

# WSPR 2.1: Supplement to User's Guide

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## Overview

WSPR 2.1 is the latest version WSPR, the "Weak Signal Propagation Reporter." It differs from WSPR 2.0 by including support for software defined radios (SDRs) like the SoftRock RxTx Ensemble. With I/Q mode enabled, the program uses 2-channel sampling at 48000 Hz for both input and output. Your SoftRock or similar hardware sends I and Q baseband signals to the computer's soundcard input; the soundcard output, also in I/Q format, goes to the SoftRock's Tx audio port. T/R switching is accomplished over the USB port. You need no other software such as Rocky or PowerSDR, and there's no need for anything like Virtual Audio Cables. This brief supplement covers program features that are new in WSPR 2.1.

## Installation

WSPR 2.1 can be downloaded from the WSJT Home Page, <http://www.physics.princeton.edu/pulsar/K1JT/>. Click on the WSPR link at the left margin and then on the appropriate download link. Install the program in the usual way for your operating system. Under Windows, execute the downloaded file and follow the installation instructions. During a test period you may wish to have both WSPR 2.0 and WSPR 2.1 available on your computer; in this case you should install WSPR 2.1 in a new directory, for example the Windows folder C:\HamRadio\WSPR21. (In the Vista or Windows 7 operating systems, if you use the default location C:\Program Files\WSPR you may need to set some access permissions explicitly.)

## Setup for IQ Mode

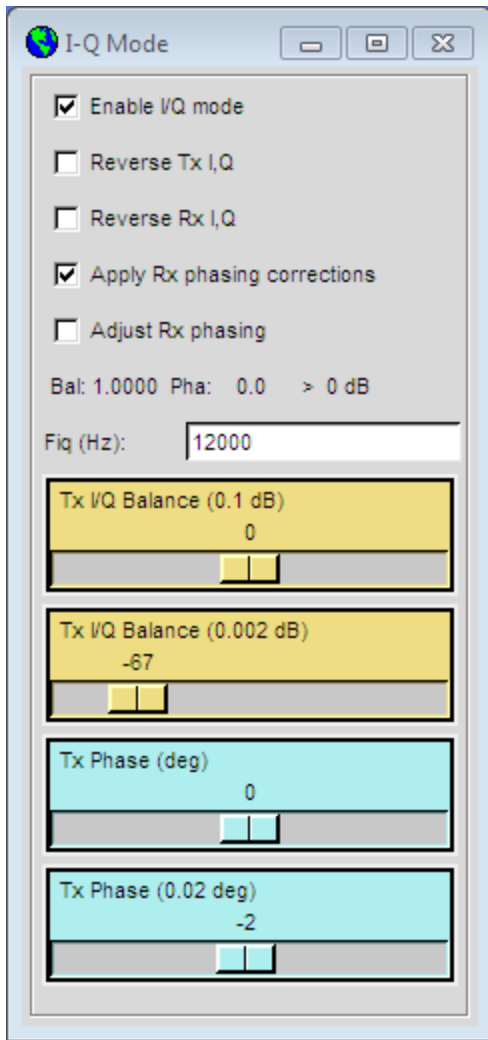
Configure WSPR 2.1 as described in the WSPR 2.0 User's Guide, [http://physics.princeton.edu/pulsar/K1JT/WSPR\\_2.0\\_User.pdf](http://physics.princeton.edu/pulsar/K1JT/WSPR_2.0_User.pdf), with the following specific additions:

On the **Setup | Station Parameters** screen, select:

**PTT method:** CAT

**Rig number:** 901 SoftRock RxTx Ensemble

On the **Setup | IQ mode** screen, check **Enable I/Q mode** as shown in the following screen shot:



Depending on how you have wired your SoftRock, you may or may not need to check **Reverse Rx I,Q** or **Reverse Tx I,Q**. Mine does not need these boxes checked.

The parameter **Fiq (Hz)** determines the frequency offset between the “Dial frequency” specified on the WSPR main screen and the frequency (times 1/4) of the Si570 programmable oscillator. The default value for **Fiq** is 12000 Hz; this puts the 200 Hz WSPR band 12 kHz above mid-band. For example, in my system when operating on the 30 m band, I set:

**Dial frequency:** 10.1387 MHz  
**Fiq:** 12000 Hz

These settings result in a commanded Si570 frequency of 40.506800 MHz.

I have not followed any procedure to calibrate my Si570 outside of WSPR. Consequently, I found the resulting received frequencies to be off by about 60 Hz. As a correction, I check **Enable frequency correction** on the **Setup | Advanced** screen and set the correction constants to A = 0.0, B = 5.92. This value of B was calculated from

$$B = (60 \text{ Hz}) / (10.1387 \text{ MHz}) = 5.92 \text{ ppm}$$

Your calibration constants will most likely be different. Of course, you can use other calibration schemes, as well. Remember that for most effective use of WSPR, you will want your frequencies to be correct to within a few Hz.

