

ExpertSDR3

User Manual

SunSDR2 DX Transceiver

Revision: 1.3.2 | Software: 1.3.2

September 2026

Table of Contents

1. What's new in ExpertSDR3 5
1.1. ExpertSDR3 1.3.2 (September 8, 2026) 5
1.2. ExpertSDR3 1.3.1 (September 3, 2026) 7
1.3. ExpertSDR3 1.3.0 (August 26, 2026) 10
1.4. ExpertSDR3 1.2.0–1.2.1 12
1.5. Document version history 14
2. READ IT FIRST 18
2.1. Congratulations 18
2.2. Features 18
2.3. Supplied accessories 22
2.4. Precautions 23
2.5. ExpertSDR3 Software License Agreement 25
2.6. Contacts 25
3. TECHNICAL CHARACTERISTICS 27
3.1. Receiver 27
3.2. Transmitter 29
3.3. Other 30
3.4. Firmware-based protections 32
4. FRONT PANEL DESCRIPTION 34
5. REAR PANEL DESCRIPTION 36
5.1. Antenna 38
5.2. Grounding 38
5.3. Accessories 39
5.4. External Linear Amplifier 40
5.5. External Control devices 49
5.6. Reference input 49
5.7. DAC OUT low power output 50
5.8. ADC IN and RX OUT 50
6. CONNECTORS PIN-OUT 52
6.1. MIC1 52
6.2. MIC2 52
6.3. EXT CTRL 53
6.4. ATU cable 55
7. Setup procedure 56
7.1. First run 56
7.2. Ports Validation Procedures 58
7.3. System requirements 59
7.4. Mac specific MicPC setup 60
8. Device Manager 67
9. ExpertSDR3 software description 73
9.1. Global controls panel 73

9.2. Transceiver control panel....79
9.3. Indicators....87
9.4. DSP control panel....91
9.5. Panorama....98
9.6. Status bar and quick settings....104
9.7. Settings menu....109
9.8. Operating System (OS) installation dependencies....128
10. RadioSync....129
10.1. CAT commands....138
11. TCI: Third-Party Software Integration....155
11.1. What is TCI....155
11.2. Connection....155
11.3. Compatible software....156
11.4. Typical schemes....156
11.5. For developers....157
12. RadioSpot....158
13. RadioMacros....161
14. TRANSCEIVER OPERATIONS....168
14.1. Band Manager....168
14.2. Output power per band....170
14.3. S-meter....171
14.4. RX1/RX2 TX priority....172
14.5. E-Coder panels....173
14.6. Connection to AAT-100 tuner....181
14.7. Transverter (XVTR)....183
14.8. Frequency Tuning....184
14.9. Voice Recorder Operation....185
14.10. IQ Recorder formats....186
14.11. RIT/XIT....188
14.12. CW mode....190
14.13. Digital modes operation....194
15. Remote operation....195
15.1. ExpertCloud....196
15.2. ExpertStarter....198
15.3. Operator Location....199
15.4. Quick Start....199
15.5. TURN services....216
15.6. Profile Menu Section....218
15.7. Subscription Menu Section....219
15.8. Sharing Menu Section....219
15.9. Setup examples....221
15.10. A ExpertStarter Web Panel (localhost:5531)....224
15.11. B ExpertStarter CLI....225
15.12. C Custom STUN/TURN Servers....225

15.13. D Device Sharing: TX Lock 226
15.14. E Remote Control of the AAT-100 Tuner 226
15.15. F Remote CW Operation 226
15.16. G ExpertCloud Authorization 226
15.17. H Audio Quality in Remote Operation 227
16. RESET SETTINGS AND FIRMWARE 228
17. Solving typical issues (FAQ) 230
17.1. Installation and Startup 230
17.2. Network and Connection 231
17.3. Remote Operation 232
17.4. Audio 233
17.5. Transmission 234
18. Troubleshooting guides 235
18.1. How to open the transceiver 235
18.2. Low output power on HF 237
18.3. VHF TX path check algorithm 239
18.4. ATT resistors replacement 241
18.5. ADC replacement 241
19. Hardware modifications 244
19.1. HF/VHF switching relay 244
19.2. Spectrum improvement 244
19.3. Supply voltage stability 246
19.4. RF interference elimination 248
19.5. Mic1 fix 248
20. REGULATORY REQUIREMENTS 252
21. Appendix A. Typical usage scenarios 253
21.1. Scenario 1. DXpedition and Portable Operation 253
21.2. Scenario 2. Remote (Club) Station 253
21.3. Scenario 3. Contest Position 254
21.4. Scenario 4. Digital Modes (FT8 and others) 254
21.5. Scenario 5. Skimmer / Band Monitoring 254

1. What's new in ExpertSDR3

This chapter summarizes the key user-facing changes in ExpertSDR3, starting with the most recent version.

1.1. ExpertSDR3 1.3.2 (September 8, 2026)

ExpertSDR3 1.3.2 (released September 8, 2026) is a fix release. The binaural CW effect has been rewritten, the personal account and remote device workflow has been put in order, and the crash of the utilities on Linux startup has been eliminated. The suite composition is unchanged: ExpertSDR3 1.3.2, RadioSync 1.4.0, RadioMacros 1.2.0, RadioSpot 1.2.0.

1.1.1. CW: the binaural effect

- The effect has been rewritten: minimum-phase shelving filters for the level difference, a cascade of all-pass sections for the interaural delay, and phase centering at the tone frequency. The image at the tone sits in the center both in level and in phase, and the path delay is a fraction of a millisecond.
- The computation targets the 500 Hz receiver bandwidth: the reference settings and the interaural delay are measured at the edges of that band, where the signal actually is. The panorama slope is now a parameter, 34 dB per octave by default — with a 700 Hz tone that is exactly 15 dB of channel difference at the upper edge of the band, which is full lateralization for the ear.
- The CW tone frequency from the settings reaches the effect in every receive channel, in both local and remote mode. Previously the effect ran at 700 Hz regardless of the setting.
- Changing the settings produces no click: the filter is synthesized aside and the audio stream switches to the new one within a single block. Enabling the effect after a pause is seamless for the same reason. Identical settings in different channels produce one and the same filter, so a receiver needs one computation for four channels.
- The effect does not depend on the device sample rate: at the 39,062.5 Hz of SunSDR2 devices it is the same as at 48 and 96 kHz.

1.1.2. Personal account and remote devices

- Signing in under a different account does not return you to the previous one. The cause was a cookie substitution: the service extended the previous session and sent its tokens over the fresh ones. Signing out now clears both the tokens and both cookie stores.
- Signing out of the personal account persists across program launches. Previously the settings file kept a sign-in marker, and the next launch silently restored the previous account.
- A refusal from the cloud is now visible: the button is released and a dialog appears with the serial number of the device. An empty response from the service means the device is

switched off, busy, or access to it is closed. Previously such a response passed silently — the program did not start, while the device looked as if it were opening.

- Starting a remote device no longer waits for the location to be determined. Previously the driver requested geolocation and held the connection because of it, up to about ten seconds in the worst case. The personal account now sends this data in the same command that requests the connection address, for both your own and a shared device.
- The location is sent only when a response with a country code has been received; the city and coordinates are recorded only as the provider supplied them. The response is requested once per program run and remembered.

1.1.3. Utilities

- The crash of RadioSync, RadioMacros and RadioSpot on Linux startup has been eliminated. The cause was the nested Zoom menu introduced in 1.3.1: a second or two after start the notification area host asks for the menu contents, and the reply crashed inside Qt. Verified on Qt 6.11.1, 6.11.2 and 6.12.0, on xcb and on wayland. Windows and macOS were not affected.
- The interface scale has its own Zoom item again, with the options expanding on hover: as a flat list the notification area menu grew from six lines to eleven. The menu is now one for all three utilities, and the set of scale values is shared across the whole suite.
- Audio in all three utilities goes through one common wrapper: RtAudio on Linux, PortAudio on Windows and macOS — the same choice made for the audio plugin of the program itself.
- RadioMacros looks up the audio device by name rather than by index. Previously a busy device did not appear in the new list, the indices of the following ones shifted, and recording could open a neighboring device. If the device is gone, the stream is not opened and the utility reports it in the log.
- Audio device names on Linux changed together with the driver, and the ALSA prefix is not appended to them. The startup log on Linux is now empty: the previous library was built with ALSA and JACK and on PipeWire systems enumerated devices through shims, reporting it on every start.
- An incompatible x86_64 library has been removed from RadioMacros on Raspberry Pi.

1.1.4. Important when updating

- RadioSync on Linux: the VAC device has to be selected again. Audio device names changed together with the driver, and the name stored in the settings will not match the new list.

- The logs of this release intentionally contain more service records than usual: the whole path of the recovery cookie in the personal account, and the parameters the binaural effect is rebuilt with. The recovery cookie is a key to the personal account session, so such a log should not be posted publicly. When contacting support, send the log in a private message rather than to a public forum.

1.2. ExpertSDR3 1.3.1 (September 3, 2026)

ExpertSDR3 1.3.1 (released September 3, 2026) brings the interface scale selector to every program of the suite, transceiver control via OmniRig in RadioSync, a rewritten TCI log and the completed Chinese translation. The suite includes RadioSync 1.4.0, RadioMacros 1.2.0 and RadioSpot 1.2.0. The key user-facing changes are:

1.2.1. Interface scale

- The Zoom item in the menu of the ExpertSDR3 icon in the notification area offers five sizes: very small 75%, small 85%, normal 100%, large 110% and very large 120%. The choice is stored next to the color scheme and the language.
- The same item is now present in RadioSync, RadioMacros and RadioSpot. The set of values is common to the whole suite, so “large” means the same everywhere.
- A ready image is never stretched: every element recalculates its geometry, text is drawn with a new font size and icons are rendered from the source at the new size. That is why there is no blurring either.
- The system display scale is applied as it is. Previously the fractional values of 125% and 150% were reduced to 100%, and on such displays the program looked the same as at normal pixel density.
- The default scale is now identical on all operating systems.

1.2.2. Interface languages

- The Chinese translation is complete: the units on the panorama, in the bandscope and on the S-meter (dBm, W, SWR, Hz, kHz, MHz, GHz), the sample rate and tuning step lists, the Firmware utility and the TCI log window.
- The terminology of the transmitter chain and of the IF filter settings has been clarified: Monitor, High shelf, Low shelf, Stages, Rotator, Compressor, Accumulate, Boost.
- On-the-fly language switching now works in every window, including the panorama, the bandscope and the signal processing graphs.
- Switching the language no longer changes the device settings. Previously replacing a list reset the selected item, and along with the language the sample rate, the tuning step, the RIT and XIT step, the remote channel bitrate, the panorama background type and the generator mode could change as well.

- The weekday names in the calendar, the bandscope span label and the quick memory labels now follow the language too.
- Input fields have been widened for translation: the Chinese units are twice as wide as the Russian and English ones, and the labels used to overflow.

1.2.3. Bands and hotkeys

- The 10M and 11M band hotkeys work. Previously they failed for everyone without an 11M permission, that is by default for everyone.
- The band buttons select the intended band after the ITU region has been changed. Previously the mapping table was built once at startup, while the band list depends on the region, which can also change during operation — from the settings and when a profile is loaded.
- Saved keyboard shortcuts are no longer lost when the language is switched or when an update adds new commands.
- Commands work on computers with a non-English system locale.

1.2.4. Device Manager

- The graphics API selector is placed in the device row, between the start button and the icons on the right. While the device is running the selector is locked but stays visible. The field is present under Windows only: Linux and macOS have a single graphics backend.
- The device list refresh button. When pressed, the Device Manager forgets the automatically discovered devices and scans the network again, so the list matches reality after a device has changed its address or stopped responding. Manually added and running devices stay in the list.
- The window position and size are preserved between runs, together with the maximized state. The restored position is validated, so the window will not end up outside the screens after a monitor has been disconnected, the resolution changed or a laptop undocked.
- The Firmware utility is launched on equal terms with the others: it receives the language and the color scheme and shuts down correctly.
- Windows installer: the installation proceeds normally even if the program directory was deleted manually. Previously the uninstaller disappeared together with the directory while the registry entry remained, and the installer ended with a request to uninstall ExpertSDR3 manually.

1.2.5. Utilities

- RadioSync 1.4.0: the new OmniRig CAT section links a TCI transceiver with a CAT transceiver owned by the OmniRig COM server. It differs from the Transceiver synchronization section in who holds the COM port: there the program opens it itself, here it

is OmniRig. The settings define the exchange direction, the transceiver number RIG 1...4 and the server version; the button that opens the OmniRig settings window is available even when synchronization is off, because a transceiver is configured before the first run. The section is visible under Windows only and only if the server is registered in the system.

- The Firmware utility has been brought in line with the rest of the suite: it accepts the language and the color scheme from the menu of the ExpertSDR3 icon in the notification area and applies them on the fly, it has an About window and a complete Russian and Chinese translation.
- Firmware started on its own discovers devices on the network under macOS.
- All About windows now carry a single copyright line: © 2026 Expert Group LLC. / Expert Electronics (Beijing) Tech. Co., Ltd.
- The interface scale is selected from the menu of each utility's icon in the notification area.

1.2.6. TCI log

- The log has been rewritten. Previously every new line forced the whole document to be parsed, and the window slowed down the longer it stayed open. Now the lines live in a model, incoming data is accumulated in batches and the window keeps no more than forty thousand lines.
- Filters and copying: an all / incoming only / outgoing only switch, a counter of the displayed lines out of the total, and clearing. Lines are selected with the mouse, with Shift and with Ctrl+A, and copied with Ctrl+C or from the right-click menu.
- The direction is shown by a triangle: up — from the server, down — from the client.

1.2.7. Panorama and bandscope

- The units in the panorama filter labels are translated. The VFO A and B frequencies, XIT, RIT, the band edges and the offset used to stay in English whatever the interface language.
- Subbands and EiBi stations are calculated once per frame — previously the scene tree was rebuilt several times.
- When zooming in, extra subbands no longer remain on the screen and visible ones are no longer lost.
- EiBi stations that fall on the same point are all displayed — previously only one was shown and the rest were lost.
- The label of the previous frame no longer stays after zooming, and a station marker is not blurred when the window is moved to another monitor.

1.2.8. Audio, recording and system behaviour

- The program itself transcodes a recording from WAV to MP3 in all three places where this is done. Previously a separate ffmpeg process was launched, and if it was missing the recording silently stayed in WAV. The Windows distribution directory is 36 MB smaller.
- The audio channels at the device outputs match what the PC sound card shows.
- The NFM deviation is stored up to 13 kHz.
- The computer does not go to sleep while a device is running. Reception and transmission continue without the operator, and going to sleep on idle used to interrupt them. The inhibition is enabled together with the device and released with it; Windows, macOS and Linux are supported.
- The remote channel libraries for macOS, Windows and Linux have been updated.

1.3. ExpertSDR3 1.3.0 (August 26, 2026)

ExpertSDR3 1.3.0 (released August 26, 2026) brings the light interface theme to the menu of the ExpertSDR3 icon in the notification area and to the utilities, three interface languages in every program, a reworked waterfall, notification area menu integration for the utilities, and support for Linux ARM64 and Raspberry Pi 5. Key user-facing changes:

1.3.1. Appearance

- Light and dark color schemes are now available in the menu of the ExpertSDR3 icon in the notification area and in the utilities RadioSync, RadioMacros and RadioSpot. The main application window remains dark-only for now: its light theme requires more careful work and is planned for a future version.
- The color scheme is selected from the menu of the ExpertSDR3 notification area icon and applied to the utilities at startup — a program immediately opens in the chosen theme. If no scheme is selected, the dark one is used.
- Interface elements are about 20% larger: the «100%» scale position now corresponds to the former 120%; the available scale range is 84–168% of the previous sizes.

1.3.2. Interface languages

- Russian, English and Chinese are available in every program of the suite, including RadioSync, RadioMacros and RadioSpot (previously — only in the menu of the ExpertSDR3 icon in the notification area).
- The language is switched on the fly, without restarting the program.

1.3.3. Utilities in the notification area

- The menu of the ExpertSDR3 notification area icon has a new Utilities section for launching RadioSync, RadioMacros and RadioSpot; selecting an already running utility brings its window to the front.
- The Autostart submenu allows selected utilities to start together with ExpertSDR3.
- Utilities are closed together with the ExpertSDR3 icon in the notification area and receive the interface language and color scheme from its menu automatically.

1.3.4. Waterfall and panorama

- Waterfall flickering has been eliminated: vertical filtering moved to the GPU shader, and the line being accumulated is no longer visible.
- Panorama rendering is more than 3 times faster.
- The first position of the waterfall speed slider now gives full speed (previously — 2/3).

1.3.5. RadioSpot

- New DX-cluster client: supports password authorization and correct spot parsing.
- If the cluster is unavailable, connection attempts repeat every second until the link is established — synchronization recovers automatically, without restarting the program.

1.3.6. RadioMacros

- The macros panel no longer hides together with the main window and stays on top of other windows.
- On Linux, audio is handled via RtAudio (Windows and macOS implementations are unchanged).
- The interface scale is aligned with the other utilities: both 12-row tables fit the window entirely.

1.3.7. CW macros and TCI

- The callsign_send confirmation is now sent after the callsign has actually finished on the air, not when the text queue ends.
- Cyrillic in CW macros no longer depends on the system locale; the TCI protocol has moved to UTF-8.

1.3.8. Platforms

- Linux ARM64 and Raspberry Pi 5 are supported; an AppImage package is available.
- macOS: all programs are shipped as a single ExpertSDR3.app bundle; the minimum system version is macOS 13.0.

- Windows: programs start without a console window; executable icons and version info are restored.

1.3.9. Settings and windows

- Settings are saved immediately when changed — previously they could be lost when the program was closed other than via the notification area menu.
- Window position, monitor and maximized/full-screen state are restored on the next launch.
- On macOS, the S-meter works as an overlay of the main window in full-screen mode.

1.4. ExpertSDR3 1.2.0–1.2.1

1.4.1. Panorama and Waterfall

The waterfall is fully processed on the GPU (GPU shader): video memory consumption reduced 4x, flickering eliminated at any scroll speed, the image remains stable when the spectrum is moved. The waterfall is scalable — the new display algorithm keeps even very weak signals clear and distinguishable regardless of zoom level.

In addition to preset color schemes, full waterfall palette customization is available: creating, applying and saving your own color schemes in the software settings.

The maximum number of spots on the panorama is **1000** (previously 500). Note that the number of spots affects CPU load. Spot lifetime — up to 60 minutes. If a station operates on several bands, its callsign is duplicated on each of them. The default telnet server port is 23 (the standard telnet port); if you enter a server address without a port, port 23 is substituted automatically.

1.4.2. Transmitter Signal Processing

- **CESSB** — the transmitter clipper works using the CESSB algorithm (Controlled Envelope Single Sideband): it forms a denser and more efficient SSB signal envelope, increasing average power without the characteristic distortion of classic clipping. The CESSB filter bandwidth is from 0 Hz to 5 kHz and cannot be changed; if you need to transmit wider than 5 kHz, do not use the clipper.
- **Minimum-phase FIR filter** — a minimum-phase FIR filter is built into the transmitter modulator: it reduces transmit path latency. Can be disabled in the interface (TX settings) if needed.
- Audio stream processing for connected TCI clients has been optimized (lower CPU load when loggers and digital-mode software are running).

1.4.3. E-Coder2 Panel

Starting with version 1.2.0, direct on/off commands are available from the E-Coder2 panel:

- **PA** — power amplifier;
- **BS** — band select;
- **BreakIN** — full break-in mode in CW.

Also available from E-Coder/E-Coder2 panels: quick MON (self-monitoring) on/off, SAM on/off, RIT/XIT tuning step selection (10 Hz or 1 Hz). In some cases, scroll the menu with the mouse wheel to display the SQL and SAM elements.

1.4.4. CW Mode

- **CW Pitch** setting is available for all receivers.
- Pressing the **SPLIT** button again returns transmission to VFOA.
- CW signal sources: transceiver KEY input, E-Coder2 panel KEY input, TCI.

Generation methods: transceiver (firmware, CW core), E-Coder2, software.

1.4.5. Installation and OS Support

- The correct install/update procedure (see the "Troubleshooting" chapter, section 1).
- **macOS:** builds are available for both architectures — Intel and Apple Silicon; download the build matching your processor.
- Russian-language interface: language switching in the software settings.
- When the software is launched again, the main window of the first instance is displayed, even if it was hidden.

1.4.6. Output Power

The transmitter output power is bound to the band **and modulation** and does not depend on the software receiver. Example: RX1 on the 40M band in CW with 75% power; when RX2 is tuned to the same 40M/CW band, RX2 power automatically becomes 75% and will then change synchronously with RX1. Power in TUNE mode is bound to bands only and does not depend on modulation; if both RX are on the same band, the TUNE sliders are synchronous.

1.4.7. Hotfix 1.2.1

Version 1.2.1 is a minor update that fixes two issues identified after the 1.2.0 release:

- Waterfall display on Windows 10 operating systems has been fully restored and now works correctly.
- Fixed the authentication issue in Expert Cloud — authorization now works reliably.

Version 1.2.1 introduces no new features; all 1.2.0 capabilities described in this file are retained. Wording such as "version 1.2.0 and newer" in the manual remains valid for 1.2.1.

1.5. Document version history

Below is the revision history of this manual itself and the software version to manual revision table. Starting with revision 1.3.0 the rule is: **the manual revision number matches the ExpertSDR3 version it documents.** The document no longer carries a separate numbering of its own.

Document version	Comment	Date	ExpertSDR3 version
1.0.0	The first edition of the user manual.	4 Aug 2023	1.0.4 Beta 86.8 SDR firmware
1.1.0	New sections:- RadioSpot;- RadioMacros;- Troubleshooting;- Hardware modifications. TCI added as a signal source to signal processing settings. New note about software protection against high SWR. Multiple text corrections.	5 Sep 2023	1.0.4 Beta 86.8 SDR firmware
1.1.1	A lot of text corrections and clarifications, i.e.: Mic1 fix applicable only to Gen1, DAC OUT info, Rotator, AAT-100 SWR, etc.	21 Nov 2023	1.0.5 Beta 86.8 SDR firmware
1.1.2	New sections: - ATU cable - Complete overhaul of the **External Linear Amplifier** section Clarified info about Mic selection and utilities connection to TCI server	28 Dec 2023	1.0.6 Beta 86.8 SDR firmware
1.1.3	Precautions for VHF operation in FM mode Expanded Drive slider description Firmware Manager APF - **audio** peak filter, not analogue	12 Feb 2024	1.0.7 Beta 86.8 SDR firmware

	Link to the mic signal adjustment guide		
1.1.4	**Setup for the Server software on RaspberryPi** section was expanded New section for remote operation: Setup examples	22 Feb 2024	1.0.7 Beta 86.8 SDR firmware
1.1.5	Updated cable schematic for connection to SPE PA New BCD schematic for connection to Burst PA	14 Mar 2024	1.0.7 Beta 86.8 SDR firmware
1.1.6	Expanded CW mode section Text updates according to changes presented in the latest software version RX.ANT button description Add device function in Device Manager	29 Oct 2024	1.0.9 Beta 86.8 SDR firmware
1.1.7	**Remote operation** and **Setup procedure** sections have been expanded Text updates according to changes presented in the latest software version RX DSP description	09 Feb 2026	1.1.5 88.8 SDR firmware
1.3.0	New section "What's new in ExpertSDR3 1.3.0"; light/dark themes, interface languages, utilities in the notification area; reworked waterfall description; RadioSpot, RadioMacros and TCI updates.	26 Aug 2026	1.3.0
1.3.1	New section "ExpertSDR3 1.3.1": interface scale in every program of the suite, OmniRig CAT in RadioSync, rewritten TCI log, new controls in the Device Manager; the TCI protocol version raised to 2.1	3 Sep 2026	1.3.1
1.3.2	New section "ExpertSDR3 1.3.2": the binaural CW effect, personal account and remote devices, utilities on Linux, "Important when updating". A 1.3.2 row added to the version mapping table.	8 Sep 2026	1.3.2

1.5.1. Software version ↔ manual revision table

SW version	SW release date	Manual revision	Key document changes
1.0.x beta	2023–2024	1.0.0–1.0.5	Initial revisions; core functionality
2024 updates	Oct 29, 2024	1.0.6	RX.ANT button, Add Device function in Device Manager; extended CW chapter
1.1.5	Feb 9, 2026	1.0.6	ExpertCloud (profiles, 2FA); TURN server; reworked "Remote Control" and "First Launch"; firmware 88.8
1.1.7	2026	1.0.6	Added correct install/update procedure (uninstall previous version + VC++ Redistributable)
1.2.0	Aug 4, 2026	**1.2.0**	GPU waterfall and custom palettes; up to 1000 spots; CESSB; minimum-phase FIR filter in the modulator; TX lock when sharing a device; new browser-based ExpertCloud authorization; PA/BS/BreakIN commands for E-Coder2; TCI: cw_mon and cw_macros_* responses; macOS Intel/Apple Silicon builds
1.2.1 (hotfix)	Aug 2026	**1.2.0**	Notes: stable waterfall operation on Windows 10; stable ExpertCloud authentication
1.3.0	Aug 26, 2026	1.3.0	Light/dark themes in the notification area menu and utilities; 3 languages in all programs; utilities in the notification area with autostart; reworked waterfall; new RadioSpot DX-cluster client; Linux ARM64 / Raspberry Pi 5
1.3.1	Sep 3, 2026	1.3.1	Interface scale 75–120% in every program; OmniRig CAT in RadioSync; rewritten TCI log with filters; graphics API selector and list refresh in the Device Manager; TCI 2.1
1.3.2	Sep 8, 2026	1.3.2	The binaural CW effect rewritten and the CW tone frequency reaching it; sign-in under a different account and sign-out fixed; a cloud refusal shown as a dialog; remote device start no longer waits for geolocation; the utilities crash on Linux eliminated and the Zoom item restored

1.5.2. What's new in revision 1.2.0

1. New chapter **"TCI: Third-Party Software Integration"** — port, server principles, compatible software table, typical connection schemes.

2. New chapter **"Troubleshooting"** — typical installation, startup, network, audio and firmware problems with step-by-step solutions.

3. The **"Remote Control"** chapter extended: Starter web panel (localhost:5531), custom STUN/TURN servers, TX lock when sharing a device, remote control of the AAT-100 tuner, remote CW, ExpertStarter CLI.

4. Panorama and transmitter sections updated for ExpertSDR3 1.2.0.

5. New appendix **"Typical Use Scenarios"** — DXpeditions, remote club station, contest position.

6. Added the software version ↔ manual revision table (this section).

> **Note on version 1.2.1.** Hotfix 1.2.1 addresses two issues found after the 1.2.0 release: waterfall display on Windows 10 has been fully restored; Expert Cloud authentication fixed. If you experience these issues, update to 1.2.1 or newer.

2. READ IT FIRST

2.1. Congratulations

Thank you for purchasing one of our best modern SDR transceivers.

This SunSDR2 DX transceiver is the smallest 100W 160M-6M + 2M HF/VHF SDR transceiver in the world, which makes it an ideal companion for your future contests and DXpeditions.

2.2. Features

This SunSDR2 DX transceiver is based on the popular, well-known SunSDR2 PRO model. On top of all our previous radios' functionality, the SunSDR2 DX transceiver offers extra features, such as compact hardware design, active cooling, improved power supply system and dedicated connector for a native external ATU.

The upgraded hardware design coupled with the ExpertSDR3 software makes this high-performance SDR transceiver an outright base station for any DXpeditions.

2.2.1. SunSDR2 DX hardware evolution

Gen1

Nov 2019	1st TW	EED064219XXXXX	NA

Gen2

Dec 2019	2nd TW	EED065119XXXXX	• Redesigned heatsink, with thinner and more frequent high effective grill • Improved temperature sensor placement for more accurate temperature readings

Gen3

July 2020	3-4-5th TW 1st RU	EED062920XXXXX EED060121XXXXX EED062021XXXXX	• Improved TX IMD3 up to ~37 dB across all HF bands, with 100W output power • Output power on 6M band has been increased up to 80W

			• Improved SDR PCB protection from cross-talks and protection for the supply chain • Added ferrite bead on the flex-cable connecting PA and SDR PCBs for more stable operation with external ATU • Added filtering of the headphones' connector

Gen4

Dec 2021	6th TW	EED064421XXXXX	• Slight improvement of the RX path

Gen5

Dec 2022	7th TW	EED064622XXXXX	• Redesigned TX filter of the DAC chip, providing better TX signal linearity • Redesigned PA input band pass filter, improving linearity of the PA operation • Improved structure of 160, 6M TX filters • More resilient RX/TX switching node on PCB

Gen5.5

Oct 2022	2nd RU	EED063122XXXXX	• Improved structure of 80, 10, 2M TX filters

Gen5.6

Aug 2023 Oct 2023 June 2024	8th TW 3rd RU 4th RU	EED062923XXXXX EED063523XXXXX EED061724XXXXX	• Improved resilience of the PA input supply line

Note:	***Certain SunSDR2 DX units from earlier batches may have hardware upgrades from later revisions, rendering them Gen5 and newer.***

Gen6.0

Feb 2026	1st, 2nd China 5th Russia		• Optimized RF circuitry from the DAC to the power amplifier, resulting in a significant reduction in harmonic levels • Upgraded 6M low-pass filter, resulting in additional harmonic suppression. • Upgraded 2M low-pass filter, resulting in a significant reduction in power loss. • Increased sensitivity of microphone inputs Mic1 by 4.2 times, Mic2 by 2.13 times. • Output power at the DAC OUT connector increased from +4 dBm to +9 dBm. • Optimized the VHF amplifier's BIAS node to improve stability.

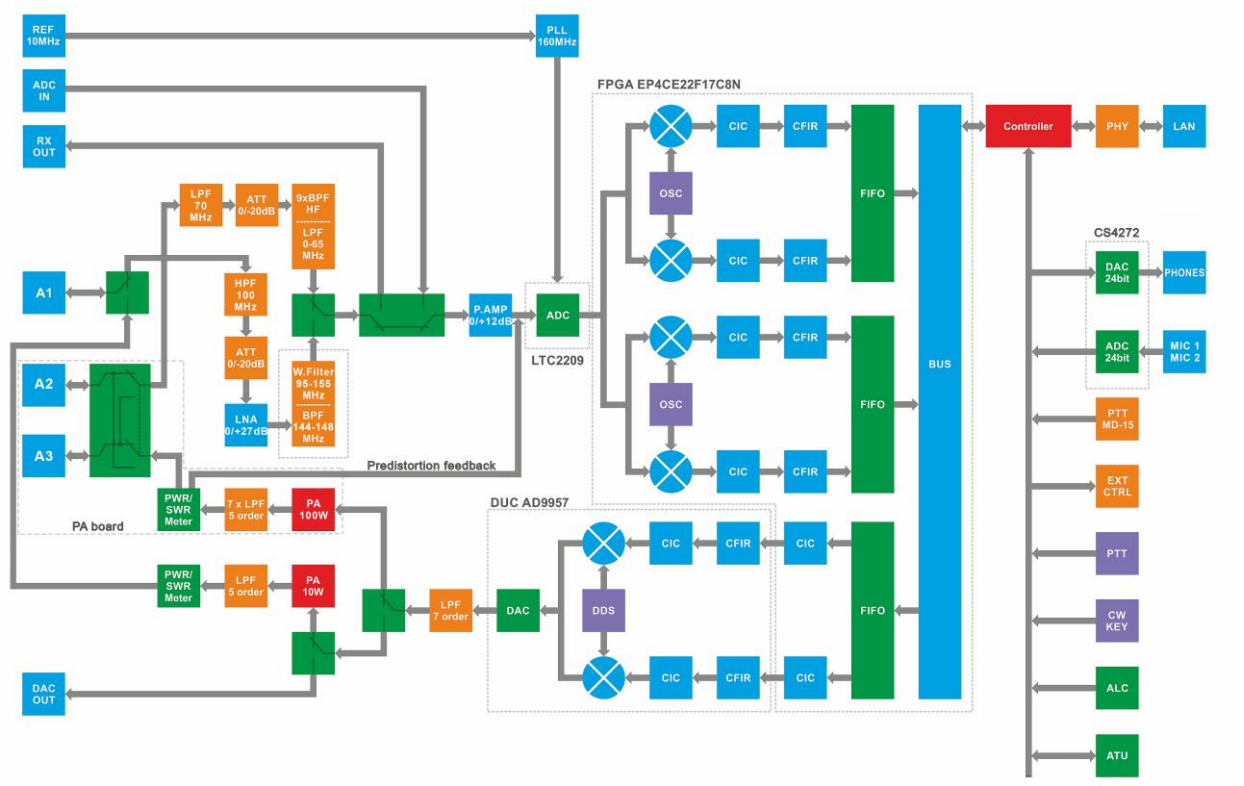
2.2.2. SunSDR2 DX main features and capabilities

- Independent RX path based on DDC (Direct Down-Conversion) architecture
- Independent TX path based on DUC (Direct Up-Conversion) architecture
- Output power: 100W on HF, 80W on 6M and 8W on 2M
- 2 software RXs + SubRX for each of them (4 slices total) + independent wideband Bandscope up to 80 MHz
- Remote control operation, using it, you can connect Microphone, PTT and CW-key to the E-Coder2 panel for the easiest setup
- TCI interface for seamless connection with third-party software, the list of **software with TCI support** is published on our website
- Professional TX processing module provides the most advanced tuning capability for voice operation
- High-performance built-in stereo audio codec 24-bit with 114 dB dynamic range (CS4272)
- ExtCTRL connector to control external devices with 8 powerful keys with open collector
- ALC connector for external power amplifiers*

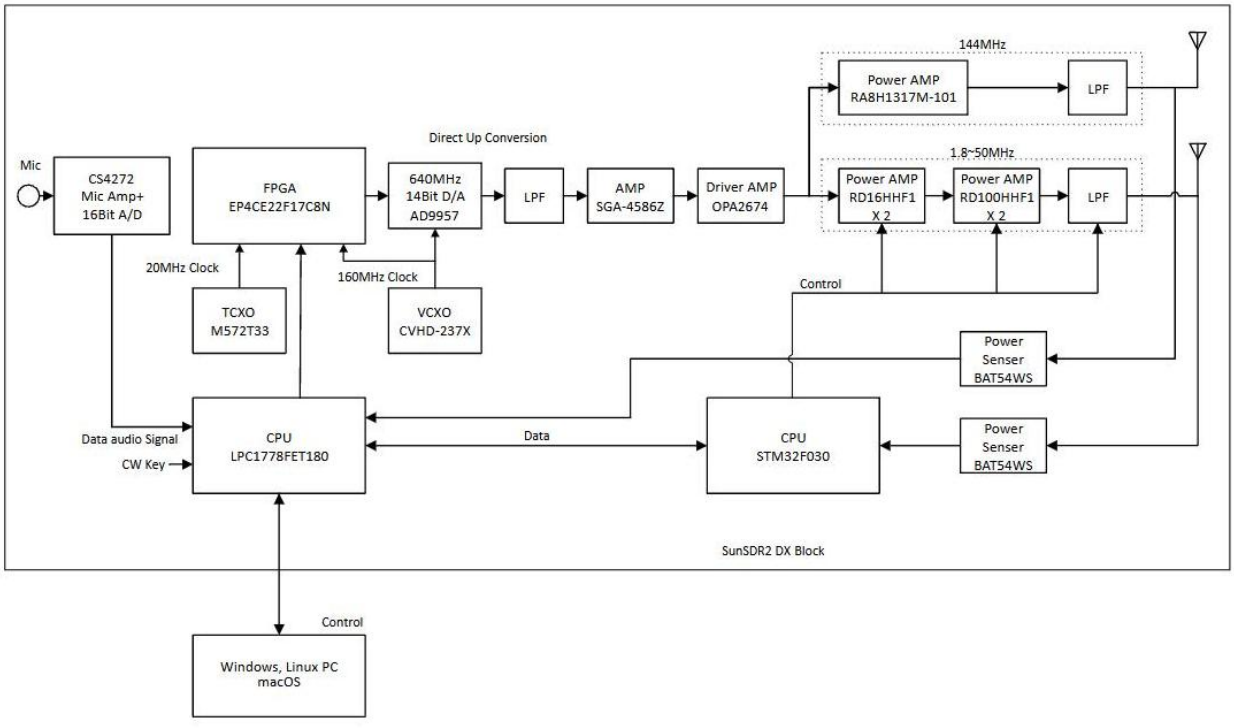
- VHF transverters support
- An opportunity to use the transceiver as a signal generator via DAC OUT connector (SMA connector)
- An opportunity to use external filters in the middle of the RF path, using ADC IN and RX OUT (SMA connector)
- Monitoring delay in CW mode is about 2-3 ms
- Input for external 10 MHz reference oscillator
- An opportunity to use the transceiver in SO2V mode
- Full duplex or half duplex modes*
- Antenna switch with 2 HF antenna connectors and separate VHF antenna connector (Mini UHF connectors)
- Internal power-meter for HF and VHF bands and SWR-meter for HF band
- Ethernet LAN interface provides a fast and reliable connection to PC

** These current transceiver hardware functions will be fully supported in the future ExpertSDR3 software releases.*

2.2.3. SunSDR2 DX Block diagram



2.2.4. TX Path



2.3. Supplied accessories

- SunSDR2 DX transceiver
- In-build cooling fan fastened to the heatsink (140mm x 140mm)

- LAN cable for connection to a local network (1.8m)
- Power Supply cable with Anderson Powerpole connector (2m)
- Audio-adapters JACK 6.3mm to JACK 3.5mm (2 pcs)
- Adapter Mini UHF — HF PL259 1Ft (0.3m 1 pc)

2.4. Precautions

To prevent any damage to SunSDR2 DX hardware, please read the following operation rules carefully, before connecting and attempting to operate the SunSDR2 DX.

- **Visually inspect the SunSDR2 DX transceiver**, checking for any mechanical damages before connecting it to LAN and PC.
- **Ensure SunSDR2 DX transceiver is properly HF grounded** before connecting the transceiver to the DC power line. Never use the SunSDR2 DX transceiver without HF ground.
- **Do NOT operate (plug or unplug) with the LAN cable on powered SunSDR2 DX**. Always power off the transceiver first and only then perform any LAN cabling operations.
- **Do NOT use the power supply with the voltage higher than +15.8 V**. DO NOT reverse polarity!
- **The transceiver is powered by DC voltage!** Never use AC power supply with the transceiver.
- **Do NOT use the SunSDR2 DX in temperatures lower than 0ºC (32ºF) and higher than +50ºC (122ºF).**
- **Avoid the exposure of the atmospheric downfalls on the SunSDR2 DX** and never spill any liquids (especially aggressive) on the transceiver.
- **High humidity can cause moisture to enter the SunSDR2 DX**. Moisture can cause corrosion of internal components and degradation of properties such as electrical resistance, thermal conductivity, physical strength, and size. The transceiver is rated to operate at 8- to 80-percent relative humidity, with a humidity gradation of 10 percent per hour.
If the SunSDR2 DX was stored in abnormal climatic conditions (very high or very low temperature and/or high humidity), it is recommended to keep it in normal operating temperatures for at least 2 hours before switching it on. Buildings in which the climate is controlled by air-conditioning in the warmer months and by heat during the colder months usually maintain an acceptable level of humidity for the transceiver. However, if the transceiver is located in an unusually humid location, you should use a dehumidifier to maintain the humidity within an acceptable range.
- **Do NOT store and use the Transceiver in the dusted rooms.** Do NOT expose it to direct sunlight for a long period of time (longer than 2 hours).

- **Do NOT connect a VGA monitor to EXT CTRL port**, because such connection will damage the transceiver! Read the appropriate sections of this manual before connecting transceiver to the external devices via EXT CTRL connector; learn tables and diagrams providing information of typical external devices connections.
- **DO NOT transmit without a load, always use dummy load or matched antenna**. Operating without the proper load will lead to overheating of the engaged components and may result in failure. SunSDR2 DX has in-build non-matched antenna protection, do NOT try to override the protection.
- **DO NOT use the transceiver during storm and/or lightning weather conditions!**
- **Use Ethernet lightning protection for regions prone to lightning strikes.**
- **Always disconnect the antenna from the transceiver when not in use**, or if there is any potential danger of the atmospheric electricity impact.
- **Don't open the transceiver**, it contains high-sensitivity radio elements, which may be easily damaged by the static electricity. This document contains all necessary information about the internal design to satisfy the Users' curiosity. Contact the manufacturer if there is any need to repair the transceiver. Unauthorized self-repair voids the warranty.
- **Ensure the transceiver and any connecting cables are free from the defects** caused by the electromagnetic interference and/or high currents and voltages.
- **Always take great care when moving or transporting the transceiver.**
- **Always consider to use RFI protection**; ground the antenna-mast and antenna-feeders to avoid accumulation of atmospheric static electricity on them; use ferrite beads on antenna cable and other cables, connected to the transceiver.
- **FM mode operation on VHF is 50% duty cycle**. The transmit duration is limited to 5 minutes. **Any damage to the hardware caused by not following the transmit duration limit is not covered by warranty.**
- The transceiver must be operated by a licensed HAM only to prevent damage to the transceiver itself and avoid causing harmful interference on the air. Always operate under country specific HAM license rules and regulations.
- Keep the transceiver out of the reach of children.
- If the transceiver emits an abnormal odor, or smoke, **immediately** turn it OFF and remove the power cable; then contact your nearest Expert Electronics dealer for advice.
- RF Sense is not a recommended method of amplifier control, any potential equipment failure caused by RF Sense is not covered by manufacturer's warranty.

Relying on RF output detection while activating T/R relay will lead to three major problems:
1. RF output will be switched on when there is RF output already
2. The switching can cause a transient high SWR that may damage the exciter.

3. Switching under power may cause arching, which damages the T/R relay itself. Even if it doesn't cause an immediate failure, it can put more stress on the equipment, leading to premature failure. The best practice is to use a separate keying line to engage the T/R relay slightly before the exciter starts making power. Adjust ***PTT switching delay*** *in the software.*

2.5. ExpertSDR3 Software License Agreement

The ExpertSDR3 software is the proprietary product and intellectual property of Expert Group LLC. It is forbidden to modify, copy or disclose to third parties ExpertSDR3 software distribution.

All official versions of the software are published on the Expert Group LLC website ExpertSDR3 section.

ExpertSDR3 future or updated software versions may have different titles. This license agreement applies to all existing and future software versions; and may be supplemented and/or amended by Expert Group LLC at any time without prior notice.

Expert Group LLC reserves the right to edit and/or improve the ExpertSDR3 software, adding new features and bug fixes. In this regard, the software may differ from the description herein. Contact your nearest dealer for the latest complete version of the User Manual, or check our official website for the updates.

Expert Group LLC assumes no responsibility for the material, moral or any other kind of damage, whether expressed or implied, caused by using an alpha/beta or modified version of the ExpertSDR3 software and/or changes to the settings or other files which are related to the ExpertSDR3 functionality.

Expert Group LLC assumes no responsibility for the material, moral or any other kind of damage, whether expressed or implied, caused by using of a third-party software.

Expert Group LLC assumes no responsibility for the material, moral or any other kind of damage, whether expressed or implied, caused by using of external devices along with radios controlled by ExpertSDR3.

2.6. Contacts

Expert Group LLC

Web-site: www.eesdr.com

E-mail: info@sunsdr.com

2.6.1. Copyrights

Expert Group LLC holds copyrights for the ExpertSDR3 software and all User Manuals and Instructions for the device and software. It is strictly prohibited to present this document as your own, sell it or use it in any other commercial activity.

3. TECHNICAL CHARACTERISTICS

3.1. Receiver

RX frequency range, MHz	0,09 ... 65; 95 ... 148
ADC type	LTC2209
RF ADC, bit @ MHz	16 @ 160
Independent software receivers	2 (+2 SubRX)
Sample rate for each receiver, kHz @ 24 bit	39; 78; 156; 312
Sensitivity, uV	0.2
Maximum width of the Bandscope, MHz	80
Blocking Dynamic Range (BDR) on HF, dB	130
Blocking Dynamic Range (BDR) on VHF, dB	129
Dynamic Range over IMD3 (2 kHz), dB	110
Reciprocal Mixing Dynamic Range (2 kHz), dB	119
Local oscillator (TCXO), MHz +/- ppm	20 +/- 0.5
ATT/Preamp, dB	-20 dB; -10 dB; 0 dB; +10
Additional VHF preamplifier, dB	+27
Built-in audio codec, bit / Dynamic Range, dB	24 / 114

3.1.1. The list of SunSDR2 DX hardware RX filters

HF octave band pass filters:

160M	0-2.5	Chebyshev I - 7 Order
80M	2.5-4	Chebyshev I - 3 Order
60M	4-6	Chebyshev I - 3 Order
40M	6-7.3	Chebyshev I - 3 Order
30M	7.3-12	Chebyshev I - 3 Order
20M	12-14.5	Chebyshev I - 3 Order
17-15M	14.5-21.5	Chebyshev I - 3 Order
12-10M	21.5-30	Chebyshev I - 3 Order
6M	30-65	Chebyshev I - 3 Order

HF WideRX filter: LPF (low pass filter)

160-6M	0-65	Chebyshev I - 7 Order

Narrow band pass filter for VHF 2M

2M	144-148	(SAW Filter) - preferred for normal operation

VHF WideRX

VHF	95-155	Butterworth - 5 Order

Additionally, SunSDR2 DX has filters which are a part of the RX path and cannot be switched off: **HPF** for VHF (100 MHz cut frequency) to eliminate strong out-of-band stations coming from HF. **LPF** for HF (70 MHz cut frequency) to eliminate strong out-of-band stations coming from VHF.

There is 1 dB attenuation on VHF in comparison to HF, which does not influence sensitivity because there is a +27 dB VHF LNA.

3.1.2. SunSDR2 DX Capabilities Notes

- ***Independent software receivers**: SunSDR2 DX has single ADC and supports two independent software receivers, which are sharing single antenna input. Therefore, when you jump from one band to another with RX1 (main), the ANT input for the RX2 also changes to the same ANT input by default. For example, if you were operating on the 40M band (using both RX1 and RX2 on ANT3 input); and then switched the RX1 (the main receiver) to ANT2 input and jumped to 80M band, the settings of the RX2 (the secondary receiver) will change to the same antenna input.*

- ***HF/VHF simultaneous reception**: Because of the SunSDR2 DX has two independent software RXs and single ADC, it cannot receive on HF and VHF simultaneously. The SunSDR2 DX can either use both receivers to work in the first 0...80 MHz, or the second 80...160 MHz Nyquist zone of the ADC.*

- ***Duplex capabilities**: Duplex mode is supported by SunSDR2 DX at the hardware level, however the capability is yet to be implemented at the SunSDR2 DX firmware and software levels. SunSDR2 DX and ExpertSDR3 have two independent software RXs, and currently they can be used by one or two operators only for receiving at the same time. For the 1st operator to receive on RX1 frequency using one antenna connector (e.g. A2) and the 2nd operator to transmit on RX2 frequency using the other antenna connector (e.g. A3) at the same time, we should implement the Duplex mode. At this point, while you transmit with either software RX, receiving on the other RX is blocked.*

- ***Diversity Reception**: It requires at least two ADC, hence two hardware receivers. This way, each ADC can work with a separate antenna, which allows to phase and eliminate an unwanted interference. Since SunSDR2 DX has **single ADC**, diversity reception cannot be implemented with current hardware versions of the SunSDR2 mainline. However, it will be considered in future SunSDR hardware revisions.*

3.2. Transmitter

TX frequency range, M	All amateur bands (160-6; 2 M)
RF DAC, bit @ MHz	14 @ 640
Built-in audio DAC resolution, bit	24
Maximum output power on HF, W	100
Maximum output power on 6M, W	80 (50 for Gen1, Gen2)

Maximum output power on VHF, W	7 (up to 8)
TX IMD3 on HF / VHF, dB	37 / 30 (since Gen3)
TX filters	Output LPF on the DUC chip: 202 MHz (Eleptic - 7 order) 8 x LPF: 160M: (Eleptic - 5 order) 80M: (Eleptic - 5 order) 60-40M: (Eleptic - 5 order) 30-20M: (Eleptic - 5 order) 17-15M: (Eleptic - 5 order) 12-10M: (Eleptic - 5 order) 6M: (Eleptic - 5 order) 2M: (Eleptic - 5 order)

Note:	• *Nominal (PEP) HF output power of the SunSDR2 DX is 100W, in SSB mode it might differ from 30W up to 80W; peak-factor is the reason for that, and it equals 3 for voice signals. TONE signals have constant output power, with maximum 100W. PEP voice signals at 100W have real power approximately 3 times lower. To increase the real power of voice signals, use the compressor and other features in the Mic signal processing module.*

3.3. Other

Default static IP address and Port	192.168.16.200:50001, 50002
Antenna input impedance, Ohm	50
DC voltage range in RX/TX, V	8...14.8 / 10...14.8
Recommended DC voltage, V	13.8
Current consumption RX/TX, A	1.2 / 24

Power consumption RX/TX, W	16.5 / 330
Operating temperature, °C (°F)	0...+50 (+32...+122)
Dimensions L x W x H, mm (inches)	190 x 170 x 80 (7.48 x 6.69 x 3.14)
Fan dimensions L x W x H, mm (inches)	140 x 140 x 25 (5.51 x 5.51 x 0.98)
Weight, kg (lbs)	2.6 (5.73)

Warning!	• ExpertSDR3 uses two UDP ports for each radio. The indicated port (50001 by default) is used for control data, and the next following (50002 by default) is used for signals transfer. Do not use these ports in another applications. The default 50001-2 can be changed in ExpertSDR3 settings.
Note:	• *Watch the power supply voltage: max allowed power supply voltage for TX mode is 14.8V. If the voltage exceeds 14.8V, the SunSDR2 DX will not go into TX mode. This limitation is because of max 14.8V voltage supported by in-build power amplifier.* • *The fan of the transceiver is controlled by the SunSDR2 DX firmware, it should start rotating at about 40 degrees Celsius. There are 3 speed rotation modes, which depend on the internal temperature: 40-50, 50-60, 60+.* • *All SunSDR2 transceivers must operate with loads close to 50 Ohm impedance (mandatory requirement).* *Based on our experience, antenna SWR may be at 4-5 for RX mode without significant drop in quality of reception. We do not recommend going above SWR 1.7-2 for TX mode.*

There are few ways to identify your transceiver MAC address. ***Option 1 - in a router/switch***. If your transceiver is connected directly to a router/switch, then the IP and MAC addresses can be found in the router/switch's ARP table. In the ARP table, locate your transceiver's IP address in the 'Internet Address' column, and then MAC address in the 'Physical Address' column. The first 2 bytes of the MAC address is '00EE' and the rest 4 bytes are the serial number of the transceiver. MAC address is in-built, and it cannot be changed.

Option 2 - with transceiver directly connected to PC via LAN cable. In Windows run command prompt, then type the command “arp -a” to view the arp table and press enter. In MacOS/Linux run “arp -a” command in Terminal.

3.4. Firmware-based protections

There are following types of SunSDR2 DX unique firmware in-build protections:

1. Software PA protection against high SWR. The transceiver will not go into TX mode if the following conditions are met: the SWR is 5+, and the output power is higher than 25W.

2. If SWR is above 5 and the output power is equal to or below 25W, the software will attempt to reduce the SWR level for 5 seconds. If the SWR cannot be reduced to below 5, the transceiver will go into RX mode.

3. If SWR is above 3.5 and below 5 while in TX mode, the output power will be automatically reduced to 10W. After switching back to RX mode, the Drive level will return to original state (set by the user).

4. If the temperature of the heatsink reaches 75° Celsius, the transceiver will automatically go into RX mode.

5. If the connected power supply voltage is above 14.8V, the transceiver will power off the internal PA unit.

6. If the power supply current is equal to or above 25A while in TX mode, the transceiver will go into RX mode.

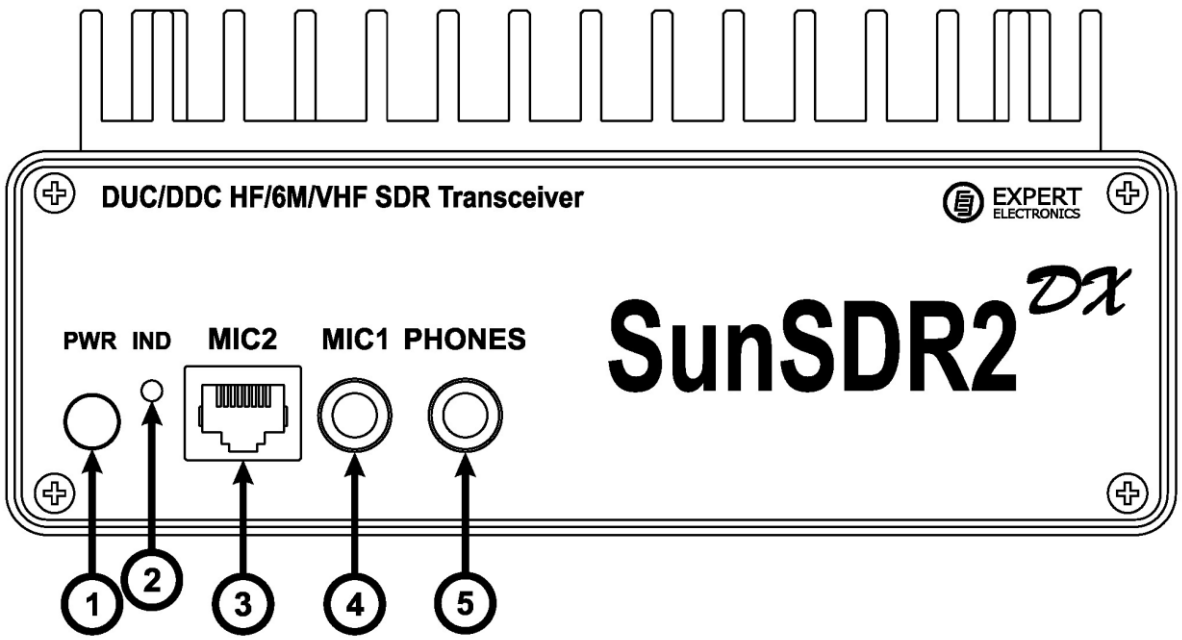
7. If the power supply current is above 25A while in RX mode, the transceiver will shut down completely.

8. A single TX cycle is defaulted to maximum 5 minutes uninterrupted session regardless of the mode. This is a software embedded safety precaution intended to prevent TX filters overheating.



Important: internal PA protection is disabled during native ATU tuning (when AAT-100 is installed).

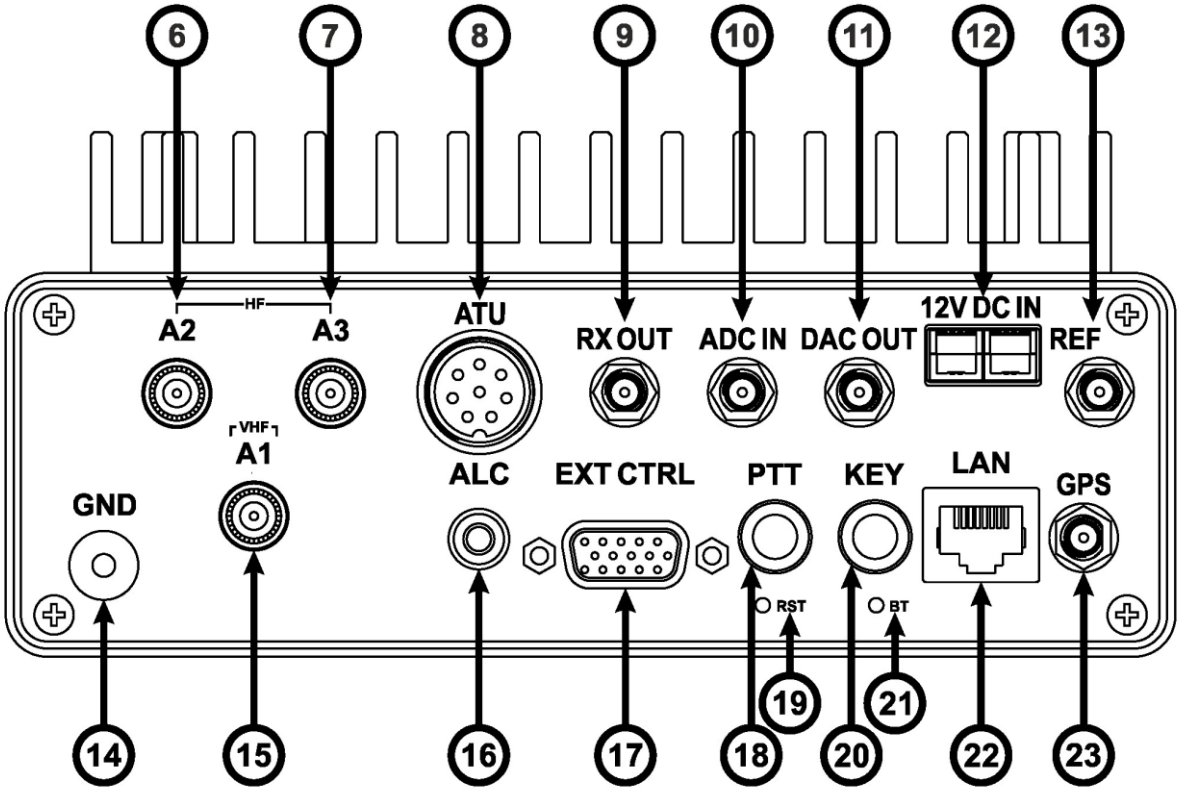
4. FRONT PANEL DESCRIPTION



1	PWR	The power on/off button; use the button to power on/off the device.
2	IND	The power and connection LED indicator; use to monitor the device operation modes: **Greendouble blinks, pause, double blinks** (constant cycle) – the device searching the network. If the LED is in the double blink state for a prolonged time, it means connection between the device and PC cannot be established, likely due to the burnt Ethernet chip. **Green constant light** - the network connection is established; the device is connected. **Greensteadily blinking** - the device is in bootloader mode; you need to install firmware using ExpertSDR2/3 software. **Green** and **red** are blinking - the device has been reset; you need to install firmware using ExpertSDR2/3 software. **Red constant light** - the device is in transmission mode. **Redsteadily blinking** - the FPGA chip got burnt and requires replacement. **Orange/Yellow** - WLAN mode is enabled. The internal WLAN module is not available for SunSDR2 DX, this indication passed with firmware roots from SunSDR2 PRO. It will be disabled in the next versions of the firmware. Press the BT button on the rear panel while the transceiver is active, this way you switch it to LAN mode, LED will change its color to **green**.

<table>
<tr><td>3</td><td>MIC2</td><td>The dynamic microphone socket; use to connect a dynamic microphone MH-31, or any other type of the dynamic microphone with the RJ-45 connector and similar pin-out.
Note: Allowed output impedance is not less than 500-600 Ohm.</td></tr>
<tr><td>4</td><td>MIC1</td><td>The electret microphone jack 6.3 socket; use to connect an electret microphone from a PC's headset.</td></tr>
<tr><td>5</td><td>PHONES</td><td>The headphones jack 6.3 socket; use to connect speakers or headphones with 16-30 Ohm impedance.
<table>
<tr><td>Warning!</td><td>• Never use headphones with mono connector! If you have mono headphones, use the stereo 6.3 mm Jack and connect headphones to one of the channels.</td></tr>
<tr><td>Warning!</td><td>• Never connect two stereo channels with each other!</td></tr>
<tr><td>Note:</td><td>• Headphones with high impedance may sound quieter.</td></tr>
</table>
</td></tr>
</table>

5. REAR PANEL DESCRIPTION



6	A2	The HF antenna connector; use when operating on HF or 6m band.
7	A3	The HF antenna connector; use when operating on HF or 6m band.
8	ATU	The external connector designed for the connection to AAT-100 native Antenna Tuner Unit (ATU).
9	RX OUT	The RX OUT connector; use for the receiver's internal front-end output. **Warning!** • Improper use or high voltage through this connector may damage the transceiver!
10	ADC IN	The ADC IN connector; use for connecting receiving antennas. Between ADC IN and RX OUT you can put a transverter, additional Band Pass Filters (BPFs), preamplifier, attenuator etc. When the signal is going into ADC IN, it bypasses all receive Band Pass Filters (BPFs).

		Warning! • Improper use or high voltage through this connector may damage the transceiver!
11	DAC OUT	The DAC OUT connector; use for connecting external power amplifiers, transverters, and as a signal generator of the measuring signal. When the signal is going on the air through DAC OUT, it bypasses all transmit Band Pass Filters (BPFs). **Warning!** • Improper use or high voltage through this connector may damage the transceiver! **Note:** • *Transmission is possible only on the amateur bands*
12	12V DC IN	The Anderson Power pole connector, is the DC power source connector with voltage of up to +14.8V and maximum load current 24A. Recommended DC voltage 13.8V. The transceiver has a shutdown circuit, protecting the device from the power polarity reversal.
13	REF	The REF connector; use as an input connector to an external reference oscillator with 10 MHz CMOS level. Appropriate Voltage amplitude for this input: 1...3 V Pk-to-Pk. Input impedance 2 kOhm. **Warning!** • Improper use or high voltage through this connector may damage the transceiver!
14	GND	The ground connector.
15	A1	The VHF antennas connector; use when operating on 2m band.
16	ALC	The ALC input connector; use for external power amplifier. **Note:** • *ALC is not supported yet, it will be implemented with the new firmware.*
17	EXT CTRL	The EXT CTRL connector; use to control external devices. **Warning!** • Improper use or higher voltage through this connector may damage the transceiver!
18	PTT	The PTT footswitch connector, jack 6.3.

19	RST	The reset button, use the button to reset IP-address and UDP-ports of the transceiver to the default values: 192.168.16.200, ports: 50001, 50002.
20	KEY	The CW key connector, jack 6.3.
21	BT	Use the BT button to send the transceiver in the boot mode. **Warning!** • DO NOT PRESS WITHOUT NEED!
22	LAN	The RJ-45 LAN connector; use to connect to local network via the LAN cable.
23	GPS	The GPS connector, NOT AVAILABLE in this device series.

5.1. Antenna

Always check the integrity of the antenna-feeder path before connecting the antenna.

For best results, the antenna should have an impedance of 50 Ohm to match the 50 Ohm impedance of the HF nodes of the transceiver.

The recommended antenna SWR level is no worse than 1.5:1! Use AAT-100 native Antenna Tuner Unit or other common matching devices if the SWR is worse than 1.5:1.

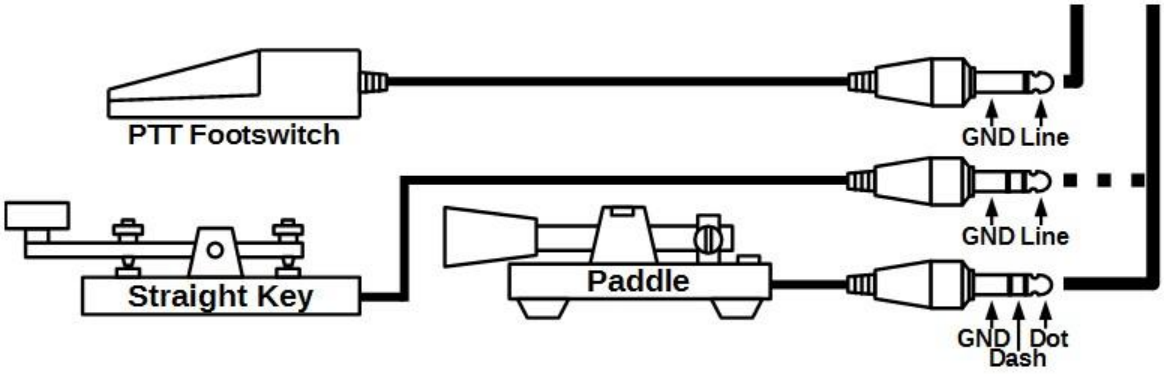
Warning!	• Always use E-type ferrite beads on antenna and other cables, connected to the transceiver!
Note:	• *A mismatched antenna-feeder path might lead to non-linear distortion of the transmitted signal, HF interference on the transceiver's cables and/or interference of TV's or other devices.* • *Do not transmit on a receiving-only antenna, such as magnetic loop or any other similar kind, which might be damaged by incoming TX power.*

5.2. Grounding

It is essential to use a reliable grounding connection for the transceiver to eliminate the risk of electric shock. The best grounding point is the GND connector.

Warning!	• Never use water or gas pipes for grounding! • Do not use the SunSDR2 DX transceiver without a reliable grounding!

5.3. Accessories



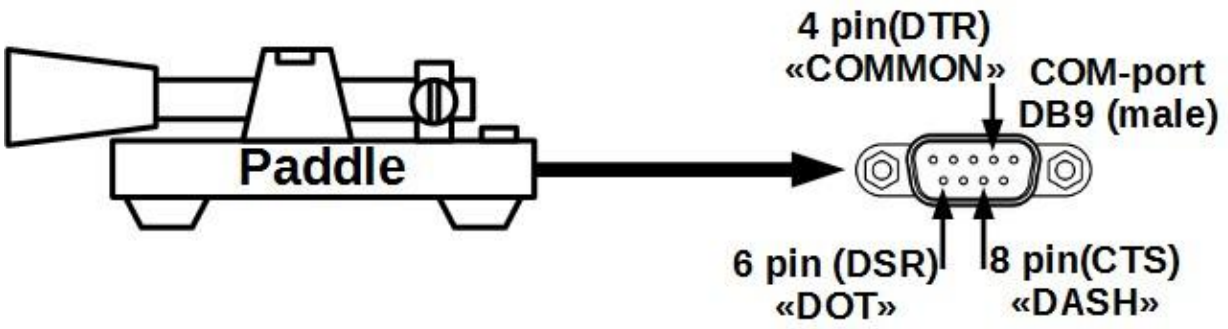
The above diagram provides pinout for various accessories, which can be connected to the KEY socket (rear panel).

PTT Footswitch has to be connected to the PTT socket to control the transceiver's TX mode. The connector type is mono 6.3 mm Jack. When the footswitch pressed down, the PTT Line connects to the Ground (Case) and turns on the transceiver TX mode. The red LED TX indicator on the front panel and in the software window, indicating the TX mode is on. The release of the footswitch will return the transceiver to RX mode.

Straight Key has to be connected to the KEY socket using the stereo 6.3 mm Jack, with disconnected ring contact. Pressing the key turns on the transceiver TX mode and generates a continuous CW signal (manual mode). The release of the straight key will return the transceiver to RX mode.

Twin-paddle key (single-paddle) has to be connected to the KEY socket using the stereo 6.3 mm Jack, with disconnected ring contact. Pressing one of the key's paddles (or one side - for single-paddle) will turn on the transceiver TX mode and begin automatic generation of dots and dashes. The release of the paddle will return the transceiver to RX mode.

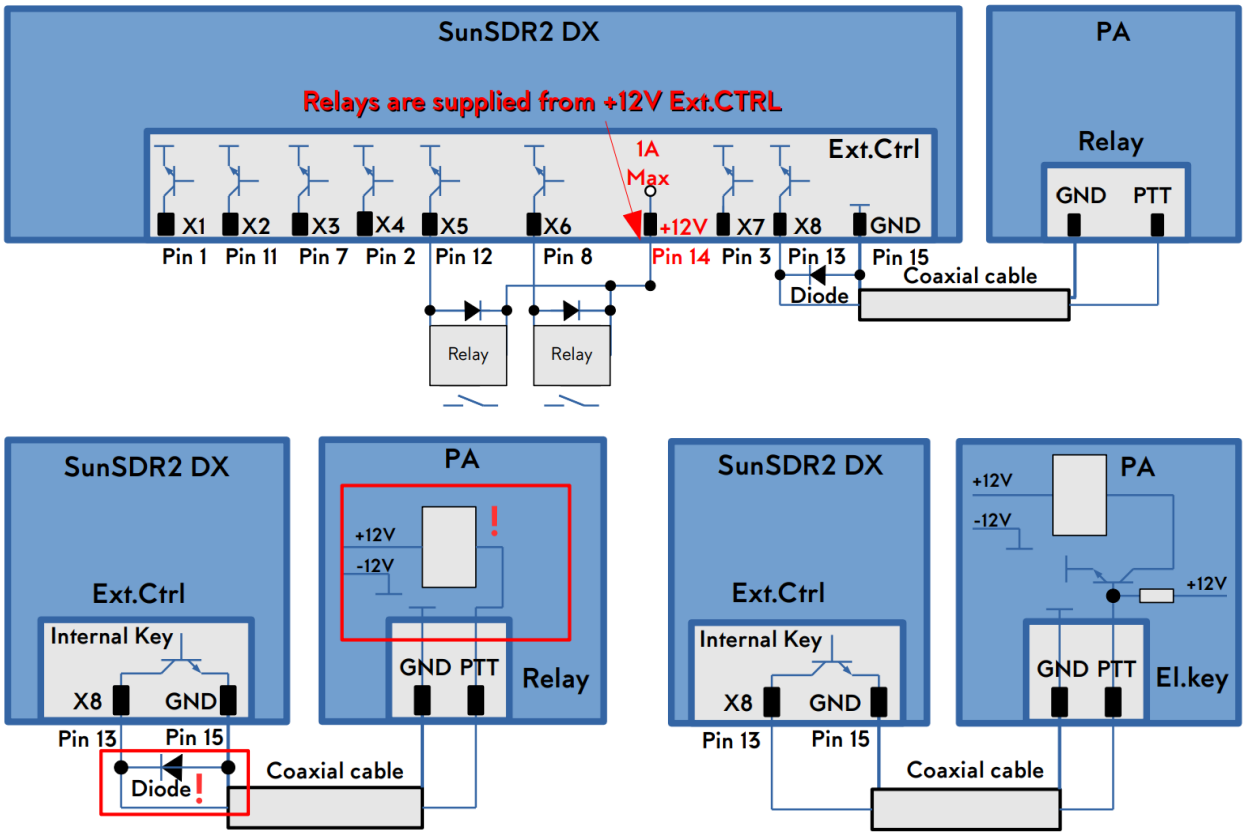
CW key connection via COM-port (Windows or Linux only). CW paddle can also be connected to the **COM**-port of your Windows PC, according to the picture below.



