

GhostBox SO2R Controller

User Guide

Version 1.0

Author: YO3HEX

Date: January 2025

Table of Contents

1. [Introduction](#)
 2. [System Requirements](#)
 3. [Hardware Setup](#)
 4. [First-Time Configuration](#)
 5. [Daily Operation](#)
 6. [Feature Guides](#)
 7. [Advanced DSP Features](#)
 8. [Recording Setup](#)
 9. [OTRSP Integration](#)
 10. [Troubleshooting](#)
 11. [Tips & Best Practices](#)
-

Introduction

GhostBox SO2R Controller is a software solution that replaces to an extent the hardware SO2R boxes. It provides dual-radio audio management, advanced DSP processing, and seamless integration with contest logging software.

What You'll Need

- Two transceivers with USB audio capability
 - Headphones/speakers
 - Microphone (for TX audio) - not needed for CW operation
 - Contest logging software with OTRSP support (DXLog, N1MM+ etc.)
-

System Requirements

Minimum Requirements

- **Operating System:** Windows 10/11 (64-bit)
- **CPU:** Modern dual-core processor
- **RAM:** 4 GB
- **Disk Space:** ~200 MB (plus recording storage)

Recommended

- **Operating System:** Windows 10/11 (64-bit)
 - **CPU:** Quad-core or better
 - **RAM:** 8 GB or more
 - **Disk Space:** ~400 MB
-

Hardware Setup

Step 1: Connect Your Radios

Option 1: Built-in USB Audio (Recommended)

Most modern radios (Icom IC-7300/7610/9700, Yaesu FT-991A/710, Elecraft K3/K4 etc.) have built-in USB audio:

1. Connect **Radio 1** to PC via USB cable
2. Connect **Radio 2** to PC via USB cable
3. Install radio manufacturer's USB drivers if required – usually the drivers are automatically installed by Windows OS

Option 2: External USB Sound Cards (not the optimal way)

If using older radios or external interfaces:

1. Connect audio cables from Radio 1 to USB Sound Card 1
2. Connect audio cables from Radio 2 to USB Sound Card 2
3. Connect USB sound cards to PC

Step 2: Connect Headphones and Microphone

1. Connect headphones to your default audio output
 2. Connect microphone to PC (can be USB microphone or sound card input)
 3. An integrated headphones+microphone headset be used with excellent results if the solution will be used for SSB operation (for CW the microphone is not needed)
-

First-Time Configuration

Step 1: Launch GhostBox

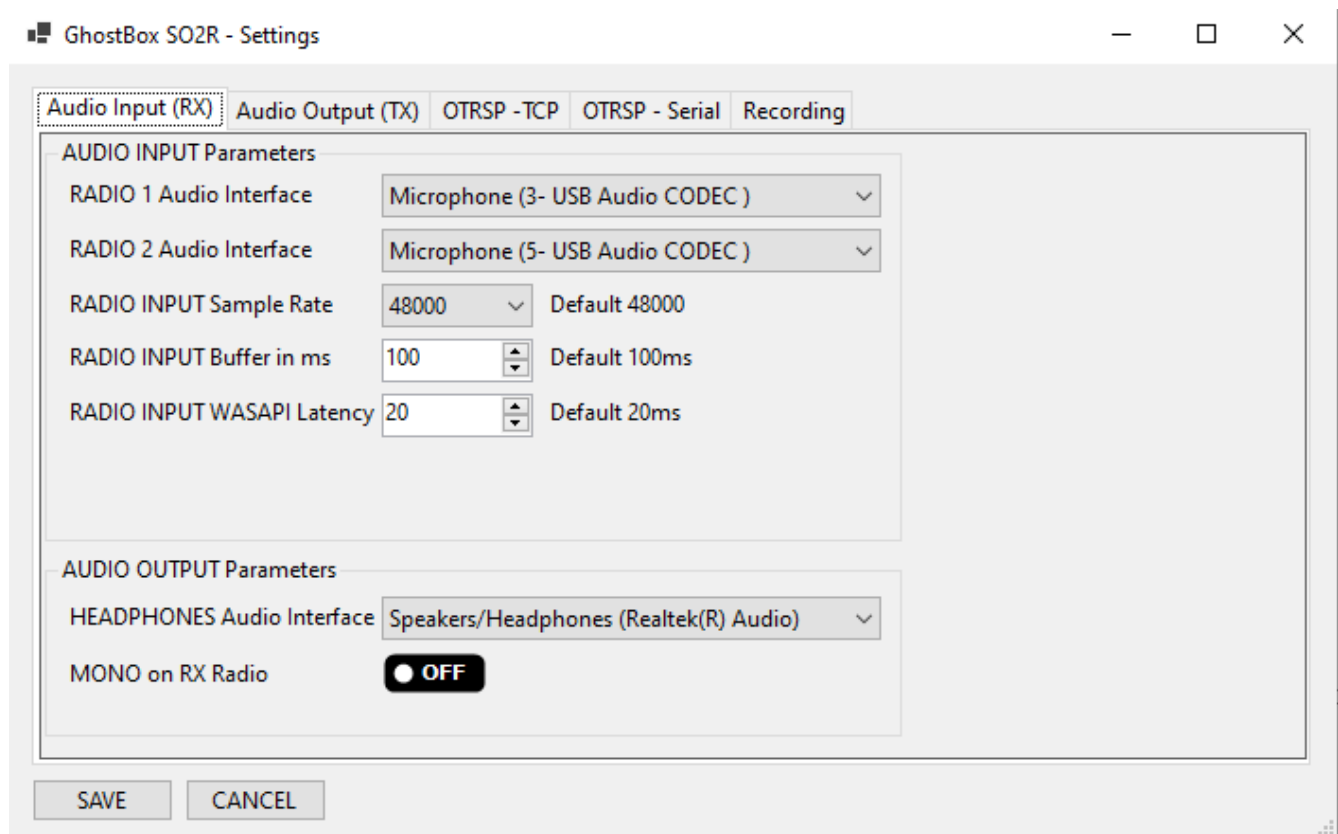
1. Double-click **SO2RGui.exe**
2. You'll see a splash screen briefly
3. The main window will open with "**Audio config invalid**" warning (expected on first run)

