

Digital-Analogue Converter  
DAC-109

Technical Documentation  
(109-3-160308)

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## 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 synchrosignals which are necessary for controlling analogue repeaters and other devices based on synchros.

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. Specifications

### Electrical Specifications

Supply voltage:	18..32 VDC
Power supply protection of the converter:	against polarity reversal, overvoltage, overload
Output voltage:	Reference – 120 VAC Reference – 400 VAC*
Maximum summary power consumption of connected synchros:	150W / 400W
Frequency of the output alternating voltage:	50 Hz / 500 Hz
Types of connected analogue repeaters:	Synchro/Stepper

\* - 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 bps
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 bps
Number of stop bits:	1
Parity:	No

### Characteristics of LCD

Type of display:	Symbol (16 symbols 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
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Number of keys:	12 (4 x 3)
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### Warning

Audible warning in case of absence the NMEA signal in the basic channel
Visual warning in case of absence the NMEA signal in the basic channel (at LCD)
Output for connection 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	absence of the NMEA signal in the basic channel, absence of input power supply of the converter

### Operating Characteristics

Overall dimensions:	420.8 x 266 x 86.5 mm
Weight:	no more than 6 kg
Temperature of operation:	-20..+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) Setup bridge in the terminal block P21 and connect wires to the terminal block P10 according with needed voltage for analogue repeaters (see section 5).
- c) Energize the converter.
- d) Adjust operating regime of the converter (see section 6), pay your attention to adjusting the 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 diagram (see Figure 2, Figure 3, Figure 4).
- g) Power on DAC-109.
- h) Enter an initial current course at the analogue repeaters (see section 6).
- i) If necessary, use the modes of gyrocompass imitation and imitation of cyclical turn 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.