5.4. External Linear Amplifier

You can connect various external Power Amplifiers (PAs) to the transceiver. The number of required wiring connections depends on the external PA model, check the following section.

Connect a 50 Ohm HF cable to the transceiver's antenna connectors A2, A3 (or A1 if it's a VHF PA), connect the other end of the cable to the input of the PA. To control the TX mode of the external PA, you can use the X8 pin of the **EXT CTRL** connector (make sure to enable the PA button in the ExpertSDR3). Generic connection diagrams are below:



Warning!	• **If you control PTT switching relays inside the PA by switching EXT CTRL relays, you have to use a protective diode.**

	• If you control electric switching schematic inside the PA, there is no need in a protective diode.

Note:	• *While connecting the cables, transceiver and PA should be switched off.* • *There is a number of 3rd party Power Amplifiers, which can be controlled via TCI, like RF-kit, BURST and Linear Amp Gemini.*

If an external PA supports operation with the transceiver's ALC system, you can connect it via cable with RCA-type phono plugs. The ALC voltage range -3...0 V (note the warning below).

Warning!	• **ALC is not supported yet, it will be implemented with the new firmware.** • **There is a small delay in the ALC-system functionality, which may lead to a short-term overload of the external PA. This phenomenon could cause either off-frequency emissions or failure of your PA! The User of the transceiver must take this condition into consideration and accept full responsibility for the potential consequences of using the ALC-system. Expert Group LLC is not responsible for direct or indirect damages of any kind caused by using the ALC-system.**

5.4.1. Binary Code Decimal (BCD) or BAND-data connection

Some amplifiers are designed to receive Binary Code Decimal information from the radio to enable them automatic band change, in comparison to detecting the RF from a couple of “dits” on the key. Use a BAND-data cable to connect the ExtCtrl connector of the transceiver to a power amplifier (PA) which supports BCD control. With the help of this cable, the transceiver can switch bands and turn an external PA to TX mode. It can be used with MB1, SunSDR2 DX, SunSDR2 PRO and SunSDR2 QRP.

Binary Coded Decimal is a process for converting decimal numbers into their binary equivalents. The built in Band Decoder provides source driver outputs, which provide a source of 12V DC for the “hot” side of external relays or switches in the amp or antenna switch. Set up the ExtCtrl connector in the **Band Manager menu**exactly as below:



X3 = A, X4 = B, X5 = C, X6 = D. Empty checkbox = high level; Set checkbox = low level

As an alternative you can assemble your own 4-wire cable, which must be able to plug into the Ext CTRL socket on the transceiver and to, for example, the AUX socket of a KPA500 amp. Use a DB15 male plug for the SunSDR2 transceiver end and either a male or female plug for the amplifier end as appropriate (beware of buying VGA cables which are not wired pin to pin in some cases). It is convenient to add four more wires to the cable to enable the amp PTT line, 12Vdc, Ground connection and a wire for a thermostatically controlled fan for the SunSDR2 PRO (4th additional wire is not needed for the SunSDR2 DX/QRP and MB1).

Make-up of the cable:

Pin 2	X4 Bit 1
Pin 7	X3 Bit 0
Pin 8	X6 Bit 3
Pin 12	X5 Bit 2

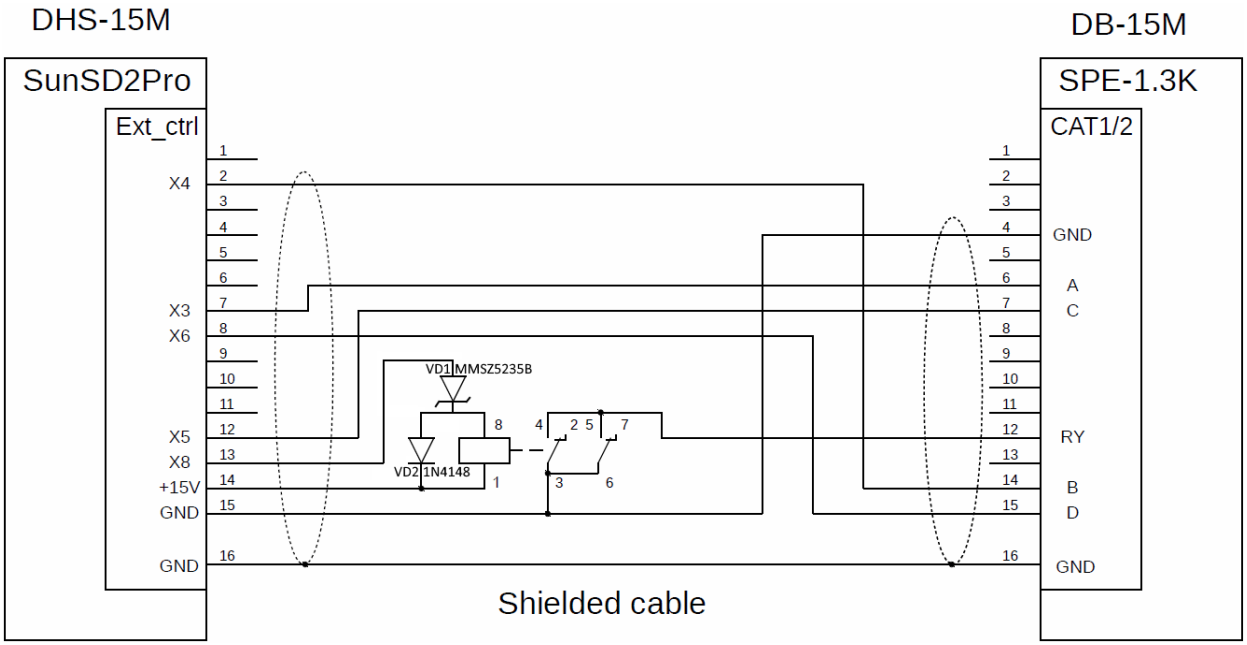
Optionally three wires to include: amplifier PTT control & 12V DC & ground	
Pin 13	X8 PTT
Pin 14	+12V DC
Pin 15	Ground
For the SunSDR2 PRO an additional wire to thermostatically control fan ON/OFF	
Pin 3	X7 for fan control

Note:	• *For fan control you need to enable the **Thermostat** in the Status bar, it'll automatically activate Key 7 for both RX & TX modes. Add a tap on the Pin 14 wire for 12V DC and to the Pin 15 wire for ground/earth. The fan is fed with the 12V DC and the ground connection switched by the SunSDR2 PRO. You may choose to add a diode (e.g. 1N400X etc.) across the fan connection for protection.*

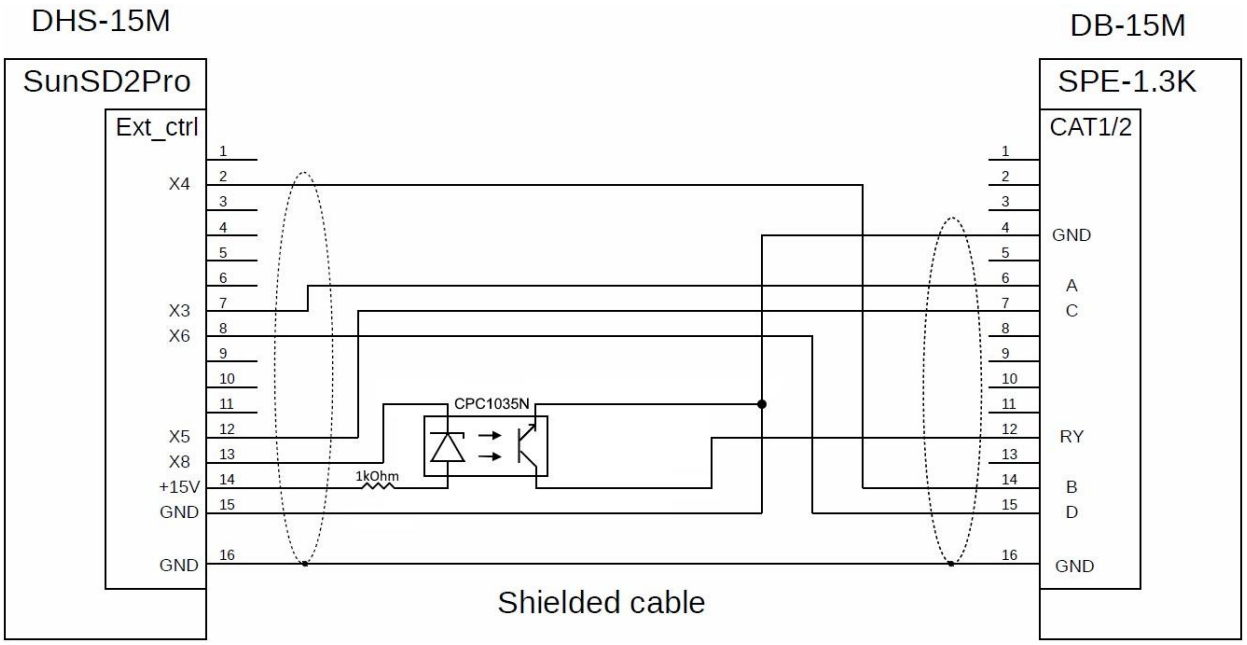
Thanks to Erik Carling G0CGL / EI4KF.

5.4.1.1. BCD to SPE range of PAs

Using **our standard BAND-data cable**, PTT and BCD band data are automatically passed to the SPE PA, just set SPE PA to "Yaesu Band-Data". In this schematic we use relay 4.5V (IM02GR), stabilitron 6.8V (MMSZ5235B, VD1) and diode (1N4148, VD2).

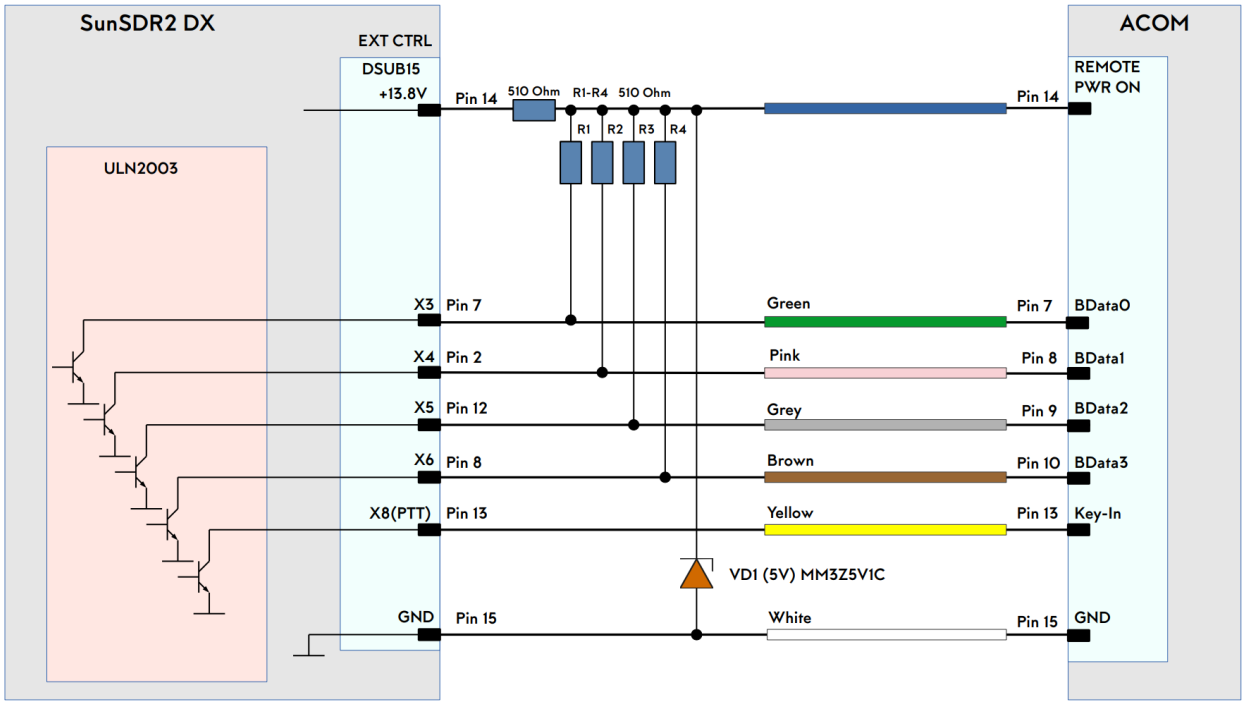


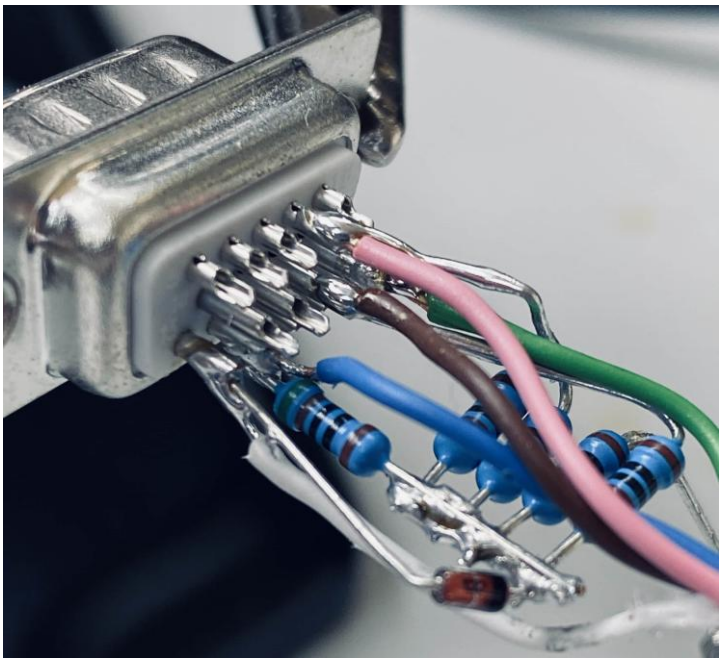
The schematic using optocoupler.

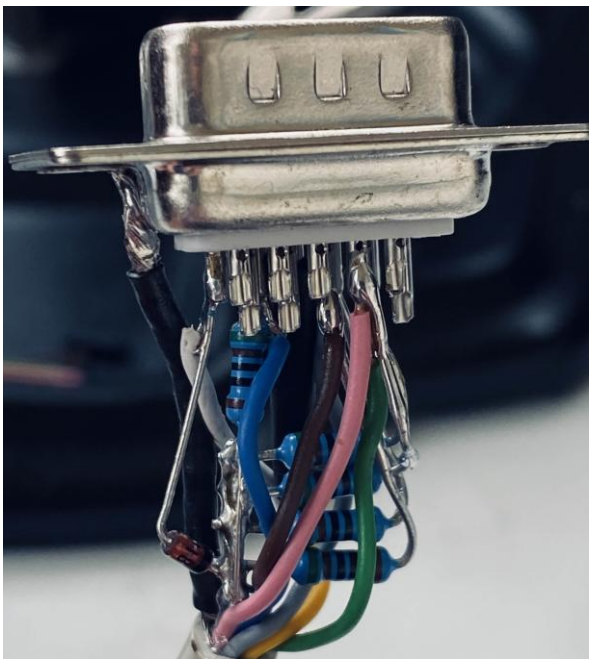


5.4.1.2. BCD to ACOM range of PAs

Use the cable wired as shown below for the BCD connection to ACOM PA, tested with ACOM 1200S.


SunSDR2 DX
EXT CTRL
DSUB15
+13.8V
Pin 14
510 Ohm
R1-R4
510 Ohm
R1
R2
R3
R4
ULN2003
X3
Pin 7
X4
Pin 2
X5
Pin 12
X6
Pin 8
X8(PTT)
Pin 13
GND
Pin 15
VD1 (5V) MM3Z5V1C
ACOM
REMOTE
PWR ON
Pin 14
Green
Pin 7
BData0
Pink
Pin 8
BData1
Grey
Pin 9
BData2
Brown
Pin 10
BData3
Yellow
Pin 13
Key-In
White
Pin 15
GND





Thanks to Mathias Davidheimann DD5MD.

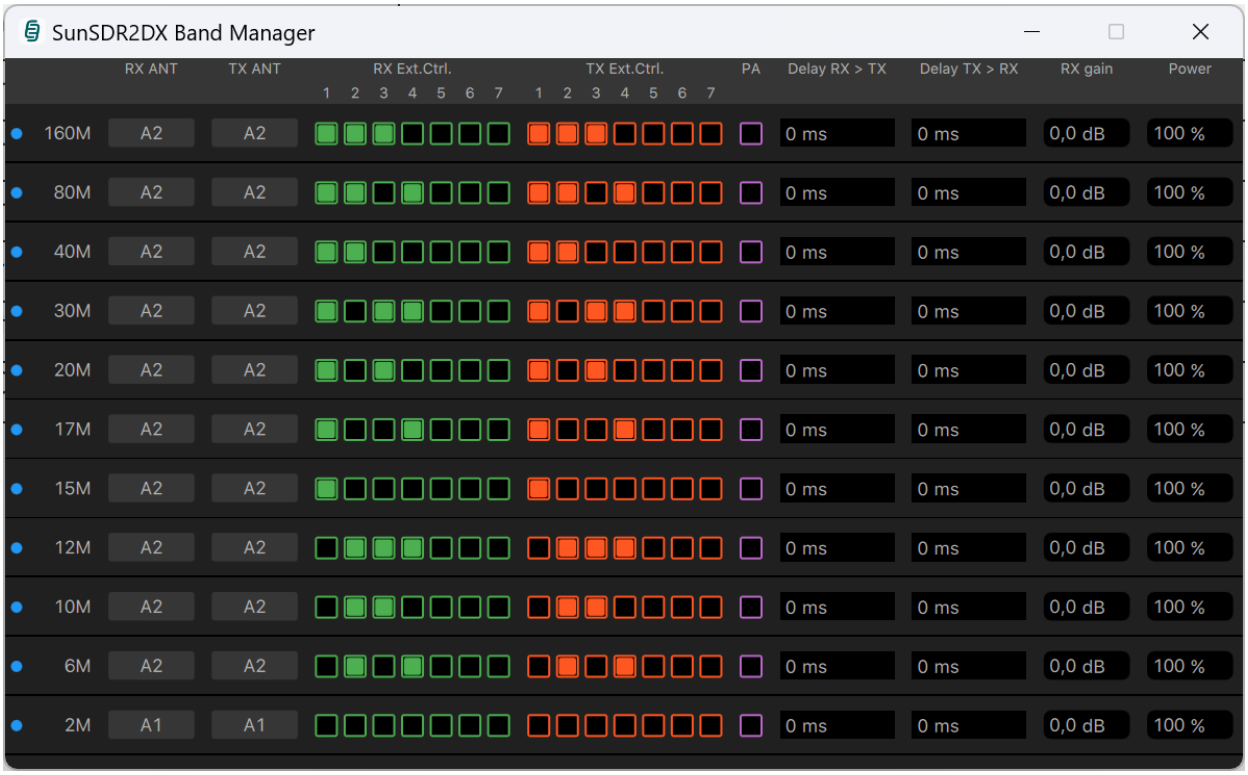
5.4.1.3. BCD to Elecraft KPA1500

Using an HD15 cable, wired as shown below, PTT and BCD band data are automatically passed to the Elecraft KPA1500 amplifier. Setting it up like this will enable the PA to automatically follow the radio's band changes and the TX enable (PTT in).

In KPA1500 set "Radio Type" to "BCD". Connect Shields on HD15's and use clamp-on ferrites on both ends.

Ext Ctrl	Comment	Male HD15 pin#		Female HD15 pin#
X1	BCD-3	1	->	14
X2	BCD-2	11	->	9
X3	BCD-1	7	->	3
X4	BCD-0	2	->	13
X8	PTT out to PA	13	->	10
GND	GND	15	->	5

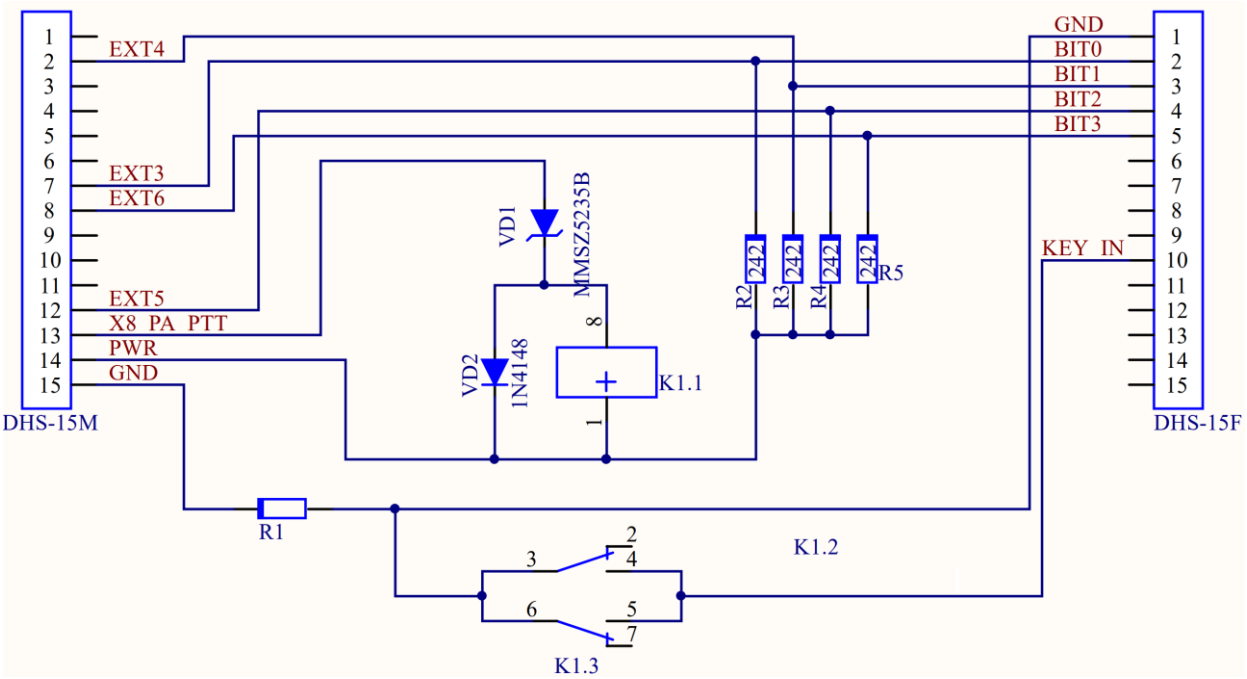
Set the Ext CTRL settings as shown below, they differ from the standard configuration.



Thanks to Terry N1KIN and Erik Carling G0CGL / EI4KF.

5.4.1.4. BCD to Burst range of PAs

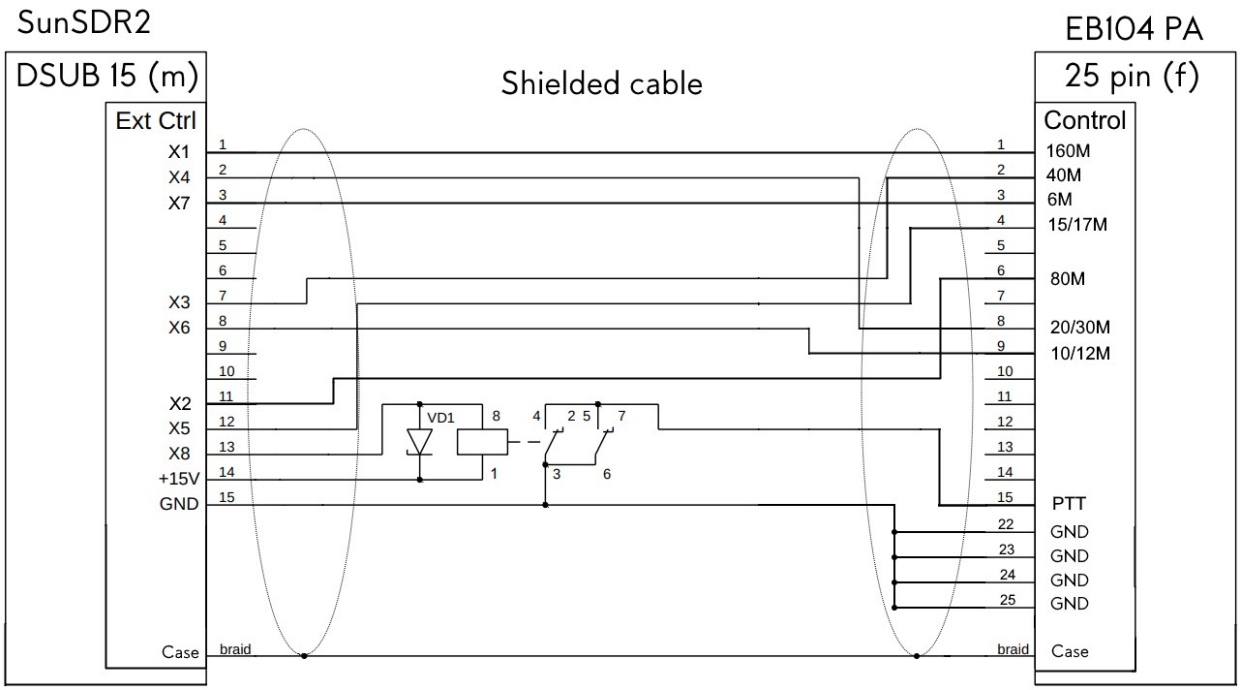
Below you'll find the recommended wiring for connection to Burst PA, tested with Burst 1000A.



As with BAND-data cable for SPE, this cable has a relay 4.5V (IMO2GR), stabilitron 6.8V (MMSZ5235B, VD1) and diode (1N4148, VD2).

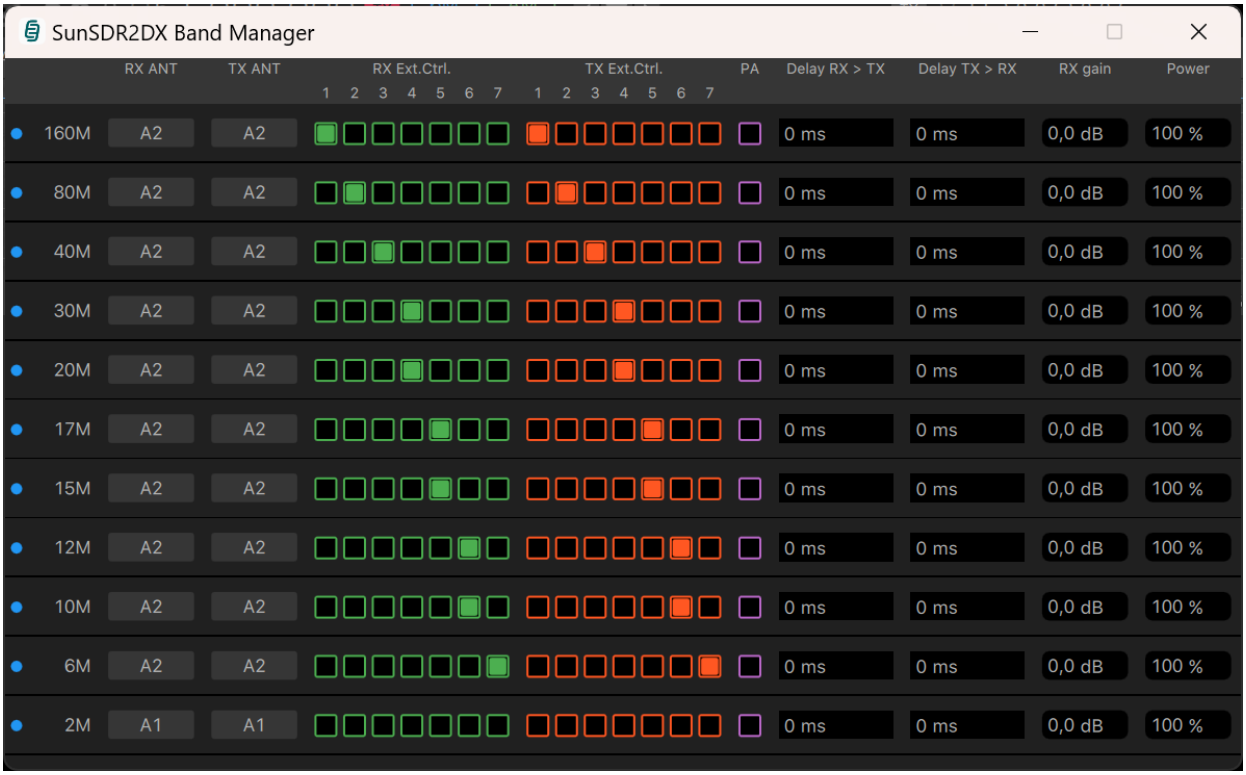
5.4.2. Connection to EB104 range of PAs

Use the cable wired as shown below for the connection to EB104 PA, tested with EB300.



PA manufacturer recommends the wiring without the relay and 5V diode, but we still suggest implementing them in the cable for guaranteed galvanic isolation.

Set the Ext CTRL settings as shown below, they differ from the usual configuration.



5.5. External Control devices

The SunSDR2 DX transceiver allows you to control external devices via seven electronic keys in the **EXT CTRL** connector. With these keys you are getting direct control of antennas, external band pass filters, external PA's bands, HF preamplifiers, external transverter PTT etc. Commutation depends on the band and RX/TX mode.

You can adjust Ext CTRL operation in the Band Manager window.

Warning!	• Never use a VGA cable from your monitor, to connect external devices! • Never connect monitors with the VGA interface to the ExtCTRL connector!

5.6. Reference input

A 10 MHz external reference oscillator can be connected to the **REF IN** connector with a coaxial cable.

Press the **EXT.REF button** in the **Filters menu** to enable REF input on the rear panel of the transceiver.

Signal parameters of the Reference Frequency:

- Reference signal frequency of 10 MHz
- Reference signal voltage: min. 2.5 V; max. 3.3 V
- Input impedance of 2 kOhm
- SMA type connector (female)

Note:	• *Use an external reference oscillator via REF IN connector to increase the stability of the transceiver's tuning frequency, if in-build +/- 0.5 ppm stability is not enough for your application. The transceiver's frequency synchronization with an external reference oscillator can also be used to sync several devices with each other from a single reference oscillator.* • *The Phase frequency of the transmitted and received signals depends on the phase frequency of the external reference oscillator.*

5.7. DAC OUT low power output

The **DAC OUT** is the transceiver's low-power output, which functions in the wide frequency range. It could be used for connection of external power amplifiers, transverters and as a source of measuring signal.

DAC OUT output parameters:

Output power: 1...3 mW for Gen5, 8mW for Gen6

Frequency band: 0.1...150 MHz

Transmitted signal band: 20 kHz

Impedance: 50 Ohm

5.8. ADC IN and RX OUT

The **ADC IN** connector is the direct receiver input, which is bypassing Band Pass Filters (BPFs). Use the **ADC IN** for connection of RX antennas, transverters, additional BPFs, preamplifiers, attenuators etc.

Warning!	• Maximum allowed signal level on the ADC IN connector is 0.3V of the active voltage (RMS). Do not exceed this level, as it may result in the transceivers overload and ADC fatal damage.

Note:	• *The signal from ADC IN connector goes directly to the ADC input and may be amplified by the +10dB preamplifier (set it in the software).* • *ATT is disabled when you use ADC IN alone, without RX OUT.* • *When you select ADC IN, A3 antenna input is still working and can pick up some strong stations, the A1 and A2 inputs are disabled.*

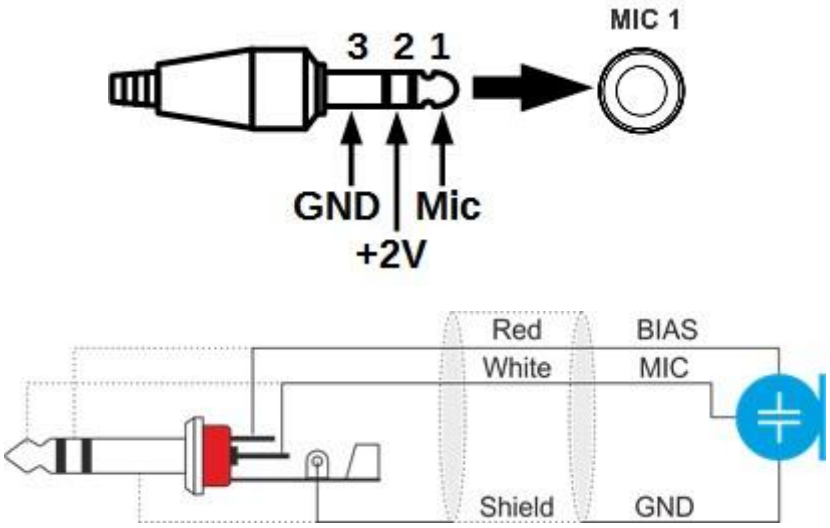
The **RX OUT** connector is the output of the transceiver's receive path. When the **ADC IN** is enabled, the signal (received on the HF path from the active antenna input) goes to the **RX OUT**. An additional filter or box of switched filters, preamplifier, attenuator, signal divider, etc., can be added between the **RX OUT** and **ADC IN** connectors. To use it **RX OUT**:

Select ADC IN, in this case the signal goes either: A3 ANT (for HF)-> internal BPF-> RX OUT -> there you put your external BPF/ATT/PREAMP -> ADC IN

Note:	• *The signal passing through the HF path, with output via RX OUT, can be attenuated by the -20dB attenuator (set it in the software).*

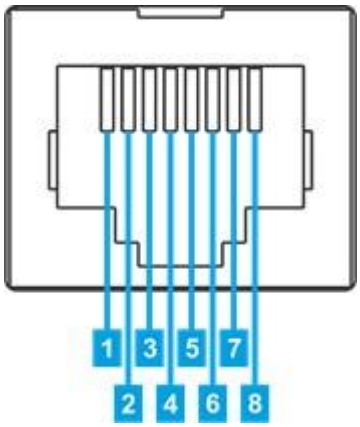
6. CONNECTORS PIN-OUT

6.1. MIC1



1	MIC	Mic signal input	Input
2	+2V	DC 2V supply into the MIC	Output
3	GND	Ground	--

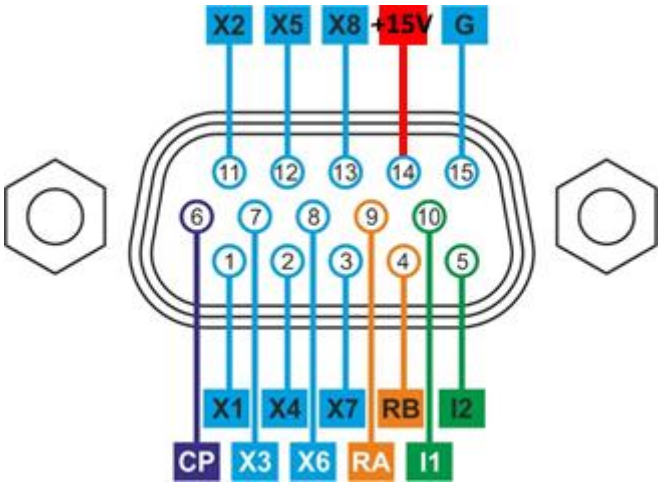
6.2. MIC2



1	DWN TNG	Not implemented in the software	--
2	UP TNG	Not implemented in the software	--
3	+5V	DC 5V output with maximum current up to 20 mA	Output

4	MIC GND	MIC case	--
5	MIC	Mic signal input	Input
6	PTT TNG	PTT signal input Connection of the PTT to the GND will turn the transceiver to the TX mode	Input
7	GND	Ground	--
8	FST TNG	Not implemented in the software	--

6.3. EXT CTRL

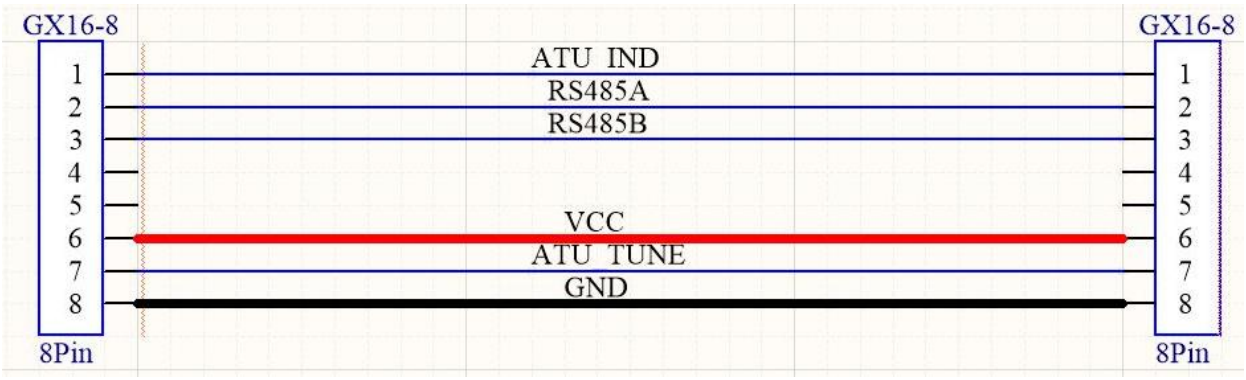


1	X1	Programmable key with open collector	Output
2	X4	Programmable key with open collector	Output
3	X7	Programmable key with open collector	Output
4	RB	RS-485 (-) Line. In reserve.	Input/Output
5	I2	Connection of buttoned detector. Connect to ground. In reserve.	Input
6	CP	Contact of protected diode	--
7	X3	Programmable key with open collector	Output
8	X6	Programmable key with open collector	Output
9	RA	RS-485 (+) Line. In reserve.	Input/Output

10	I1	Connection of buttoned detector. Connect to ground. In reserve.	Input
11	X2	Programmable key with open collector	Output
12	X5	Programmable key with open collector	Output
13	X8(PTT)	Programmable key with open collector for control of external PAs PTT	Output
14	+13.8V	Pin to supply external devices, nominal current 1A There is a 1A fuse integrated in the line - 2A fused	Output
15	GND	Ground	--

Warning!	• The Electronic keys have the built-in protection diodes for inductive loads (relays, fans, solenoids, etc.) with the max current of up to 500 mA. • While connecting an inductive load (relay, solenoids, etc.) to the X1-X8 keys, it is important to connect an external protective diode in parallel to the load. Switching voltage must not exceed 50V! • Incorrect connection of external devices and/or uncontrolled galvanic connections could lead to the malfunctions of the transceiver or its failure!
Note:	• *When an electronic key with open collector is in TX mode - it is opened, and the voltage on the output pin drops to 0.7V (logic 0). If your PA does not switch TX/RX in this condition, it most likely needs "dry contact" (0V), hence we recommend connecting via a 12V relay to the X8 (pin 13, 0.7V) and +12V supply (pin14) or optocoupler to +12V supply.* ***IMPORTANT****: A protection diode should be used in parallel with a relay, cathode to +12V.* • *The pin 14 is directly connected to an external power supply connector and has the same voltage. Pin 14 power line has the in-build 1A fuse combined with the serial diode for the line protection. The pin 15 (GND) has a direct connection to the common GND of the radio and direct connection to a negative pin of the power supply connector.* • *The X8 key is designed for control of the external PA (controlled by the PA button in ExpertSDR3).*

6.4. ATU cable



1	ATU IND	Line to signal that ATU is tuned	Input
2	RS485A	RS-485A line. In reserve.	--
3	RS485B	RS-485B line. In reserve.	--
4			--
5			--
6	VCC	Power supply line	--
7	ATU TUNE	Line to signal to ATU to start tuning	Output
8	GND	Ground	--

Note:	• *ATU connector can be used only for connection to AAT-100 external tuner.*

7. Setup procedure

7.1. First run

1. After unboxing, for the initial run, SunSDR2 DX must be directly connected to your PC/notebook with a CAT5/6 Ethernet cable. Additionally:
- Make sure that PC and transceiver both are in the same sub-net.
- Connect headphones and microphone to the respective ports.
- Connect HF-antenna to the either A2 or A3 connector.

2. Make sure your PC/notebook has a fixed IP address with subnet 192.168.16. X e.g.: 192.168.16.50. On direct LAN connection between SunSDR2 DX and your PC/notebook, both devices must be in the same subnet. Make sure your PC IP address is not 192.168.16.200, because this IP is used by SunSDR2 DX by default.

3. Make sure you have downloaded and installed the latest version of the ExpertSDR3 software from ourweb-site.

4. On Windows only: Add all .exe files from ExpertSDR3 folder to the Windows Firewall exceptions list for both Private and Public networks.

5. Update transceiver's firmware to the latest version (88.8 or newer), otherwise it won't work properly. More details in Device Manager section.

6. Check if AnyDesk or other application (ICOM IC-9700 network connector, for example) does not block the common ExpertSDR3 UDP ports pair (50001 and 50002 by default). ExpertSDR3 always uses two ports for each radio; one is indicated in the Options-> Radio-> Address-> Port and +1 e.g.: 50001 (indicated) and 50002.

Note:	• *If ExpertSDR3 launches with an error, even if Visual C++ is installed on your PC, reinstall the latest version of the Microsoft Visual C++ Redistributable as Administrator.* • *If you cannot see the transceiver in the Device Manager, it is most likely located on a different subnet than your PC. Please return to Step 2.* • *If you see the Failed to read the device calibrations! message, but you can ping the transceiver, it likely means AnyDesk (or other software) installed on the same PC and uses UDP port 50001. The ports in use can be validated by running 'netstat' command in Windows and Linux and 'lsof' command in Mac (see* Ports Validation Procedures below).

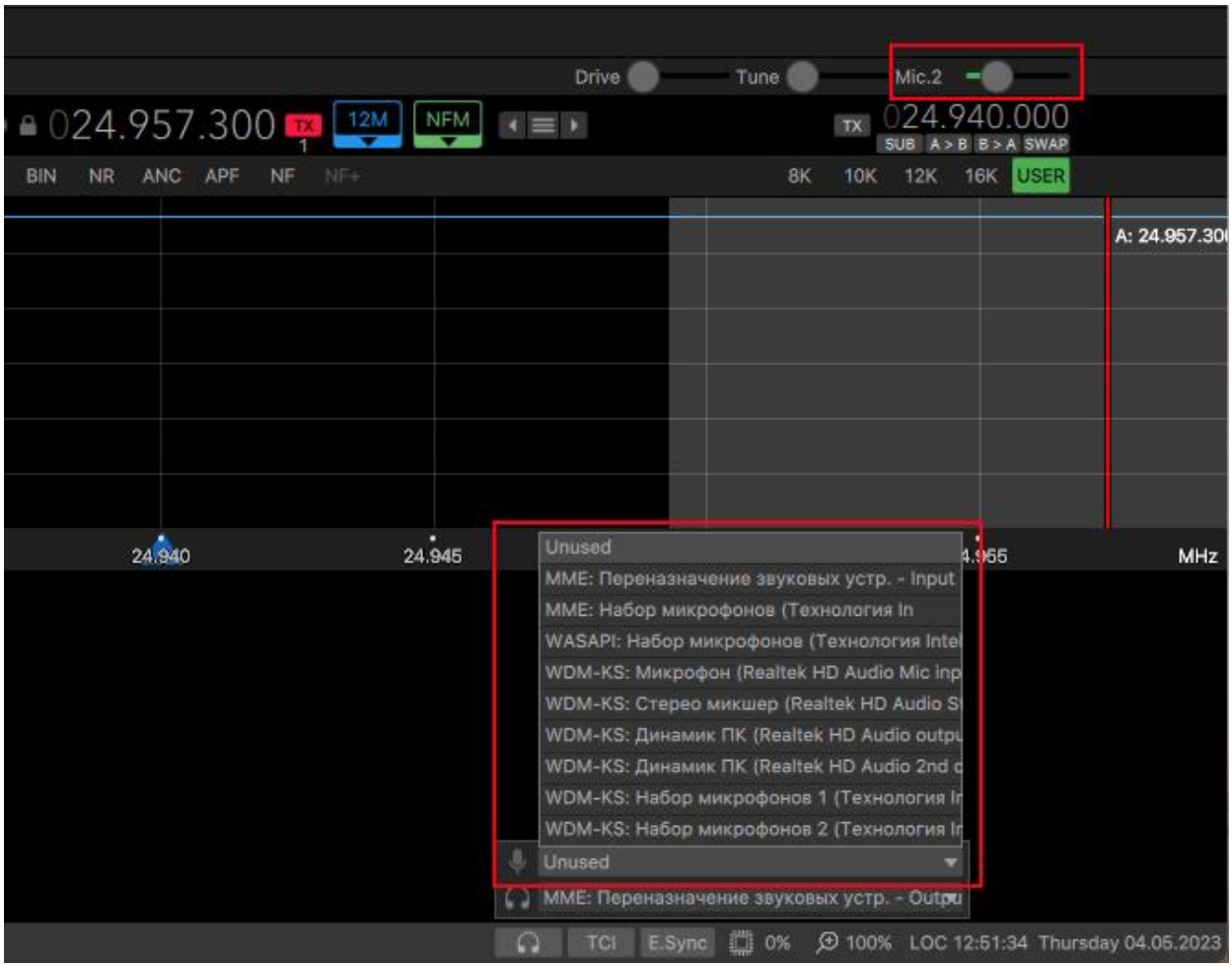
1. Run ExpertSDR3. The Device Manager application will start, displaying the list of available SunSDR2 transceivers in its main window.

2. Click-on the **Start** button on the line with your transceiver; this will launch ExpertSDR3 instance.

3. Start the radio by clicking the **Start transceiver** button in the ExpertSDR3 top-left corner.

4. In the ExpertSDR3 top right corner, select the microphone you are going to use.

5. In quick Sound Card settings, in bottom right corner, select the audio driver.



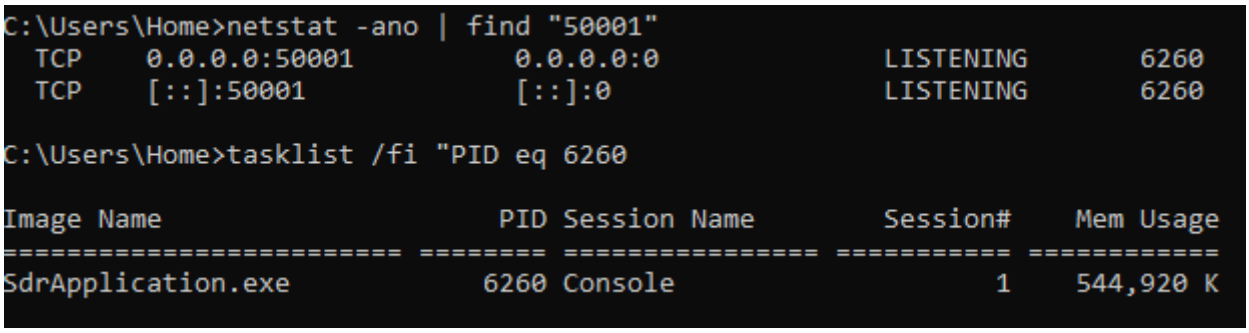
1. If everything is done correctly, you will see the air noise on the panorama, and hear the sound in the headphones.

7.2. Ports Validation Procedures

7.2.1. In Windows

start 'Command Prompt' application ('CMD'), type the following command and press Enter:

netstat -ano | find "50001"



Look at the response, then type the following command, replacing 'XXXX' with process ID (four digits on the right side) and press Enter:

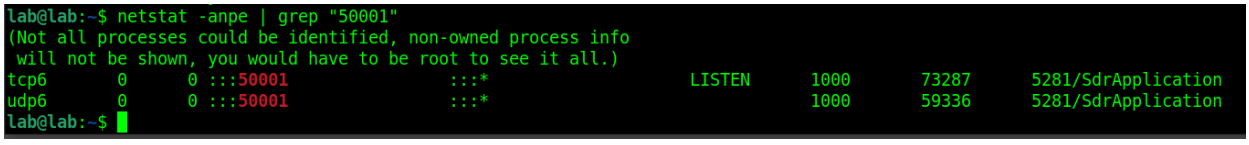
tasklist /fi "PID eq XXXX"(using above example screenshot XXXX replaced with 6260).

The response will display the application name, which is using UDP port 50001. In above example, it is "SdrApplication.exe", which is ExpertSDR3. In case of other application (like AnyDesk) is using port 50001, its name will be displayed.

7.2.2. In Linux

start 'Terminal', type the following command and press Enter:

netstat -anpe | grep "50001"

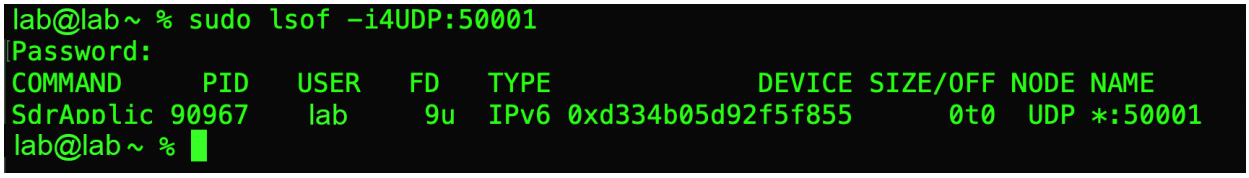


The response will display the application name, which is using UDP port 50001 – in the above example it is "SdrApplication" (on the right side of the screenshot). In case of other application (like AnyDesk) is using port 50001, its name will be displayed.

7.2.3. In macOS

start 'Terminal', type the following command and press Enter, then enter admin password and press Enter:

sudo lsof -i4UDP:50001



The response will display the application name, which is using UDP port 50001 – in the above example it is "SdrApplic" (on the left side of the screenshot). In case of other application (like AnyDesk) is using port 50001, its name will be displayed.

Note:	• *It is always a good idea to check both ports - 50001 and 50002 (defaults).*

If you have found that, say, AnyDesk is using UDP port 50001, this is exactly what is preventing ExpertSDR3 to communicate with the transceiver. Either completely delete AnyDesk, or alternatively (if you need to use AnyDesk further) temporarily delete AnyDesk first, then change the port in the ExpertSDR3 to any unused port (50071 for example) in the Options-> Radio-> Address-> Port (Note: second port will automatically be set to 50072 for this example). When port changed and connection ExpertSDR3 to transceiver is successful, then install AnyDesk back.

Note:	• *It is always a good idea to check what UDP ports are already in use in your OS, before reassigning port in ExpertSDR3. For the port checking use:* *netstat -ano (in Windows)* *netstat -anpe (in Linux)* *sudo lsof (in Mac)*

Note:	• *TCPView application can also be used on Windows for port checking. Select UDP v4 and sort all ports by Local Port.*

7.3. System requirements

ExpertSDR3 is a cross-platform application. Minimum system requirements:

- CPU: 4 physical cores Intel Core i3/i5 or higher, or an equivalent AMD.
- RAM: 8 GB.
- Additional software: the latest Microsoft Visual C++ Redistributable (Windows only).

- Network: direct LAN connection 100 Mbit/s (WLAN is not recommended for stability).
- Operating systems: Windows 10 (1809 or newer) x86_64 or Windows 11 x86_64; Ubuntu 22.04 x86_64, Ubuntu 24.04 x86_64 and arm64; macOS 13.0 or newer (x86_64, x86_64h, arm64).

Graphics card requirements for ExpertSDR3 1.3.0 and newer:

- Windows: DirectX 11.0 (feature level 11_0, shader model 5.0).
- Linux (x86_64): OpenGL 3.3.
- Raspberry Pi 4/5: OpenGL ES 3.0.
- macOS: Metal (any Mac with macOS 13.0 or newer).
- Minimum video memory: 256 MB.

Minimum GPU families:

- Windows: NVIDIA GeForce 400 series (Fermi, 2010) or newer; AMD Radeon HD 5000 series (Evergreen, 2009) or newer; Intel HD Graphics 4000 (Ivy Bridge, 2012) or newer.
- Linux: NVIDIA GeForce 400 series (Fermi, 2010) or newer; AMD/ATI Radeon HD 7700 series (GCN, 2012) or newer; Intel HD Graphics 4000 (Ivy Bridge, 2012) or newer.

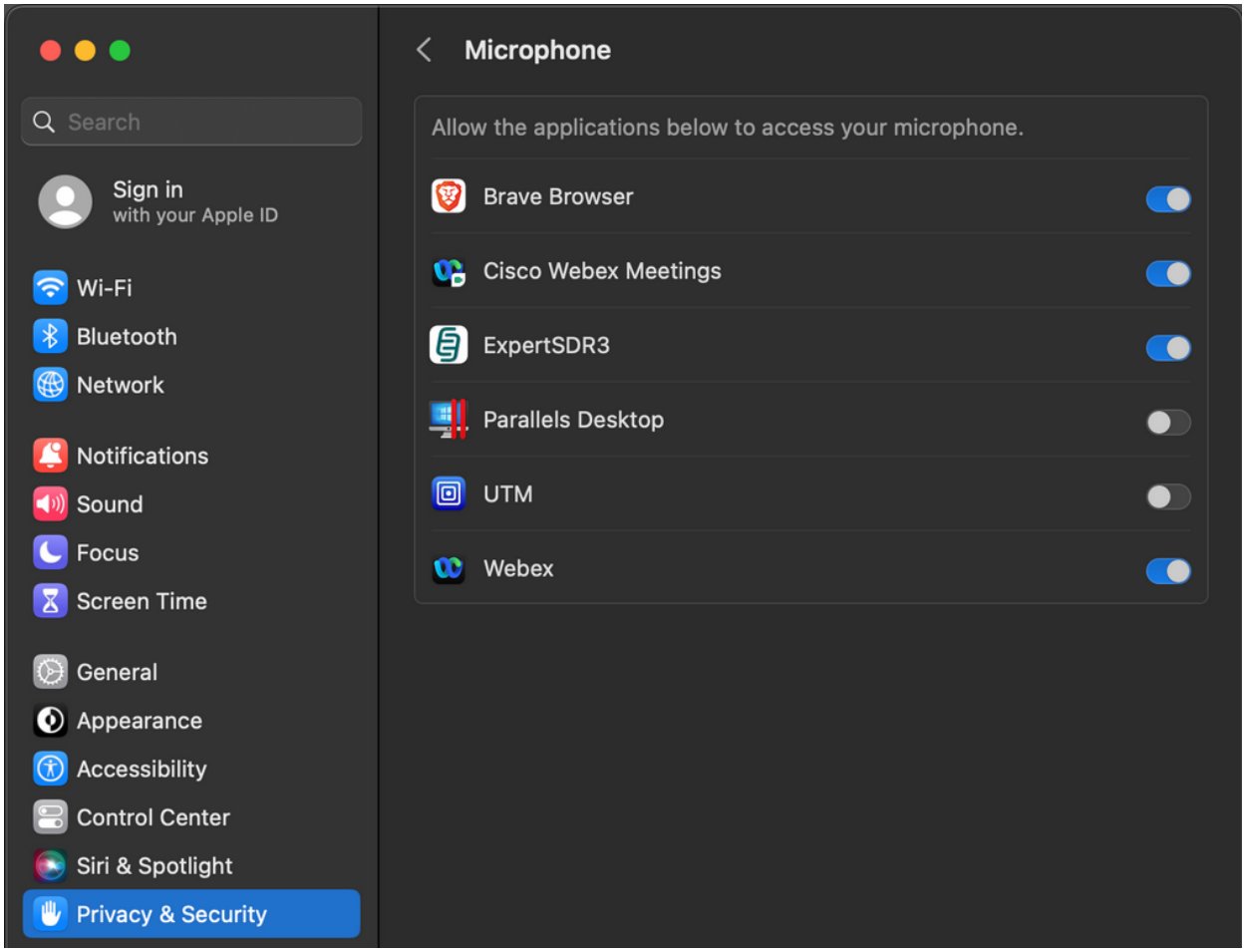
By modern standards these requirements are extremely low: virtually any discrete or integrated graphics card released after 2012 will do.

7.4. Mac specific MicPC setup

Unfortunately, due to the security access for Microphone limitations in current version of the development framework for Mac computers, some extra steps required to enable in-build and external microphones (including Bluetooth) to be used as MicPC in macOS Ventura (all models Intel/Silicon).

Important: Below procedure has to be repeated before launching every new ExpertSDR3 Beta version for the first time.

1. Go to System Settings -> Privacy & Security -> Microphone.



If this is the first time you are launching ExpertSDR3, the ExpertSDR3 will not be in the Microphone list, and you can go straight to step 5 below. However, if you have used any version of ExpertSDR3 before and granted MicPC access for it, then ExpertSDR3 is listed in devices, and you have to revoke the access rights to previous version, before proceeding with new beta. Perform the following steps:

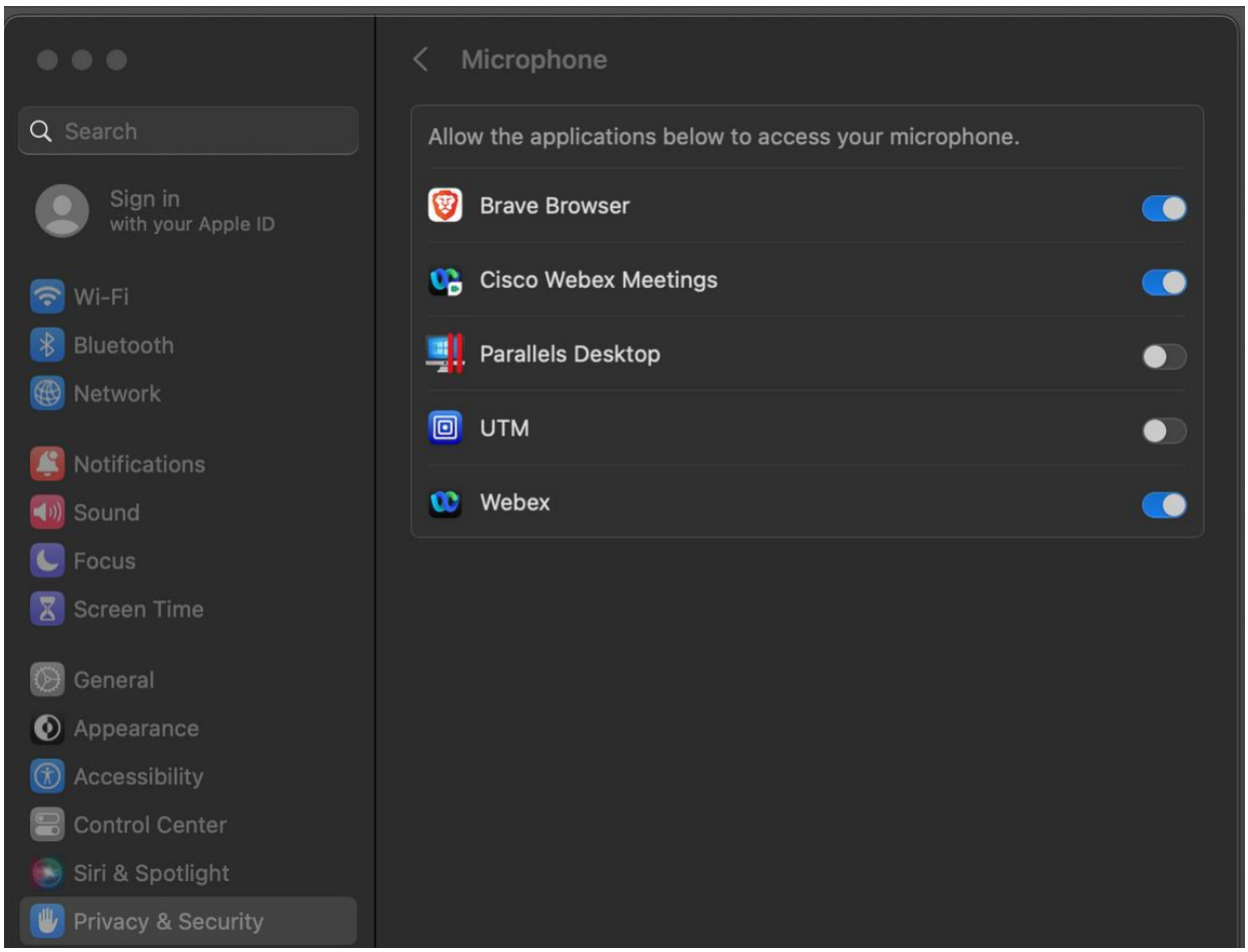
2. Open Terminal and issue the following command:

sudo tccutil reset Microphone com.eesdr.expertsdr3

press Enter

enter password and press Enter again

The system response 'Successfully reset Microphone approval status for com.eesdr.expertsdr3' ensures that revoke is complete, and now you would not see ExpertSDR3 listed in System Settings -> Privacy & Security -> Microphone.



3. Remove old ExpertSDR3 version from Application folder and Restart OS (this is the easiest way to deal with Apple TCC relaunch).

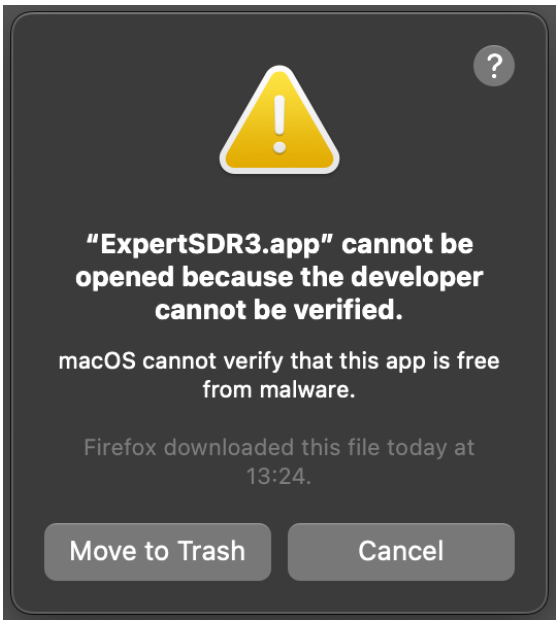
4. Connect provided .dmg, move ExpertSDR3 into Application folder.

5. Open Terminal and issue the following command:

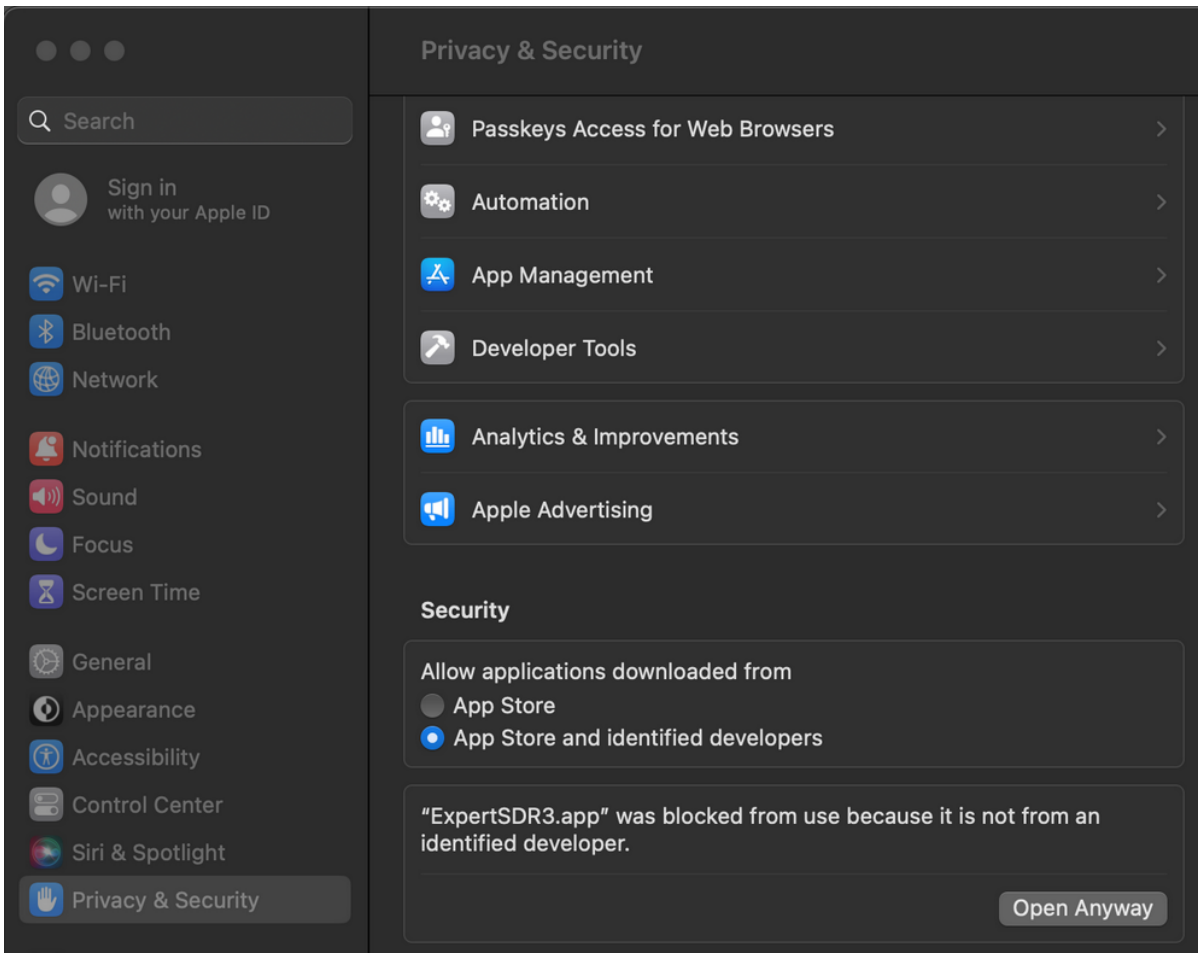
codesign --force --deep --sign - /Applications/ExpertSDR3.app

Important: the above command assumes ExpertSDR3 application is located in the Application folder. If you keep ExpertSDR3 application in other than Application folder, then use your path replacing /Applications/ExpertSDR3.app.

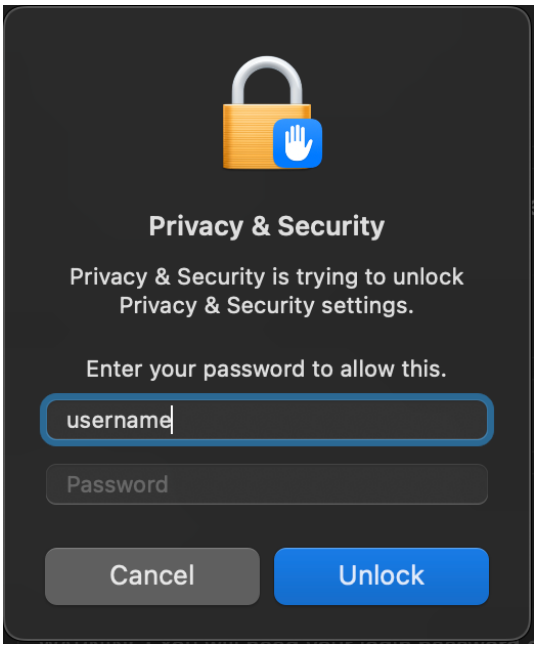
6. Navigate to ExpertSDR3 and launch it. On a first launch under Ventura, you will get the following warning:



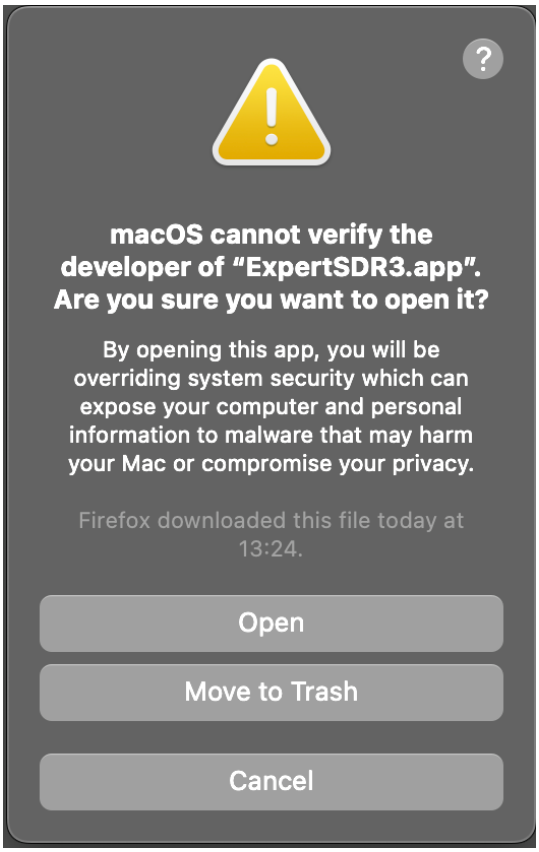
7. Press "Cancel" and then open System Settings -> Privacy & Security and in right pane scroll down till Security section; you will see the notice that "ExpertSDR3.app was blocked, because it is not from an identified developer". Click 'Open Anyway'.



8. The next pop-up will prompt you to enter an account password; enter your password and click 'Unlock'.



9. The next popup will prompt that macOS cannot verify the developer, just ignore it and click 'Open', this will trigger ExpertSDR3 Device Manager to start.



