

Unicont SPb Ltd

Digital-Analogue Converter DAC-109

Technical Documentation

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Table of Contents

1. PURPOSE.....	3
2. DELIVERY SET.....	3
3. SPECIFICATIONS	3
4. INSTALLATION AND CONNECTION OF THE CONVERTER.....	5
5. VOLTAGE SELECTION	10
6. PRINCIPLE OF CONVERTER OPERATION	13
7. DEBUG TOOLS AND DIAGNOSTIC AIDS	18
8. TYPICAL DEFECTS AND METHODS OF TROUBLESHOOTING.....	20
9. WARRANTY	22
10. DATE OF PACKING.....	23
11. ACCEPTANCE DETAILS	23
12. DATE OF COMMISSIONING	23

1. PURPOSE

The digital-analogue converter DAC-109 is intended for converting a digital value of course, which is received in the sentence NMEA, into the synchro or step signals which are necessary for controlling analogue repeaters and other devices based on synchro or step repeaters.

In addition, the converter DAC-109 may be used as a digital repeater for displaying a current value of course.

2. DELIVERY SET

1. Digital-analogue converter DAC-109	1 piece
2. Operation manual	1 piece
3. SPTA	
fuse 5 A	5 pcs.
fuse 15 A	1 pcs.

3. SPECIFICATIONS

Electrical Specifications:

Supply voltage:	18..32 VDC
Power supply protection of the converter:	against polarity reversal, overvoltage, overload
Output voltage (for synchro repeaters):	Reference – 120 VAC Reference – 400 VAC*
Output voltage (for step repeaters):	Reference – 150 VDC
Maximum total power consumption of connected synchro or step repeater:	250W/400W
Maximum number of connected synchro receivers:	8
Frequency of the output alternating voltage:	50 Hz/500 Hz
Types of connected analogue repeaters:	Synchro/Step
* - as an option	

Characteristics of Digital Inputs:

Number of digital inputs NMEA:	2 x RS-232/422/485 (1 basic + 1 reserve)
Maximum data receive rate:	115 200 Bd
Protection:	The inputs are optoisolated, galvanically isolated from the mains supply
Supported link protocols:	NMEA 0183 versions 1 and 2, with a check sum and without it
Supported sentences NMEA:	HDG, HDT, HDM

Characteristics of the Remote Control Interface:

Type of Interface:	RS-232/422/485
Number of inputs/outputs:	1
Speed of data receive/transmit:	9600 Bd
Number of stop bits:	1
Parity:	No

Characteristics of LCD:

Type of display:	Character (16 characters x 2 lines)
Displayed data:	Accepted value of course from the signal source NMEA, current position of analogue repeaters (transformed value of course)

Control Elements:

Type of keyboard:	Membranous
Number of keys:	12 (4 x 3)

Warnings:

Audible warning in case of missing NMEA signal in the basic channel.
 Visual warning in case of missing NMEA signal in the basic channel (at LCD).
 Output for connection of an external alarm module.

Characteristics of Alarm Output (“Alarm”):

Type of output:	Contacting/breaking of “dry” contacts
Maximum voltage, supplied to the output “Alarm”:	220 V
Maximum allowed current, flowing through the contacts “Alarm”:	1 A
Possible reasons of alarm response:	missing NMEA signal in the basic channel, missing input power supply of the converter

Operating Characteristics:

Overall dimensions:	305 x 305 x 134 mm
Weight:	no more than 6 kg
Temperature of operation:	-15..+55 °C
Storage temperature:	-55..+75 °C
Protection class:	IP 22

4. INSTALLATION AND CONNECTION OF THE CONVERTER

It is recommended to perform installation and connection of the converter as follows:

- a) Select the place for installation of the converter (at the vertical bulkhead or mounting panel) and prepare mounting holes as per outline drawing (see Figure 1).
- b) Install a wire link in the terminal block P21 and connect wires to the terminal block P12 according with needed voltage for analogue repeaters (see section 5).
- c) Power on the DAC-109.
- d) Set the operating mode of the converter (see section 6), pay attention to setting the correct type of connected repeaters.
- e) Power off the DAC-109.
- f) Lead coupling cables from the external devices and power source. Connect cables to removable terminal blocks in accordance with the type (step or synchro) of repeaters (see Figure 2, Figure 3, Figure 4, Figure 5).
- g) Power on the DAC-109.
- h) Enter an initial current course at the analogue repeaters (see section 6).
- i) If necessary, use the gyrocompass imitation mode and the imitation of cyclical turns of the ship in order to check workability of the converter and connected repeaters (see section 7).
- j) Check workability of the converter.

Warning! If you want to connect ADPC-101 to DAC-109 you shall use special filter FDA-122. Otherwise ADPC-101 will not recognize synchro signal.