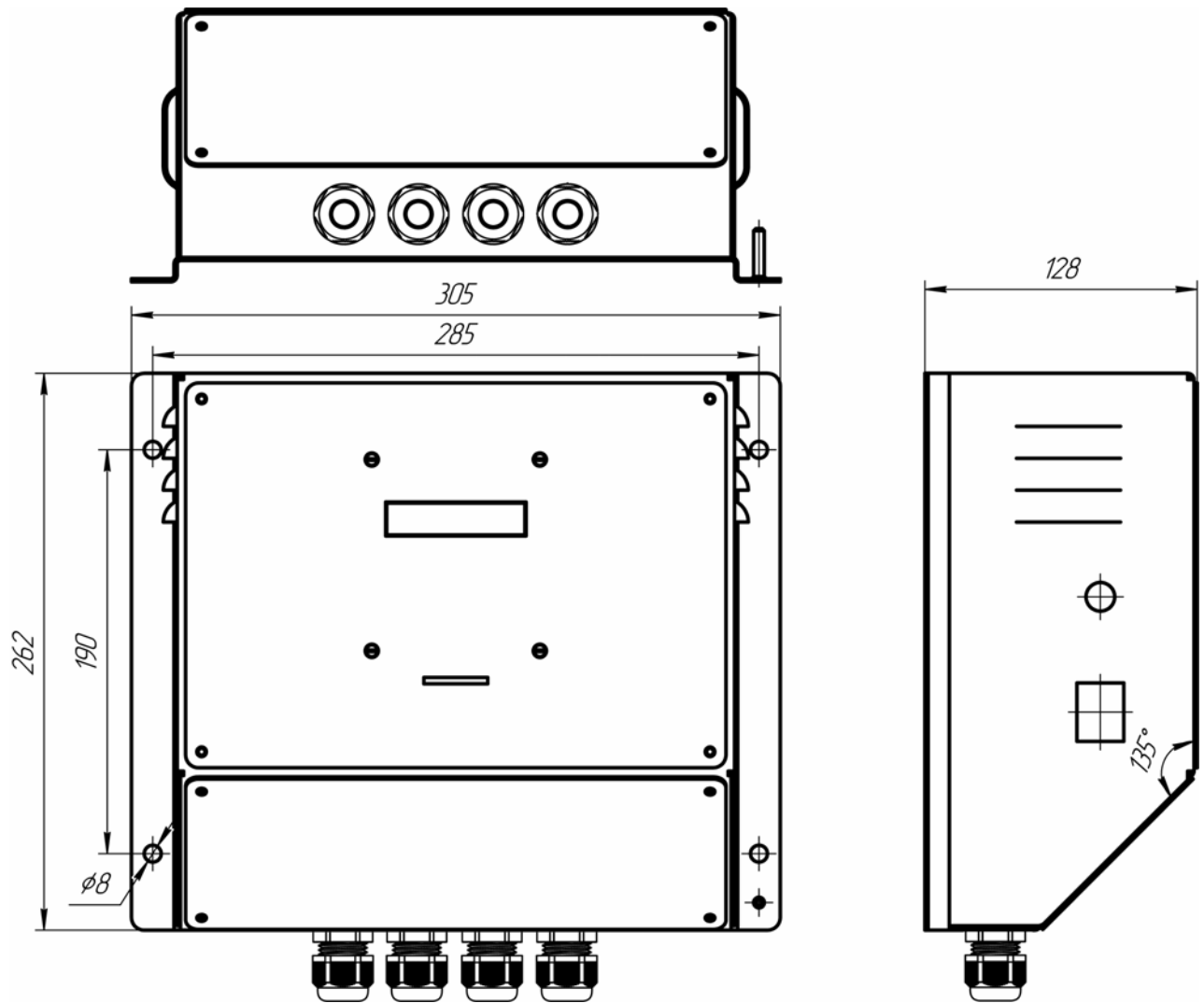


Fig. 1. Outline drawing of the converter

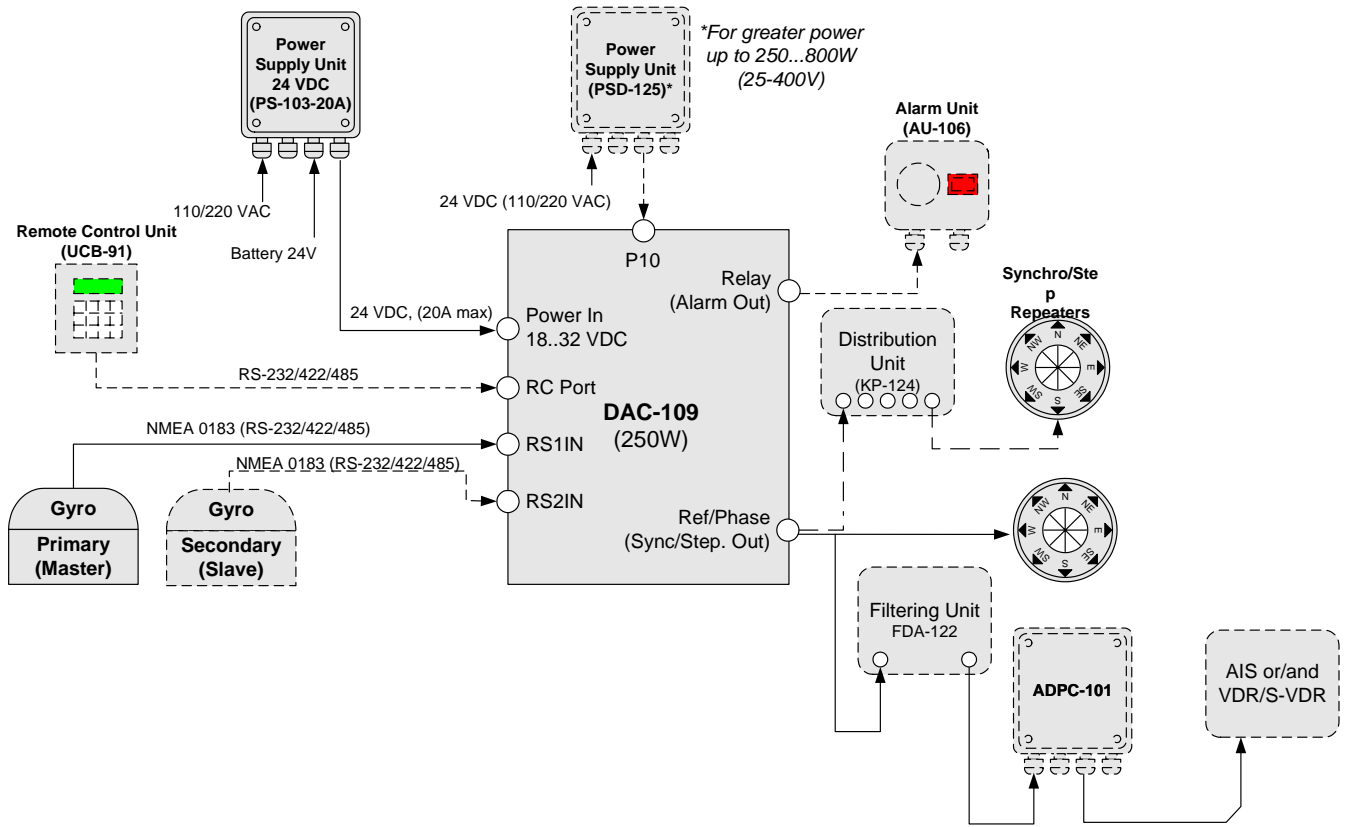