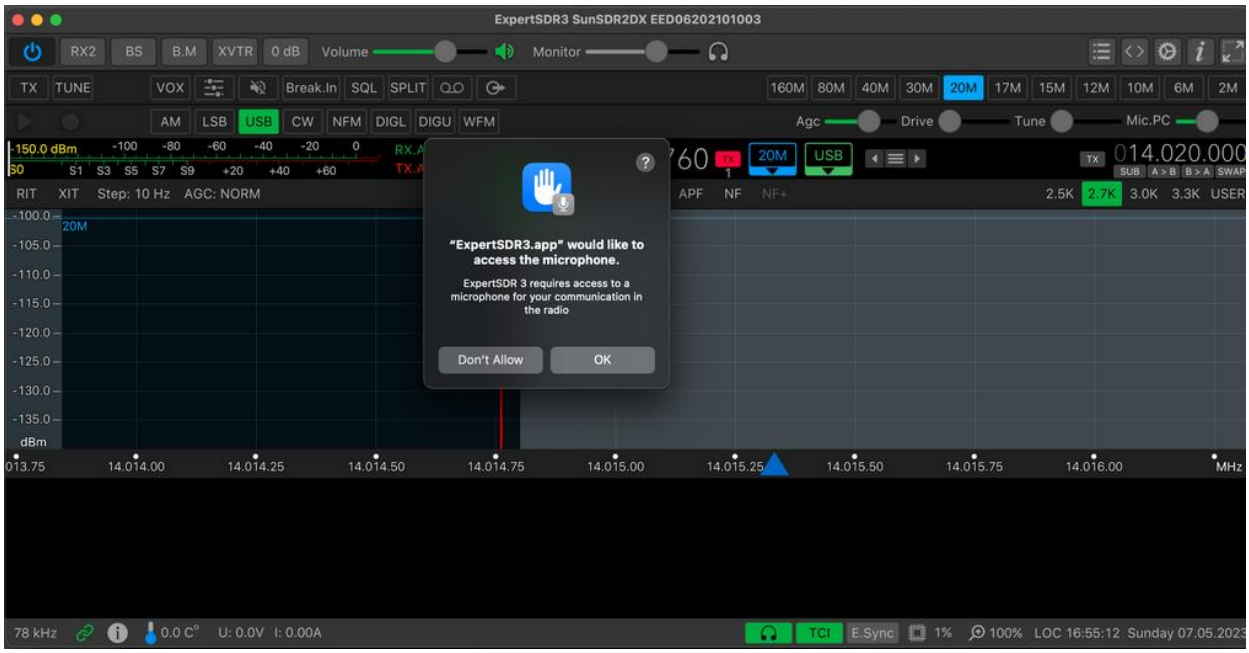
10. Press 'Start' in ExpertSDR3 Device Manager.

Important: when main ExpertSDR3 window will open, do **NOT** start transceiver as yet.

11. Make sure that Sound Card indicator in the Status bar is inactive (**gray**), right click on it and select (with drop-down arrow at right) the desired devices for Core Audio Mic and Headphones. Also make sure that MicPC is selected (in right top corner of ExpertSDR3). Initially you can select in-build devices, however if you have external devices already connected, you can select those at this stage. Once desired devices selected, activate the Sound Card indicator with left mouse button click, it'll become **green**. With ExpertSDR3 compiled with Qt6.5 builds there is no need to authorize additional devices as MicPC, the procedure is performed once.



12. Turning transceiver ON, you will get prompted to enable ExpertSDR3 access to microphone. Click 'OK'.

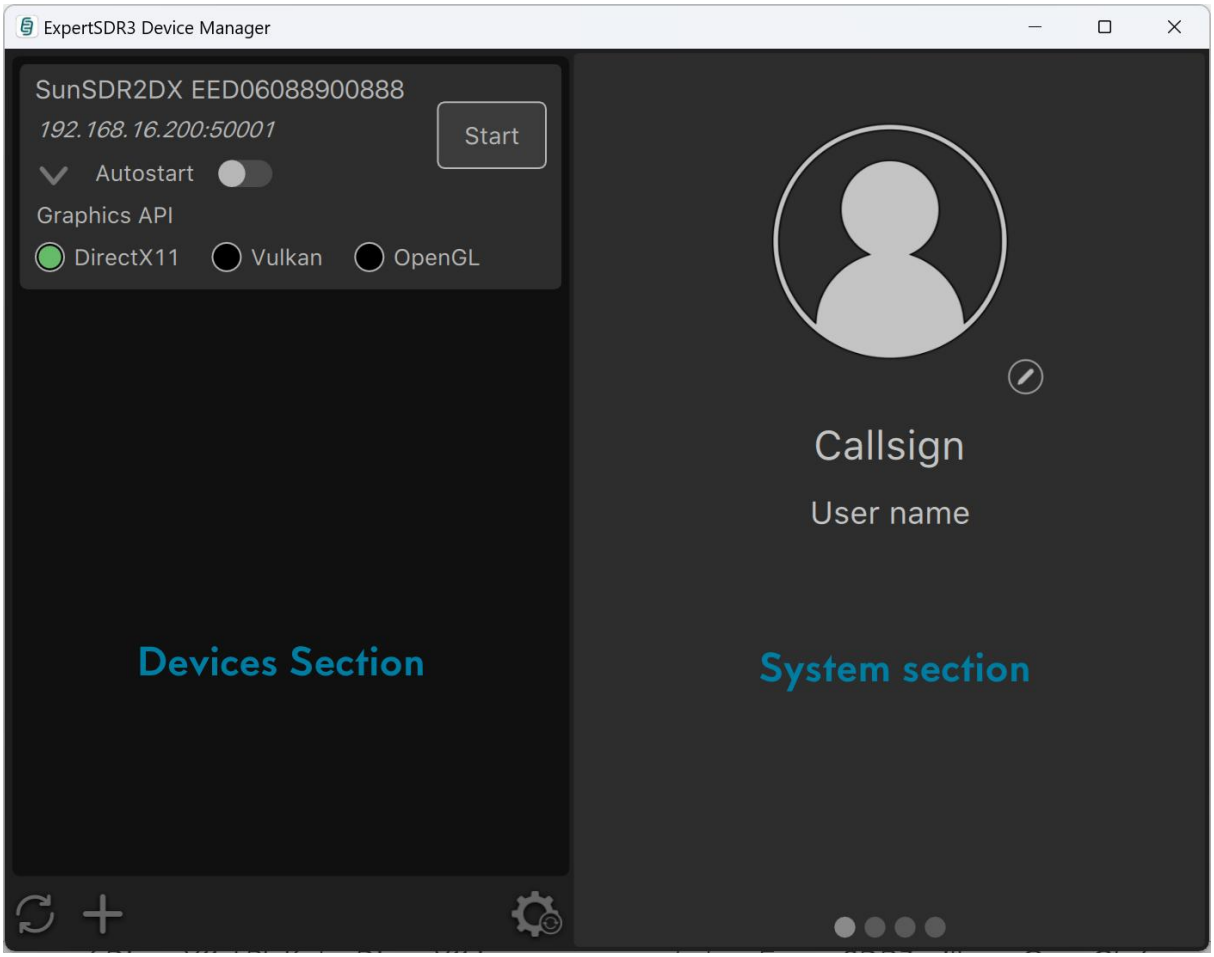


From now on, the selected microphone is enabled as MicPC.

Note:	• At this stage, after ExpertSDR3 is launched and certain microphone is determined as MicPC, the plug-and-play use of new microphones as MicPC is not supported under macOS Ventura. If you want to connect alternative microphone as MicPC, you have to do it before you start the ExpertSDR3 Device Manager.

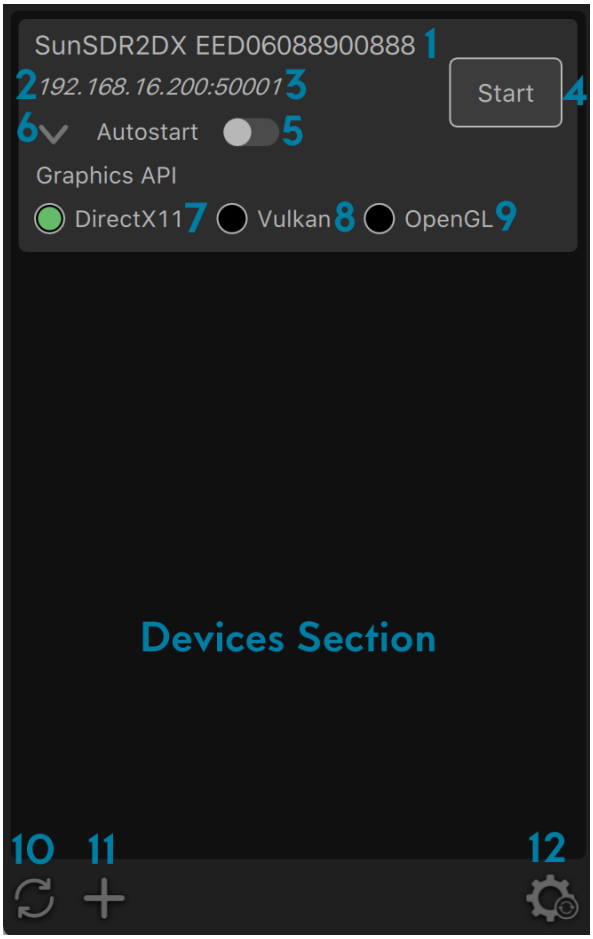
8. Device Manager

ExpertSDR3 Device Manager is the first window you will see after launching the ExpertSDR3 application. The window is divided in two sections, the **Devices** on the left-hand side of the window and the **System** on the right-hand side of the window.



Note:	• *When application is launched in Windows PC, it will check for support of DirectX11 API. If the DirectX11 is not supported, then ExpertSDR3 will use OpenGL (experimental function).* • *When application is launched in Mac PC or Linux PC, there is no Graphic API selection.*

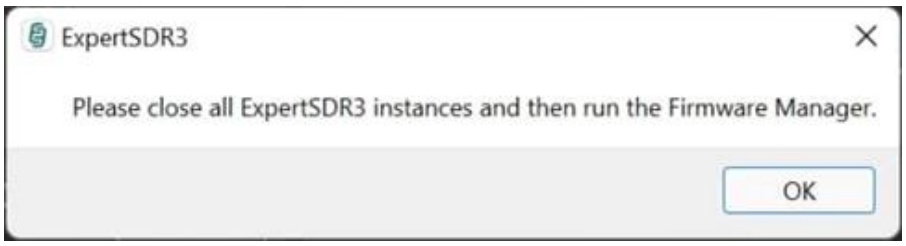
The Devices section (Windows layout).



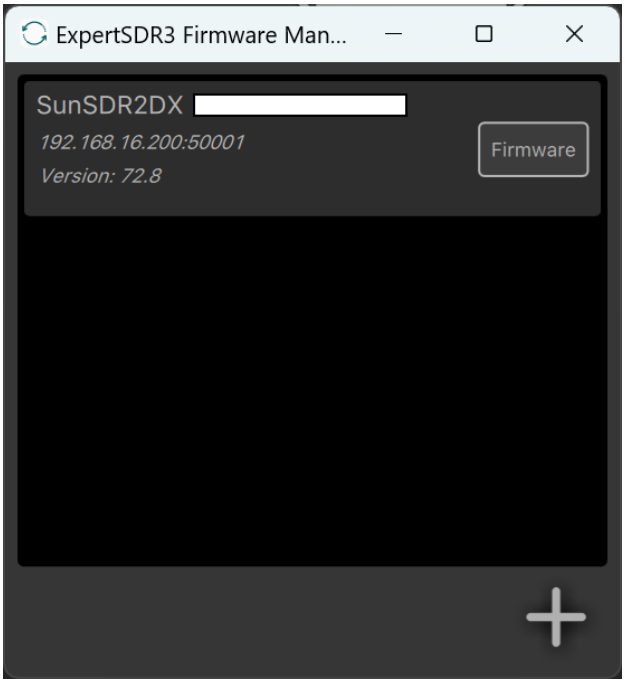
1	Serial number	Radio model SunSDR2 DX - serial number.
2	IP address	The selected device IP address: 192.168.16.200 (default value).
3	Port number	The selected device port: 50001 (default port).
4	Start	The **Start** button, click-on the button to launch an ExpertSDR3 instance to work with the selected device.
5	Autostart	The **Autostart** switch button, toggle-on the button to enable automatic launch of the instance. Toggle-off the button to disable automatic launch of the selected device.
6	Chevron (Windows only)	The **chevron** button, toggle-on/-off the button to show/hide the graphics APIs menu for the selected device.
7	DirectX11	The **DirectX11** radio button, click-on the button to choose DirectX11 as a graphics API for the selected device.

8	Vulkan	The **Vulkan** radio button, click-on the button to choose Vulkan as a graphics API for the selected device.
9	OpenGL	The **OpenGL** radio button, click-on the button to choose OpenGL as a graphics API for the selected device.
10	Discover	The **Discover** icon, click-on the icon to re-run scan for the available devices.
11	Add device	The **Add device** icon, click-on the icon to open a Add device window. Select Device model, enter IP address:port, enter serial number.
12	Firmware Manager	The **Firmware Manager** icon, click-on the icon to open the Firmware Manager window.

Note:	• *Add device function was implemented for manual addition of a device, in case automatic discover doesn't work. It'll be especially helpful for those who uses VPN.* *Also, this function allows you to create a virtual instance for any device to take a look at the GUI.* • *Before open the Firmware Manager, the ExpertSDR3 checks for active instances, and if detected - you'll be asked to close all the instances and to run the Firmware Manager again.*



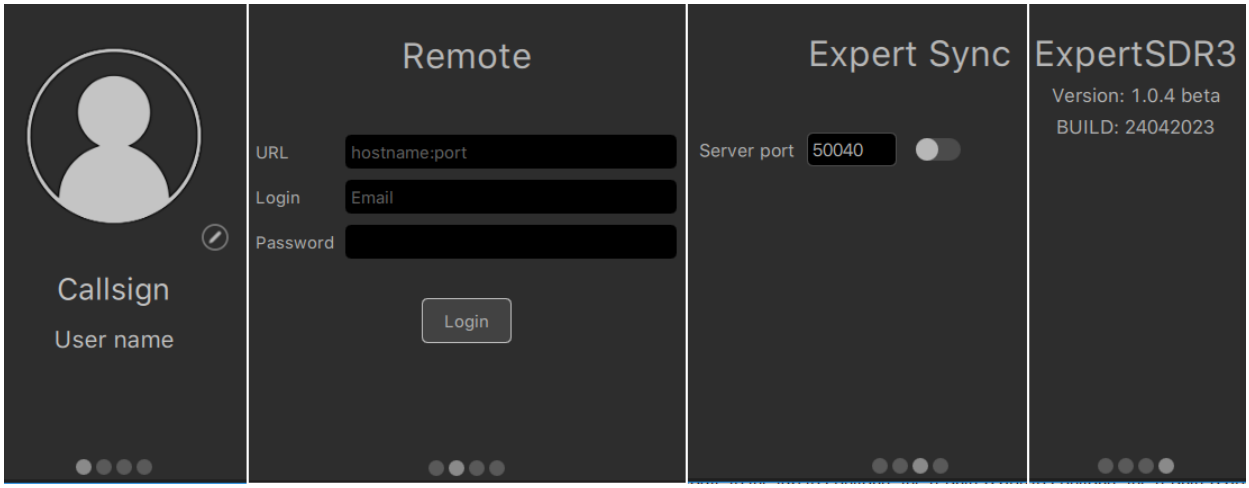
If any of your radios is running on an older firmware version, you can update it via the **Firmware Manager** menu, by clicking on Firmware Manager button (11).



It is recommended to set the default IP address (192.168.16.200:50001) before starting the firmware update of your transceiver. Press the **Firmware** button to start the Firmware update. If the radio is connected to LAN and has different from the factory default IP address, during firmware upgrade preparation, the process could be hanged. Switch OFF and ON the radio with the PWR button on the front panel (SunSDR2 DX/PRO). The green LED will start blinking and in 10-15 secs the upgrade will be completed.

Note **Windows Only**	• *If you don't see your transceiver displayed in the Firmware Manager window, it means the ExpertSDR3 Device Manager is blocked by Windows settings (e.g., Windows Firewall). To work around, add all .exe files from the ExpertSDR3 folder to the Windows Firewall exceptions list for both Private and Public networks, or disable the Firewall and your antivirus software.*

The System section



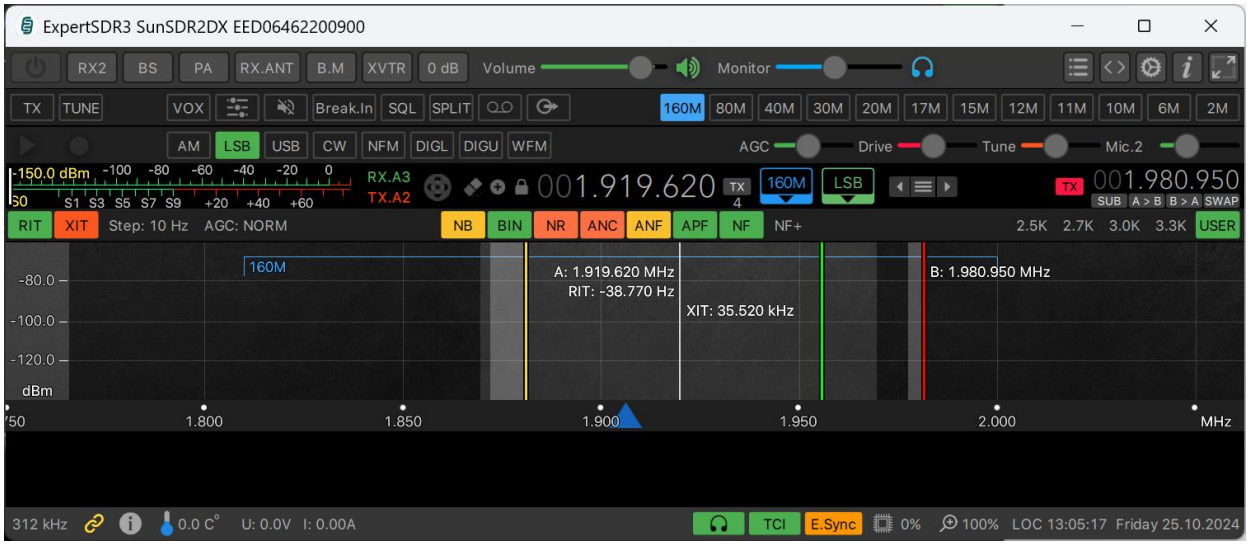
1	Profile	Navigate to the tab to personalize your account and to enable the edit mode: • Set a profile picture, drag the desired picture to the avatar field. • Enter your Callsign. • Enter your Name.
2	Remote	Navigate to the tab to enter your Profile credentials for remote operation, check **Remote operation** section for the details.
3	Expert Sync	Navigate to the tab to configure the required port for the ExpertSync server. **Note:** • *It was designed to sync between any number of ExpertSDR3 instances/devices. Synchronization could be set up within the same local host or within the home network (between different PCs in the same LAN). Using **ExpertSync** you can **synchronize RX1, RX2** frequencies**, filter** bandwidth and **RIT** parameters.*
4	Information	Navigate to the tab to check the details of the ExpertSDR3 software version and its build date.

Utilities. The menu of the ExpertSDR3 notification area icon contains the Utilities section for launching RadioSync, RadioMacros and RadioSpot (selecting a running utility brings its window to the front) and the Autostart submenu — checked utilities start together with ExpertSDR3. Utilities receive the interface language and color scheme from the menu of the ExpertSDR3 icon in the notification area automatically and are closed together with the icon.

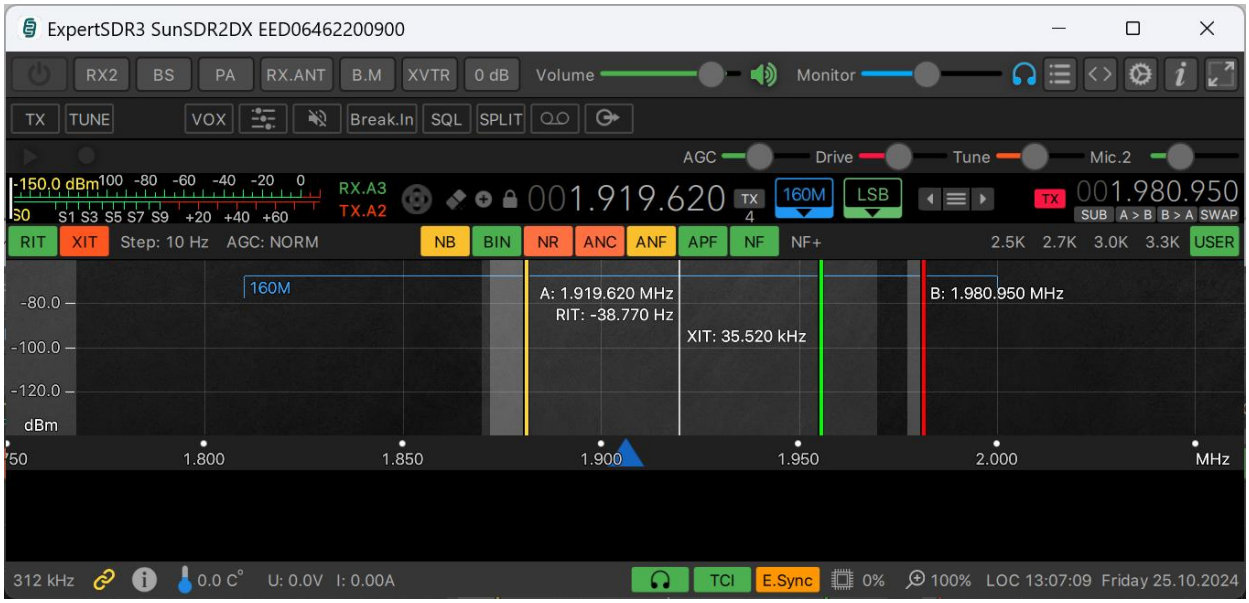
New in version 1.3.1. The device row now contains a graphics API selector, between the start button and the icons on the right; while the device is running the selector is locked but stays visible. The field is present under Windows only, because Linux and macOS have a single graphics backend. A refresh button has been added next to the device list: when pressed, the Device Manager forgets the automatically discovered devices and scans the network again, while manually added and running devices stay in the list. The window position and size are now preserved between runs, together with the maximized state, and the restored position is validated — the window will not end up outside the screens after a monitor has been disconnected, the resolution changed or a laptop undocked.

9. ExpertSDR3 software description

Default main layout of the ExpertSDR3 software.



Compact layout of the ExpertSDR3 software (band and mode panels are disabled).



9.1. Global controls panel



This panel consists of the following buttons:



- toggle the **Start** button to switch-on/-off the receive mode in the ExpertSDR3 instance.



- click-on the **RX2** button to enable/disable second software receiver. Right-click on the button to switch between the RX2 window views (vertical or horizontal). For more information about the RX2 button operations, refer to the **RX1/RX2 priority section**.



- click-on the **BS** button to enable/disable wide bandscope in the same Nyquist zone as the RX1, from 0 to 80 MHz or from 80 to 160 MHz. When **bandscope is in use**, Band Pass Filters can still be active or you can switch to the WideRX filter. More information about RX filters operation is presented in the **Filters menu**(the chain sign in the status bar). The **bandscope** window is displayed as a separate window. Navigation and settings of the **bandscope** are similar to the panorama settings of the main receiver.

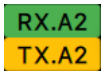


- click-on the **PA** button to enable/disable the X8 pin in the ExtCTRL connector, which is reserved for control of an external power amplifier (PA). There are two ways to control X8 pin:1. **Global state of the PA key** - PA button is displayed on the software main window.

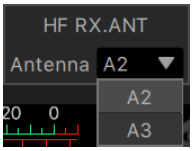
2. **Save by band**, if you enable this function in the **Settings-> Radio-> PA section** the Global PA button will be replaced with the **PA** column in the **Band Manager** window, where you can assign it to any band.

Note:	• *To activate X8 in Tune mode, enable **Use in Tune** in Settings-> Radio-> PA section.*



- press the left mouse button to enable **RX.ANT** button, it'll set the selected antenna for all bands in the RX-only mode. When transmission is prohibited due to the **RX.ANT** being enabled, the TX antenna has a yellow background and the RX antenna has a green background 

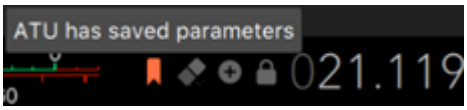
. When **RX.ANT** button is active you still can change the TX antenna output, but RX antenna selection is locked.



- press the right mouse button to open a drop-down menu, where you can select A2 or A3 antenna for RX-only mode.



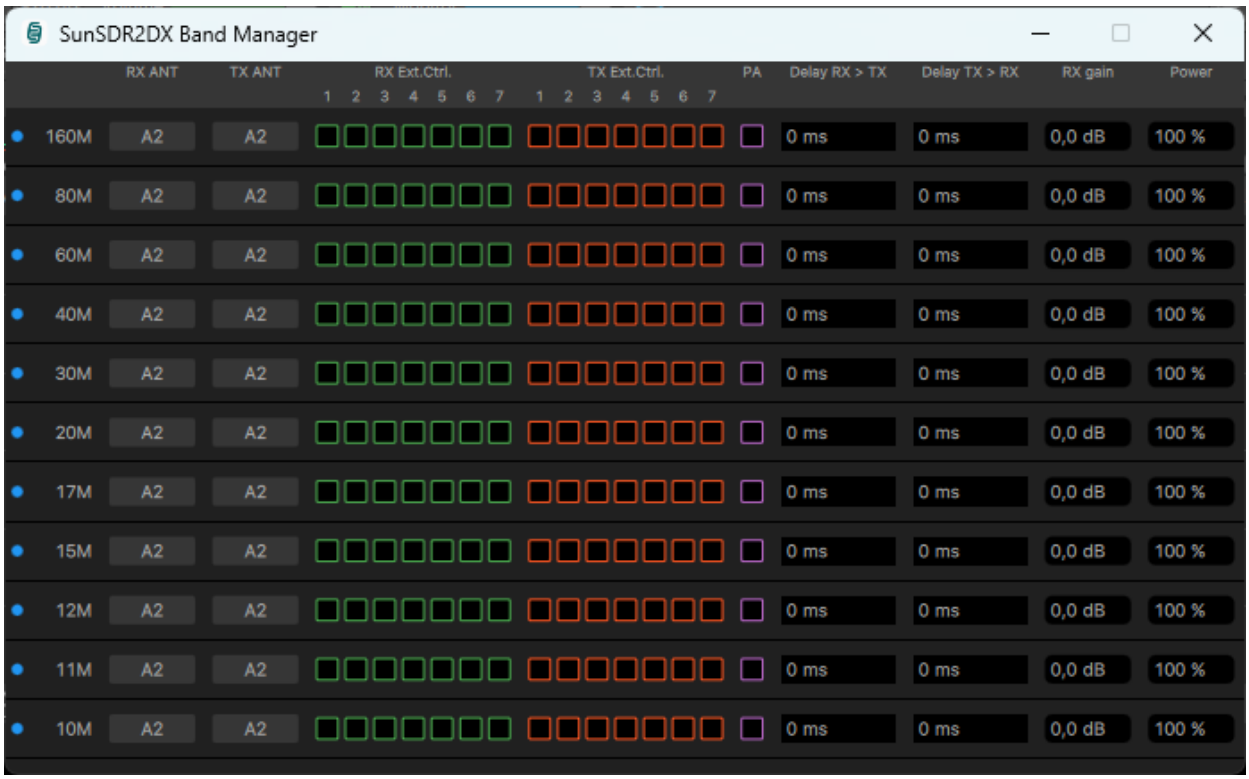
- the **ATU** button is displayed in the main software window when AAT-100 is connected to the transceiver. If you disable the ATU button, then AAT-100 will switch to bypass mode.



- there is a special indicator (it turns **orange** if ATU has pre-saved parameters for the current frequency, and **dark-gray** if the memory is empty). For more information about the AAT-100 indicator operations, refer to **this section**.



- click-on the **B.M** button to open the **Band Manager** window. For information about the window functionality, refer to **this section**.





- click-on the **XVTR** button to open the **Transverter Manager** window. Transverter operations are described in **this section**.



- click-on the **Attenuator/preamp** with the left mouse button to cycle upwards the attenuation coefficient in the following order: -20dB, -10dB, 0dB, +10dB or right mouse button to cycle it backwards.

Note:	• *When using Band Pass Filters (BPFs), the attenuator and preamplifier unique values are stored for each individual filter and band. And if you use the WideRX filter (LPF) for the entire Nyquist zone, the attenuator/preamplifier level is identical for all the bands.* • *Attenuator **specifics**: Because of the antenna's input signal level remains unchanged regardless of the attenuator level when the attenuator is in use the S-meter values and audio level will have software compensation. This means you no longer need to calculate real values every time you use the -20 dB attenuator. Moreover, unlike most classic transceivers on the market, this transceiver doesn't require an adjustment of AF or RF level every time the -20 dB attenuator is used. The attenuator only influences the receiving dynamic range level, the S-meter and audio level remain unchanged. If you start switching the ATT while the antenna is disconnected then you would be able to observe changes of the receiver's noises. For example, when you select*

	ATT 0 dB the RX noise level will reduce, which means the RX sensitivity is higher. And if you select ATT -20 dB the RX noise level will increase, which means the RX sensitivity is lower. These functions are now handled by our new hardware.



- adjust the **Volume** slider to change the volume. The volume settings are stored per band; it affects the LF output on the transceiver's front panel and PC's sound card output. Toggle the **Speaker** icon to mute/unmute the audio.



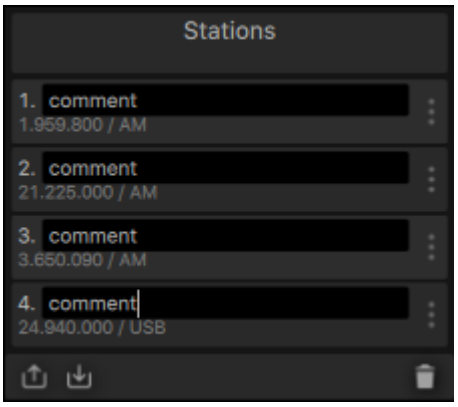
- adjust the **Monitor** slider to change the monitoring volume. Toggle the **Headphones** icon to enable/disable monitoring. This function allows you to listen to the generated signal and control its quality.

Note:	• *An excessive monitoring volume may lead to the positive acoustic connection between the microphone and headphones and cause a self-triggered audio path.* • *In CW mode, the transceiver will always generate a monitoring signal, even if you don't click-on the MON button.* • *TX CW signal is always displayed on the panorama.* • *If you noticed the transceiver HF crosstalk on the PHONES jack, install ferrite beads with transparency 1000-4000 on the coax cable of the antenna and Mic cable. Make 5-10 winds of cable around the bead. Such crosstalk may impact an external PA, thus they should be eliminated. The crosstalk phenomenon may occur due to the HF current on the outer part of the cable.*



- click-on the **Stations** button to open the Stations menu. To add a new station in the menu, press the **Save station** button, marked with blue rectangle, close to the main frequency indicator 

. CTCSS and repeater settings are also stored in memory.



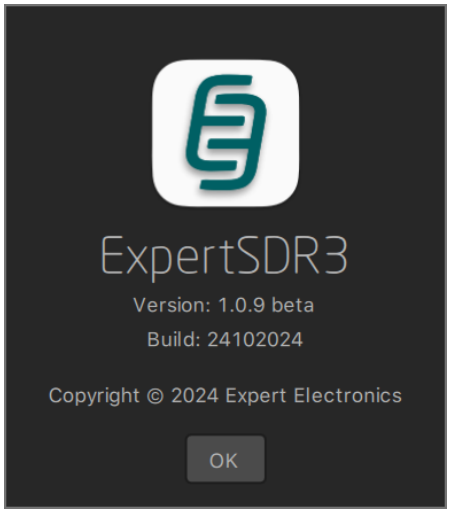
Previously saved stations can be edited; and any of the stations' parameters can be applied to RX1 or RX2 receiver. The list of saved stations can be exported and imported (for sharing and backup purposes). Click-on the **Bin** icon to clear all the stations from the list.



- toggle the **Expand** left/right buttons to tile the ExpertSDR3 controls to the left/right corner of the window.  - click-on the **Settings** button to bring up the Settings menu from the bottom of the ExpertSDR3 window. For more information about the ExpertSDR3 settings, refer to **this section**.



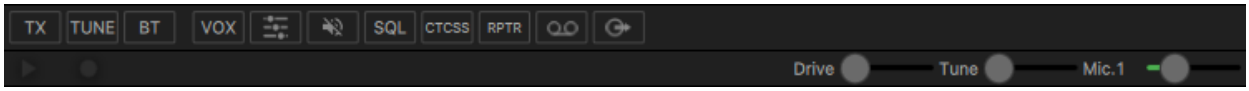
- click-on the **About** button to open the information window, containing the version and the build of the ExpertSDR3 currently in use.





- press the **Fullscreen** button to enter full screen.

9.2. Transceiver control panel



In this panel, the buttons and sliders layout dictated by selected mode. **The above picture displays the NFM mode layout.**



- toggle the **TX** button to manually enable/disable the transmission.



- toggle the **TUNE** button to manually enable/disable the transmission of the tone signal.

Note:	• *To activate ExtCTRL X8 key in Tune mode: tick the **Use in Tune** checkbox in Settings-> Radio-> PA section.*



- click-on the **BT** button to enable **Burst Tone**. Some repeater models goes to "sleep" mode when timeout is reached; to awake the repeater from sleep simply send the Burst Tone of the exact frequency for a short period of time (common tone frequency value is 1750 Hz, however this can vary in some repeaters).

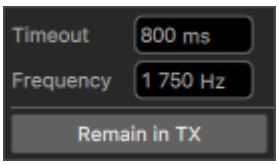
To form a **Burst Tone**:

1. Set the NFM mode.

2. Set the tone frequency.

3. Set the required tone TX time, enough for the current repeater.

4. Press the BT button.



The transceiver will send the FM tone signal with your settings. to adjust signal **Timeout** and **Frequency**, right mouse click to open the drop-down menu. **Remain in TX** – click-on the button to keep the transceiver in TX mode after timeout.



- **VOX** (Voice Activated Transmit) button enables the TX mode when a signal detected in the microphone. VOX settings are saved for each microphone type, and can be adjusted in the **Mic signal processing** menu.



- **Mixer** button opens the menu with volume and balance control for the first and second software receivers. If only RX1/VFO A is in use, the Mixer settings disabled. As soon as you start using VFO B for RX1 or RX2, the Mixer settings get enabled.

Sync with VFO is the special function that syncs VFO A and VFO B balances in according to their position on Panorama. If the VFO located on the left, then it will be better heard in left phone. And if the VFO located on the right, then it will be better heard in the right phone.





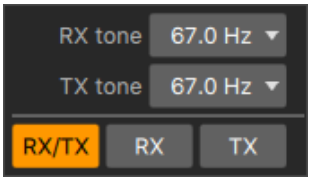
- toggle the **Mute** button to mute LF signal.



- click-on the **SQL** button to enable/disable squelch. Squelch threshold is displayed as a vertical **yellow** needle on the S-meter. If the air signal (**green** needle), surpasses the SQL trigger threshold (**yellow** needle), then you will hear the sound of the receiving station on the receiver's LF output. And if the air signal level is below the trigger threshold (**yellow** needle), you won't hear a thing.



- click-on the **CTCSS** button to enable Continuous Tone-Coded Squelch System. In some cases, it might be necessary to activate squelch with the help of the CTCSS tones.



- right mouse click to open a drop-down menu.

How to use CTCSS mode:

1. Set the NFM mode.

2. Set the receiver's tone frequency in the RX TONE input-box.

2.a. Set the transceiver's tone frequency in the TX TONE input-box.

3. Press one of the buttons RX/TX, RX ONLY, TX ONLY:

RX/TX - CTCSS mode is active in RX and TX modes.

RX ONLY - CTCSS mode is active in RX mode.

TX ONLY - CTCSS mode is active in TX mode.

4. Press the CTCSS button to activate CTCSS mode.

5. Receive signals with the CTCSS tone.

5.a. Press the PTT button on the Mic to transmit the signals with the CTCSS tone.

6. Release the PTT button on the Mic to turn to RX mode.



- click-on the **RPTR** button to enable repeater mode. This function is usually used on the 10M, 6M, 2M and 70cm bands.



- right mouse click on the **RPTR** button to get access to the **Shift** parameter. You can use this function to adjust the TX frequency for a certain repeater. The sub-receiver displays the TX frequency, and the main receiver displays the RX frequency. Parameters set in the **Shift** are saved for each AM, LSB, USB and CW modes.



- click-on the **Line Out to MP3 file** button to record audio in MP3 file.



- click-on the **Line Out to Sound Card** button to transfer audio stream into Sound Card. **Line Out** settings are presented in **Settings-> Receiver audio section**.

The **SPLIT** feature is only available in AM, SSB and CW modes.



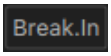
- click-on the **SPLIT** button to initiate a split state. When in split state you will receive on the VFO A frequency, and transmit on the VFO B frequency with the parameters set in **Shift**. 5. Pressing the **SPLIT** button the second time TX frequency returns to VFO A frequency.



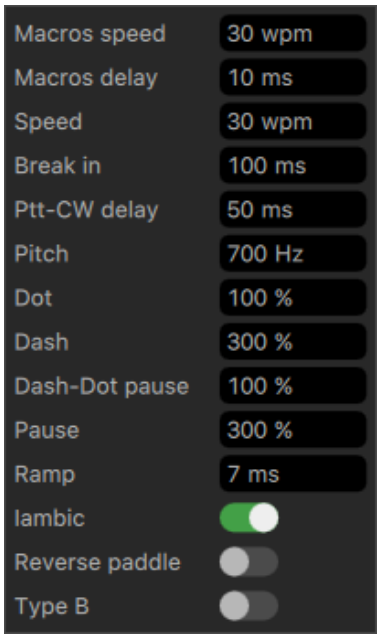
- right mouse click on the **SPLIT** button to get access to the **Shift** parameter. Parameters set in the **Shift** are saved for each AM, LSB, USB and CW modes.

Note:	• *When CW key is pressed while you are in the CW mode with the BREAK IN and SPLIT functions enabled, the transceiver will turn to TX on VFO B frequency automatically.* • *When the PTT signal received via the CAT-system or COM-port (if configured) while you are in digital mode, the transceiver will turn to TX on VFO B frequency automatically.*

The **Break.In** can be used in SSB and CW modes.



- toggle the **Break.In** button to initiate the **Break.In** mode. When CW key is pressed while you are in this mode, the transceiver will automatically turn to the TX mode.



- right mouse click to open the **CW settings** drop-down menu.

Macros Speed - this field displays the CW macros generation speed via TCI interface.

Macros delay - this field displays the CW macros generation delay after its switch from RX to TX via TCI interface.

Speed - this field displays the speed of the CW signal being sent. This value determines **reference Dot length**.

Break In - this field displays the TX->RX delay for CW-keyer. The time control is useful for keeping the transceiver in the TX mode. Use this field to set the time required for the transceiver to hold in the TX mode after the CW key is released.

PTT-CW delay - this field displays the RX->TX delay for CW-keyer. This delay is applied to RF signal only, it won't affect audio monitoring. Use this feature for the TRX connection to external PAs.

Pitch - this field displays the CW signal's frequency tone control (also used for the RX mode).

Dot - this field displays the determined Dot length in relation to the CW-keyer and macros.

Dash - this field displays the determined Dash length in relation to CW-keyer and macros.

Dash-Dot pause - this field displays the determined Dash-Dot pause length in relation to the CW-keyer and macros.

Pause - this field displays the determined Bigger Pause length in relation to the CW-keyer and macros.

Ramp - this field displays the CW signals' slope length control. The higher the manipulation speed, the shorter the slopes.

Iambic – toggle the button to enable/disable automatic dots and dashes generation. When you press the CW-keyer while the IAMBIC mode is off, it will generate tone signal with PITCH frequency.

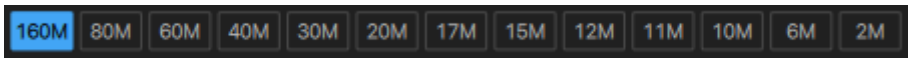
Reverse paddle - toggle the button to enable/disable generation of dots and dashes in reverse order.

Type B - toggle the button to enable/disable CW mode type B.

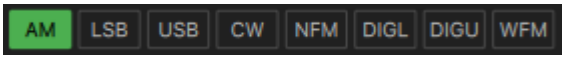
The Stereo can be enabled in WFM mode.



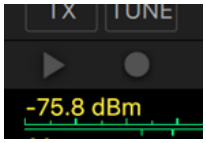
- click-on the Stereo button to enable Stereo mode for FM BC stations. In this mode ExpertSDR3 automatically detects whether the station is strong or not, and if it transmits in stereo.



- to display the HAM bands buttons panel in the main software window, go to Options-> Pallet -> Contest-> **Bands panel** and activate the panel. In some regions, you will be able to operate on the 4M (70 MHz) and 5M bands. Transmit using low power output DAC OUT, to get more power you can use an external power amplifier. To receive on 4M/5M band, use ADC IN. In Ireland, you can operate on 8M band.



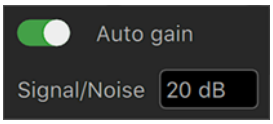
- to display the HAM modes buttons panel in the main software window, go to Options-> Pallet -> Contest -> **Modulations panel** and activate the panel.



- click-on the **Record** button to record the RX filter signal and your microphone signal in the TX mode. Click-on the **Play** button to play back the record. For further information about the **Voice Recorder** functions refer, to **this section**.



- adjust the **AGC** slider to change AGC sensitivity control of your transceiver. The adjusted parameter is saved per band per mode. The AGC sensitivity control is an equivalent of the Automatic Gain Control in classic transceiver.



- right click mouse to open the menu where you can select the preferred air noise level above horizontal scale. The automatic AGC threshold is saved per band per mode. The receiver's AGC has a parameter maximum allowed amplification of the RX signal. In ExpertSDR2 this parameter called RF gain, in ExpertSDR3 we named it AGC (max gain). The AGC is used to amplify weak RX signal until its max value is achieved, or the amplification coefficient has reached the parameter you set. For example, if you select FAST or NORM parameter then the signal volume on the AGC's output will never exceed the maximum allowed volume. And if you select AGC OFF parameter then the signal's maximum volume can exceed this threshold and get clipped. We've kept the AGC OFF parameter for digital modes (e.g. FT8, FT4, etc.) to eliminate AGC influence on the RX signal for better decoding. For voice modes we recommend to use AGC NORM and AGC FAST for CW.



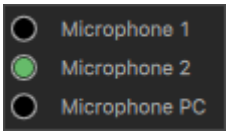
- adjust the Drive slider to change the output power (HAM bands only). Right click on the Drive slider to copy Tune slider value.



- adjust the Tune slider to change the output power in Tune mode (carrier).

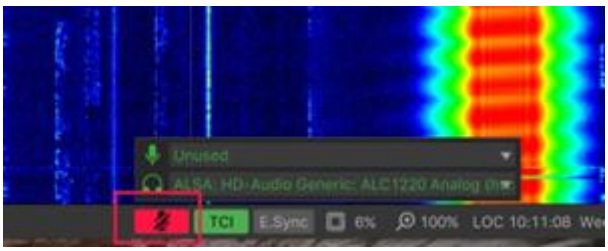


- adjust the Mic.2 slider to change the microphone gain level. In the CW mode, this slider switches to WPM slider.



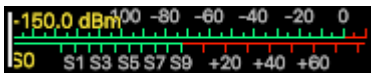
- right mouse click on **Mic** to choose between **Mic.1**, **Mic.2, Mic.PC** (your PC microphone) or **E-Coder2** (if microphone is connected to E-Coder2 panel) options from the drop-down menu. **The microphone you select in this menu will be used for operation in voice modes!**

Note:	• If the Mic.PC option has been selected from the Mic menu, and it doesn't match the Mic setting in the Sound Card, the software will inform you about it by displaying the red highlighted mic icon.



9.3. Indicators





- the S-Meter displays the signal level in the RX filter bandwidth. This scale consists of two grade types, one in S-units at the bottom and another in dBm at the top. The signal strength in dBm to mW is displayed in yellow in the top left corner. If no antenna connected, the S-Meter will show radio's internal noises level. In TX mode, the output power is indicated in W and antenna's in SWR (for frequencies below 60 MHz). For further information about S-meter operations, refer to **this section**.

Note:	• Software protection against high SWR is always active. If SWR is higher than 3.5 with output power higher than 10W, software will automatically lower the output power below 10W. To use the transceiver with an external tuner adjust the output power to 8W, this way the output power will be constant despite SWR changes during tuning.



- the antenna switch indicator displays the antenna input used by RX and TX.



- toggle the **Start/Stop** button to execute IQ-file recording. IQ files are the records of the whole RX Panorama bandwidth. Go to the Settings to configure the files directory and select one of the three file format options ExpertSDR2, HDSDR, Wave. All the recorded files formats can be played using HDSDR software. For further information about IQ recorder formats refer to **this section**.



- click-on the **Eraser** icon to clear off all displayed spots from the Panorama. 

- click-on the **Save station** button to add a new station to the **Stations** menu.



- click-on the **Lock** icon to lock frequency tuning for a software receiver.



- **VFO A** frequency indicator (main receiver).



- click-on the **grayed** TX indicator button to switch the **red** TX status between the two VFOs. There are two TX indicators, one near VFO A frequency and another near VFO B frequency. The active one is marked **red** and the inactive is marked **gray**. The TX indicator in **red** denotes the frequency of the associated VFO which you're transmitting on.



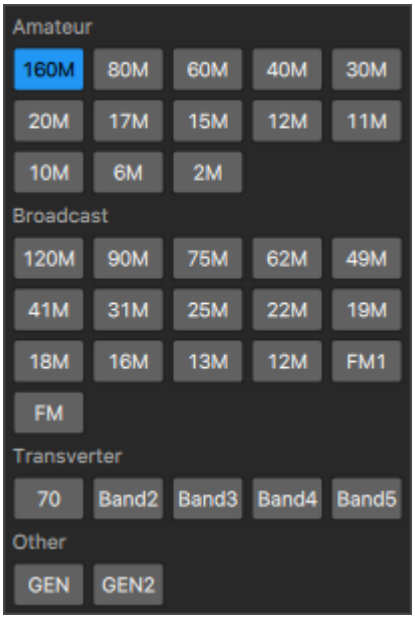
- the **Band Stacking Memories**indicator (VFO A only), can be used for a quick switch of frequency/mode changes within the active band. Each memory slot has a frequency, mode, and RX filter settings. Each band has five memory slot's associated with it. The memory slots latest state saved automatically. The switch stacks procedure includes the following steps:

- right mouse click on the band selection button;

- left mouse click on the selected band in the band panel.



- left mouse click on the band selection icon to open the band menu.



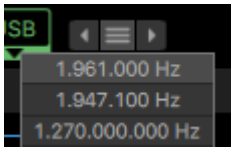


- left mouse click on the mode selection icon to open the mode menu.



Note:	• **CW works only in CW-U** *for all bands by default, and cannot be changed by user. The CW-U was a logical choice because if a frequency inside the RX filter has raised, the tone lowers, and you watch the signal in the filter moving right-to-left. And if you use the DSE feature, when the signal is on the left or right filter's side, you can hear a panoramic effect.* • *To operate in digital modes select DIGL/DIGU. The part associated with* ***Digital modes*** *buttons is still in development, therefore some features are either yet to be implemented or implemented partially. For example, currently if you select the FT8, it will only set the filter width.*

	• *Amplitude Frequency Characteristic (AFC) has deemphasis when you operate in NFM. The European standard determines the AFC slope in WFM with time constant 50 us (like in first order LPF), US standard 75 us. Because there is no unified standard for NFM, our development team used its own set parameter. In NFM, time constant is high, which allows to mute HF noise when there are no stations. The AFC can be adjusted by user to a desired level.*



- **quick memory** navigation buttons (total 15 cells). Every new frequency entry is added in the cells automatically if the receiver stands still on a single frequency over a second. You can jump back and forth over recorded frequencies by pressing left/right arrows or select a certain frequency from the list.



- **VFO B** frequency indicator (sub-receiver).



- click-on the **SUB** button to enable sub-receiver (**VFO B**). Use it to enable the second RX filter on the same band with **VFO A**.

Note:	• The audio from the VFO B is not audible when it is out of the panorama bandwidth (not visible). • The ***Red*** *color of the IF (either VFO A or VFO B) indicates active transmission on the frequency.* • Click-on middle mouse button is switching the point and the click control on the panorama between VFO A and VFO B receivers. The TUNE A or TUNE B *near the mouse cursor indicates which of - VFO A or VFO B – is currently controlled.* • *If selected band is changed, the SubRX will be switched off automatically.*

A>B – assign the VFO A frequency to VFO B

B>A – assign the VFO B frequency to VFO A

SWAP – swap frequencies between the VFO A and VFO B

9.4. DSP control panel





- press the left mouse button to enable Receive Incremental Tuning (RIT).



- press the right mouse button to open a drop-down menu, where you can set the frequency offset and tuning step (used for control from E-Coder/E-Coder2 panels) in Hz. **Reset** - resets the offset value to zero (more details in **RIT**).



- press the left mouse button to enable Transmit Incremental Tuning (XIT).



- press the right mouse button to open a drop-down menu, where you can set the frequency offset and tuning step (used for control from E-Coder/E-Coder2 panels) in Hz. **Reset** - resets the offset value to zero (more details in **XIT**).

Note:	• When you enable RIT or XIT modes, RX filter becomes yellow, so you won't confuse it with VFO B.



- press the left mouse button to reveal a drop-down menu and select required tuning step size. There are 9 values available: 1 Hz, 5 Hz, 10 Hz, 25 Hz, 50 Hz, 100 Hz, 200 Hz, 250 Hz, 500 Hz.

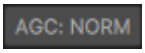
AGC presets menu. Press the left mouse button to switch between NORM and FAST. Press the right mouse button to switch off and on receiver's AGC.



- **AGC** is off.



- preset with fast **AGC** reaction, recommended for CW mode.



- preset with normal **AGC** reaction, recommended for all other modes. You can adjust the speed of AGC reaction for FAST and NORM presets in **Settings-> RX filter DSP**.



- press the **SAM** button to enable/disable Synchronous AM demodulator.



- press the **NB** button to enable Noise Blanker and remove impulse interference.



- press the right mouse button to open drop-down menu with **NB** settings. Adjust the trigger **Threshold** depending on the interference level (right-click will reset the default value).

Adjust the **Pulse width** slider (right-click will reset the default value).

Purpose

A Noise Blanker (NB) is a tool for suppressing impulse interference in radio reception. It is effective against short, high-amplitude spikes, such as those from household appliances with switching power supplies, fluorescent lamps, cars with internal combustion engines, and atmospheric discharges.

Operating Principle

The filter operates across the entire panoramic band. Its algorithm consists of three stages:

1. **Detection**: The program continuously monitors the signal level, identifying short spikes (bursts) that exceed a user-set threshold.

2. **Suppression**: When a spike is detected whose amplitude exceeds the threshold and matches the specified duration (pulse width), the NB instantly "cuts out" that portion of the signal in the time domain.

3. **Interpolation**: The algorithm fills the resulting void (gap in the useful signal) by approximating the data based on adjacent samples located before and after the spike.

Key Setting Parameters

1. Threshold: The most important parameter.

• Correct Setting: The threshold should be set above the average level of the desired signal, but below the peak amplitude of the impulse interference. This allows the watchdog algorithm to ignore the desired signal but respond to sharp "jabs" of interference.

• Setting Errors:
Too low a threshold: The NB will erroneously clip peaks of the desired signal (for example, the voice envelope or CW modulation), causing distortion and "gurgling".
Too high a threshold: The filter will not respond to interference, and it will pass through unchanged.

1. Pulse Width: Allows the filter to distinguish short impulse interference from desired signals. Set according to the characteristics of specific interference.

Visual and Audio Effect

On Panorama: Impulse "spikes" or spikes in the spectrum become less pronounced or disappear.

By ear: Sharp clicks, pops, and crackles in headphones or speakers are suppressed, leaving a cleaner, more desirable signal.

When to use and limitations

Use NB if: There is pulsed interference on the air—short, loud, periodic clicks and crackles.

Do not use NB if: The primary problem is broadband "white" noise (hiss) with an amplitude lower than the desired signal. A noise reduction (NR) device is designed to combat this.

The main limitation of this technology: NB is ineffective against interference whose amplitude is comparable to or lower than the desired signal level. In this case, it will either not work or will begin to damage the desired signal itself.

Practical advice: Turn on NB and gradually raise the threshold from the minimum value until the crackles and pops no longer cut through the pauses. The desired signal should remain unaffected. Adjust **Pulse width** so that it specifically responds to interfering pulses.

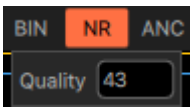
Noise Blanker is a "surgical" tool for pinpointing pulse noise. Its effectiveness depends almost entirely on the accuracy of the threshold setting. When configured correctly, it discreetly cleans the air, eliminating distracting sharp sounds while leaving the desired signal intact.



- press the **BIN** button to enable binaural audio mode (pseudo-stereo) (the phasing of the audio signal within the RX filter gives a stereo-like effect).



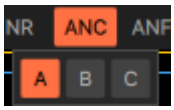
- press the **NR** button to enable the adaptive Noise Reduction. This is a special adaptive filter, which removes any abnormal noises and white noise in the RX filter band.



- press the right mouse button to open a drop-down menu with **NR** settings. Adjust the **Quality** value which influence the speed of adaptation rate. **The lower the value the cleaner the sound**, but adaptation takes more time (right-click will reset the default value).



- press the **ANC** button to enable Automatic Noise Cancellation.



- press the right mouse button to open a drop-down menu where you can select one of three presets, which is optimal for a certain air situation.

Purpose

Automatic Noise Reduction (ANC) is a modern adaptive algorithm designed to suppress continuous broadband noise (hiss, "white" noise) in voice modulation systems (SSB, AM, FM). Its goal is to remove background noise from the reporter's speech while preserving the intelligibility and naturalness of the voice as much as possible.

Technological Basis

ANC is based on neural network technology trained on a large array of audio data. The algorithm was trained to recognize and distinguish human speech (in particular, the announcer's voice) from various types of noise.

Architecture: Based on recurrent neural networks (RNN) for efficient processing of the audio stream in real time.

Efficiency: Although training required significant computational resources, the final optimized model operates with low CPU load, allowing ANC to be used on any modern PC.

Operating Principle

The algorithm analyzes the incoming audio stream in real time, separating it into two components:

1. **The desired signal** (human speech).
2. **The noise component** (background hiss, constant noise).

Based on this assessment, the ANC dynamically generates a filter that suppresses the noise component, while maintaining the speech component as close to unchanged as possible. The filter continuously adapts to changing broadcast conditions.

Controls and Settings

For user convenience, ANC configuration is simplified as much as possible:

Controls: Accessible via the drop-down menu by right-clicking on the ANC control element.

Modes: Three preset modes are available for different broadcast conditions.

Practical Recommendations and Limitations

- When to Use: ANC is most effective against constant, stationary noise (receiver noise, background hiss). It is the primary tool for improving speech intelligibility in challenging broadcast conditions.
- Limitations and features:

1. **Weak signals**: When receiving very weak stations, when the desired signal level is comparable to the noise level, the ANC algorithm may mistakenly perceive parts of speech as noise, resulting in distortion or a "robotic" sound. In such cases, it is recommended to disable ANC.
2. **Not for impulse interference**: ANC is not designed to combat impulse interference (pops, crackles, etc.). For this purpose, use Noise Blanker (NB).
3. **Voice-specific**: The algorithm is optimized for speech signals. Its performance on tonal signals (e.g., CW) may be lower.

Comparison with other DSPs

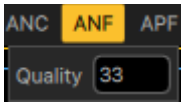
with Noise Blanker (NB): NB is a surgical tool against short impulse "pokes." ANC is a system for cleaning speech from constant background "hiss."

with Noise Reduction (NR): Traditional NR often requires fine-tuning the threshold and depth manually. ANC operates fully automatically, based on a model trained to recognize speech.

ANC (Automatic Noise Cancelling) is an intelligent, self-configuring filter that uses neural networks to automatically isolate speech from noise. It offers simple control via preset selection and is a powerful tool for comfortable SSB/QSOs, especially for operators who don't want to delve into manually adjusting complex filters.



- press the **ANF** button to enable Automatic Notch Filter for adaptive rejection of the narrowband interference in the receiving band (interference, carrier signals, CW signals, etc.).

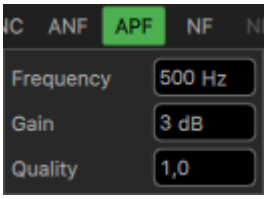


- press the right mouse button to open a drop-down menu with **ANF** settings. Adjust the **Quality** value which influence the speed of adaptation rate. **The lower the value, the cleaner the sound**, but adaptation takes more time (right-click will reset the default value).

Note:	• If there are no interferences, ANF could slightly affect the reception quality of the desired signal. Disable ANF, if you don't need it.



- press the **APF** button to enable Audio Peak Filter for CW and SSB modes.



- press the right mouse button to open a drop-down menu with **APF** settings. **Frequency** – tone frequency (pitch) of the voice signal (in CW equals Pitch, adjustable in SSB). **Gain** – analog peak-filter amplifying factor. **Quality** – analog peak-filter quality (slope sharpness) (in CW equals RX filter width, adjustable in SSB).

Purpose and Operating Principle:

The Audio Peak Filter (APF) is a specialized filter for SSB and CW modes, designed to improve the intelligibility and subjective comfort of the desired signal. Its purpose is to form a bell-shaped amplitude-frequency response (AFR) within the passband of the main filter.

Unlike a notch filter, which attenuates a signal at a specific frequency, the APF works in reverse: it boosts the signal in a narrow band around the center frequency (peak) and gradually attenuates everything outside this band. This creates an effect whereby a station with a frequency matching the filter peak sounds clear, while interfering signals located on the sides

are subjectively perceived as more distant and quieter, making the broadcast sound more "lively" and natural.

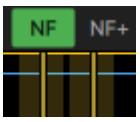
CW is the preferred mode for APF use. This mode features automatic pitch locking: The center frequency of the filter peak is automatically aligned with the selected pitch of the received CW station. This eliminates the possibility of accidental detuning, which would weaken the desired signal. Manually changing the peak frequency is not possible in CW mode.

Usage Recommendations and Limitations:

- Effectiveness depends on the main filter bandwidth: The peaking filter reveals its potential when used with sufficiently wide main filter bandwidths (e.g., 500 Hz or more in CW). If the main filter is set very narrowly (e.g., 50-100 Hz), it physically rejects most interfering signals, and the additional effect of the APF becomes barely noticeable.
- In SSB mode, the filter peak frequency can be manually adjusted by the operator to precisely match the timbre of the correspondent's voice.

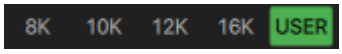
APF is a fine-tuning tool developed in response to requests from operators, especially CW operators. It doesn't just cut out interference, but creates a more comfortable and natural sound space, amplifying the useful signal and smoothly "pushing" interfering stations into the background.

Note:	• When filter bandwidth is thinner than 200 Hz, there is no point in APF, thus it is switched off automatically.

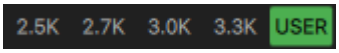


- press the **NF** button to enable/disable all set Notch Filters. Press the **NF+** button to add a new filter placing it inside the RX filter. To remove an existing Notch filter click twice with a left mouse button or once with the middle mouse button on it. Notch Filter is the IIR filter, its quality depends on its width. On the panorama you can see the result of the Notch Filter operation, it cuts out signals inside the filter. Tune and adjust the width of the Notch Filter the same way you do that for the main RX filter. For fine-tuning rotate the mouse wheel with a 1 Hz step. You can set up to 8 Notch Filters for each band. When you change the band, you automatically activate previously set Notch Filters settings for the current band. Each Notch Filter stores two parameters: tuned frequency and width, until you delete it. RX1 and RX2 may operate on different bands, thus you may have up to 16 active Notch Filters at the same time.

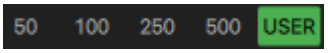
RX filter bandwidth presets. Presets list depends on the mode type:



- AM, NFM modes (8 – 16 kHz);



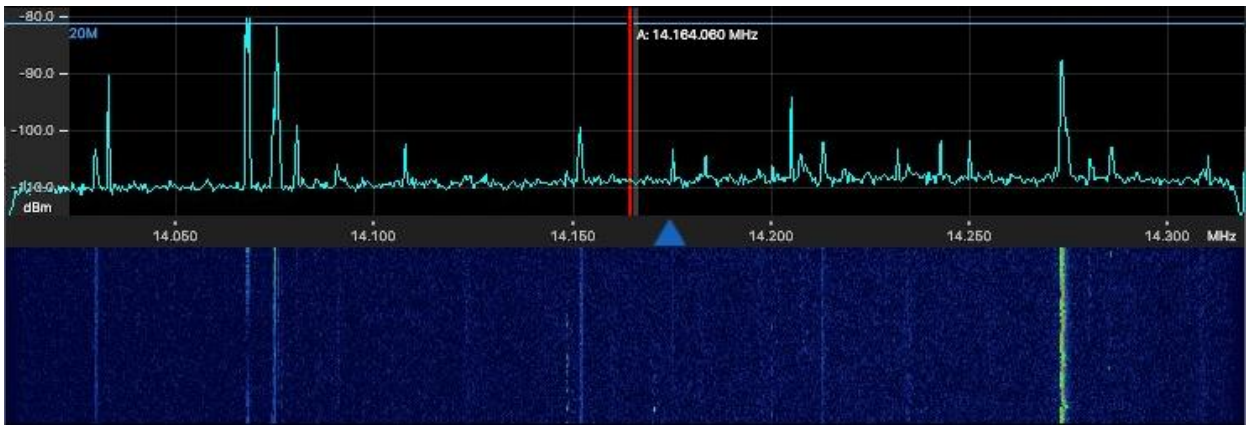
- SSB, DIGI modes (2.5 - 3.3 kHz);



- CW mode (50 - 500 Hz).

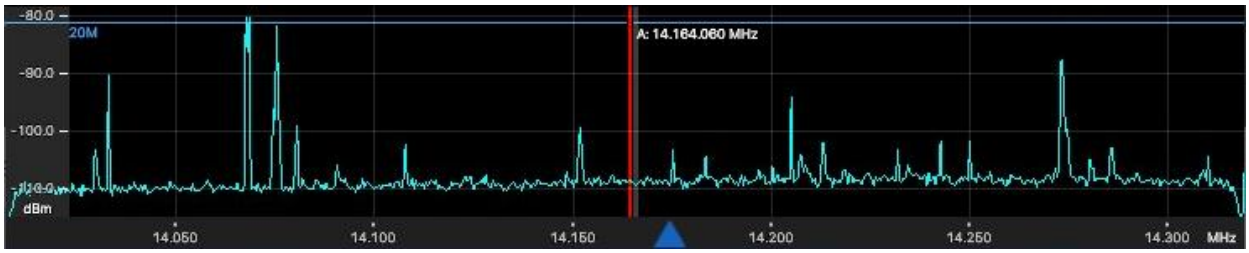
9.5. Panorama

The Panorama window is divided by the horizontal scale in two parts: Spectrum Scope and Waterfall:



9.5.1. Spectrum Scope

The Spectrum Scope displays combined air noise, signals (the Spectrum, with the sample rate of 39-312 kHz, adjustable by User) and the RX filter to tune and listen to the stations. For further information about Spectrum parameters, refer to **this section**.



Other parameters displayed in Spectrum Scope window are: **Band Indicator** - The Band Indicator, at the top of the window, is a horizontal line with the band name that reflects the current band boundaries. The Band Indicators are color-coded, the **blue** line corresponds with an Amateur band, and the **orange** line with a Broadcast band. (Note: amateur 20M band is shown on above picture).

VFO A filter. In its default state, the VFO A filter is represented by the vertical **red** line that indicates the tuning frequency. The RX filter bandwidth is represented by the gray translucent area around the tuning frequency; the listened audio is limited by the bandwidth boundaries. A tuning frequency is displayed at the RX filter right-hand side. To view the filters' low and high frequencies' edges ("L:" and "H:") hover over the filter. (Note, the "O:" reflects the mouse cursor frequency inside the filter).

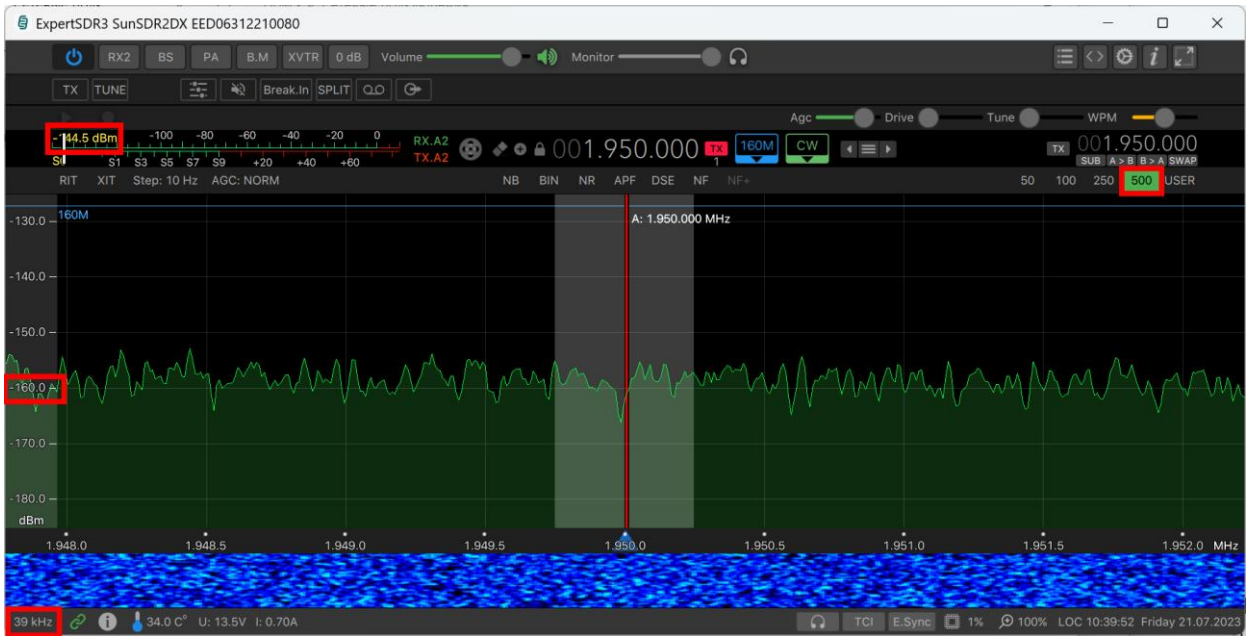
The Power Level of signals (dBm) is represented by the vertical scale on the left-hand side of the spectrum scope. You might notice variation in the dBm readings on the Panorama and S-meter, this is due to different algorithm used in its calculation:

1. The Noise level, displayed in the spectrum scope, calculation is based on the actual spectrum scope resolution.

Note:	• *In ExpertSDR3, the FFT settings were replaced by the adaptive spectrum resolution feature. This feature is based on the constant of ~9.53Hz per sample ("single-unit filter") and adapts to the sample rate and window size.* • *The only exception is ExpertSDR3 for ColibriNANO, with sample rate values higher than 384 kHz resolution will drop.*

In general, the panorama consists of single-unit filters. Each of the filter calculates power in its own band and display the result as an individual unit (per filter) on the panorama. A spectrum line (the bright blue line on the screenshot above) is a group of such units. If a strong useful signal, with a high signal-to-noise ratio, present inside the single-unit filter, then panorama and S-meter readings will be the same. This rule applies to monochrome and/or narrowband signals (e.g. CW, PSK), or carrier tone signals. If there are no useful signals, then the panorama reading will indicate air nose level in the filter bandwidth.

2. **S-meter** displays a sum of useful signals and noises in the bandwidth within the RX filter bandwidth.



S-meter calculation example: combined (noise + signal) calculation within RX Filter Source conditions: Sample rate 39062 Hz

- FFT size 4096
- CW filter bandwidth 500 Hz
- noise level on panorama -160 dBm (approximate readings from the screenshot)

Back-end process of the S-meter readings calculation (with air noise inside RX filter): Step 1. The FFT bin band (single-unit filter) is always ~9,53 Hz, in current example the calculation goes like this: *39062/4096 = ~9,53 Hz.*

Step 2. Calculate the difference between RX filter bandwidth and single-unit filter: *500 Hz / 9,53 Hz = ~52,46 (times)*. RX filer bandwidth is approximately 52.46 times wider than a single-unit filter.

Step 3. Calculate the difference in dB between summed noise power in single-unit filter bandwidth and summed noise power in RX filter bandwidth: *10*log(283) = ~17 dB*. i.e. noise power in 500 Hz bandwidth will be higher than in single-unit filter on 17 dB.

Step 4. Calculate S-meter readings.*-160 dBm + 17 dBm = -143 dBm*.

Step 5. S-meter shows the **signal power** in the RX filter bandwidth and panorama shows the graph of **amplitude spectral density**.

Final result: Approximate S-meter readings will be **-143 dBm**.

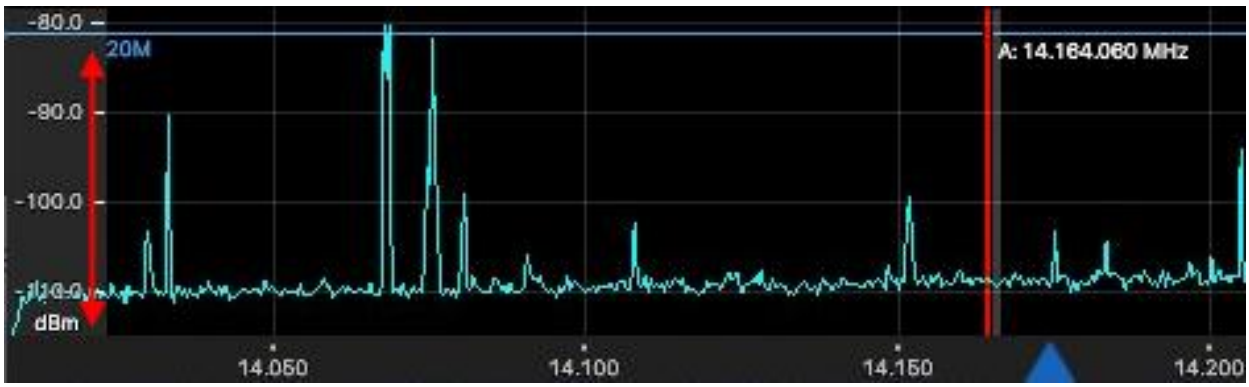
Conclusion: The calculated value of the S-meter readings is similar to real readings on the screenshot. The difference is 1.5 dB, it could be a deviation of the noise level from -143 dBm (assumed from the screenshot). If a useful signal present within the RX filter bandwidth (e.g. SSB signal), then S-meter will display the sum of all the voice components power within the filter bandwidth. Each individual voice component will be displayed lower than the overall S-meter readings on panorama. This is also valid for TX mode.

