RADIO RECEIVER

«MALAHIT-DSP1»

«MALAHIT-DSP2»

«MALAHIT-DSP3»

Table of contents

1 GENERAL INFORMATION

The radio receiver is built on the SDR principles. Most receiver functions are determined by the software. Software updates will add new functions. Manual covers all models of radio receivers of the Malahit family. The differences depending on the specific model are clarified in the text.

Main characteristics:

1) GENERAL INFORMATION:

   Malahit-DSP1 - from 50 kHz to 250 MHz, from 404 MHz to 2 GHz;

   Malahit-DSP2 / DSP3 - from 10 kHz to 380 MHz, from 404 MHz to 2 GHz;

2) Modulation types:
   AM, AM sync, AM U-sync, AM L-sync
   SSB, (USB/LSB)
   DSB,
   CW,
   NFM,
   WFM (with support for RDS and stereo reception);
3) DSP functions:
   FIL - Variable filter width
   NR - Adaptive noise suppressor
   SQL - Threshold noise suppressor
   NB - Noise Blanker
   AGC – Automatic Gain Control
   EQ - Equalizer,
   Pseudo stereo effect
4) Powerful processor with a frequency of 480 MHz is used
5) 3.5 inch, backlit touch screen display
6) UHF reception
7) Controls - 2 encoders with push-button control
8) Power supply – 18650 Lipo Accumulator and USB, charging from USB
9) Power consumption - 300mA with headphones
10) Reception with telescopic antenna or external antennas.
    For improved HF reception on a telescopic antenna, an additional board is available for the Malahit-DSP1 model (extra fee), which contains:
    - HiZ scheme for best reception SW with telescopic antenna

- adjustable attenuator in the range of 0-30dB in 1dB steps
- 4 Filters: LPF 500 kHz, bandpass filter 500-1500kHz, bandpass filter 1500-4500kHz, HPF 4500 kHz
- The board was designed just for the Malahit DSP1 Model
  The Malahit-DSP2 / DSP3 model already includes all the components at no additional cost.

11) USB connection to a computer with the ability to transfer CAT, for control, IQ and audio signal.

12) Span:
Malahit-DSP1: 160 kHz, 80 kHz, 40 kHz;
Malahit-DSP2 / DSP3: 192 kHz, 96 kHz, 48 kHz;

13) Sensitivity - 0.3 µV at frequencies up to 1 GHz; in the rest of the frequency range sensitivity is not standardized;

14) Blocking dynamic range - 82dB;

15) Headphone jack - 3.5mm, stereo;

16) Antenna socket - SMA;

17) Input resistance - 50 Ohm / HiZ (in the Malahit-DSP1 model only at additional cost);

18) Aluminum case is used, the dimensions of the receiver are
Malahit DSP 1 - 120x88x39mm
Malahit DSP 2 / 3 - 140x88x39mm

19) Type of battery used - Lithium-Ion, 18650.

Receiver developers:

- *Georgy Yatsuk*, *RX9CIM* (idea, dsp, general scheme),
- *Vladimir Gordienko*, *R6DAN* (gui and controls),
- *Vadim Burlakov*, *R6DCY* (clarification of the scheme, wiring, design)
- *Igor Naumenko* (active participation in the discussion of decisions, stylized retro scale, GUI functions).

Read this manual before using the receiver

Commercial distribution without the authors consent is prohibited!

Software, manual and USB driver are on our website

Malahiteam.com in the Documentation section, as well as the link

https://drive.google.com/drive/u/1/folders/1WiQdee4R8XBenx-E7PT3dPy4iDjbuofR

Welcome to our Telegram groups:

- for Russian-speaking users - https://t.me/MalahitReceiver

- for English-speaking users - https://t.me/MALAHITEAM_EN

- for German-speaking users - https://web.telegram.org/k/#-1431135990

Attention! In order to meet the safety requirements for transportation, the receivers will be delivered WITHOUT battery. You need to buy a 18650 LiPo rechargeable battery and install it into the receiver yourself. Loosen the 4 screws of the back cover and insert the battery into the battery holder. Make sure, no cable hanging out the housing, when closing it back up. Insert screws back into the housing and your Malahit is ready to go

2 EXTERNAL VIEW OF THE RECEIVER. CONTROLS AND DESIGN ELEMENTS

Malahit-DSP1 is shown below as an example. For Malahit-DSP2 / DSP3, everything is the same. The location of the receiver elements on the front cover:

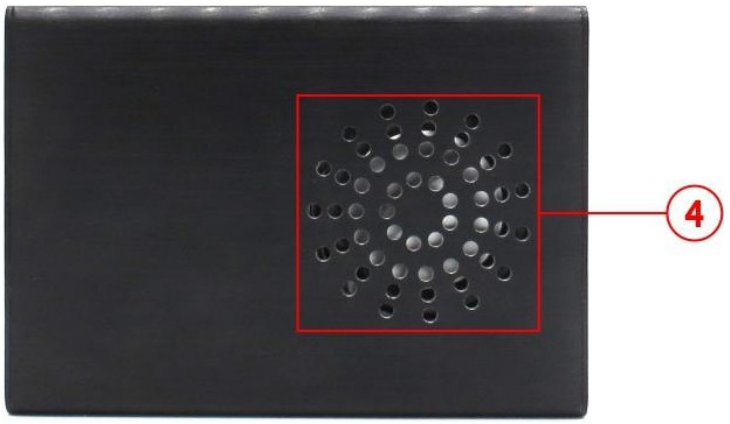
1 Screen with sensory panel

2 Encoder ENC_VOL

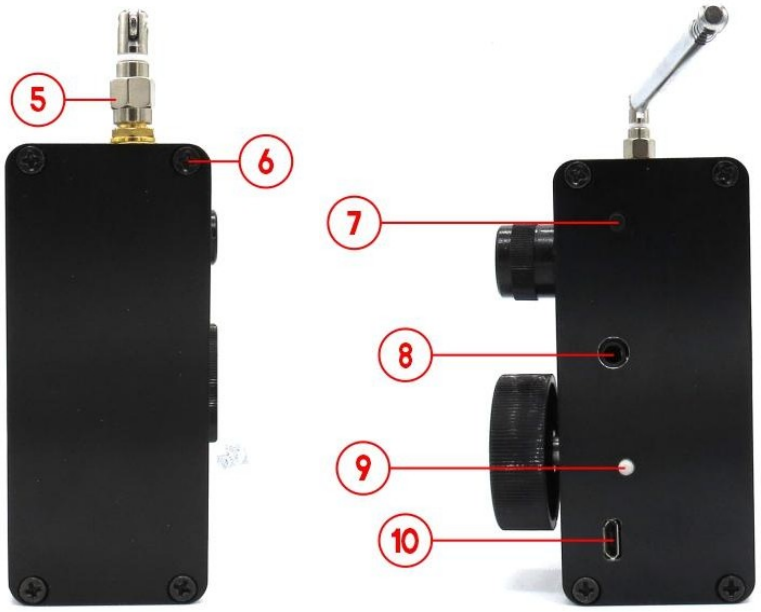
3 Encoder ENC_FREQ

4 Speaker

Arrangement of elements on the back cover:



Location of elements on the side cover:



5 Antenna socket and antenna

6 Mounting screw

7 Power button

8 Headphone jack

9 Indicatior LED batteries

10 USB socket

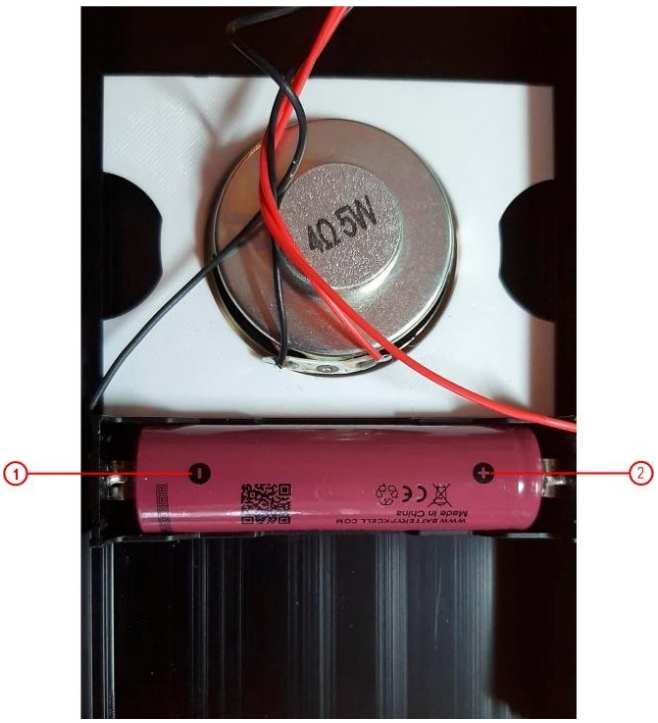
3 PREPARING THE RECEIVER FOR OPERATION.

Please read the manual before operating the receiver. The receiver does not initially contain a battery.

Before using the receiver for the first time, it is necessary to unscrew the screws securing the rear cover of the receiver and install the battery in the existing holder.

Attention! Strictly observe the polarity of the battery connection! If a holder for one battery is installed in the receiver, the positive contact of the battery must be connected to the red wire of the holder, the negative contact to the black wire. If a holder for two batteries is installed in the receiver, then connect the batteries in accordance with the polarity indicated on the holder (a flat contact is a positive contact, a spring contact is a negative contact). If the polarity is reversed, the radio may be damaged.