Fig.2. DAC-109 connection flowchart

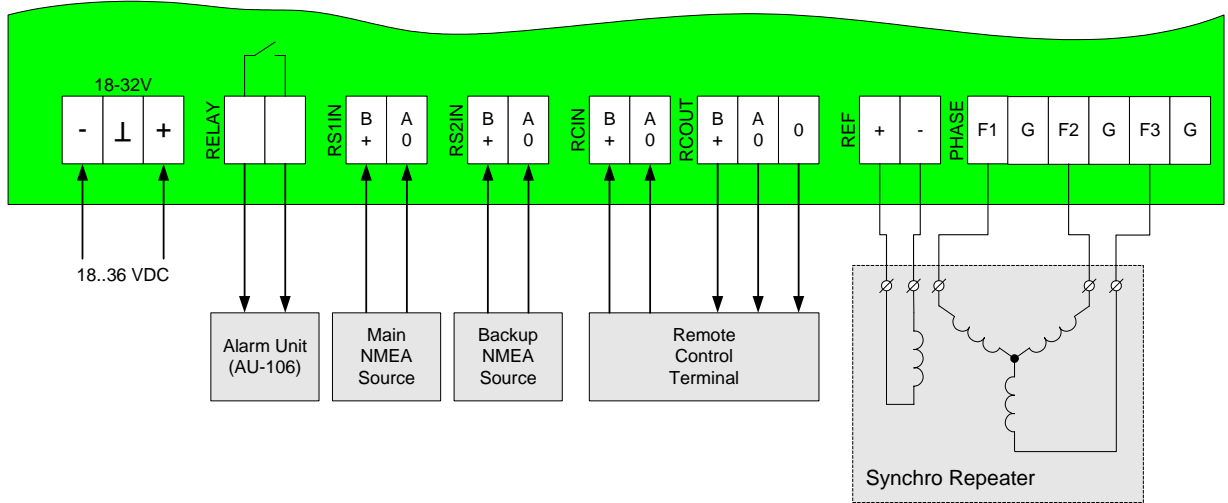


Fig. 3. External