Step 2: Open Settings

1. Click the **orange "SETT" button** at the bottom of the main window
2. The Settings dialog will open with multiple tabs

Step 3: Configure Audio Input (RX)

Navigate to the "Audio Input (RX)" tab



Radio Audio Inputs

1. **RADIO 1 Audio Interface:** Select your first radio's USB audio input
 - Example: "USB Audio CODEC 3"
2. **RADIO 2 Audio Interface:** Select your second radio's USB audio input
 - Example: "USB Audio CODEC 5"
3. **RADIO INPUT Sample Rate:** Select **48000** (recommended)

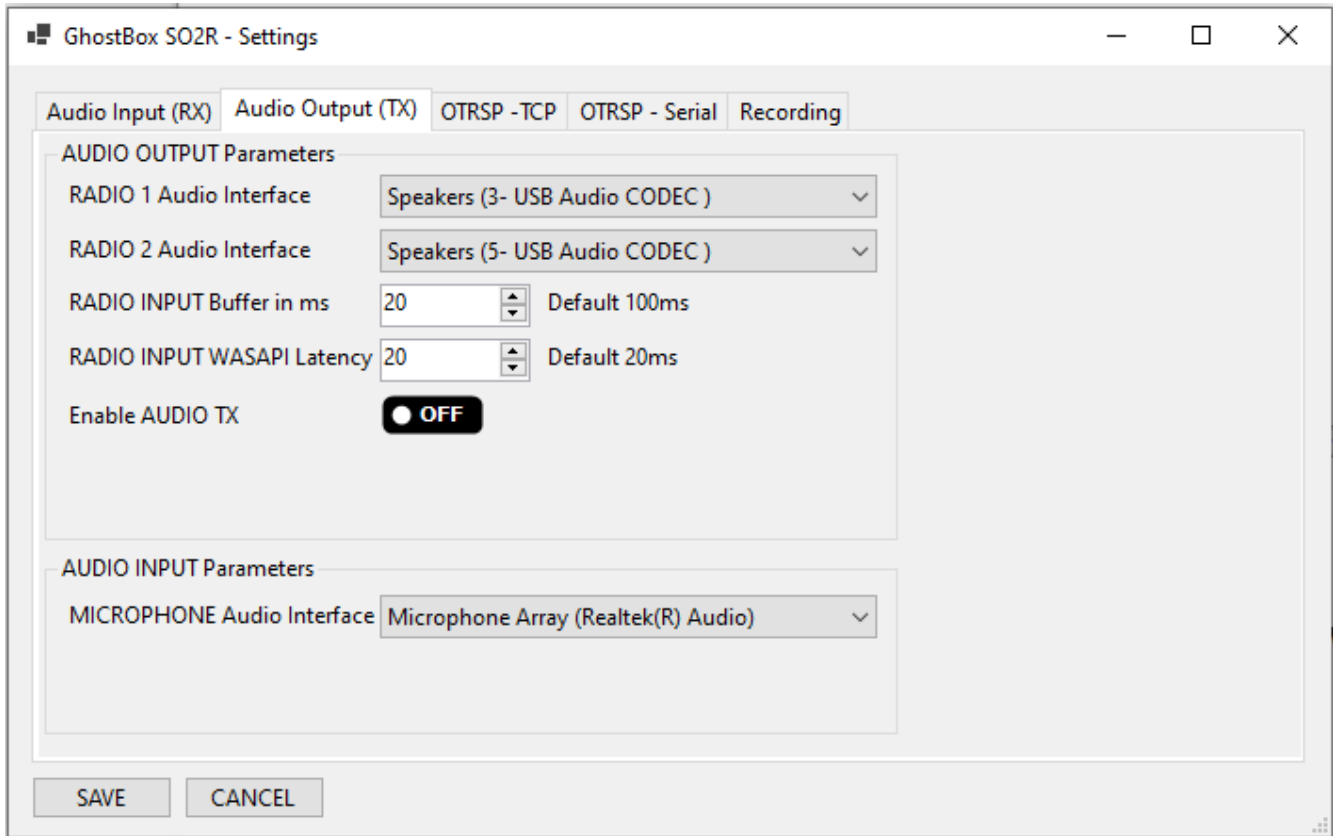
- Use 48000 Hz unless your radios require different rate
4. **RADIO INPUT Buffer:** Leave at **100 ms** (default)
 - Increase if you experience audio dropouts
 - Decrease for lower latency – with a modern computer this can be decreased to **20ms**
 5. **RADIO INPUT WASAPI Latency:** Leave at **20 ms** (default)
 - Lower = less delay, higher = more stable