For example, given photo of a correctly installed battery in the Malahit -DSP1 radio receiver:



1 Negative battery terminal

2 Positive battery terminal

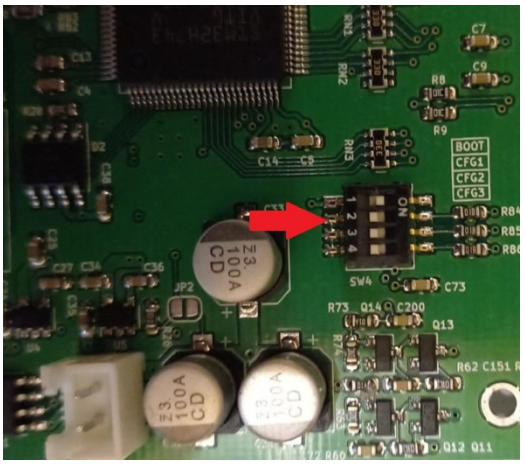
After installing the battery, it is necessary to close the receiver by docking the rear cover and tightening the fastening screws.

4 TURN RECEIVER ON AND OFF.

By default, the receiver is turned on by briefly pressing the power button.

The receiver has a false press protection function - this function allows you to turn on the receiver only if the power button is pressed at least three times in an interval of 5 seconds. To enable this feature, you must:

- for Malahit-DSP1: it is necessary to remove the rear cover of the radio receiver and connect pin number 7 of the connector (according to the diagram in section 9) intended for connecting an additional board to the minus of the power supply or a common wire.
- for Malahit-DSP2 / DSP3: it is necessary to remove the rear cover of the radio receiver and set SWITCH 2, on the DIP SWITCH panel, to the ON position.



Switching off is carried out by long pressing the power control button until a tone sound signal appears (message "73" transmitted in Morse code). After the signal sounds and the button is released, the receiver will turn off.

5 FIRMWARE ACTIVATION.

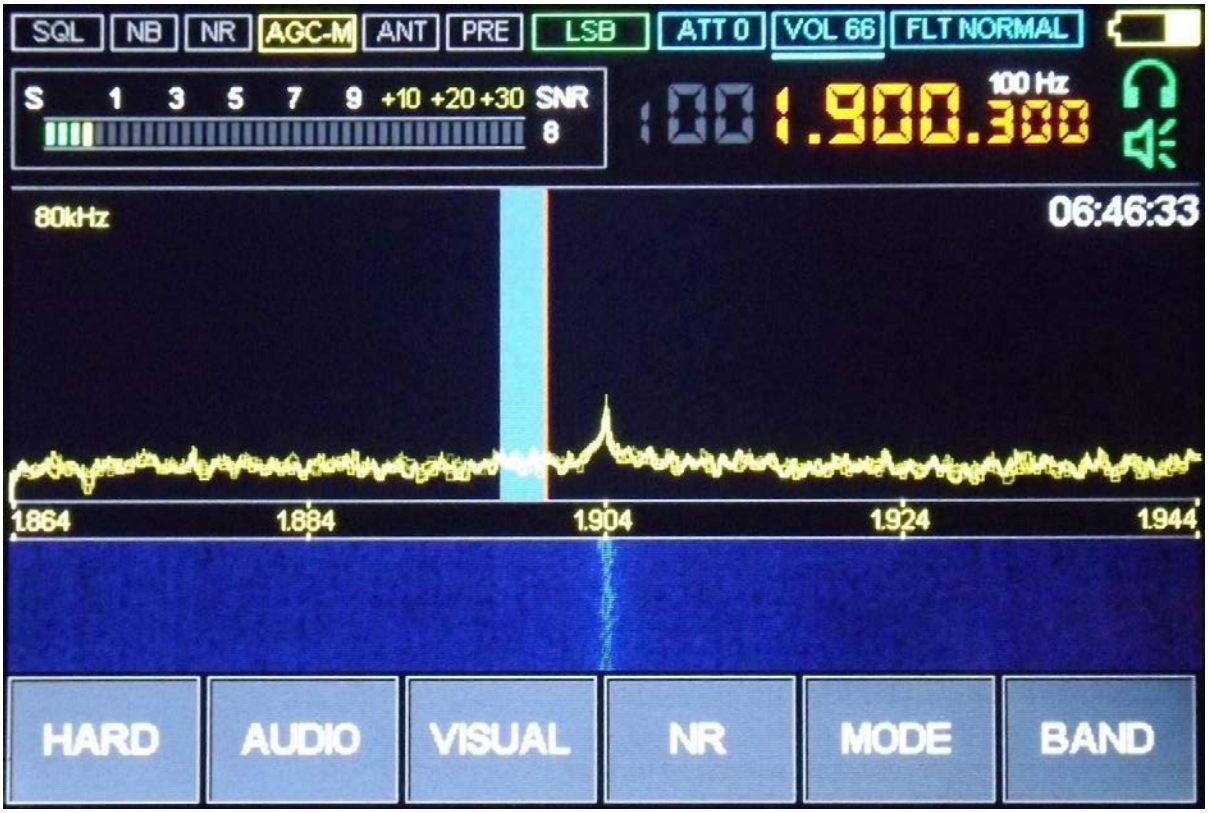
This procedure is necessary only for Malahit-DSP1, Malahit kits or Malahit Radio Clones. To activate the firmware, please email malahiteam@gmail.com.

6 USER INTERFACE.

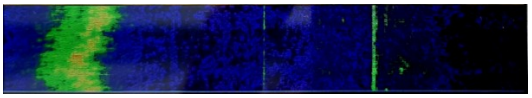
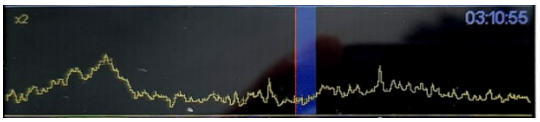
The photos of different types of menus are shown as an example and may differ depending on the receiver software version and receiver model. The information display logic is built taking into account the fact that the "On" state corresponds to green or yellow color, the "Off" state - red or gray.

6.1 RADIO MAIN SCREEN

The main operating screen of the radio receiver is as follows:



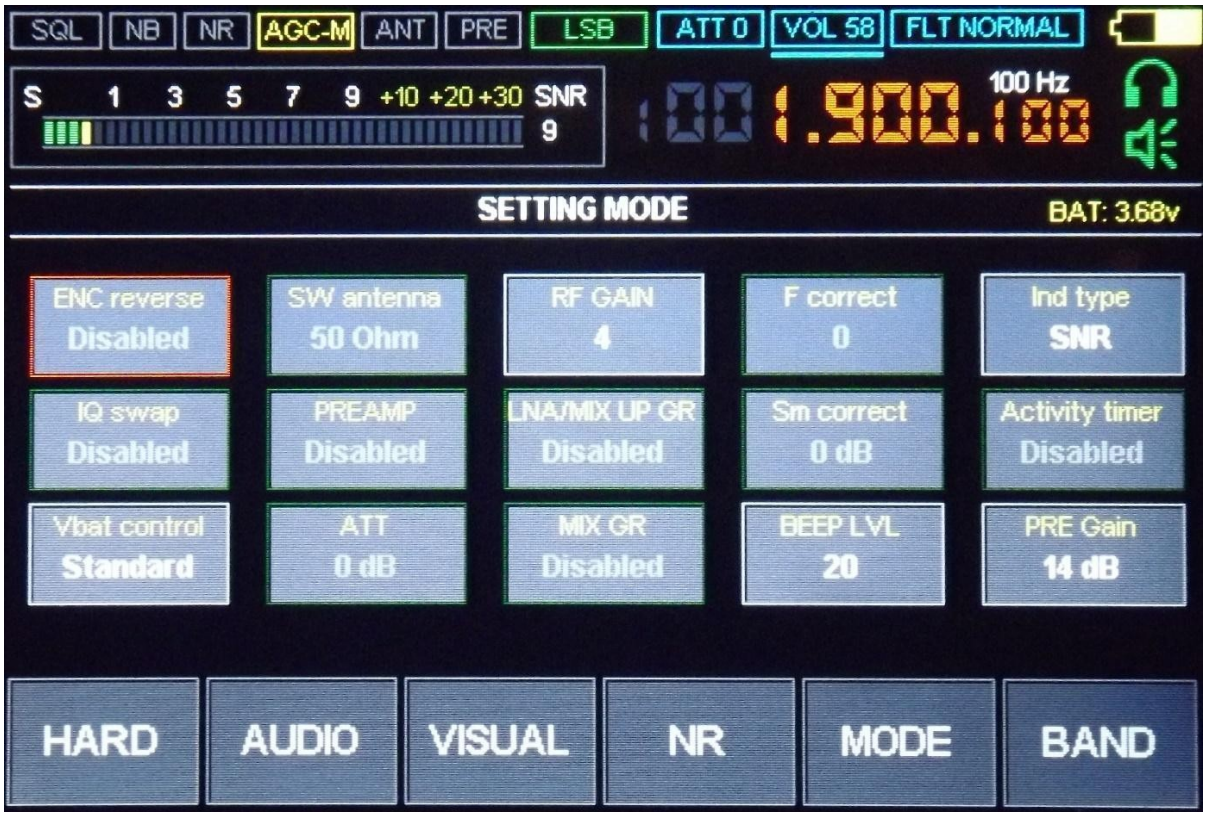
INDICATOR					
FLT NORMAL	**Vol 66**	**ATT o**	**LSB**	**PRE**	**ANT**
PURPOSE					
type of selected filter	volume level	Attenuator value	modulation type	PREamp Indicator green – „on" gray – „off".	selected Antenna Indicator for SW Grey input 50 Ω, green – HiZ, red – active antenna power „on" (for Malahit-DSP2 / DSP3 and DDC receivers only)
AGC-M	**NR**	**NB**	**SQL**	**100 hz**	**SNR 8**
status indicator AGC yellow – „on" gray – „off"	"Noise Reduction" Indicator adaptive squelch green - "on", gray - "off".	Noise Blanker status indicator red - „on" gray - „off"	squelch indicator red - „on" gray - „off"	Tuning steps here: „100hz"	signal-to-noise ratio indicator „S-meter"
80 kHz	**RADIO**	**AUDIO**	**VISUAL**	**NR**	**MODE**
Width stripes spectrum analyzer	RADIO menu button	AUDIO menu button	VISUAL menu button	Adaptive Noise Gate on/off button	MODE menue button to select modulation mode
BAND	**06:46:33**				
Button for selecting memory locations and frequency range	Current time	Battery Indicator (charge status / Voltage display)	type of selected audio output headphones or speaker, or both	Signal level indicator Clicking on this area enters / exits the hard menu	Reception Frequency Clicking this area enters the direct frequency input mode.

	
waterfall window	Spectrum analyzer window
	
Frequency scale	Operation indicator decoder
	Receiver settings save indicator. Appears when the receiver settings are changed. When the save is completed, it changes color to green and disappears.