devices connection diagram to DAC-109

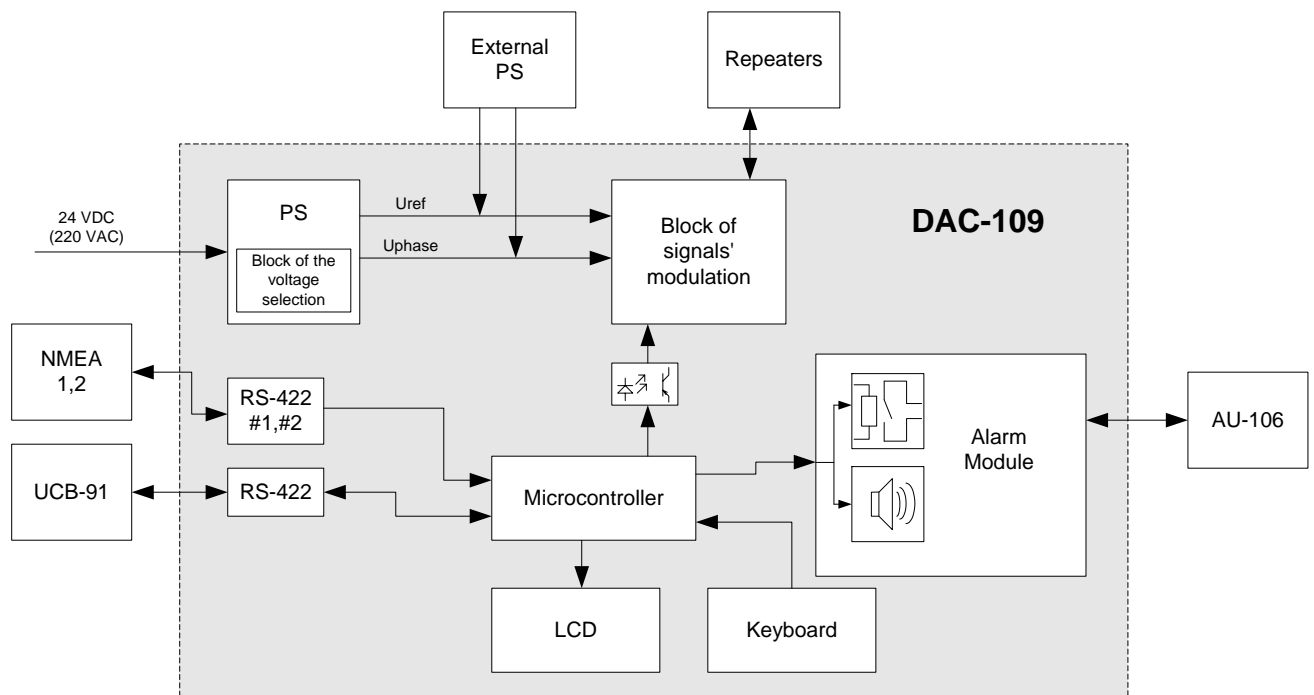


Fig. 3a. DAC-109's block-scheme.

