “UP” and “DOWN” buttons, see figure 20. This mode is useful when working with equipment supporting different NMEA headlines. Still in this mode, press “UP” and “DOWN” to change the NMEA headline to the one supported by the equipment, and press “ENTER” button.

Figure 20 – “MOD HEAD” mode

2.3.14 The structure of the Product menu is shown in figures 21, 22.

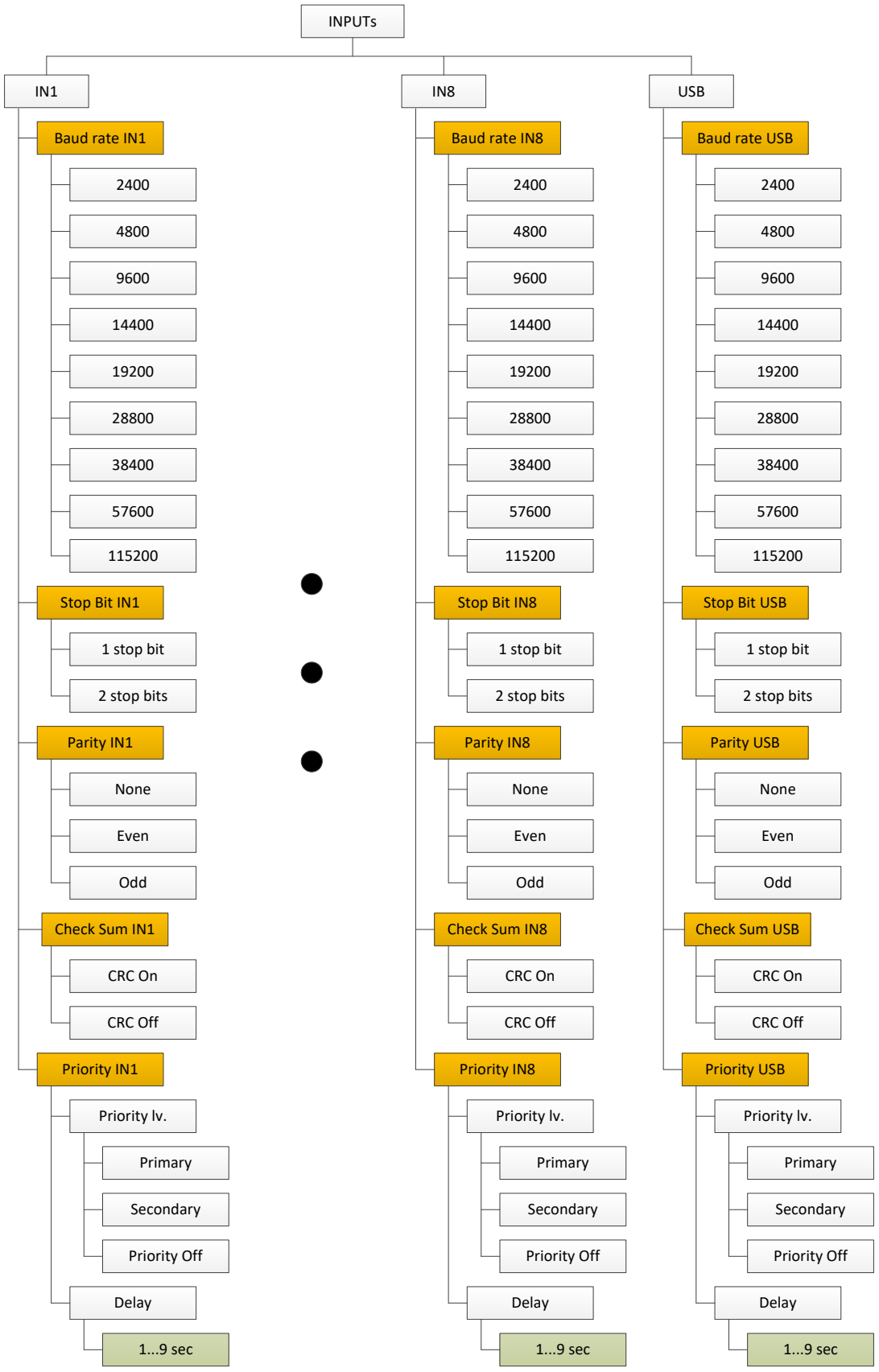

Figure 21 – Structure of the input ports menu

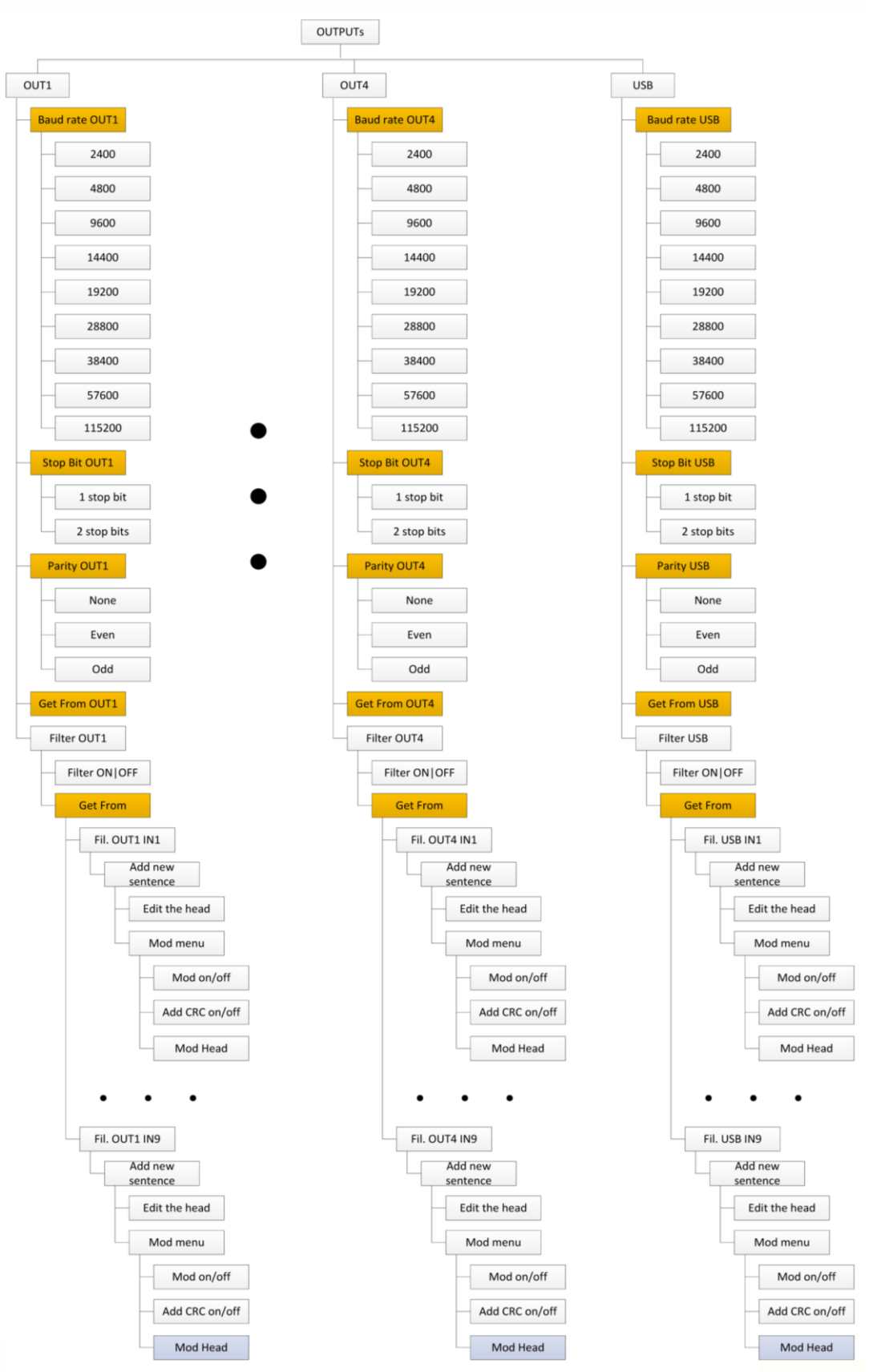

Figure 22 – Structure of the output ports menu

2.3.15 The output interface capacity shall meet the following condition: sum of input data streams per time unit shall be less than channel capacity.