6.2 RADIO MENU (Previous Version: HARD)

In the previous version of the software, this menu was called HARD.

Entering the RADIO (HARD) menu is done by pressing the corresponding button. The RADIO (HARD) menu is exited by pressing the RADIO (HARD) button, or by pressing the ENC_FREQ encoder button.



New Menu

6.3 CLOCK MENU - CLOCK SETTING

Clock setting menu is accessed by long pressing the RADIO (HARD) button. The setting is carried out using the ENC_VOL encoder and its button. To save the value of the set time, you must press and hold the encoder button ENC_VOL until the sound signal appears. The menu is exited by pressing the RADIO (HARD) button.

6.4 VISUAL MENU

Entering the VISUAL menu is done by pressing the corresponding button. This menu contains various display settings for displaying information and display operation. Exit from the menu to the main screen of work is carried out by pressing the VISUAL button, or by pressing the ENC_FREQ encoder button.

6.5 AUDIO MENU

The menu is intended for selecting digital signal processing settings, mainly in the audio processing path. Exit from the menu to the main screen of work is carried out by pressing the AUDIO button, or by pressing the encoder button ENC_FREQ.

6.6 BAND MENU (MEMORY Channels)

This menu is used to save and restore currently tuned frequency, modulation, and other settings to memory cells. Moving through the cells is carried out by using the encoder ENC_FREQ. The exit is carried out by pressing the BAND button, or by pressing the encoder button ENC_FREQ.

In the latest firmware, the function to scan memory cells has been added (see section 7).

6.7 MODE MENU

The menu is designed to select the type of modulation and control decoders. The exit is carried out by pressing the MODE button, or by pressing the encoder button ENC_FREQ.

7 MAIN FUNCTIONS AND THEIR USE

7.1 RESET RECEIVER

The function is designed to reset the current settings and bring them to the default state.

To reset the settings, it is necessary to exit all menus during the operation of the receiver and, when the main screen is displayed, hold down both encoders until a sound appears.

In this case, user settings, including those saved in memory, will be lost.

7.2 REVERSE ENCODER

The function is designed to change the direction of rotation of encoders.

To enable the function, enter the RADIO menu by pressing the touch panel

select the parameters "EN1 reverse" - to reverse the encoder ENC_FREQ, or "EN2 reverse" - to reverse ENC_VOL. The value of a parameter changes when you click on it. Disabled - reverse disabled, Enabled – reverse enabled.

7.3 VOLTAGE MONITORING FUNCTION

This feature is not available in the latest software versions.

This function ensures that the receiver turns off when the battery voltage drops below 3.3V. This feature is designed to conserve battery life and prevent the battery from completely discharging.

To enable or disable the function, go to the HARD menu, click on the "Vbat control" parameter.

The value of the "Vbat control" parameter:

- Standart - the function is enabled, the receiver will turn off automatically when the battery voltage reaches 3.3V.
- Low - the function is disabled, the receiver will work as long as the battery voltage allows, but not lower than 2.7V.

For Malahit-DSP2 / DSP3, the shutdown voltage is controlled by the hardware and an automatic shutdown occurs when the voltage reaches 3.1V.

7.4 SELECTING THE TYPE OF ANTENNA INPUT

This function only works at frequencies up to 50 MHz. In Malahit-DSP1, the function works only if there is an additional board installed in the receiver. To select the type of antenna input, go to the RADIO menu, click on the "SW antenna" parameter.

The value of the "SW antenna" parameter:

- HiZ - high-impedance antenna input, for working with short antennas such as a whip antenna.
- 50 Ohm - Antenna input: Recommended for use with long antennas and active Antennas whose impedance is comparable to 50 ohms.

7.5 BUILT-IN PREAMP CONTROL

To turn PREAMP on or off, go to the RADIO menu, click on the parameter

PREAMP.

Value of the "PREAMP" parameter:

- „Enabled" - PREAMP is ON
- „Disabled" - PREAMP is OFF

7.6 ATTENUATOR OPERATION

This feature only works if the DSP1 has an optional board installed. DSP2 has the board installed. To select the attenuator value, go to the RADIO menu, click on the "ATT" parameter and set the desired value by turning the ENC_FREQ encoder.

It is also possible to change the attenuator value while in the main display mode

- using the ENC_VOL encoder button, select the ATT parameter, by rotating the ENC_VOL encoder, select the required value. A value of 0 dB corresponds to the minimum attenuation of the attenuator, 30 dB - to the maximum.

7.7 ADJUSTING INTERNAL RF-GAIN

The hardware allows you to adjust the gains of the built-in mixers and LNA.

The parameters responsible for the adjustments are in the RADIO menu:

- **RF GAIN** – coefficient broadband mixer gain;
- **LNA/MIX UP GR** - parameter responsible for enabling or disabling gain reduction. On VHF, the amplification of the built-in LNA is affected, on HF - on the first mixer;
- **MIX GR** is a parameter responsible for enabling or disabling gain reduction. On VHF, the amplification of the built-in mixer is affected, on HF, on the second mixer.

  To change the values of these parameters, go to the RADIO menu and click on relevant parameters. Changing the RF GAIN parameter is done using the ENC_FREQ encoder with the RF GAIN parameter selected. LNA/MIX UP GR and MIX GR parameter values occurs when you click on this option.

  LNA/MIX UP GR and MIX GR parameter values:
- Enabled – gain reduction enabled;
- Disabled – Gain reduction disabled.

Recommendations:

1) The LNA/MIX UP GR and MIX GR parameters inherently act as an attenuator and should be used when working with long antennas or when receiver overloads, which is expressed as the reception of false stations.
2) It is not recommended to use the value of the RF GAIN parameter more than 40 when working with short antennas such as a telescope and more than 20 when working with long antennas.

7.8 RX FREQUENCY CORRECTION

This function corrects the tuned frequency deviation.

To work with this function, you need to go to the RADIO menu, click on the "F correct" parameter. Set the desired value by turning the ENC_FREQ encoder.

7.9 AUDIO OUT SELECT

This function allows you to select the required audio output for listening to sound: headphones; speaker; or speaker and headphones.

Audio output is selected by clicking on the icon  on the main receiver screen. Another way to select is to go to the RADIO menu and press the Audio out button to select the desired audio output type. Enabled – indicator lights up in green, disabled – indicator is gray.

7.10 NOISE BLANKER (NB)

This function provides suppression of broadband impulse noise (with a bandwidth comparable to 192kHz). The function settings are found in the AUDIO menu, selected by pressing the corresponding parameters and are grouped into NB block:

- Threshold – operation threshold, selected manually using the ENC_FREQ encoder to suppress interfering noise. It is not recommended to set a value less than 3;
- Config - NB configuration, selected manually using the ENC_FREQ encoder to suppress interfering noise;
- NB - enable and disable NB, has the value Disabled - disabled, Enabled - enabled. NB settings are carried out by ear, for better suppression of interfering broadband interference. This function is not capable of suppressing narrowband noise.

7.11 AUTOMATIC GAIN CONTROL (AGC)

This function ensures that the audio level is maintained at an optimal level.

The function settings are found in the AUDIO menu, are selected by clicking on the relevant parameters and are grouped in the AGC block:

- AGC LIM - maximum signal level;

- AGC GAIN - signal amplification value;

- MANUAL GAIN – manual gain, available when AGC is off;

- AGC MODE - timing characteristics of the AGC loop. AGC MODE has the following meanings:

- FAST - "fast" timeAGC reactions;

- MIDDLE-"average" AGC response time;

- SLOW - "slow"AGC response time;

- LONG - "long" AGC response time;

- OFF - AGC disabled.

For setting AGC parameters, you must go to the AUDIO menu and select the appropriate parameter. The value of the corresponding parameter is carried out using the encoder ENC_FREQ.

When AGC is off, the MANUAL parameter is available instead of the AGC GAIN parameter.

AGC does not work with WFM modulation.

7.12 EQUALIZER

The EQ TYPE option is found in the AUDIO menu and selects the type of equalizer. Enter the AUDIO menu by pressing the button on the main screen of the receiver. The corresponding settings window will open.

You can select the type of equalizer, or turn it off. The function settings are found in the AUDIO menu, selected by pressing the EQ TYPE parameter and turning the ENC_FREQ encoder:

- EQ-OFF - equalizer off;

SOFT, LIVE, CLUB, ROCK, BASS, JAZZ, POP, VOICE, USER1, USER2, USER3 – type of equalizer enabled.

When inactive, the button has a frame color of either dark green for equalizer off (EQ-OFF), or dark gray for any type in use, when active, either red for EQ-OFF, or bright green for any type in use.

Attention! It is recommended to select the equalizer type while listening to a radio station, for example, in the VHF FM band, since changing the equalizer settings is immediately reflected in the sound of the received station. The first 8 types (SOFT - LIVE - CLUB - ROCK - BASS - JAZZ - POP - VOICE) correspond to the fixed settings preset in the receiver's firmware, they cannot be changed, the last three (USER 1 - USER 2 - USER 3) can be adjusted by the user (see . item 2). Set the desired EQ state and save it - just exit the AUDIO menu by pressing the AUDIO button.