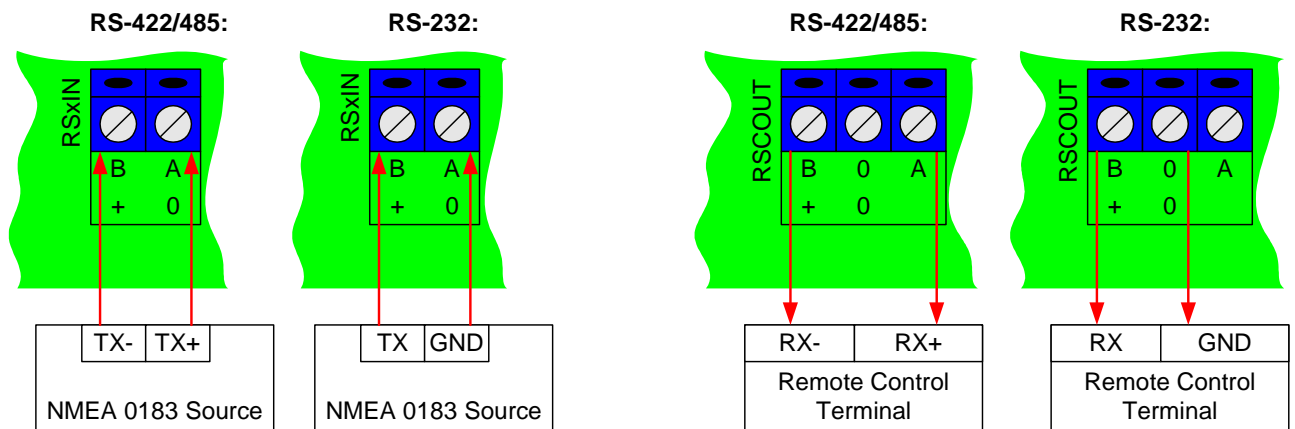


Fig. 2. Connection diagram of interfaces RS-232 and RS-422/485

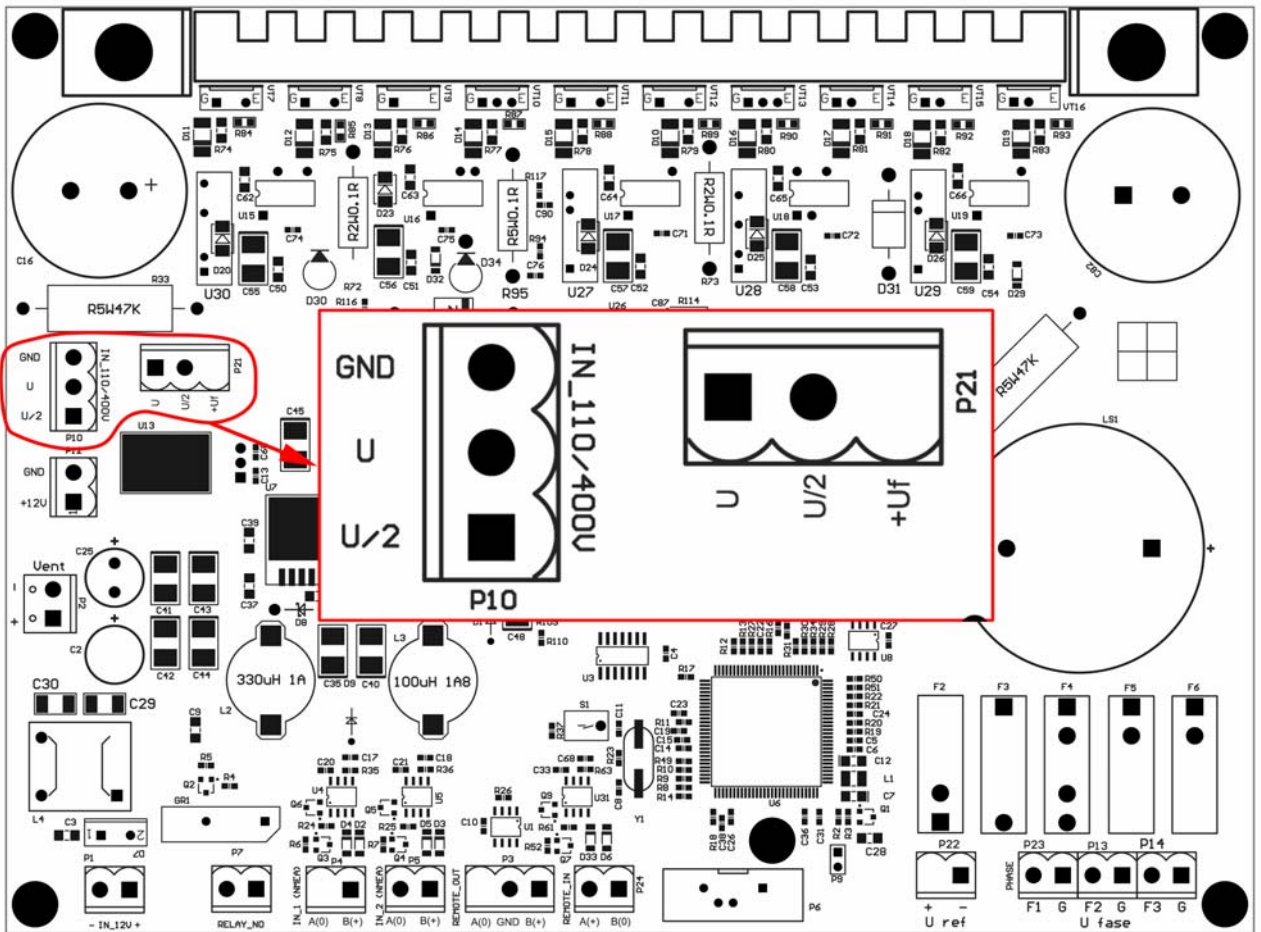
## 5. Voltage Selection

Output voltage selection on phase and reference channels provides in 2 ways:

1. By scheme of the wires' connection to the terminal block P10 and position of a bridge in the terminal block P21.
2. By choosing of the maximal output voltage amplitude in the device's menu.