Headphone Output

6. **HEADPHONES Audio Interface:** Select your headphones/speakers
 - Example: "Speakers (Realtek Audio)"
7. **MONO on RX Radio:**
 - **OFF** (default): Both radios audible in both ears when in mono mode
 - **ON:** Single-ear mono (left ear = Radio 1, right ear = Radio 2)
 - **Recommendation:** Leave OFF unless you prefer single-ear

Step 4: Configure Audio Output (TX) [Optional – not needed for CW]

Navigate to the "Audio Output (TX)" tab



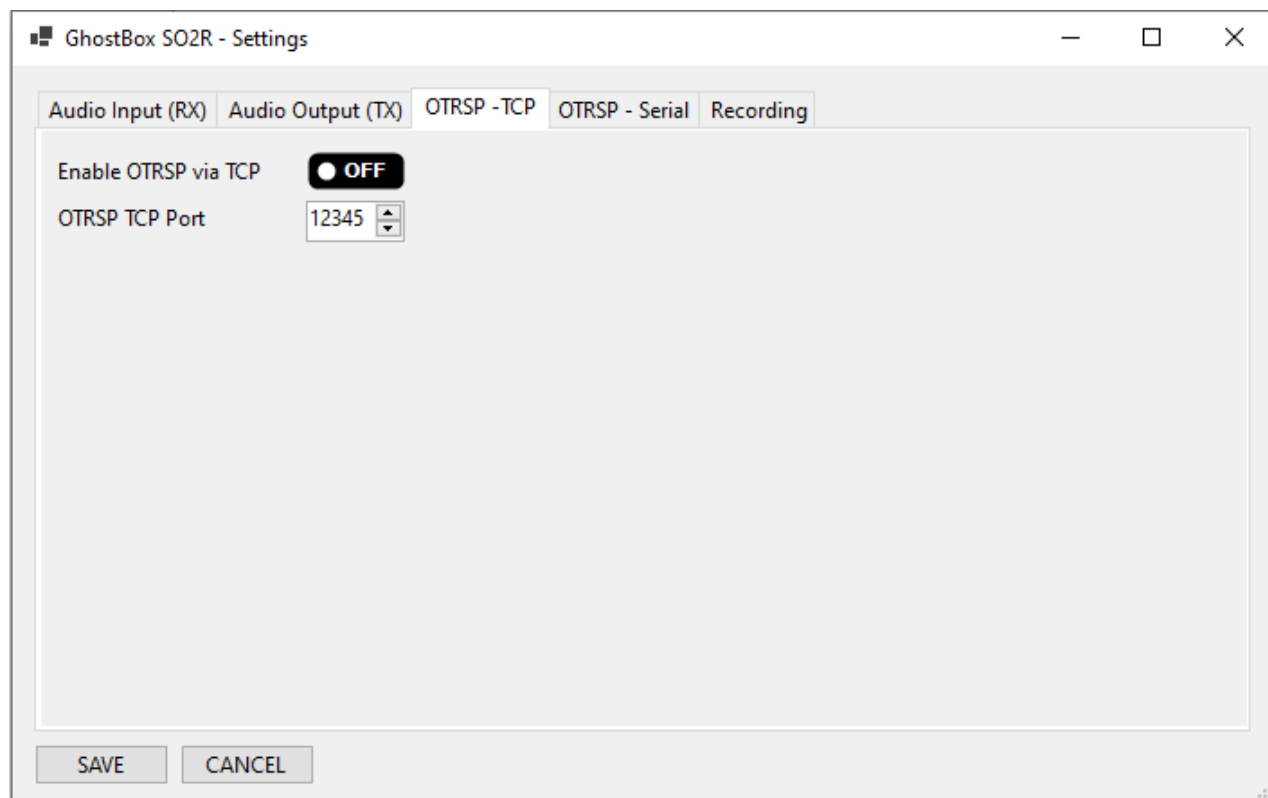
TX Audio Devices

1. **RADIO 1 Audio Interface:** Select TX audio output to Radio 1
 - Example: "USB Audio CODEC (IC-7300) - TX"
2. **RADIO 2 Audio Interface:** Select TX audio output to Radio 2
 - Example: "USB Audio CODEC (IC-7610) - TX"
3. **MICROPHONE Audio Interface:** Select your microphone
 - Example: "Microphone (USB Audio)"
4. **RADIO INPUT Buffer:** Leave at **100 ms** (default)
5. **RADIO INPUT WASAPI Latency:** Leave at **20 ms** (default)
6. **Enable AUDIO TX:** Toggle to **ON** to enable transmit audio processing

Note: If you don't use GhostBox for TX audio (using radio's direct mic input), you can skip this tab.