Setting user-adjustable EQ types USER 1 - USER 2 - USER 3

The receiver is equipped with a five-band equalizer, which includes a shelving low-pass filter (EQ Band 1), three bell-shaped mid-range filters (EQ Band 2 - EQ Band 3) and a shelving high-pass filter (EQ Band 5).

Initially, the filter tuning frequencies are 105 Hz - 300 Hz - 850 Hz - 2.4 kHz - 6.9 kHz, respectively, with a step of approximately 2.82 times (2 x 2^1/2). The user has the ability to:

- change these frequencies, for each filter there are 4 fixed options: For the EQ Band 1 filter, the cutoff frequency can be set to 80, 105, 135 and 175 Hz. For the EQ Band 2 filter, the center frequency can be set to 230, 300, 385, and 500 Hz. For the EQ Band 3 filter, the center frequency can be set to 650, 850, 1100 and 1400 Hz. For the EQ Band 4 filter, the center frequency can be set to 1.8, 2.4, 3.2 and 4.1 kHz. For the EQ Band 5 filter, the cutoff frequency can be set to 5.3, 6.9, 9.0 and 11.7 kHz.
- select the bandwidth from two fixed values - NARROW BAND or WIDE (WIDE BAND) for each of the three bandpass filters EQ Band 2 - EQ Band 3.
- adjust the signal boost/fade levels in each of the five filters in the range from + 12 dB to - 12 dB in 1 dB steps. To set one of the user types of equalizer USER 1 - USER 2 - USER 3) enter the AUDIO menu, select the desired type, as indicated in step 1, for example, USER 3, and then press the EQ-TYPE button once or twice, in whether the button was active or not. In the central part of the receiver screen, a setting window for the selected type will open in the form of a graphic equalizer:

On the left side there is the graphic equalizer itself - the signal level scale and the corresponding horizontals for the levels, as well as five verticals with sliders / sliders for each of the filters. The three middle sliders can be of different widths, depending on the filter setting. At the bottom, under each of the sliders, the frequency of the filter setting is indicated. On the right side there are four buttons - SAVE (SAVE), FREQUNCY (FREQUENCY), WIDE BAND (WIDE BAND) or NARROW BAND (NARROW BAND) and CANCEL (CANCEL). When you enter the settings window, all verticals and sliders are gray because none of the filters is selected. Accordingly, the inactive SAVE, FREQUNCY, WIDE BAND / NARROW BAND keys are dark gray, only the CANCEL key is active, designed to exit the settings without making changes.

If you select the right or left slider, the SAVE and FREQUNCY keys will become active, if you select one of the middle ones, an active WIDE BAND (or NARROW BAND) key will be added to them - in accordance with the current bandwidth setting of the selected band pass filter. If the bandwidth of the selected filter is narrow, the key says NARROW BAND, while the width of the image of the corresponding slider on the graph is equal to the width of the leftmost and rightmost sliders, which always remain narrow. To change the bandwidth, press the NARROW BAND key, the inscription on it will change to WIDE BAND, the filter bandwidth will become wide and, accordingly, the slider on the graph will become somewhat wider. Repeated key presses will change the bandwidth to the opposite value. To change the frequency of the selected filter, press the FREQUENCY key, the frequency will alternately take one of four possible values, displayed below under the corresponding slider. To change the boost/fade level of the signal of the selected filter, rotate the large knob (receiver tuning knob), the slider will move along its vertical to the appropriate level. Select one by one all the filters whose settings you want to change. At the end of the settings, you can save the changes by pressing the SAVE key or discard them by pressing the CANCEL key, after which you will return to the original AUDIO menu, from which, by pressing the AUDIO button, you will exit to the main mode of the receiver. To change the boost/fade level of the signal of the selected filter, rotate the large knob (receiver tuning knob), the slider will move along its vertical to the appropriate level. Select one by one all the filters whose settings you want to change. At the end of the settings, you can save the changes by pressing the SAVE key or discard them by pressing the CANCEL key, after which you will return to the original AUDIO menu, from which, by pressing the AUDIO button, you will exit to the main mode of the receiver. To change the boost/fade level of the signal of the selected filter, rotate the large knob (receiver tuning knob), the slider will move along its vertical to the appropriate level. Select one by one all the filters whose settings you want to change. At the end of the settings, you can save the changes by pressing the SAVE key or discard them by pressing the CANCEL key, after which you will return to the original AUDIO menu, from which, by pressing the AUDIO button, you will exit to the main mode of the receiver.

7.13 STEREO WFM RECEPTION

The receiver allows stereo reception of FM broadcast radio stations. In order to enable or disable stereo reception, go to the AUDIO menu and click on the "WFM stereo" parameter.

The value of the "WFM stereo" parameter:

- Enabled – stereo reception is „on"
- Disabled - stereo reception is „off"

Stereo reception is possible if the signal level of the station is sufficient and only if listening to headphones or both headphones and speaker. If there is stereo reception, the modulation type indicator contains the inscription "WFM-ST".

7.14 NOISE REDUCTION (NR)

The receiver has an adaptive noise reduction function that allows you to significantly improve the intelligibility of the received station in the conditions of noise and interference. The denoiser uses different algorithms depending on the filter bandwidth:

- with a bandwidth of more than 1 kHz, a noise suppressor more suitable for a speech type signal is used;
- at bandwidths less than or equal to 1 kHz, the squelch is suitable for tone-type signals.

The choice of algorithm type is carried out automatically, depending on the bandwidth. Squelch for speech signals, it has a noise reduction level setting. To turn the noise suppressor on or off, press the "NR" button. For setting the suppression level when receiving speech signals, you must go to the AUDIO menu and click on the "Threshold" parameter in the NR visual block. Use the ENC_FREQ encoder to select the optimal value. The Threshold parameter does not affect the signal when the bandwidth is less than or equal to 1 kHz.

7.15 THRESHOLD SQUELCH (SQL)

The receiver has a threshold noise reduction function - there is sound if the signal level is above the selected threshold.

To enable or disable the squelch, go to the AUDIO menu and click on the "SQL" option.

The value of the "SQL" parameter:

- Enabled - squelch is enabled;
- Disabled - squelch is disabled.

To select the noise suppressor threshold, select the "SQL threshold" parameter in the SQL column and set the required value by rotating ENC_FREQ.

If SQL is enabled, then it is possible to change the SQL threshold parameter using the ENC_VOL encoder - you need to select this parameter using the ENC_VOL button and set the required value by rotating ENC_VOL.

7.16 DISPLAY BACKLIGHT CONTROL

The receiver has the function of adjusting the brightness of the display backlight:

- backlight brightness adjustment - minimum and maximum value;
- the time after which the backlight level will be reduced to the minimum value;
- the time after which the backlight will turn off completely.

To change the settings, you must go to the VISUAL menu. Changes in parameter values are made using the ENC_FREQ encoder.

To set the minimum value for the backlight level, select the option "BRIGHT MIN"

To set the maximum (working) value of the backlight level, select the "BRIGHT MAX" parameter.

To set the time after which the backlight level will change from maximum to minimum, select the "REDUCT TIME" parameter.

To set the time after which the backlight will turn off, select the "SLEEP TIME" parameter. This time is set relative to the "REDUCT TIME". If there is no need to change the backlight level from maximum to minimum, then it is necessary to set the value of the parameter "REDUCT TIME" to the "Disabled" state.

Turning the backlight off completely is only possible if the Backlight Turn Off feature is enabled.

To enable or disable the full backlight off function, select the "LCD SLEEP" option.

The meaning of the "LCD SLEEP" parameter:

- Enabled - the function of completely turning off the backlight is enabled;
- Disabled - the backlight completely off function is disabled.

7.17 CHANGING SPECTRUM UPDATE RATE

The receiver has a function of adjusting the rate, the spectrum is displayed on the main screen. To change the setting, go to the VISUAL menu and select
FFT ave parameter. Changing the parameter values is carried out using the encoder ENC_FREQ.
The larger the value of the parameter, the slower the spectrum image changes.

7.18 CHANGING THE SPECTRUM DISPLAY RANGE

This function allows you to define the displayed amplitude range of the spectrum in relation to the noise level. To change the setting, go to the VISUAL menu and select the parameter

FFT scale. The parameter value is expressed in decibels. Changing the parameter values is carried out using the encoder ENC_FREQ.
Small values of the parameter allow you to view signals with a weak level in more detail.

7.19 CHANGE SPECTRUM DISPLAY COLORS

This feature allowschange the color of the spectrum. To change the setting, go to the VISUAL menu and select the "FFT color" parameter. Parameter value changes
carried out using the encoder ENC_FREQ.

7.20 CHANGING THE RATIO OF THE IMAGE OF THE SPECTRUM AND WATERFALL

This function allows you to change the relative ratio of the displayed area of the spectrum and the displayed area of the waterfall. To change the setting, go to the VISUAL menu and select the “Pan percent” parameter. The parameter value is expressed as a percentage. Changing the parameter values is carried out using the encoder ENC_FREQ.

7.21 CHANGING WATERFALL SCROLL SPEED

This function allows you to change the rate of the waterfall scroll speed.
To change the setting, go to the VISUAL menu and select the "WTF delay" parameter. Changing the parameter values is carried out using the encoder ENC_FREQ. The lower the value, the faster the waterfall moves.

7.22 CHANGING WATERFALL BRIGHTNESS

This feature allows change the brightness of the waterfall depending on the signal level. To change the setting, go to the VISUAL menu and select the "WTF Gain" parameter.
Changing the parameter values is carried out using the encoder ENC_FREQ. The lower the value, the less bright the waterfall will be.

7.23 CHANGING SPECTRUM WIDTH AND TYPE

This function allows you to change the bandwidth of the spectrum. In WFM mode, it is possible to change the spectrum type.
The current spectrum span is indicated in the left corner of the spectrum. The larger the value, the smaller the displayed bar, but the more detail.
SSB, CW, DSB, AM, NFM modulation types are available in 48kHz, 96kHz and 192kHz bandwidth.
For WFM possible spectrum types:
- normal, with a span of 192 kHz;
- MPX – spectrum of demodulated WFM signal; in addition, markers of the pilot tone (red), stereo signal (green) and RDS (blue) are indicated on the spectrum.