Output data baud rate must exceed the output channel capacity, which is calculated using the formula

$$E = \sum_{n} (C_n \cdot f_n), \quad (1)$$

where *n* is the number of input channel;

C_n – message size on channel n;

f_n – transmission frequency on channel *n*;

E – required capacity of output channel in bytes/s.

Since there are various options for data coding in serial transmission, then under the following conditions required capacity bit per second shall comply with the parameters described in table 4.

Table 4 – Capacity value under various options of coding

Stop bites	Parity	Capacity
1	No	E * 9
1	Even или Odd	E * 10
2	No	E * 10
2	Even или Odd	E * 11

Max. output channel capacity is 115200 bit or 14400 byte, it is recommended to use not more than 90% of channel capacity of 102400 bit or 12800 byte.

To calculate the required output channel capacity, sum the data for the three input channels and the parameters shown in table 5.

Table 5 – Parameters to calculate output channel capacity

Channel no.	Message size, byte	Message frequency, Hz
1	50	10
2	30	5
3	100	1

Therefore, the required output channel capacity shall make

E = (50 – 10) + (30 – 5) + (100 – 1) = 750 byte/sec.

For the output port the parity is set to “NO” (none), stop bit – 1. Then the output channel capacity should be at least

E = 750 – 9 = 6750 byte/s.

Consequently, the output port rate must be set to at least 7200 byte/s or 57600 bps; the output port rate is selected from the available settings of the Product.

3 TECHNICAL SERVICE OF THE PRODUCT

3.1 GENERAL DESCRIPTION

Before performing the TS the staff shall familiarize with the Product's structure, design and operation features.

In order to provide safe and reliable operation of the Product, the staff shall maintain semi-annual TS.

TS is carried out on the equipment in operation.

3.2 SAFETY FEATURES

While providing TS the staff shall follow the instructions, see 4.2.

3.3 MAINTENANCE ROUTINE

The list of works for all types of the TS is given in table 6. Maintenance routine procedure is described in the CL, represented in tables Table 7, 8.

Table describes consumables required for the TS.

Table 6 – TS works

CL №	Name of work	TS
1	Visual check of the Product	+
2	The Product's operation test	+
Note – "+" – work is obligatory.		

Table 7 – CL № 1. Visual check

To be done	Routine	Man-hours per 1 Product
Examine the Product visually	1 Check the external condition of the Product, make sure there is no mechanical damage, coating damage, pay attention to the condition of the legends, they shall be read easily. 2 Clean up the Product surfaces with clean cloth. 3 Remove severe contamination, corrosion marks, oil stains from the metal surfaces - using soap suds, avoiding its penetration inside the Product; then wipe the surfaces dry with a clean cloth and dry up. 4 If varnish coating is damaged, polish it with sand paper, then clean with alcohol-soaked cloth, cover with varnish and dry up	1 person 5 mins
Check reliability of cable and bus connection to the Product	1 Check that connectors and attaching screws are tightened; provide further tightening if necessary. 2 Check the cable intactness (no mechanical damage) within visibility	1 person 5 mins

Table 8 – CL №2. Operation test of the Product

To be done	Routine	Man-hours per 1 Product
Checking the performance of the product	1 Connect the power cable and supply power to the Product. 2 Make sure that the Product and LCD turns on. 3 Provide necessary input and output data settings. 4 Connect the input and output data cables. 5 Send the input data to the Product. 6 Make sure that the LEDs of receiving and transmitting data, located on the PCB of the Product, are lighting up. 7 Once the test is completed, power off the Product	1 person 15 mins

3.4 PRESERVATION

The Product and set of operational documents are stored in preserved condition in Manufacturer's packaging boxes.