User should setup output voltage with method #1 at first, so at to voltage be identical of small greater than needed level. After it user should adjust needed output voltage by the changing of the according settings in the device's menu (method #2)

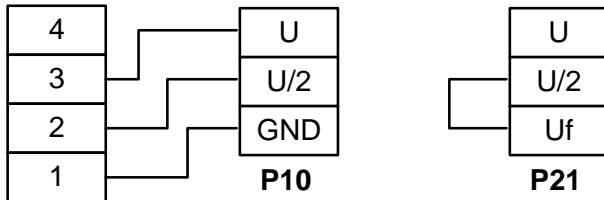
Terminal blocks' P10 and P21 position on the PCB:



**Warning! Producers doesn't connect wires to the P10 and user shall connect them!**

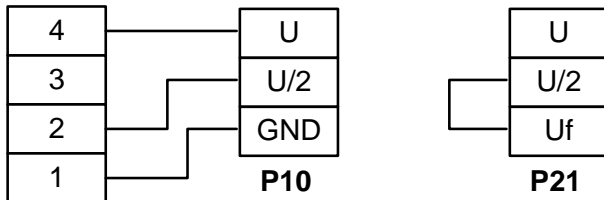
Wiring diagrams for different levels of output voltages:

Ref. voltage: 35~75 VAC  
Phase voltage: 0~35 VAC



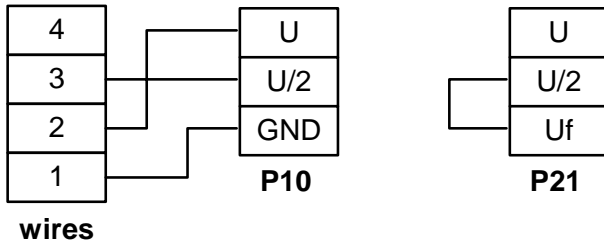
**Wires**

Ref. voltage: 75~110 VAC  
Phase voltage: 0~35 VAC

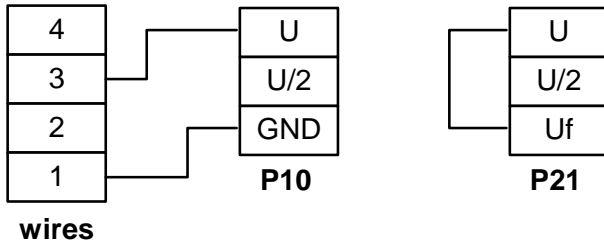


**wires**

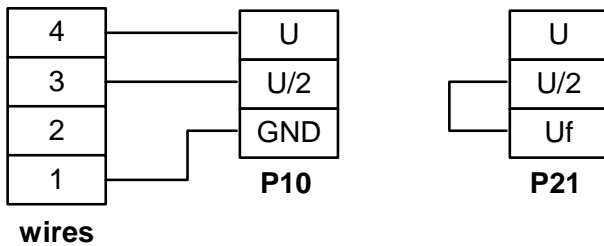
Ref. voltage: 0~35 VAC  
 Phase voltage: 35~75 VAC



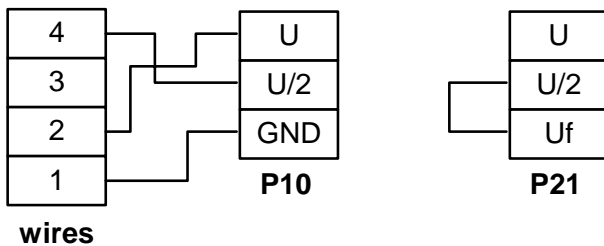
Ref. voltage: 35~75 VAC  
 Phase voltage: 35~75 VAC