To change the width or type of the spectrum, you must click on the displayed zone of the waterfall.

7.24 CLOCK SETTING

Clock setting is described in section 6.

7.25 SAVING AND RESTORING FROM MEMORY

This function allows you to store settings in memory, or load previously saved settings.
To select a memory cell, go to the BAND menu and select the desired memory cell. The choice is made by pressing the button with the image of the cell. With the ENC_FREQ encoder, you can scroll through the list of memory locations for subsequent selection. To save the current settings in a memory cell, you must select the desired cell memory and carry out a long press on the button with the corresponding cell. Hold the button until you hear a signal or the button flashes red

Next, a new window will open containing the following fields and settings:

- field for entering the name of the cell. Movement within the field is carried out using the encoder button ENC_FREQ or by pressing the arrow buttons -> or <-, the choice of a character or letter is performed by rotating the encoder ENC_FREQ. By default, the pre-existing cell name is suggested. If in the process of entering the name it became necessary to leave the original name unchanged, you must press the DEFAULT NAME button;
- SQL - Threshold squelch setting, enabled or disabled for this cell. To enable the noise suppressor, select the SQL ON value, by pressing the ENC_VOL encoder button select the noise suppressor threshold setting, by rotating ENC_VOL select the noise suppressor operation threshold;
- IN SCAN - setting to include or exclude this cell in the process of scanning through memory cells. When you have finished entering the cell parameters, you must press the SAVE button. If you do not want to save the cell, then you must press the CANCEL button.

7.26 CW - MORSE CODE DECODER

This function allows you to decode telegraph signals onto the display.

To turn on the decoder, go to the MODE menu, press the Decoder button. In this case, the inscription CW should appear on the decoder button. For the correct operation of the decoder, it is necessary to select the Min SNR parameter. To adjust this parameter, you must press the Min SNR button and turn ENC_VOL to set the optimal value.

The essence of the Min SNR parameter is to set the decoder threshold. If the parameter value is too small or too large, then the decoding will be incorrect.

The optimal Min SNR value is selected from the following considerations:

- in the absence of a telegraph signal, the decoder operation indicator should not light up;
- the decoder operation indicator should flash approximately in time with the sound of the telegraph signal.

Decoded signal displayed as text on the main screen of the receiver. To clear the line with the text of the decoder, click on the S-meter icon.

7.27 CHANGING THE TUNING STEP

To change the tuning step, you must press the encoder button ENC_FREQ, then rotate the encoder to select the desired step. The step will be displayed in the frequency field in white font. After selecting the desired step, you must press the encoder button ENC_FREQ. The value of the tuning step is tied to the type of modulation - each type of modulation has its own set of steps.

7.28 CORRECTING S-METER FOR RF GAIN OPERATION

To take into account the influence of RF-Gain in the operation of the S-meter, you must go to the RADIO menu and select the RF-GAIN parameter. By rotating the ENC_FREQ encoder, it is necessary to set the actual value of the RF GAIN. If the value is set to „0", then the RF gain factor is not taken into account in the operation of the S-meter. The default value is 14dB.

7.29 BEEP SIGNAL VOLUME

To change the volume of the tone that sounds when the receiver is turned off and when changing some parameters, it is necessary to select the BEEP LVL parameter in the RADIO menu. By rotating the ENC_FREQ encoder, you must set the required value.

7.30 S-METER OPERATING MODES

The S-meter has two modes of operation:

- signal level, in dBm;
- SNR, the ratio of the received signal level to the noise level.

To select the operating mode of the S-meter, go to the RADIO menu and click on the „Ind" type parameter to select the desired value - dBm or SNR.

7.31 S-METER CORRECTION

To correct the S-meter readings, go to the RADIO menu and select the „Sm correct" parameter. By rotating the ENC_FREQ encoder, you must set the required value. For correction, it is advisable to apply a signal with a reference level to the input of the receiver and change the „Sm correct" parameter to achieve similar readings on the S-meter. In this case, the dBm scale should be selected as the S-meter scale.

7.32 ACTIVITY TIMER

The receiver has the function of turning off after a specified time from the moment the last user action on the controls. To enable this function, go to the RADIO menu and select the „Activity timer" option. By rotating the ENC_FREQ encoder, you must set the required value in minutes. If „DISABLED" is selected, the activity timer is off.

7.33 SPECTRUM RENDERING MODES

There are two spectrum rendering modes:

- line drawing;
- drawing with a solid fill.

To select the rendering mode, go to the VISUAL menu and select the „FFT scale" file option. The choice of value is carried out by clicking on the image of this parameter. The value of the disabled parameter means that the spectrum will be drawn as a contour line.The Enabled parameter means that the spectrum will be completely filled in the area under the contour line.

7.34 DC SUPPRESSION

The receiver has the function of suppressing the DC component during signal processing. This function also affects the display of the spectrum - in the center of the spectrum there is a rise in the 0 Hz region, this is the constant component. However, this function does not affect the quality of radio reception.

To control the setting of this function, go to the VISUAL menu and select „DC reject" parameter. The value is selected using the ENC_FREQ encoder. A larger value leads to an increase in the DC suppression and affects the display of the spectrum - at higher values, there is a "dip" in the 0 Hz region. The value of the parameter is chosen, based on the optimality of the display in the spectrum.

7.35 DISABLE THE SPECTRUM AND WATERFALL DISPLAY

To reduce the level of interference, the receiver has a function to turn off the spectrum and waterfall in the display. When the spectrum and waterfall display is disabled, the display image changes only when the user settings are changed, while the transmission of information to the

display is used only when the settings are changed, which eliminates interference from the interface with the display.

To control the setting of this function, go to the VISUAL menu and select „View Pan&Wtf" parameter. The choice of value is carried out by clicking on the image of this parameter. The value of the „Always" parameter corresponds to always displaying the spectrum and waterfall. When set to Single, the spectrum and waterfall display is disabled. This function also affects the display of S-meter values - when set to Single, the S-meter is updated only when the receiver settings are changed.

7.36 BANDWIDTH SELECTION AND SOUND FILTERS

The receiver has a function to select the filter bandwidth and filter type. There are three types of filter:

- Narrow - narrowband;
- Normal - normal
- Wide - broadband.

- **First way** - being in the main operating window of the receiver, by pressing the ENC_VOL encoder button, select the FLT parameter and select the desired type by rotating the ENC_VOL encoder;
- **Second way** – go to the AUDIO menu and select the Filter parameter, turn the ENC_FREQ encoder to select the desired type.

Changing the bandwidth is possible by setting the upper and lower frequencies for each of the three filter types. To set the upper and lower frequencies of the filters, go to the AUDIO menu, select the Low freq parameter (for the lower filter frequency)
or High freq (for the upper frequency of the filter) and turn the ENC_FREQ encoder to select the desired value.

In CW reception mode, it is also possible to select three types of filters (Narrow, Normal and Wide), the characteristics of the filters are set in the form of the following parameters:

- Pitch - the center frequency of the filter (arithmetic mean between the lower and upper f requencies of the filter);
  Width - bandwidth width.

To set the Pitch and Width parameters, you need to go to the AUDIO menu in the CW reception mode, select the Pitch or Width parameter (for the upper filter frequency) and select the desired value by rotating the ENC_FREQ encoder.

7.37 SELECTING THE MODULATION AND DEMODULATOR TYPE

The receiver allows you to receive signals with the following types of modulation:

- single-sideband SSB in upper (USB) and lower (LSB) sideband mode;
- CW keying in USB and LSB mode;
- 2-way DSB modulation;
- narrowband frequency modulation NFM;
- wideband frequency modulation WFM;

To select the SSB modulation type, go to the MODE menu and select the USB or LSB option, depending on the required reception bandwidth.

To select the CW modulation type, go to the MODE menu and select the CW parameter, and also select the USB or LSB parameter, depending on the required reception bandwidth.

To select the DSB modulation type, go to the MODE menu and select the DSB parameter, and also select the USB or LSB parameter.

To select the AM modulation type, go to the MODE menu and select the AM parameter. The receiver has the following types of AM demodulators:

– classical amplitude detector (MAG);
- synchronous amplitude detector (SAM);
- synchronous amplitude detector (SAMU), with upper sideband reception;
- synchronous amplitude detector (SAML), with low sideband reception;

To select the type of AM demodulator, you must go to the MODE menu and select the parameter

„AM det."

To select the type of NFM modulation, go to the MODE menu and select the NFM parameter. To select the type of WFM modulation, go to the MODE menu and select the WFM parameter.

7.38 RETRO STYLE SCALE

The receiver allows you to display a stylized retro scale when receiving WFM signals, in the spirit of classic transistor and tube radios. The retro scale is displayed only when receiving radio on the FM broadcast band.

To turn on the display of the retro scale, press in the area of the touch panel, between the image of the menu buttons and the middle of the screen (vertically), until the retro scale appears.

The retro scale interface allows you to:

- display a stylized image of a retro scale;
- add stations and their names at the request of the user;
- change the color of the scale depending on the user's preferences;
- load station presets from the receiver's memory;
- edit, save and load saved stations into separate lists - user-generated scales. The user is provided with two such lists, the names of the lists and their composition can be edited in whole or in part;
- perform automatic scanning to search for stations.

  To exit to the retro scale menu, press the area of the touch panel between the middle of the display (vertically) and the frequency display. When you exit to the retro scale menu, you are given the option to change the current user scale.

The retro scale menu contains the following buttons:

1) ADD/EDIT STATION - to add a station to the current list and enter its name, make changes or delete a station.