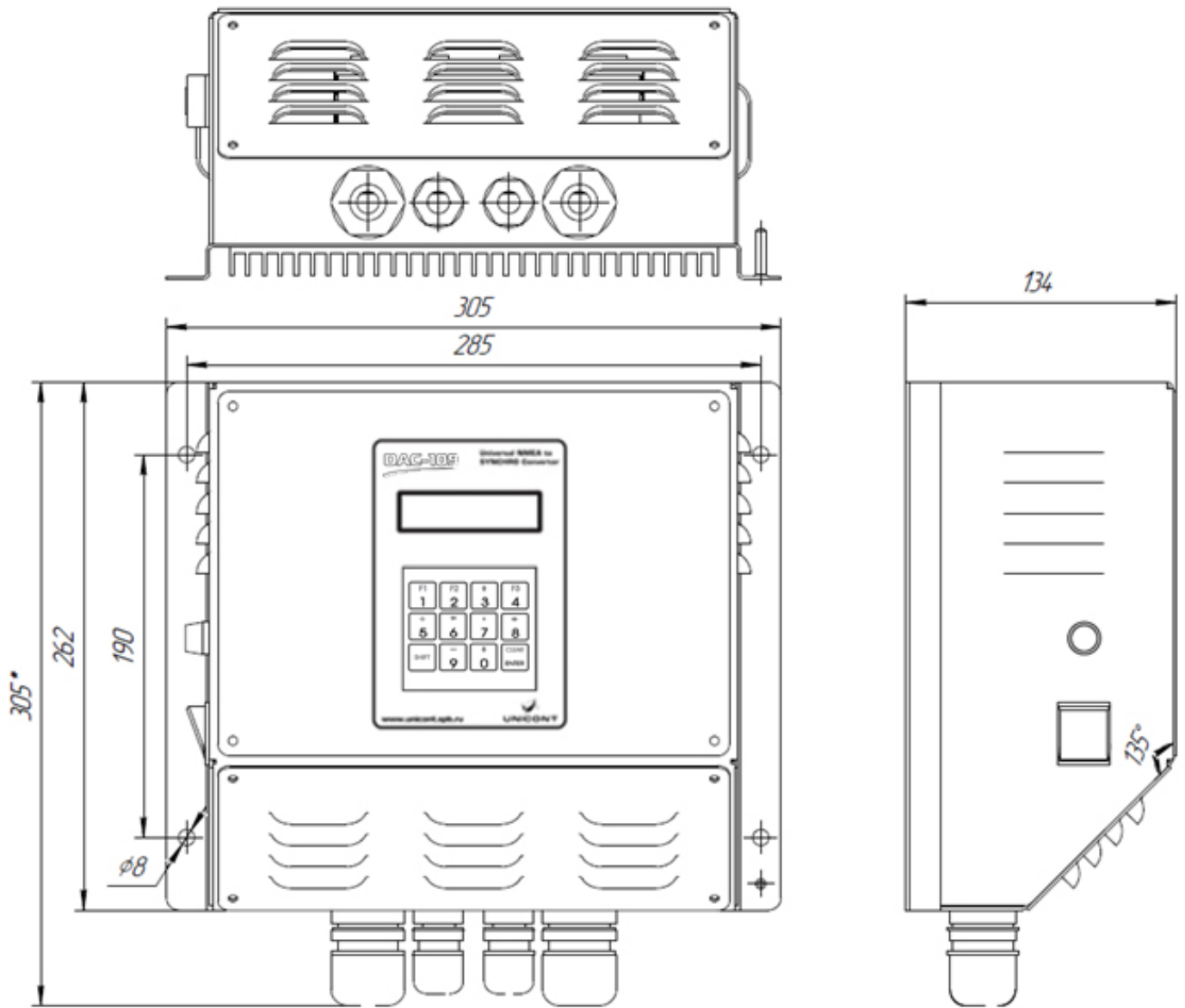


Figure 1. Outline drawing of the converter.

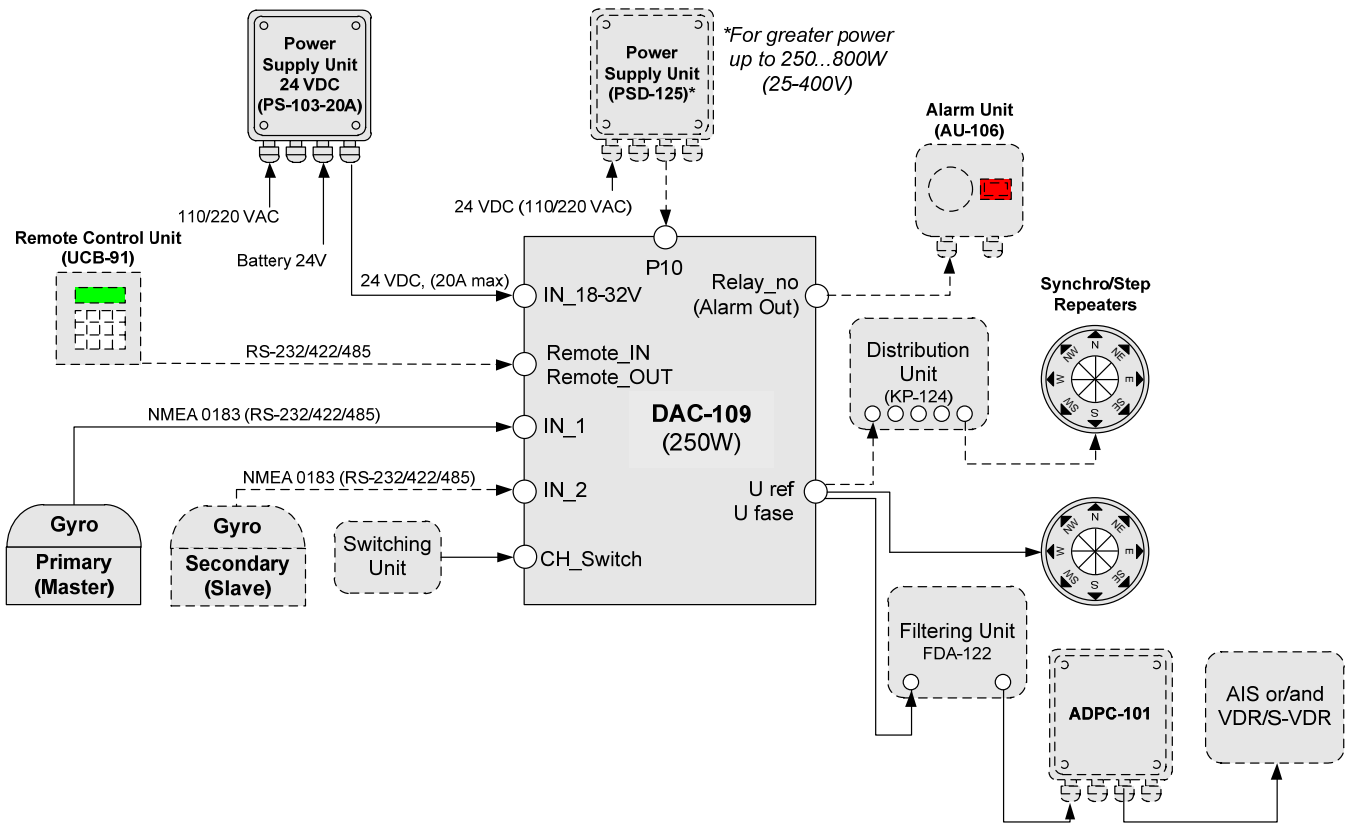


Figure 2. DAC-109 connection flowchart.