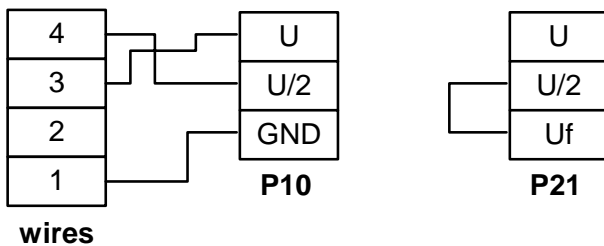
Ref. voltage: 75~110 VAC  
 Phase voltage: 35~75 VAC



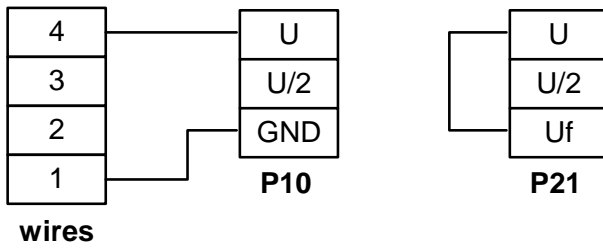
Ref. voltage: 0~35 VAC  
 Phase voltage: 75~110 VAC



Ref. voltage: 35~75 VAC  
 Phase voltage: 75~110 VAC



Ref. voltage: 75~110 VAC  
 Phase voltage: 75~110 VAC



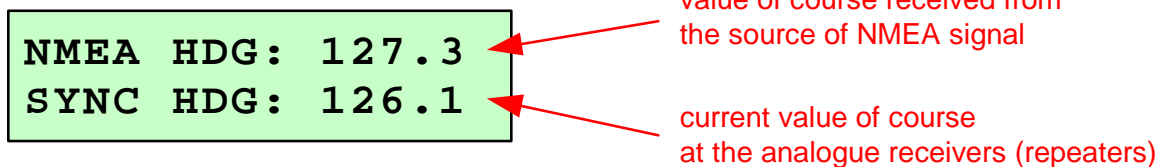
## 6. Principle of Operation of the Converter

### 6.1. Standby Mode of the Converter

Right after its energizing the converter DAC-109 is switched over to the standby mode. 2 values of course are displayed at the indicators 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:



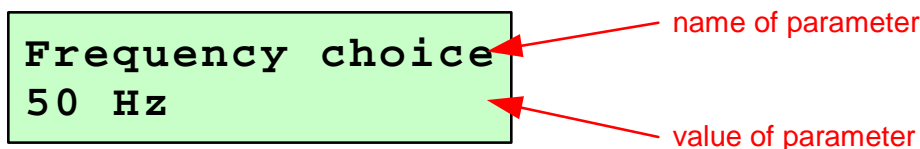
The necessity to display two values of course is caused by the inertia of synchro receivers (see p.5.5).

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 p. 5.4).**

### 6.2. Configuration Menu of the Converter

When pressing the key [F3] in the standby mode of the converter (see p. 5) 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 [◀] и [▶]. 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 accessible: 50 Hz, 500 Hz

## Repeater Type

Selection of the type of the connected repeaters.

The repeater types which are accessible: Stepper, Synchro

## Reference Voltage

Selection of the output level on the reference channel. This is ratio of voltage which is setup by P10 and P21 (see section 4).

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

## Reference Voltage

Selection of the output level on the phase channels. This is ratio of voltage which is setup by P10 and P21 (see section 4).

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.

Accessible 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.

Accessible 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 accessible:

Name of port setting	Value of setting for selection
Baudrate (Data receive 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 (Control sum checking)	On, Off

Upon setting the parameter CRC Checking into "On" the converter checks the control sum of coming NMEA sentences. If the control sum of the sentence mismatch the calculated (i.e. the sentence is received with errors), the converter ignores accepted 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 control sum is not foreseen.

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

Selection of necessity to switch over to the reserve channel if data at the main channel are absent. If the reserve source of NMEA signal is not connected, it is necessary to set this parameter in the position “Off”.

Accessible 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 absent.

Accessible 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 be switched over to the reserve channel when data at the main channel is absent.