   Clicking on this button will open a new menu that allows you to:

- before entering the name of the station - tuning in frequency in both directions;
- enter the name of the station - for this you need to press the buttons and, to select letters, you need to rotate the encoder ENC_FREQ, after starting to enter the name of the station it becomes impossible to tune the frequency until saving or refusing to add (see below);
- save the name of the station and exit to the retro scale menu by pressing the SAVE AND EXIT button;
- save the station and continue further search and input of parameters of other stations – SAVE AND CONTINUE button;
- delete a station – DELETE STATION button;
- exit to the retro scale menu without saving changes – CANCEL button.
- it is possible to add stations without manually entering their names, simply by tuning into a frequency and pressing SAVE AND CONTINUE if more stations need to be added or SAVE AND EXIT if the search is over, in both cases the name is assigned automatically as a frequency value in megahertz, for example, "87.5 " for a station operating on 87.5 MHz. Such entering stations is quite simple and fast, therefore it is a good alternative to the automatic search described in par. 7.40.

2) RENAME SCALE - to enter or change the name of the current scale associated with the corresponding list of stations.
Clicking on this button will open a new menu that allows you to:

- enter or change the name of the scale - for this you need to press the and buttons, to select letters you need to rotate the encoder ENC_FREQ;
- clear the entered name of the scale - to do this, press the CLEAR NAME button;
- save the entered nameand exit to the retro scale menu - SAVE AND EXIT button;
- exit to the retro scale menu without saving changes – CANCEL button.

3) CLEAR SCALE - to clear the retro scale data from the receiver's memory.
When this button is pressed, a warning sign will appear with a warning that all data for this scale is lost, as well as two buttons CLEAR and CANCEL.
Pressing CLEAR clears the data for the current scale and exits the menu, while the current scale becomes empty and takes the name MY LOCATION 1 or 2, depending on depending on its original name.

Pressing CANCEL exits the menu without erasing the current scale (cancellation of erasing).

4) SWITCH USER SCALE - to switch between two user lists of retro scale radio stations. Pressing this button switches the list of radio stations. This function can be useful when the user needs to have and quickly switch several lists of radio stations, for example, when changing location frequently ("city - cottage", "at home - on a business trip", etc.).

5) LOAD PRESET - to load lists of radio stations built into the receiver's memory. Clicking on this button will open a new menu that allows you to:

- select a city from the list. The selection is made by turning the encoder ENC_FREQ;
- exit to the retro scale menu without saving changes – CANCEL button;
- LOAD PRESET - to load the list of radio stations according to the selected city. When you click this button, a warning will appear stating that all data the current scale will be lost - in fact, replaced with data from the selected built-in list.

6) CHANGE COLOR - to select the color of the retro scale. Eachof the two custom scales can have its own color, regardless of the color of the other. Clicking on this button will open a new menu that allows you to:

- choose a color from the available examples. The choice is made by rotating the ENC_FREQ encoder or by clicking on the icon with the corresponding color;
- exit to the retro scale menu without saving changes – CANCEL button;
- SAVE COLOR & EXIT - save the selected color for the currentscale and exit to the retro scale menu.

7) CANCEL - to exit to the main menu of the radio.

8) AUTOSEARCHING - to automatically search for and save found radio stations. The function is described in more detail in section 7.40.

While in the retro scale mode, the user can tune in frequency in 50 kHz steps, or immediately from station to station. To rebuild immediately from one station to another, you must press the ENC_FREQ encoder and rotate it until it appears in the field character pitch display NEXT.

Depending on the type of FM broadcasting band being used, it is possible to select two types of retro scale: European (for the European FM band) and Japanese (for the Japanese

FM band). To select the type of retro scale for the desired type of FM band, go to the VISUAL menu and select the desired value of the Retro scale parameter.

7.39 AUTO SEARCH FOR FM RADIO STATIONS

The radio has an automatic station search function. To perform auto search, enter the retro scale menu and press the AUTO SEARCHING button. When this button is pressed, the radio will start an automatic search. The scan time is long to improve the quality of the search for weak stations. The search status is displayed as:

- progress bar. Upon completion of the auto search, the progress bar should be completely filled with green.
- number of found stations – number specified as [XX], where XX – number of found stations;
- the fact of detection of the station in the form of the appearance of the inscription PILOT DETECTED;
- highlighting the detection of the station's pilot tone as a section of the spectrum.

Auto search can be canceled by pressing the CANCEL button - pressing it will stop scanning and go to the retro scale menu.

When the auto search is completed, a new window will open containing buttons:

- CANCEL – to cancel autosearch results and exit to the retro scale menu;
- SAVE SCALE & EXIT - to save the autosearch results and exit to the retro scale menu.

Attention! Auto search works in the presence of reception of stations with a level sufficient for decoding a stereo signal and detects just such stations. For auto search to work, you must turn on headphones as an audio output, turn on the WFM stereo parameter in the AUDIO menu.

To search for stations in conditions of poor reception, it is better to use the option

ADD / EDIT STATION clause 7.39.1, in this case it is enough to change over the range manually, making "on the go" decisions to add or not a station to the list, to add, press the SAVE SND CONTINUE button and continue the search. When a station is added, it will automatically be given a name in the form of a frequency value in megahertz. After searching and memorizing the scale can be edited by changing the names and adding or deleting stations. Manual search is quite fast and simple, that is, it is quite competitive automatic.

7.40 MANUALLY ENTERING FREQUENCY

The radio receiver has a manual frequency entry function.

In order to enter the desired frequency, you must:

- click on the frequency image in the upper right corner of the main screen of the radio;
- enter the value of the desired frequency in Hz, kHz or MHz.

If you do not need to enter a frequency, or you want to exit the frequency entry menu, then you must click on the frequency icon in the upper right corner of the main screen of the radio receiver.

7.41 AUTOMATIC NOTCH FILTER

This function allows you to remove an interfering signal such as "tone" from the received signal.

This function can only be used when receiving in USB, LSB modes.

To enable the function, go to the AUDIO menu and press the ANF button.

7.42 PSEUDO-STEREO

This function allows you to create a surround sound effect. The use of this function is possible when using all types of modulation, except for WFM, and only when listening to headphones.

7.43 PGA BST FUNCTION

This feature can be useful when receiving very strong signals that overload the receiver. To control this function, go to the RADIO menu and press the PGA BST button. The Enabled state corresponds to the maximum gain. If the receiver is overloaded with input signals, PGA BST must be set to Disabled. The default value is Enabled. It is not recommended to use this feature unless it is really necessary.

7.44 CHANGING THE DISPLAY FREQUENCY

This feature is only available in Malahit-DSP2, it is experimental. To work with this function, it is necessary to remove the rear cover of the radio receiver and set switch 3 on the DIP SWITCH on the printed circuit board to position:

- OFF - for low frequency (NORMAL SETTING);
- ON - for increased frequency.

The overclocked mode is a test mode, the display may not work correctly.

7.45 USER EQUIPMENT MANAGEMENT

This function is currently only available in Malahit-DSP1, it allows you to control additional equipment (for example, a Bluetooth module) using a logical discrete signal. The logical signal is generated on pin 8 of the connector (according to the diagram in section 9) intended for connecting an additional board. Logic 0 corresponds to a voltage of 0V, logic 1 corresponds to a voltage of 3.3V.

To control logic signals, go to the RADIO menu and press the User funct button. The Enabled state corresponds to logical 1, the Disabled state corresponds to logical 0.

7.46 CLOCK SPEED CORRECTION

This function allows you to change the speed of the real time clock, by slowing it down or speeding it up. To correct the clock speed, go to the RADIO menu and select the Time correct parameter. Rotate ENC_FREQ to set the required value. The value of the parameter is the number of seconds per day by which you want to adjust the speed

7.47 NCO

This function allows radio reception of signals without changing the center frequency of the spectrum. To control this function, go to the RADIO menu and select the value of the NCO parameter:

- Enabled - for radio reception of signals without changing the center frequency of the spectrum; in this mode, the sight moves, the center frequency of the spectrum does not change until the sight reaches the extreme left or right value; in this mode, signals with AM and NFM modulation are received with distortions when they are located in the center of the spectrum, at a frequency of 0 Hz - at this frequency, the signal carrier is suppressed due to hardware features;
- Disabled – in this mode, the sight is motionless, while tuning the center frequency of the spectrum changes.

7.48 DISPLAY NOISE REDUCTION

This function allows you to reduce noise from the display. To enable this function, go to the RADIO menu, select the EMI Reduction parameter and set the value to Enabled. This function affects the speed of the user interface of the radio - when set to Enabled, the speed of the user interface is reduced.

7.49 DISPLAY FREQUENCY GRID AND SPECTRAL AMPLITUDE

This function allows you to display vertical and horizontal lines on the spectrum, for the convenience of assessing the received signals. The horizontal (frequency) grid spacing is 50 kHz with a 192 kHz span, 25 kHz with a 96 kHz span, and 10 kHz with a 48 kHz span. The vertical grid step (amplitude) is 10dB.

To enable the grid, go to the VISUAL menu and set the FFT grid parameter to Enabled. To turn off the grid, go to the VISUAL menu and set the FFT grid parameter to Disabled.

7.50 SPECTRUM LEVEL ADJUSTMENT

This function allows you to set the necessary base spectrum display level. To set the required level, go to the VISUAL menu and select the FFT level parameter, turn the ENC_VOL encoder to set the desired value in the range from -50dB to +50dB, or set the value to AUTO. This option allows you to change the position of the spectrum vertically, higher or lower. The AUTO value corresponds to the state of constant automatic calculation of the zero level for the spectrum.

7.51 MEMORY SCAN

This function allows you to scan stored memories. It is possible to scan all cells, as well as their sets, both in manual and automatic mode.

To scan memory cells, go to the BAND menu and press the MONITOR SETTING button. The BAND MONITOR menu opens, showing a field with memory numbers and settings.