Note:	• *If current mode is CW with filter bandwidth 20 Hz and sample rate 312 kHz, the S-meter readings and panorama noise level will be approximately the same.*

9.5.1.1. Spectrum Scope scaling

When the mouse cursor moved over the left side vertical scale, a “hand” icon will appear with the following operational options:

- To change the dBm scaling, click-on and hold the the right mouse button, then drag it up/down.
- To change the air noise floor position in relation to horizontal scale, click-on and hold the left mouse button, then drag it up/down.



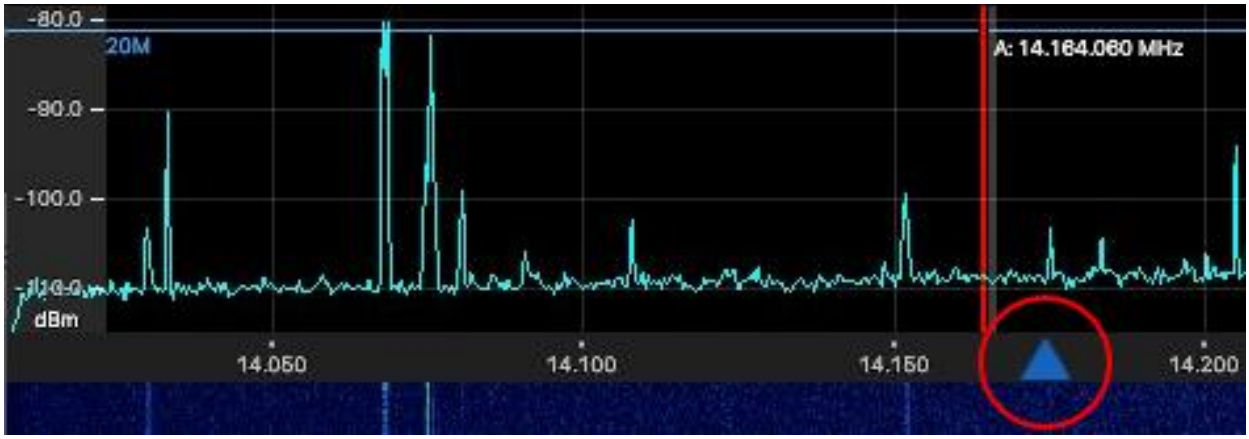
The horizontal scale between the spectrum scope and waterfall shows the frequency of the certain point on the spectrum:



When the mouse cursor moved over the horizontal scale, a “hand” icon will appear with the following operational options:

- To zoom in/out the panorama, click-on and hold the right mouse button and move mouse left/right.
- To change the ratio of the spectrum to waterfall, or click-on and hold the left mouse button, then drag mouse in “up/down” direction.

Important: **Zoom position marker** defines the zoom in/out panorama center:



There are few ways to change **position** of the **Zoom marker**:

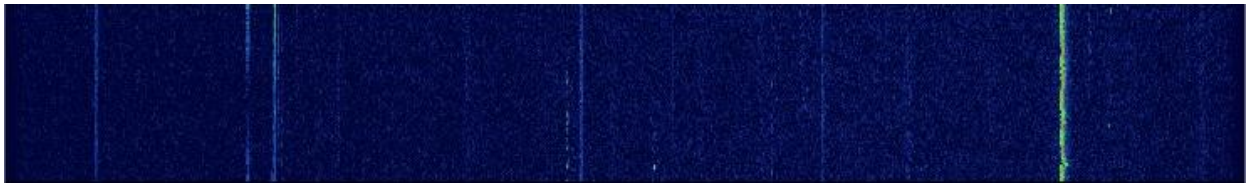
1. Hold down left mouse button on the Zoom marker and move mouse to the left/right; or

2. Hoover over the horizontal frequency scale and click the mouse wheel; or

3. Hoover over the horizontal frequency scale and double click left mouse.

9.5.2. Waterfall

Waterfall graphic (Spectrogram) is the timed spectrum scope assembled out of the amplitude - brightness, frequency - horizontal, and time – vertical parameters. By default all the parameters pre-configured based on our recommended settings, but can be customized if required. To customize the parameters follow the instructions in **Settings-> Visuals section**.



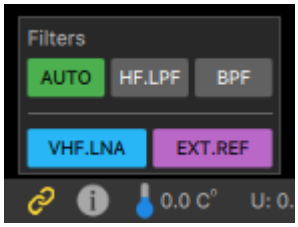
9.6. Status bar and quick settings

Quick settings and status bar located at the bottom of the main window:





- the **sample rate indicator** in the far-left corner of the control panel; left mouse click to select a sample rate from the drop-down menu.  - the **connection indicator**displays your transceiver current state. The **yellow** means your transceiver is unavailable, and the **green** the transceiver is available.



- right mouse click on the **connection indicator** opens a drop-down **Filters** menu with the filter type selection:

AUTO – use this option to auto-enable the RX wide filter when the bandscope, and/or the second receiver on another band is switched on.

HF.LPF – use this option to manually enable the wide filter for the entire HF (0...65 MHz) or VHF (95...155 MHz) band, depending on the RX1 position.

BPF – use this option to manually enable the HF band pass filters or VHF SAW filter, depending on the RX1 position.

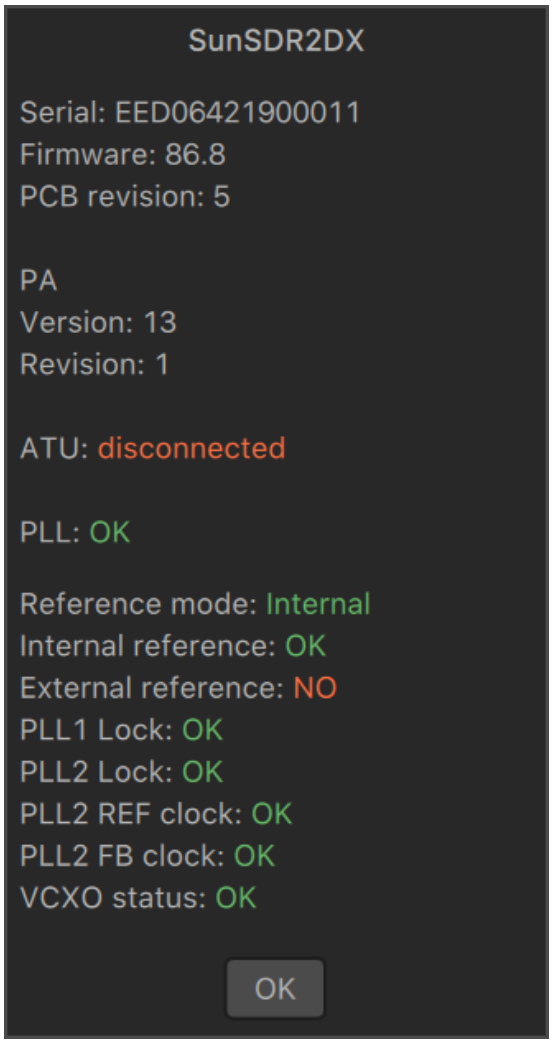
VHF.LNA – use this option to auto-enable the Low Noise Amplifier for the VHF band.

EXT.REF – use this option to enable the REF input connector, on the rear panel, to connect to an external 10 MHz reference oscillator.

Note:	• *When using RX1 and RX2 on the same band, the SunSDR2 DX uses BPF for both receivers. However, if you switch the RX2 to another band while the RX filter is set to AUTO mode, then the SunSDR2 DX will auto-switch from the BPF to HF.LPF. You still can use BPF in these situations, but they will be controlled by the RX1, and the RX2 will only be able to listen to the air outside the pre-filtered band.*



–**Device information** button; click on the button to view information about the operated SunSDR2 DX hardware and firmware status in a pop-up window.





–**temperature indicator** displays the current reference temperature inside the transceiver. Right mouse click on the indicator to choose between Celsius and Fahrenheit.



U: - voltage supply indicator (measured in the transmitter path).

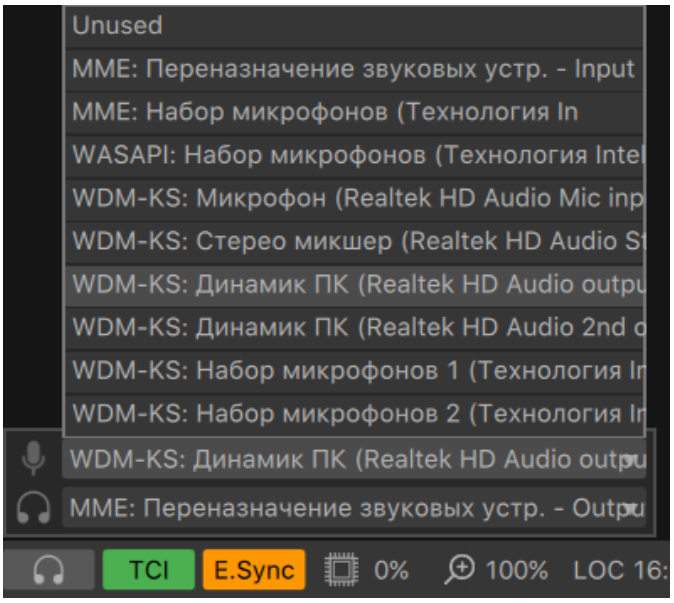
I: - current consumption indicator (measured in the transmitter path).



– tone generator indicator (displayed when generator is enabled).



–E-Coder panel indicator (active when E-Coder/E-Coder2 is connected to PC). For further information about E-Coder operation, refer to **E-Coder section**.

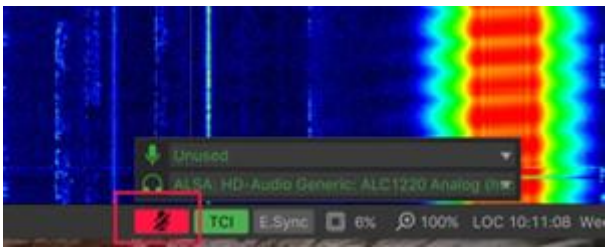


–**Sound Card** indicator with the drop-down menu option. It's editable while the icon indicator is **gray color**, when activated, the icon color changes from **gray** to **green**. There are two sets of options: "**Microphone**" and "**Headphones**" icons, that are explained below.



– the "**Microphone**" indicator icon, provides access to the sound card physical input and driver type selection. Left mouse click on the icon to select options from the drop-down menu.

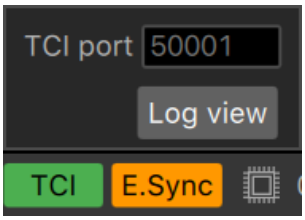
Note:	• *If Mic.PC is selected in the Mic menu, but it is not selected in the Sound Card settings, the "microphone" icon will turn **red**, notifying that the current selection is not active.*



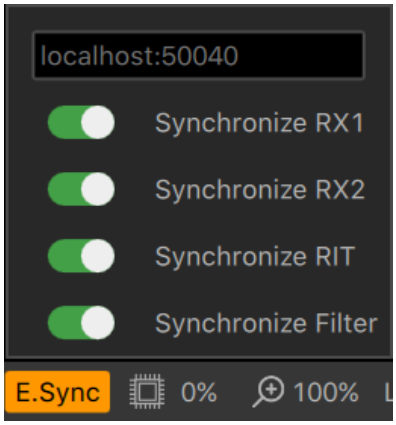


–the "**Headphones**" indicator icon, provides access to the sound card physical output and driver type indicator. Left mouse click on the icon to select parameters from the drop-down menu.

Note:	• *Make sure that all sound devices parameters are set correctly before enabling Sound Card.* • *48 kHz Sample Rate is pre-defined by the software and cannot be changed.*

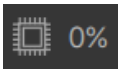


- the **TCIindicator;** right mouse click to open the settings. Enter the required **TCI Server port** and click-on the **Log view** button to view a command log in a pop-up window. Left mouse click to activate TCI server.

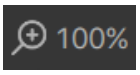


–left mouse click on the **E.Sync** indicator to activate the ExpertSync. The indicator legend: **gray** - disabled, **orange** - connecting to server, **green** - connected to server.

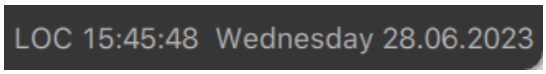
Right mouse click on the **E.Sync** indicator to access the ExpertSync settings menu with the following options: **Synchronize RX1** – toggle to activate this option if you'd like to synchronize the RX1 receiver of the current transceiver with other transceivers connected to the same ExpertSync server. **Synchronize RX2** – toggle to activate this option if you'd like to synchronize the RX2 receiver of the current transceiver with other transceivers connected to the same ExpertSync server. **Synchronize filter** – toggle to activate this option if you'd like to synchronize the filter bandwidth of the current transceiver with other transceivers connected to the same ExpertSync server. **Synchronize RIT** – toggle to activate this option if you'd like to synchronize the RIT parameters of the current transceiver with other transceivers connected to the same ExpertSync server.



– the **CPU load** of the current ExpertSDR3 instance in Operating System.



– the ExpertSDR3 application **zoom scale**. Left mouse click to open selection of scale presets from the drop-down menu.



– **time and date indicator**. Left mouse click to switch between local time and Coordinated Universal Time (UTC).

9.7. Settings menu



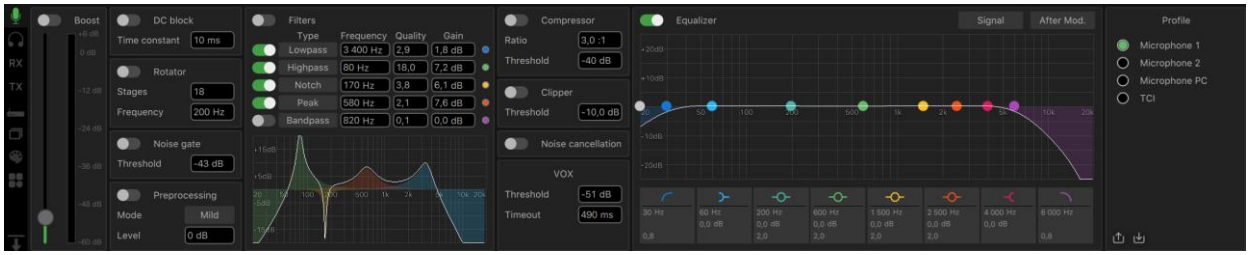
The global ExpertSDR3 **Settings** menu ("wheel" icon in the top right corner of the ExpertSDR3 window) is opened by the left mouse button click. To close the **Settings** menu either click-on the wheel icon  again or click-on arrow icon  in the left bottom part of the **Settings** menu.

The **Settings** menu contains selectable subsections in the far-left vertical pane. Selected subsection icon is colored.

Interface language. English, Russian and Chinese are available in all programs of the suite. The language is switched on the fly, without restarting the program.

9.7.1. Mic signal processing

Mic signal processing settings is in the top left corner of the far-left vertical pane ("**Microphone**" icon).



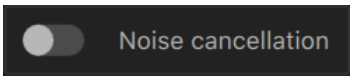
The Mic signal processing menu represents the chain of the software modules. These modules are placed in order the voice signal passes through them: **Boost-> Noise cancellation-> DC block-> Rotator-> Preprocessing-> Noise gate-> Filters-> Compressor-> Equalizer-> Clipper.**

The **Mic Gain** slider (the AGC max gain), located on the right-hand side of the main ExpertSDR3 application window, applies to the processed Mic signal that is already passed through all the modules.

Note:	• *ExpertSDR3 and ExpertSDR2 use different DSP algorithms (processing modules); hence, ExpertSDR3 and ExpertSDR2 provide inherently different end-user experience. The rationale behind the ExpertSDR3 transformation is to preserve the quality of the TX signal within the capabilities offered by a new programming framework.* • *Unlike the ExpertSDR2, the ExpertSDR3 always keeps the Mic AGC active, and it cannot be changed.* • *Nevertheless, the overall concept of setting up the mic signal in ExpertSDR3 and ExpertSDR2 is very similar, thus we recommend using* ***the video made by Vasily R6NY ex. RN6LHF*** *as a guide.*

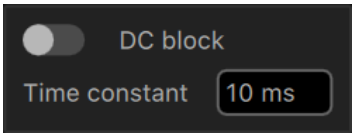


–**Boost**: is a Mic signal input amplification measured in dB.

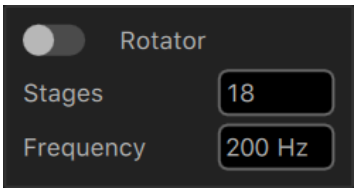


–the **Noise cancellation** role is to suppress ambient noises (e.g. TV, vacuum cleaner, street noise, etc.). This feature allows the operator to maintain high TX signal quality in noisy environments.

Note:	• *Very loud ambient noises may still overlap with an operator's voice and cause the signal distortion.*



–the **DC block** role is to effectively eliminate the **Time constant** in the microphone signal. Changing of the **Time constant** value in the range of 1-10 ms impacts quality of the signal. For example, if you reduce the Time constant value to 1 ms, you will notice low frequency signal degradation. And if you change the Time constant value to 10 ms, then you will notice the signal improvement.



–**Rotator (Phase Rotator).** Every single human voice is unique and has its own AFC. This is the reason why we are recommending this module parameters to be adjusted by every user individually.

Stages – displays the total number of phase rotators.

Frequency – frequencies above the indicated figure (it works like a threshold) will have their phase changed.

The algorithm itself is simple:

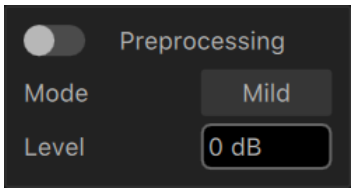
- First, adjust the Stages parameter (also known as Taps in some applications) in order to reach the max symmetric AFC. Check the result in the analyzer after each change of the Stages parameter.
- Then change the Frequency parameter, with a 50 Hz step, for example. Only the frequencies above this threshold are processed by the Rotator, the frequencies below the threshold are ignored.

Rationale behind the Phase Rotator feature:

Sound vibrations created by human speech have asymmetric amplitude, comprising negative and positive half-waves. Sometimes the asymmetric levels so significant they can create asymmetric signal peaks. In such cases the compressor and limiter, controlled by peak or RMS signal level, would rapidly drop their levels. Due to such dramatic drift (vary in real-time) and after passing the Mic processing chain, the voice sound will become unnatural.

Unlike in equalizers, when voice signal phase ratios altered by the Phase Rotator, the AFC remains intact. As the result, the voice harmonics get shifted in respect to the main frequency, which improves the signal symmetry. The elimination of the majority of asymmetric peaks in the signal reduces the "aggressiveness" level of the compressor influence, which in return makes the “resulting voice” sound dense and natural at the same time.

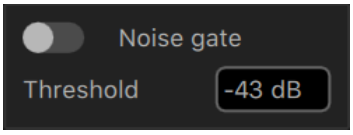
Moreover, the Rotator generates a psychoacoustic effect by amplifying low frequencies that makes the voice sound “clearer”. This effect is caused by harmonics time-shift in respect to a voice fundamental frequencies. After the voice is processed by the Rotator, the harmonics and main frequencies will be reproduced at a different time. This makes the harmonics more prominent to the human brain and creates a psychoacoustic effect of a “clearer” voice.



–the **Preprocessing** module enriches the signal with new harmonics by imitating a tube (valve) preamplifier.

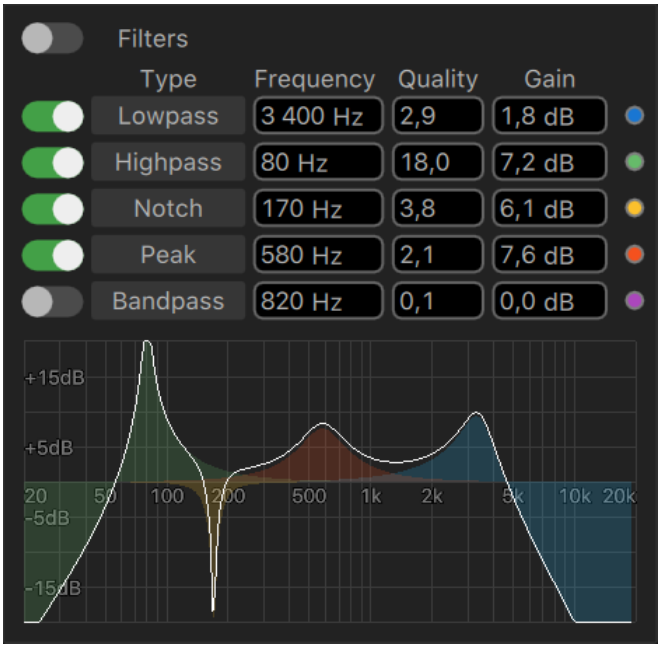
Mode has three algorithms Mild, Medium and Strong. Each of the algorithms determines harmonic distortion intensity of the Mic signal.

Level is a preamplification of the input Mic signal prior to the preprocessing.



–the **Noise Gate** (or Gate), removes all signals below the Threshold level. Its main role is to reduce the noise in speech pauses. The Gate will forward a signal to the next processing if the signal has surpassed the **Threshold** (state: gate open). And if the signal is below the **Threshold**, the gate will either ignore it, or pass it through to the next processing only after considerable attenuation (state: gate is closed). It is recommended to enable the Gate in the cases, where the desired signal level exceeds the noise level, and assumed to be set above the noise level and below the useful signal level.

Note:	• *The Noise Gate does not remove noises from a signal. When the Gate is open, then the signal and noise will get through.*



–the **Filters (Parametric filter module)** is a graphic display of a summed AFC (Amplitude-Frequency Characteristic) configuration. In the graphic, the AFC is represented by a white line and every enabled filter by its own-colored chart area. Up to 5 filters can be used concurrently. The filter types available are:

Lowpass – is a Low Pass Filter (LPF) that passes through signals only with a frequency lower than the determined cut-off threshold. The cut-off required threshold is determined by **Frequency**. The **Quality** determines the required steepness of the filter slope.

Highpass – is a High Pass Filter (HPF) that passes through signals only with a frequency higher than the determined cut-off threshold. The required cutoff threshold is determined by **Frequency**. The **Quality** determines the required steepness of the filter slope.

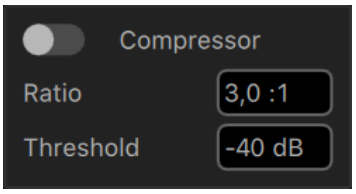
Bandpass – is a Band Pass Filter (BPF) that passes through signals only with a frequencies within the determined band range and filters out frequencies outside of the range. The required cut-off threshold is determined by **Frequency**. The **Quality** determines required bandwidth of the passband.

Notch – is a band-stop filter with a narrow stopband. It filters out a determined range of frequencies and passes through all the other frequencies as is. The required tuning frequency is determined by **Frequency**. The **Quality** determines the required stopband bandwidth.

Peak – is also known as Bell filter. This filter is similar to the Notch filter, but it has many flexible settings. It boosts or cuts a determined frequency by a **Gain** value applied to the surrounding frequencies in a bell-shaped curve. The required tuning frequency is determined by **Frequency**. The **Quality** determines the required cut-off bandwidth.

Low Shelf – is a filter that boosts or cuts frequency signals below the cut-off threshold determined by **Frequency**. The **Gain** value determines required boost or attenuation for the frequency levels below the cut-off threshold. The Frequencies above filter's AFC will not be adjusted.

High Shelf – is a filter that boosts or cuts frequency signals above the cut-off threshold determined by **Frequency**. The **Gain** value determines required boost or attenuation for the frequency levels above the cut-off threshold. The Frequencies below filter's AFC will not be adjusted.



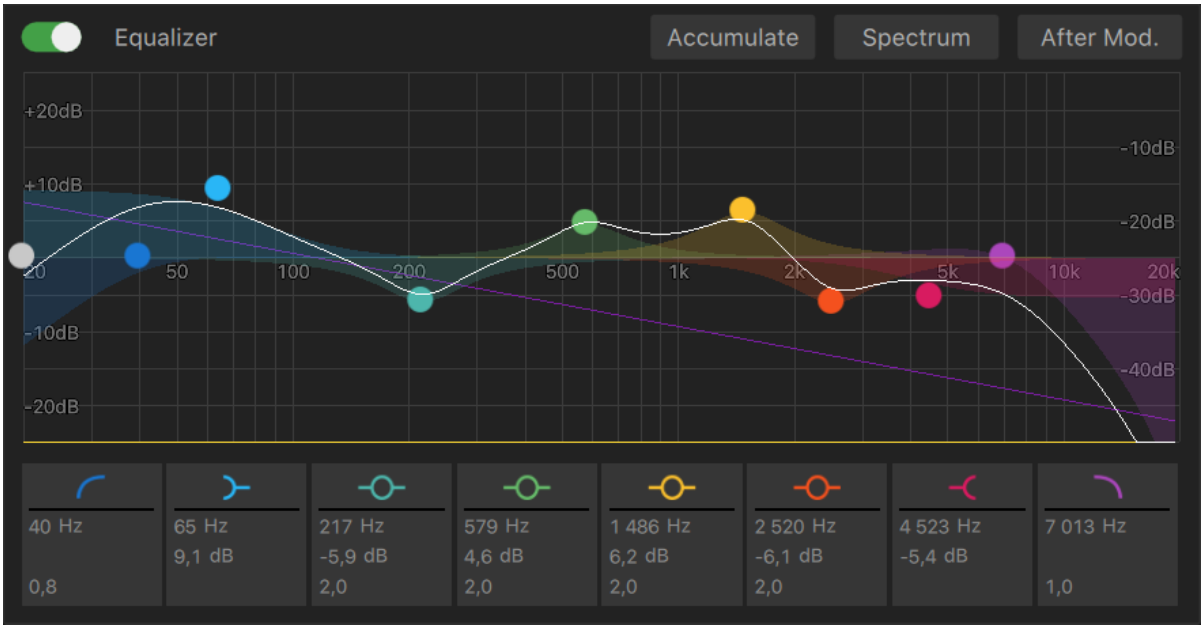
–the **Compressor** is used to reduce dynamic range of the audio signal. In other words, the primary role of the compressor is to minimize the discrepancy between quietest and loudest sounds.

The compressor automatically controls the Volume. The Downward compression reduces loud sounds over a determined Threshold, while quiet sounds remain unaffected. This compression may improve sound audibility in rough environments, where background noises may suppress quiet sounds. While the loud sounds easily audible, the quiet sounds are not. An overall volume increase can improve the quiet sounds, but this will also impact the loud sounds making them

unbearable for human ear. When the downward compression is applied to such audio, the overall volume may be increased to the level at which both sound levels become comfortable.

Ratio – determines input/output signals exceeding Threshold. For example, the ratio of 3:1 translates to the input level of 3 dB over the threshold, and the output signal level of 1 dB over the threshold.

Threshold – is a compressor that reduces the level of an audio signal if its amplitude exceeds a certain threshold (in dB).



–**Equalizer:** the primary role of the Equalizer is to perform the finest tuning on a required frequency. The Parametric equalizer module with graphic display of the resulting AFC represented by a white line and each of the equalizers by its own marker and colored chart area. To adjust an equalizer, either drag the marker on the graph or adjust its parameters in the tiles underneath. An equalizer tile parameters from top to bottom: frequency, gain, quality. Right mouse click on a band sign to set default settings to any EQ band.

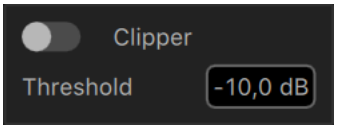
There are eight filters (left to right): High Pass, Low Shelf, Peaking or Bell (4 units in between), High Shelf, Low Pass (on the right); those function similar to the Filters module described above.

When the **Spectrum** mode is enabled, the Equalizer graph can serve as a **TX signal analyzer**. The controls of the **analyzer** can be found at the top right corner of the Equalizer menu. The **analyzer** does not process signals, it only displays the signal entering the modulator. Press the **Accumulate** button to display your voice peak values during the time of analysis. An average value of the spectral density amplitudes represented by **Grey** color. Peak values of the spectral density amplitudes represented by **Yellow** color.

Spectrum – is a display of the real Mic TX signal in respect to **pink** noise line. When the **Spectrum** is enabled, the **pink** noise line shows the energy spread by frequency.

Signal – is a time diagram of a signal that will be sent on the air. This mode enables you to visually inspect TX signal as well as to observe the Rotator, Compressor and Clipper effects.

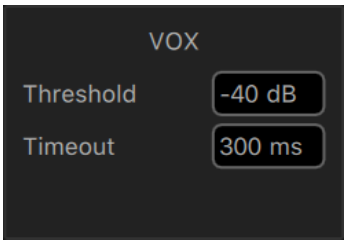
Before Modulator / After Modulator – enables you to choose the kind of signal to display in the analyzer and to pass to the PC sound card.



–**Clipper.** Clipping is a form of waveform distortion that occurs when the output Voltage exceeds the **Threshold**. The clipping sounds like splutters and cracks, and looks like altered signal peaks in an oscilloscope. The Clipper reduces signals peak-factor and increases RMS power while distorting the signal. The **CESSB** filter bandwidth is locked to 0 Hz low and 5 kHz high. If you want to use TX filter bandwidth higher than 5kHz do not use Clipper.

Threshold – the threshold level is set in dB. If a signal exceeds this level, the Clipper will cut it.

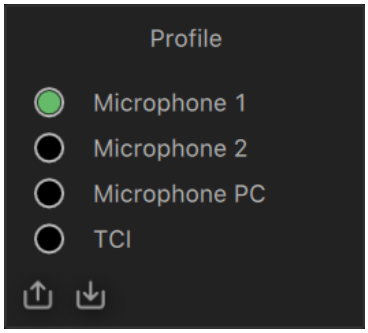
Note:	• *Use the Clipper to increase RMS output power in SSB, AM and NFM modes. In compare to the ExpertSDR2, the ExpertSDR3 RMS output power is somewhat lower due to the higher quality of the output signal.* • *Clipper in ExpertSDR3 works as CESSB algorithm.*



–**VOX** is triggered when the **Threshold** is exceeded by the microphone's voice signal. VOX settings are saved independently for each microphone.

Threshold – VOX response threshold.

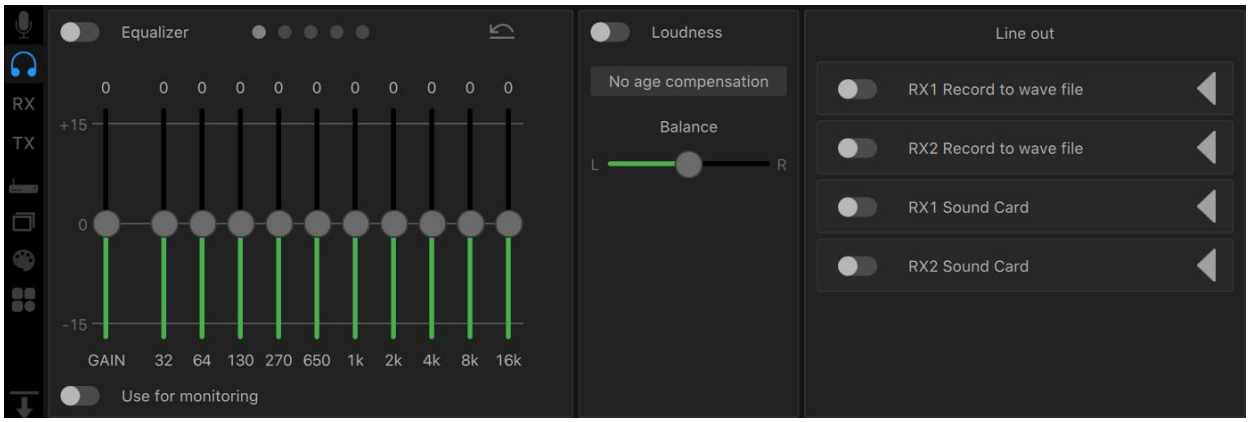
Timeout – time before the transceiver switches back to receive mode.



– in the **Profile** menu you can adjust voicesignal parameters separately for each microphone: **Mic1**, **Mic2**, **MicPC**, **E-Coder2 Mic** (if connected) or apply them to a signal coming from **TCI**. If Mic2 is selected in this menu, while Mic1 is in use, the displayed settings will not be applied to the Mic signal. Profile can be used to import and export Processing module settings to share with other hams.

9.7.2. Receiver audio / Line out

Receiver audio settings and Line out ("**Headphones**" icon).



Equalizer

If Equalizer is "ON", it will apply settings to the receiver audio.

The RX equalizer has 5 editable sets and Reset icon .

If **Use for monitoring** function is "ON", it will apply RX equalizer settings to the self-monitoring audio (after signal processing).

Note:	• *This effect (EQ settings) is not applied to the transmitted signal.*

Loudness

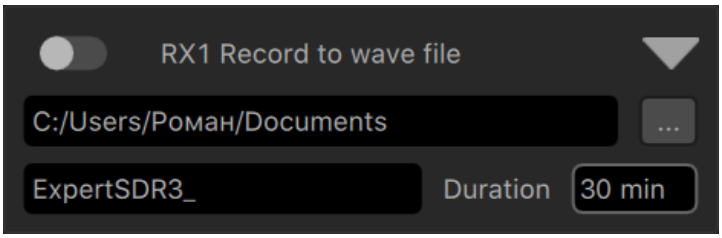
If the Loudness function is “ON”, it will apply tone and AFC compensation to the receiver audio in accordance to a selected mode:

- No age compensation,
- Under 30 years,
- From 30 to 60 years,
- Over 60 years old.

Compensation AFC is based on the average hearing loss statistics.

Balance is applied to global receiver audio **Balance**.

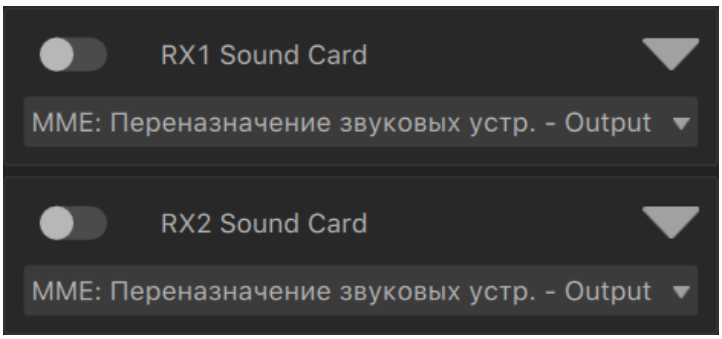
Line out menu is controlling PC sound card Line out settings.



Toggle **RX1/2 Record to MP3 file** to activate recording of the sound output from the sound card in the RX and TX modes in MP3 format.

The max file length is 30 min. You can customize the files location directory.

Note:	• *Sample rate is always 48 kHz.* • *Sound output via the Line out will be simultaneous with the sound output from the transceiver.* • *Line out volume has a constant max value and cannot be changed by the operator.* • *Line out always operates in 2 channels.*

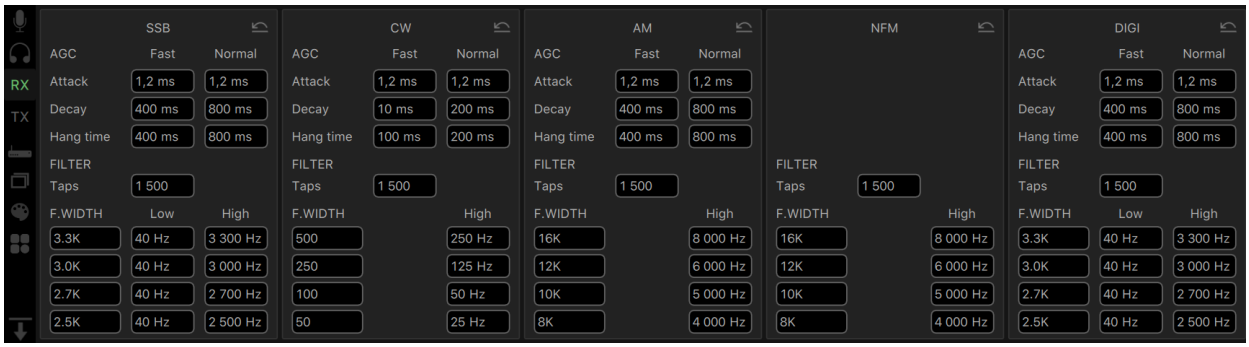


Toggle **RX1/2 Sound Card** to activate audio playback from the RX1 or RX2 in the selected audio device/driver.

Note:	• *Sample rate is always 48 kHz.* • *Signal output delay via the sound card is card/platform/OS dependent and can be up to 250-500 ms. In some scenarios, it is adjustable via Audio driver selection. ExpertSDR3 supports the following drivers: standard Windows drivers (MME, WDM-KS, WASAPI) and professional audio cards driver ASIO, Apple built-in and Linux built-in audio drivers.* ***For Windows 10** ASIO4ALL is the fastest driver (minimal latency), WDM-KS is slightly slower (moderate latency), WASAPI and MME slower (the biggest latency).* ***For Windows 11 the audio driver latency is different**, please consult MS documentation.* *Please consult relevant information for **Apple** and **Linux**-based PC.* • *If the sound card installed in the PC supports a certain type of driver (and driver is set in OS), then it will be displayed in the drop-down menu.*

9.7.3. RX filter DSP

RX filter DSP settings menu. In this menu you can customize the AGC parameters, Filter taps, and Filter bandwidth for each mode, i.e. SSB (LSB/USB), CW, AM, NFM, DIGI (DIGL/DIGU) ("**RX**" icon).



AGC:

Attack – when a signal gets stronger, this value determines how quickly the AGC will decrease gain.

Decay – when a signal gets weaker, this value determines how quickly the AGC will increase gain.

Hang time – sets time (in ms) to keep the signal level the same, after the Attack period is over and before the Decay period is initiated.

FILTER Taps – is a value that determines a shape of the RX filter. The higher the value, the more rectangular its shape gets. The higher the value, the higher the signal pass delay. Optimal filter taps are set to 1500 by default. The users can customize the settings as required, balancing between acceptable filter slopes and signal delay.

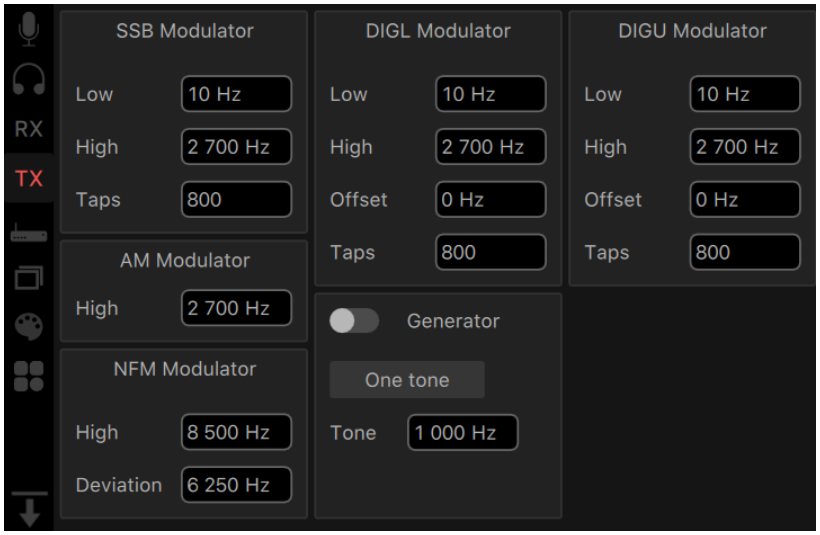
FILTER WIDTH – here you can set up four filter bandwidth presets for each mode, if required.

Enter the desired preset name in **F.WIDTH** column and configure its **Low** and **High** edges in their respective columns.

To reset to default settings, click on the reset  button.

9.7.4. TX modulator DSP

TX modulator DSP settings menu. In this menu you can customize the bandwidth, offset and taps for each mode modulator (“**TX**” icon).



SSB/DIGL/DIGU/AM modulators.

Low – is a low front filter frequency.

High – is a high front filter frequency.

Offset– is a frequency offset used in digital modes. The frequency offset requirements depend on a third party digital mode software. To determine the right offset refer to the selected digital mode software instructions.

Taps– is a value that determines a shape of the TX filter in SSB and DIGL/DIGU modes. The higher the value, the more rectangular its shape gets. The higher the value, the higher the signal delay and CPU load. The default **Taps** value is 800 that is equal to 20 ms delay. Each 100 taps is equal to 2.5 ms delay.

Note:	• *Limits of the TX filter bandwidth in SSB mode: low – from 1 Hz up to 200 Hz, high – from 1000 Hz up to 10000 Hz.* • *The modulation coefficient of the AM mode is locked by default at 0.95 (95%). So that carrier power is approximately 50% to sidebands 50%.*

NFM modulator - Narrow FM.

Deviation – is an FM signal deviation. The width of the signal on the air will be twice the deviation width.

High – is a frequency of the high filter slope of the LF signal before FM demodulator. You can set the required LF signal width from zero up to high filter edge.

Generator is a section with the dual-tone signal settings;



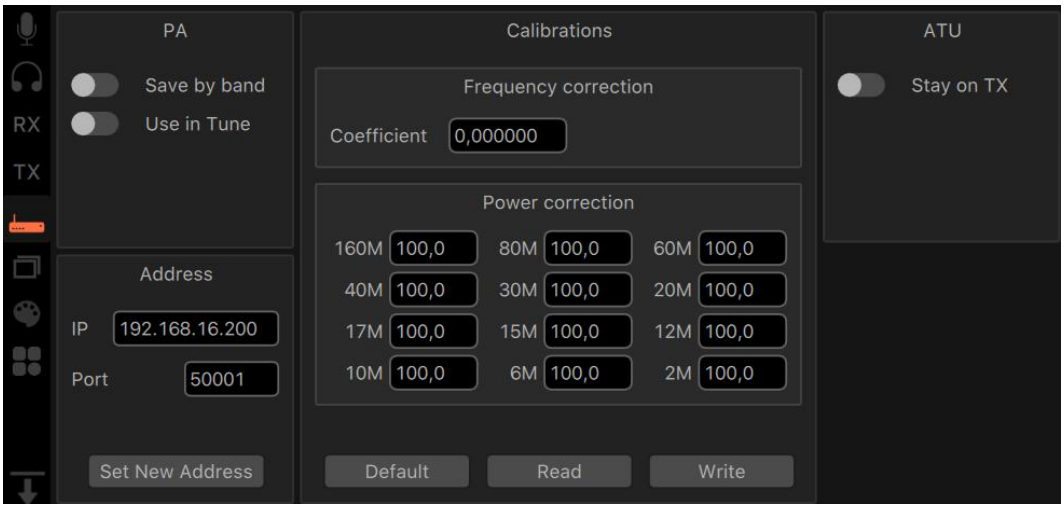
– tone generator indicator in Status bar (active when generator is enabled).

Choose between **One tone** or **Two tones** mode to generate the dual-tone signal.

The Tone 1, Tone 2 - set independent frequency for the Tone 1 and Tone 2 signals respectively.

9.7.5. Radio

Firmware settings menu. In this menu you can customize the transceiver IP address, Calibrations, internal PA operation and ATU control ("**Radio**" icon).



PA

Toggle the **Save by band** to enabled, to replace the **Global PA** button by the **PA column** in the Band Manager window.

Toggle the **Use in Tune** to enabled, to activate X8 ExtCtrl key in Tune mode.

Address

IP - is a current transceiver IP address.

Port - is a current transceiver UDP Port. ExpertSDR3 always uses two ports for each radio, one is indicated, and another is "increment +1": e.g.: 50001 (indicated), 50002 (hidden). To change the IP address and Port, enter new values in their respective fields and click on the **Set New Address** button.

Calibrations

Frequency correction: adjust the **Coefficient** value when received signal (known frequency) does not match with the tuned frequency. Correction of the displayed frequency can be done

in accordance to the known pulse time signals on the 14.996MHz (preferably), 4.996MHz and 9.996MHz IARU region 1 frequencies, or 5.0MHz, 10.0MHz, 15.0MHz IARU region 2 frequencies. If the received time signal does not match with the tuned frequency, adjust the Coefficient until they match, by following the below steps:

1. Select the minimal sample rate 39 kHz.

2. Select CW mode.

3. Tune on 14.996 kHz in day-time, 9.996 or 4.996 in night-time (note: the higher the calibration frequency the better).

4. Zoom Panorama to the maximum level.

5. If peak of the time signal is away from the red tuning filter, change the Coefficient until they match. After each change click-on the Write button (note: corrections are stored in the transceiver's firmware).

Note:	• ***Coefficient*** *is a multiplier; the higher the coefficient - the higher the deviation. Examples:* *1'800'000 * 1.001 = 1'801'800 (based on the 1,8 MHz with multiplier 1.001)* *144'100'000 * 1.001 = 144'244'100 (Based on the 144,100 MHz)* *The higher the frequency for calibration, the higher the adjustment precision. If you have a "known signal" generator, then you can use it to define frequency coefficient (same logic applies: higher frequency is better, with 79 MHz limit).* *Note that all SunSDR2 DX transceivers are calibrated at the manufacturing and usually will not require an additional calibration.*

Power correction – is a per band output power value correction menu. "Value = 100" means the maximum output power of the transceiver.

Note:	• *Power correction is a coefficient, not Watt; the coefficients are not equal to real output power.* *Example: power coefficient 50 on 20M is not equal 50W, it can be close to 60W.* *The power coefficients for the output power below 100W are not equal through every band. Maximum care is recommended when changing coefficients: always start with lower values. Adjustments may also be required when connecting an external power amplifier to the transceiver.* • *These settings are stored in the transceiver firmware and deemed as the primary power output settings.* • *After adjusting the power values, click on the Write button.*

Default – click on the **Default** button to return to default settings of the section.

Read - click on the **Read** button to read the firmware settings from the transceiver's memory.

Write - click on the **Write** button to store the hardware settings in the transceiver's memory.

ATU

Enable the **Stay on TX** for the transceiver to stay in TX mode after tuning with the connected AAT-100 is completed.

9.7.6. Autostart

Click on the **AutoStart** menu to add 3rd party applications to ExpertSDR3 startup.



Enter the executable file path into **Application file path** field and toggle to enable.

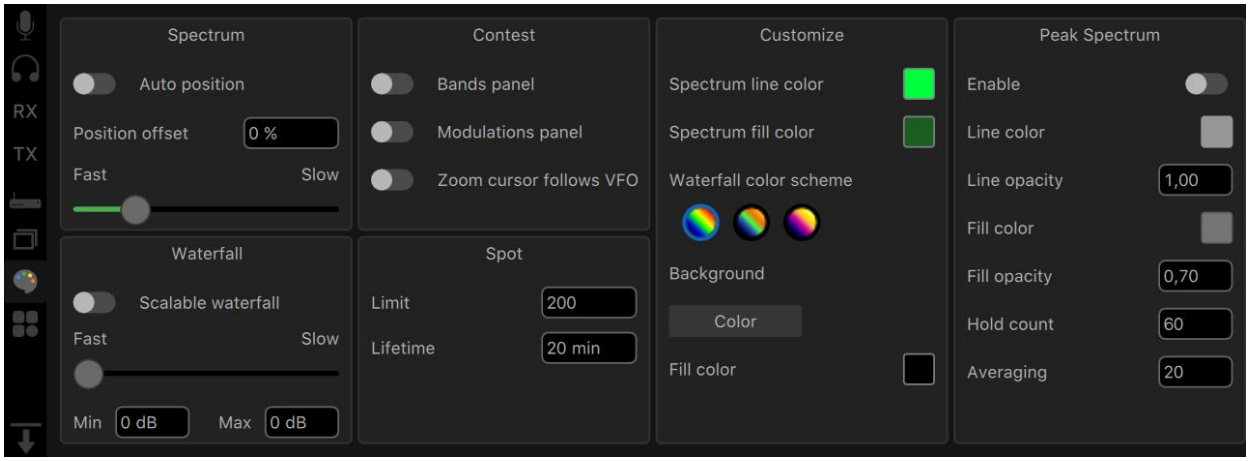
The same application can be launched with different arguments, you can have up to three instances of the application with different arguments at a time. The Arguments may determine a unique settings file for a certain instance, to learn about supported arguments refer to the 3rd party application instructions.

Click-on the **Delete** icon  to remove a 3rd party application from the Autostart list.

Note:	• *Bat scripts for Windows 10/11 and .sh files for Linux and macOS are supported.*

9.7.7. Visuals

The ExpertSDR3 instance appearance can be adjusted via the **Visuals** menu.



Color scheme — light and dark interface themes are available in the menu of the ExpertSDR3 icon in the notification area and in the utilities (RadioSync, RadioMacros, RadioSpot); the theme is selected from the menu of the ExpertSDR3 notification area icon and applied at startup, the dark theme is used by default. The main application window currently uses the dark theme only.

Spectrum

Enable the **Auto position** to auto-position the noise floor level in respect to the horizontal scale. If enabled, the noise floor will always stay above the horizontal scale. The **Position offset** sets the distance between noise floor and horizontal scale. The higher the value, the bigger the distance. Position of the **Fast <-> Slow** slider sets the animation speed of the spectrum scope. The first (leftmost) position of the slider gives the full waterfall speed.

Waterfall

When **Scalable waterfall** is enabled: Position of the **Fast <-> Slow** slider sets the speed of the waterfall (spectrogram) animation. Change the **Min** and **Max** values to adjust contrast of low and high power signals displayed in the waterfall. The Waterfall color is calculated based on the noise floor (Min) and most powerful signal level (Max). The color adjustment is a non-stop process. Adjust Min/Max values to make the noise floor darker or brighter. **For example**, when you are operating with AM stations where the central frequency towers above all other signals. By lowering the Max value, you will make the weaker signals more sound on the spectrogram.

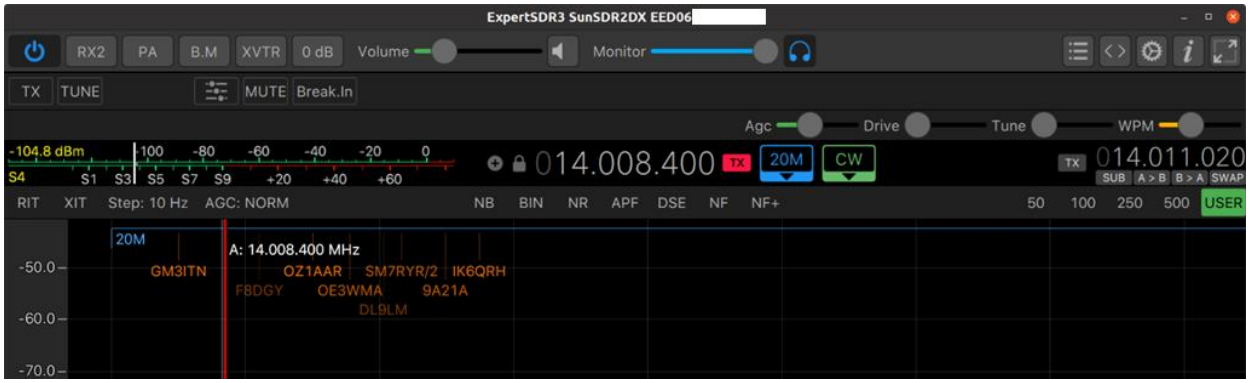
Contest

Enable the **Bands panel** to display all bands on one panel in the **Transceiver control panel** section.

Enable the **Modulations panel** to display all modes on one panel in the **Transceiver control panel** section.

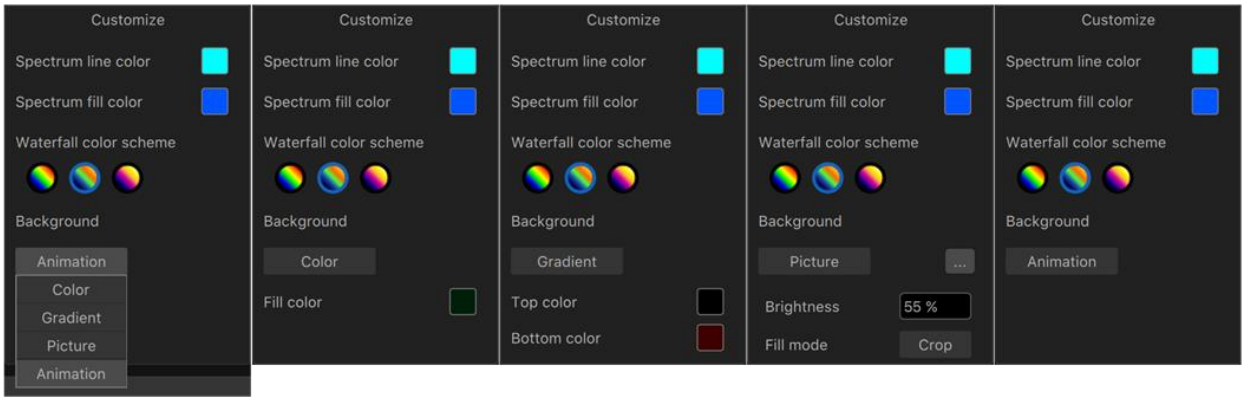
Enable the **Zoom cursor follows VFO** to make sure the zoom cursor follows the frequency set from TCI.

Spot



By changing the **Limit value,** you can set the number of spots within a range of 50 - 500 to be displayed in the Spectrum at a time (the more spots the higher CPU load). By changing the **Lifetime** value, you can set a spot lifetime between 3 - 60 minutes. If the ExpertSDR3 is connected to a logger with a spot share capability, the spots will be displayed in the panorama. The ExpertSDR3 does not have its own Spot server implemented yet. The left mouse click on a spot in tunes spot's frequency to tune it to VFO A, and the right to VFO B.

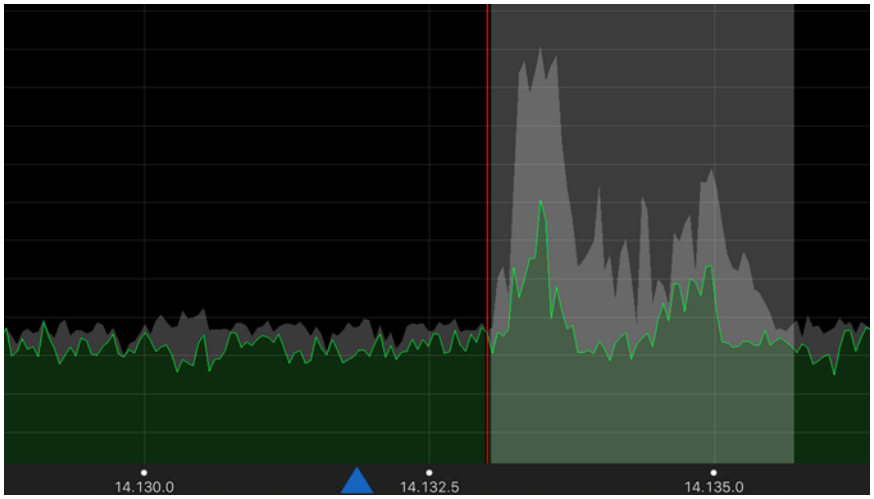
Customize



Click on the **Spectrum line color** and the **Fill color** to select the required color from the palette. The **Waterfall color scheme** provides selection of color scheme from the predefined waterfall color patterns. The following options are available for the spectrum **Background** setup: **Color** - is a single solid color option. Right mouse click on the color palette to set the default color. **Gradient** – allows you to select the main Top color and an additional Bottom color that will blend in the middle of the spectrum. Right mouse click on the color palette to set the default color. **Picture** – allows you to add an image. You can also adjust the image with the **Brightness**

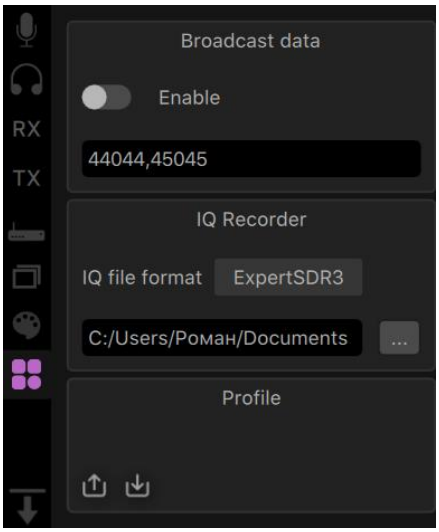
and select the fill from the **Fill mode:** Fit, Crop, Stretch. Right mouse click on the selected picture to set the default image. **Animation** – enables the snowflake animation.

Peak Spectrum



When **Enable** is "ON" the spectrum peaks will be displayed. **Line color** – allows you to select the line color from the palette. **Line opacity** - is a value that determines the opacity of the colored line. **Fill color** - allows you to select the fill color from the palette. **Fill opacity** – is a value that determines the opacity of the colored fill. **Hold count** – allows you to set the hold time of the spectrum peaks display in FPS. **Averaging** - is a value that determines the smoothness of a peak lowering down to the noise floor level.

9.7.8. Other



Broadcast data This section is currently in development.

IQ Recorder Select the **IQ file format** between ExpertSDR3, WAVE or HDSDR. More information about IQ recorder formats is in **this section**. Select the folder to save IQ files.

Profile Profile settings file holds all the Settings menu and ExpertSDR3 instance parameters. Profile settings can be imported/exported for backup and share purposes.

9.7.9. Settings folder

ExpertSDR3 settings are stored in specific and OS dependent locations: **Windows**: C:\Users\User_Name\AppData\Local\Expert Electronics\ExpertSDR3**Linux**: /home/[UserName]/.config/Expert Electronics/ExpertSDR3**Mac OSX**: /Users/[UserName]/Library/Preferences/Expert Electronics/ExpertSDR3

9.8. Operating System (OS) installation dependencies

Linux only.

In Linux ExpertSDR3 is auto-installed in the system folder /opt/ExpertSDR3. Shortcuts for ExpertSDR3 and RadioSync are provisioned during the installation and placed within the list of installed applications.

It is recommended to use install.sh, so the installation process can automatically create the permission rules for USB-devices, making ColibriNANO receiver and E-Coder2/E-Coder control panels to work without manual OS permission changes.

To delete ExpertSDR3, start uninstall.sh; it will also delete the rules created earlier.

10. RadioSync

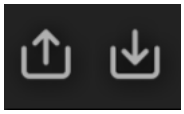
Launch. RadioSync is launched from the Utilities section of the ExpertSDR3 notification area icon menu; selecting an already running utility brings its window to the front. Via the Autostart submenu it can be set to start together with ExpertSDR3. The utility receives the interface language and color scheme from the menu of the ExpertSDR3 icon in the notification area and closes together with the icon.

SyncPair unit is a core **RadioSync** function that is virtually bridging SunSDR2 DX (TCI) and 3rd party (non-TCI) devices. ExpertSDR3 instance has its own in-build TCI server. Each **SyncPair unit** has a two-way connection, the TCI connection towards the ExpertSDR3 and the connections towards 3rd party software/hardware. Unlimited number of **SyncPair units** can be setup within the same ExpertSDR3 instance (the TCI server), these units are independent of each other.

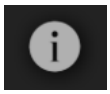


Note:	• *RadioSync is installed along with ExpertSDR3 and the RadioSync application shortcut is placed in the same installation folder: e.g. C:\Program Files\ExpertElectronics\ExpertSDR3 (in Windows).*

Common RadioSync functionality:



- click on the export/import icons to share/backup current settings.



- click on the information icon to view current RadioSync version.



- click on the plus icon to create a new **SyncPair unit**.

Header settings for each SyncPair unit:



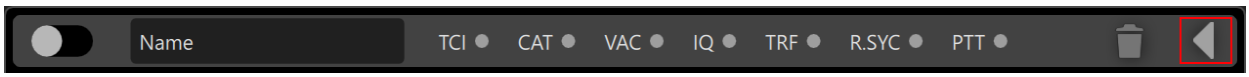
- toggle the switch to enable/disable a **SyncPair unit**. If a unit is enabled, its connection parameters cannot be changed.



- is a field for custom **SyncPair unit** name.

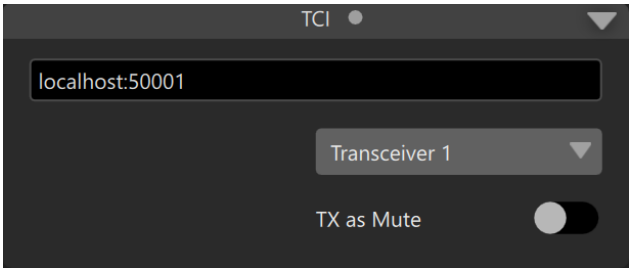


- click on the bin icon to delete the selected **SyncPair unit**. You can delete a **SyncPair unit** only when it's disabled.



Click on the marked arrow button to collapse a **SyncPair unit** from the menu to a string. This feature is very convenient when you have established multiple **SyncPair units**.

Core settings for each SyncPair unit, left side:



- enter *valid* IP address and port of the **ExpertSDR3 TCI server** (not IP address and port of the transceiver) to establish a connection between a SyncPair and TCI server. By default you can see a working value: **localhost:50001**.

Color indicators:

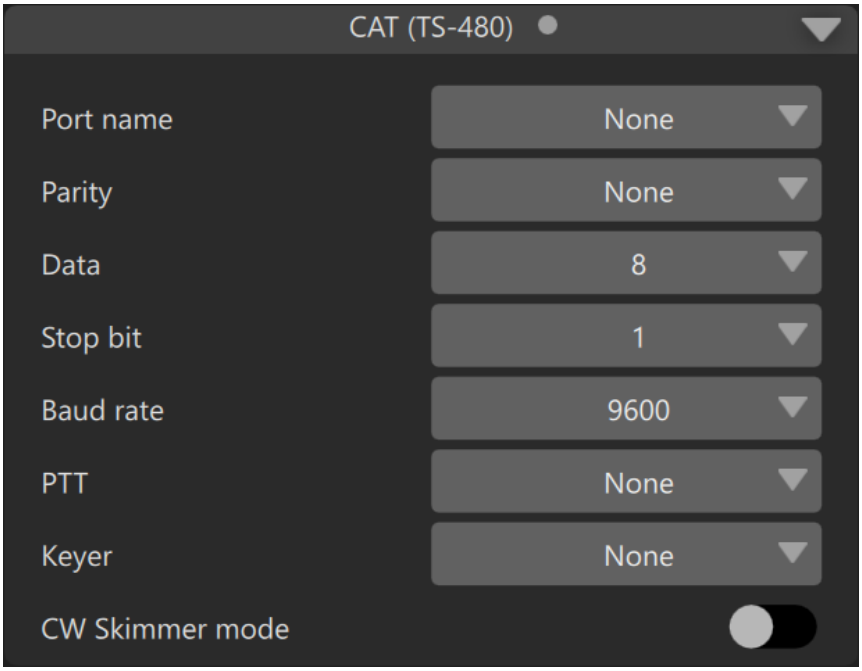
- *Grey indicator - inactive*
- ***Green indicator** - connected / device is opened (CAT/VAC)*
- ***Yellow indicator** - establishing connection*
- ***Red indicator** - failed to connect / open device*

Note:	• *A Transceiver Control Interface (**TCI**) is an advanced solution for a seamless integration between the ExpertSDR2/3 (server) and 3rd party applications (clients). The TCI offers all the required control commands similar to CAT system and much more. Unlike CAT system, it can transfer IQ-streams from the ExpertSDR2/3 to the clients (e.g. Skimmers, etc.) via numerous channels such as LAN, Internet, CW macros, and Audio In/Out streams for digital modes. The TCI universal multi-client interface is able to support unlimited concurrent connections with radio Loggers, Skimmers, PAs, antenna switches, etc. Moreover, it is an open protocol solution that can be used with multi-band transceivers, that support single, dual, or multiple receivers/transmitters. This is a game-changer in SDR radio, isn't it! But wait, it is also an open-source protocol, the usage of which we've discussed with hardware and accessory developers. For instance, the Band Pass Filters unit with LAN interface can now get an information about radio frequency via LAN, switch filters, the same applies to antenna switches and PAs, and so on. The TCI integration experience is so seamless, you would not believe your eyes!* • *For more information, detailed TCI manual and demo-client software, please visit **GitHub documentation repository**.*

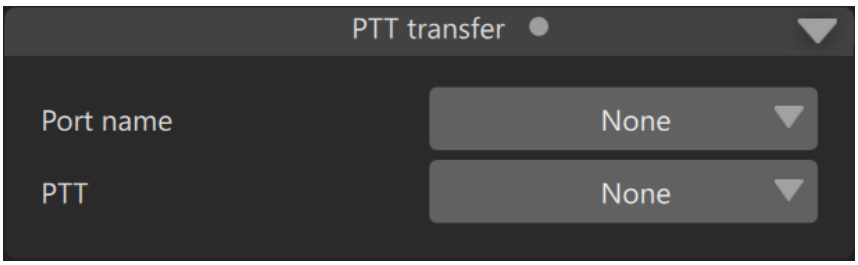
Transceiver 1/2 - click on the dropdown menu to select RX1 or RX2 receiver. **TX as Mute** - toggle the switch to replace TX command with Mute. For ColibriDDC and ColibriNANO, it is required to Mute transmission when the connected transceiver is in TX mode.

Right side.

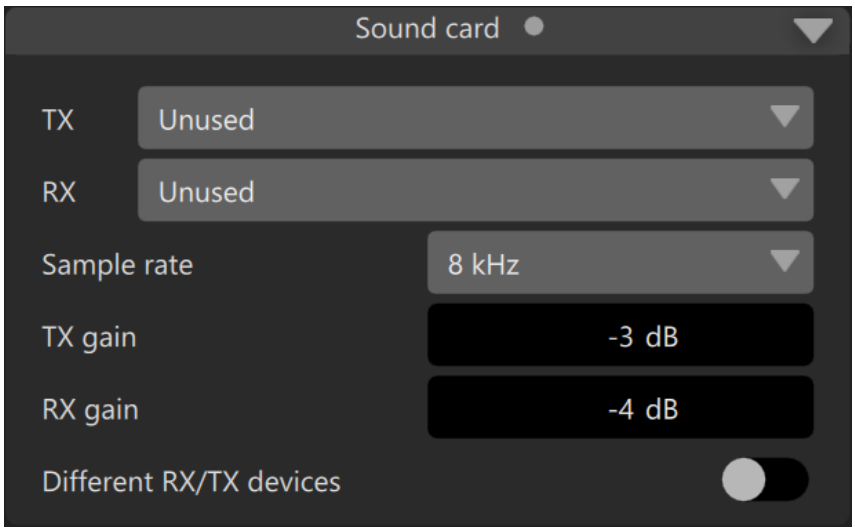
All active modules on the right side of every **SyncPair unit** are interdependent. For example, if CAT and VAC are active, and the TX device is selected in the Sound Card module, then a PTT command received from CAT will automatically capture the TX signal from VAC. Otherwise, the TX signal will be captured from the Mic selected in ExpertSDR3.



- the **CAT** module emulates the behavior of Kenwood TS-480 CAT protocol, that is limited to commonly used commands (the **list of commands**). It works the same way as the ExpertSDR2. This module is required for synchronization with third-party software such as N1MM, FL-DIGI etc. **Port name** – click on the dropdown menu to select a COM-port number. **Parity** – click on the dropdown menu to select a parity (e.g. Even, Odd, Space, Mark). **Data** – click on the dropdown menu to select the number of data in bits (e.g. 5, 6, 7, 8). **Stop bit** – click on the dropdown menu to select the number of stop bits (e.g. 1, 1.5, 2). **Baud rate** – click on the dropdown menu to select the port speed (baud rate) (e.g. 1200, 2400, 4800, 9600, 19200, 38400, 57600, 115200). **PTT** – click on the dropdown menu to select the COM-port line activating the TX mode (e.g. DTR, RTS). **Keyer** - click on the dropdown menu to select the COM-port line for the CW mode (e.g. DTR, RTS). **CW Skimmer mode** – toggle the switch to enable the right operation with the CW Skimmer. When enabled, the tuning frequency displayed in the CW Skimmer will correspond to the center frequency of the panorama in the ExpertSDR3. The right settings for the CW Skimmer are SoftRock-IF, which controls work through OmniRig.

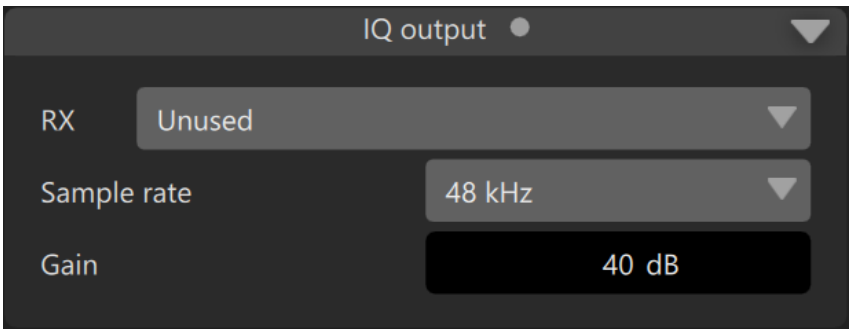


- the **PTT transfer** module is required for configuration of the PTT signal transfer from E-Coder2/E-Coder panel to TCI interface, which then forwarded to DTR or RTS line. It automatically splits the TX signal source by activating **PTT-transfer** when the PTT-footswitch is pressed. This feature was implemented for better compatibility with N1MM logger. If CAT / VAC / PTT-transfer set up in one **SyncPair unit**, then the choice of TX signal source is determined by the state of the PTT-key:- If the PTT-footswitch is pressed, you will transmit the mic signal- If the PTT-footswitch is not pressed, you will transmit the signal from VAC**Port name** – click on the dropdown menu to select the COM-port number. **PTT** – click on the dropdown menu to select the COM-port line activating the TX mode (e.g. DTR, RTS).