Time of represervation – 2 years since the date of packaging at the Manufacturer's plant.

The preservation is done in full terms, for 2 years, applying protection and packaging.

The represervation is done in heated rooms in the same order as the preservation.

The Product after represervation and documents are placed in packaging.

4 CURRENT REPAIR OF THE PRODUCT

4.1 GENERAL DESCRIPTION

To provide diagnostics of the problems, see table 9.

If a problem cannot be diagnosed or trouble shooting cannot be provided, contact the Manufacturer's service center.

4.2 SAFETY FEATURES

Only qualified personnel, examined in occupational safety may perform repair works.

The Product must be grounded before repair works.

Put a poster "DO NOT switch on! Under Operation!" to the power supply switch in "OFF" position.

Replacing damaged parts, boards and modules is PROHIBITED if power supply of the repaired unit is on

Installation, commissioning and repair works are PROHIBITED in the room, where less than 2 people are present

4.3 CURRENT REPAIR

The service personnel can provide repair works as given in table 9.

Table 9 – Potential problems/defects and troubleshooting

Problem/defect	Potential reasons	To do
The Product does not switch on	Power cable is not connected	Connect the power cable
	No voltage from power supply source	Supply voltage
	The fuse is blown	Replace the fuse
No input data	Interface cable is not connected	Connect the interface cable
	Incorrect settings	Provide correct settings
No input data on the receiver	Interface cable is not connected	Connect the interface cable
	Incorrect settings	Provide correct settings

5 STORAGE

The Product must be stored in packaging inside areas complying with the required storage conditions (+5°C to +40°C) with the concentration of dust, oil, moisture and aggressive impurities in the air within the required limits for the working areas of production facilities.

After storage or transportation of the Product below +10°C, it must be unpacked only in heated premises and left in normal climate conditions for 12 hours beforehand.

6 TRANSPORTATION

The Product must be transported in the Manufacturer's transportation package in closed means of transport.

Types of shipment:

– motor vehicle and railroad transportation in closed means of transport (covered cars, multipurpose containers);

– air transportation (in sealed and heated compartments);

– sea transportation (in dry service spaces).

The Product must be transported in compliance with transportation rules applicable for each means of transport.

During loading/unloading operations and transportation, the requirements indicated on warning labels on the boxes/packaging must be observed, and no impacts are permitted since they can affect the safety and performance of the Product.

Inside the means of transport, the packed device must be firmly secured/fastened.

7 DISPOSAL

New equipment, the parts of the Product damaged during operation, and any outage equipment must not be disposed as standard household wastes, since they contain the materials suitable for re-use.

Decommissioned and non-used components of the Product must be delivered to a special waste disposal center licensed by local authorities. You can also send an overage equipment/unit to the manufacturer for its further disposal.

Proper disposal of Product components allows avoiding possible negative environmental and health impacts, and it also allows for proper restoration of components with substantial energy and resources saving.

During operation and upon completion of its service life, the equipment is not hazardous for health and environment

This unit must be disposed according to the rules applied to electronic devices

Any products marked with a crossed trash bin must be disposed separately from standard household wastes

8 WARRANTY

The Manufacturer is under warranty obligations in case of correct System exploitation according to the OM. The Manufacturer will not consider damage claims in case of violation of operating conditions.

More information about warranty terms you can find on the official site of “NPK MSA” LLC, section Support.

