RADWAV

SkyPī-40 CW Pi 2 Software

Introducing SkyPi CW for Raspberry Pi 2

SkyPi's software now works with the Raspberry Pi 2. New features such as the real-time spectrum display and improved 700Hz CW filter are included. Present SkyPi and SkyPiRx owners only need a Raspberry Pi 2 and this software.

New SkyPi builders, using a Raspberry Pi 2, gain support for RadWAV's new SkyPi's that cover other amateur bands.

Version 2.0 New Features
- *Works with Raspberry Pi Model 2*
- *Real-Time Spectrum Waterfall*
- *Improved DSP Filter*

This CW application, RadWAV's first software release for the Raspberry Pi 2, heralds more releases with additional features in the near future. More applications and modes, which benefit from the Pi 2's processing power, are in testing at RadWAV.
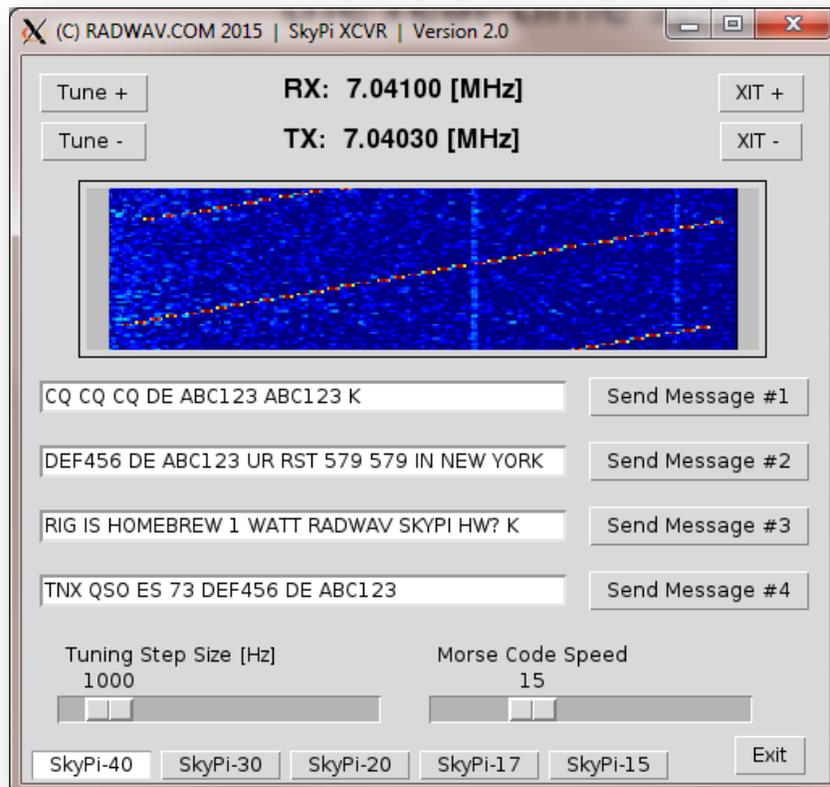
SkyPi CW Version 2.0 GUI

Observing a laboratory signal generator sweep from 7.031 to 7.051MHz in 20 seconds.

Table of Contents

1   Introduction

This manual explains how to operate QRP CW using the latest software. The manual also explains how you can measure how far your CW signal is reaching using the reverse beacon network.

2   Required Items

The following items will be necessary to complete this project:

❒ *Working Raspberry Pi Model 2* – *Visit http://www.raspberrypi.org if you need help getting started with Raspberry Pi Model 2. RadWAV recommends using the HDMI output from the Raspberry Pi. (If desired, advanced Linux users can also use SSH with X11-forwarding, via an Ethernet connection.)*

❒ *RadWAV SkyPi Transmitter Kit*

❒ *RadWAV SkyPiRx* – *This includes an SMT receiver board that is already built and tested, plus the required USB sound card and audio cable.*