The diagrams of connection of external devices and Synchro or Step consumers to DAC-109

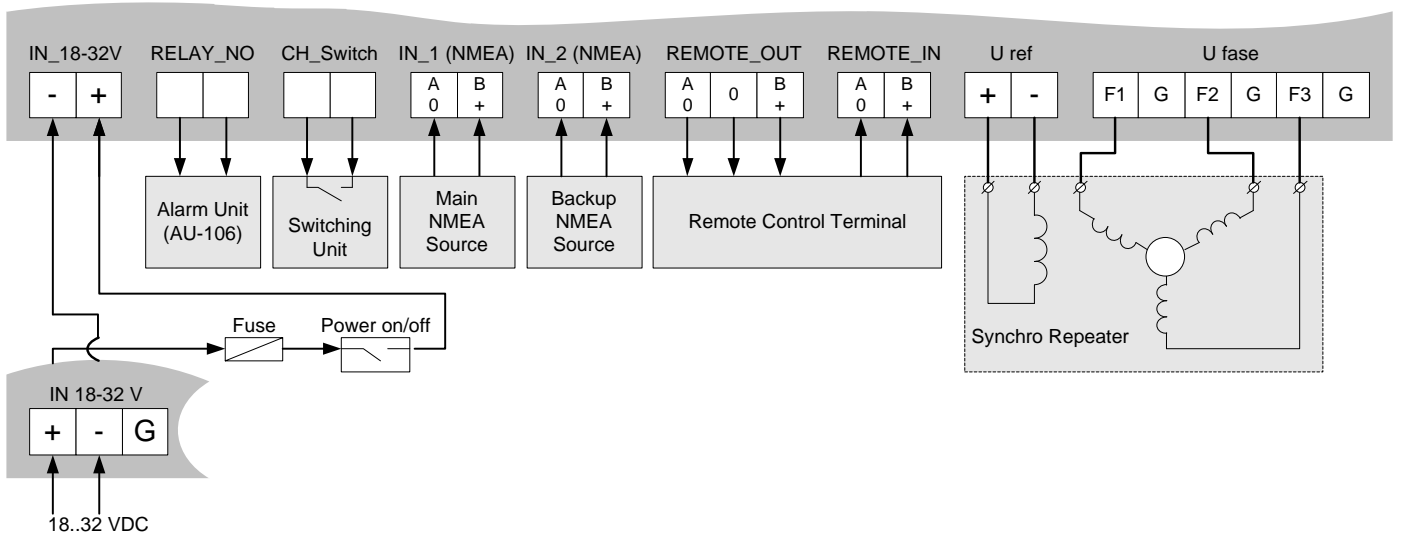


Figure 3. The diagram of connection Synchro consumers to DAC-109

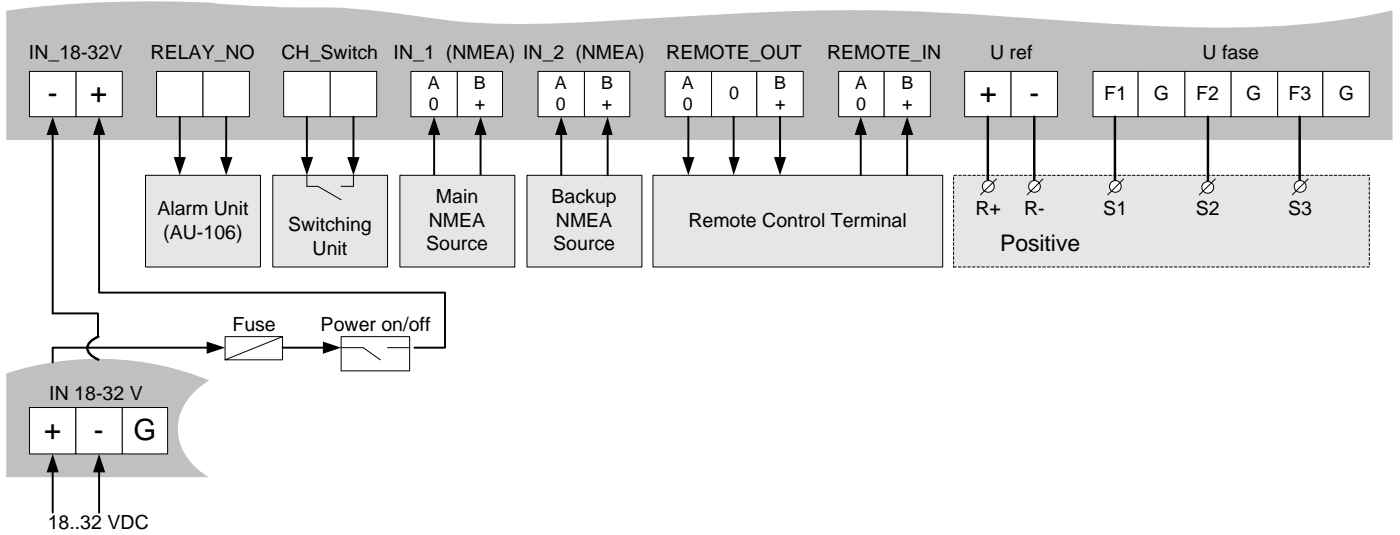


Figure 4. The diagram of step consumers connection to DAC-109 with "common plus"

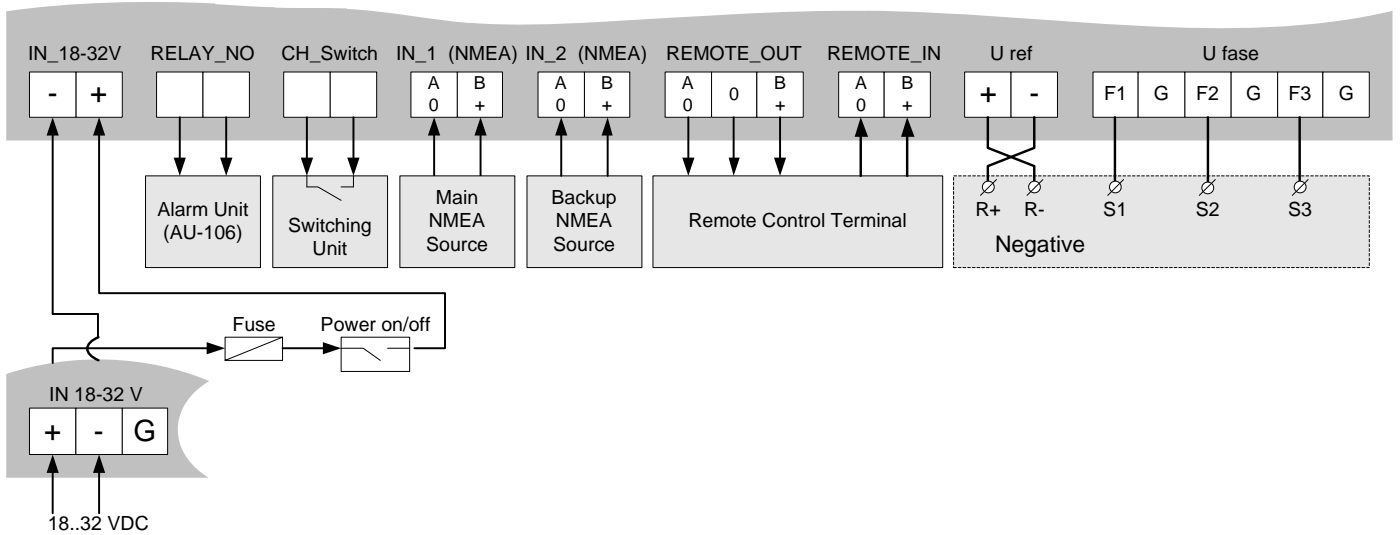


Figure 5. The diagram of step consumers connection to DAC-109 with "common minus"