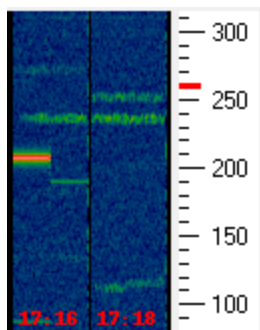
## Image Rejection

WSPR 2.10 r2194 includes facilities for optimizing image rejection on transmit and receive. You should start by establishing whether **Reverse Rx I,Q** or **Reverse Tx I,Q** need to be checked. A typical SoftRock should exhibit around 30 dB of unwanted sideband rejection without further adjustment. However, rejections of 60 dB or more can easily be achieved in WSPR. Here's how.

To adjust Tx image rejection you need a separate communications receiver. Start WSPR, select the desired band, check the **Idle** box, set **Tx fraction** to 100%, and click the **Tune** button. WSPR will send a series of long dashes at the selected frequency. Tune in the main signal on the separate receiver; then find the unwanted image, which will be offset in frequency by twice the sum of  $F_{iq}$  and the Rx BFO frequency. (For the example setup described above, the image is 27 kHz below the desired signal.) While listening to the unwanted image, slowly adjust the sliders labeled **Tx I/Q Balance** and **Tx Phase** on the **Setup | I-Q Mode** screen, seeking a null. There are two sliders for each parameter — the upper one for coarse adjustments, the lower for fine. New settings are applied at the start of each transmitted dash. When you have found the best null you may exit WSPR. The program will remember your last settings of **Tx I/Q Balance** and **Tx Phase**.

Rx image rejection is accomplished in a semi-automatic way. With another transmitter or stable signal generator, generate a moderately strong signal inside (or within  $\pm 500$  Hz of) the 200 Hz WSPR band you will be receiving. Start WSPR, clear the **Idle** box, and set **Tx fraction** to 0. After a reception interval starts, check the box **Adjust Rx phasing** and watch the numbers labeled **Bal** and **Pha** converge to stable values. This may take 30 seconds or so. You may then uncheck **Adjust phasing** and check **Apply Rx phasing corrections**. The measured phasing parameters will then be applied to received signals at the end of each Rx interval.

With this procedure, unwanted sideband suppression should be better than 60 dB. An example is illustrated by the following screen shot showing the WSPR waterfall for two successive Rx intervals:

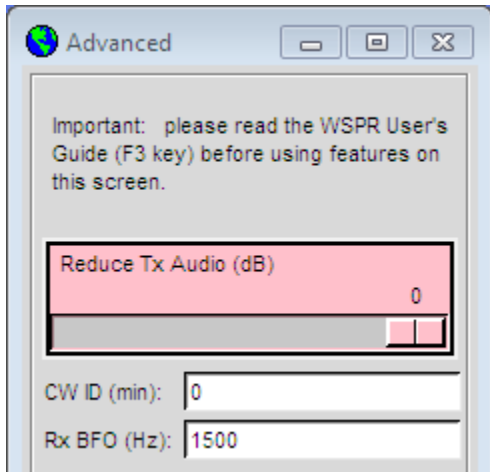


At the start of the first interval the signal generator was set near the center of the WSPR band, producing the bright unmodulated carrier just above 200 Hz. **Adjust Rx phasing** was checked at  $t = 10$  s and unchecked at  $t = 50$  s, by which time the **Bal** and **Pha** numbers had stabilized. At  $t = 60$  s, halfway through the 2-minute Rx interval, the signal generator was moved 27 kHz lower, to the image frequency. The partially suppressed image is visible on the waterfall just below 200 Hz. (The small frequency offset is twice the error in the SoftRock's LO frequency setting.) During the second Rx interval, the box **Apply Rx phasing corrections** was checked. As shown in the second waterfall segment, the newly determined phasing parameters suppress the unwanted

signal enough to make it completely invisible. The measured suppression was more than 70 dB.

## Tx Audio Level

As shown in the screen shot below, a slider control on the **Setup | Advanced** screen now allows you to reduce your Tx audio signal by a calibrated amount.



The normal setting for full output is 0 dB (slider all the way to the right). You can reduce power by up to 30 dB by moving the slider to the left. Changes take effect at the start of the next transmission. It may be convenient to adjust this slider by setting **Tx fraction** to 100% and clicking the **Tune** button to produce a series of transmitted dashes. Each dash will then reflect any new slider setting.