The field has the following settings and buttons:

- BACK button - to exit the BAND MONITOR menu;
- SAVE&EXIT button - to save the scan settings and exit the BAND MONITOR menu;

-button START - to start scanning;

- SKIP button - to exclude the selected cell from scanning;

- TIMEOUT button – setting the scanner stop time to listen to the signal (if any) of the cell;

- button SUBMON1-4 - to create sets of cells for scanning

- SQL button - to enable or disable the threshold noise suppressor for a specific cell during scanning;

- SQL LEVEL button - to set the squelch threshold for a specific cell during scanning.

Regardless of the type of scan, each cell can be included or excluded from the scan process. To do this, select the desired cell by rotating ENC_FREQ and press the SKIP button - the red color of the cell means that it is excluded from the scanning process.

Scanning is possible only in the BAND MONITOR menu.

Manual Scan

It is necessary to rotate ENC_FREQ in the BAND MONITOR menu. The memory cells will be switched and listened to, taking into account the SKIP settings (red cells will be excluded) and the squelch.

To exit to the BAND menu, press the EXIT button.

Automatic cell scanning

It is necessary to press the START button in the BAND MONITOR menu.

After pressing the START button, a new menu will open containing buttons:

- SKIP – to exclude the selected cell from scanning;

- NEXT – for forced switching to the next cell;

- PREV – for forced switching to the previous cell;

- EXIT - to stop automatic scanning and exit to the general BAND MONITOR menu.

The memory cells will be automatically switched and listened to, taking into account the SKIP settings (red cells will be excluded) and the noise threshold. If there is a signal in a particular cell, scanning will be suspended for the time specified in the TIMEOUT setting, after this time the scanning will continue.

To stop scanning, press the STOP button.

Scanning cell sets

The user can select the required cells in separate sets for scanning. It is possible to create 4 sets.

To create kits, go to the BAND MONITOR menu and press the SUBMON 1-4 button.

A menu will open containing buttons:

- Back- to return to the previous menu;

- SET SM 1-4 - to set up sets 1-4;

- START SM 1- 4 - to start scanning the set, respectively from the 1st to the 4th; these buttons are active only if there are cells in the sets.

Pressing any of the SET SM buttons will open a new menu containing buttons:

- BACK to return to the previous menu;

- SET/RESET - to add a cell to the set, or exclude from the set.

To create a set, you must press the desired SET SM 1-4 button, rotate ENC_FREQ to select the desired cell and press the SET / RESET button. If a cell is added to the set, then a colored marker will be located opposite this cell. To exclude a cell from the set, select the desired cell and press the SET/RESET button. In this case, the marker near the cell should disappear.

After adding or deleting the necessary cells, you must press the BACK button.

If cells are added to the set, the START SM 1-4 button will become active for the corresponding set. To start scanning the required set, press the START SM 1-4 button corresponding to the set.

This will open a menu containing the buttons:

- EXIT – to stop scanning and return to the previous menu;

- <<< PREV – to switch to the previous cell during scanning;

- >>> NEXT – to switch to the next cell during scanning;

- STOP – to stop scanning;

- START - to start scanning.

Scanning is performed only in automatic mode.

After pressing the START button, a new menu will open containing buttons:

- SKIP – to exclude the selected cell from scanning;

- NEXT – for forced switching to the next cell;

- PREV – for forced switching to the previous cell;

- EXIT - to stop automatic scanning and exit to the general BAND MONITOR menu.

The memory cells will be automatically switched and listened to, taking into account the SKIP settings (red cells will be excluded) and the noise threshold. If there is a signal in a particular cell,

scanning will be suspended for the time specified in the TIMEOUT setting, after this time the scanning will continue.

To stop scanning, press the STOP button.

7.52 CONNECTING BLUETOOTH MODULE

The radio receiver allows you to connect Bluetooth modules to transmit sound to audio devices, such as audio speakers or headphones.

Signals required for connection:

- output audio signals of the left and right channels;
- 3.3V power supply circuit;
- common wire circuit (GND);
- discrete connection control signal.

For ease of use, a function to control the connection of Bluetooth modules is provided - a discrete control signal CON is generated. The initial state of the CON signal is logic 1 with a voltage of 3.3V, the connection command is issued to the Bluetooth module in the form of a logic zero, the command duration is 150ms.

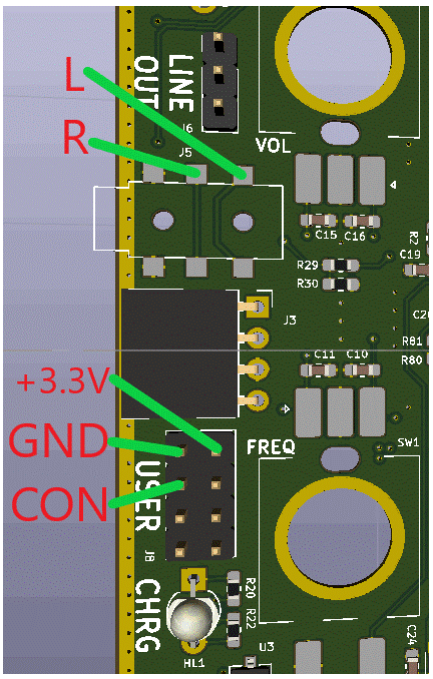
Connecting the Bluetooth module must be carried out in accordance with the recommendations given below. Before connecting, you must completely turn off the power to the radio - disconnect the charger from the USB connector, remove the batteries.

The connection of the KCX_BT_EMITTER module was checked, the following signals of this module were used:

- IN_L, IN_R – outputs of the left and right audio channels;
- PGND and AGND are connected together and connected to the GND circuit of the radio receiver;
- 5V is connected to 3.3V, while despite this discrepancy, the operation of the module is stable;
- The module's CON is connected to the radio receiver's CON signal.

Connection in the radio receiver Malahit-DSP2 / DSP3.

To connect, use the following connectors - J5, USER. Connection points are shown in the figure:

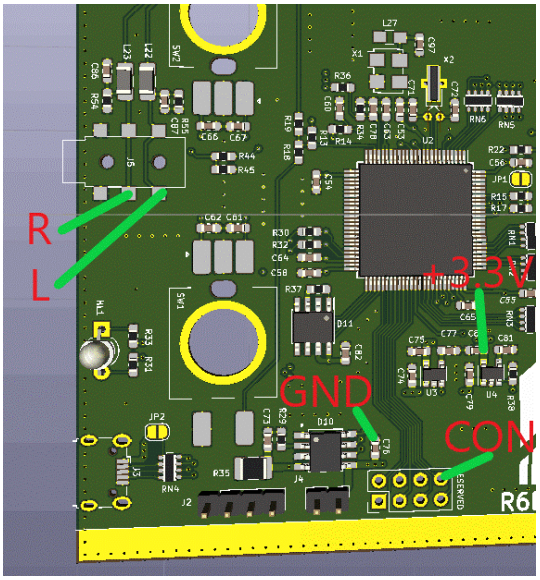


Signals:

- L and R - output signals for headphones, connected to the corresponding inputs of the Bluetooth module;
- +3.3V – power output for the Bluetooth module;
- GND - common wire, negative power circuit;
- CON - output logical signal, connected to the Bluetooth input of the module, to control the connection.

Connection in the radio receiver Malahit-DSP1.

Connection points are shown in the figure:



Signals:

- L and R - output signals for headphones, connected to the corresponding inputs of the Bluetooth module;
- +3.3V – power output for the Bluetooth module;
- GND - common wire, negative power circuit;
- CON - output logical signal, connected to the Bluetooth input of the module, to control the connection.

7.53 CONNECTING RECEIVER TO PC

Connecting the radio to a PC via USB for CAT control and audio transmission is carried out in accordance with the video instruction: - https://youtu.be/ePji1m4968Y.

8 UPDATING RECEIVER FIRMWARE

Follow instructions in this video to update receiver firmware via USB:

- for Malahit-DSP1 – https://www.youtube.com/watch?v=4SF-XynJvMs

- for Malahit-DSP2 / DSP3 - https://www.youtube.com/watch?v=3RMuSRu4kuA

9 FREQUENTLY ASKED QUESTIONS

What type of battery is used?

Battery type 18650.

Does the receiver have a controller to charge the battery?

Yes, an integrated controller is available and provides full charge control.

Can the device work only from USB?

A built-in battery is recommended even when powered by USB.

What type of 18650 battery to use - with or without protection board?

The type of battery holder used does not allow the use of batteries with a protection board. they have large dimensions.

How to choose a battery?

I recommend using batteries with a capacity of more than 1500 mAh. But keep in mind that there are many fakes, the maximum capacity for 18650 batteries is 3600mAh. If a capacity of more than 3300mAh is indicated, this is definitely a fake! Try to use batteries from well-known manufacturers - Samsung, LG and the like. Please note that high-capacity batteries also have good weight - if the battery by designation has a capacity of 3000 mAh, but weighs less than 50 grams - this is a fake!

What type of antenna do you recommend?

As a telescopic antenna, I recommend using antennas with a length of about 1m or more. This will provide reception of HF, MW, LW and will even be acceptable for VHF. On VHF, it may be necessary to

use shorter antennas.

What is an attenuator and what is it for?

The attenuator is designed to protect the radio from overload.

An attenuator may be required:

if you are receiving a very strong station that overloads the radio

there is a strong interfering signal near the received signal

there are any spurious signals present in the receiver caused by strong radio signals.

An attenuator value of odB corresponds to no attenuation (attenuator off).

What is a HiZ input?

Telescopic short antennas at frequencies up to 30 MHz have a high input impedance (hundreds of ohms and higher) and when connected to devices with an input impedance of 50 ohms, good reception will not be possible - 50 ohms will shunt the antenna.

You can see that in our radios turning on the HiZ input will greatly improve the reception quality. **Why switch the antenna input type?**

This function is only needed to receive signals up to 50 MHz.

HiZ is needed when using short telescopic or wire antennas,for example,with a length of about 1m. 50 Ohm input is recommended to be used with long antennas, for example, dipole type, inverted V, the length of which is units and tens of meters.