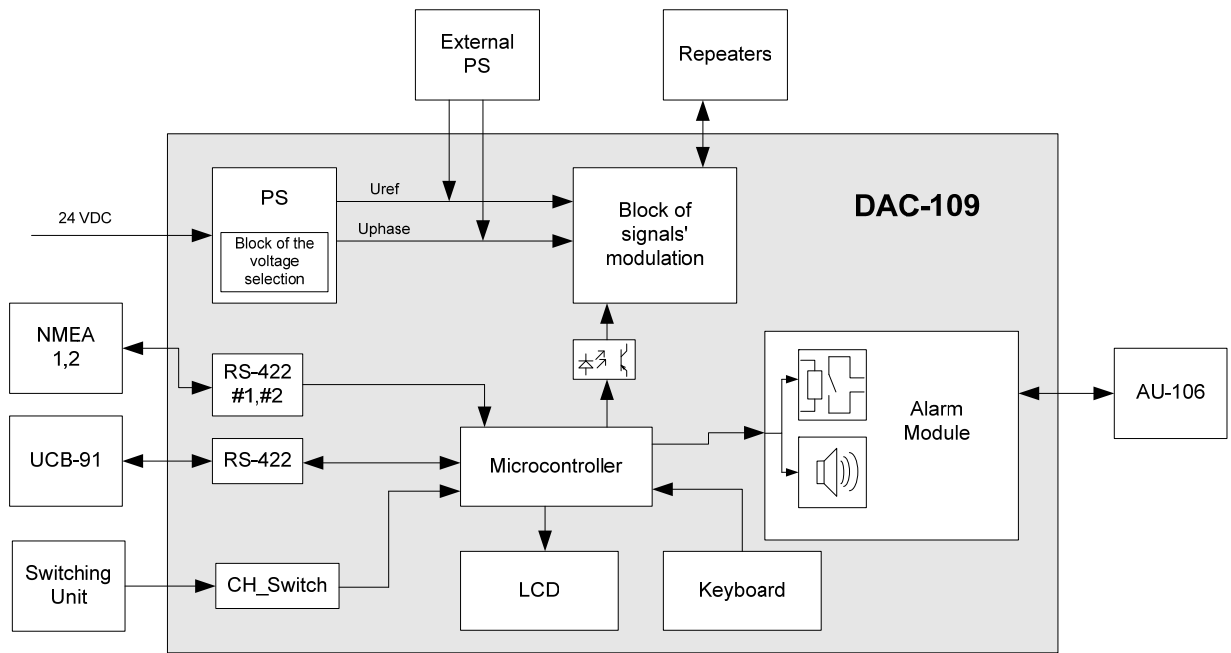


Figure 6. DAC-109 block-diagram.

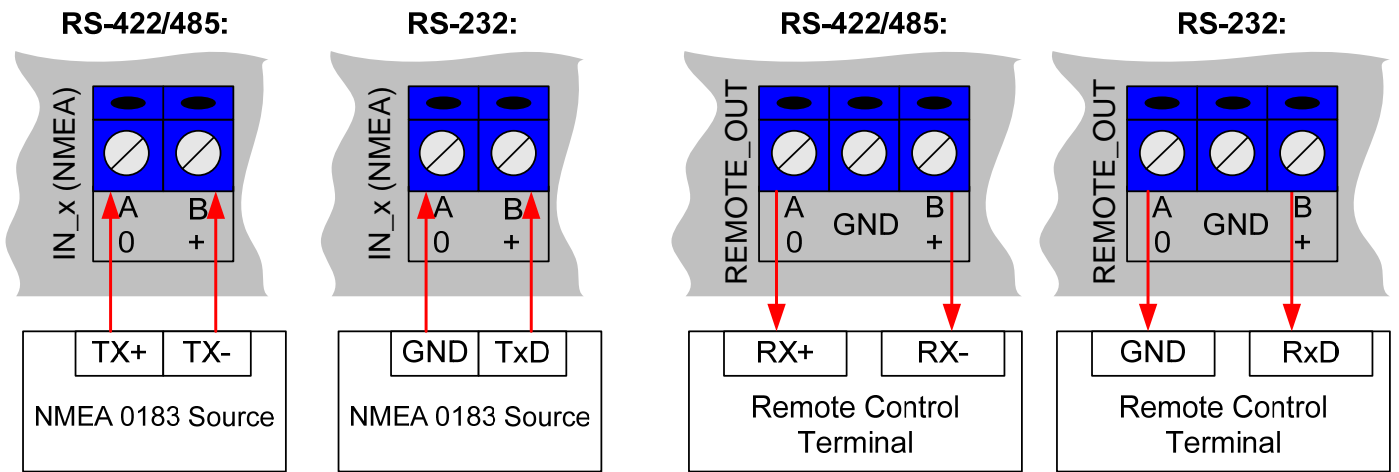


Figure 7. Connection diagram of interfaces RS-232 and RS-422/485

5. VOLTAGE SELECTION

The output voltage for the phase and reference channels may be selected by two methods:

1. By the connection of the wires to terminal block P12 and position of a wire link in terminal block P21.
2. By selecting the maximum output voltage amplitude in the device's menu.

The user should setup the output voltage by method #1 at first, so that the voltage is equal or little greater than required. Then, the user should adjust the output voltage to the required level by selecting the applicable settings in the device's menu (method #2).

Example: It is necessary to power the synchro type repeater with excitation voltage 100 V and maximum synchronizing voltage 50 V.