Step 5: Configure OTRSP - TCP

Navigate to the "OTRSP - TCP" tab

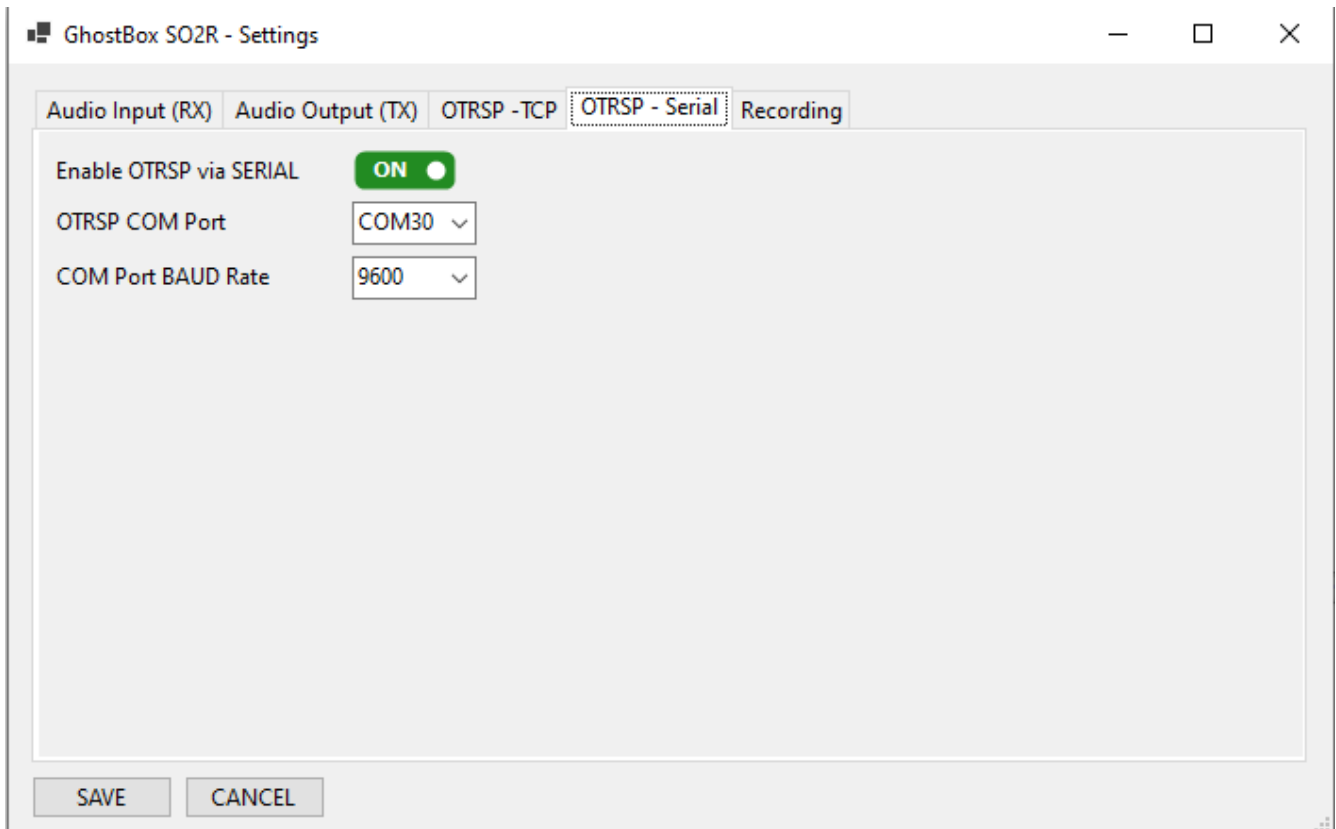


1. **Enable OTRSP via TCP:** Toggle to **ON**
2. **OTRSP TCP Port:** Enter **12060** (default for OTRSP)
 - Use different port if 12060 conflicts with other software

!IMPORTANT NOTE: DXLog does offer OTRSP directly via TCP, so if you are using DXLOG as your main logger software is recommended to use TCP as your main connection to the GhostBox

Step 6: Configure OTRSP – Serial

Navigate to the "OTRSP - Serial" tab



1. **Enable OTRSP via SERIAL:** Toggle to **ON**
2. **OTRSP COM Port:** Choose one of the available com ports – please note that the chosen comport will have to be a virtual one that was created with the existing solutions like Com0Com / VSPE etc. – this is needed because logging software like N1MM+ does not offer OTRSP connection via TCP – the OTRSP is offered only via a serial port – which in this case will have to be emulated (like in many other situations)
3. **OTRSP COM BAUD Rate:** this will have to match the baud rate set in your logger – 9600 baud is more than enough for this application.

Step 7: Configure Recording

Navigate to the "Recording" tab

Basic Recording Settings

1. **ENABLE Audio Recording:** Toggle to **ON**
2. **Recording Save Path:** Click "**Browse...**" and select folder
 - Example: C:\Users\YourName\Documents\S02R_Recordings
3. **ROTATE Recording Files:** Toggle to **ON** (recommended)
 - Prevents single large file
4. **ROTATE at:** Set to **100 MB** (recommended)
 - Smaller = more files, easier to manage
 - Larger = fewer files

MP3 Encoding

5. **Encoding Mode:** Select **CBR** (Constant Bit Rate)
 - CBR = consistent quality, predictable file size
 - VBR = variable quality, smaller files
6. **Bitrate** (if CBR selected): Select **64 kbps**
 - 64 kbps = good quality, small file size
 - 96-128 kbps = higher quality, larger files

Click "SAVE" when done

Normal Operation

Starting the System

Step 1: Power On Equipment

1. Turn on **Radio 1**
2. Turn on **Radio 2**

Step 2: Launch GhostBox

1. Start **GhostBox SO2R Controller**
2. Wait for main window to appear
3. Check status bar at bottom:
 - Should show "**Stopped**" in red

Step 3: Start Audio Engine

1. Click green "**START**" button
2. Status bar changes to "**Running**" in green
3. Wait 1-2 seconds for initialization

Step 4: Verify Audio

1. Tune both radios to active frequencies
2. Watch the **VU meters** you should have audio activity
3. Adjust **VOL knobs** for each radio to comfortable level
4. Master **OUTPUT VOL** knob controls final headphone volume

You're now ready to operate!