How long does the radio battery last?

It all depends on the capacity of the battery and the operating modes of the receiver.

For example, for models DSP1, DSP2 and DSP3, when listening to headphones, a 1500 mAh battery will last for at least 4 hours.

Where can I see what firmware I have?

The firmware version has a designation like "X.YYZ", where X is the receiver version (1 for DSP1, 2 for DSP2/DSP3), YYZ is the alphanumeric designation of the firmware version. For the DSP1 model, the receiver firmware version is indicated on the start screen. If it is not specified, then you have a test version or version 1.10C. For the DSP2 / DSP3 model, the receiver firmware version is indicated in the HARD menu(RADIO).

Does the receiver ship with the latest firmware?

The receiver is shipped with the latest firmware at the time the particular receiver was manufactured.

The update may come out literally during the delivery of the receiver. The user can update the firmware himself.

What type of RF connector is on the receiver?

SMA female

The DSP1 receiver version does not accept the 250-400MHz range, is it possible to solve this somehow

This is a hardware limitation and cannot be solved by software. In the DSP2 / DSP3 version, reception of the frequency range 250-380 MHz is possible.

Can I install multiple batteries in the radio receiver?

Yes, it's possible. The receiver allows you to install multiple batteries. To do this, the batteries must only be connected in parallel! This will increase the charging time.

Which battery charger?

Charging current 0.9A.

What is the battery charging time?

The charging time depends on the capacity of the battery. Approximate charge time can be determined by dividing the battery capacityaboutra for charging current. For example, the battery capacity is 1800mAh, then the minimum charge time will be 1800mAh/900mAh = 2 hours.

I have a problem updating the firmware. The Stm32CubeProgrammer program does not see the radio.

First, make sure the receiver is visible to the computer. On the computer, go to Control Panel\Hardware and Sound\Devices and Printers - there must be a MALAHIT RECEIVER DFU device or similar. If the device is not visible, try replacing the USB cable. After that, try to flash the radio in accordance with the video instructions. If Stm32CubeProgrammer gives an error when connecting, then the likely cause is a driver conflict for the computer. You need to download and install the Zadig program from the link - https://zadig.akeo.ie/ . After that, launch Zadig, select the Options tab, then List All Devices. In the list that appears, select MALAHIT RECEIVER DFU, in the right part of the working field (in the direction of the arrow) select the WinUSB driver type and click the Reinstall Driver button. After completing the procedure, close the Zadig program and try to update the receiver's firmware again. If this action did not help, then try updating the Stm32CubeProgrammer version - https://www.st.com/en/development-tools/stm32cubeprog.html .

How to update radio firmware?

The radio receiver allows you to update the software - firmware.

All firmware is here -https://malahiteam.com/dokumentacija/

You need to select the firmware strictly for your radio model.

Instructions for updating the firmware for Malahit-DSP1 -https://www.youtube.com/watch?v=4SF-XynJvMs

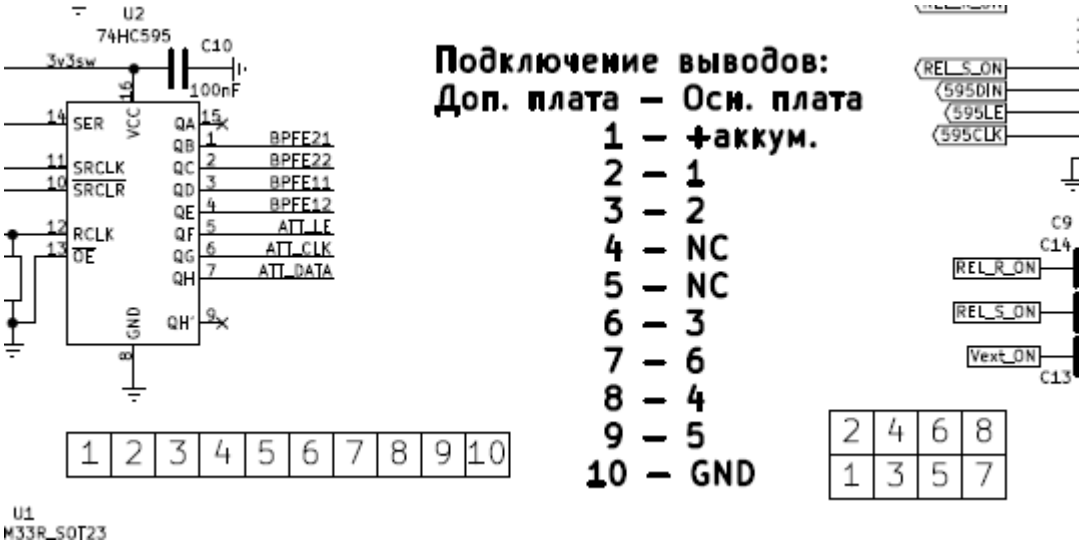
Instructions for updating the firmware for Malahit-DSP2 / DSP3 -

https://www.youtube.com/watch?v=3RMuSRu4kuA

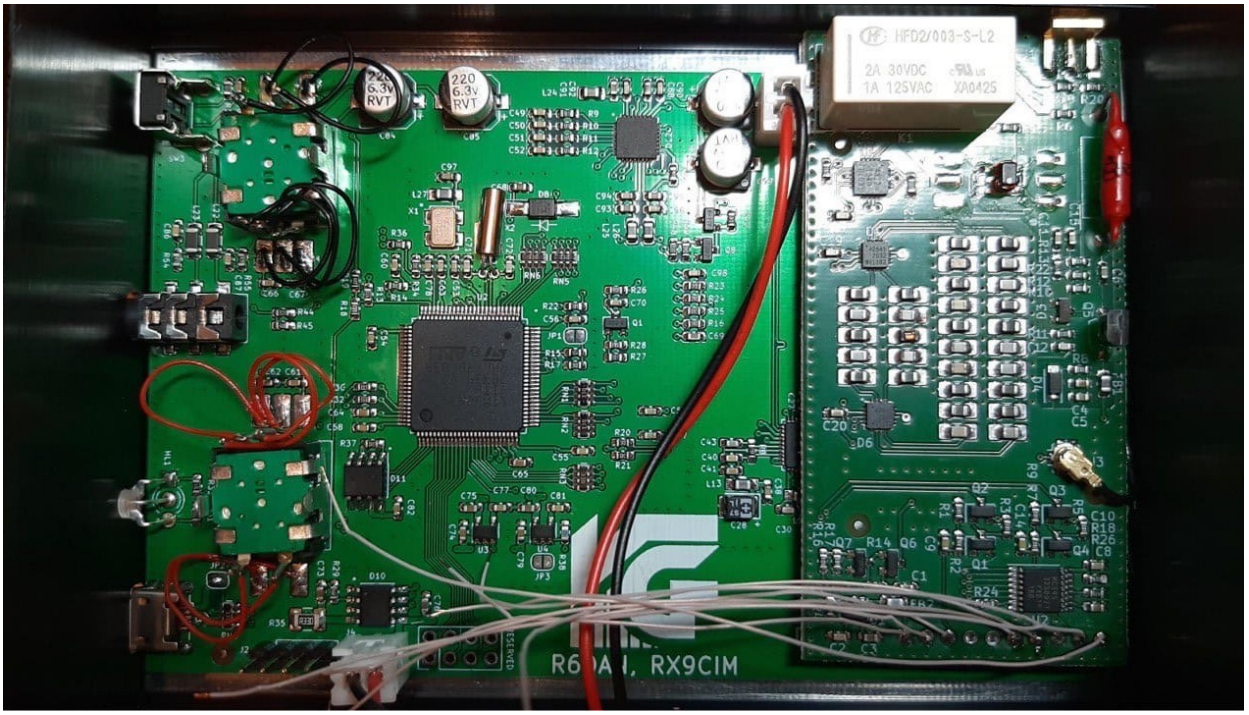
10 CONNECTING THE ADDITIONAL BOARD

This section is relevant only for Malahit-DSP1.

Additional board connection diagram:



The location of the contacts is given in the form in which they are visible when mounting the board in the radio receiver:



To provide an additional board with power, it is possible to connect both to the battery and to other points. For example, to the capacitor C76, located near the battery connector. The top of C76 is GND, the bottom is "+".

11 RADIO SENSITIVITY MEASUREMENT RESULTS

Sensitivity, dBm, SSB, dF=300-800Hz, S/N=10dB, Input 50 Ohm, optional board is present, display is OFF

frequency	RF GAIN=0	RF GAIN=20	RFGAIN=0, PRE=EN	RF GAIN=10, PRE=EN	RF GAIN=20, PRE=EN
100000	-97	-96	-92	-92	-94
1000000	-109	-111	-121	-120	-120
5000000	-109	-114	-121	-127	-128
10000000	-110	-120	-123	-125	-125
15000000	-115	-121	-121	-121	-121
20000000	-117	-121	-123	-125	-124
30000000	-111	-113	-115	-116	-117
50000000	-115	-112	-109	-107	-115
70000000	-122	-121	-127	-125	-127
90000000	-120	-125	-128	-128	-127
100000000	-119	-123	-124	-127	-126
120000000	-118	-113	-117	-116	-113
140000000	-108	-124	-130	-128	-130
145000000	-110	-125	-130	-130	-130
150000000	-104	-122	-130	-130	-127
170000000	-112	-124	-126	-130	-129
20000000	-120	-121	-127	-128	-127
24000000	-105	-108	-117	-117	-114
410000000	-106	-109	-109	-109	-109

43000000	-116	-116	-118	-118	-117
44000000	-117	-114	-115	-116	-115
50000000	-96.5	-108	-111	-114	-112
60000000	-117	-119	-124	-126	-124
80000000	-114	-121	-123	-126	-122
110000000	-98	-105	-109	-113	-111
120000000	-103	-106	-110	-112	-112
150000000	-108	-114	-113	-116	-117
19000000	-101	-106	-98	-103	-104

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