1. Select the wiring diagram P12 and P21 from Table 1. For the repeater excitation voltage (equal to 100 V) select the limit of 110 V. For the repeater maximum synchronizing voltage (equal to 50 V) select the limit of 75 V. Thus, the switching scheme will correspond to the sixth row of Table 1.
2. For the excitation voltage calculate how many percent makes the target voltage from the maximum value

$$\frac{100\text{V}}{110\text{V}} \times 100\% = 90.9\%$$

and set the value of 90 % using menu. Similarly, calculate the repeater maximum synchronizing voltage

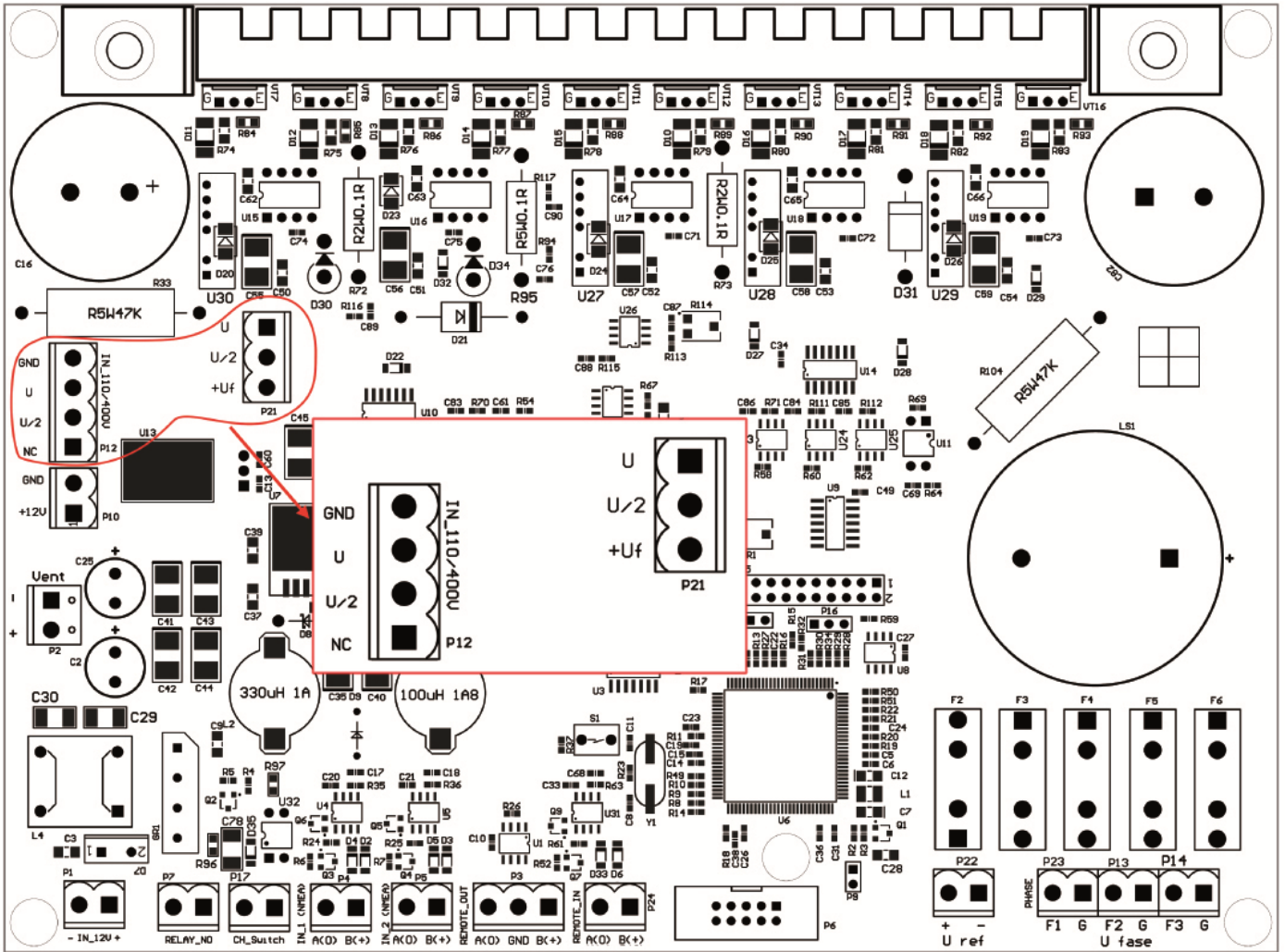
$$\frac{50\text{V}}{75\text{V}} \times 100\% = 66.7\%$$

and set the value of 65 % using menu.

Calculation formula:

$$\frac{U_{\text{target}}}{U_{\text{max}}} \times 100\% = \begin{array}{l} \text{Setting} \\ \text{percent} \end{array}$$

Positions of terminal blocks P12 and P21 on the PCB:



Warning! Producers doesn't connect wires to the P12 and user shall connect them!

Wiring diagrams for different levels of output voltages:

Table 1. The choose of synchro peripheries voltage level.

The chart of bridges installation on the terminal block of voltage choose		Voltage consumers
<p>Wires P12</p> <p style="text-align: center;">P21</p>	<p>Ref. 0~35 VAC Phase 0~35 VAC</p>	
<p>Wires P12</p> <p style="text-align: center;">P21</p>	<p>Ref. 35~75 VAC Phase 0~35 VAC</p>	

<p>Wires</p>	<p>P12</p>	<p>P21</p>	<p>Ref. 75~110 VAC Phase 0~35 VAC</p>
<p>Wires</p>	<p>P12</p>	<p>P21</p>	<p>Ref. 0~35 VAC Phase 35~75 VAC</p>
<p>Wires</p>	<p>P12</p>	<p>P21</p>	<p>Ref. 35~75 VAC Phase 35~75 VAC</p>
<p>Wires</p>	<p>P12</p>	<p>P21</p>	<p>Ref. 75~110 VAC Phase 35~75 VAC</p>
<p>Wires</p>	<p>P12</p>	<p>P21</p>	<p>Ref. 0~35 VAC Phase 75~110 VAC</p>
<p>Wires</p>	<p>P12</p>	<p>P21</p>	<p>Ref. 35~75 VAC Phase 75~110 VAC</p>
<p>Wires</p>	<p>P12</p>	<p>P21</p>	<p>Ref. 75~110 VAC Phase 75~110 VAC</p>

Table 2. The choose of step peripheries voltage level.