Feature Guides

RADIO CONTROL Tab (Main Operating Screen)



RADIO 1 Section

VOL Knob (Yellow)

- Controls Radio 1 receive volume
- Range: 0-100
- Adjust for comfortable listening level

MIX Knob (Green)

- Cross-mixes Radio 1 into right ear
- Range: 0-100
- Useful for hearing both radios in stereo mode
- **Tip:** Set to 10-20% for ambient awareness

LINK R1-R2 VOL Toggle

- **ON:** Both radio volumes linked (adjust together)
- **OFF:** Independent control
- **Use case:** Quick simultaneous volume adjustments

OUTPUT Toggle

- **ON:** Radio 1 audio enabled (green)
- **OFF:** Radio 1 muted (black)
- **Use case:** Quick mute without changing volume

TX Indicator (Top)

- **DIM GRAY:** Not transmitting, no focus
- **ORANGE:** TX focus on Radio 1
- **RED:** Actively transmitting on Radio 1

RX Indicator (Bottom)

- **DIM GRAY:** Not receiving
- **LIME GREEN:** Receiving on Radio 1

RADIO 2 Section

Same controls as Radio 1, but for second radio

OUTPUT Section

VOL Knob (Cyan)

- Master output volume control
- Range: 0-100
- Controls final level to headphones
- Affects both radios

INPUT Section (TX Audio - if enabled)

MIC Knob (Red)

- Microphone gain control
- Range: 0-100 (0.0x to 2.0x)
- Adjust until TX VU meter shows good levels without red

VU Meter

- Shows microphone input level
- Aim for green/yellow peaks, avoid constant red

Control Buttons

Green START Button

- Starts audio engine
- Only clickable when stopped
- Takes 1-2 seconds to initialize

Gray STOP Button

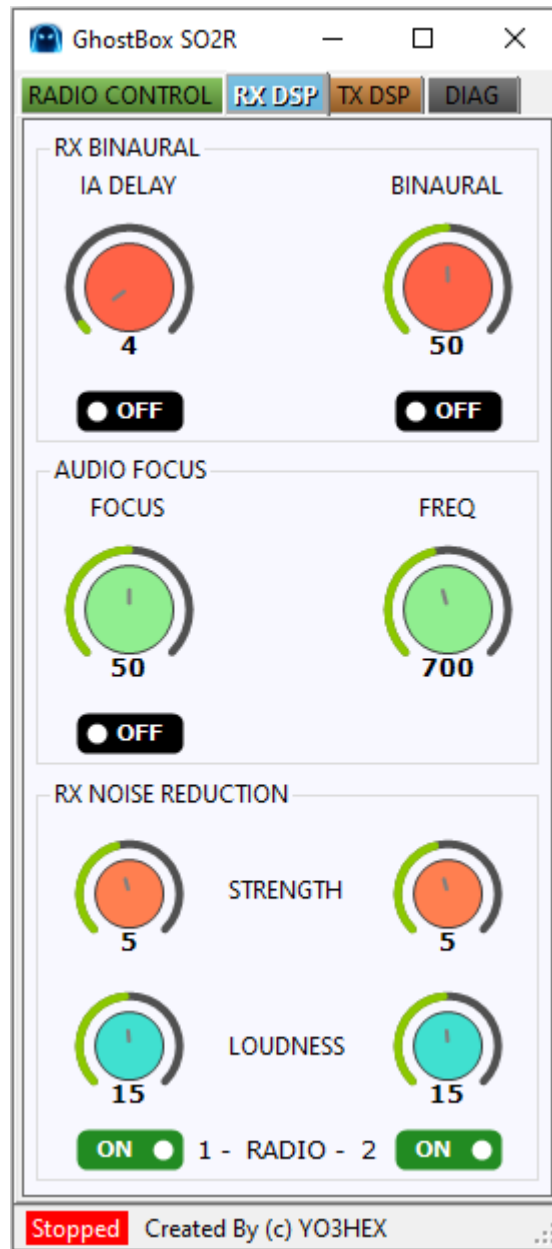
- Stops audio engine
- Saves current settings
- Use before changing audio device configuration

Orange SETTINGS Button

- Opens Settings dialog
 - Only available when audio engine is **stopped**
 - **Important:** Stop before changing settings
-

Advanced DSP Features

RX DSP Tab



RX BINAURAL Section

IA DELAY (Inter-aural Delay)

This feature adds a small time delay to one ear, enhancing stereo separation and reducing listening fatigue.

1. IA DELAY Toggle:

- **OFF:** No delay (normal stereo)
- **ON:** Delay enabled

2. IA DELAY Knob: Sets delay time

- Range: 1-100 ms
- **Recommended:** 3-15 ms for natural effect
- **Higher values:** More separation, can sound artificial
- **How it works:** When in RX1 Mono mode, right ear is delayed. When in RX2 Mono mode, left ear is delayed.

BINAURAL Enhancement

This feature simulates spatial audio using intensity differences and cross-talk.