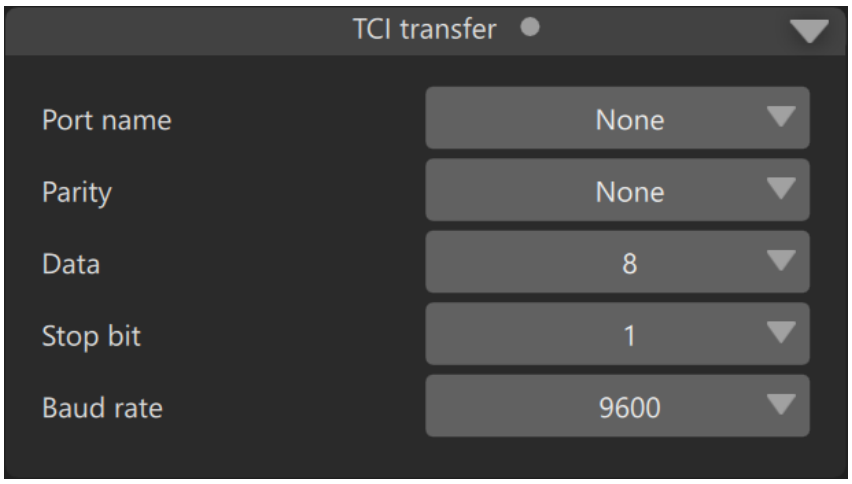


- the **Sound card** module is required for configuration of a 3rd party application connections via VAC. **TX** - click on the dropdown menu to select a sound card's output and driver for the audio signal originated from the 3rd party application that will be transferred to the RadioSync via VAC. **RX** - click on the dropdown menu to select a sound card's input and driver for the audio signal received by the RadioSync that will be transferred to a 3rd party application via VAC. **Sample rate** – click on the dropdown menu to select the sampling frequency (e.g. 8, 12, 24, 48 kHz). **TX gain** – use this field to configure an additional signal amplification in the virtual audio cable's TX path in dB. **RX gain** – use this field to configure an additional signal amplification in the virtual audio cable's RX path in dB. **Different RX/TX devices** – toggle the switch to enable different devices for RX and TX audio in the RadioSync. This is required if you decided to use two different devices or audio drivers concurrently.

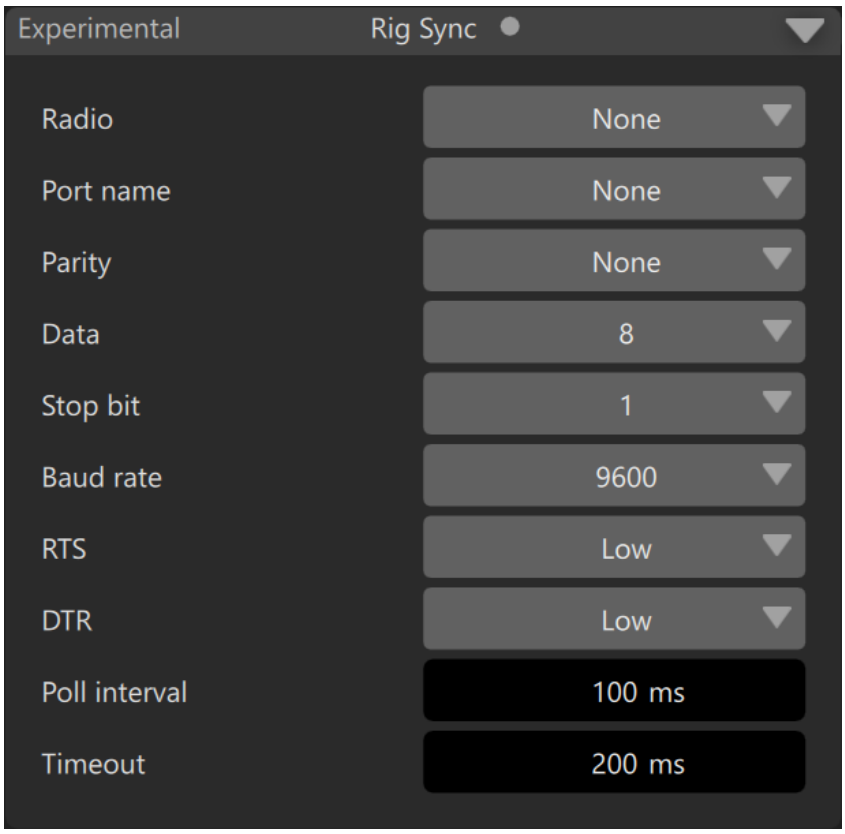
Note:	• *The following conditions must be met to enable transmission of a signal from the selected TX device ExpertSDR3 via RadioSync:* *- CAT interface must be active.* *- If a PTT command comes from CAT interface, then the TX signal received from the Sound Card takes a priority. However, if the **PTT transfer** module is enabled and the PTT command has been received by the module before the command originated from the CAT interface, then it will block the transmission from the Sound Card. This new algorithm aims to aid the N1MM logger with priority management of the traffic originated from the Mic and CAT.* • *VAC is always operate in 2 channels*



- the **IQ output** module is required for configuration of the IQ signal transfer from TCI to the sound card via VAC. This is required for CW Skimmer. **RX** - click on the dropdown menu to select an input and driver for the audio signal received by RadioSync that will be transferred to a 3rd party application via VAC. **Sample rate** - click on the dropdown menu to select the sampling frequency (e.g. 48, 96, 192, 384 kHz). **Gain** - use this field to configure a gain of an IQ output signal. Due to its weakness, IQ signals require an additional amplification to be able to pass through from the Sound Card to a 3rd party software.



- the **TCI transfer** module is required for TCI configuration between the web-socket and COM-port. The module was designed to support the 3rd party software/hardware that don't have an in-build web-socket connection. The TCI command can be transferred via CAT-module by adding the "TC:" prefix to the TCI command (e.g."*TC:volume:-6*"). **Port name** – click on the dropdown menu to select the COM-port number. **Parity** – click on the dropdown menu to select the parity (e.g Even, Odd, Space, Mark). **Data** – click on the dropdown menu to select required number of data in bits (e.g 5, 6, 7, 8). **Stop bit** – click on the dropdown menu to select the number of stop bits (e.g 1, 1.5, 2). **Baud rate** – click on the dropdown menu to select the port speed / baud rate (e.g 1200, 2400, 4800, 9600, 19200, 38400, 57600, 115200).



- the **Rig Sync is an experimental** module. The module is designed to synchronize ExpertSDR3 and 3rd party transceivers via COM port, it is practically duplicating the OmniRig application features. The module is always polling the connected transceiver. This module was tested with Elecraft K3 and Kenwood TS-2000. **Radio** - click on the dropdown menu to select the transceiver for synchronization. **Port name** – click on the dropdown menu to select the COM-port number. **Parity** – click on the dropdown menu to select the parity (e.g. Even, Odd, Space, Mark). **Data** – click on the dropdown menu to select the number of data in bits (e.g. 5, 6, 7, 8). **Stop bit** – click on the dropdown menu to select the number of stop bits (e.g. 1, 1.5, 2). **Baud rate** – click on the dropdown menu to select the port speed /baud rate (e.g. 1200, 2400, 4800, 9600, 19200, 38400, 57600, 115200). **RTS** - click on the dropdown menu to select the level (e.g. low, high). **DTR** - click on the dropdown menu to select the level (e.g. low, high). **Poll interval** - is the time interval between polls transmission. Choose from the range between 50 and 2000 ms to configure the **poll interval** for your connection. **Timeout** – is the time interval the RadioSync will have to wait for the answer from the transceiver. Choose from the range between 200 and 2000 ms to configure the **timeout** for your connection.

Information for developers:

- *TCI protocol uses web-socket interface for data transfer, but not all developers are willing to implement web-socket in their applications. You can reach out to developers who have not yet implemented TCI in their software, ask them to support TCI via a COM port.*

10.1. CAT commands

Here you can find the list of **CAT** commands supported by the CAT module in RadioSync software. This module emulates the behavior of Kenwood TS-480 CAT protocol, that is limited to commonly used commands.

CAT commands are composed of a text command (Latin alphabet), various parameters, and the terminator that signals the end of the control command.

Text command	Parameter	Terminator
FA	00007000000	;

CAT commands can be classified in the following order:

1) Input command (Incoming to RadioSync)

a) Set command (Sets a particular condition)

b) Read command (Gives an answer)

2) Output command (Outgoing from RadioSync)

a) Answer command (Transfer a state of a parameter)

To set the frequency to 7 MHz, the following command is sent from CAT system to RadioSync via COM-port	"FA00007000000;"	Set command
To read the frequency of VFO A, the following command is sent from CAT system to RadioSync via COM-port	"FA;"	Read command
As a reply to **Read command** RadioSync send an answer to CAT system via COM-port	"FA00007000000;"	Answer command

The list of supported CAT commands:

AG	Sets or reads the AF gain	Parameters: P1 0: Always 0 P2

		000(min) - 255(max)								
Set	1	2	3	4	5	6	7	8	9	10
	A	G	P1	P2	P2	P2	;			
Read	1	2	3	4	5	6	7	8	9	10
	A	G	P1	;						
Answer	1	2	3	4	5	6	7	8	9	10
	A	G	P1	P2	P2	P2	;			

AN	Select the antenna connector HF A1/ HF A2	Parameters: P1 1: Selects HF A1 2: Selects HF A2								
Set	1	2	3	4	5	6	7	8	9	10
	A	N	P1	;						
Read	1	2	3	4	5	6	7	8	9	10
	A	N	;							
Answer	1	2	3	4	5	6	7	8	9	10
	A	N	P1	;						

CN	Sets or reads the CTCSS tone number	Parameters: P1 00 - 41								
Set	1	2	3	4	5	6	7	8	9	10

	C	N	P1	P1	;					
Read	1	2	3	4	5	6	7	8	9	10
	C	N	;							
Answer	1	2	3	4	5	6	7	8	9	10
	C	N	P1	P1	;					

CT	Sets or reads the CTCSS function status	Parameters: P1 0: CTCSS function OFF 1: CTCSS function ON

Set	1	2	3	4	5	6	7	8	9	10
	C	T	P1	;						
Read	1	2	3	4	5	6	7	8	9	10
	C	T	;							
Answer	1	2	3	4	5	6	7	8	9	10
	C	T	P1	;						

FA	Sets or reads the VFOA frequency	Parameters: P1 Specify the frequency in Hz (11 digits). For example, 00014195000 for 14.195 MHz.

		The blank digits must be 0.

Set	1	2	3	4	5	6	7	8	9	10
	F	A	P1	P1	P1	P1	P1	P1	P1	P1
	11	12	13	14	15	16	17	18	19	20
	P1	P1	P1	;						
Read	1	2	3	4	5	6	7	8	9	10
	F	A	;							
Answer	1	2	3	4	5	6	7	8	9	10
	F	A	P1	P1	P1	P1	P1	P1	P1	P1
	11	12	13	14	15	16	17	18	19	20
	P1	P1	P1	;						

FB	Sets or reads the VFOB frequency	Parameters: P1 Specify the frequency in Hz (11 digits). For example, 00014195000 for 14.195 MHz. The blank digits must be 0.

Set	1	2	3	4	5	6	7	8	9	10
	F	B	P1	P1	P1	P1	P1	P1	P1	P1
	11	12	13	14	15	16	17	18	19	20
	P1	P1	P1	;						
Read	1	2	3	4	5	6	7	8	9	10

	F	B	;							
Answer	1	2	3	4	5	6	7	8	9	10
	F	B	P1	P1	P1	P1	P1	P1	P1	P1
	11	12	13	14	15	16	17	18	19	20
	P1	P1	P1	;						

FT	Turn on or turn off Split mode	Parameters: P1 0: Split OFF 1: Split ON

Set	1	2	3	4	5	6	7	8	9	10
	F	T	P1	;						
Read	1	2	3	4	5	6	7	8	9	10
	F	T	;							
Answer	1	2	3	4	5	6	7	8	9	10
	F	T	P1	;						

FW	Turn on or turn off Split mode	Parameters: P1 0000 – 9999 (in Hz) **CW:** 0050, 0080, 0100, 0150, 0200, 0300, 0400, 0500, 0600, 1000, 2000 **DIGL/DIGU:** 0250, 0500,

		1000, 1500 **SSB/AM/FM:** 0000=Normal (2 kHz), 0001=NAR (2.7 kHz), 0002=NAR2 (3 kHz)								
Set	1	2	3	4	5	6	7	8	9	10
	F	W	P1	P1	P1	P1	;			
Read	1	2	3	4	5	6	7	8	9	10
	F	W	;							
Answer	1	2	3	4	5	6	7	8	9	10
	F	W	P1	P1	P1	P1	;			

GT	Selects or reads the AGC constant status	Parameters: P1 000: OFF 001: Fast 002: Slow								
Set	1	2	3	4	5	6	7	8	9	10
	G	T	P1	P1	P1	;				
Read	1	2	3	4	5	6	7	8	9	10
	G	T	;							
Answer	1	2	3	4	5	6	7	8	9	10
	G	T	P1	P1	P1	;				

IF	Retrieves the	Parameters: P1

	transceiver status	Specify the frequency in Hz (11 digits). P2 00000 P3 RIT frequency ±9990 Hz P4 0: RIT OFF, 1: RIT ON P5 0: XIT OFF, 1: XIT ON P6 Always 0. P7 00 P8 0: RX, 1: TX P9 Operating mode. P10 See FR and FT commands. P11 Always 0. P12

		0: Split off, 1: Split on P13, P14, P15 Always 0.								
Set	1	2	3	4	5	6	7	8	9	10
Read	1	2	3	4	5	6	7	8	9	10
	I	F	;							
Answer	1	2	3	4	5	6	7	8	9	10
	I	F	P1	P1	P1	P1	P1	P1	P1	P1
	11	12	13	14	15	16	17	18	19	20
	P1	P1	P1	P2	P2	P2	P2	P2	P3	P3
	21	22	23	24	25	26	27	28	29	30
	P3	P3	P3	P4	P5	P6	P7	P7	P8	P9
	31	32	33	34	35	36	37	38	39	40
	P10	P11	P12	P13	P14	P14	P15	;		

KS	Sets or reads the CW electric keyer's keying speed	Parameters: P1 010(min) – 060(max) in WPM							
Set	1	2	3	4	5	6	7	8	9	10
	K	S	P1	P1	P1	;				
Read	1	2	3	4	5	6	7	8	9	10

	K	S	;							
Answer	1	2	3	4	5	6	7	8	9	10
	K	S	P1	P1	P1	;				

MD	Recalls or reads the operating mode status	Parameters: P1 1: LSB 2: USB 3: CW 4: NFM 5: AM 6: DIGL 7: CW 8: Unused 9: WFM

Set	1	2	3	4	5	6	7	8	9	10
	M	D	P1	;						
Read	1	2	3	4	5	6	7	8	9	10
	M	D	;							
Answer	1	2	3	4	5	6	7	8	9	10
	M	D	P1	;						

MG	Sets or reads the microphone gain status	Parameters: P1 000(min) - 100(max)

Set	1	2	3	4	5	6	7	8	9	10
	M	G	P1	P1	P1	;				
Read	1	2	3	4	5	6	7	8	9	10

	M	G	;							
Answer	1	2	3	4	5	6	7	8	9	10
	M	G	P1	P1	P1	;				

NB	Sets or reads the Noise Blanker (NB1) function status	Parameters: P1 0: NB1 OFF 0: NB1 ON								
Set	1	2	3	4	5	6	7	8	9	10
	N	B	P1	;						
Read	1	2	3	4	5	6	7	8	9	10
	N	B	;							
Answer	1	2	3	4	5	6	7	8	9	10
	N	B	P1	;						

NL	Sets or reads the NB1 level	Parameters: P1 001(min) - 010(max)								
Set	1	2	3	4	5	6	7	8	9	10
	N	L	P1	P1	P1	;				
Read	1	2	3	4	5	6	7	8	9	10
	N	L	;							
Answer	1	2	3	4	5	6	7	8	9	10
	N	L	P1	P1	P1	;				

NR	Sets or reads the Noise Reduction (NR) function status	Parameters: P1 0: NR OFF 1: NR ON								
Set	1	2	3	4	5	6	7	8	9	10
	N	R	P1	;						
Read	1	2	3	4	5	6	7	8	9	10
	N	R	;							
Answer	1	2	3	4	5	6	7	8	9	10
	N	R	P1	;						

PA	Sets or reads the pre-amplifier function status	Parameters: P1 0: Pre-amplifier OFF 1: Pre-amplifier ON P2 (Answer only) 0: Always 0								
Set	1	2	3	4	5	6	7	8	9	10
	P	A	P1	;						
Read	1	2	3	4	5	6	7	8	9	10
	P	A	;							
Answer	1	2	3	4	5	6	7	8	9	10

	P	A	P1	P2	;					

PC	Sets or reads the output power	Parameters: P1 000(min) – 100(max)								
Set	1	2	3	4	5	6	7	8	9	10
	P	C	P1	P1	P1	P1	;			
Read	1	2	3	4	5	6	7	8	9	10
	P	C	;							
Answer	1	2	3	4	5	6	7	8	9	10
	P	A	P1	P2	;					

PR	Sets or reads the Speech Processor ON/OFF	Parameters: P1 0: Speech Processor OFF 1: Speech Processor ON								
Set	1	2	3	4	5	6	7	8	9	10
	P	R	P1	;						
Read	1	2	3	4	5	6	7	8	9	10
	P	R	;							
Answer	1	2	3	4	5	6	7	8	9	10
	P	R	P1	;						

PS	Sets or reads the Speech Processor ON/OFF	Parameters: P1 0: Power OFF 1: Power ON								
Set	1	2	3	4	5	6	7	8	9	10
	P	S	P1	;						
Read	1	2	3	4	5	6	7	8	9	10
	P	S	;							
Answer	1	2	3	4	5	6	7	8	9	10
	P	S	P1	;						

RA	Sets or reads the Attenuator function status	Parameters: P1 00: Attenuator OFF 01: Attenuator ON P2 00: Always 00								
Set	1	2	3	4	5	6	7	8	9	10
	R	A	P1	P2	;					
Read	1	2	3	4	5	6	7	8	9	10
	R	A	;							
Answer	1	2	3	4	5	6	7	8	9	10
	R	A	P1	P1	P2	P2	;			

RG	Sets or reads the RF gain status	Parameters: P1 000(min) – 100(max)								
Set	1	2	3	4	5	6	7	8	9	10
	R	G	P1	P1	P1	;				
Read	1	2	3	4	5	6	7	8	9	10
	R	G	;							
Answer	1	2	3	4	5	6	7	8	9	10
	R	G	P1	P1	P1	;				

RX	Sets the receiver function status	Parameters: P1 0: Always 0								
Set	1	2	3	4	5	6	7	8	9	10
	R	X	;							
Read	1	2	3	4	5	6	7	8	9	10
Answer	1	2	3	4	5	6	7	8	9	10
	R	X	P1	;						

SD	Sets or reads the DSP filter settings	Parameters: P1 00 – 13 **SSB/FM (Hz)** 00: 1000, 01: 1200,

		03: 1400, 04: 1800, 05: 2000, 06: 2200, 07: 2400, 08: 2600, 08: 2600, 09: 2800, 10: 3000, 11: 3400, 12: 4000, 13: 5000 **AM (Hz)** 00: 2500, 01: 3000, 02: 4000, 03: 5000

Set	1	2	3	4	5	6	7	8	9	10
	S	H	P1	P2	;					
Read	1	2	3	4	5	6	7	8	9	10
	S	H	;							
Answer	1	2	3	4	5	6	7	8	9	10
	S	H	P1	P2	;					

SL	Sets or reads the DSP filter settings	Parameters: P1 00 – 11 **SSB (Hz)** 00: 0, 01: 50, 03: 100, 04: 200, 05: 300, 06: 400,

		07: 500, 08: 600, 08: 700, 09: 800, 10: 900, 11: 1000								
Set	1	2	3	4	5	6	7	8	9	10
	S	L	P1	P2	;					
Read	1	2	3	4	5	6	7	8	9	10
	S	L	;							
Answer	1	2	3	4	5	6	7	8	9	10
	S	L	P1	P2	;					

SM	Reads the S-meter status	Parameters: P1 0: Always 0 P2 Meter readings 0000 - 0020								
Set	1	2	3	4	5	6	7	8	9	10
Read	1	2	3	4	5	6	7	8	9	10
	S	M	P1	;						
Answer	1	2	3	4	5	6	7	8	9	10
	S	M	P2	P2	P2	P2	;			

SQ	Sets or reads the	Parameters: P1

	squelch level	0: Always 0 P2 Meter readings 000 - 255								
Set	1	2	3	4	5	6	7	8	9	10
	S	Q	P1	P2	P2	P2	;			
Read	1	2	3	4	5	6	7	8	9	10
	S	Q	P1	;						
Answer	1	2	3	4	5	6	7	8	9	10
	S	Q	P1	P2	P2	P2	;			

TX	Sets the transceiver in TX mode	Parameters: P1 0: Always 0								
Set	1	2	3	4	5	6	7	8	9	10
	T	X	P1	;						
Read	1	2	3	4	5	6	7	8	9	10
Answer	1	2	3	4	5	6	7	8	9	10
	T	X	P1	;						

11. TCI: Third-Party Software Integration

11.1. What is TCI

TCI (Transceiver Control Interface) is an open protocol developed by Expert Electronics for connecting ExpertSDR3 with third-party software. TCI provides all control commands similar to the CAT system, but its capabilities go much further:

- **Receiver IQ streams** — for skimmers and spectrum recording;
- **Audio In/Out streams** — for digital modes and audio macros transmitted by loggers;
- **CW macros and CW messages** — transmit telegraph messages via commands;
- **Multi-client architecture** — a logger, a skimmer, a power amplifier, an antenna switch and other software and hardware can connect to a single TCI server simultaneously.

ExpertSDR3 acts as the **TCI server**: when a client connects, it receives the current software state; afterwards the server proactively notifies all clients about every change — no polling required, network load is minimal. All connected clients are automatically synchronized with each other. If several clients control the same parameter, priority goes to the first one; the ExpertSDR3 operator always has the highest priority.

The current protocol version is TCI 2.1 (compatible with 1.10; the versions before 2.0 were numbered 1.x). Version 2.1 adds the RX_ENABLE, ECODER_SWITCH_RX, ECODER_SWITCH_CHANNEL, HW_SENSORS_ENABLE and HW_SENSORS commands, the KEYER command has gained a third mandatory argument, and the CHANNEL_COUNT command has been renamed to CHANNELS_COUNT — this is the only breaking change and the first thing a third-party developer has to account for. The same version tabulates the CW_MACROS, CW_MSG, CW_MACROS_STOP, CW_TERMINAL, CW_MACROS_EMPTY, CALLSIGN_SEND and CW_MON commands for the first time; all of them worked in earlier versions as well, what is new is their description. Starting with ExpertSDR3 1.3.1 the TCI log window has been rewritten: lines can be filtered by direction, selected and copied, and the window no longer slows down during long sessions. The protocol uses a web-socket interface; the full specification (EN/RU) and demo client source code are published on GitHub — see the link on the Software page at eesdr.com.

11.2. Connection

1. In ExpertSDR3 the TCI server runs permanently — no separate activation is required.
2. In the third-party software, enter the **IP address and port of the ExpertSDR3 TCI server**. Default: `localhost:50001` (if the software runs on the same PC) or `PC_IP:50001` for LAN connections.

> Important: specify the **ExpertSDR3 TCI server** address and port, not the transceiver's IP address.

1. Connection indicators in client software: grey — inactive, green — connected, yellow — connecting, red — connection failed.

11.3. Compatible software

The up-to-date list is published on the website: eesdr.com → Software. Main categories:

Category	Software	Platform
Digital modes	JTDX (UA3DJY, ES1JA); MSHV (LZ2HV); WSJT-X Improved (DG2YCB)	Windows, Linux, macOS
Loggers	LogHX (RX4HX); 5MContest (RM5F); SWISSLOG (HB9BJS, EA3GCV); RUMlog (DL2RUM); MacLoggerDX (VE3VRW); Log4OM (IW3HMH, G4POP); OCLog (VK6NX)	Windows / macOS / Linux
Power amplifiers	RF2K-S (RF-kit); BURST; Gemini Multi Control (OE3IDE)	Windows
Other	N4PY Control Software; TCI Macro (IW7DMH); TCI-Hamlib Adapter (DL3NEY); HamDeck (DL3NEY); TunerReminder (OE3IDE); TCI Arduino/ESP32 libraries (IW7DMH); VSELink for N1MM+	various

If your software does not support TCI directly:

- **RadioSync** — the stock "bridge": synchronizes ExpertSDR3 with software lacking TCI support via CAT and VAC (see the "RadioSync" chapter). Supports PTT transfer from the E-Coder/E-Coder2 panel into TCI (actively used for N1MM), IQ output via VAC (48–384 kHz sample rate) and TCI commands via CAT (prefix `TC:`, example: `TC:volume:-6`).
- **TCI-Hamlib Adapter** (DL3NEY) — adapts TCI to the Hamlib network protocol: WSJT-X, FLDigi and CQRLog work through it.
- For developers: a module for exchanging TCI commands between RadioSync and third-party software via a COM port is available (for software without web-socket support).

11.4. Typical schemes

11.4.1. ExpertSDR3 + logger (LogHX, Log4OM, etc.)

TCI connection: frequency, mode, SPLIT and PTT are synchronized automatically; logger audio macros are transmitted on air via TCI Audio In. No CAT or virtual COM ports needed.

11.4.2. ExpertSDR3 + JTDX / WSJT-X Improved (FT8 and others)

1. Select DIGU (or DIGL) mode in ExpertSDR3 — the software applies the correct offsets automatically.

2. In JTDX, select the TCI connection (server address and port), or use RadioSync (CAT + VAC).

3. Audio: via TCI Audio or via VAC (when using RadioSync).

4. Reduce power in digital modes (see "Troubleshooting", the section about power in digital modes).

11.4.3. ExpertSDR3 + CW skimmer / spectrum recording

The receiver IQ stream is transferred to the client via TCI — the skimmer decodes stations across the entire panorama bandwidth without additional receivers.

11.4.4. Contests with N1MM

The ExpertSDR3 + RadioSync + N1MM combination: PTT transfer from the E-Coder2 panel into TCI, CW macros transmission. With Break-In enabled, use ExpertSDR3 version 1.1.7 or newer (CW macros operation in this combination was fixed). Spots from N1MM can be transferred to the panorama via VSELink.

11.5. For developers

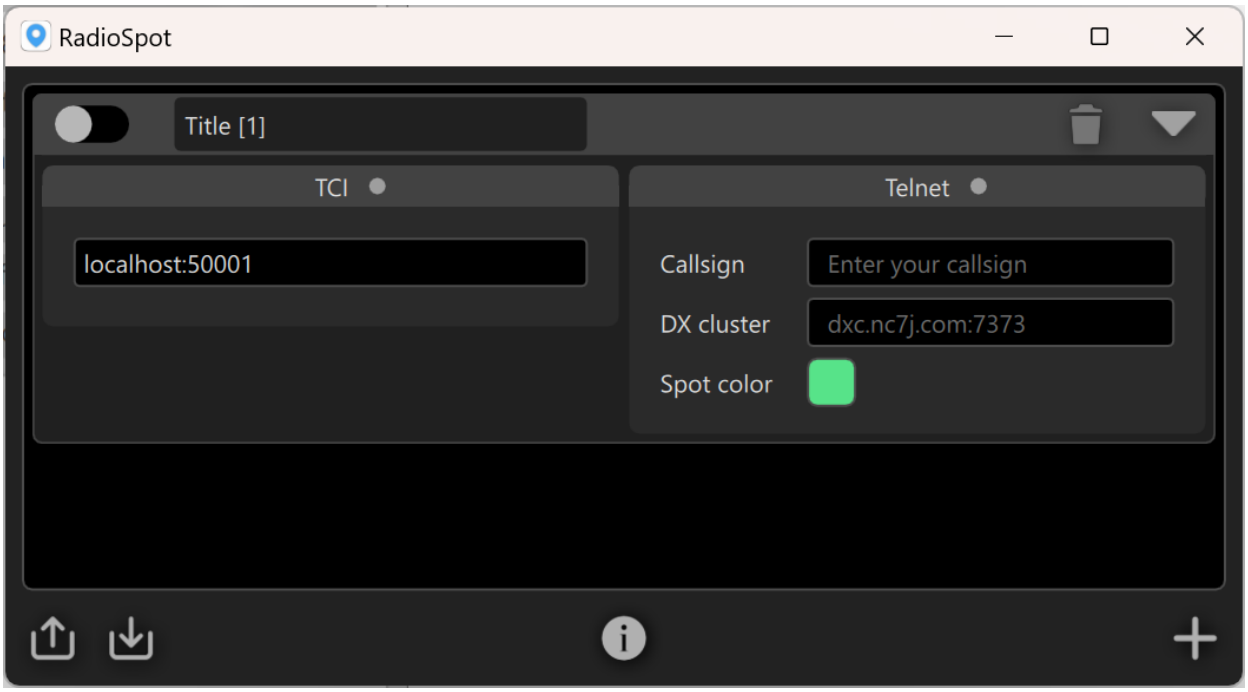
- The TCI specification (EN and RU) and demo client source code are on GitHub (link on the Software page at eesdr.com).
- New commands in version 1.2.0: `cw_mon:arg;` — notifies the TCI client about letters transmitted during CW macros playback; responses to `cw_macros_speed`, `cw_macros_delay`, `cw_keyer_speed` have been restored.
- TCI libraries for ESP32/Arduino (IW7DMH) allow connecting your own devices via LAN: filters, antenna switches, relays, indicators.

CW macros via TCI. The TCI protocol uses UTF-8 — Cyrillic text in CW macros is transmitted correctly regardless of the system locale. The callsign_send confirmation is sent after the callsign has actually finished on the air, so third-party software sees the true end of the transmission.

12. RadioSpot

Launch. RadioSpot is launched from the Utilities section of the ExpertSDR3 notification area icon menu; selecting an already running utility brings its window to the front. Via the Autostart submenu it can be set to start together with ExpertSDR3. The utility receives the interface language and color scheme from the menu of the ExpertSDR3 icon in the notification area and closes together with the icon.

RadioSpot gets data (callsign and frequency) from Telnet servers about spots and transfers it to ExpertSDR3 via TCI.



Note:	• *RadioSpot is installed along with ExpertSDR3 and the RadioSpot application shortcut is placed in the same installation folder: e.g. C:\Program Files\ExpertElectronics\ExpertSDR3 (in Windows).*

Common RadioSpot functionality:



- click on the export/import icons to share/backup current settings.



- click on the information icon to view current RadioSpot version.



- click on the plus icon to add a new Telnet connection.

Header settings for each Telnet connection:



- toggle the switch to enable/disable a synchronization setup. If a setup is enabled its connection parameters cannot be changed.



- is a field for Telnet connection name.

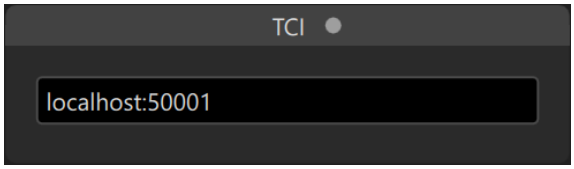


- click on the bin icon to delete the selected Telnet connection. You can delete a setup only when it is disabled.



Click on marked arrow button to collapse Telnet setup connection from the menu to a string. This feature is very convenient when you have established multiple setups.

Core settings for each Telnet connection, left side:

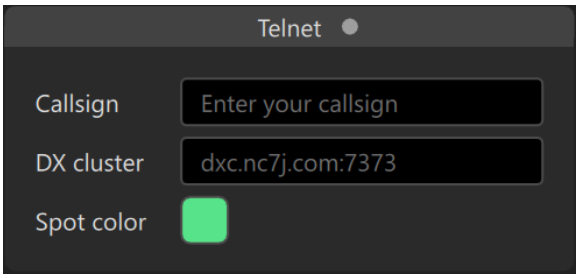


- enter *valid* IP address and port of the **ExpertSDR3 TCI server** (not IP address and port of the transceiver) to establish a connection between a SyncPair and TCI server. By default you can see a working value: **localhost:50001**.

Color indicators:

- *Grey indicator - inactive*
- ***Green indicator** - connected*
- ***Yellow indicator** - establishing connection*
- ***Red indicator** - failed to connect / open device*

Right side.



- the **Telnet** module settings. Callsign - a field where you should enter your callsign. DX cluster - enter DX cluster server address. Here are a couple of lists with active DX-clusters: link1, link2 as an example. Spot color - click-on the colored field to open the color palette, where you can pick the desired color for spots from a certain DX cluster server.

The DX-cluster client supports password authorization for clusters that require it. If the cluster server is unavailable, RadioSpot retries the connection every second until the link is established — synchronization recovers automatically after network issues, without restarting the program.

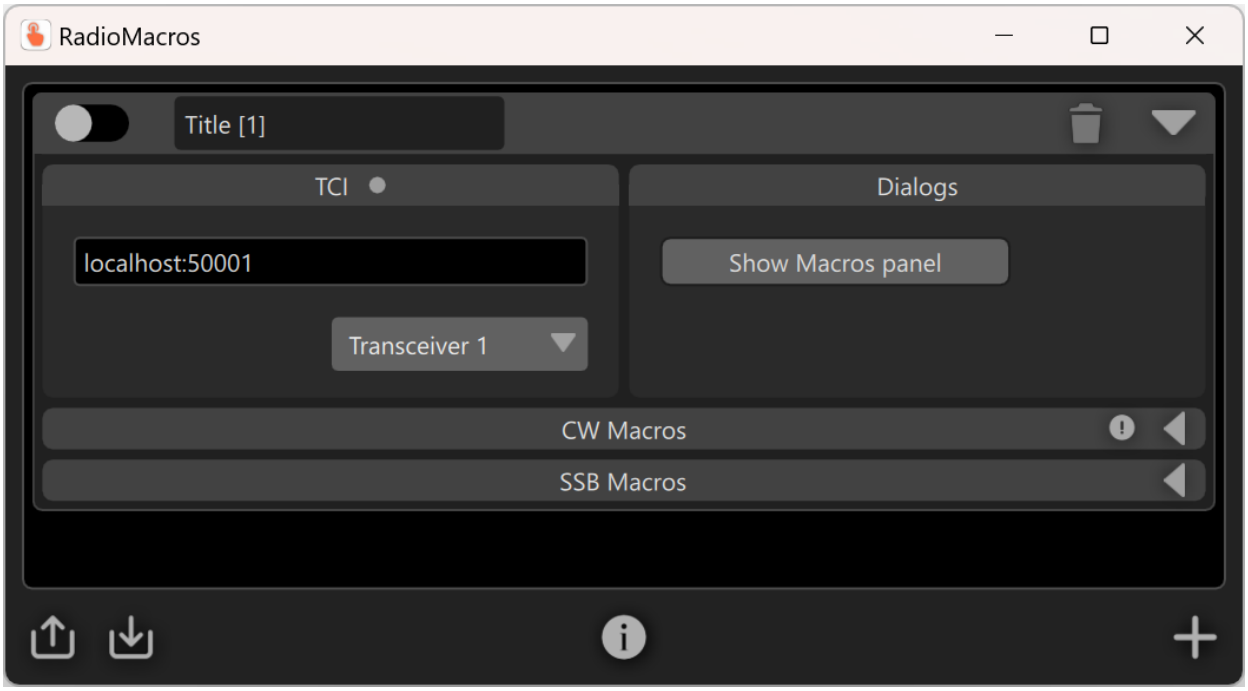
Note:	• *Default server's telnet port in RadioSpot utility equals 23 (standard port for telnet). If you indicate telnet address without the port, then RadioSpot will automatically use port 23.*

13. RadioMacros

Launch. RadioMacros is launched from the Utilities section of the ExpertSDR3 notification area icon menu; selecting an already running utility brings its window to the front. Via the Autostart submenu it can be set to start together with ExpertSDR3. The utility receives the interface language and color scheme from the menu of the ExpertSDR3 icon in the notification area and closes together with the icon.

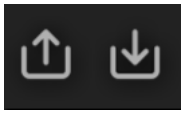
RadioMacros is designed to transmit on the air automated CW messages and recorded SSB/AM/NFM voice messages or wave files.

Note: the macros panel stays on top of other windows and remains visible even when the main program window is minimized. On Linux, audio is handled via RtAudio. The interface scale is aligned with the other ExpertSDR3 utilities.

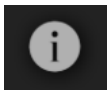


Note:	• *RadioMacros is installed along with ExpertSDR3 and the RadioMacros application shortcut is placed in the same installation folder: e.g. C:\Program Files\ExpertElectronics\ExpertSDR3 (in Windows).*

Common RadioMacros functionality:



- click on the export/import icons to share/backup current settings.



- click on the information icon to view current RadioMacros version.



- click on the plus icon to add a new Macros setup configuration.

Header settings for each Macros setup:



- toggle the switch to enable/disable a synchronization setup. If a setup is enabled its connection parameters cannot be changed.



- is a field for custom Macros setup configuration name.

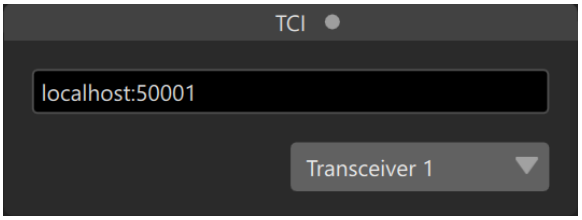


- click on the bin icon to delete the selected Macros setup. You can delete a setup only when it is disabled.



Click on marked arrow button to collapse Macros setup from the menu to a string. This feature is very convenient when you have established multiple setups.

Core settings for each Macros setup, left side:



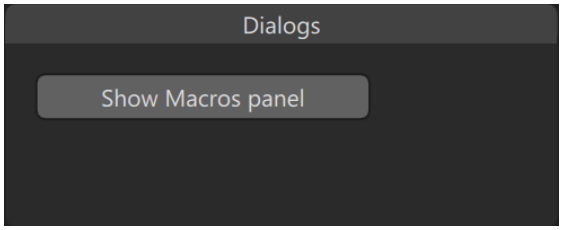
- enter *valid* IP address and port of the **ExpertSDR3 TCI server** (not IP address and port of the transceiver) to establish a connection between a SyncPair and TCI server. By default you can see a working value: **localhost:50001**.

Color indicators:

- *Grey indicator - inactive*
- ***Green indicator** - connected*
- *Yellow indicator - establishing connection*
- ***Red indicator** - failed to connect / open device*

Transceiver 1/2 - click on the dropdown menu to select RX1 or RX2 receiver.

Right side.



- the **Dialogs** section contains the **Show Macros panel** button, pressing it you'll open the Macros panel. There are two types of Macros panels: CW and SSB, what panel is displayed/active depends on what mode is selected in the ExpertSDR3.



- CW macros panel. TRX 1/ TRX 2 - what software receiver will transmit the Macros. Title [1] - the title of the Macros setup.30 wpm - Macros speed in wpm set in BreakIn menu.



- crosshair sign, when colored means that this Macros panel is active. F1-F12 - quick Macros buttons, each can be named in the CW Macros menu. Pressing a button you start the transmission and put certain Macros in a queue, active queue is displayed below F buttons.



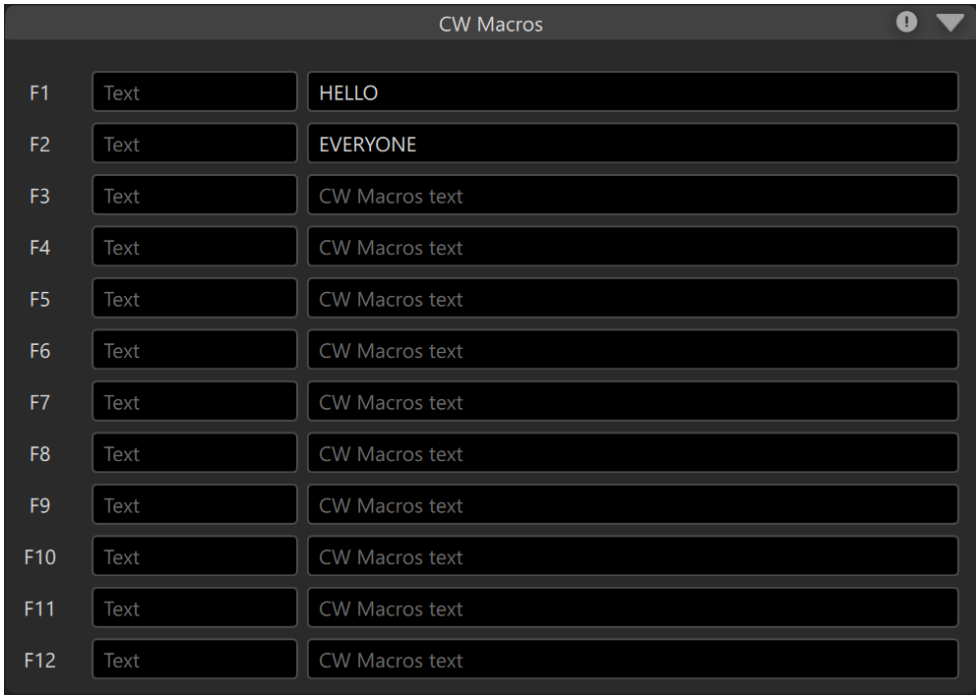
- SSB macros panel. TRX 1/ TRX 2 - what software receiver will transmit the Macros. Title [1] - the title of the Macros setup.



- crosshair sign, when colored means that this Macros panel is active. F1-F12 - quick Macros buttons, each can be named in the SSB Macros menu. Pressing a button you start the transmission of the selected wave file.

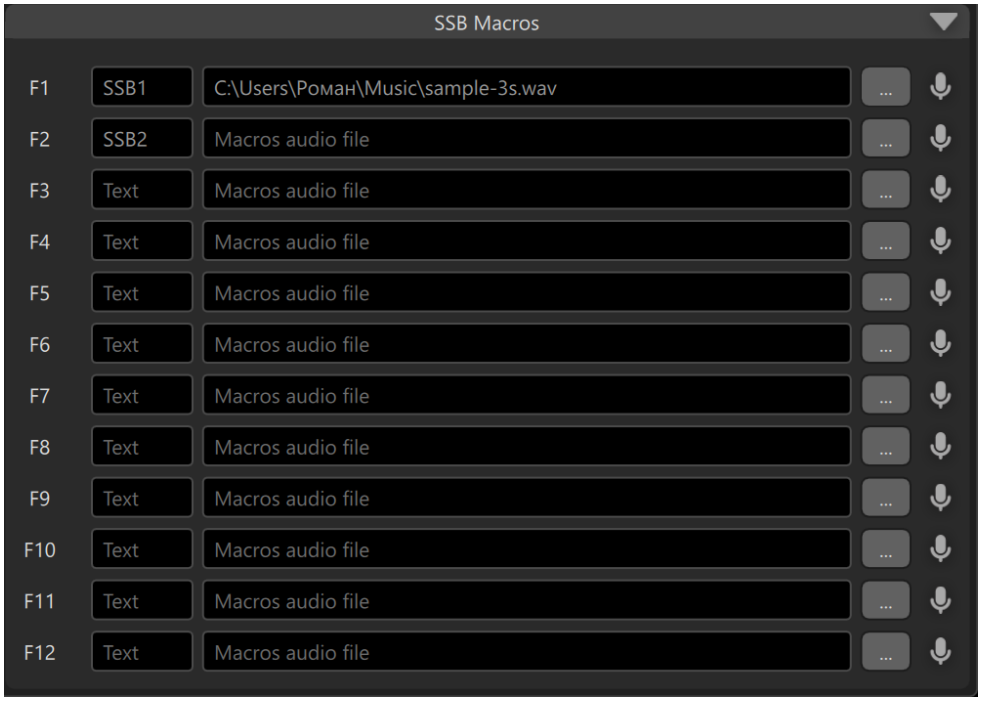
Footer settings for each Macros setup:

CW Macros



- here you can:1. Name each of twelve F buttons, the name will be displayed in the Macros panel.2. Enter the CW Macros text.

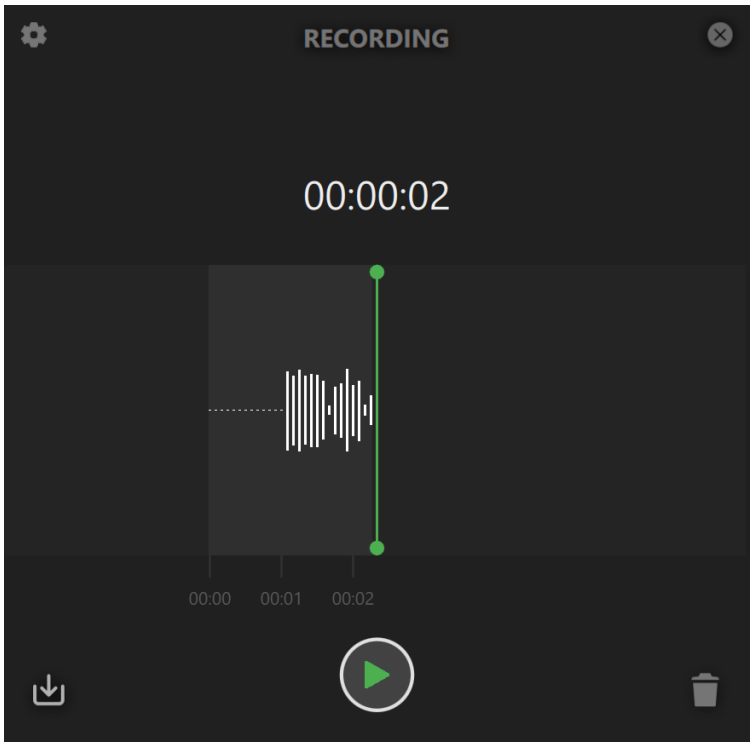
SSB Macros



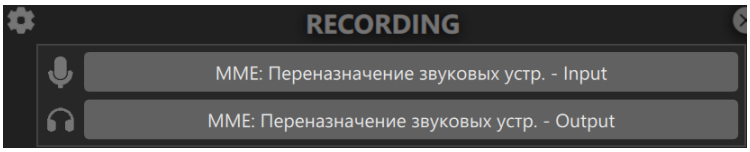
- here you can:1. Name each of twelve F buttons, the name will be displayed in the Macros panel.2.



Select the path of the wave file.3. click-on the mic sign to open the **RECORDING** window.



- in the **RECORDING** window you can record your own voice and prepare a special message for the transmission. In the Profile menu of the Mic signal processing menu you can select **TCI** to apply signal processing to the recorded file before transmitting it on the air.



- pressing the wheel sign in the left top corner of the **RECORDING** window opens the audio input/output settings, similar to the main ExpertSDR3.



- click on the Record button to start recording, then press it again to stop recording.



- click on the Play button to listen to the recording.



- click on the Save button to save the recorded wave file.

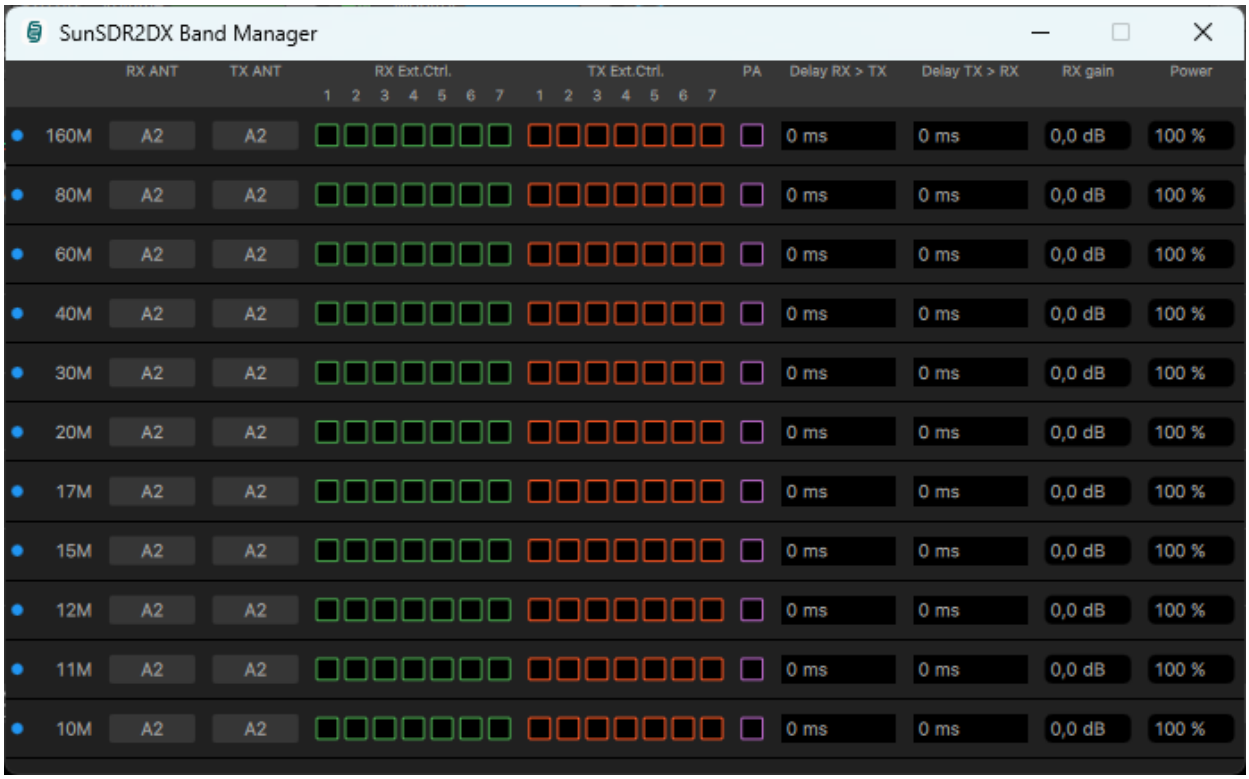


- click on the bin icon to delete the recorded wave file.

14. TRANSCEIVER OPERATIONS

This chapter describes all basic transceiver functionality.

14.1. Band Manager



Use the RX ANT, TX ANT to assign an antenna input for RX and TX modes to a specific band, including XVTR bands.

To control external devices, use the **RX/TX Ext. Ctrl** to set up the **Ext. Ctrl** pins for **RX** or **TX** modes per band. The Ext. Ctrl settings for the RX mode and TX mode can vary. The Ext. Ctrl connector output uses transistor keys with “open collector”. For more information about the Ext. Ctrl connection to PAs refer to the External Linear Amplifiersection. The Ext. Ctrl connector can be used for:

- switching the narrowband filters in the RX mode;
- switching the LPF in the TX mode;
- control an external PA via BAND-data cable (PA should support Yaesu BAND data protocol) or Ext. Ctrl to PTT cable;
- arrange your own antenna switch, having only the relay.

RX Ext. Ctrl - are electronic keys settings for the RX mode.

TX Ext. Ctrl - are electronic keys settings for the TX mode.

1...7 - are electronic keys numbers.

If you activate **Save by band** function in Settings-> **Radio**-> PA menu, the **PA (X8 key)** can be assigned separately to any band.

Use the **Delay RX > TX** to adjust the delay between engaging TX mode and actual RF signal appearance.

Note:	• *It usually takes several ms from the moment of the ExpertSDR3 received the TX command from TCI Client (e.g. MSHV) to the moment of the actual signal gets forwarded by the ExpertSDR3 to Power Amplifier (PA). The TX mode "ON" background actions sequence is outlined below:* 1. *TCI Client sends the "Switch to TX mode" TCI command to the ExpertSDR3.* 2. *The ExpertSDR3 is slowly decreasing the RX volume (it takes 1-2 ms).* 3. *The ExpertSDR3 sends the "Turn ON TX mode" command via UDP protocol to the transceiver. The ExtCtrl forwards the "Switch to TX mode" command to the PA.* 4. *The RX→TX delay (0-1000 ms, as set in the Band Manager). The transceiver turns into TX mode after the configured delay timeout. (Note: In CW mode, delay is set in Break.In menu-> PTT-CW delay of 0-50 ms).* 5. *The TX signal goes on the air, with a soft front.*

Use the **Delay TX > RX** to adjust the delay between the actual RF signal stop and the RX mode engagement.

Note:	• *The sequence of actions to turn to RX mode:* 1. *TCI Client sends the "Switch to RX mode" TCI command to the ExpertSDR3.* 2. *The ExpertSDR3 is slowly decreasing the TX volume (it takes 1-2 ms).* 3. *The TX→RX delay (0-1000 ms, as set in the Band Manager). The transceiver turns to RX mode after the configured delay timeout. (Note: there is no delay for CW mode in this sequence).* 4. *The ExpertSDR3 sends the "Turn OFF TX mode" command via UDP protocol to the transceiver. The Ext. Ctrl forwards the "Switch into RX mode" command to the PA.* 5. *The RX signal appears on the panorama with soft volume raise.*

RX gain - is used to adjust the correction coefficient when an additional external preamplifier in the RX path.

Power- this is a **software power correction coefficient** similar to a **Settings-> Radio-> Calibrations-> Power correction**. It can be used to lower the maximum output power for per band.

Note:	• *Power correction in Settings-> Radio-> Calibrations-> Power correction menu takes precedence over **software** power correction coefficient.*

14.2. Output power per band

ALC is not supported on a SunSDR2 firmware level yet. The ALC system has a small delay, and can cause an external PA overload. ALC is much worse in comparison to a fixed power correction per band. This is why we recommend to use power correction by setting max output power per band in the Settings->**Radio**-> Calibrations-> Power correction menu. Such setup will allow an external PA operation without overload.

An example of the fixed output power correction setup (per band) to 50%:

1. Connect an antenna to the transceiver. Select the correct antenna in ExpertSDR3 and set the Tune slider to 100%.

2. Click on the TUNE button to send maximum output power and stable amplitude carrier signal on the air. This step allows you to check if the max output power is OK for the selected band.

3. Toggle the Tune switch to 50%.

4. Open Settings->**Radio**-> Calibrations-> Power correction menu and change the output power to 50% for each band. Click on the "Write" button after all the bands are set to 50%. Toggle the Drive slider to the maximum level. The transceiver output power should be similar to the output power in Tune mode.

5. Validate the output power per band using an external Power Meter.

Note:	• *The **transmitter output power is band and mode specific**, it is independent of the software RX.* *Example: RX1 is operating on the 40M band in CW mode and is set to 75% output power. Then RX2 is also tuned to the 40M band with CW mode. In this case, the power in RX2 will automatically be set to 75% and will change synchronously with RX1.*

	• *The transmitter output power in TUNE mode is band related only and is independent of mode. If both software RXs are tuned to the same band, the TUNE sliders will be controlled synchronously.* • *The Tune slider is the carrier signal controller of the output power in the Tune mode. In all other modes, use the Drive slider. The Power correction coefficients are not equal to real output power (i.e. coefficient 50% on 20M is not equal to 50W), but can be adjusted. The coefficients are varying from band to band, they are NOT the same. Please be careful when making changes in Power Corrections and always start with low values.* • *The output power in a range of 1W - 100W is not linear across all bands. Every band requires its own amplification coefficient for the internal PA, which is set in engineering menu during the manufacturing process. This is due to physical differences of the transceiver components such as capacitors, ferrite rings, etc.; we perform measurements and individually adjust amplification coefficients for each of our transceivers during the manufacturing. The **Top** end **internal PA values**, when the Drive slider set to 100% at each band, are set close to 100W; and they are more or less in line. However, the **Low values** (i.e. below 30-35%) may vary in Watts from band to band.* • *The output power meter shows accurate values starting from about 10-15W.*

14.3. S-meter

S-meter readings depend on the filter bandwidth. For example, when 3 kHz filter set for SSB mode, the S-meter readings will be at the higher level; when 100 Hz filter set for CW mode, the S-Meter readings will be lower.

The transceiver's internal noises level is dependent on the Preamp level (sensitivity). For example, when -20dB ATT is set, the sensitivity will be at its worst, and the S-meter readings at the higher level. When +10dB Preamp is set, the sensitivity will be higher and the transceiver's noises will be at their lowest level.

Follow **this link**, to view the calibrations tables for HF (Table 3) and VHF (table 4).

For example:

29 MHz -127 dBm ~ S0.5 (preamp on)

52 MHz -127 dBm ~ S3.5 (preamp on)

Use the signal generator connected to an antenna port to compare the generator signal with the S-Meter readings for all S-levels, and to the above-mentioned table's data.

Note:	• *S-Meter in the ExpertSDR3 has two different calibrations: for HF (0-30 MHz) and VHF (30-300 MHz). HF and VHF signals with the same dBm level will have different S-scale values.* *For example: HF S9 = -73 dBm = 50 uV (50 Ohm), VHF S9 = -93 dBm = 5 uV (50 Ohm). S-Meter in the ExpertSDR3 corresponds to the IARU recommendations, each device is individually calibrated at the manufacturing.*

Right mouse click on the S-meter to choose between the **Mic meter** and the **Power meter** modes, or to enable the S-Meter in a separate window by selecting the **Show S-Meter**.



In the **Mic meter** mode, the S-meter represented by the microphone's peak signals level (**orange needle**) and the RMS (**white needle**) signals level.

In the **Power meter** mode, the S-meter represented by the output power level and the SWR.



- the external S-meter resizable window that displays the Mic level, SWR and output power.

14.4. RX1/RX2 TX priority

RX1 and RX2 have equal TX priority, with some exceptions. By default, when the RIT/XIT is off, the TX frequency is equal to the RX frequency.

1. The CW-key and PTT inputs are the only exceptions, as these inputs are solely controlled by RX1 with default settings.

2. Break-in mode special conditions:

• When the Break-in is active for both RX1 and RX2, then the RX1 has the priority over RX2, and the transmission will occur on the RX1 TX frequency.

• When the Break-in is active only for RX2, then the RX2 has the priority over RX1; and the “closed” CW-key will engage the TX on the RX2 TX frequency.

3. VOX operation special conditions:

- When the Mic1 is assigned to RX1 and the Mic2 is assigned to RX2, and the VOX for the RX1 and RX2 is active, then the VOX on the RX1 will be given a priority; and the VOX on the RX2 will not be activated.
- When Mic1 is assigned to RX1 and Mic.PC is assigned to RX2 or vice versa, then the VOX on both the RX1 and the RX2 will be active. The VOX activated with Mic.PC, will transmit on the RX2 TX frequency.

4. The ExpertSDR3 detects TX frequency for each radio using the following logic:

- By default, the TX frequency is equal to RX frequency (VFO A).
- If the SPLIT is engaged, then the TX frequency will be equal to VFO B frequency.
- If the XIT is enabled, then the TX frequency will be equal to VFO A + XIT offset.

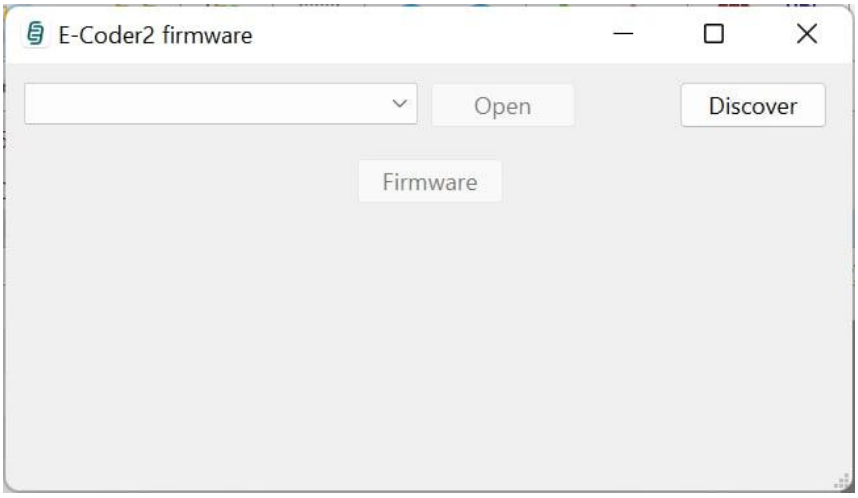
5. To transmit on the RX2 frequency with CW-keyer, follow the below procedure:

- Step 1: Connect the CW-keyer to the E-Coder/E-Coder2;
- Step 2: Activate the RX2 in E-Coder settings;
- Step 3 (optional): Enable Break.In for both RX1 and RX2.

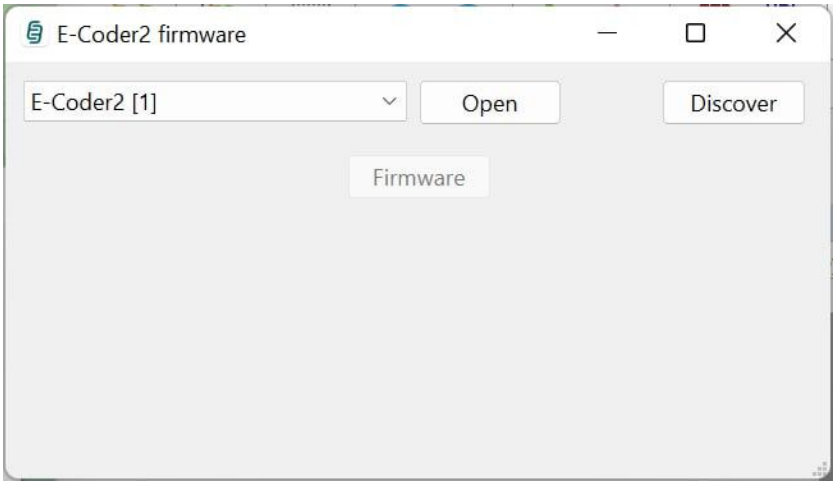
14.5. E-Coder panels

To use E-Coder2 control panel with ExpertSDR3 you might need to update its firmware, here is the installation procedure:

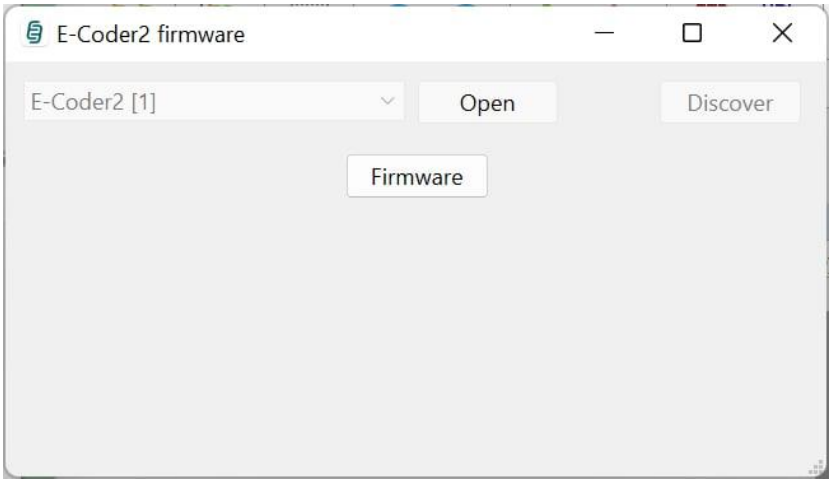
1. Launch the Ecoder2Firmware.exe file, it's placed in the same folder with ExpertSDR3. For macOS: ExpertSDR3.app >> (right click) >> Show Package Contents >> Contents >> MacOS >> Ecoder2Firmware >> (right click) >> Open



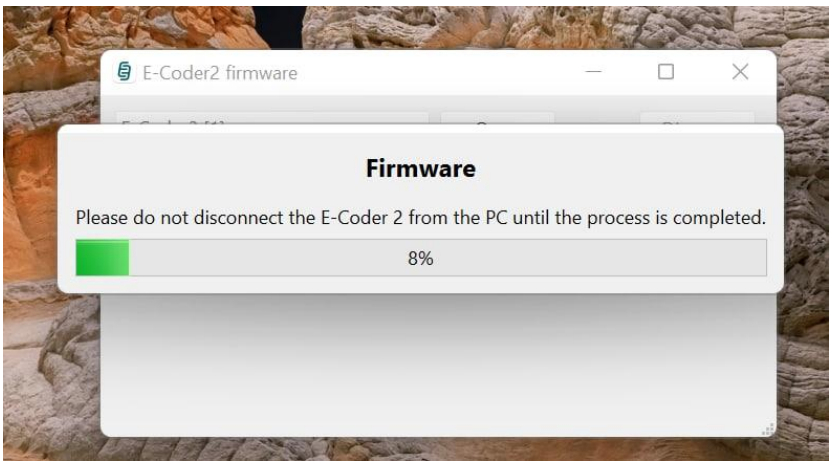
2. Press the Discover button, you'll see a connected to PC E-Coder2 panel. Then Press the Open button.



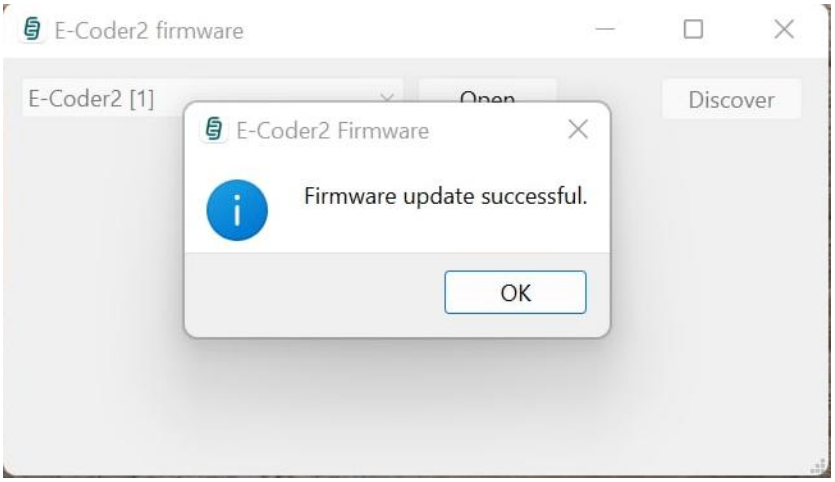
3. You'll see that the Firmware button is active, press it.



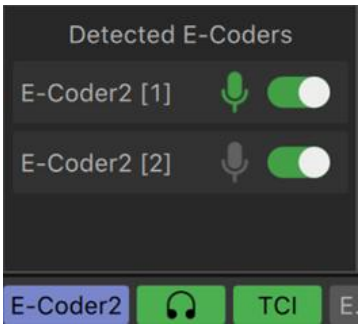
4. It'll start the Firmware update process.



5. When the Firmware update is finished, you'll see this window.



That's all, enjoy your E-Coder2!



- right mouse click on the E-Coder2 indicator to open a window with **Detected E-Coders**, where you can enable/disable control panel mic input.



- right mouse click on the **E-Coder2 [1]** to open a new menu with E-Coder2 settings.

Note:	• E-Coder2 has a DSP processor on board for self-monitoring without delays, avoiding the transfer of the signal to a PC with ExpertSDR3 and back to the panel. With enabled monitoring, the signal from the mic is being processed by the built-in DSP processor and played directly in headphones connected to the E-Coder2. At the same time, mic signal is transferred to ExpertSDR3 without processing. The built-in DSP processor is required for the monitoring audio to be almost identical to what you actually send on the air and remove any delays. • When ExpertSDR3 detects E-Coder2, a new mic (E-Coder2) will appear in mic selection list. The audio you hear from the headphones connected to the transceiver is duplicated to the E-Coder2 headphones connector.

The schematic picture of the E-Coder panel with buttons and knobs is on the menu left side. Left mouse click on any button/knob icon to assign a function from the list. Right mouse click on the knob icon to assign a function from another list for a press action.

The following functions can be assigned to the E-Coder panel buttons and knobs:

NO – the button is unused.

Main: Start/Stop – toggle the button to start/stop the ExpertSDR3.

Band Up/Down – toggle the button to switch band up/down.

Modulation Up/Down – toggle the button to switch mode up/down.

AGC Up/Down – toggle the button to switch AGC type up/down.

Filter Up/Down – toggle the button to switch the receiver's filter up/down.

Preamp Up/Down – toggle the button to switch the preamp or attenuator level up/down.

Step Up/Down – toggle the button to change the tuning step up/down.

Zoom In/Out – toggle the button to switch spectrum zoom modes in/out.

TX – toggle the button to enable/disable manually operated transmit mode.

TUNE – toggle the button to enable/disable tone signal in TX mode.

VFO:

A->B – use to assign the frequency from heterodyne VFO A to heterodyne VFO B.

B->A - use to assign the frequency from heterodyne VFO B to heterodyne VFO A.

A<->B - use to enable frequency exchange between VFO A and VFO B.

Change VFOA/VFOB – use to switch between VFO A and VFO B.

IF as RIT – use to tune the RIT offset by moving the filter over the panorama.

Lock - use to lock the frequency tuning.

RX2 On/Off - use to enable/disable RX2.

RIT On/Off – use to enable/disable RIT offset.

RIT Reset – use to reset RIT offset to 0.

XIT On/Off – use to enable/disable XIT offset.

XIT Reset - use to reset XIT offset to 0.

Sub RX On/Off - use to enable/disable SubRX.

Split On/Off - use to enable/disable Split mode.

Switch DDS/IF – use to enable the frequency tuning by moving the filter over the panorama, in other words changing the digital IF; or when filter stands still and spectrum moves. This is the central frequency tuning.

Switch Receiver – use to switch between software RX1 and RX2. The main knob will tune the frequency of one of the receivers.

Adaptive Tune - use to enable/disable adaptive tuning. The faster you rotate the main knob, the bigger the step.

Fine Tune - use to enable/disable fine tuning (when adaptive tuning is disabled), slows the tuning speed by 10 times.

Usually while you operate with RX1 and RX2 simultaneously, you need to listen to either one of them or both of them in different channels (left/right). To enable this we have added special functions to the E-Coder2 panel, that set the mixer for both RXs.

Audio:

Listen both RX1, RX2 – is a default setting that enables equal volume in both channels for both RXs.

Listen RX1 only – is a setting that allows to listen to RX1 in both channels.

Listen RX2 only - is a setting that allows to listen to RX2 in both channels.

Listen RX1 in left, RX2 in right – is a setting that allows to listen to RX1 in the left channel and RX2 in the right channel.

Listen RX1 in right, RX2 in left - is a setting that allows to listen to RX1 in the right channel and RX2 in the left channel.

There are similar settings for VFOs:

Listen both VFO A/B – is a default setting that enables equal volume in both channels for both VFOs.

Listen VFO A only - is a setting that allows to listen to VFO A in both channels.