Address and contacts of the Manufacturer's service centre:

“NPK MSA”, LLC
26E, Kibalchicha str., 192174, St Petersburg, Russia
Tel.: + 7 (812) 602-02-64, 8-800-100-67-19
fax: +7 (812) 362-76-36
e-mail: service@unicont.com

APPENDIX A
(MANDATORY)
REGULATORY DOCUMENTS

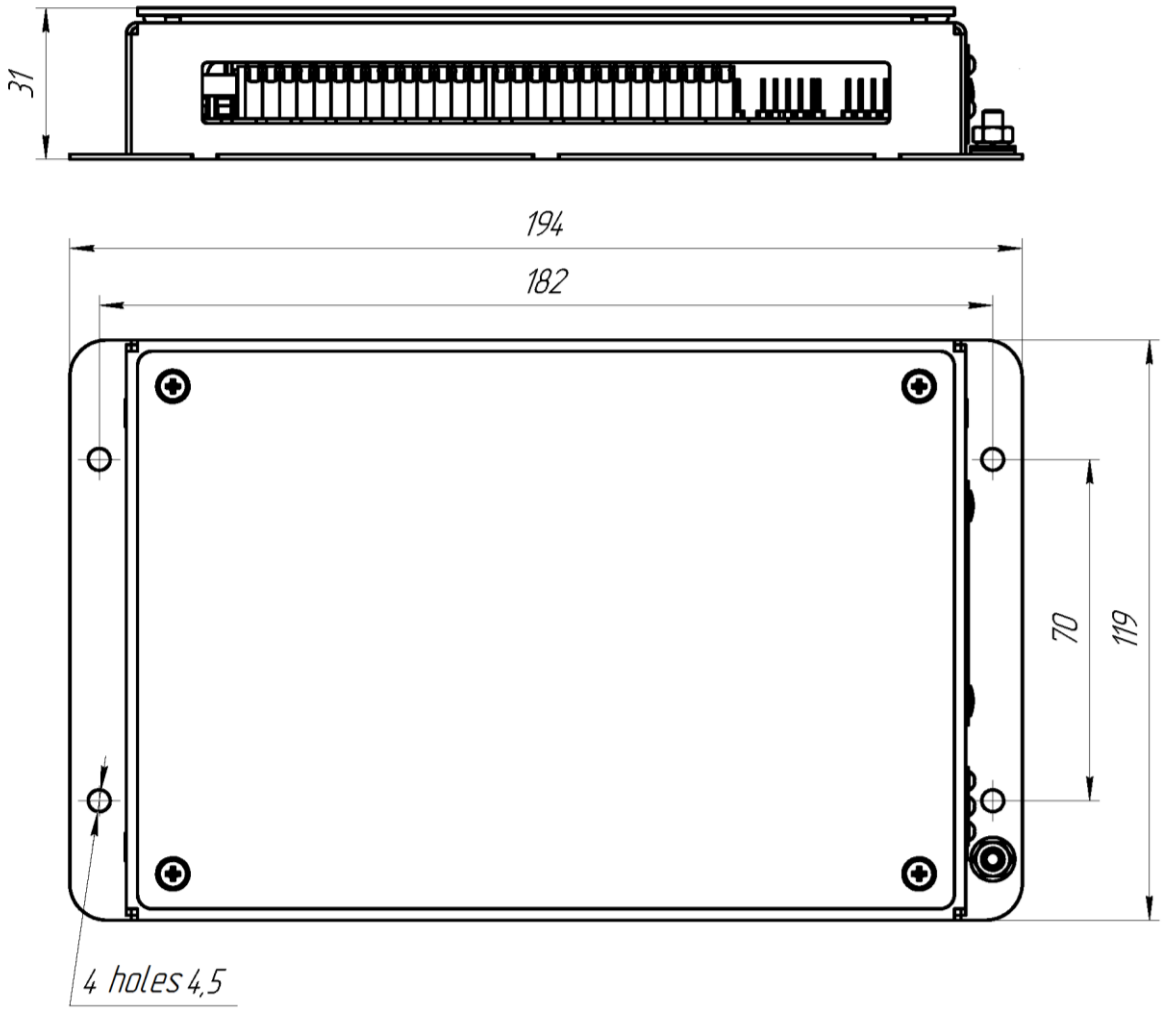

Figure A.1 – Outline and installation dimensions of the Product