1. BINAURAL Toggle:

- **OFF:** Standard mono/stereo
- **ON:** Binaural processing active

2. BINAURAL Knob: Controls effect strength

- Range: 1-100%
- **Recommended:** 50-70% for natural effect
- **How it works:** Creates volume difference between ears and adds subtle cross-talk

When to use Binaural Features:

- Long contest sessions (reduces fatigue)
- Difficulty distinguishing radios in stereo
- Headphone listening

RX NOISE REDUCTION Section

Adaptive noise reduction using Wiener-like filtering

NS RADIO A (Noise Suppression Radio A)

1. NS RADIO A Checkbox: Enable/disable for Radio 1

- Check to activate noise reduction

2. NR Strength (0-10)

- **0:** No reduction
- **5:** Moderate (recommended starting point)
- **10:** Maximum reduction
- **Warning:** High settings can make signals sound "robotic"

3. NR Loudness Compensation (0-30)

- Automatically compensates for volume loss from noise reduction
- **0**: No compensation (quieter output)
- **15-20**: Moderate compensation (recommended)
- **30**: Full compensation (loudest)
- **Tip**: Increase if NR makes audio too quiet

NS RADIO B (Noise Suppression Radio B)

- Same controls as Radio A
- Independent settings per radio
- Can use different NR settings for each radio

Best Practices:

- Start with NR Strength = 5, Loudness = 15
- Increase strength gradually until noise is reduced
- Adjust loudness to maintain comfortable volume
- Disable if signals sound distorted
- Works best on weak SSB signals with steady noise

AUDIO FOCUS Section (CW Enhancement that works very nice for SSB)

Adaptive CW tone enhancement for weak signals

1. AUDIO FOCUS Toggle:

- **OFF**: No CW enhancement
- **ON**: CW enhancement active

2. FOCUS Knob: Enhancement strength

- Range: 0-100%
- **Recommended**: 40-60% for subtle boost
- **Higher values**: More aggressive enhancement
- **Warning**: Too high can boost noise or create artifacts

3. FREQ Knob: CW tone center frequency

- Range: 300-1200 Hz
- **Common settings**:
 - **500 Hz**: Low CW tone
 - **700 Hz**: Standard CW tone (default)
 - **900 Hz**: High CW tone
- **Tip**: Match to your radio's CW filter center frequency

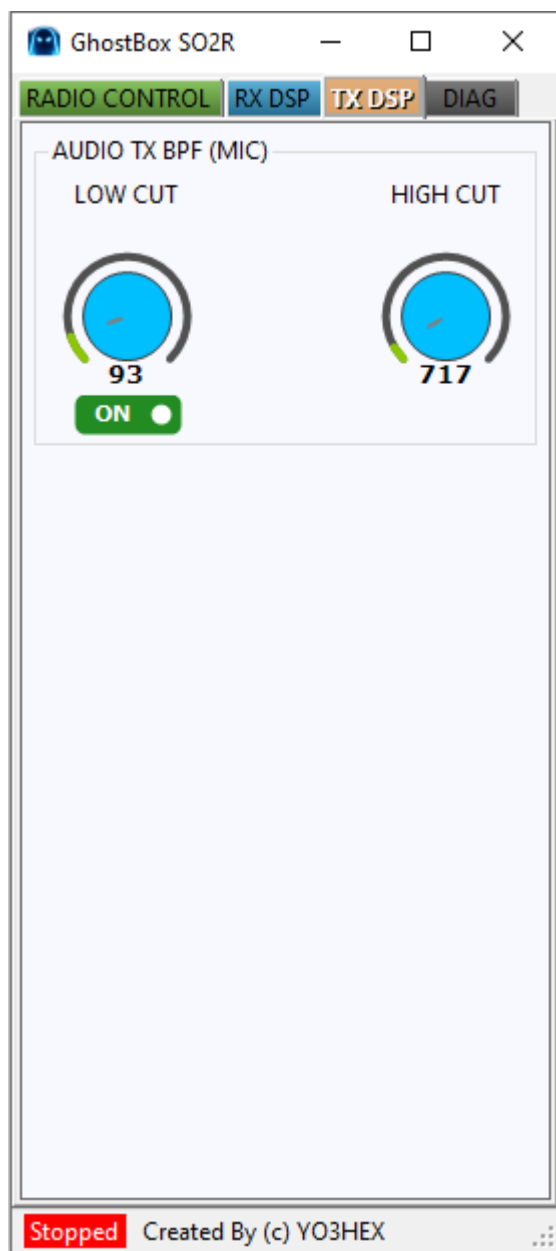
How CW Enhancement Works:

- Uses Goertzel resonator to detect tones at target frequency
- Analyzes signal coherence (CW-like vs. noise-like)
- Adaptively boosts signals that match CW characteristics
- Reduces non-tonal noise

When to use CW Enhancement:

- Weak CW signals in noise
 - QRM (interference) situations
 - Pileups where you need to pick out specific calls
-