Listen VFO B only - is a setting that allows to listen to VFO B in both channels.

Listen VFO A in left, VFO B in right - is a setting that allows to listen to VFO A in the left channel and VFO B in the right channel.

Listen VFO A in right, VFO B in left - is a setting that allows to listen to VFO A in the right channel and VFO B in the left channel.

Mute – is a setting that allows to switch off the sound.

Switch RX and mute former – is a setting that allows to change the software receiver and mute the former one.

TX/Play – is a setting that allows to switch to TX and play the signal record in air.

Voice recording – is a setting that allows to enable/disable voice recording.

Volume Up/Down – is a setting that allows to volume adjustment up/down.

VOX - is a setting that allows to enable/disable VOX for the software receiver selected in the E-Coder settings.

MON - is a setting that allows to enable/disable monitoring of your TX signal.

DSP:

ANF – enable/disable auto notch filter.

BIN – enable/disable binaural mode.

NR – enable/disable noise reduction.

APF – enable/disable audio peak filter.

NB – enable/disable noise blanker.

NB2 – enable/disable noise blanker 2.

NF – enable/disable notch filters.

NF+ – add a new notch filter on panorama.

SQL – enable/disable squelch.

SAM – enable/disable Synchronous AM demodulator. In some cases, it is necessary to scroll the menu with the mouse wheel to display SQL and SAM.

The following functions may be assigned to the E-Coder panel knobs:

Unused – encoder is unused.

Mic Gain – Mic gain adjustment.

Squelch - squelch threshold adjustment.

Filter Low/High – tuning the frequency of the low/high filter's front.

Filter Width – adjusting the filter width.

Filter Shift - shifting the filter's central frequency.

Drive – adjust the output power.

Tune Drive - adjust the TUNE output power.

AGC Gain – AGC Gain control.

CW Speed – CW Speed control.

RIT Offset – adjusting the RIT Offset.

XIT Offset – adjusting the XIT Offset.

Volume – volume adjustment.

Monitor – monitoring (self control) volume adjustment.

In the central part of the menu you can see another settings panel:

Enable - enable E-Coder2 panel control.

Use IF - frequency tuning by moving the filter over the panorama.

Use IF as RIT - tuning by IF when the RIT offset is on.

Use IF as XIT - tuning by IF when the XIT offset is on.

VFO B - enable sub-receiver.

Adaptive Tune - enable/disable adaptive tuning, the faster you rotate the main knob, the bigger the step.

Fine Tune - enable/disable fine tuning (when fine tune is disabled), 10 times slows the tuning speed.

Key Led - enable backlit keypad.

Encoder Led - enable backlit encoder.

Transceiver 1 - select RX1 or RX2 receiver.

No transfer PTT - do not pass PTT command via TCI.

Transfer PTT to TCI – enable reroute of the PTT signal from the panel to TCI.

Sound card panel displays mic signal level and headphones audio level connected to the E-Coder2.

--

In the menu on the right you can see the E-Coder2 internal DSP core's settings:

There are 2 ways to monitor yourself with E-Coder2:

1. Toggle the **Monitor** switch to enable/disable the DSP core in the panel. If enabled, all mic (connected to E-Coder2) audio is being processed through the panel's DSP core and played in headphones, not only the signal which is being transmitted. Use this mode to adjust the DSP parameters for the monitoring signal you hear through headphones connected to the E-Coder2.

2. Toggle the **Monitor in TX** switch to enable/disable the TX monitoring through E-Coder2. If disabled you'll listen to the actual TX signal transmitted on the air, but with a delay. If the **Monitor in TX** is enabled, it will automatically activate monitoring through E-Coder2 DSP-core **only in TX** mode. Monitoring yourself through **a mic and headphones connected to the E-Coder2** allows you to eliminate the delay, but the sound will slightly differ from what is actually transmitted on the air.

Low Pass filter - toggle the switch to enable/disable LPF. Frequency – use to adjust the cutting edge of the LPF.

Noise gate – toggle the switch to enable/disable noise gate. Threshold – use to set the threshold level for the gate to open and pass through the useful signal. The threshold must be set above the noise level, but below the useful signal level.

Compressor - toggle the switch to enable/disable compressor. Threshold - set the Threshold for the compressor to reduce the level of audio signals if their amplitude exceed this Threshold. Ratio - determines the ratio of input/output signals that exceed the Threshold, i.e. the 3:1 ratio means input level is 3 dB exceed the Threshold, and the output signal level is 1 dB exceed the Threshold.

AGC - toggle the switch to enable/disable Mic AGC. Gain - set the gain level that will be applied to your Mic signal.

There are three LEDs on the E-Coder panel, from left to right:

1. Lights **green** when the VFO B is active

2. Lights **red** when on TX

3. Lights **orange** when the RX2 is active

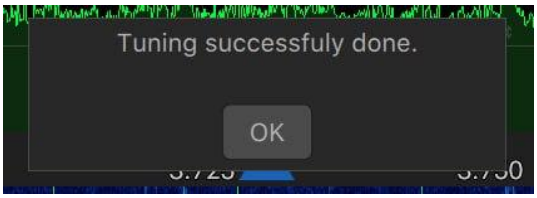
Note:	• *The functions you can assign to buttons and knobs are the same for E-Coder2, E-Coder and E-Coder Plus.* • *If you change parameters with horizontal knobs on E-Coder/2 or TCI these changes will be briefly displayed in the ExpertSDR3 window.*

14.6. Connection to AAT-100 tuner

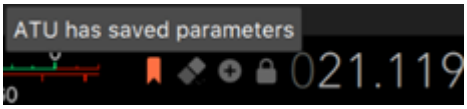
The ATU button is available in ExpertSDR3 when ATT-100 external tuner is connected to the SunSDR2 DX. If the ATU button is manually set to disabled in the software, it will set the ATT-100 to a BYPASS mode.

- Minimal output power for tuning is 5W- Recommended output power for tuning is 15W- Maximum output power for tuning is 20W

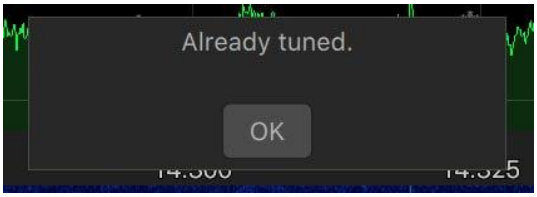
Click on the TUNE button in the ExpertSDR3 to perform manual tuning. If “initial” SWR is within the “tunable” limits, the tuner will engage the tuning process. When the tuning completed, the ExpertSDR3 will display the pop-up window



. After the successful tuning, the ExpertSDR3 will save the tuner values with 50 kHz “step” (i.e., 7.0-7.05; 7.05-7.1; 7.1-7.15, etc.).

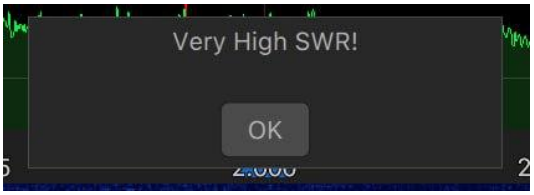


- the ATU indicator is **orange** when the ATT-100 has saved parameters for the current frequency; and it turns **dark-gray** if the ATU memory is empty. When ATU is enabled and the tuning engaged on a frequency with earlier saved parameters, then ATU will use memory settings and the ExpertSDR3 will inform you that the tuner is



.

Tuning is not required when the SWR is below or equal to 1.25. With the SWR values of 3.5 and above, the tuning will not occur due to the high SWR level; instead the ExpertSDR3 will switch to RX mode and display the pop-up window informing you about it



.

The SWR value you see in the ExpertSDR3 window shows SWR between SunSDR2 DX and AAT-100. The ATT-100 performs its own measurement of the SWR, and these values may differ from those displayed in the ExpertSDR3 SWR-meter. ATT-100 performs tuning based on its own SWR values.

Stay On TX can be enabled in Settings-> Radio-> ATU; if enabled, it will force the transceiver to stay in TX mode after the ATU tuning is completed.

The tuner current status is displayed in the software status bar, e.g. ATU: Tuning; ATU: Tuned; ATU: Failed to tune.

Note:	• *If you operate using one HF antenna connector e.g. A2 and have an active AAT-100 connected to A3, pressing the TUNE button will start the tuning process of AAT-100 on A3. To use TUNE feature the standard way (on A2 in the current example) set AAT-100 to BYPASS mode.*

14.7. Transverter (XVTR)

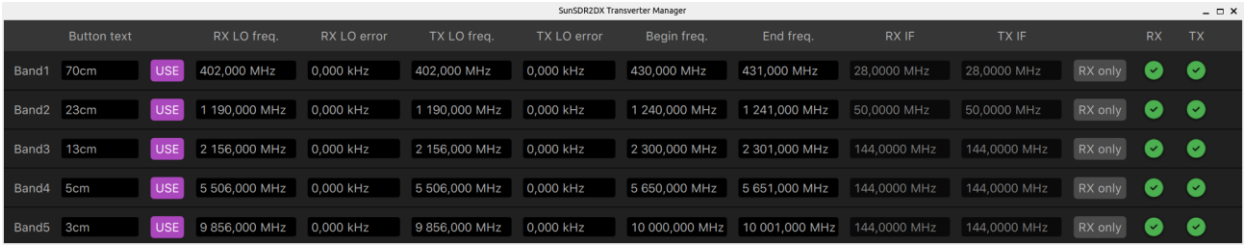
First of all you should know that in **XVTR** mode you can use **all antenna ports** and **ADC IN** (for RX mode) and **DAC OUT** (for TX mode) connectors.

For example, If operating frequencies of your XVTR are **430...431 MHz**, enter them in **Begin freq** and **End freq** fields. Frequency of internal **XVTR LO** is **402 MHz**, enter it in **RX LOfreq** and **TX LOfreq** fields.

Now deduct **XVTR LO** frequency from XVTR operating frequency to get **IF of your transceiver** (real frequency which your transceiver will transmit on).

Example: 430 - 402 = 28 and 431 - 402 = 29.

Use in-build RX/TX indicators to validate the accuracy of your **receiver (RX) IF** and **transmitter (TX) IF** settings. When the IF correlates with one of the ham bands, and the XVTR bandwidth is within the ham band limit, the indicator will turn **green**. This means your settings are correct, and you are good to go on the air.



An XVTR antenna switch can be controlled from the Band Manager. Bear in mind, the antenna input/output determined by its IF values.

The Max XVTR frequency limit is 99 GHz.

14.8. Frequency Tuning

There are several ways to **tune frequency**:

- **Fine-tuning.**

This tuning way accuracy depends on the **STEP** setting. Place the mouse cursor anywhere on the spectrum or waterfall graph and roll the mouse wheel forward/backwards - the tuning frequency will increase/decrease in **STEP** increments.

- **Quick tuning by the mouse click.**

A mouse cursor in the spectrum is represented by a crosshair. The exact current frequency and its dBm level are displayed alongside the cursor. Use left mouse click to fetch RX filter.

Note:	• *When the **Sub-receiver** is enabled, click-on the **mouse wheel** on the panorama to switch the **Quick tuning by the mouse click** between the **VFO A** and **VFO B**.* ***TUNE A** or **TUNE B** information will be displayed near the mouse cursor, confirming which receiver is controlled.* • *Use both - the **Quick tuning by the mouse click** and **Fine-tuning** modes. Click on the station and then perform fine-tuning with the wheel.*

- **Dragging the RX filter over the spectrum scope**.

Hold down left mouse click on the filter, then drag-and-drop as required.

- **Moving the spectrum, the RX filter stands still**.

Hold down right mouse click anywhere on the spectrum, then move the spectrum. The filter will not change its position in respect to the spectrum.

- **Moving the spectrum, the RX filter moves along**.

Hold down right mouse click on the filter to move it left/right.

Note:	• *The above is not a "best recommended" tuning process, it just allows you to observe the air outside of the panorama window without changing the tuning frequency.*

- **Click on the digit of the frequency indicator.**

Click on the left button to increase the value; click on the right button to decrease the value; click on the wheel to reset all digits on the right to zero.

- **Rotate the mouse wheel on the digit of the frequency indicator.**

Scroll mouse wheel forward to increase the value; scroll the mouse wheel backward to decrease the value.

- **Synchronous tuning by the click on the bandscope.**

Hover over the required bandscope position and left mouse click to move RX filter to the required location on bandscope and panorama.

14.9. Voice Recorder Operation

The voice recorder allows you to record the signal in the RX filter bandwidth in receive mode, and to record the microphone signal in transmit mode.

Toggle the **Record** button  to Start/Stop recording of **the receive voice signal**.

Note:	• *Recording of the received signal is available in all modes.* • *The format of the recorded file is RAW. By eliminating format conversion we're reducing CPU load. Make sure there is enough space in the HDD/SSD.* • *Recorded files are saved in the following directory:* *Windows: C:\Users\User_Name\AppData\Local\Expert Electronics\ExpertSDR3\voice* *Linux: /home/[UserName]/.config/Expert Electronics/ExpertSDR3/voice* *Mac OSX: /Users/[UserName]/Library/Preferences/Expert Electronics/ExpertSDR3/voice*

Recording of the microphone signal:

1. Click on the microphone PTT button or the ExpertSDR3 **TX** button to switch the transceiver to the TX mode.
2. Click on the **Record** button to start recording the transmitted microphone signal.



3. Click on the **Record** button again to stop the recording.



Play the recorded signal without transmitting it on the air:

1. Right mouse click on the **Play** button to play back the recorded voice signal in headphones or in an internal speaker. This will suppress the receiver output.



2. Once the record playback ends, the receiver output will return to active state.

Play the recorded signal with transmitting it on the air:

1. Left mouse click on the **Play** button to play back the recorded voice signal in phones and transmit it on the air. This will suppress the receiver output.



2. Once the record playback ends, the receiver output will return to active state.

Note:	• *Voice recorder transmits the recorded signal "as is" with max volume level. If the recorded signal wasn't initially compressed by the transmitter, it has lower RMS power, than the compressed signal.*

14.10. IQ Recorder formats

Each IQ Recorder file format has its own unique header information:

- WAVE - the standard wave header followed by payload;
- HDSDR - the standard wave header + auxi header followed by payload;
- ExpertSDR3 - the standard wave header + ExpertSDR3 header followed by payload;

A central frequency and Sample Rate values can be found in ExpertSDR3 header.

```
//=============================================

struct SysTime

{

uint16_t wYear;

uint16_t wMonth;

uint16_t wDayOfWeek;

uint16_t wDay;

uint16_t wHour;

uint16_t wMinute;

uint16_t wSecond;

uint16_t wMilliseconds;

};

struct HdsdrHeader
```

```
{
SysTime startTime;
SysTime stopTime;
uint32_t centerFreq;
uint32_t spare[32];
};
//================================================
struct EsdrHeader
{
uint32_t version;
SysTime start;
SysTime stop;
double freq;
double sampleRate;
double preamp;
};
```

14.11. RIT/XIT

14.11.1. RIT

When the **RIT** offset is ON, the RX frequency is the TX frequency diverged by the offset value. In this case, the **TX** frequency is represented by a **red** line and the **RX** frequency by an **orange** line surrounded by the filter band (see the AM mode example in the below screenshot).



- right mouse click on the RIT offset value to open the drop-down menu and set a frequency offset in Hz.

If you hover over the RIT filter, the following information will be displayed below the main receiver's frequency indicator:

RIT: - the frequency offset.

L: and **H:** - the low and high filter's edges frequencies.

O: - the mouse cursor frequency inside the filter.

To adjust a single edge of the RIT filter bandwidth: Hold down left mouse click on the filter edge (the selected area will be highlighted), then drag and drop to the desired position.

To adjust both edges of the RIT filter bandwidth: Hold down right mouse click on the filter edge (the selected area will be highlighted), then drag and drop to the desired position.

When the **RIT** is enabled, frequency tuning changes a bit:

Hold down left mouse click inside the RIT filter to drag it over the panorama within 50 kHz distance from the VFO A frequency.

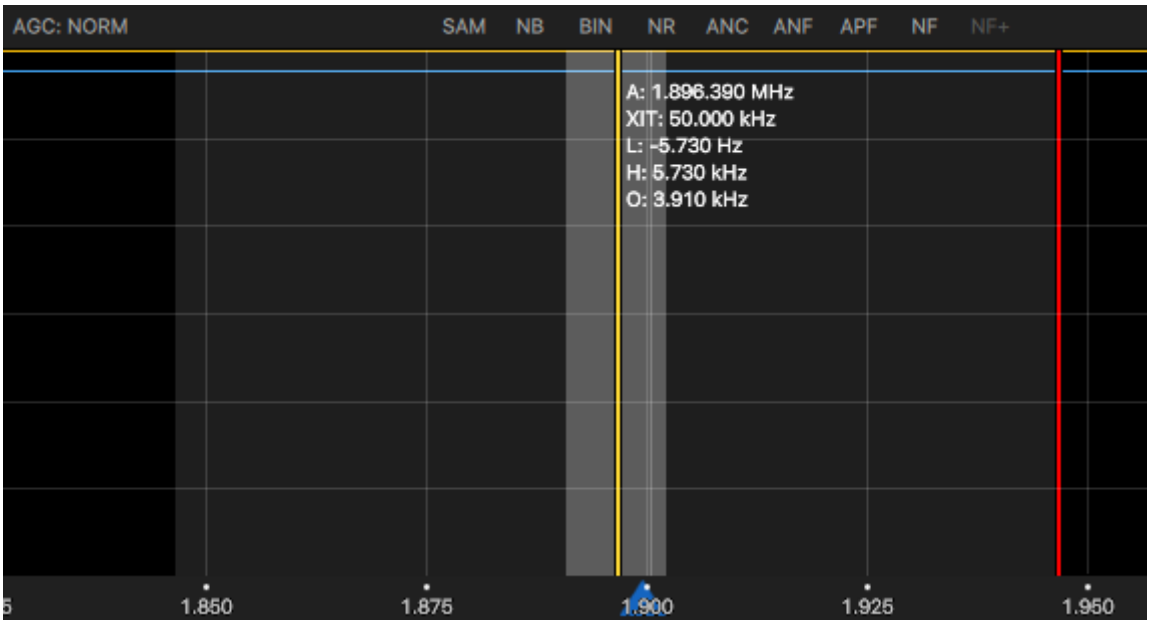
Hold down right mouse click inside the RIT filter to move the whole panorama with the filter.

Click the mouse wheel on the RIT button to reset offset.

Note:	• *Unless **RIT** is reset, the latest settings of a disabled **RIT** offset will be saved. Therefore, the next time the **RIT** is activated, its offset value will remain the same.*

14.11.2. XIT

When the **XIT** offset is ON, the TX frequency is the RX frequency diverged by the offset value. In this case, the **TX** frequency is represented by a **red** line and the **RX** frequency by an **orange** line surrounded by the filter band (see the AM mode example in the below screenshot).





- right mouse click on the XIT offset value to open the drop-down menu and set a frequency offset in Hz.

If you hover over the RX filter the following information will be displayed below the main receiver's frequency indicator:

XIT: - the frequency offset.

L: and **H:** - the low and high filter's edges frequencies.

O: - the mouse cursor frequency inside the filter.

When the **XIT** is enabled, the frequency tuning is a little bit different:

Hold down left mouse click on the XIT IF to drag it over the panorama within 50 kHz distance from the VFO A frequency.

Hold down right mouse click on the XIT IF to move the whole panorama with the filter.

Hold down the middle mouse click on the XIT button to reset the offset.

Note:	• *Unless **XIT** is reset, the latest settings of a disabled **XIT** offset will be saved. Therefore, the next time the **XIT** is activated, its offset value will remain the same.*

14.12. CW mode

In late 2022 we've released the new CW-core, which is an integrated part of the transceiver's firmware. The new CW-core is available in ExpertSDR3 only (note: ExpertSDR2 has previous CW-core version). **To enable new CW-core, please ensure you use the latest ExpertSDR3 application version, AND your SunSDR2 DX has the latest firmware loaded - this is essential when upgrading from ExpertSDR2 to ExpertSDR3.**

There are several sources of CW signal in ExpertSDR3:1. KEY input in transceiver2. KEY input in E-Coder2 panel3. TCI

Then we should say, that there are several means to playback CW-signal:1. Transceiver (firmware)2. E-Coder2 (firmware)3. ExpertSDR3:- Sound Card output- Line Out into Sound Card- Line Out into wave file- A special core which displays CW signal on the panorama

Difference between “old” and “new” CW-core:

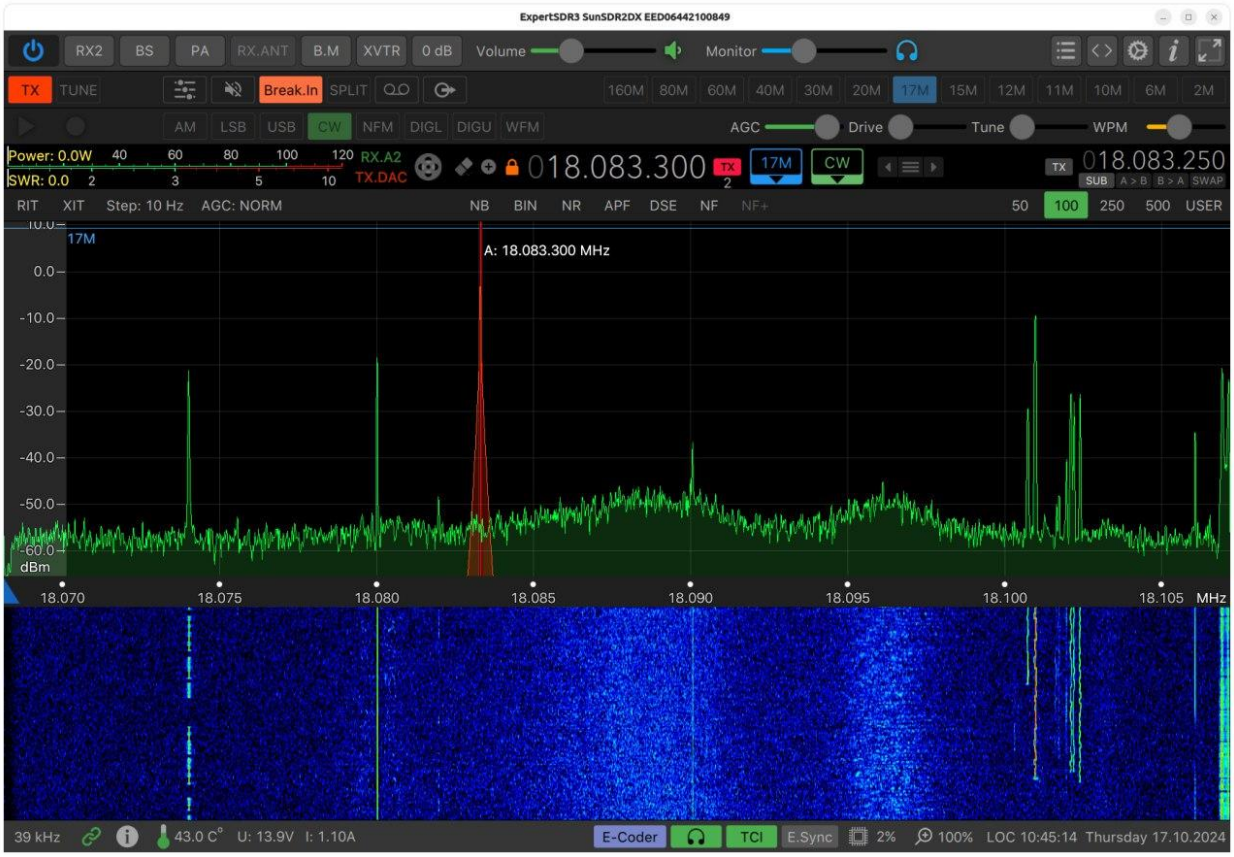
“Old” CW-core: Both CW-core firmware and software components had its own delays. The combination of the aforementioned delays resulted in a combined delay during the monitoring of the CW signal. For example, a CW key connected to the transceiver and monitoring audio was routed via a PC Sound Card. During the CW operation, a single character of the CW sequence may appear to be “lost” due to the OS delay. In the meantime, the CW-core did not “loose” anything and the CW sequence was transmitted on the air as it should. As a result, the monitoring signal deviated from what was actually transmitted on the air, causing misinterpretation and confusion. The above scenario could happen in reverse order.

“New” (actual) CW-core: we have managed to achieve the minimal monitoring delay (about 3 ms) by combining the CW signal generation and monitoring within the same device. The recommended way of use is when both CW-key and headphones are connected to transceiver or E-Coder2. From now on, the macros is "played" in the transceiver's firmware, not ExpertSDR3 application (like it used to be in “old” CW-core). The new CW-core eliminates the “PC CPU issue”, the scenario when less powerful CPU caused an increased symbol intervals for CW macros, which could be interpreted as uneven CW manipulation. Additionally, the new CW-core improves CW macros operation by using TCI.

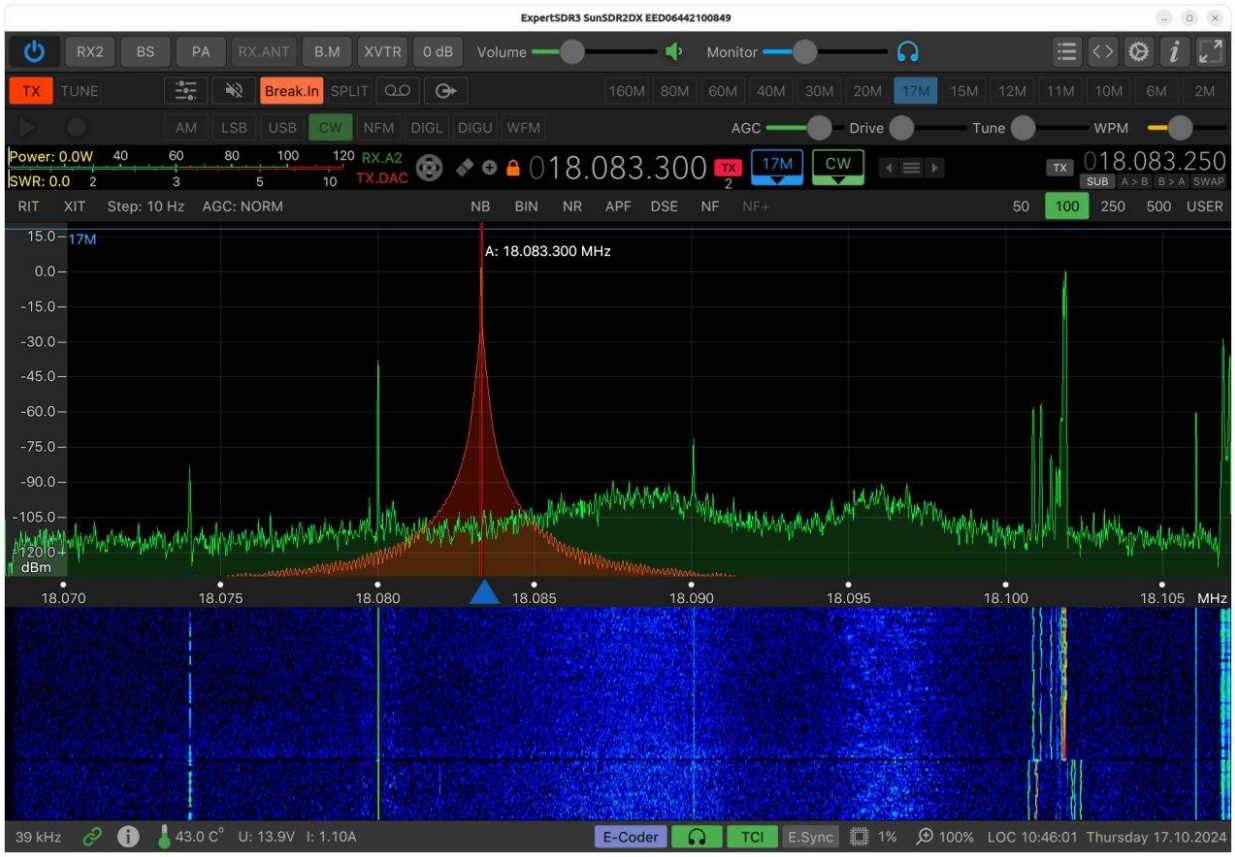
Note:	• ***CW works only in CW-U*** *for all bands, and it cannot be changed by user. CW-U was a logical programming selection choice: when you raise a frequency inside an RX filter, the tone lowers - this is because signal goes from right to left side of the filter. Also, when DSE feature is in use (when the signal is on the filter's left or right side), a panoramic effect could be heard.*

When you transmit in CW mode you'll always see your signal on panorama, examples below:

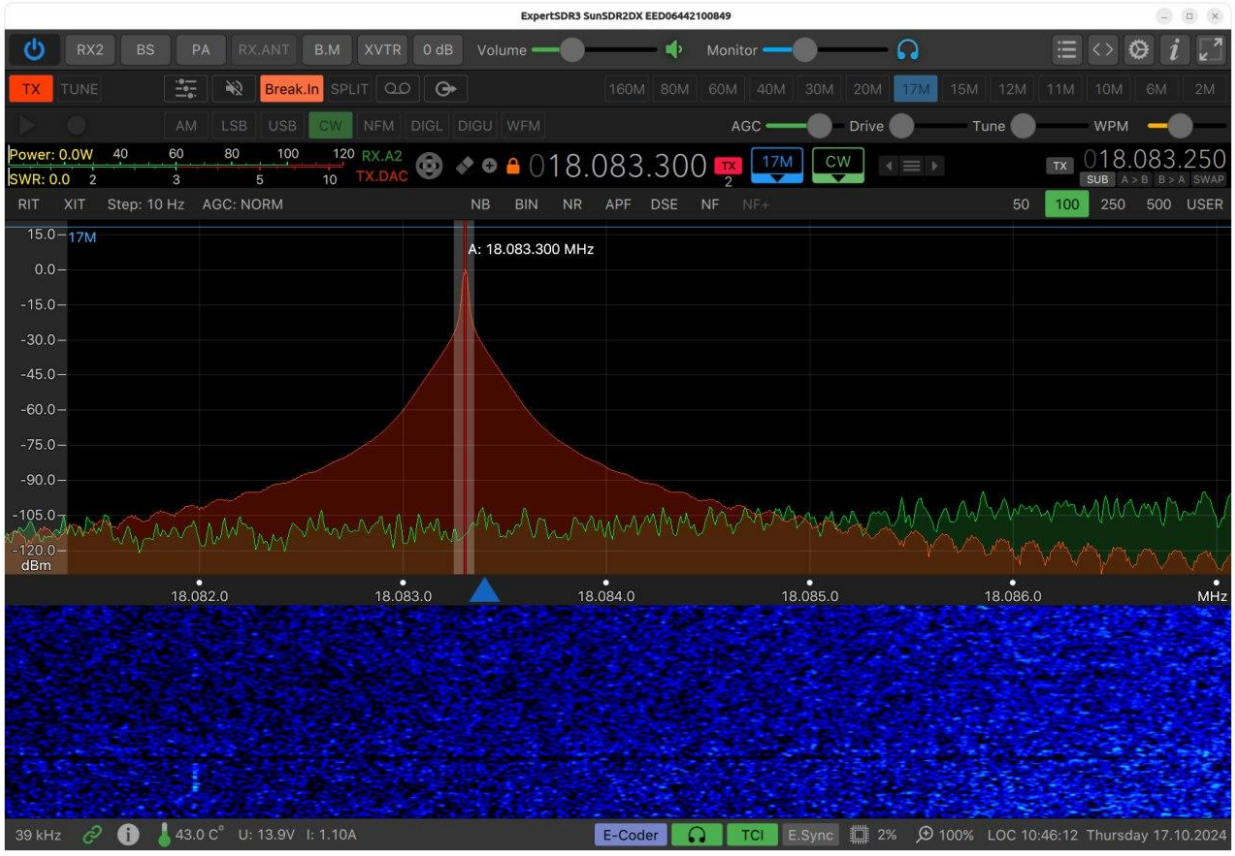
TX CW signal with the vertical dynamic range scale set to 60 dB.



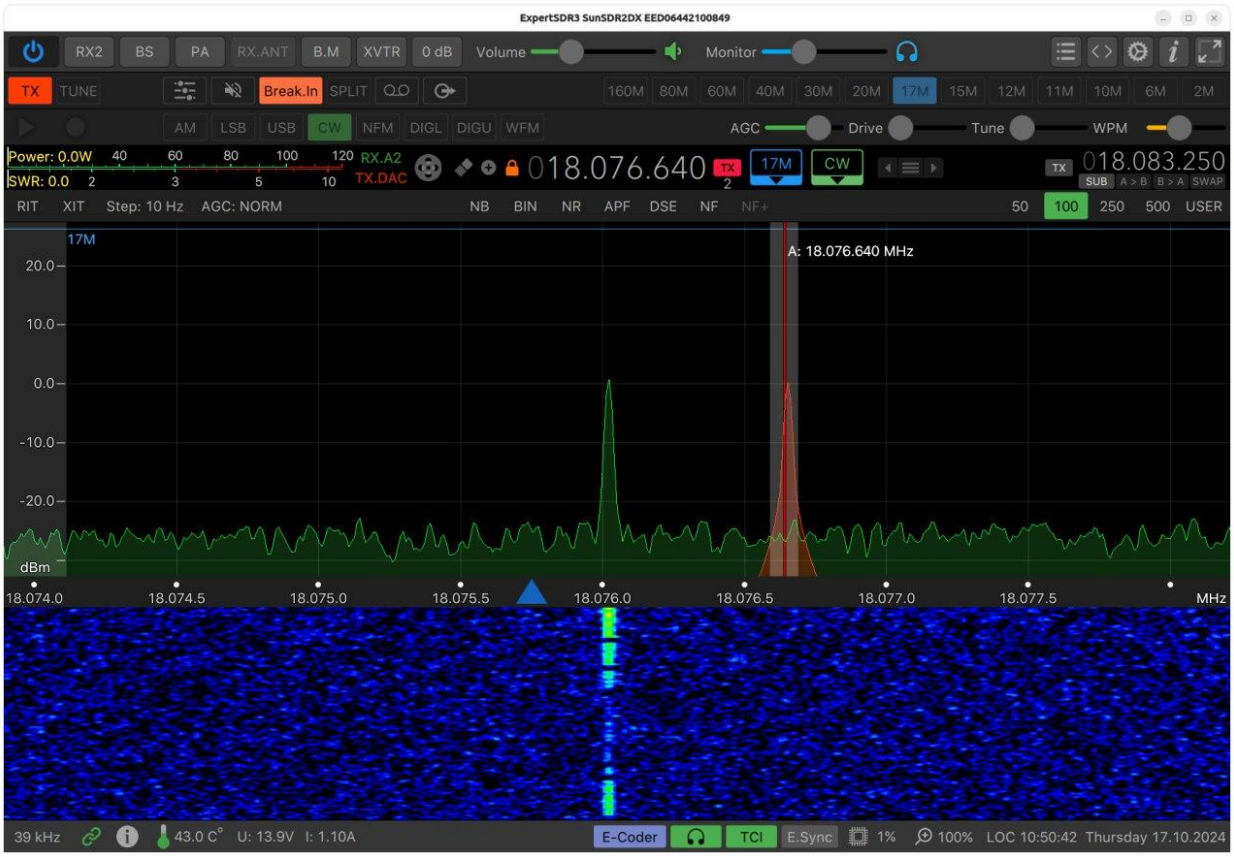
The same TX CW signal with the vertical dynamic range scale set to 120 dB.



The same TX CW signal zoomed by horizontal frequency scale.



The same TX CW signal in comparison to a RX CW signal when the scale is matched.



14.13. Digital modes operation

Operation in digital modes is available with SunSDR2 DX / ExpertSDR3 in combination with 3rd-party digital mode applications.

Note:	• *Select generic DIGL/DIGU buttons to operate in digital modes.* • *The "**Digital**" part of modes menu is not finished yet. At the moment, selecting FT8, for example, will only set filter width.*



More information about the connection between **ExpertSDR2** and digital software is explained in the **User Manual Addendum by Erik Carling EI4KF**.

15. Remote operation

Expert Remote is a comprehensive, software-defined ecosystem designed for **full remote access and control of modern SDR equipment** located in a distant, optimally positioned radio shack.

Key Benefits:

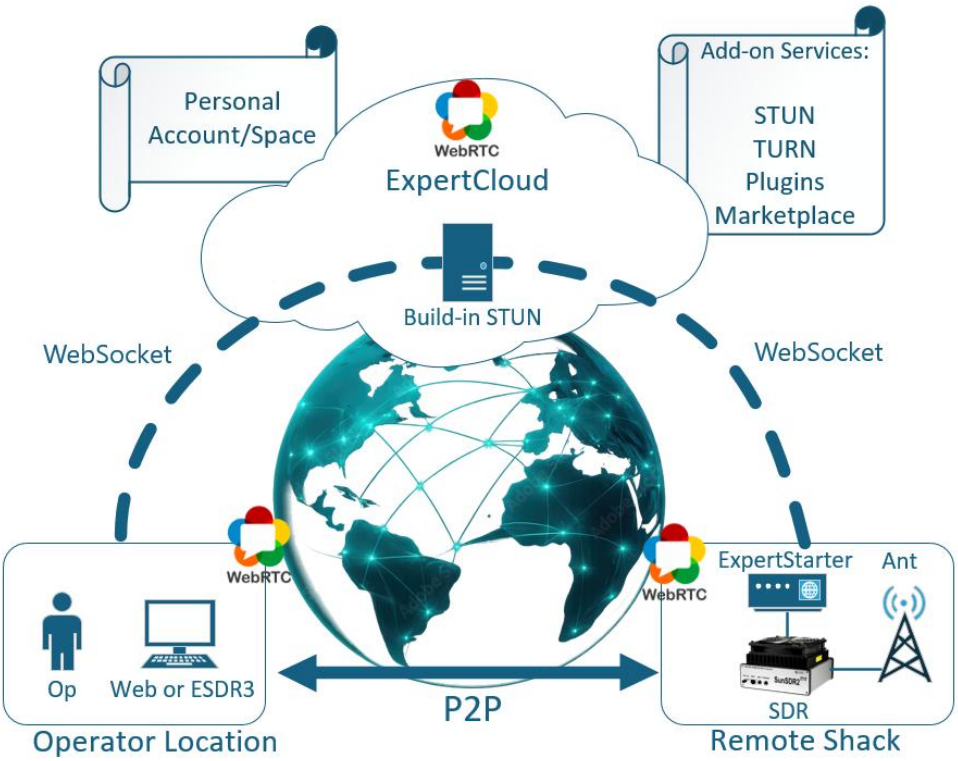
- **Eliminates Geographic Barriers:** Operate a high-performance station from a location with ideal radio conditions (low noise, excellent propagation) directly from your computer, anywhere in the world.
- **Enables New Operating Scenarios:** Perfect for DX-peditions, contests, extended portable operations, or maintaining your station access while traveling.
- **Simplifies Station Deployment:** Ideal for users who cannot install a full station at their primary residence but have access to a remote site (e.g., a country house).

Designed For:

- Radio amateurs seeking the highest receive signal quality from low-noise areas.
- Operators unable to deploy a full station in an urban environment.
- Enthusiasts who frequently travel but wish to stay active in the hobby.
- Those who want to evaluate transceiver operation and remote capabilities before purchasing hardware.

Ecosystem Components:

1. **ExpertCloud:** A personalized cloud service for centralized account management, device discovery, and secure connection establishment.
2. **ExpertStarter:** A compact hardware/software unit installed at the remote shack, acting as a connectivity bridge.
3. **Dual User Interface Options:**
   - A **Web-based Interface** for quick access via a browser.
   - The **full-featured ExpertSDR3** Application for professional operation.



15.1. ExpertCloud

ExpertCloud is the central cloud-based management and orchestration service of the Expert Remote ecosystem.

Core Functions:

1. **User Account & Security Hub:** Provides personalized account management, secure authentication, and optional Two-Factor Authentication (2FA).
2. **Intelligent Connection Facilitator:** Acts as an automated "helper" to discover and establish the optimal connection path between the operator's location and the remote shack.
3. **Service Platform:** Offers a gateway to additional services like custom TURN server configuration and future add-ons.

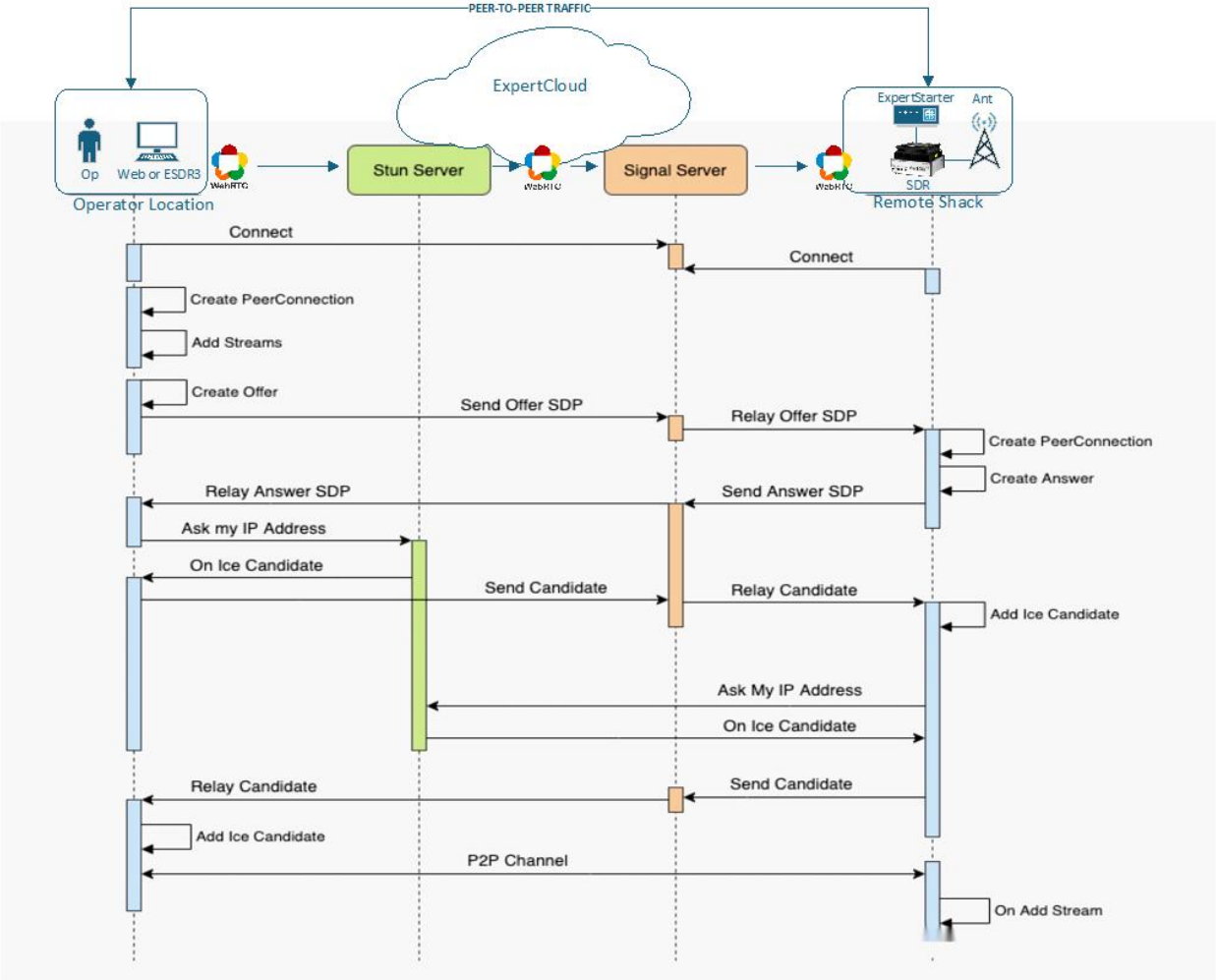
Underlying Technology & Security (WebRTC):

The entire ecosystem leverages the modern **WebRTC (Web Real-Time Communication)** standard for all connections, ensuring low latency and high security.

- Connection Flow: ExpertCloud facilitates the initial handshake and network discovery. Once peers (your computer and the remote transceiver) have exchanged necessary data, a direct, peer-to-peer (P2P) connection is established whenever possible, minimizing latency. ExpertCloud does not relay user data traffic.
- Automatic Network Traversal: WebRTC automatically handles complexities like NAT, firewalls, and various internet connections (DSL, mobile, fiber), eliminating the need for manual router configuration or VPNs in most home networks.

- Mandatory Security: All communication is secured by design:
- End-to-End Encryption: Media and data streams are encrypted using SRTP (Secure Real-time Transport Protocol).
- Secure Signalling: All communication with ExpertCloud uses HTTPS.
- Secure Key Exchange: Cryptographic keys are exchanged directly between peers using robust, modern protocols.

For more in-depth details on WebRTC security, please visit the official source: https://webrtc.org.



WebRTC protocol security comes down to securing two main elements: the signal used to help two peers to discover and communicate with one another and the media they share between them. WebRTC is based on the Mandatory Media Encryption, Mandatory Secure Key Exchange, Secure Signalling and Browser Security and Privacy Protection principles.

Unlike common voice and video conferencing technologies, encryption is mandated in WebRTC. To send data (including voice and video) between two peers, the WebRTC information must be encrypted with Secure Real-time Transport Protocol (SRTP). SRTP encrypts the session, so no one can decode the message without the proper encryption keys.

In fact, the unencrypted version of the Real-time Transport Protocol (RTP) is explicitly forbidden by WebRTC specifications.

The WebRTC specifications mandate secure setup of the encryption channel and demands use of robust keys exchange methods directly between peers on the media plane. Old encryption mechanisms specifically barred from use in WebRTC.

WebRTC requires a secure connection between the server that handles HTPPS-secures signalling traffic to/from ExpertCloud and between each peer client.

Finally, WebRTC is further secured by operating within a browser sandbox (with Web user interface) or sandboxed browser-alike environment (with Application user interface), which helps to isolate and keep sensitive user information.

15.2. ExpertStarter

ExpertStarter is a dedicated hardware/software component that must be installed **at the remote location alongside your SDR transceiver.**

Primary Role: It acts as a **local WebRTC endpoint and protocol adapter**, enabling full remote-control capabilities for transceivers that may not have native WebRTC support in their firmware.

Key Characteristics:

- Hardware Flexibility: Designed to run on low-cost, low-power hardware such as a Raspberry Pi, Intel NUC, or any mini/micro-PC.
- OS Compatibility: Supports Windows, macOS, and Linux operating systems.
- Ease of Setup: Features a streamlined installation process with clear instructions, making it accessible for users without deep technical expertise.
- Critical Network Requirements:
- Must be connected to the same local area network (LAN) as the transceiver via a wired Ethernet connection for reliability.
- The remote location must have a stable internet connection with uninterrupted access to the ExpertCloud service (cloud.eesdr.com).

15.3. Operator Location

The Expert Remote ecosystem provides two types of user interfaces for the Operator, each suited to different tasks.

Access Method	Launched directly from your Personal Account in ExpertCloud in a new browser tab.	Requires the ExpertSDR3 application to be installed on your PC.
Installation	Not required. Runs in a modern web browser.	Required. The current version of ExpertSDR3 must be installed.
Key Features	Basic control, panadapter, and settings displayed as an HTML page.	Support of almost all transceiver functions, all emission types, and integration with third-party software (e.g., JTDX, loggers).
Limitations	Simplified functionality, limited support for third-party software integration.	There is no: - Bandscope - RX2 - Calibrations menu
Platforms	Any device with a modern browser (PC, laptop, tablet).	PC running Windows, macOS, or Linux.
Best Suited For	Quick access, monitoring, basic operation, and testing from anywhere.	Professional operation, contests, digital modes, and full control over your remote station.

Summary:

Web-based Interface is your "quick access" solution from any browser without software installation, ideal for testing and basic use.

ExpertSDR3 Application is the professional environment for full control, offering the complete power and flexibility of your transceiver in remote mode. The same application works with both local and remote hardware.

You can easily switch between these interfaces based on your current needs.

15.4. Quick Start

Who is considered «new user»? Anyone who is completely new to Expert Remote.

Heard about Expert SDR Remote and wish to try it prior considering buying transceiver? Evaluating how complex setup and configuration is? Already have the transceiver, but never used it in Remote mode and consider to explore the feature set to validate if it has potential use in your setup? Then this Quick Start for New Users is for you.

15.4.1. Account Registration Process

Creating a Personal Account is a mandatory first step. It becomes your central hub for managing all remotely registered devices and services.

How to Register:

1. Open the following link in your browser: https://cloud-eesdr.com/auth/register.
2. Fill in the form:

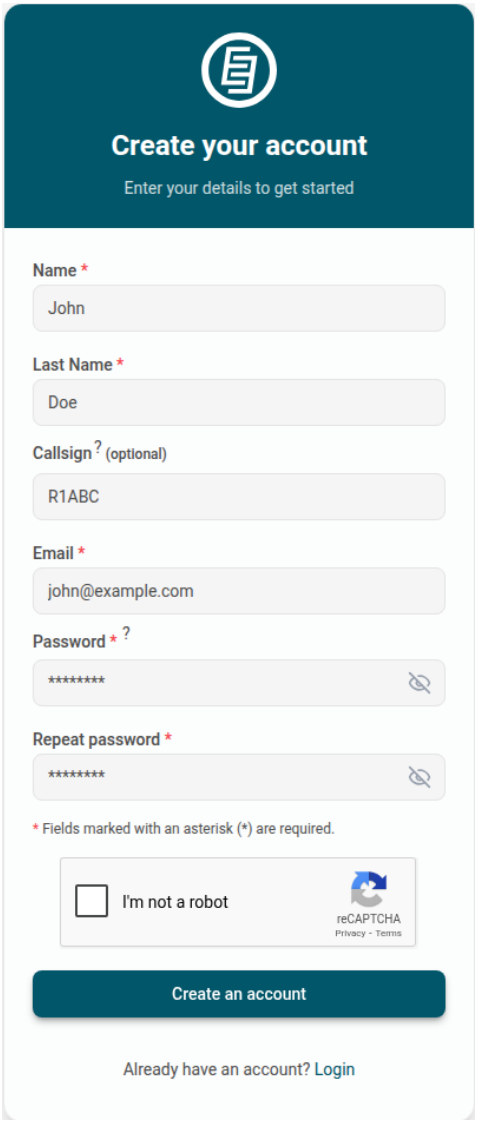
- First and Last Name: Required.
- Email Address: Must be valid and accessible. A confirmation link will be sent to complete registration.
- Password: Must be 8–20 characters and include at least one uppercase letter, one lowercase letter, one number, and one special character.
- Call Sign: Optional at this stage.

3. Click the confirmation link sent to your email to activate your account.

Security Notes:

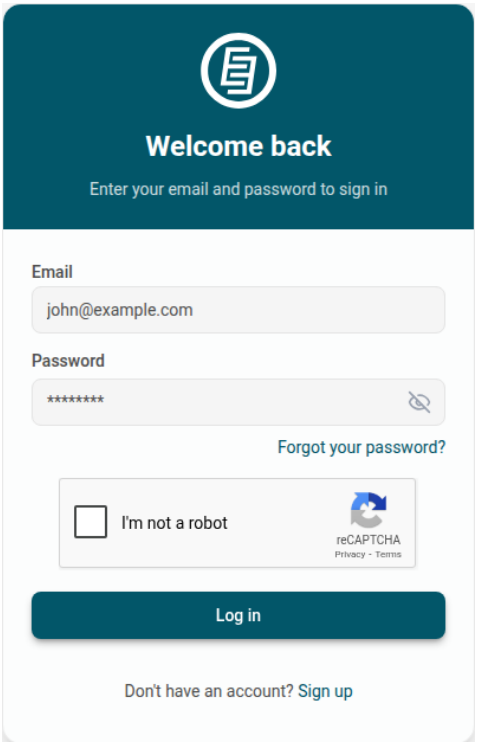
- Never share your password.
- Always ensure you are connecting to the official site: https://cloud-eesdr.com.
- After logging in, you can enhance security by enabling Two-Factor Authentication (2FA) in your Profile settings.

Warning!	• This version of the ExpertCloud service uses a new, updated database. This means that your existing accounts and data from the old platform have not been migrated and will not work. To start working, you must register a completely new account on the current service website. • To complete registration, you must pass the CAPTCHA verification. If the verification is not displayed, try refreshing the page or using a different browser. Without confirming the CAPTCHA, it is impossible to continue registration.



After registration, an email will be sent to your email address. Confirm the specified email by following the link in the email (after clicking the link you will not receive additional confirmation, no further action is required – your account will be activated). If you do not see the email, check your Spam folder.

Log in to the ExpertCloud personal account by following**the link**.



15.4.2. Supported Browsers, Internet, NAT and VPN Considerations

Browsers: For the best experience, use the latest version of a modern browser: Chrome, Brave, Edge, Firefox, Safari, or Opera.

- Ensure WebRTC is enabled in your browser settings.
- Remove or disable any old WebRTC plugins; modern browsers do not require them.
- Note: Full remote operation is recommended on a PC or laptop. Tablet and mobile browser support is limited in this release.

Internet Connection: Stable internet with sufficient bandwidth is required at both the Operator and Remote locations. Since Expert Remote establishes a direct peer-to-peer (P2P) connection, the latency between these sites greatly affects quality. Use the table below as a guide:

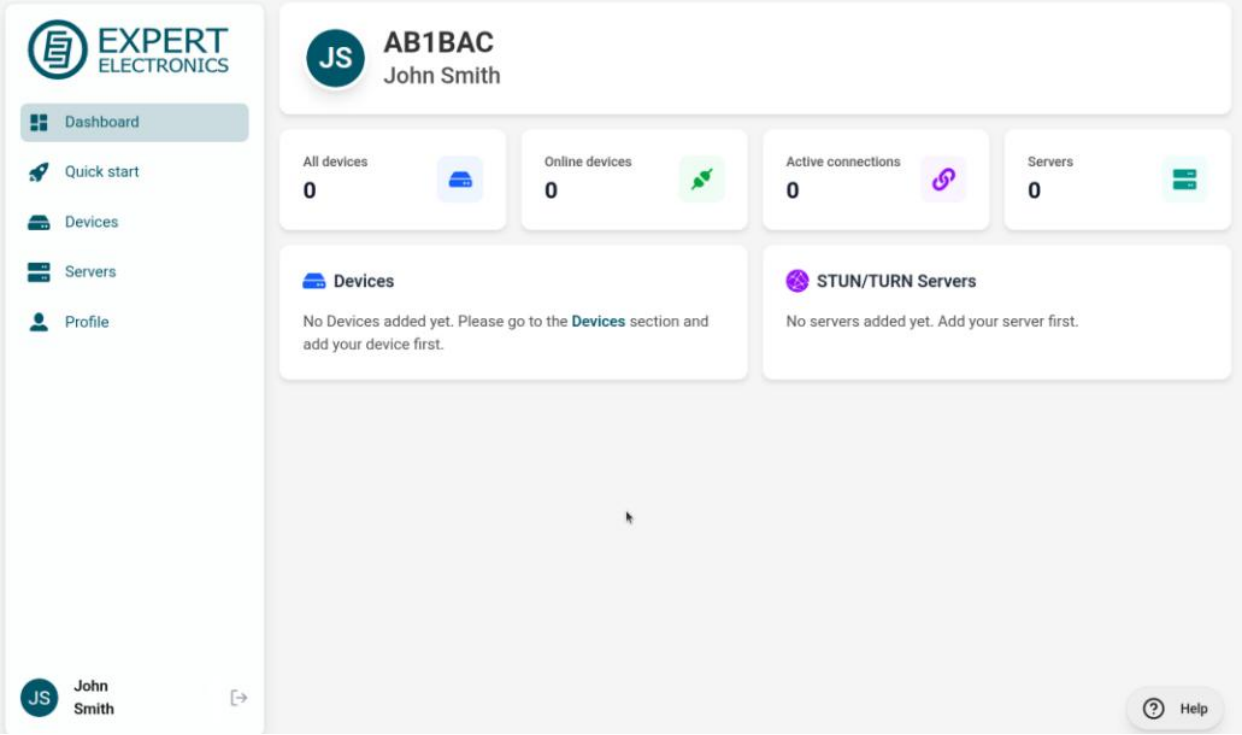
Below 40ms	Very good, full feature set supported, no adjustments required
40-100ms	Good, all features supported with minimal adjustments
100-250ms	Average, some features will be limited
Above 250ms	Poor, unsuitable for most intensive radio activities

NAT: The vast majority of modern NAT configurations (Single, Dual, CGNAT) are fully supported automatically. No manual router or firewall configuration is typically needed. Rare, restrictive setups (like Symmetric NAT in corporate networks) may require assistance.

Warning!	• A VPN **is not required and is generally not recommended** for most users, as it can interfere with WebRTC's automatic NAT traversal. Advanced users employing VPNs should be aware of potential complications.

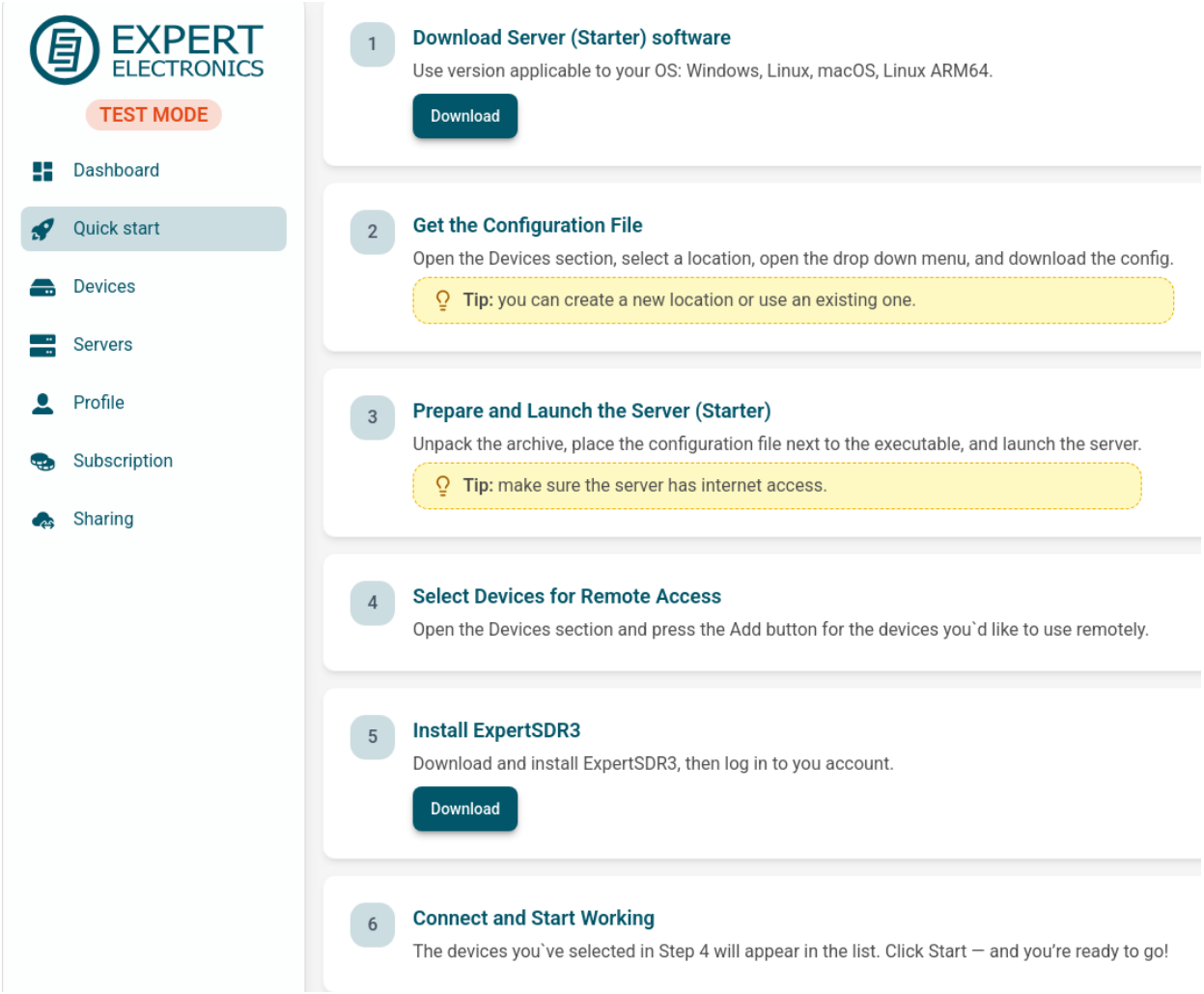
15.4.3. Stage #1 (Server)

Once registered and logged into your Personal Account, you will be able to access ExpertCloud dashboard via your browser. Current dashboard version is very simplistic, user friendly and streamlined and enables registered user quick access to current supported features. When you logged in first time, you will see “zero” values in devices, connections and servers – consider it is normal at this stage, as you just logged in and have no devices configured yet.



This section guides you through the initial setup. Your path depends on whether you already own a supported SDR.

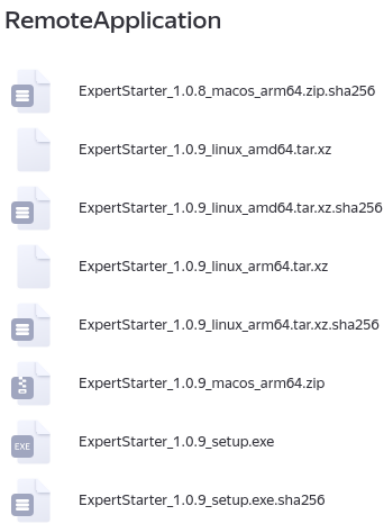
Scenario A: I own a supported SDR and want to enable Remote Access.



Step 1. Download Server (Starter) software.

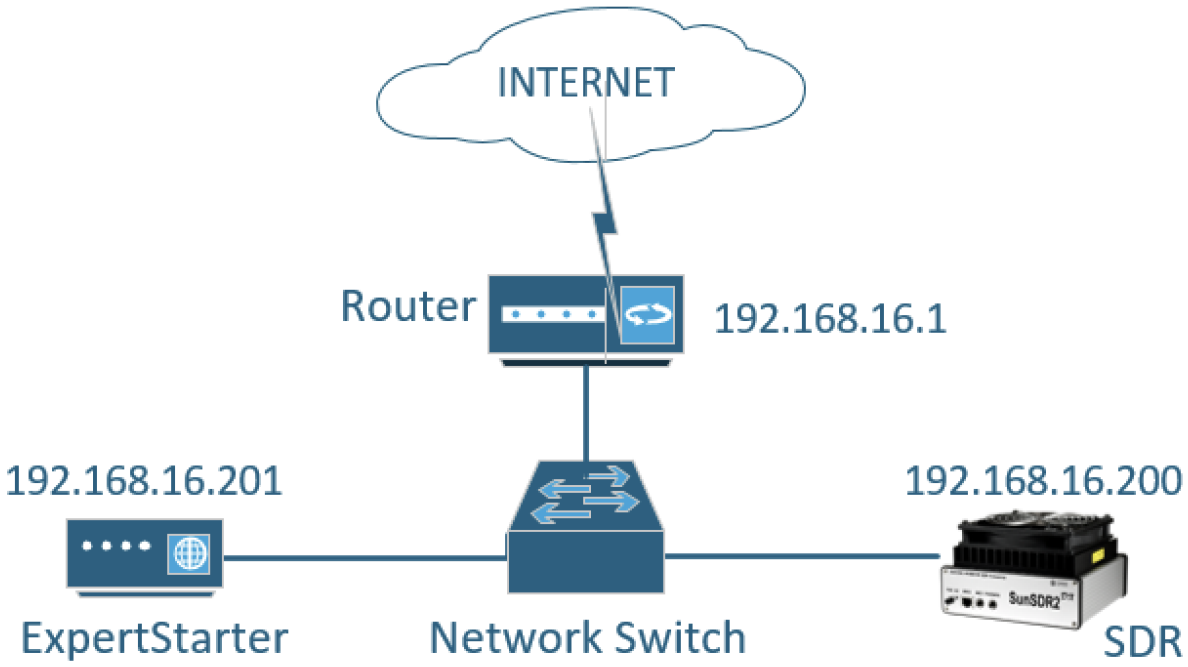
Click the Download button in the "Download Server" section.

Choose the software version for your hardware platform (Windows, macOS, Linux, Raspberry Pi):



Download relevant software version for your chosen hardware platform. Note that the sha256 files are containing the SHA-256 hash (a unique digital fingerprint) - those files are not, strictly speaking, needed to run the server software and can be used only to validate the downloaded software file integrity.

Once Server Starter installed – do NOT run it yet. There is still one additional step required before you run - perform Step 2 (below).



Note:	• Information about typical Server Starter device IP network and connectivity:

	The selected device with loaded Server Starter must be connected to same LAN segment with your SDR and configured with the IP address and mask from the same range, i.e.: SDR IP is 192.168.16.200 255.255.255.0 Server Starter IP is 192.168.16.201 255.255.255.0

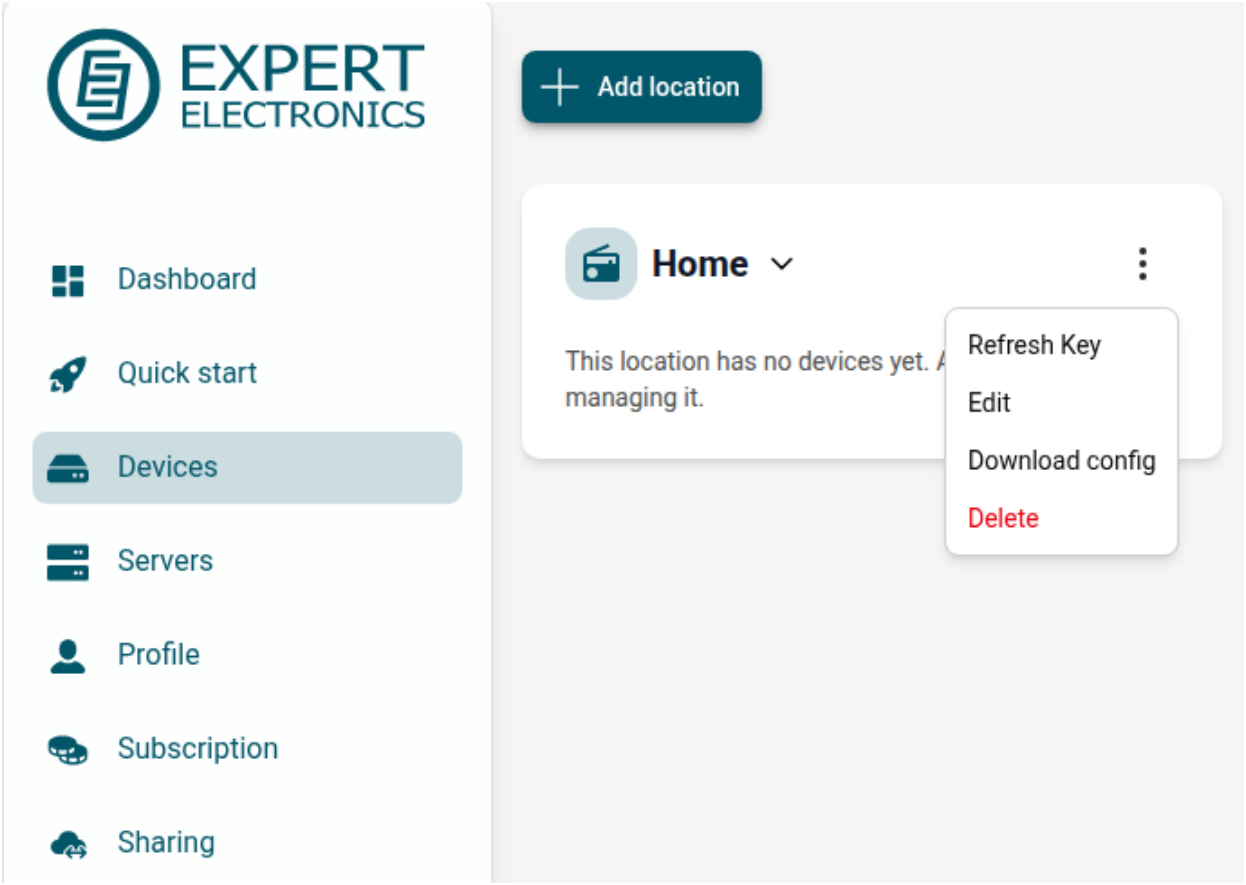
Once Server Starter installed – do NOT run it yet. There is still one additional step required before you run - perform Step 2 (below).

Step 2: Get the Configuration File.

In your Personal Account, go to the **Devices** section in the left menu.

Click **Add Location**, name it (e.g., "Country House"), and save.

Click the three vertical dots next to the new location and select **Download config**. Save the ecloud.jbc file.



For the owner of supported SDRs: please note that Step 2 (as currently described in Quick Start section) is indicative. The real process of the Configuration file download is located in Devices section of the dashboard.