The chart of bridges installation on the terminal block of voltage choose		Voltage consumers
<p>Wires</p> <p>P12</p> <p>P21</p>	0~50 VDC	
<p>Wires</p> <p>P12</p> <p>P21</p>	50~100 VDC	
<p>Wires</p> <p>P12</p> <p>P21</p>	100~150 VDC	

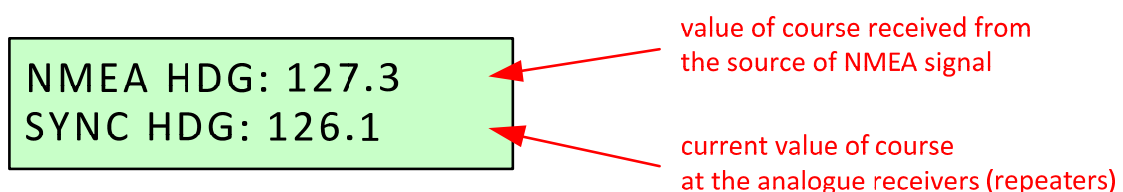
6. PRINCIPLE OF CONVERTER OPERATION

6.1 Standby Mode of the Converter

Right after power-up the converter DAC-109 switches to the standby mode. Two course values are displayed at the display in this mode:

1. Accepted value of course from the NMEA source (e.g. digital gyrocompass)
2. Current value of course at the receivers of analogue signal (for example, at the repeaters connected to DAC-109).

In this mode, the internal display of the converter looks as follows:



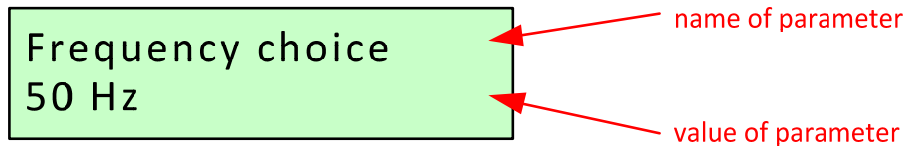
The necessity to display two values of course is caused by the inertia of synchro receivers (see par.6.5).

In the standby mode the user may enter into the configuration menu of the converter – in order to do it, it is necessary to press the key [F3].

Attention! After switching on the converter it is obligatory to enter initial positions of connected analogue repeaters (see par. 6.4).

6.2 Configuration Menu of the Converter

When pressing the key [F3] in the standby mode of the converter (see par. 6.1) the configuration menu appears at the display of DAC-109:



Exit from this menu to the standby mode of the converter is performed by the key [F3] (the set configurations are stored).

The name of configured parameter is displayed in the upper line of the display. The current value of this parameter is displayed in the lower line.

Selecting a parameter is performed by pressing the keys [▲] and [▼], changing the value of selected parameter is performed by pressing the keys [◀] and [▶]. Confirmation of selected parameter value and its storing in the permanent memory of the converter is performed by pressing the key [Enter].

The settings of the converter which may be changed and their purpose are listed below.

Frequency Choice

Selection of the output sinusoidal analogue signal frequency.

The frequencies which are available: 50 Hz, 500 Hz

Repeater Type

Selection of the type of the connected repeaters.

The repeater types which are available: Step, Synchro

Reference Voltage

Selection of the output level on the reference channel. This is ratio of voltage which is setup by P12 and P21 (see section 5).

Available values: 100%, 95%, 90%, 85%, 80%, 75%, 70%, 65%, 60%, 55%, 50%, 45%, 40%, 35%, 30%, 25%, 20%, 15%, 10%, 5%.

Phase Voltage

Selection of the output level on the phase channels. This is ratio of voltage which is setup by P12 and P21 (see section 5).

Available values: 100%, 95%, 90%, 85%, 80%, 75%, 70%, 65%, 60%, 55%, 50%, 45%, 40%, 35%, 30%, 25%, 20%, 15%, 10%, 5%.

Ratio Choice

Selection of the relation between the ship's turn and the analogue receiver synchro's turn.

Available relations: 1:36, 1:60, 1:90, 1:180, 1:240, 1:360

Channel Select

Selection of the main channel for receiving data about a course in the digital sentences NMEA 0183. If channel #1 is selected, channel #2 will be used as a reserve channel. If channel #2 is selected, channel #1 will be used as a reserve channel.

Available options for selection the main channel: Channel 1, Channel 2.

Port 1 Settings

Settings of channel #1. In order to enter into the submenu of settings for channel #1 press the key [Enter].

For each channel (#1 and #2) the following settings are available:

Name of port setting	Value of setting for selection
Baudrate (Baud rate)	4800, 9600, 14400, 19200, 28800, 38400, 57600, 115200
Parity (Parity check)	No, Even, Odd
Stop bit (Number of stop bits)	1, 2
CRC Checking (Checksum verification)	On, Off

Upon setting the parameter CRC Checking to "On" the converter verifies the checksum of incoming NMEA sentences. If the checksum of the sentence does not match the calculated checksum (i.e. the sentence is received with errors), the converter ignores the incoming data.

Switching on this option for connecting sources of NMEA signal, version 1 is forbidden, since in the sentences of this version of NMEA, transferring the checksum is not specified.

After changing this parameter, in order to store the selected value it is necessary to press the key [Enter]. In order to exit from the submenu for setting the channel press the key [F3].

Port 2 Settings

Settings of channel #2. See «Port 1 Settings».

Backup Channel

Turning on / turning off of switching over function to reserve channel data

If reserve source of NMEA signal is not connected, it is necessary to set this parameter in the position "Off".

If reserve source of NMEA signal is connected and parameter of "Backup Channel" in the position "Off" then the switching over to the reserve channel and back is possible by manual mode only (see Figure 3 "CH_Switch" terminal block).

If the parameter of “Backup Channel” in the position “On” then the switching over to the reserve channel and back is possible as in automatic as in manual mode.

Available values of this parameter are: On, Off

Alarm Sound

Selection of necessity to switch on the audible warning when the input NMEA signal at the main channel is missing.

Available values of this parameter are: On, Off

Alarm Period

Selection of the period after which the audible warning will be switched on, and the converter will switched over to the reserve channel when data at the main channel is missing.

Available values of this parameter are: 2, 3, 4, 5, 6, 7, 8, 9, 10 sec.

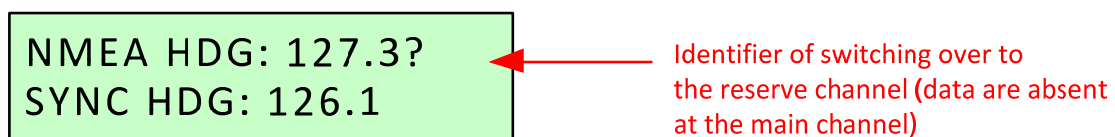
6.3 Alarm System

Several types of warning are foreseen in the DAC-109: absence of data at the main channel, absence of data at the reserve channel, absence of data at the main and reserve channel, absence of connection to the synchro-receiver, the initial position of connected analogue repeaters are not entered (see par.6.4).