❒ *RadWAV SkyPi Optional Power Cable* – *Recommended, however the SkyPi manual shows you how to make a cable if you want to do-it-yourself.*

In addition to these items, you will also need the following ordinary ham radio accoutrements:

❒ *Headphones or an Amplified Speaker* -- *with a standard 1/8"-type audio cable. Amplified PC speakers, Radio Shack amplified speakers, and Walkman-style headphones work well.*

❒ *BNC Connector/Adaptor*, *to connect your antenna to SkyPi, which has a BNC connector included.*

❒ *+12 Volt Power Supply* – *choose a quality unit that can deliver at least 1 Amp. Wall mounted transformers are usually inadequate despite the markings on these units. Batteries or power supplies that hams typically use with HT's or HF radios work well.*

❒ *A Valid Amateur Radio License and Call Sign Issued by Your Government* – *You need a license to transmit in the amateur radio service. Many clubs offer free and fun classes to help unlicensed individuals to qualify for a license -- there is no age requirement. As well, passing the test helps hams to gain essential technical knowledge needed to build and operate radio equipment. Contact RadWAV if you need help finding a class or exam so that you can qualify for a license. Amateur radio is great hobby for anyone who enjoys the Raspberry Pi.*
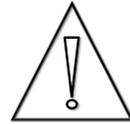
3   Connect the Raspberry Pi Model 2

Follow these steps carefully and verify that you have completed each step correctly. Pay special attention to the steps with exclamation mark symbols; these steps are critical.

☐ Disconnect all power cables, if any, from the Raspberry Pi 2

☐ Disconnect all power cables, if any, from the SkyPi.

⚠   ☐ NOTE: *NEVER CONNECT A POWER SUPPLY OR <u>ANY</u> POWERED USB DEVICES OR USB HUBS TO THE RASPBERRY PI WHILE THE SKYPI IS CONNECTED. THIS MIGHT DESTROY YOUR HARDWARE.*   ⚠

☐ Attach the SkyPi to the Raspberry Pi using <u>only</u> the 26 pins that are <u>farthest</u> from the USB connectors on the Rapsberry Pi 2. See Figure 3-1. Note the alignment is critical. You must check this carefully as any error might cause damage.

Figure 3-1 Top view of SkyPi Connection to Raspberry Pi 2

⚠   ☐ Verify that you have correctly aligned <u>both</u> rows of Raspberry Pi pins into the SkyPi connector. ***THIS IS A CRITICAL STEP.***   ⚠
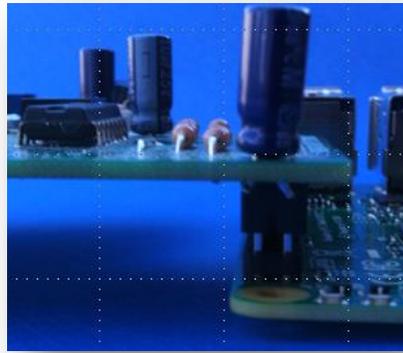
Figure 3-2 End view of SkyPi Connection to Raspberry Pi 2. Both rows of pins fit into both rows of the socket.

❒ Verify that you have correctly aligned <u>only</u> the 26 Raspberry Pi pins <u>farthest</u> from the USB connector into the SkyPi connector. ***THIS IS A CRITICAL STEP.***
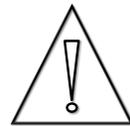

Figure 3-3 Side view of SkyPi Connection to Raspberry Pi 2. The SkyPi socket connects to only the 26 pins that are farthest from the USB connectors on the Raspberry Pi.

❒ Once you are certain that the SkyPi is aligned correctly onto the Raspberry Pi Model 2, follow the SkyPiRx Kit manual instructions for connecting the power cable exactly as you would for the Model B+. All power must be delivered to the Raspberry Pi from the SkyPi. Do <u>not</u> connect any power supply or any powered USB device to the Raspberry Pi while the SkyPi is connected.