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

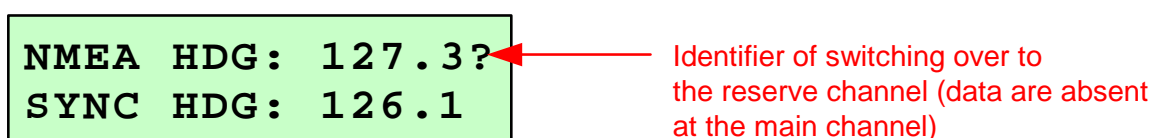
## 6.3. Alarm System

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 p.5.4).

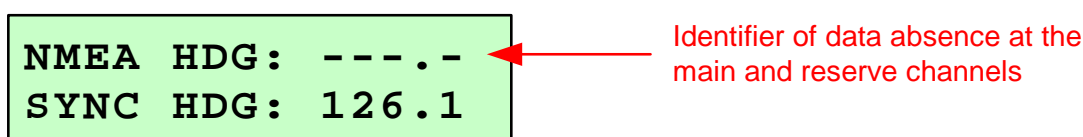
### Warning about Absence of Data at the Main Channel

If the converter does not accept data about the course through the main channel during the time, set by the setting «Alarm Period» (see p.5.2), 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.

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



If NMEA data about the course are also not transferred to the reserve channel, the converter indicator 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 (see Fig.3).

## 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 absent, 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.

```
NMEA HDG : 127.3!
SYNC HDG : 126.1
```

identifier of data absence at the reserve channel

## 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 absent	NMEA HDG : 127.3? SYNC HDG : 126.1	Closed	0.2/1
Data at the reserve channel are absent	NMEA HDG : 127.3! SYNC HDG : 126.1	Opened	0.5/5
Data at the main and reserve channels are absent	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.

## 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. In order to enter «.» (point) it is necessary to press keys [SHIFT] and [.] successively. 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 p.5.1). 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:

<b>GYRO IMITATION</b>
<b>F1 - ON                  F2 - OFF</b>

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 p. 5.4).

**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, fluctuations and changing of rotational direction.

In order to enter in the mode of imitation of cyclical turn of the ship it is necessary to press the key [9]:

**CIRCULATION**

**F1 - ON**

**F2 - OFF**

In order to switch on this mode it is necessary to 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!**

## 8. Warranty

The producer guarantees correspondence of the converter DAC-109 to the present manual if the service, transport and storage conditions are observed within the period of the warranty period.

The warranty period is terminated in 24 months from the moment of selling or in 18 months from the moment of commissioning the converter.

During the warranty period the owner has a right to repair it free of charge or to replace a separate unit if the failure occurred due to the fault of the producer. The warranty repair is performed in the presence of the operation manual and data about acceptance and commissioning registered in it.

The producer is not responsible for and does not guarantee the device operation:

- 1) On the expiry of the warranty period.
- 2) When the rules and conditions of operation, transportation, storage and installation of the device are not observed.
- 3) If the device has lost its vendibility or integrity of its case.
- 4) If the self-made electrical device is used.
- 5) If the device was repaired by the specialist who is not an authorized representative of the producer.

If the mark about commissioning is absent, the warranty period is calculated from the moment of selling the device.

If this operation manual is lost the copies of information about acceptance and commissioning of the device are not delivered, and the owner forfeits a right for free of charge repair during the warranty period. Upon expiration of warranty liabilities the producer gives assistance in the malfunction repair at the expense of the owner.

Note: In case of necessity of the warranty repair, dismantling of the device and its transportation to the service centre of the producer are performed at the expense of the owner of the device.

## 9. Sale Information

Serial number \_\_\_\_\_

Production date \_\_\_\_\_

Supplier Nuova Marea ltd

Stamp here

## 10. Acceptance Information

The device

\_\_\_\_\_  
(Serial Number)

produced and accepted in accordance with compulsory conditions of the government standards and present technical documentation

Signature of the responsible person:

\_\_\_\_\_

L.S.

## 11. Commissioning Certificate

Digital-analogue converter DAC-109

Serial number \_\_\_\_\_

Accepted for operation

Date \_\_\_\_\_

Place of installation \_\_\_\_\_

Installed by \_\_\_\_\_