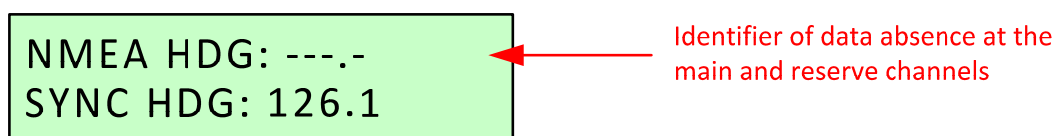
Warning about Missing of Data at the Main Channel

If the converter does not accept data about the course through the main channel during the time, set by the setting «Alarm Period» (see par.6.2), the audible warning is switched on, and if the setting «Backup Channel» is set in «On», the converter is switched over to the reserve channel for receiving data NMEA data.

Visually, the current state of warning is shown at the converter display in the standby mode as follows:



If NMEA course data is also missing at the reserve channel, the converter display switches over to the following mode:

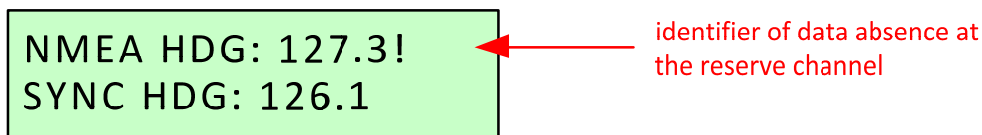


When receiving of data through the main channel is renewed the audible warning is stopped, and the converter is switched over to the main channel.

When the warning is switched on (while switching on to the reserve channel) the contacts of the output RELAY are also closed).

Warning about Absence of Data at the Reserve Channel

If the setting «Backup channel» is set in «ON», DAC-109 controls receiving of data through the reserve channel. When data at the reserve channel is missing, the mark «!» appears at the indicator in the upper line, on the right from the value of course, accepted through the main channel. At the same time the audible warning (beeps with duration of 0.5 s each 5 seconds) is switched on. Contacts of the RELAY output are not closed.



Device overload alarm

In case of device output overload (such as short-circuit), DAC-109 automatically shuts the signal conditioner to avoid damage to device circuits and connected equipment. Herewith the message appears “Overload protection”. In order to restart the device, the cause of unit overload should be eliminated and DAC-109 reset.

Possible Failures and Their Indication by the Converter

Failure	Example of indicator state	Contacts of the output RELAY	Audible warning*
The initial position of analogue repeaters are not entered	NMEA HDG: 127.3 SYNC HDG: ---.-	Closed	0.2/1
Data at the main channel are missing	NMEA HDG: 127.3? SYNC HDG: 126.1	Closed	0.2/1
Data at the reserve channel are missing	NMEA HDG: 127.3! SYNC HDG: 126.1	Opened	0.5/5
Data at the main and reserve channels are missing	NMEA HDG: ---.- SYNC HDG: 126.1	Closed	0.2/1

* - for the audible warning, the duration of audible pulses/period of their movement are given.

Note: For activation of the audible warning it is necessary to push the key [F2]. At the same time the visual warning is not interrupted, and the contacts of the output RELAY are not opened until the moment when data receiving through the main channel is renewed.

Alarm Acknowledge

In order to acknowledge an alarm (mute the audible warning), press the keys [SHIFT] and [CLEAR].

6.4 Entering Initial Positions of Analogue Repeaters

After its switching on, DAC-109 on default, thinks that connected analogue repeaters indicate course «0°». If any other value is indicated at the repeaters, the shift which equals to this value when converting the course will be generated. In order to prevent this effect, entering the initial position of connected repeaters is foreseen in DAC-109.

In order to enter the initial course of analogue repeaters it is necessary to fulfill the following actions:

1. In the standby mode press the key [F1].
2. Enter the initial course (POSITION) of analogue repeaters (see example below). In order to erase the entered value – press the key [SHIFT] and [CLEAR] (each pressing of [CLEAR] erases the last symbol), in order to exit the mode of erasing – press the button [SHIFT] once again.
3. In order to store the entered value press the key [ENTER].

Example of entering the initial value of course:

It is necessary to enter the initial position of analogue repeaters «340.1°».

[F1][3][4][0][SHIFT][.][1][ENTER]

It is necessary to enter the initial position of analogue repeaters «234°».

[F1][2][3][4][ENTER]

Attention! If the user did not enter the initial position of repeaters, instead of the value of course for the analogue repeaters the line «---.» is displayed in the lower line of the display. At the same time, the converter does not process the changes of digital course, received from the signal sources NMEA 0183.

6.5 Principle of Operation of the Converter

The converter accepts the digital value of course from the sources of signal NMEA 0183 and converts it into sinusoidal voltages at the outputs for connecting coils of the synchro-receiver. At the same time, the amplitude of oscillation is set in the way that results in the synchro-receiver occupies the position corresponding the digital value of course.

Since some time is necessary for turning the synchro-receiver, which is determined by the number of necessary turns (when the relation of the synchro turn to the turn of the ship is not 1:1) and the inertia of the synchro-repeater, changing of course at the connected analogue repeaters takes place gradually. Both courses (accepted and converted) are displayed at the converter screen (see par.6.1). If DAC-109 did not have enough time to move the connected synchro-receivers to the value of course, which was accepted before, and got the new value, the converter is switched over to processing the new value (in other words, DAC-109 always moves synchro-receivers repeaters to the last accepted value of course).

7. DEBUG TOOLS AND DIAGNOSTIC AIDS

7.1 Imitation of Digital Gyrocompass

In order to simplify the process of setting the converter and connected repeaters, DAC-109 is provided with a special mode of imitation the digital gyrocompass. In this mode the converter ignores accepted data about the course from the sources of signal NMEA 0183 and processes the values of course, entered by the user from the converter's keyboard.

In order to switch on the mode of imitation of the gyrocompass it is necessary to press the key [5] in the standby mode. The Converter's indicator is switched over to the following state:

GYRO IMITATION
F1-ON F2-OFF

In order to switch on the mode of imitation it is necessary to press the key [F1], in order to switch it off (if it was switched on before) – press the key [F2]. After pressing the key [F1] the mode of imitation is switched on, the report «IMIT HDG:» will be displayed in the upper line of the indicator instead of the report «NMEA HDG:». In order to enter the course, which should be set instead of the course accepted from the sources of NMEA signal, it is necessary to press the key [7], then to enter the value of course (similarly to par. 6.4).