TX DSP Tab



AUDIO TX BPF (MIC) - Bandpass Filter

Voice bandwidth shaping for optimal transmit audio

1. **AUDIO TX BPF Toggle:**
 - **OFF:** No filtering (full bandwidth)
 - **ON:** Bandpass filter active (recommended)
2. **LOW CUT Knob:**
 - Range: 50-500 Hz
 - **Recommended:** 300 Hz for SSB
 - Removes low-frequency rumble and noise
 - **Higher values:** "Thinner" voice, less bass
 - **Lower values:** Fuller voice, more bass
3. **HIGH CUT Knob:**
 - Range: 600-2800 Hz
 - **Recommended:** 2800 Hz for SSB
 - Removes high-frequency noise and hiss
 - **Lower values:** "Warmer" voice, less bright
 - **Higher values:** Crisper voice, more presence

Typical Settings:

- **SSB Contest:** Low=300 Hz, High=2800 Hz
 - **SSB Ragchew:** Low=200 Hz, High=2800 Hz
 - **Narrow bandwidth:** Low=400 Hz, High=2400 Hz (DX conditions)
-

Recording Setup

Understanding Recording

GhostBox continuously records your headphone output (**WHAT OPERATOR HEARS**) in MP3 format.

Recording Features

1. **Continuous Recording:** Starts when you click START, stops when you click STOP
2. **Automatic File Rotation:** Creates new files automatically when size limit reached
3. **Background Operation:** No performance impact
4. **Health Monitoring:** Status bar shows recording queue status

File Naming

Files are automatically named: S02R_YYYYMMDD_HHMMSS .mp3

Example: S02R_20250119_143022 .mp3

- Date: 2025-01-19
- Time: 14:30:22 (2:30:22 PM)

Managing Recordings

Finding Your Recordings

1. Navigate to the folder you specified in Settings
2. Files are sorted by date/time
3. Each operating session creates one or more files

Disk Space Estimates

At 64 kbps (recommended):

- **1 hour:** ~28 MB
- **4 hour contest:** ~112 MB (typically 2-3 files at 100 MB rotation)
- **12 hour contest:** ~336 MB (typically 4-5 files)

At 128 kbps (high quality):

- **1 hour:** ~56 MB
- **4 hour contest:** ~224 MB
- **12 hour contest:** ~672 MB

Storage Tip: 1 GB of storage = ~35 hours at 64 kbps

Recording Status Monitoring

Status bar shows (bottom of screen):

- **RQD (Recorder Queue Depth):** Number of audio chunks waiting to be written
 - **Normal:** 0-10
 - **Warning:** 10-50 (disk may be slow)
 - **Critical:** 50+ (risk of audio dropouts)
- **RD (Recorder Drops):** Number of dropped audio chunks
 - **Should always be:** 0
 - **If not zero:** Disk too slow or system overloaded
- **RQM (Recorder Queue Max):** Maximum queue depth reached
 - **Normal:** <20
 - **High:** Indicates occasional disk slowness

What to do if RD > 0:

1. Check disk space (need free space for buffering)
 2. Use faster disk (SSD recommended)
 3. Increase file rotation size
 4. Close other disk-intensive programs
-

OTRSP Integration

What is OTRSP?

OTRSP (Open Two Radio Switching Protocol) allows contest logging software to control GhostBox's audio routing.

Supported Commands

- **RX1:** Listen to Radio 1 only (mono)
- **RX2:** Listen to Radio 2 only (mono)
- **RX1S / RX2S:** Listen to both radios (stereo)
- **TX1:** Set TX focus to Radio 1
- **TX2:** Set TX focus to Radio 2
- **X1:** PTT ON (transmit)
- **X0:** PTT OFF (stop transmitting)

Setup HOWTO for DXLog and N1MM+ – TO BE ADDED

Troubleshooting

Audio Issues

No Audio from Radio 1 or Radio 2

Symptoms: VU meter shows activity but no sound

Solutions:

1. Check VOL knob - is it at 0?
2. Check OUTPUT toggle - is it ON (green)?
3. Check OUTPUT VOL knob - is it at reasonable level (50+)?
4. Verify Windows volume mixer:
 - Right-click speaker icon → Open Volume Mixer
 - Ensure GhostBox is not muted

Audio Dropouts / Glitches

Symptoms: Audio cuts out briefly, pops, clicks

Solutions:

1. Increase Buffer Ms in Settings (try 150 or 200)
2. Increase WASAPI Latency (try 30 or 40)
3. Close other audio applications
4. Check CPU usage (should be <20%)
5. Update USB audio drivers

Audio Latency Too High

Symptoms: Noticeable delay between CW tone and what you hear

Solutions:

1. Decrease Buffer Ms (try 50 or 80)
2. Decrease WASAPI Latency (try 15)
3. Use USB 3.0 ports
4. Reduce DSP features (disable NR, binaural if not needed)

One Radio Silent After Changing USB Ports

Symptoms: Radio worked before, now no audio after moving USB cable

Solution:

1. Click **STOP**
2. Click **SETTINGS**
3. Re-select the audio devices (Windows may have changed IDs)
4. Click **SAVE**
5. Click **START**

Recording Issues

Recording Files Are Huge

Symptoms: Files much larger than expected

Solutions:

1. Check MP3 bit-rate - use 64 kbps instead of 128
2. Enable file rotation
3. Reduce rotation size to 50-100 MB

Recording Queue Depth High / Audio Drops

Symptoms: RQD > 50, RD > 0 in status bar

Solutions:

1. Save recordings to SSD instead of HDD
2. Increase file rotation size (less frequent file creation)
3. Close other disk-intensive programs
4. Check for disk errors (run chkdsk)

OTRSP Issues

TX/RX Indicators Not Changing

Solutions:

1. Verify OTRSP is enabled in Settings
2. Check logger OTRSP configuration
3. Restart both GhostBox and N1MM

Performance Issues

High CPU Usage

Symptoms: CPU > 20%, system sluggish

Solutions:

1. Disable unused DSP features
2. Reduce sample rate to 44100 Hz (not recommended as resampling might take place)
3. Close other applications
4. Check for Windows updates

Application Crashes on Start

Solutions:

1. Check .NET 8.0 Runtime is installed (beta version is self-contained – no need of .NET Runtime)

2. Verify all audio devices are connected
 3. Check Windows Event Viewer for error details
 4. Try "Run as Administrator"
 5. Delete config file and reconfigure:
 - Location: C:\Users\YourName\AppData\Roaming\So2rVirtualBox\
config.json
-

Tips & Best Practices

Daily Operation Tips

1. **Startup Order:**
 - Power on radios first
 - Launch GhostBox
 - Click START
 - Then start logging software
2. **Shutdown Order:**
 - Stop logging software
 - Click STOP in GhostBox
 - Close GhostBox
 - Power off radios
3. **Volume Settings:**
 - Set radio VOL knobs to ~70%
 - Set OUTPUT VOL to ~60%
 - Use Windows volume as final trim
 - **Never run everything at 100%** - leaves no headroom
4. **Link R1-R2 Volumes:**
 - Enable when starting (easy simultaneous adjustment)
 - Disable once levels are balanced
 - Re-enable for quick changes

Contest Operation Tips

1. Before Contest:

- Test OTRSP with logging software
- Verify recording is working
- Set NR and binaural to preferred settings
- Note down settings that work

2. During Contest:

- Monitor Audio Health in status bar or **DIAG** tab
- Watch for recording drops (RD should stay 0)
- Adjust MIX knobs for situational awareness
- Use CW Enhancer for weak signals

3. After Contest:

- Click STOP to save final recording file
- Note recording file locations
- Save your configuration for next time

Audio Quality Tips

1. Noise Reduction:

- Start conservative (strength = 5)
- Only increase if necessary
- If signals sound "weird", reduce strength
- Different radios may need different settings

2. Binaural Enhancement:

- Try 50% strength first
- Increase for more fatigue reduction
- Decrease if sound is too "artificial"
- Combine with IA Delay for best results

3. CW Enhancement:

- Only use on weak CW signals
- Disable for strong signals
- Match FREQ to your CW filter center
- Start with FOCUS = 50%, adjust by ear

TX Audio Tips (if using GhostBox for TX)

1. Mic Gain:

- Adjust until peaks hit yellow/low-red
- Avoid constant red (distortion)
- Too low = weak signal
- Too high = distortion, splatter

2. Band-pass Filter:

- Always enable for contest SSB
- Standard setting: 300 Hz - 2800 Hz
- Narrower for DX: 400 Hz - 2400 Hz

3. Monitor Your Signal:

- Ask for audio reports
- Adjust based on feedback
- Different mics need different settings

System Maintenance

1. Weekly:

- Check recording folder size
- Delete old recordings if needed
- Verify USB connections are tight

2. Monthly:

- Update Windows
- Update audio drivers
- Check for GhostBox updates

3. Before Major Contest:

- Full system test
- Verify recordings work
- Test OTRSP thoroughly
- Have backup plan (direct audio)

Performance Optimization

1. For Lowest Latency:

- Buffer: 50 ms
- WASAPI Latency: 15 ms
- Sample Rate: 48000 Hz
- Disable unused DSP features

2. For Most Stable:

- Buffer: 150 ms
- WASAPI Latency: 30 ms
- Sample Rate: 48000 Hz
- All DSP features available

3. For Best Quality:

- Sample Rate: 96000 Hz
- Buffer: 100 ms
- WASAPI Latency: 20 ms
- Enable DSP as needed

Backup Your Configuration

Your settings are saved in: C:\Users\YourName\AppData\Roaming\So2rVirtualBox\config.json

Recommendation:

1. Copy this file after getting perfect settings
 2. Keep backup somewhere safe
 3. Restore if needed (close GhostBox first, replace file, restart)
-

Support & Resources

Getting Help

1. **Check this guide** - Most questions answered here
2. **Check TROUBLESHOOTING section** - Common issues covered
3. **Contact me** yo3hex@gmail.com

Reporting Bugs

When reporting issues, include:

1. GhostBox version number
 2. Windows version
 3. Radio models
 4. Audio interface models
 5. Steps to reproduce issue
 6. Error messages (if any)
 7. Config file (if relevant)
-

Glossary

OTRSP: Open Two Radio Switching Protocol - standard for SO2R control

VU Meter: Volume Unit meter - shows audio levels

WASAPI: Windows Audio Session API - low-latency audio system

DSP: Digital Signal Processing - audio enhancement features

NR: Noise Reduction - removes background noise

PTT: Push To Talk - transmit key

ILD: Interaural Level Difference - volume difference between ears

IA Delay: Interaural Delay - time difference between ears

CBR: Constant Bit Rate - fixed quality MP3 encoding

VBR: Variable Bit Rate - variable quality MP3 encoding

SO2R: Single Operator Two Radio - contesting with two radios

73 and Good DX!

YO3HEX

This guide covers GhostBox SO2R Controller version 1.0. Features and interface may change in future versions. Always refer to the latest documentation.