4   Download Software

❒ Using the terminal window, make sure you are in the home directory. Then, create a new directory and change into this new directory. Figure 4-1 shows the commands step-by-step.

```
pi@raspberrypi ~ $ cd ~/Documents/
pi@raspberrypi ~/Documents $ mkdir radwav
pi@raspberrypi ~/Documents $ cd radwav
pi@raspberrypi ~/Documents/radwav $ mkdir cwVer2_1
pi@raspberrypi ~/Documents/radwav $ cd cwVer2_1
pi@raspberrypi ~/Documents/radwav/cwVer2_1 $
```

Figure 4-1 Type these commands in the terminal window to set-up the directory

Tip: If you have never used the Raspberry Pi terminal window, there is a helpful page from the Raspberry Pi Foundation:
http://www.raspberrypi.org/documentation/usage/terminal/

❒ Update your Raspberry Pi's package list by entering the command in Figure 4-2 and pressing 'Enter'. This step might take several minutes to complete:

```
pi@raspberrypi ~/Documents/radwav/cwVer2_1 $ sudo apt-get update
```

Figure 4-2 Type these commands in the terminal window to update the package lists

❒ Upgrade all of your installed Raspberry Pi's packages to the latest versions by entering the command in Figure 4-3 and pressing 'Enter'. Time necessary to complete this step varies based on how many packages you have installed and how many packages have upgrades available. Completing this step will require a few minutes, at least:

```
pi@raspberrypi ~/Documents/radwav/cwVer2_1 $ sudo apt-get upgrade
```

Figure 4-3 Type these commands in the terminal window to upgrade all installed packages

Tip: If you are unfamiliar with the *update* and *upgrade* commands, you can learn more by visiting:
https://www.raspberrypi.org/documentation/raspbian/updating.md

❒ Next, download the software. You received these files in an e-mail from RadWAV Customer Care.   The Raspberry Pi Model 2's internet browser can access many web-mail portals.

Download the file "**radwavSkyPiCW2_1.tar.gz**", as you would download any e-mail attachment, and save it in the directory that you just created.

> ***Advanced User Tip:*** If you prefer to transfer the files from a PC to the Raspberry Pi, then you will need FTP software installed on your PC. FileZilla is a popular free option. The Raspberry Pi does not require additional software. You may learn about the FileZilla client software at https://filezilla-project.org/

❐ Make sure the file is in the directory as shown in Figure 4-4.

Figure 4-4 Make sure the file is in the directory as shown.

> ***Tip:*** The 'tar' file format is an abbreviation of 'tape archive' from the era when mass storage used tapes! Even though hard disks are pervasive today, the 'tar' format remains very useful. If you want to know more about the 'tar.gz' file format, visit this page: http://en.wikipedia.org/wiki/Tar_(computing)

5   Install Software

❑Before you extract the files, you can see which files are in the "tar.gz" file. Previewing the files is helpful. Otherwise, you might not know what to expect when you extract the files. Figure 5-1 shows how to preview the files. Type the command on the first line of the Figure and press enter. There are five files in the archive.

Figure 5-1 Preview the files in the 'tar.gz' before you extract them. This avoids surprises.

❑Extract the files. Figure 5-2 shows the command that you will need. Type the command on the first line and press enter. The file names that are extracted will be listed automatically.

Figure 5-2 Type these commands in the terminal window to extract the files.

❑Next, make sure that the files are now in your directory. Figure 5-3 shows the expected result. If all five of the files from the 'tar.gz' file are now in your directory, congratulations! You are well on your way to success.

```
pi@raspberrypi ~/Documents/radwav/cwVer2_1 $ ls -la
total 96
drwxr-xr-x 2 pi pi  4096 Nov 20 21:23 .
drwxr-xr-x 4 pi pi  4096 Nov 20 21:10 ..
-rw-r--r-- 1 pi pi   460 Nov 20 21:02 radwavCw2_1Install.sh
-rw-r--r-- 1 pi pi 14075 Nov 20 17:36 radwavCw2_1.pyc
-rw-r--r-- 1 pi pi 13958 Nov 18 01:39 radwavCw2.pyc
-rw-r--r-- 1 pi pi  5589 Nov 18 01:47 radwavRxProc2.pyc
-rw-r--r-- 1 pi pi  5048 Nov 18 01:47 radwavSendMorse2.pyc
-rw-r--r-- 1 pi pi 16678 Nov 20 21:17 radwavSkyPiCw2_1.tar.gz
-rwxr-xr-x 1 pi pi 14844 Nov 18 01:39 tuneRadWAV2
pi@raspberrypi ~/Documents/radwav/cwVer2_1 $
```