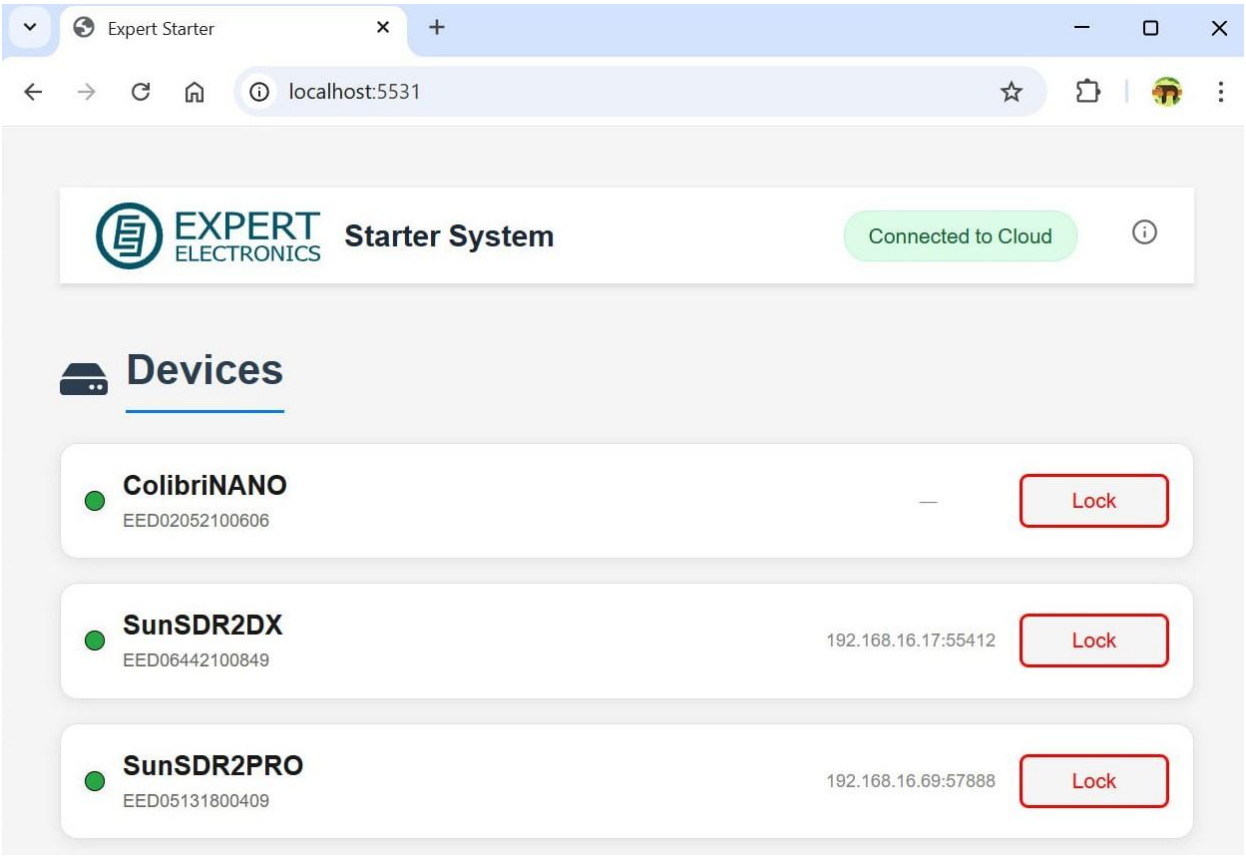
Step 3. Prepare and Launch the Server (Starter).

Install the Server Starter software on a device (e.g., Raspberry Pi, mini-PC) at your Remote Location.

Connect this device to the same wired Ethernet network as your SDR transceiver and assign it an IP address in the same subnet (e.g., SDR: 192.168.1.100, Starter: 192.168.1.101).

Copy the downloaded ecloud.jbc file into the Server Starter's working directory.

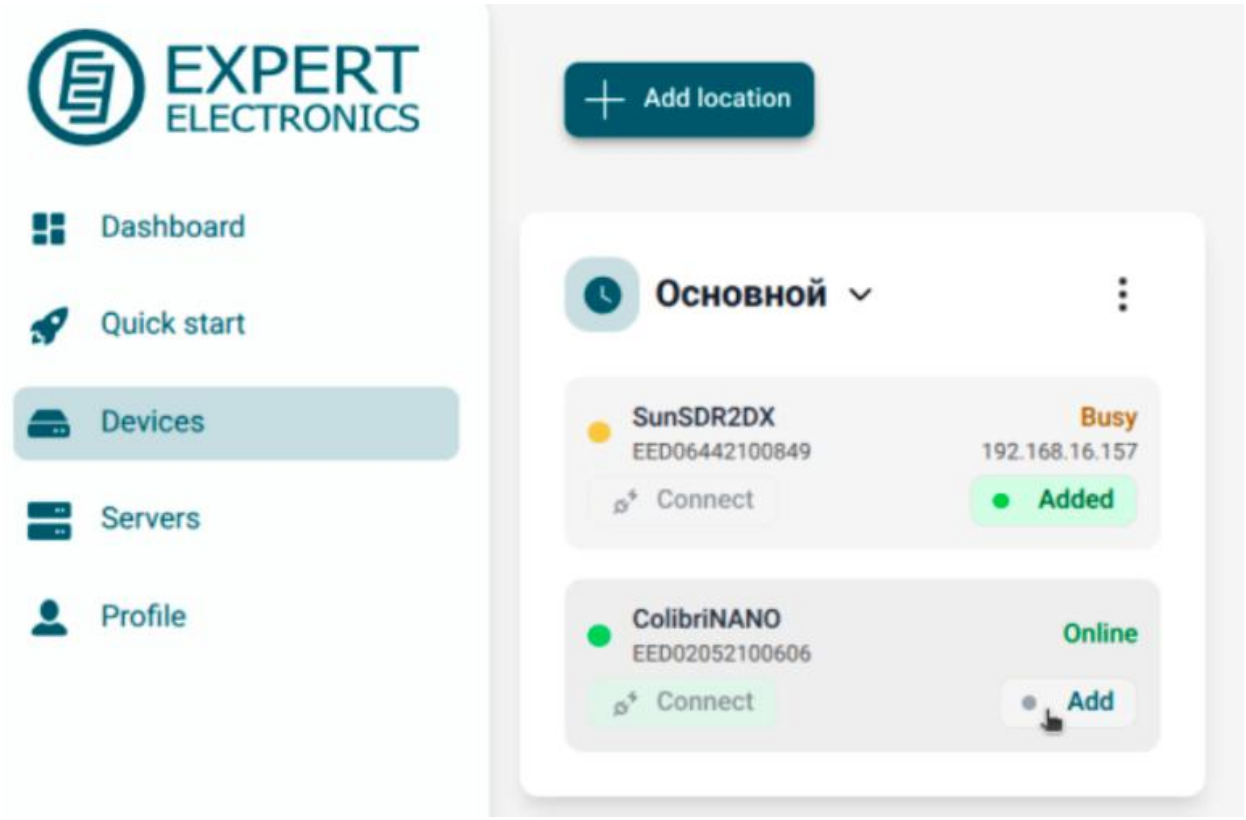
Run the Server Starter software. Ensure the remote site has an active internet connection.



Step 4. Select Devices for Remote Access.

In your Personal Account, go to Devices.

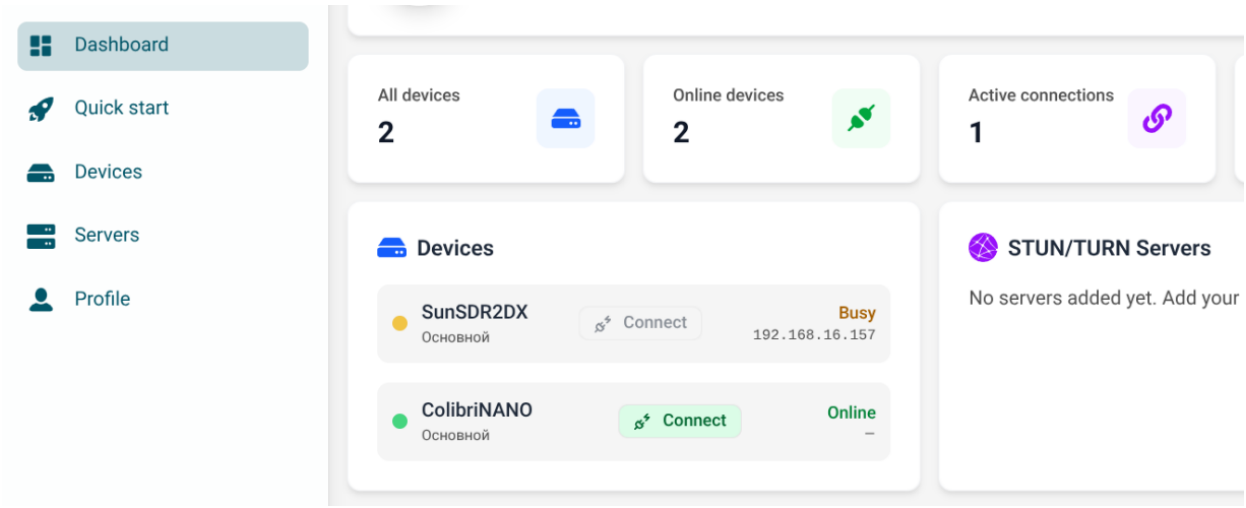
Click the arrow (<) next to your location name to expand it.



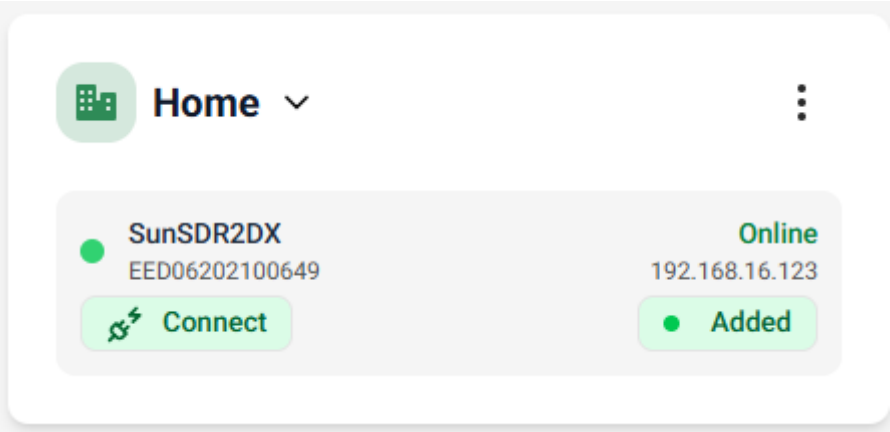
Your SDR should appear in the list. Click the **Add** button next to it. The button will change to **Added**.

Note:	• Current limitation is that same device can only be added to single location. If you want to associate device with different location, you need to unlink it first from existing location – by clicking on Added button, and then Add it to new location.

At this stage you will have everything ready to start with Web-based User Interface and you will see configured devices and locations in dashboard main view:



Your device is now linked to your account and will appear on the main dashboard with a green **Connect** button.

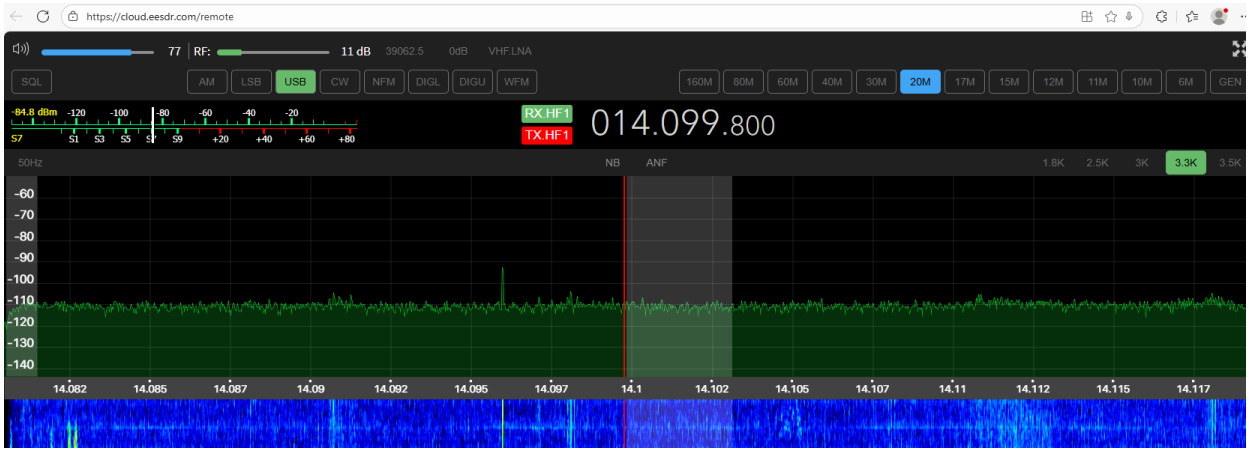


Clicking on this button will automatically open next Tab in your browser, which will load EESDR Web Version User Interface, and will attempt to connect it to Remote device. Please note that Web version must be considered as “light version” with limited features support and it is suitable for testing and exploring purposes only. The functionality of the Web version will be expanded with next releases, however if your aim is to test full feature set of the Expert Remote, proceed to Step 5.

In current release the functionality of the Web-based User Interface is limited to very basic.

It is recommended to use Web UI for initial test of the connectivity and potential troubleshooting purposes.

In future releases the Web UI functionality will be expanded to the level, when Web UI will be fully suitable for the full receive feature set.



Step 5. Install ExpertSDR3 (on Operator Location PC/laptop).

Download and install current version of the ExpertSDR3 software by clicking on the Download button listed in Quick Start Step 5.

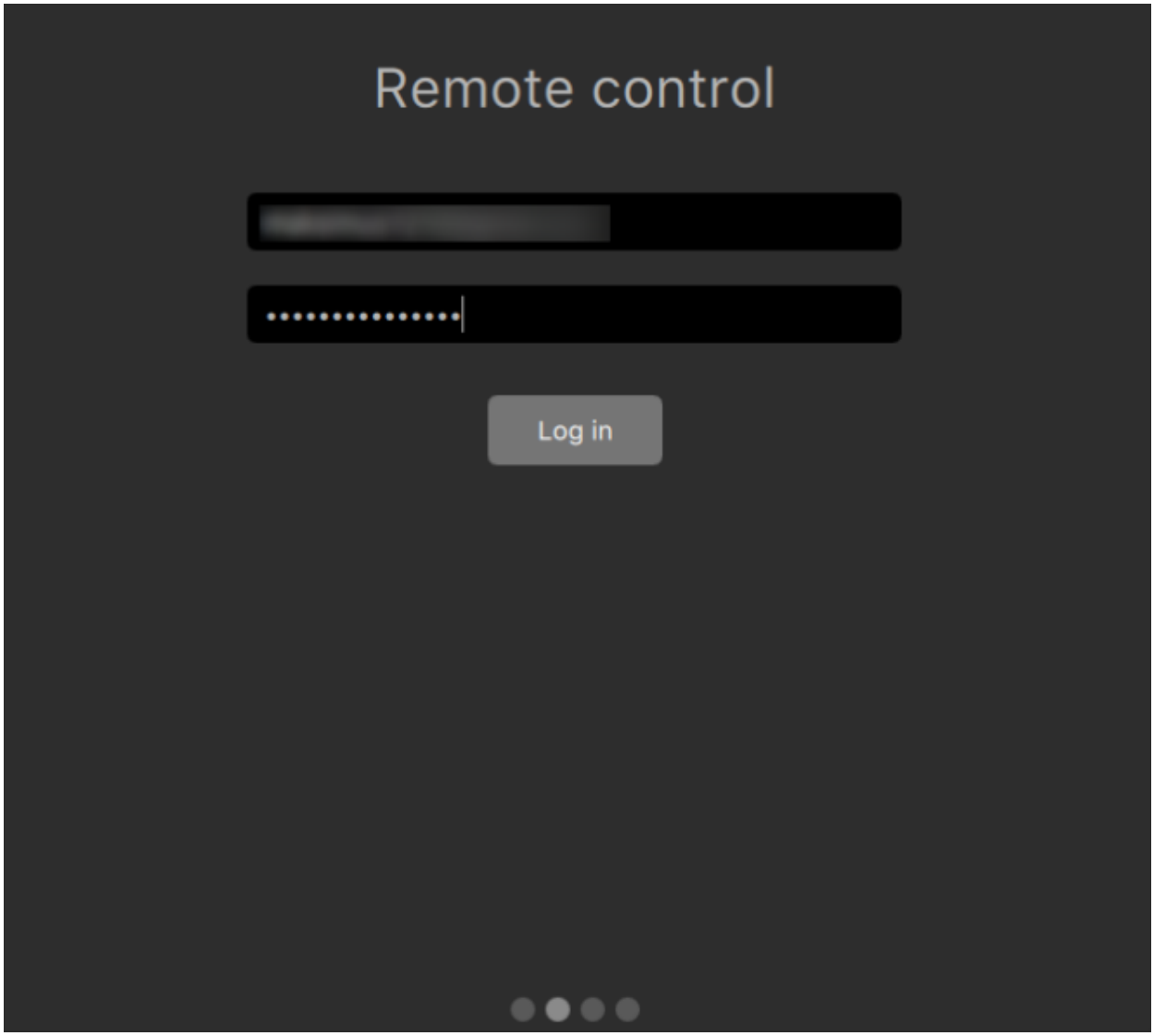
Once you click on Download button, your browser will be redirected to the external file storage server opened next Tab and listing currently available ExpertSDR3 for various OS. Download appropriate version for you Operation System, install it and run it.

15.4.4. Stage #2 (Client)

Step 6. Connect and Start Working.

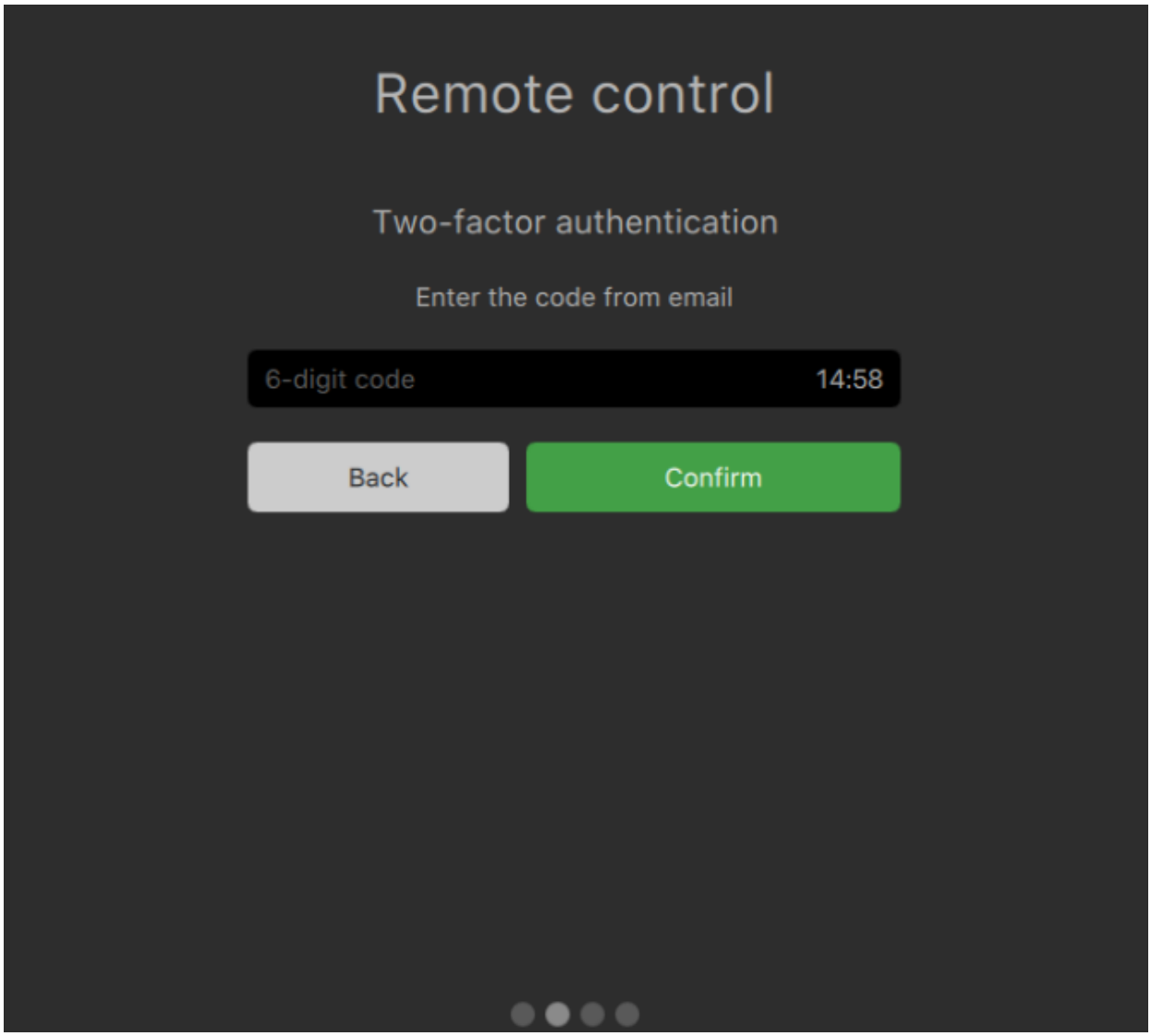
Please note that Step 6 is indicative, as the real connectivity now should be performed in ExpertSDR3.

Launch ExpertSDR3 and go to second “dot” option in ExpertSDR3 Device Manager:

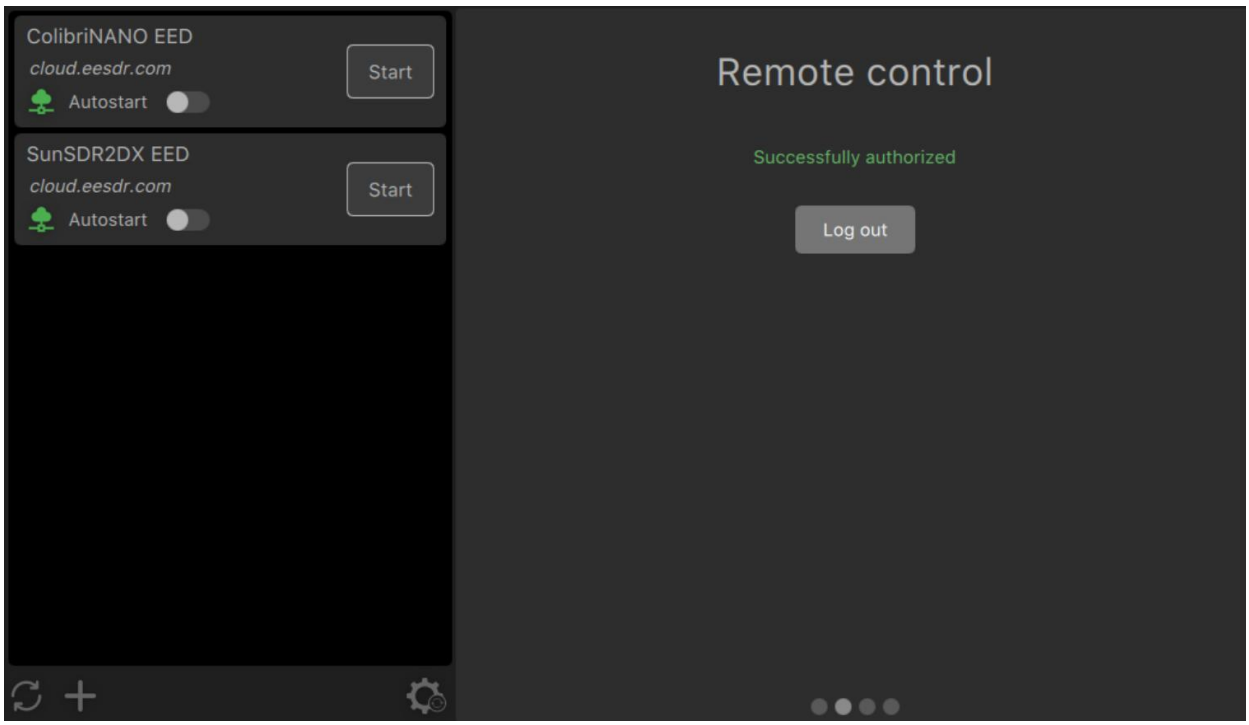


Enter your ExpertCloud Login and Password (note it is the same login and password you are using to login into https://cloud-eesdr.com) and click Login button. Note, that if you already configured

Two-Factor Authentication in your Personal Account, you will be prompted to enter 2FA parameters (delivered via you configured email).



Your credentials will be authenticated and “Successfully Connected” message will inform you that everything is ready.



The list of available devices will appear in left panel – those will be devices you have previously configured in Step 4. **Start** button will open main ESDR3 User Interface and from now you will be able to work as usual – but in full Remote mode.

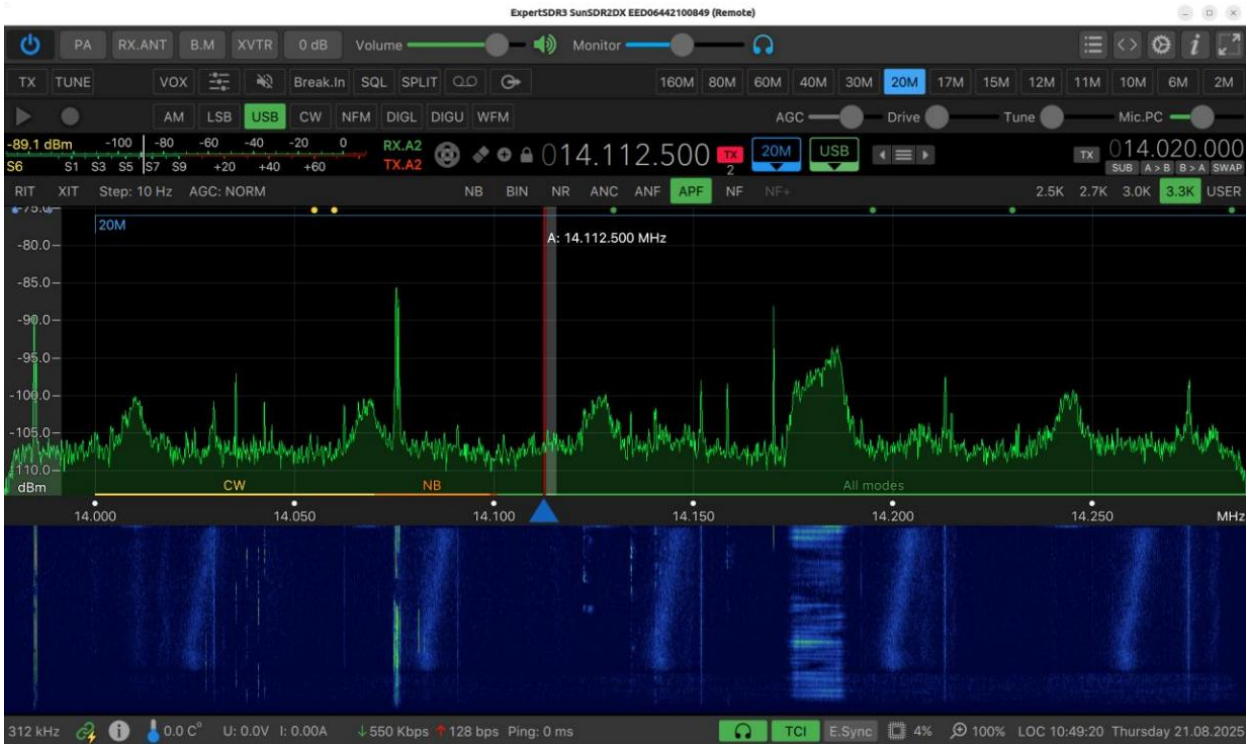
Scenario B: I want to test Expert Remote before buying hardware.

You can skip Steps 1-4 of Scenario A.

Proceed directly to Step 5: Install ExpertSDR3 on your PC.

To connect, you will need access to a shared test device. Please contact our sales or support team to inquire about temporary test access credentials. You can then use these credentials in Step 6 to log in and explore the system.

If the connection icon has a lightning in it  - it indicates that the peer-to-peer connection is established (most reliable and fast option). If there is no lightning icon , it indicates the connection is established via proxy (EE Cloud server), and this connection may have higher delays.



Important! Press the "ON" button only after the connection is established!

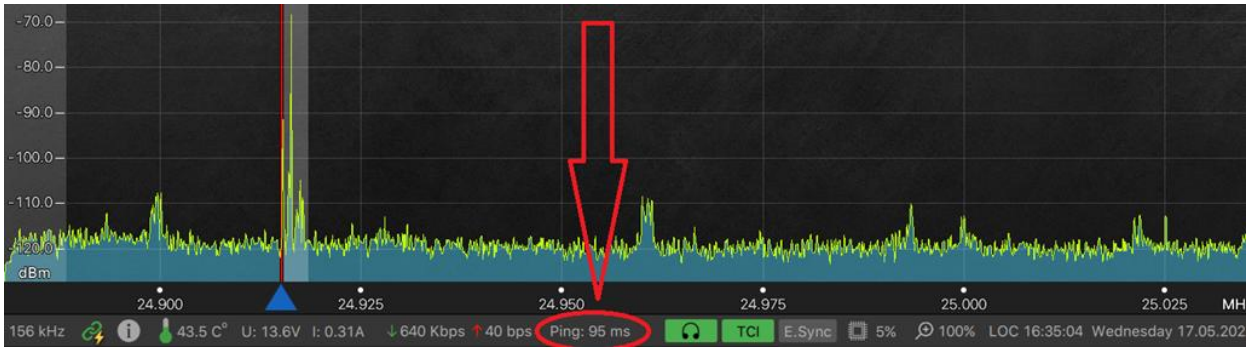


After **"ON" button** pressed - **it'll become blue** (indicates ExpertSDR3 (Client) and Server are successfully connected); then spectrum and waterfall will be active.

Note:	• Since ExpertSDR3 1.0.9 client automatically reconnects to the Server if the connection is broken.

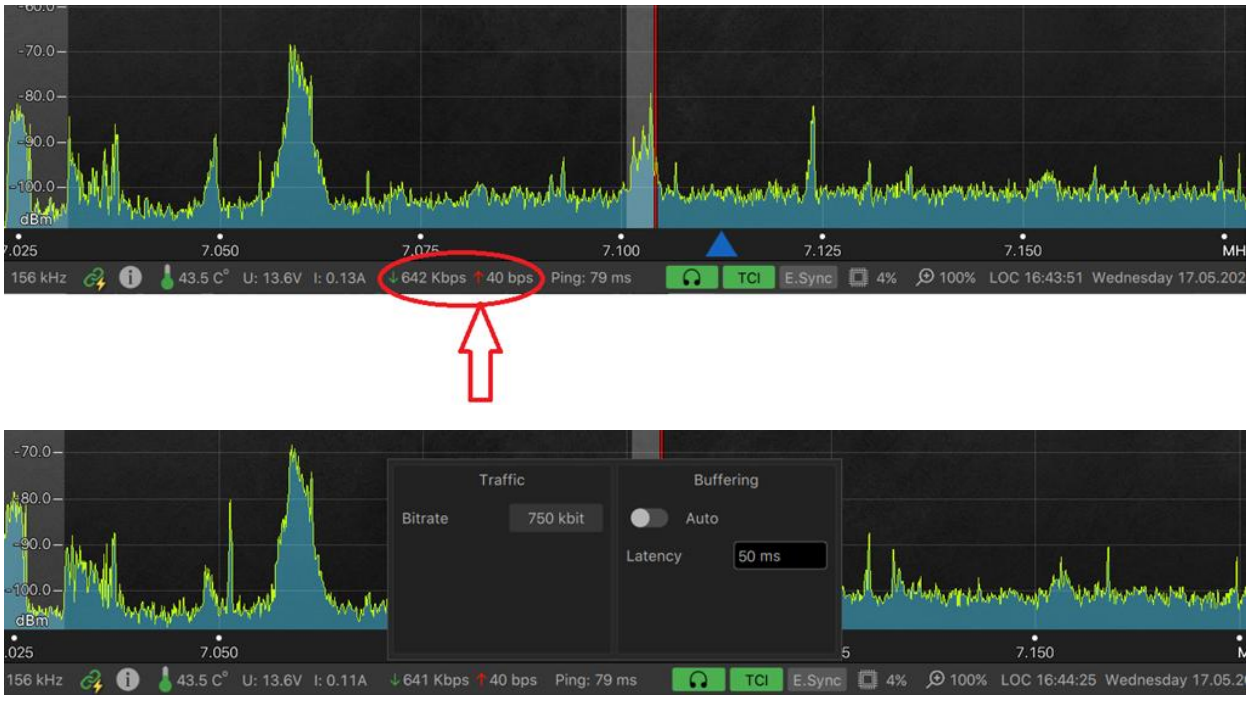
With the ICMP Ping less than 100ms you should have smooth operation in SSB and digital modes.

Below is an example of Client connection based on the following connection: PC <-> Wi-Fi <-> mobile phone <-> mobile internet YOTA (LTE).



Warning!	• If your Ping value is higher than 125ms, you'll have decoding issues in digital modes (FT8 for example)

Press the marked area with the right mouse button, you'll open a connection settings menu.



15.4.5. The practical use cases for Web-based UI

The Web-based User Interface is designed for specific scenarios where ease of access and quick setup are prioritized over full functionality.

Primary Use Cases:

- Initial System Test & Validation: Quickly check connectivity, audio levels, and basic functionality of your remote setup without installing any software.
- On-the-Go Monitoring: Access your station from a secondary device (like a tablet or borrowed computer) to monitor the bands or check the status of an ongoing digital mode session.
- Basic Operation: Perform simple listening (Rx) or straightforward voice (SSB/FM) QSOs when you don't have access to your primary computer with ExpertSDR3 installed.
- Troubleshooting & Support: Provide instant, shared access to your station's control panel for remote assistance from technical support.

Important Limitations in Current Release:

- Not Suitable for Digital Modes: Lacks integration with external software like WSJT-X or JTDX.
- Limited Control: Advanced features (full ATU control, complex macros, detailed bandscope settings) are not available.
- Performance: Optimized for simplicity, not for the ultra-low latency or high refresh rates required for competitive contesting.

Future Outlook: The functionality of the Web UI will be expanded in upcoming releases, aiming to support a full receive (Rx) feature set and broader control options.

15.5. TURN services

This section explains the role of TURN servers and how they can be configured to improve connectivity in challenging network environments.

Understanding ICE, STUN, and TURN

Expert Remote uses the Interactive Connectivity Establishment (ICE) framework to find the best connection path:

STUN (Session Traversal Utilities for NAT): Helps devices discover their public IP address and port. Used to establish a direct, low-latency Peer-to-Peer (P2P) connection. This is the preferred and default method.

TURN (Traversal Using Relays around NAT): Acts as a relay server. If a direct P2P connection is impossible (due to restrictive firewalls, symmetric NATs, etc.), audio and data traffic is routed through the TURN server.

When is a TURN Server Needed?

Restrictive Corporate/Institutional Networks: Where outbound P2P traffic is blocked.

Complex Multiple-NAT Scenarios: Some combinations of carrier-grade NAT (CGNAT) and home routers can prevent direct connections.

As a Redundant Fallback: To guarantee connectivity when the primary P2P method fails.

Trade-off: Using a TURN server increases latency (adds an extra hop) and consumes more bandwidth on the server side, which is why it's a fallback, not the primary method.

How to Configure Your Own TURN Server.

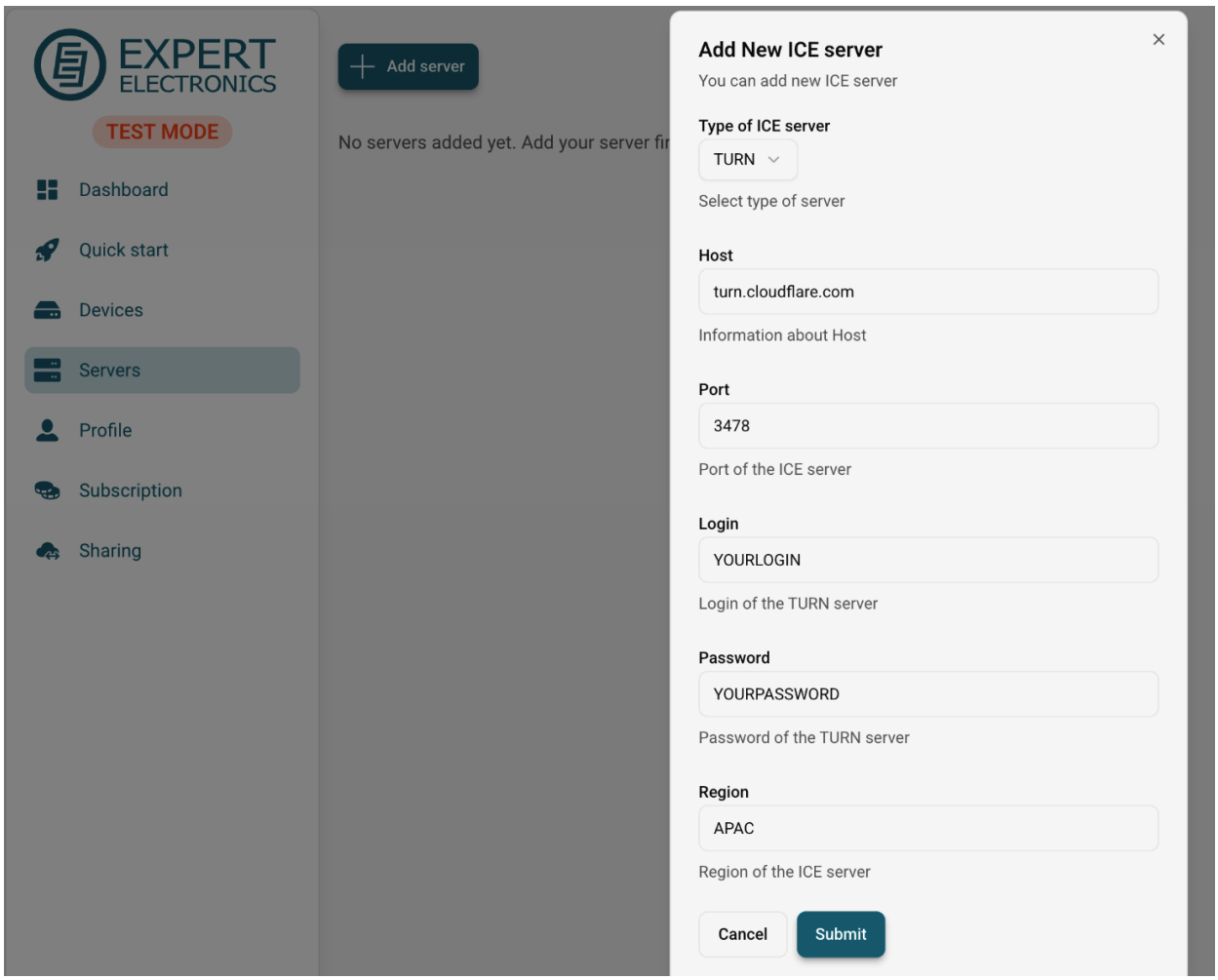
If you experience persistent connection failures and suspect network restrictions, you can configure a third-party TURN server.

Prerequisites:

1. A subscription with a public TURN service provider (e.g., Xirsys, Twilio, or a self-hosted Coturn server).
2. Obtain the server credentials: Hostname/IP, Port, Username, and Password.

Configuration Steps in ExpertCloud:

1. Log into your ExpertCloud Personal Account.
2. Navigate to the **Servers** section in the left menu.
3. Click the **+ Add server** button.
4. Fill in the details provided by your TURN service provider.
5. Click **Submit.**



Important Note for Current Release:

- The built-in system prioritizes direct P2P connections. TURN is used only if P2P fails.
- A global, region-optimized TURN fallback infrastructure is not yet fully deployed. This feature is under active development.
- Configuring your own TURN server is an advanced, early-stage feature intended for users with specific needs. General usability and stability will improve in future releases.

15.6. Profile Menu Section

The **Profile** section is your account management center. Here you can view and update your basic personal information and security settings.

Available Actions:

- Update Personal Details: Change your First Name and Last Name.
- Set Your Call Sign: Add or update your amateur radio call sign.
- Manage Two-Factor Authentication (2FA): Enable or disable 2FA for an added layer of account security. When enabled, you will need a time-based code from your authenticator app (or email, depending on configuration) in addition to your password to log in.

Current Limitation:

- The email address associated with your account cannot be changed in this version. For email changes, please contact support.

15.7. Subscription Menu Section

Status: The **Subscription** section is **currently inactive** and visible for future development.

Purpose: This section will be activated in a future release to manage optional, value-added services. These may include:

- Premium **TURN** relay bandwidth allocations.
- Advanced cloud features or analytics.
- Access to beta firmware or software features.

Action Required: No action is needed from users at this time. Please watch official announcements for updates on when subscription services will become available.

15.8. Sharing Menu Section

The **Sharing** feature allows you to securely grant temporary access to your remote station to another registered ExpertCloud user.

Typical Use Cases:

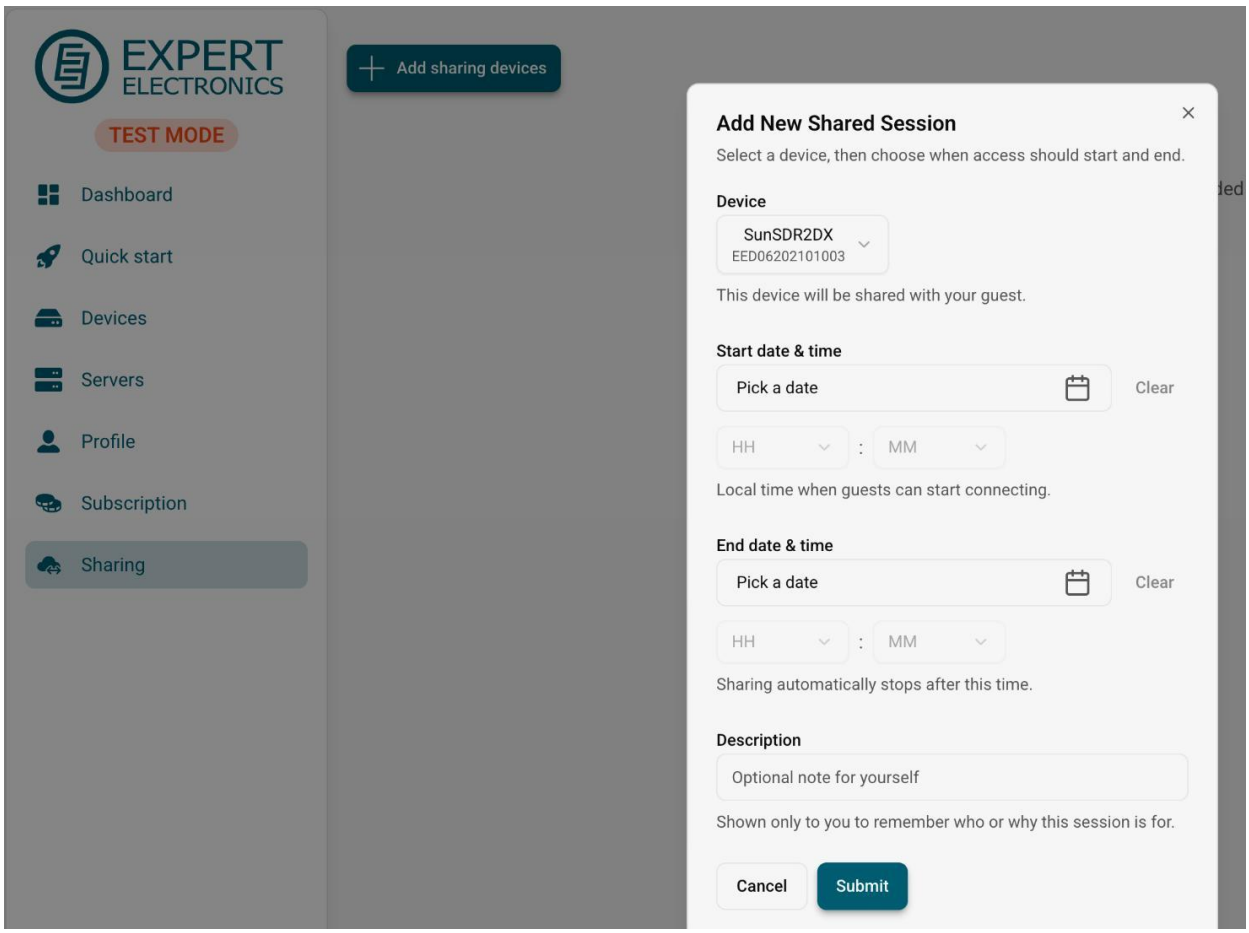
- Technical Support: Securely share access with support personnel for remote diagnostics and troubleshooting.
- Guest Operator: Allow a friend or fellow club member to operate your station for a limited time.
- Demonstrations: Show the capabilities of your remote setup without sharing your main account credentials.

How to Share Access:

1. In your **ExpertCloud** dashboard, go to the **Sharing** section.
2. Click **+ Add sharing device**.
3. Fill in the sharing form:

- Email: The registered ExpertCloud email of the person you are sharing with.
- Device: Select which of your registered transceivers to share.
- Expiration: Set a date and time when access will automatically revoke.

1. Click **Submit.**



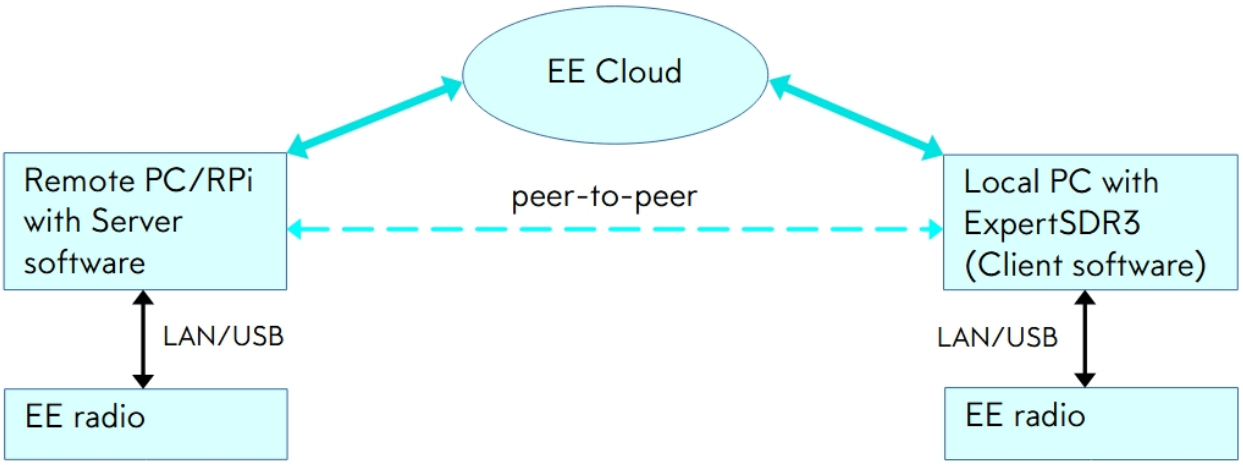
What Happens Next:

- A unique, time-limited access link is generated.
- You can copy this link and send it to the recipient.
- The recipient must be logged into their own ExpertCloud account to use the link.

Note:	• Single Session Only: Only one person can be actively connected to a shared device at a time. This includes you as the owner. • Owner's Priority: You retain full control. You can manually revoke access at any moment from the Sharing menu, even before the expiration time.

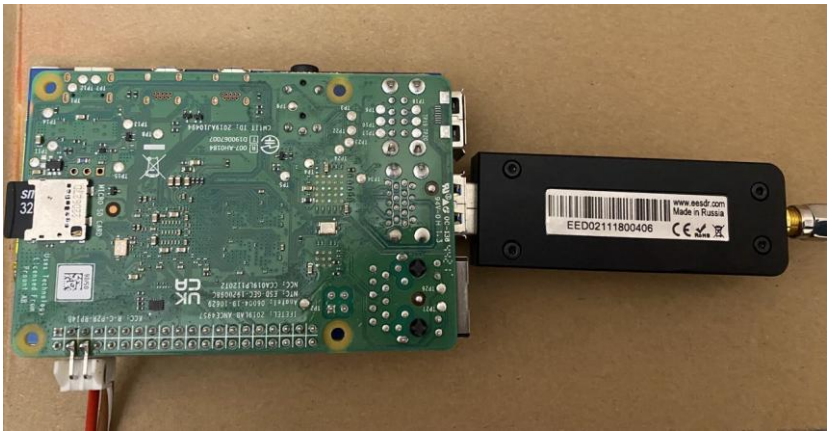
15.9. Setup examples

15.9.1. Remote EE RX + Local EE TRX



This example describes connection of a ColibriNANO + RPi4 set up for remote operation with a local Expert Electronics transceiver (MB1, SunSDR2 DX/PRO/QRP).

1. Set up remote ColibriNANO + RPi4 following the instruction presented in **this section**.





1. Launch ExpertSDR3 on a local PC. Enable ExpertSync in the Device Manager with default Server port 50040.

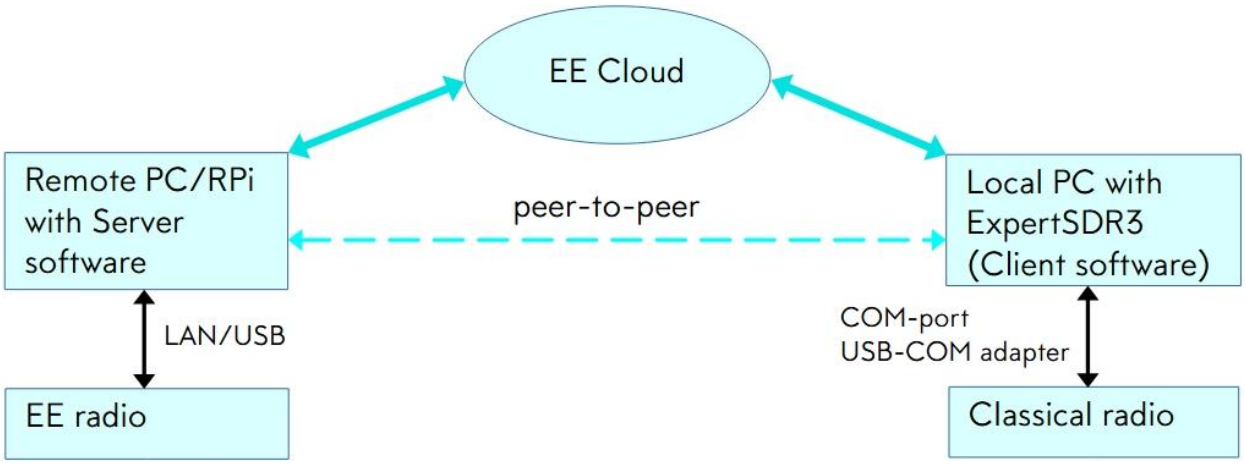
2. Start local transceiver ExpertSDR3 instance, then start remote ColibriNANO ExpertSDR3 instance.

Note:	• The device you launch first acts as Main. This feature doesn't have particular functionality at the moment, it is reserved for further development of the ERS. • At the moment if you use two transceivers this way both will turn to TX mode when you enable it from any instance by any means (TX button, PTT, etc.)

1. Enable E.Sync in the transceiver's and then ColibriNANO's ExpertSDR3 instance (button will turn green).

2. Voilà! ExpertSDR3 instances are synced, tuning frequency in any instance will have effect on both. You can lower or mute local transceiver instance and listen to remote ColibriNANO (which is probably placed somewhere far away from air noises). When you turn to TX mode with local transceiver, ColibriNANO will be muted.

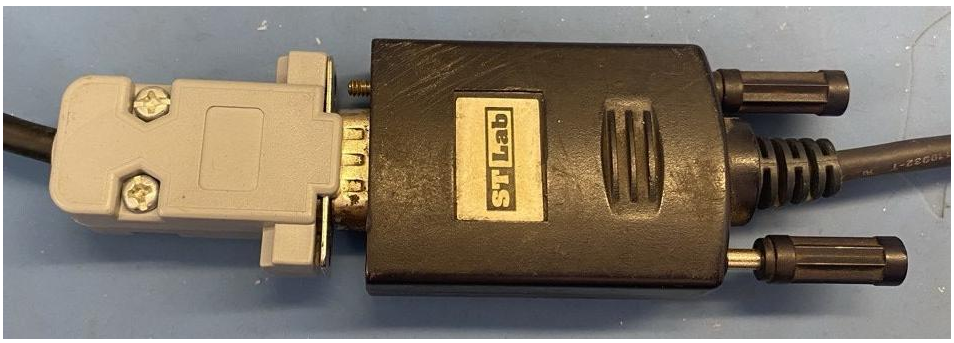
15.9.2. Remote EE RX + Local classic TRX



This example describes connection of a ColibriNANO + RPi4 set up for remote operation with a local Kenwood TS-2000 transceiver.

1. Set up remote ColibriNANO + RPi4 following the instruction presented in **this section**.

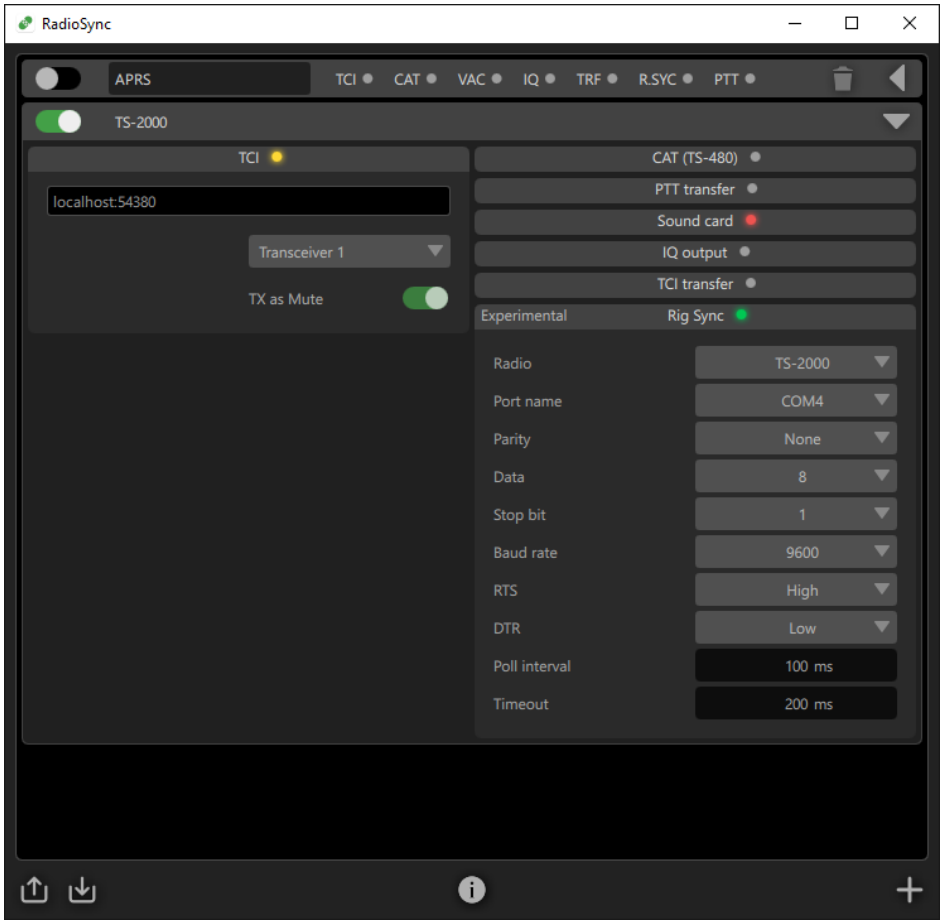
2. Connect a classic transceiver to a local PC via COM-port or USB-COM adapter (example below). Make sure that **COM-port** is displayed in Windows Device Manger. Install proper drivers for your COM adapter if necessary.



1. Launch ExpertSDR3 on a local PC, then start remote ColibriNANO ExpertSDR3 instance and RadioSync.

2. Make sure that ExpertSDR3 instance and RadioSync have the same TCI port.

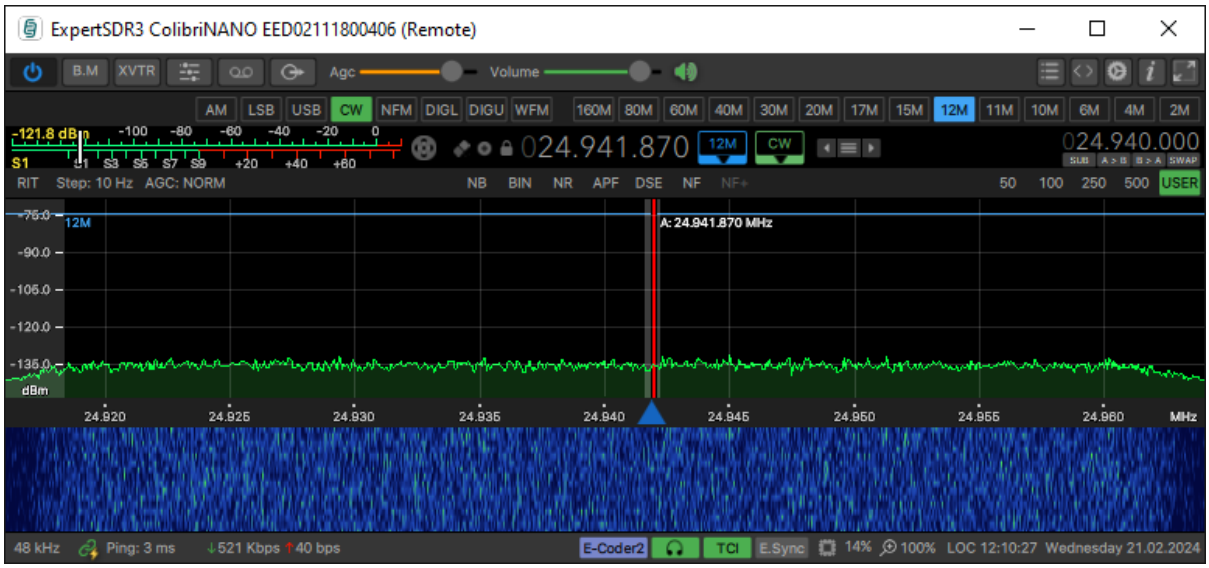
3. Setup Rig Sync (in Experimental state) in RadioSync for your classic transceiver (TS-2000 settings as an example below). In the **Port name** field indicate the COM-port used by your transceiver (displayed in Windows Device Manager).



Note:	• Remember that each classic transceiver has its own settings.

1. Enable TCI in ColibriNANO ExpertSDR3 instance and a SyncPair unit you've set up earlier.

2. Voilà! ExpertSDR3 instance and your classic transceiver are synced, tuning frequency in ExpertSDR3 will have effect on a transceiver and vice versa. When you turn to TX mode with local transceiver, ColibriNANO will be muted.





15.10. A ExpertStarter Web Panel (localhost:5531)

Starting with ExpertSDR3 1.1.5, the Starter service has a local control panel. After installing and starting Starter, open in a browser on the server PC:

`` `http://localhost:5531` ``

Through the panel you can:

- see the ExpertCloud connection status;
- view all detected devices and their state: ◍ Available / ◍ In Use;
- enable or disable remote access for each device individually.

15.11. B ExpertStarter CLI

ExpertStarter (starting with version 1.1.4) has a full-featured command-line interface on all supported operating systems. During installation, Starter is automatically added to the system PATH, so commands are available from any directory.

Command	Action
`starter start`	start the service
`starter stop`	stop
`starter restart`	restart
`starter update-config`	update configuration
`starter version`	version
`starter help`	help (detailed help per command: `starter help <command>`)

The CLI is convenient for automation: scheduled service restarts, deployment scripts for club and remote stations.

15.12. C Custom STUN/TURN Servers

By default, Expert Electronics servers are used to establish P2P connections. Starting with version 1.1.5, you can specify **your own STUN/TURN servers** in the Starter settings — this speeds up connection establishment and improves reliability in complex networks (corporate NAT, symmetric NAT).

Recommendations:

- if a direct P2P connection cannot be established, traffic goes through a TURN relay — latency is higher, but the connection always works;
- your own TURN server on your network provides minimum latency and independence from external services;
- a direct connection between server and client is the most stable: in the connection interface it is marked with a lightning bolt icon; no lightning bolt means the connection goes through the cloud relay.

15.13. D Device Sharing: TX Lock

Starting with version 1.2.0, when granting another user access to your transceiver ("Share device"), a **TX lock** option is available: the guest gets full control over reception (frequency, mode, filters, panorama) but cannot enable the transmitter.

Use TX lock when:

- giving access to the transceiver for reception (friends, club, listeners);
- the transceiver is connected to an antenna and the guest has no right/skill to transmit;
- demonstrating the station publicly.

15.14. E Remote Control of the AAT-100 Tuner

Starting with version 1.1.5, the SunSDR2 DX (and MB1) supports **remote control of the antenna tuner**: tuner control buttons are available in the client connection just as they are locally. The tuner operation algorithm (tuning, bypass, per-band settings memory) is completely identical to local operation — see the "AAT-100 Tuner Operation Algorithm" section in the "Operating the Transceiver" chapter.

This makes the SunSDR2 DX + AAT-100 combination a full-featured remote station: the transceiver, tuner and antenna remain at the remote site; the operator only needs a browser or the ExpertSDR3 client.

15.15. F Remote CW Operation

Remote CW (since version 1.1.5) works via **TCI CW macros** — identical to the local software. CW signal sources during remote operation:

1. CW keyboard/macros in the client interface;
2. a physical key connected to the **E-Coder2 panel on the client side** — iambic mode with Break-In is supported;
3. third-party software via TCI.

Fixes in version 1.2.0: paddle operation in Remote mode restored (tones were not sent when Iambic was disabled); VOX in Remote mode works correctly.

15.16. G ExpertCloud Authorization

Starting with version 1.2.0, ExpertCloud authorization is performed **via a web browser**: when logging in, the software opens the authorization page; after confirmation you return to the application. This is a more secure scheme — the password is not entered inside the application.

> If authorization works unstably — update to version 1.2.1 or newer: the hotfix addresses the Expert Cloud authentication issue.

15.17. H Audio Quality in Remote Operation

- Starting with version 1.1.7, the algorithm for restoring lost audio fragments has been improved — losses are less noticeable by ear.
- If the connection is lost, the client automatically reconnects to the server (since version 1.0.9).
- For remote transmission, VOX and correct TUNE carrier and DIGL/DIGU offset frequencies are available (fixed in 1.1.7).

16. RESET SETTINGS AND FIRMWARE

In some circumstances you may need to reset IP address and ports of the transceiver via following steps:

1. Switch off the transceiver with the **PWR** button;

2. Press and hold the **RST** button on the rear panel of the transceiver, you will hear a light click;

3. Switch on the transceiver with the **PWR** button. The **LED** will blink different colors (**green**and **red**);

4. Release the **RST** button;

5. Wait until the **LED** turns to constant **green**light, it means the reset went successfully.

After the reset procedure the transceiver will have the default IP-address 192.168.16.200 and ports 50001, 50002.

In case there is something wrong with the device, but you cannot connect with it to figure it out, you may try to do a “deep” reset:

1. Switch off the transceiver with the **PWR** button;

2. Press and hold **BT** and **RST** buttons simultaneously;

3. Switch on the transceiver with the **PWR** button. The **LED** will blink different colors (**green**and **red**);

4. Release **RST** and **BT** buttons, LED will blink with **green** light.

5. Launch ExpertSDR3 Device manager and open the Firmware Manager. There you should see your transceiver in the list, start firmware installation process.

6. Wait until the **LED** turns to constant **green**light, it means the reset went successfully.

Warning!

Do not switch off the transceiver with the PWR button while LED is blinking.

Sometimes you might need to activate the boot-loader mode, to reinstall the transceiver's firmware:

1. Switch off the transceiver with the **PWR** button;

2. Press and hold the **BT** button on the rear panel of the transceiver (you will hear a light click).

3. Switch on the transceiver with the **PWR** button. The **LED** will blink with a single **green** light;

4. Release the **BT** button;

5. Launch ExpertSDR3 Device manager and open the Firmware Manager. There you should see your transceiver in the list, start firmware installation process.

6. After firmware installation is finished, **LED** will turn to constant **green** light.

17. Solving typical issues (FAQ)

17.1. Installation and Startup

17.1.1. Correct installation and update procedure

1. Uninstall the previous version of the software and make sure the `C:\Program Files\ExpertElectronics` folder does not contain the ExpertSDR3 folder.

2. Install ExpertSDR3.

3. Install the latest Microsoft Visual C++ Redistributable from the official Microsoft website (a reboot is required).

17.1.2. The software does not start at all (no window, no error)

The most frequent cause is a missing or corrupted Microsoft Visual C++ Redistributable. Install the latest VC++ Redistributable (x64) package from the Microsoft website and reboot the PC. If this does not help — check whether the Device Manager window appears and whether the transceiver is visible in it (IP, port, serial number).

17.1.3. The software crashes or freezes when minimizing, waking from sleep, opening Settings

Measures in order of likelihood:

1. Update graphics card drivers from the manufacturer's website (NVIDIA/AMD/Intel).

2. Prevent Windows from powering down the graphics card: Control Panel → Power Options → Change plan settings → Change advanced power settings → PCI Express → Link State Power Management → "Off".

3. ExpertSDR3.exe shortcut properties → Compatibility → "Disable fullscreen optimizations" — the built-in Windows 10/11 fullscreen management mechanism conflicts with the software's graphics context.

> Windows 10 users: if the waterfall does not display correctly — update to ExpertSDR3 1.2.1 or newer (fixed in the hotfix).

17.1.4. Software and firmware version compatibility

- ExpertSDR2 has not been supported since early 2021 (last version 1.3.1 Update 11, firmware 72.8).

- ExpertSDR3 works with 8x.x firmware line. ESDR2 and ESDR3 firmware are incompatible: switching between the programs requires reflashing the transceiver.

17.1.5. Transceiver in bootloader mode (green LED blinking continuously)

Continuous green LED blinking means the device is in bootloader mode (firmware was not completed). Factory reset (RST) does not work in this mode — do not attempt it. Recovery procedure:

1. Connect the transceiver directly to the PC with an Ethernet cable.

2. Set a static IP on the PC: `192.168.16.50`, mask `255.255.255.0`, gateway and DNS empty. **Attention:** `192.168.16.200` is the transceiver's own address; the PC must have a different address in the same subnet. An address conflict is the most frequent cause of "I can't see the device".

3. Open the ExpertSDR3 Device Manager — the transceiver should appear in the list.

4. Flash the device via Firmware Manager (see the "Factory Reset and Reflashing" chapter). After flashing, power-cycle the device — it will restart with normal indication.

17.2. Network and Connection

17.2.1. First transceiver connection

1. First launch — only directly to the PC with a CAT5/6 cable.

2. Set a static IP on the PC's Ethernet adapter from the same subnet as the transceiver, but different from its address. Example: PC — `192.168.16.50`, transceiver — `192.168.16.200`, mask `255.255.255.0`, gateway and DNS empty.

3. Launch ExpertSDR3 — the transceiver will appear in the Device Manager.

4. Add all .exe files from the ExpertSDR3 folder to Windows Firewall exceptions (for private and public networks). **Completely disabling the firewall does not help — exceptions are required.** The same applies to antivirus software. On macOS, firewall exceptions are not required.

17.2.2. Moving the transceiver to the home network (router/switch)

1. While directly connected, open Settings → Radio, set a new IP and port for the home subnet (e.g. `192.168.1.120:50071`), press "Set IP address", then "Record".

2. Power off the transceiver, connect it to the router/switch, power on — it will appear in the Device Manager with the new address and will be accessible from any PC on the LAN.

17.2.3. Connection established, but no spectrum/waterfall

Classic symptom: control is established (relays click), but the waterfall is empty and voltage/temperature indicators show zeros. Causes by frequency:

1. Incorrect PC IP settings (see "First transceiver connection").

2. Firewall exceptions for all ExpertSDR3 .exe files were not added.

3. Stream check: Windows Task Manager → Performance → Ethernet → press Start in ExpertSDR3. The graph should show traffic bursts; a flat graph means the data stream is blocked.

4. Replace the Ethernet cable — a faulty cable causes a "partial" connection.

5. The data stream requires free ports 50001 and 50002 — they must not be occupied by another program.

17.2.4. Multiple transceivers on one network

ExpertSDR3 uses two ports per transceiver: the one specified in settings and the next one (+1). For parallel operation:

1. Each device — a unique static IP.

2. Each device — its own port pair: 50001/50002, 50011/50012, 50021/50022, etc. TCI ports must also differ.

3. In Windows network settings for a dedicated segment, do not specify gateway and DNS.

4. Use a gigabit switch; each connection requires ~300 Mbps.

Port conflict symptom: the second transceiver is controlled, but there is no waterfall and no transmission, indicators show zeros.

17.2.5. Connection failures and potential difference between PC and transceiver cases

If there is a potential of tens of volts between the PC and transceiver cases and Ethernet failures occur — the cause is almost always in the power/grounding configuration (e.g. a broken ground in the outlet). Diagnostics:

1. Draw the complete connection scheme (PC, amplifier, antennas, peripherals) and check where the transceiver's ground terminal is connected.

2. Test with a minimal scheme: a different known-good power supply + a different PC (laptop). If the transceiver works — the problem is in the main power/grounding scheme, not in the unit.

17.3. Remote Operation

17.3.1. No router port forwarding required

The Expert Remote System (ERS) does not require opening ports on the router. Verification procedure:

1. The PC with ExpertStarter and the transceiver must be on the same local network.

2. First run the transceiver with ExpertSDR3 locally on the same PC where Starter runs — make sure everything works locally.

3. Only then connect remotely.

> The legacy ExpertRS/ExpertRC scheme from the ExpertSDR2 era required forwarding ports 80 and 5050 — this is legacy and does not apply to ERS.

17.3.2. Remote connection established, but no audio

Check: whether the spectrum and waterfall are visible over the remote connection; whether the correct audio device is selected on the client side; whether audio works with a local connection on the server PC.

17.4. Audio

17.4.1. Audio latency: monitor echo

Latency is a consequence of the complex DSP chain. Its components:

1. **OS audio driver.** Output through the sound card on MME/WASAPI gives 250–500 ms. For Windows, the fastest option is ASIO4ALL (free), then WDM-KS; WASAPI and MME are the slowest. For professional audio cards, use the native ASIO driver with minimum buffer. MME, WDM-KS, WASAPI, ASIO and built-in Apple/Linux drivers are supported.

2. **Taps count** on the TX tab in Settings: 400 Taps ≈ 5 ms latency. Reducing to 200/100 lowers latency at the cost of slightly less steep TX filter slopes.

3. **Additional processing** (Noise Cancellation, etc.) adds latency — during diagnostics, disable functions one by one.

For CW monitoring, use the transceiver's audio codec (headphones plugged into the transceiver) rather than the PC sound card.