Attention! After debugging the converter and analogue repeaters connected to it, do not forget to switch off the mode of imitation of the gyrocompass!

7.2 Imitation of Cyclical Turn of the Ship

The second mode which is necessary for simple debugging the connected repeaters – is the imitation of cyclical turn of the ship. In this mode DAC-109 emulates a constant turn of the ship to the right with the speed of 360°/min. Changing of course at the connected repeaters, if they are connected properly, should occur with a constant speed without jerks or wobble and without changing the rotational direction.

In order to start the imitation of cyclical turn of the ship, press the key [9]:

CIRCULATION
F1-ON F2-OFF

In order to switch on this, press the key [F1], in order to switch it off (if it was switched on) – press the key [F2].

Attention! After debugging the converter and analogue repeaters connected to it, do not forget to switch off the mode of imitation of cyclical turn of the ship!

Press any key to exit the status display mode of the output channels.

8. TYPICAL DEFECTS AND METHODS OF TROUBLESHOOTING

Faulty condition of DAC-109 can be caused by mechanical or electrical damage. Some malfunctions and methods for their elimination are listed in the table below (Table 3).

Table 3 Typical malfunctions and methods of troubleshooting.

Malfunction	Course	Remedy
1	2	3
Number of controlled translator repeaters less than stated in the documentation. One or more repeaters do not rotate or rotate with difficulty, not correctly	One or more repeaters are oxidized or have mechanical problems	Eliminate the oxides in the synchros, eliminate the causes of mechanical problems
	One or more repeaters are faulty	Detect and remove a faulty repeater. (It is recommended to install all repeaters via the fuse box)
	Long cable used	It is necessary to increase the output signal power
	Small wire cross section used	The cable should be replaced with a larger cross section
	Poor contacts in repeater control lines	Eliminate "bad" cable connections to the repeater, the oxides on the connecting terminals, weak contacts, tighten and sold joints
Repeater card rotates choppy (not uniformly)	Incorrect settings of the reference and phase voltage of the synchro rotation	Set the appropriate voltage of synchro rotation (see it. 5)
The translator display indicates black squares	Too much contrast of the translator display	Reduce the display contrast to appropriate indication level of display values
No output signal	No power supply. No jumper P12 installed in the upper PCB of the course translator	Install jumper P12 of the course translator upper PCB in accordance with the synchro voltage (see it. 5)
The device does not switch on	Connected voltage not corresponding to the required ratings	Connect voltage 24 VDC
	Polarity not observed when connecting power supply	Change the polarity of the plug-in voltage
Information displayed by repeater differs from that set by translator.	Incorrect setting of the ratio between the turn of the vessel and the analog receiver synchro rotation	Set the corresponding ratio between the turn of the vessel and the analog receiver synchro rotation (see it. 6.2)
	Incorrect or no setting of the repeater course current value	Set the current position of the repeater course

1	2	3
The translator display indicates message "OVERLOAD"	Short-circuit in the load circuit	Eliminate the cause of short circuit
	The load parameters exceed the maximum allowable overload capacity	Check the connections of repeaters and control lines. (See item in this table, "The number of controlled repeaters is less than stated by the manufacturer")
	There is an old synchro excitation unit in the load circuit	Remove the old synchro excitation unit from the load circuit
Devices connected to the translator output circuit (radars, gyrocompass, etc.) do not trace or do not correctly trace the signal from the course translator.	Analog-digital receiver does not receive or receives incorrectly the signal from the transducer	Insert FDA-122 filter into the circuit of analog-digital consumer
Interferences in the radio equipment	Violation of screen integrity of the repeater power cable or translator power cable	Restore the screen integrity of the repeater power cable or translator power cable
Tripping of built-in alarm, no data reception	No course data from the data source, incorrect settings of reception channel	Customize the parameters of receiving channel from the source (see it. 6.2)
	The initial position of the repeater (-s) not set	Set the initial position of the repeater (see it. 6.4)

9. WARRANTY

The manufacturer guarantees the unit DAC-109 complies with this manual provided that the operation, transportation and storage conditions are adhered to during the warranty period.

The unit's warranty period expires 24 months from the date of its shipping from the manufacturer's storehouse.

Within the warranty period, the owner is entitled for a free repair, or a replacement of a separate part, provided that the malfunction occurred through the manufacturer's fault.

Warranty repair is provided if the unit is submitted with the manufacturer's label and a legible serial number available on it, as well as this operating manual.

The manufacturer is not responsible and cannot guarantee the unit's operation:

1. After the warranty period is over;
2. In case of the failure to observe the unit's operation, transportation, storage and installation rules and conditions;
3. If the unit is in an unmarketable condition, or has a damaged body, and other causes beyond the manufacturer's control;
4. If self-made electrical devices were used.
5. If there was an attempt to repair the unit by a person who is not an authorized representative of the manufacturer.

If the owner loses this operating manual or the manufacturer's label with a serial number, the manufacturer shall not provide their copies, and the owner shall be divested of the right for a free repair during the warranty period.

Upon the warranty expiry, the manufacturer shall facilitate the repair of the unit at the owner's expense.

Note: in case of warranty repair, the unit's disassembling from the installation site and its delivery to the manufacturer's service center are done at the owner's expense.

Visit the manufacturer's website www.unicont.spb.ru (section "support/warranty") to find:

- forms to fill in claims,
- full warranty description;
- full description of the warranty service rendering procedure.

The manufacturer service center's address and contact details:

Unicont SPb, Ltd.

Bld. 26E Kibalchich Str., Saint Petersburg, 192174, Russia

tel.: +7 (812) 622 23 10, +7 (812) 622 23 11

fax: +7 (812) 362 76 36

e-mail: service@unicont.spb.ru

10. DATE OF PACKING

Digital-Analogue Converter

name of article

DAC-109

designation

№

serial number

Packed Unicont SPb Ltd., Russia.

Manufacturer

according to the requirements of the current technical documentation.

post

signature

clarification of signature

year, month, day

11. ACCEPTANCE DETAILS

Digital-Analogue Converter

name of article

DAC-109

designation

№

serial number

was manufactured and accepted in accordance with the regulatory requirements of the state standards and applicable technical documentation, and is suitable for operation.

Quality control representative

Stamp _____
here signature

clarification of signature

year, month, day

12. DATE OF COMMISSIONING

Digital-Analogue Converter

name of article

DAC-109

designation

№

serial number

The unit has been put into operation.

Date of installation: _____

Place of installation: _____

Person in charge of installation: _____