Figure 5-3 Verify the extracted files are in the directory.

❏ Make sure that your radwavCw2_1Install.sh file has execution permissions by entering the command from Figure 5-4:

```
pi@raspberrypi ~/Documents/radwav/cwVer2_1 $ chmod u+x radwavCw2_1Install.sh
```

Figure 5-4 Grant yourself execution file privileges for this script.

❏ Run the script, which installs needed packages and launches the app for the first time:

```
pi@raspberrypi ~/Documents/radwav/cwVer2_1 $ ./radwavCw2_1Install.sh
```

Figure 5-5 Run this script to install packages and start the application for the first time.

❏ As the script installs several packages, the computer might ask if you want to install these packages. You need to install these packages.

❏ The application launches for the first time automatically when the script finishes. You will see a screen that resembles Figure 5-6.
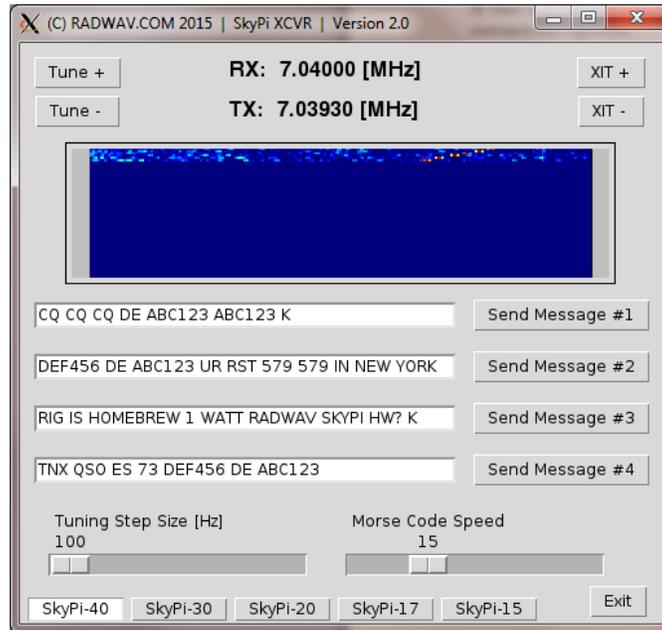
Figure 5-6 The application starts when the install script finishes.

6   Operate Software

❒ At the bottom of the GUI, make sure that your SkyPi version is highlighted. By default the software selects SkyPi-40. If you are using the SkyPi-40, you do not need to click on any versions. Click on another version only if connected to that version.

❒ NOTE: *ONLY SELECT THE SKYPI VERSION THAT IS ACTUALLY CONNECTED. SELECTING THE WRONG VERSION MIGHT DAMAGE THE HARDWARE OR VIOLATE HARMONIC SUPPRESSION LAWS WHEN YOU TRANSMIT.*

❒ As the waterfall spectrum display fills, you will notice signals if the band is open. The receiver automatic gain control, abbreviated AGC, will gradually increase the volume over several seconds. Launch another terminal window.

❒ Adjust the sound card input and output levels. Launch the 'alsamixer' as shown in Figure 6-1.