17.4.2. Audio/TX dropouts during OS activity (moving windows, GPU load)

The cause is high-priority graphics interrupts knocking out the audio stream. Solution: switch to ASIO (native audio interface driver or ASIO4ALL) in the ExpertSDR3 audio settings, update graphics drivers, apply the measures from the "Crashes or freezes" section.

17.4.3. Distortion and crackling in NFM

Set the receiver filter bandwidth equal to or slightly wider than the signal bandwidth — otherwise crackling on volume peaks is inevitable (this is normal). Check the squelch threshold SQL (yellow marker on the S-meter — slightly above the noise level). Note: CB band 27 MHz stations operate in AM, while the NFM demodulator is designed for FM signals.

17.4.4. Screeching in headphones during transmission / line-out creates a loop

Check Settings → Receiver sound / Line out: the line out must not be assigned to the same audio driver as the main PC sound — this creates an audio loop and distortion.

17.4.5. Where recordings are stored

Default paths: `C:\Users\<User>\AppData\Local\Expert Electronics\ExpertSDR3\wave\` — IQ recordings; `...\voice\` — voice recorder.

17.5. Transmission

17.5.1. Lower power in digital modes is normal

In DIGL/DIGU (FT8, etc.) the average power is lower than in SSB — this is related to the signal shape and thermal mode; reduce power for long transmission cycles.

17.5.2. Drive vs Tune

Drive — output power in transmission mode for the selected modulation. **Tune** — power of the test carrier for tuner tuning; bound to the band only. Right-clicking the Drive slider copies the value set for Tune.

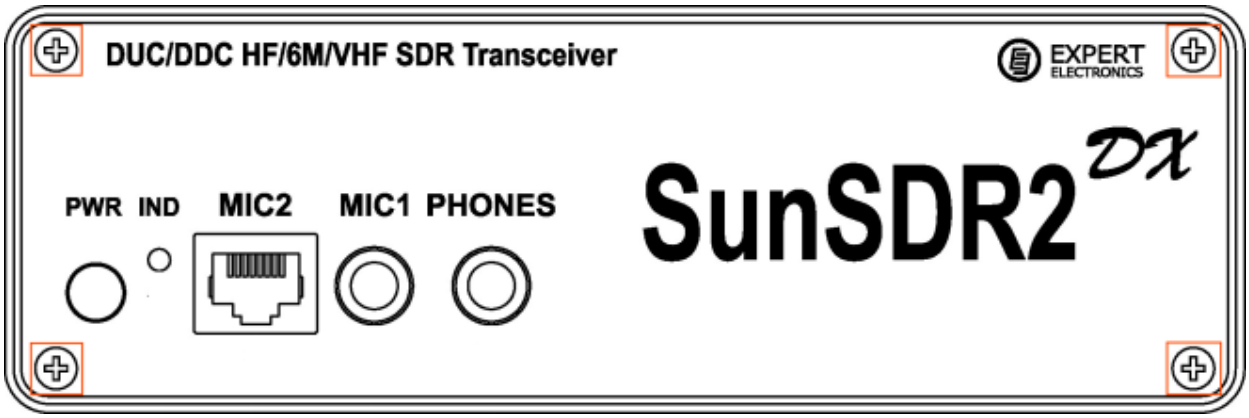
17.5.3. Power limitation for an external amplifier

Per-band limits are set in the Band Manager (see the "Operating the Transceiver" chapter) — use them to avoid overdriving the external PA input.

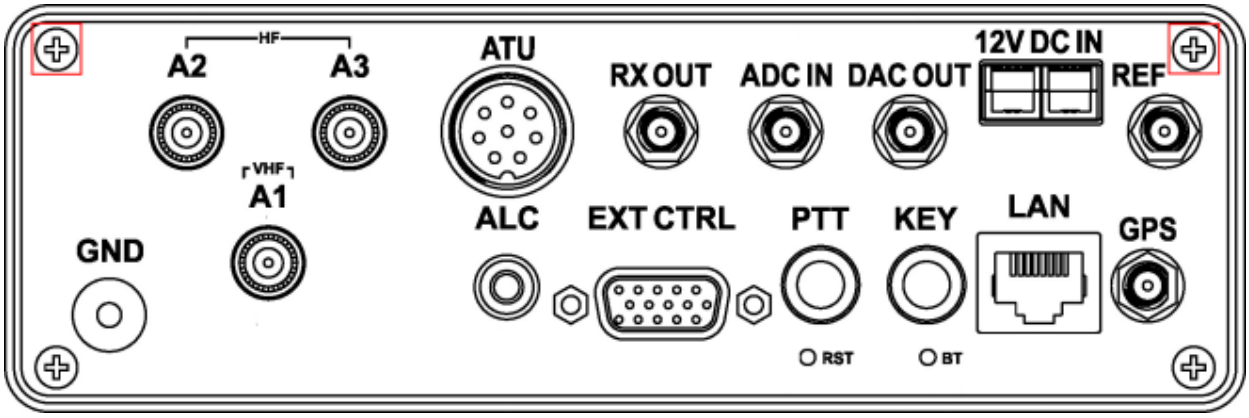
18. Troubleshooting guides

18.1. How to open the transceiver

1. Unscrew 4 screws on the front panel, remove the metal panel and plastic bezel.



2. Unscrew 2 top screws on the rear panel.



3. Grip the front of the heatsink and pull it for 2 cm (like on the picture below), you'll see the power amplifier (PA) PCB attached to the heatsink.



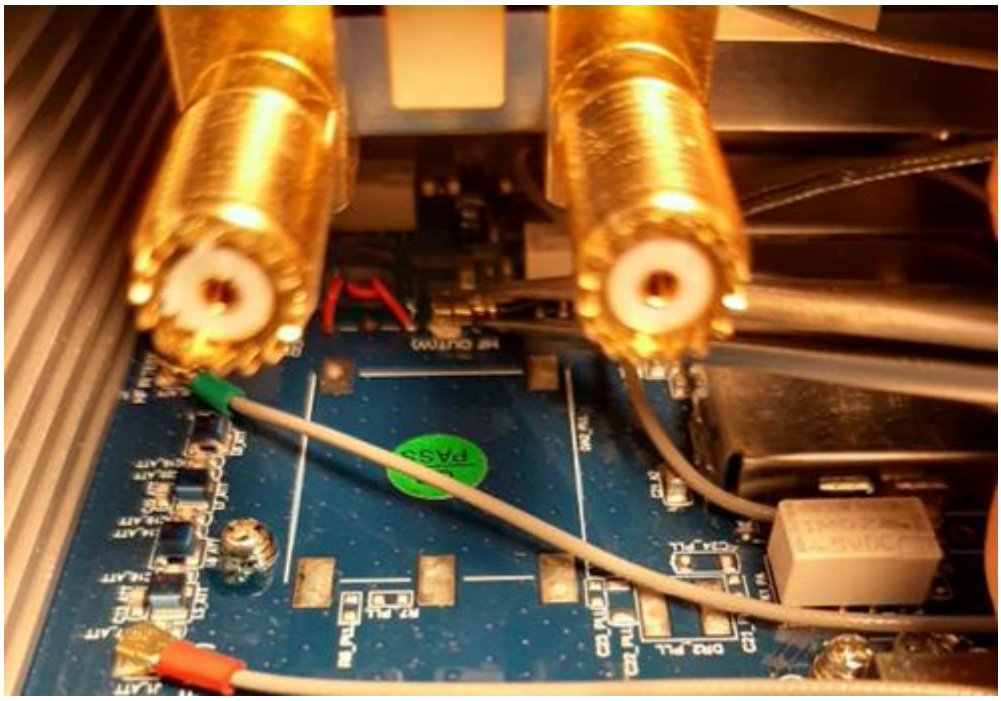
4. Carefully pull out the flex cable with the pincer.



5. Pull the heatsink till the middle of the case (like on the picture below), make sure that cables connecting SDR and PA boards are not pulled tight.



6. Disconnect 3 colored UFL cables from the SDR PCB (bottom) and pull the heatsink with PA board out of the case.



18.2. Low output power on HF

1. Make sure that firmware and software output power corrections are set to max level.

2. Connect a 100 W/50 Ohm dummy load to A2 or A3 antenna port, select it in ExpertSDR3.

3. Set the Drive slider to 100%.

4. Press the TX button.

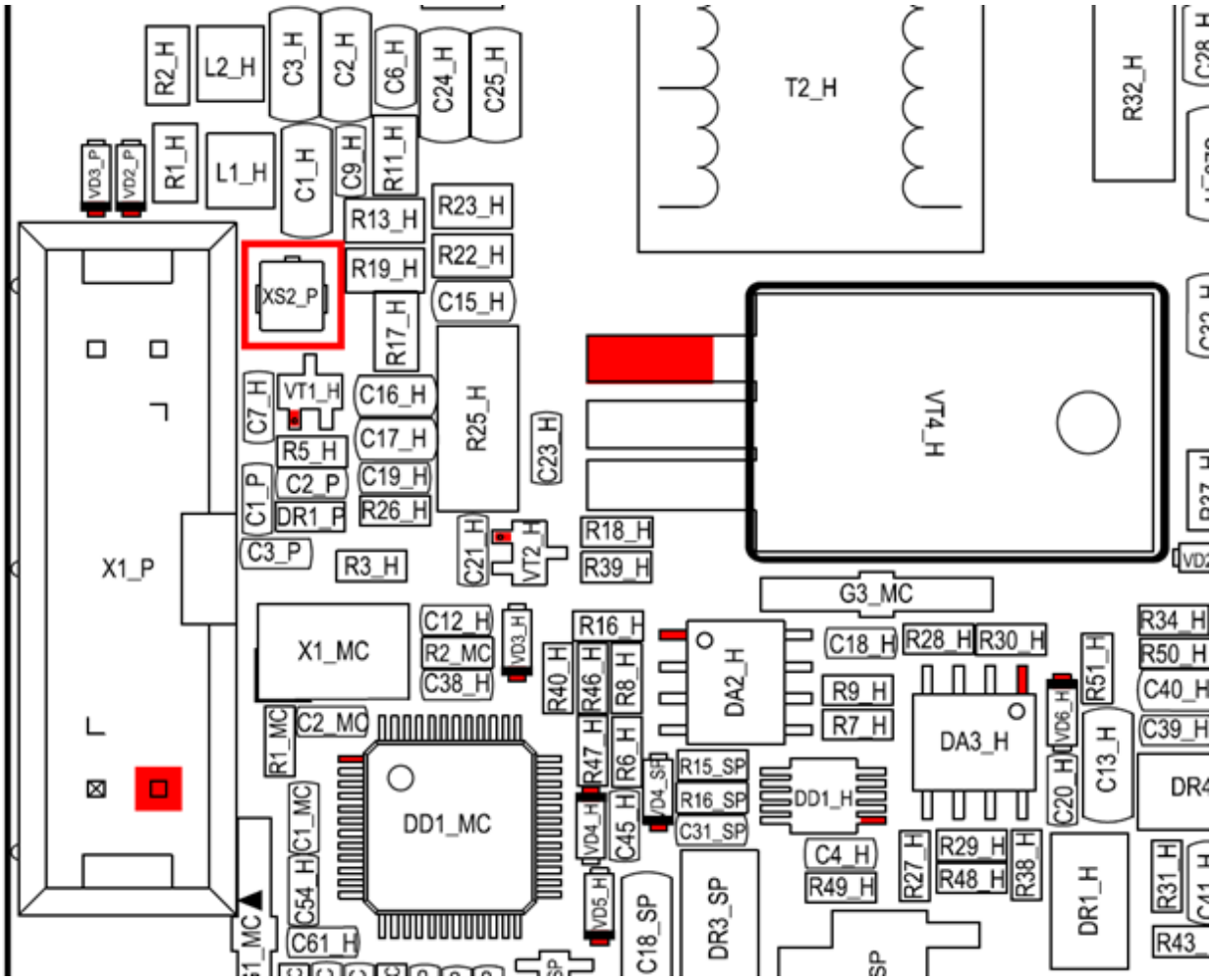
If the output power is significantly lower than 100W, do the following:

1. Set the Drive slider to 0.

2. Press the TX button.

Current should be about ~4.7A on HF bands, if it's lower, then most likely one of the transistors is dead and requires replacement. Each RD16 transistor draws 0.35A, each RD100 transistor draws 1.5A.

3. Open the transceiver and check the HF voltage on the XS2P connector, it should be around 1V.



4. Check RD16 and RD100 transistors to make sure they are not short-circuited.

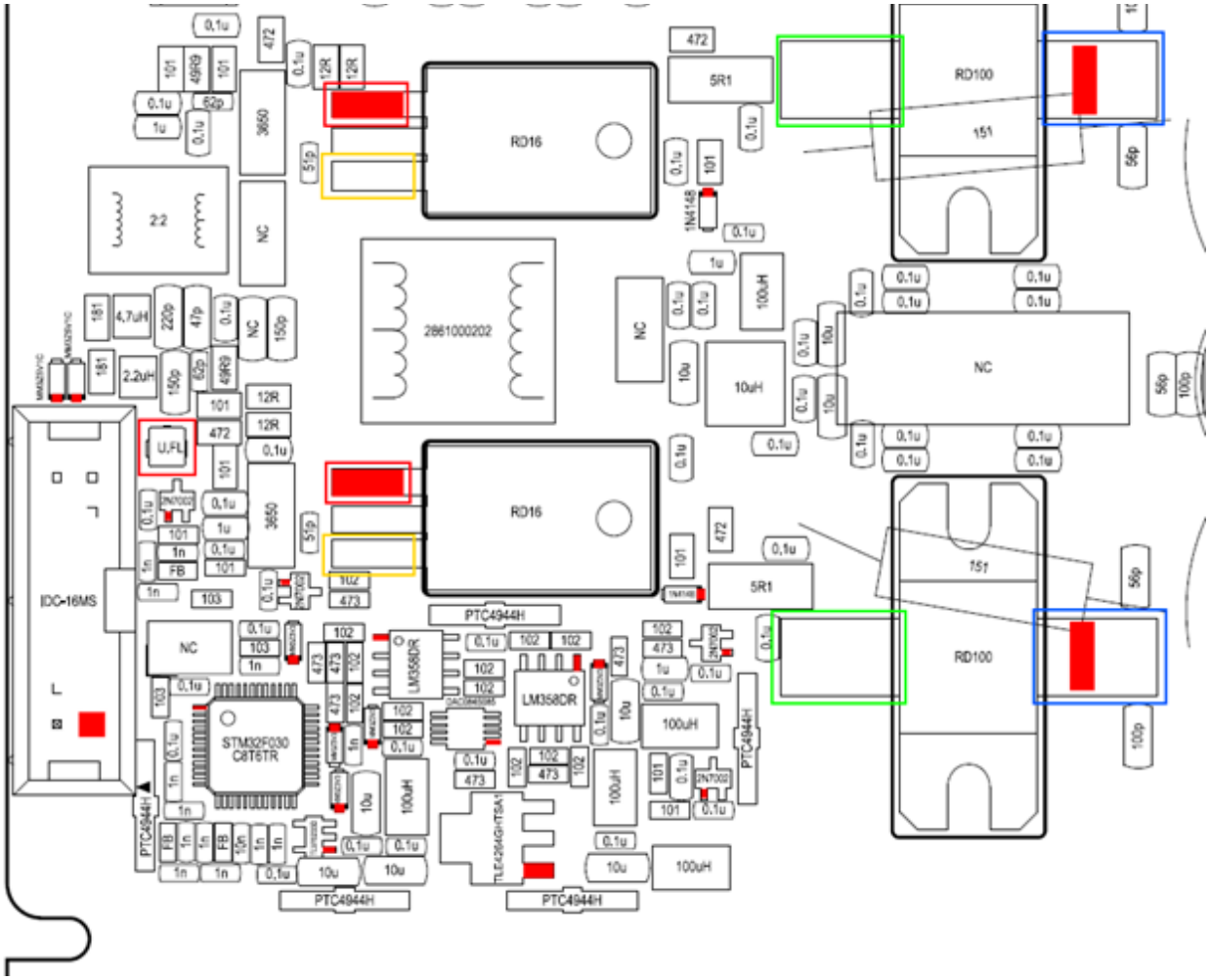
5. Do the output power check according to the picture below.

RD16 **red** contacts (gates) transistors input.

RD16 **yellow** contacts HF amplitude should be increased in comparison to **red** contacts.

RD100 **green** contacts (gates) transistors input.

RD100 **blue** contacts HF amplitude should be increased in comparison to **green** contacts.



18.3. VHF TX path check algorithm

1. Check the RX capability on VHF.

If yes

Solution: proceed to step 3.

If no – either no reception or with big attenuation.

Solution: Replace K4_ANT relay or antenna connector A1 (if relay replacement wasn't enough).

2. Check the output signal with oscilloscope on **2M** band via **DAC OUT**. Signal level on the DAC OUT connector should be 1.5 V pk-pk (+5...+8 dBm) with max Drive level.

Note: transmit for 3-5 seconds. Do not transmit for a long time.

If yes – there is a signal with required level on DAC OUT.

Solution: proceed to step 3.

If no - there is no signal with required level on DAC OUT.

Solution: proceed to step 2.1.

2.1. Check the output signal with oscilloscope on the output #4 of the K1_A4 relay. Signal level should be 1.5 V pk-pk (+5...+8 dBm) with max Drive level.

If yes - there is a signal with required level on #4 output of K1_A4 relay.

Solution: Replace K1_PA relay. Check step 2 once again.

If no - there is no signal with required level on #4 output of K1_A4 relay.

Solution: Replace K1_A4 relay. Check step 2 once again.

3. Go to **VHF 2M** and select **A1** connector in the software (connect 50 Ohm dummy load). Check the signal on the input (1st pin) of the amp module RA08H1317M (covered with the shield with screws). Signal level on the input contact should be 1.5 V pk-pk (+5...+8 dBm) or higher with max Drive level.

Note: transmit for 3-5 seconds. Do not transmit for a long time.

If yes – there is a signal on the amp input.

Solution: proceed to step 4.

If no - there is no signal on the amp input.

Solution: Replace K1_PA relay. Check step 3 once again.

4. Check the signal on the output (4th pin) of the amp module RA08H1317M (covered with the shield with screws). Signal level on the output contact should be around 30-50 V pk-pk (35-38 dBm) with max Drive level.

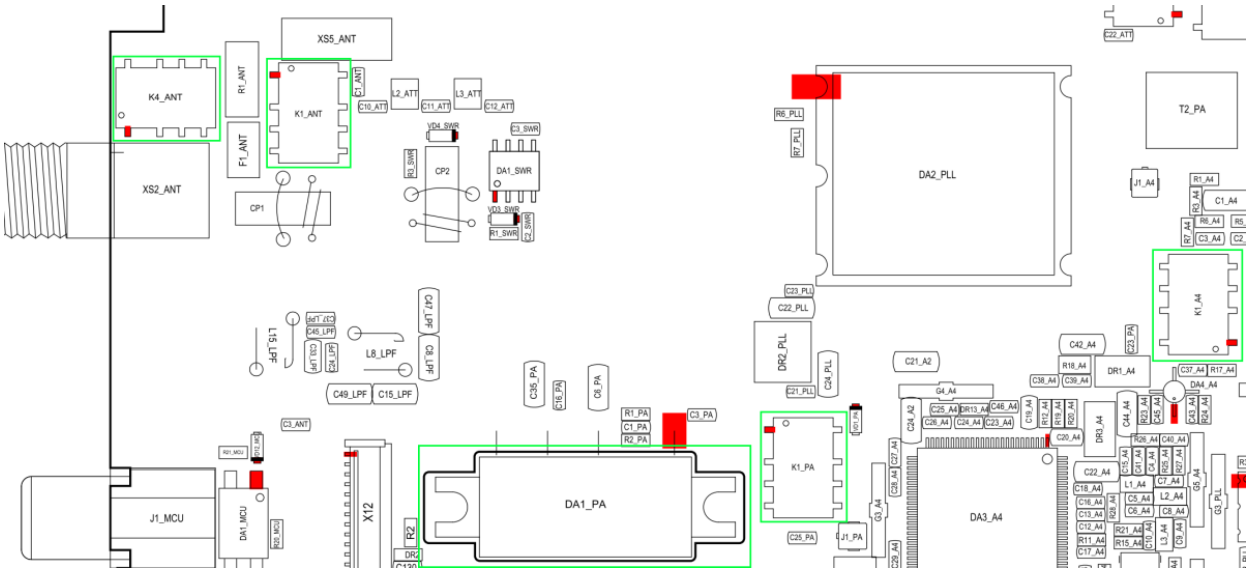
If yes - there is a signal on the amp output.

Solution: Check the signal on the LPF output, power meter, on the 3rd pin of K1_ANT relay (switches TX/RX modes on VHF). Replace LPF components or power meter or K1_ANT relay.

If no - there is no signal on the amp output.

Solution: Replace amp module RA08H1317M.

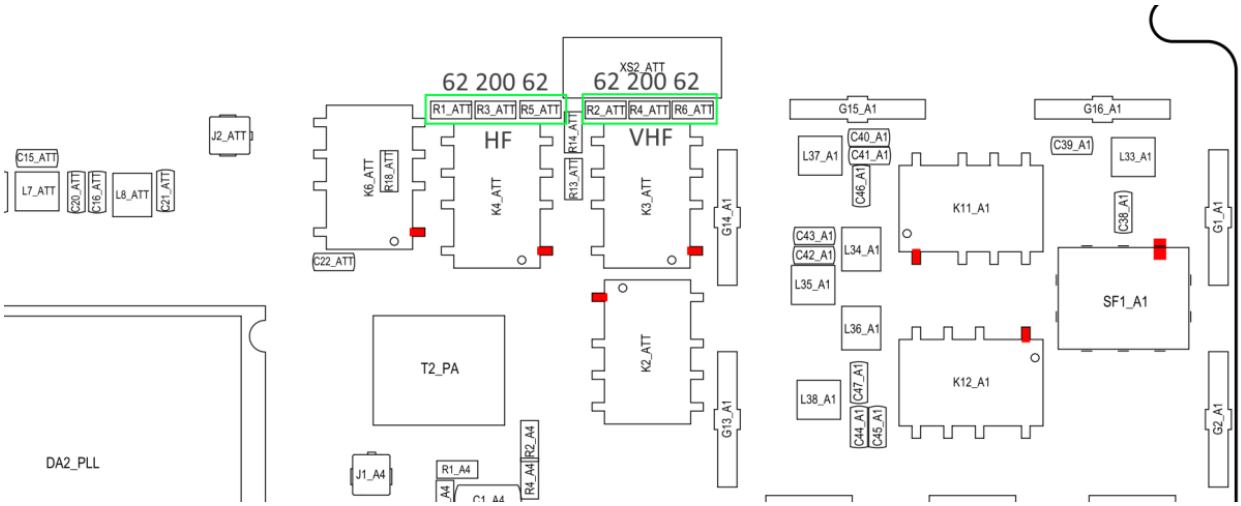
VHF relays (K4_ANT, K1_ANT, K1_PA), RX/TX switch relay (K1_A4) and RA08H1317M are placed on the SDR board close to the A1 antenna connector.



18.4. ATT resistors replacement

1. Open the transceiver.

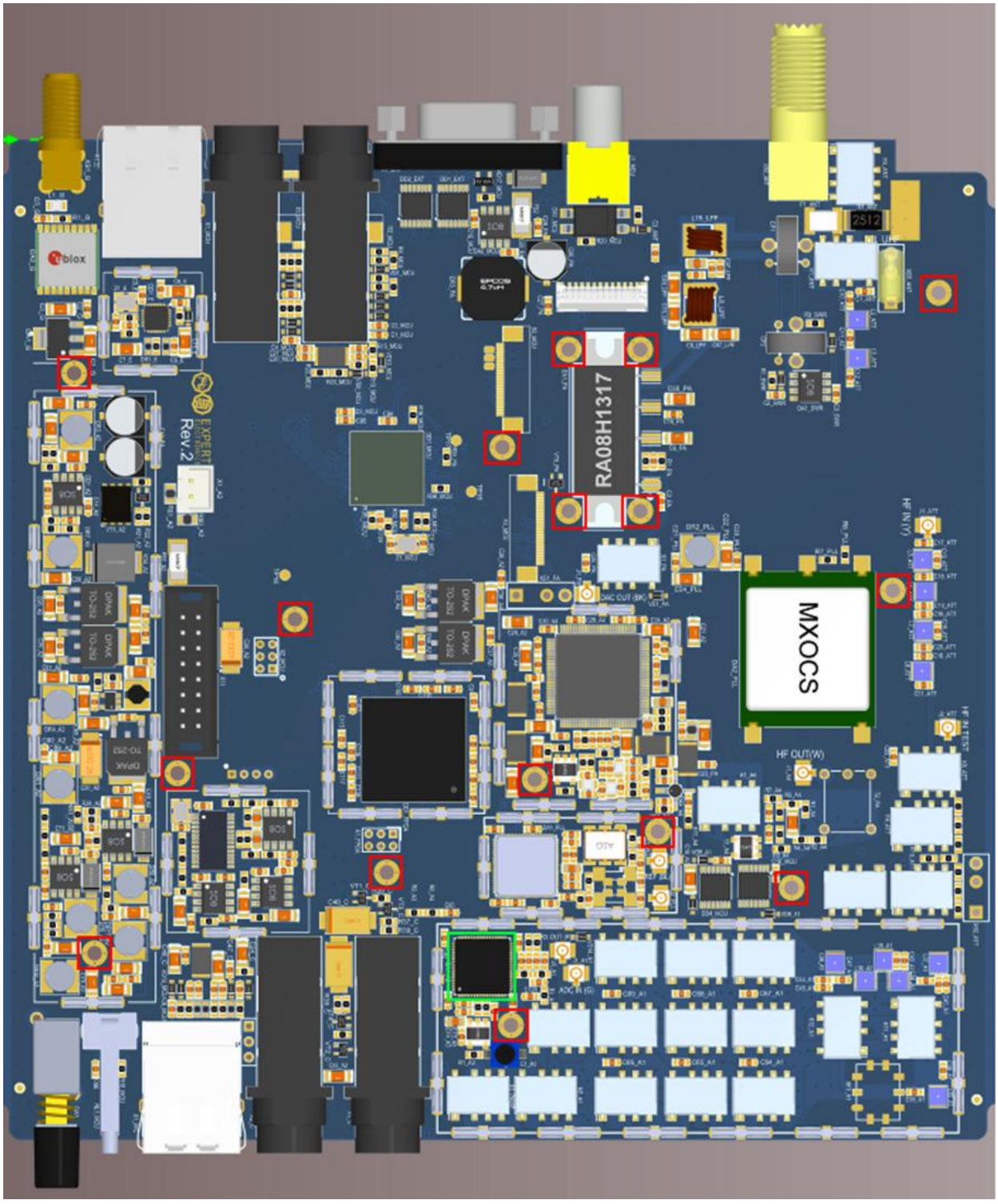
2. Replace the marked resistors on the SDR board: R1_ATT, R3_ATT, R5_ATT and R2_ATT, R4_ATT, R6_ATT. 2 groups by 3 resistors are placed on the opposite end to the A1 connector, from left to right: 62 Ohm – 200 Ohm – 62 Ohm 0603, HF and VHF resistors are the same.



18.5. ADC replacement

1. Open the transceiver.

2. Remove the shields and unscrew the marked screws.



3. Remove the heatsink below the PCB, because it will dissipate the heat while soldering. ADC chip marked with green rectangle; it needs to be resoldered/replaced. Here is a step-by-step instruction:

1. After you remove the ADC chip, you need to clean the contacts on the PCB and then fine clean them with alcohol.

2. Apply a very fine tin layer to the contacts and bottom of the ADC chip.

3. Coat the contacts on the PCB with a fine layer of flux.

4. Cover the contacts on the PCB with a very fine layer of soldering paste. Soldering paste should be of a room temperature and thoroughly mixed for 7–10 minutes prior.

5. Place the PCB on a heating oven, keeping it perfectly leveled.

6. Setup ADC on the PCB so that their contacts will be perfectly aligned.

7. Shield the closest plastic elements: connectors/relays.

8. Switch on the heating oven, the temperature should be 180 Celsius.

9. Then use the fan to solder the ADC to the PCB. Fan temperature should be 330-340 Celsius. Fan nozzle should be of square form and slightly bigger than the ADC size (~1 mm).

10. The fan tip should be 1.5-2 mm from the ADC in a perfect 90 degrees. Fan speed should be slightly higher than minimal.

11. Wait until the soldering paste will start to melt and wait for 20 seconds, then switch off the fan and heating oven. Be careful, do not disturb the PCB after heating, closest elements to ADC could fall off.

4. After soldering check the test zones on the back of the PCB for short circuit. Assemble the transceiver in the reverse order, power it and check noise floor level, it should be -118...-121 dBm with ATT 0 dBm in CW mode with filter bandwidth 500 Hz.

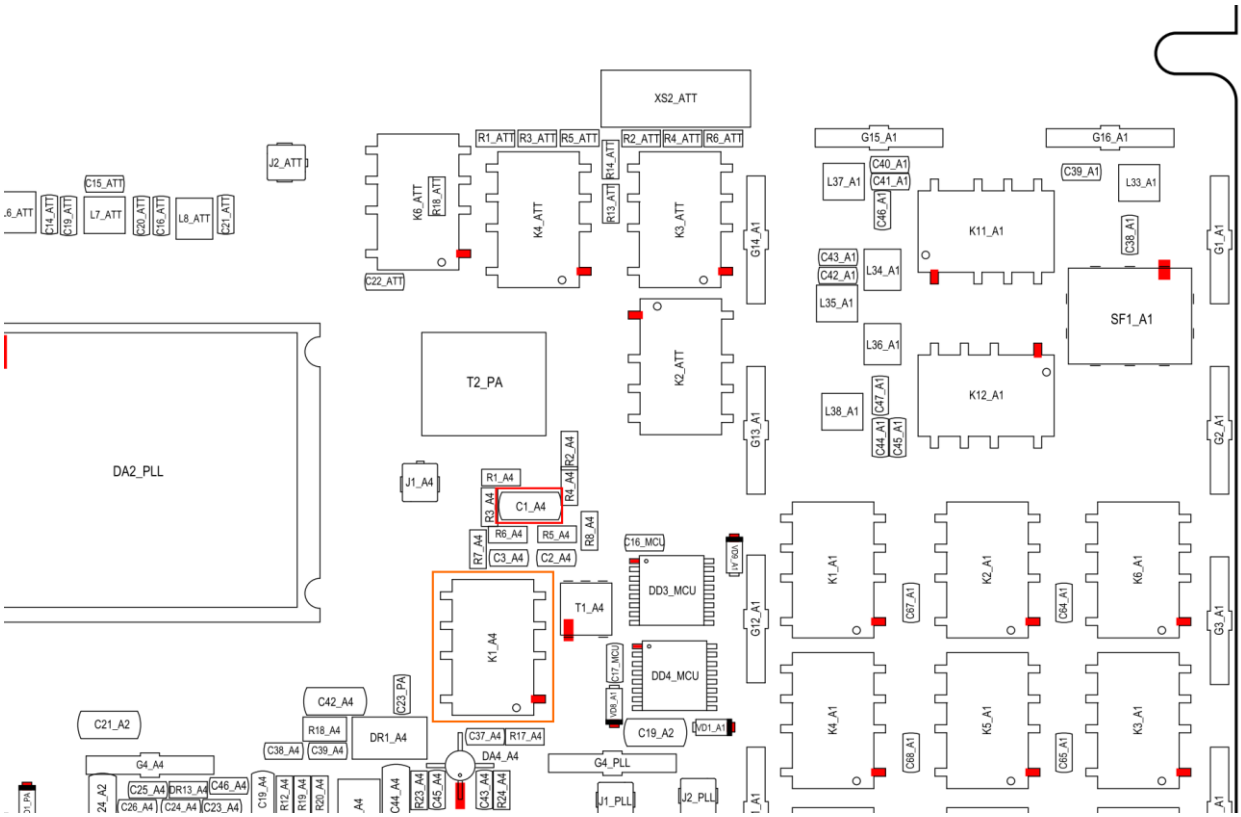
19. Hardware modifications

19.1. HF/VHF switching relay

This modification is applicable to the transceivers from Gen1-4.

1. Open the transceiver.

2. Orange rectangle marks the K1_A4 relay (p/n: IM02GR), you need to remove the capacitor marked with red rectangle.

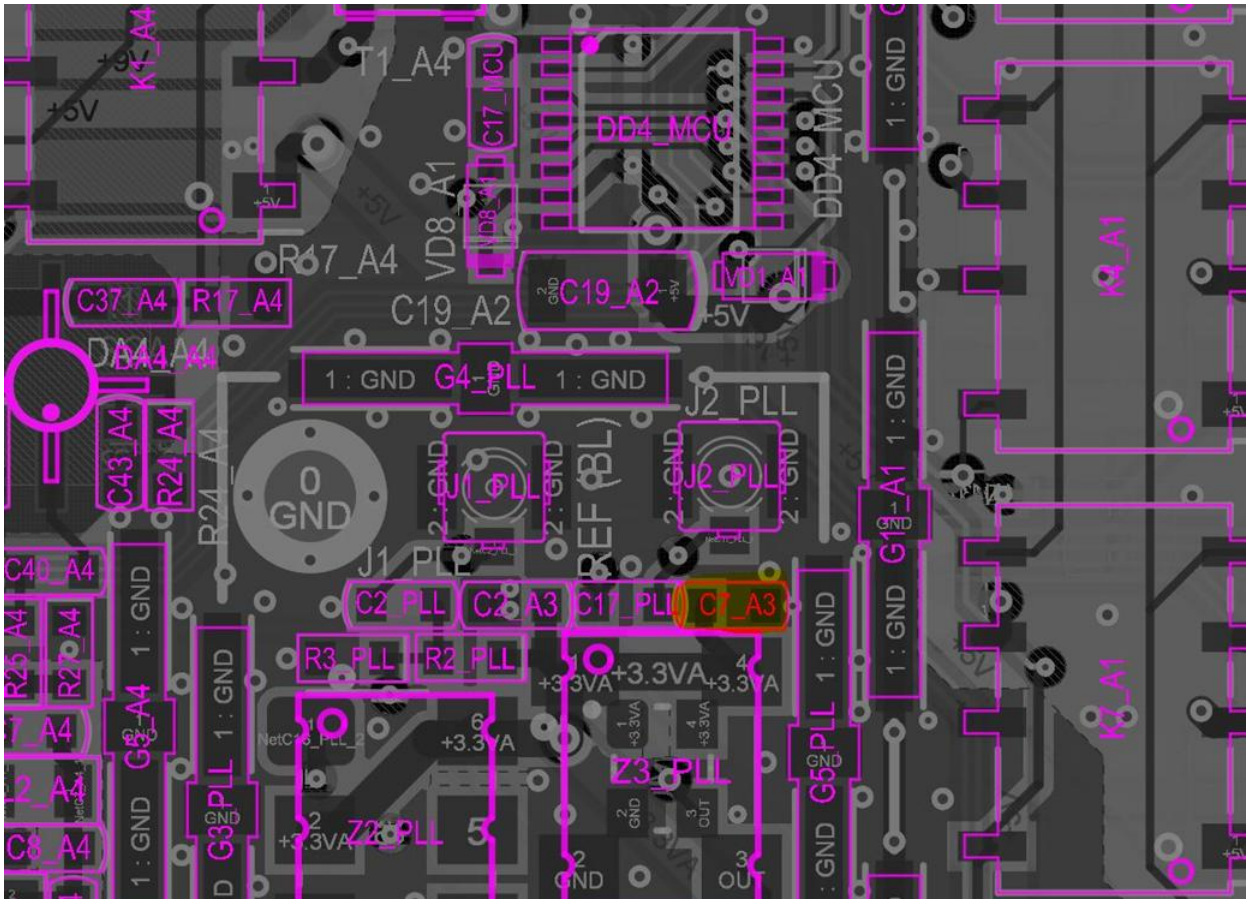


19.2. Spectrum improvement

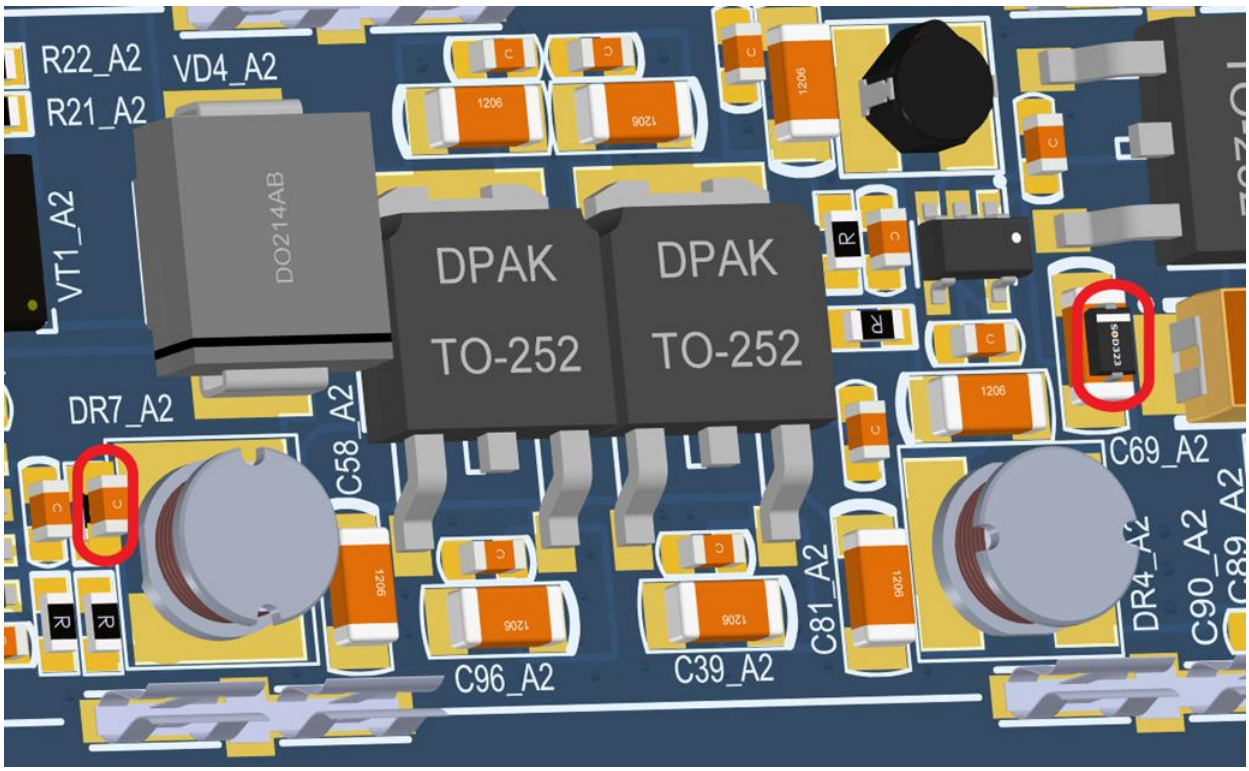
This modification is applicable to the transceivers from Gen1-3.

1. Open the transceiver.

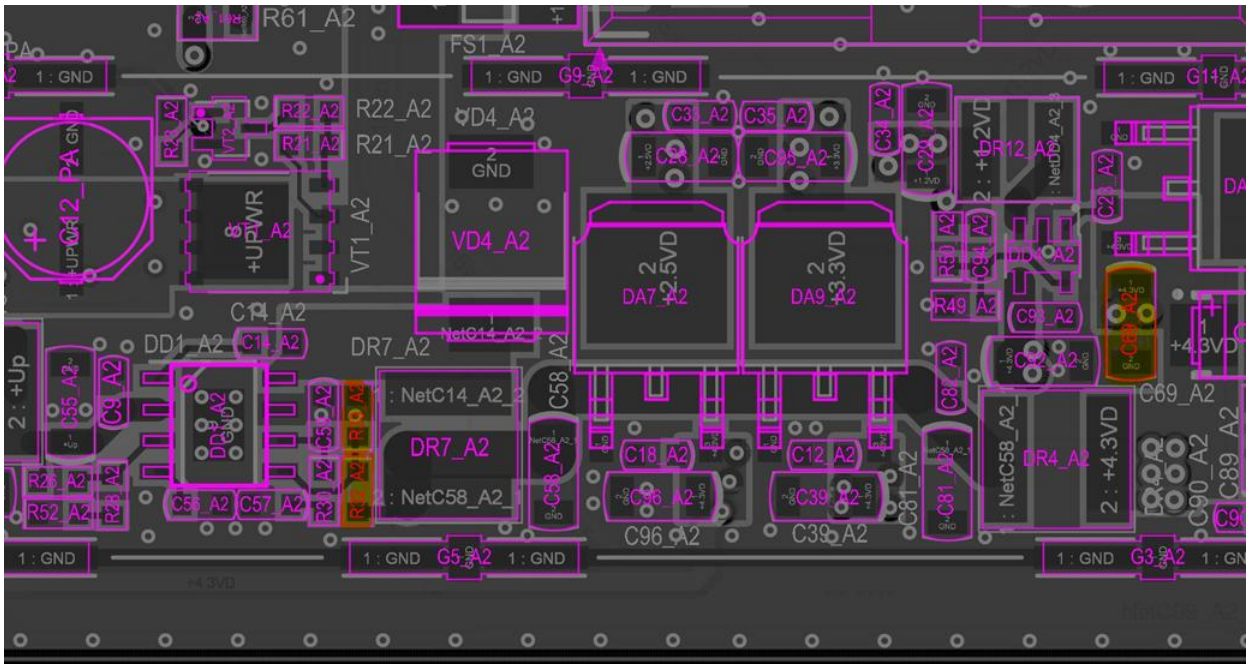
2. Mount capacitor CAP CER 100uF 6.3V X5R 0805 on top of the C7_A3.



3. Mount Zener Diode 5.1V 200mW ±6% Surface Mount SOD-323 (Part Number: MM3Z5V1C) on top of the C69_A2.



4. Replace R33_A2 with ES SMD 1.3K Ohm 1% 1/10W 0603 and mount CAP CER 1000pF 50V X7R 0603 on top of it. Replace R32_A2 with RES SMD 6.8K Ohm 1% 1/10W 0603.

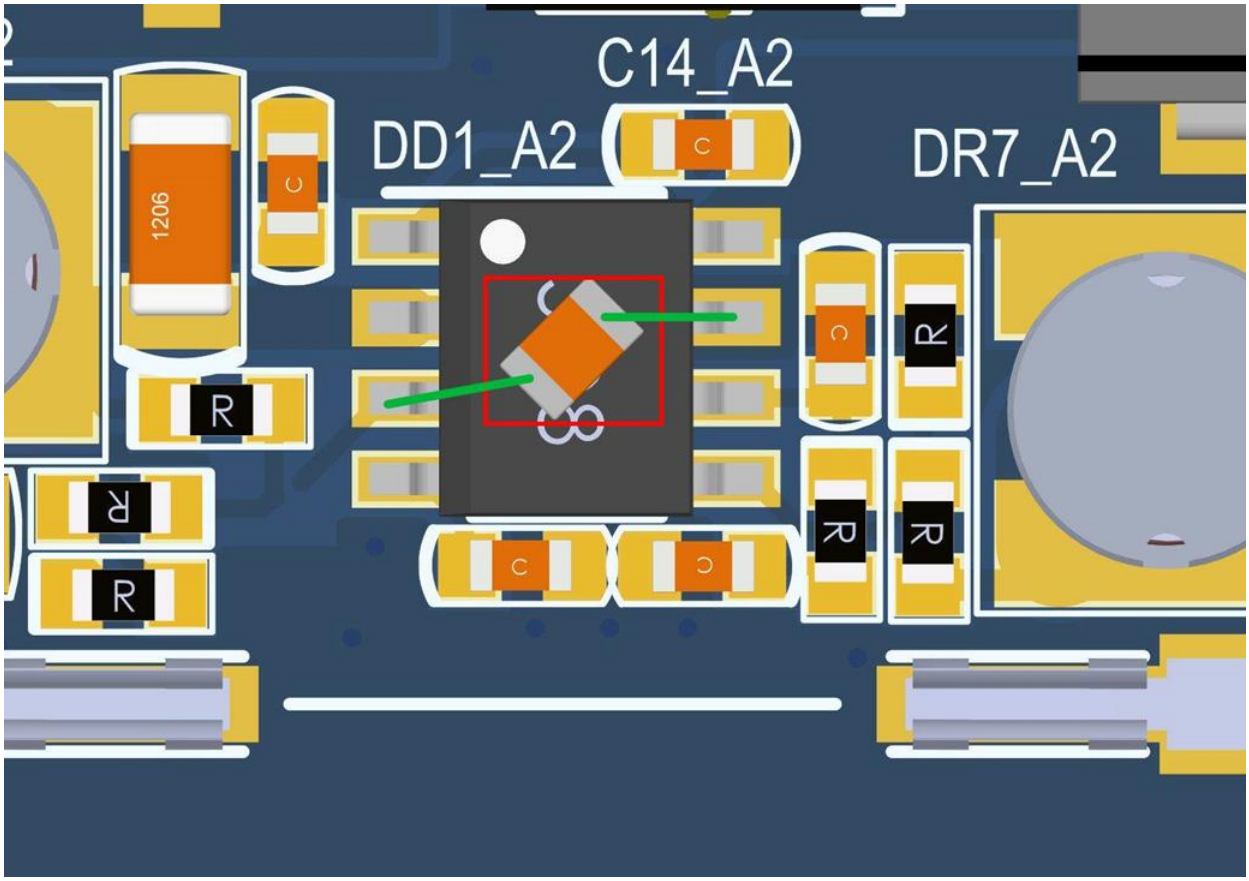


19.3. Supply voltage stability

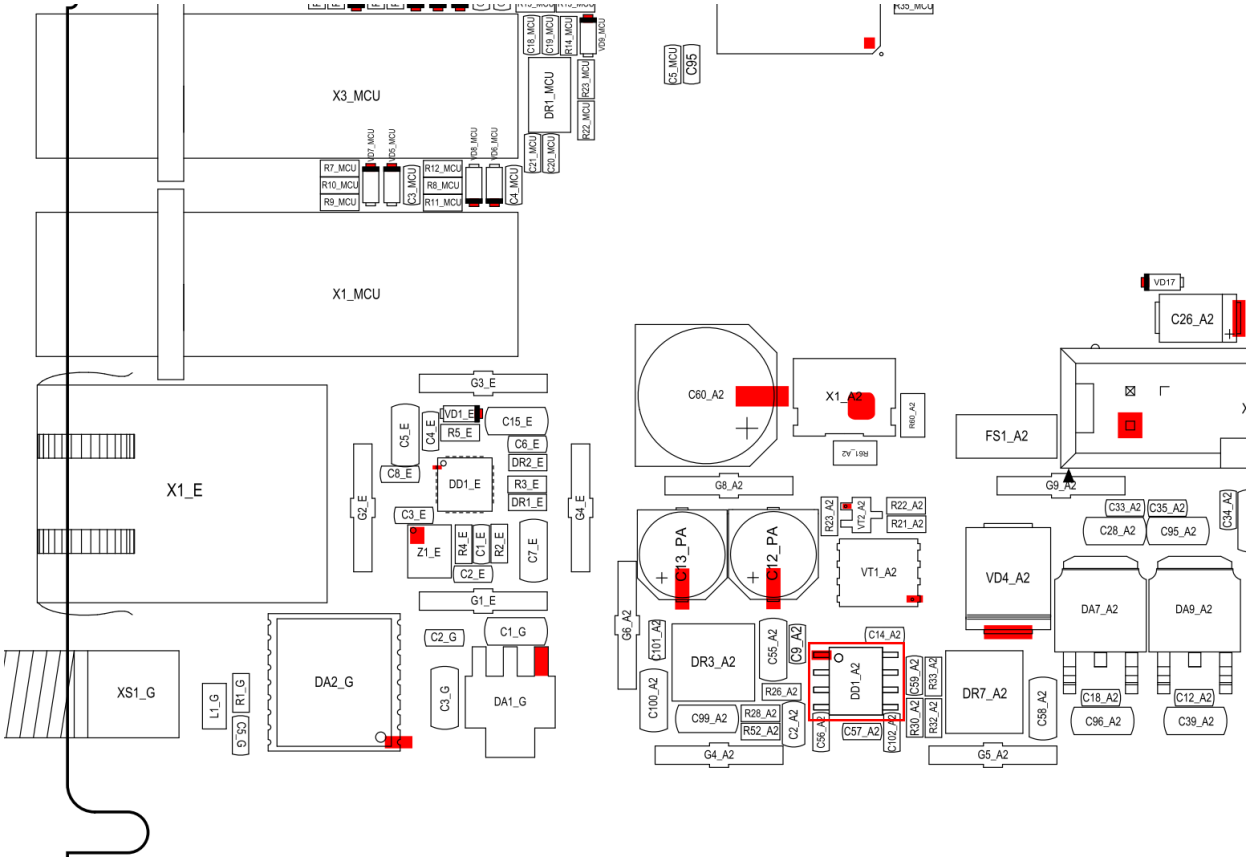
This modification is applicable to the transceivers from Gen1-2.

1. Open the transceiver.

2. Solder 1 capacitor: 1uF 0805 25V on top of the DD1_A2 chip, between the 3rd and 7th pins.



Marked on the PCB:

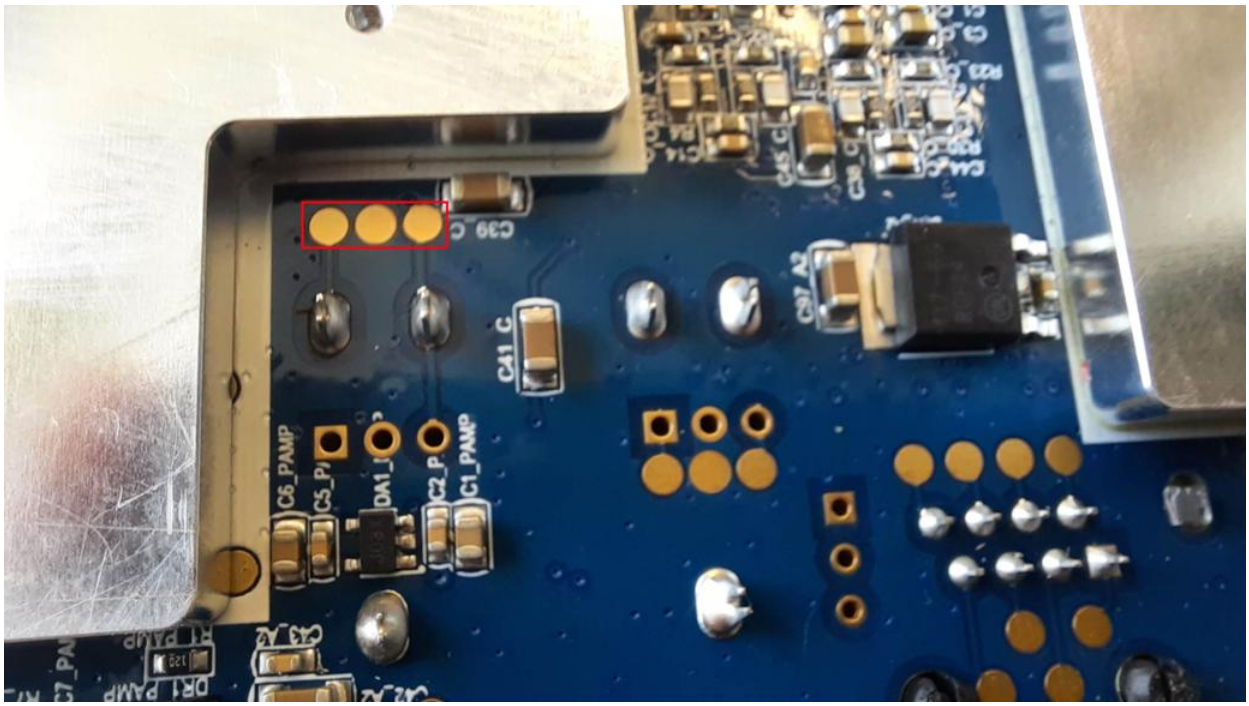


19.4. RF interference elimination

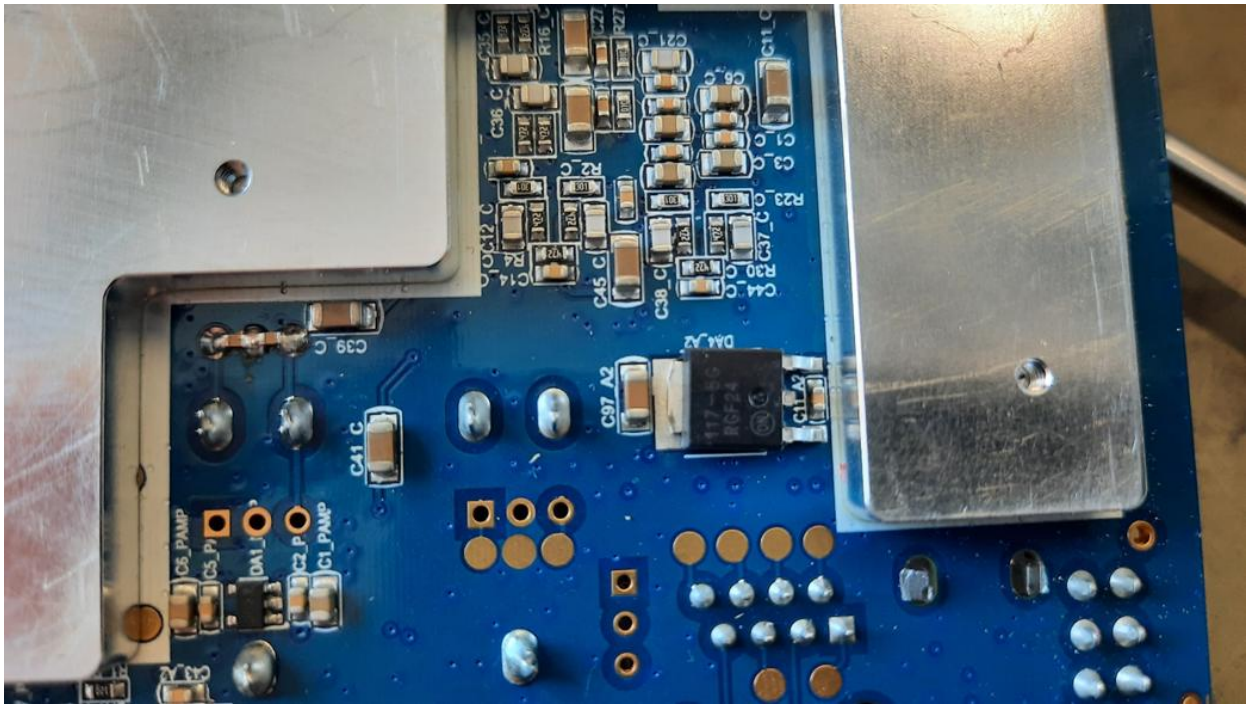
This modification is applicable to the transceivers from Gen1-2.

1. Open the transceiver.

2. Solder 2 capacitors: 0603 10nF 50V, to the marked pads.



As a result it should look like this, for example:

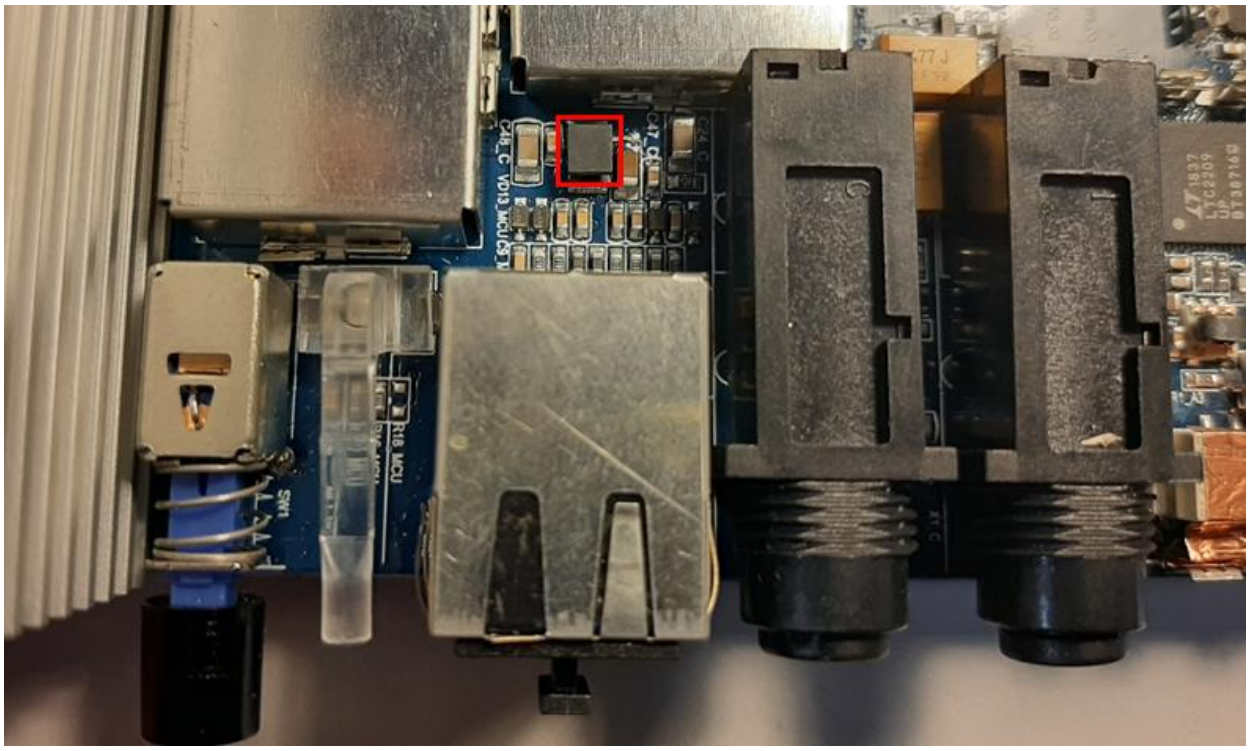


19.5. Mic1 fix

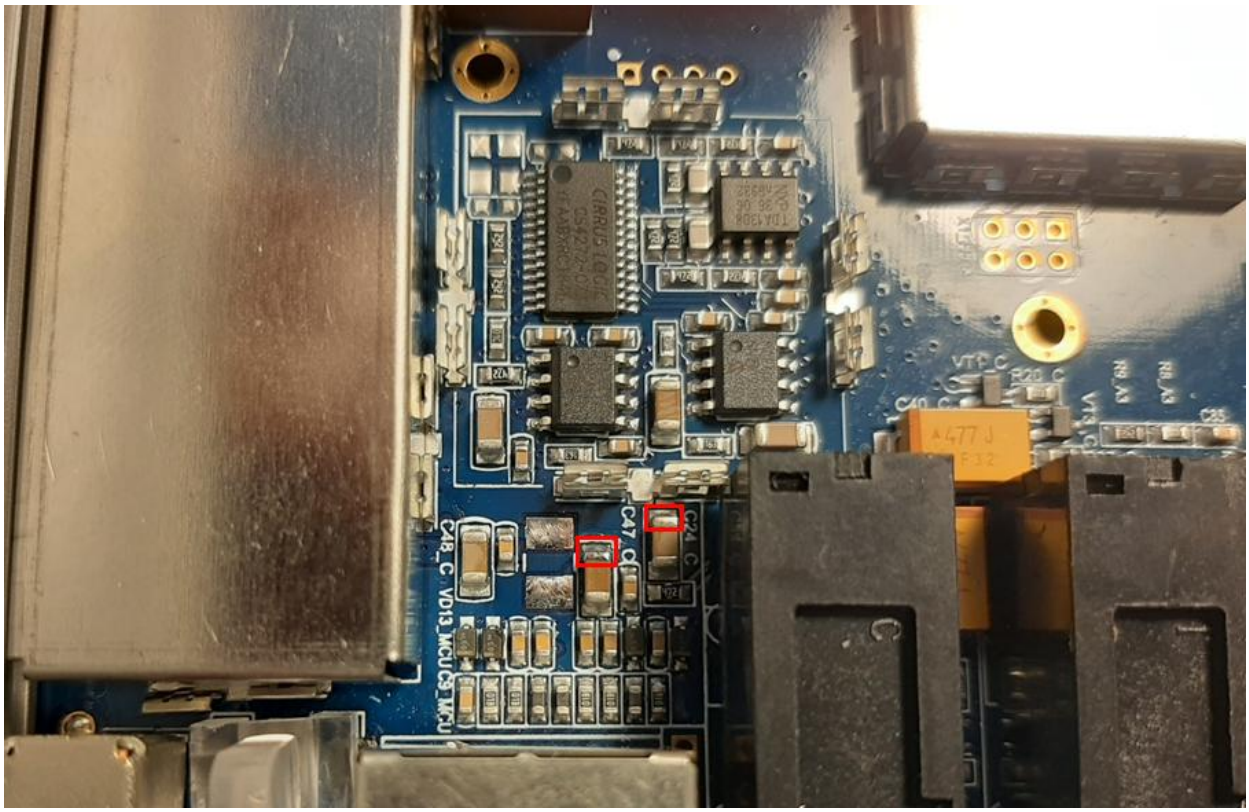
This modification is applicable to the transceivers from Gen1.

1. Open the transceiver.

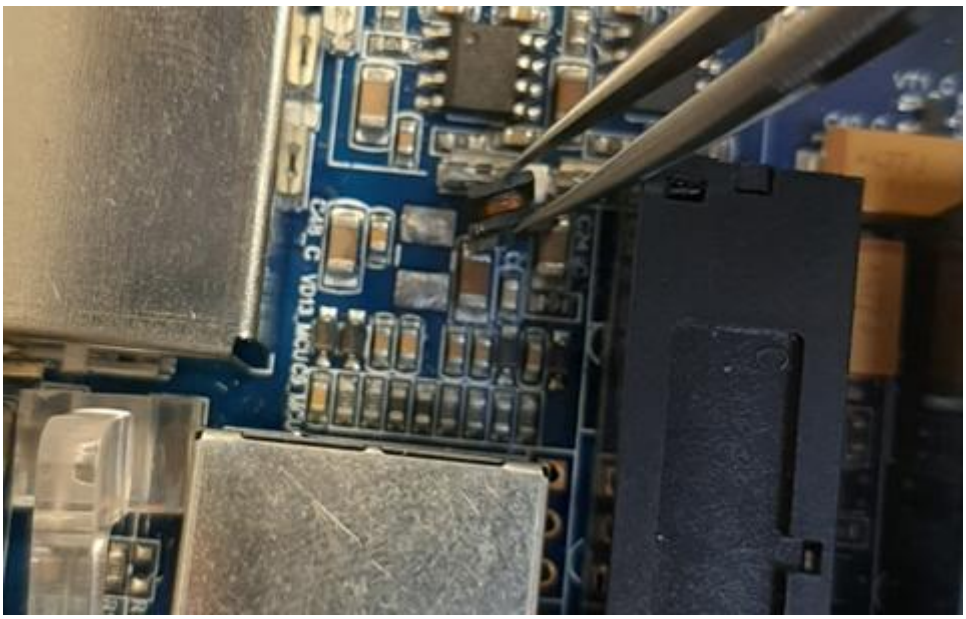
2. Remove the marked coil using a solder machine with a heating fan (250 C max) or two soldering machines.

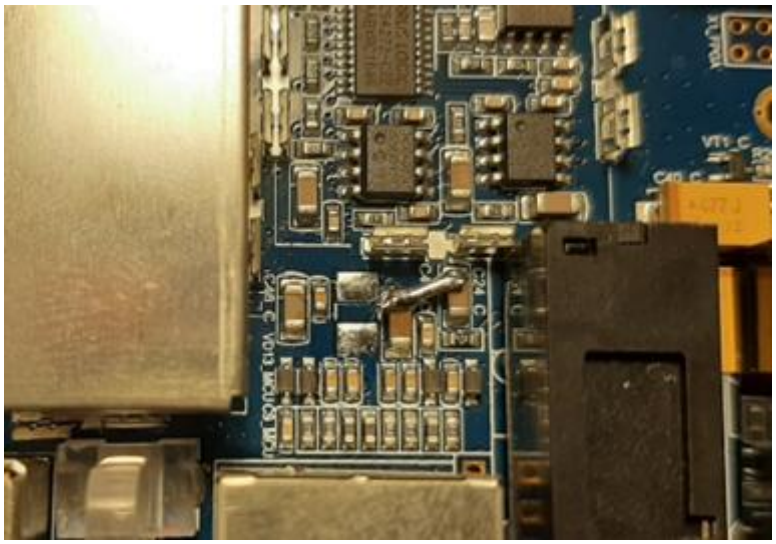


3. Install the unsoldered coil (or jumper) between marked contacts.

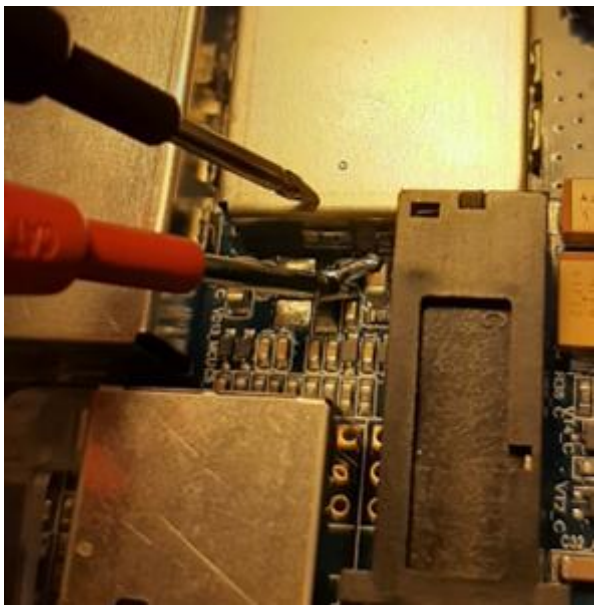


4. As a result it should look like this, for example:





5. Make sure there is no short circuit between Earth and 5V supply.



20. REGULATORY REQUIREMENTS



European Union Declaration of Conformity

Manufacturer	Expert Group LLC
Address	Polyakovskoe schosse, 16-3, ABK-1, off. 408 Taganrog, 347927 Russian Federation

Equipment	HF/50MHz/VHF Amateur Radio Transceiver Series, Base Station
Brand Name	Expert Electronics
Type	SunSDR2 DX, SunSDR2 PRO

RE Directive

We declare on our sole responsibility that this equipment complies with the essential requirements of the Radio Equipment Directive, 2014/53/EU, and that any applicable Essential Test Suite measurements have been performed.

EMC	Radio Spectrum
EN 301 489-1 : V2.2.3 (2019) EN 301 489-15 : V2.2.1 (2019)	301783 : V2.1.1 (2016-03)

RoHS Directives

We declare on our sole responsibility that this equipment complies with the restriction of the use of certain hazardous substances in electrical and electronic equipment Directives 2011/65/EU and 2015/863/EU.

Technical Documentation (RoHS)
EN IEC 63000:2018

21. Appendix A. Typical usage scenarios

21.1. Scenario 1. DXpedition and Portable Operation

SunSDR2 DX is one of the most compact and lightweight 100-watt SDR transceivers in its class: convenient to take on expeditions, to a field day, on portable outings.

Typical expedition kit:

- SunSDR2 DX;
- **AAT-100** automatic antenna tuner — the external tuner is placed at the antenna, which is more efficient than a built-in one: the entire antenna system is matched, not just the cable at the transceiver; feeder losses under mismatch are reduced;
- **E-Coder2** panel — full control without touching the PC: tuning, RIT/XIT, CW key (iambic, Break-In), quick PA/BS/BreakIN commands;
- laptop with ExpertSDR3.

Field operation notes:

- 12–16 V power supply — operation from a battery;
- with several transceivers on one network (multi-operator expeditions), assign each device a unique IP and its own port pair — see the "Troubleshooting" chapter, section 2;
- CW monitoring — via the transceiver's audio codec (headphones into the transceiver) to avoid PC sound card latency.

21.2. Scenario 2. Remote (Club) Station

A full-featured remote station without port forwarding:

Station side: SunSDR2 DX + AAT-100 + antenna + PC with ExpertSDR3 and ExpertStarter (or Starter only — the transceiver can be controlled from the web client).

Operator side: ExpertSDR3 client or web browser + E-Coder2 panel for "analog" control and CW.

Key capabilities:

- connection via ExpertCloud: registration, 2FA, browser authorization;
- Starter web panel (localhost:5531): cloud and device status, remote access on/off;
- remote control of the AAT-100 tuner — antenna matching without visiting the site;
- remote CW via TCI macros and a physical key on E-Coder2;
- station sharing with guests with TX lock (receive-only);

- automatic reconnection on connection drops;
- custom STUN/TURN servers — for stability in complex networks.

21.3. Scenario 3. Contest Position

Combination: ExpertSDR3 + logger via TCI (LogHX, Log4OM, 5MContest, etc.) or N1MM via RadioSync.

- frequency, mode, SPLIT, PTT — synchronized automatically;
- CW macros from the logger — via TCI; for the N1MM combination with Break-In enabled, use version 1.1.7+;
- logger audio macros are transmitted on air via TCI Audio In;
- DX cluster spots — to the panorama via RadioSpot (up to 1000 spots, callsign duplication on different bands);
- recording the entire band for later analysis — IQ recorder or TCI IQ stream to an external client;
- E-Coder2 panel — instant control without switching focus to the software window.

21.4. Scenario 4. Digital Modes (FT8 and others)

1. DIGU/DIGL mode in ExpertSDR3.
2. JTDX / WSJT-X Improved / MSHV — TCI connection (or via RadioSync: CAT + VAC).
3. Reduce power for long transmission cycles (see "Troubleshooting").
4. For software without TCI — TCI-Hamlib Adapter (WSJT-X, FLDigi, CQRLog).

21.5. Scenario 5. Skimmer / Band Monitoring

Receiver IQ streams via TCI allow skimmers (CW Skimmer and similar) to decode stations across the entire panorama bandwidth. Several clients connect simultaneously: skimmer + logger + band recording.