Figure 6-1 Start the 'alsamixer'

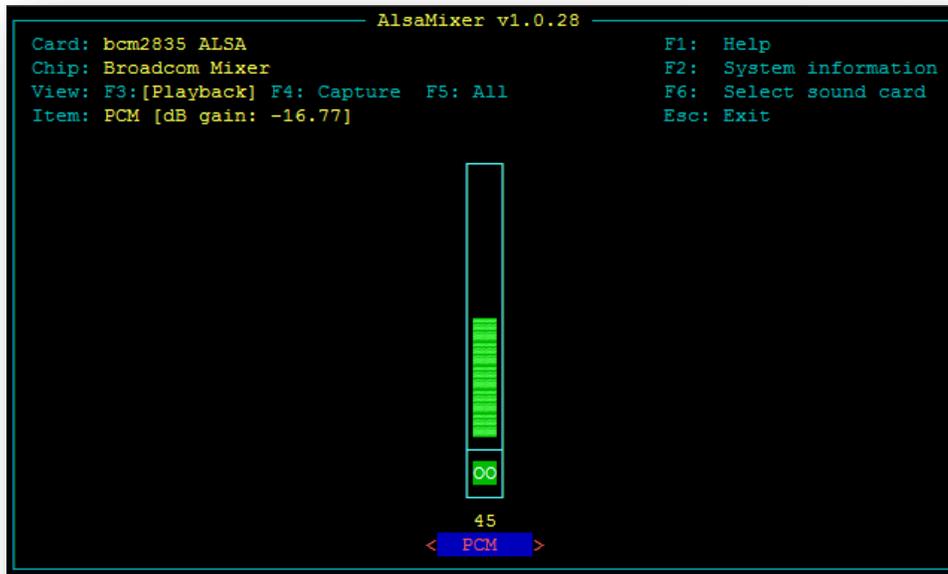❒ You will see the following screen:

Figure 6-2 Alsamixer first screen
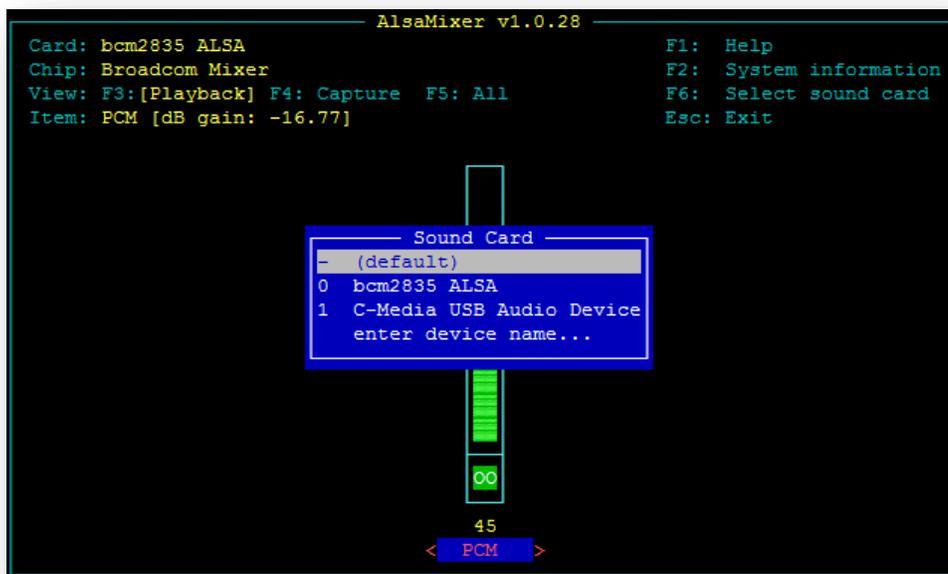
❒ Press F6. You will see the following menu:

Figure 6-3 Sound Card Selection Menu

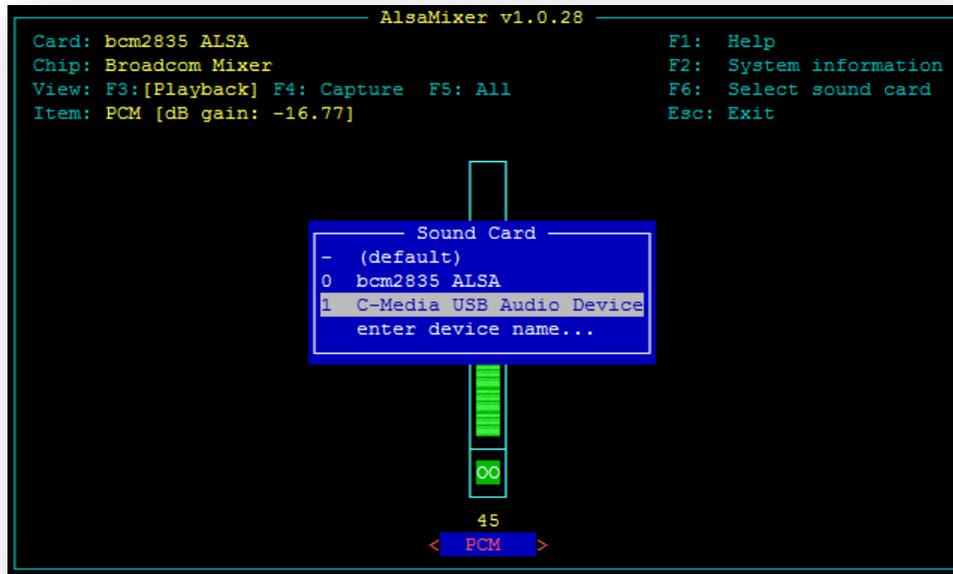❒ Press the 'down-arrow' key, ↓, and highlight 'C-Media USB…". Press Enter.

Figure 6-4 Select the C-Media USB Audio Device

❒ Press the 'up-arrow' key, ↑, or 'down-arrow' key, ↓, to adjust the volume as desired. Once you adjust the volume, it will remain approximately constant; the software application includes digital AGC so that strong signals and weak signals will have the same volume.
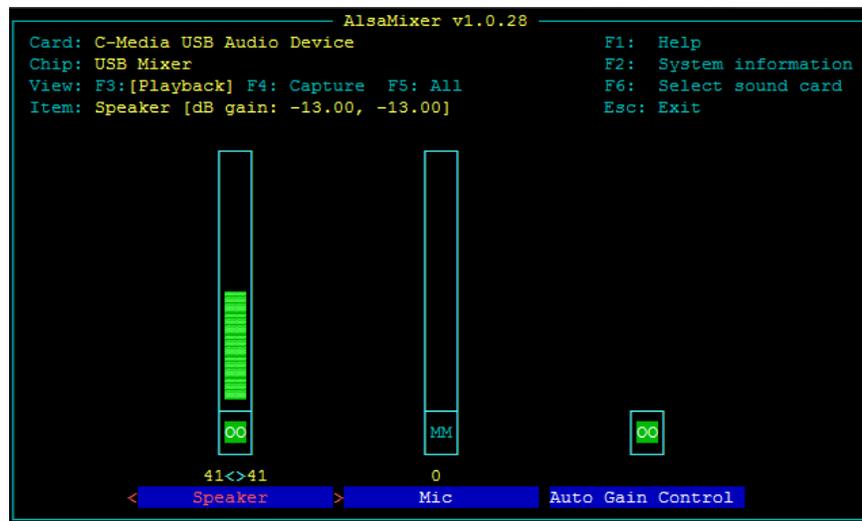

Figure 6-5 Adjust the speaker volume to your preferred level

❒ Press the F5 key. Press the 'right-arrow' key, →, until you highlight the CAPTURE MIC as shown in Figure 6-6. Then use the ↑ and ↓ keys to adjust the capture gain. Experimentally, a value close to 75 works well. Values close to zero will exaggerate internal processor noise. Full-scale values might cause distortion, due to signal clipping, if your antenna gathers particularly strong signals. Something in the middle, such as 75 or 50, works well for most stations.
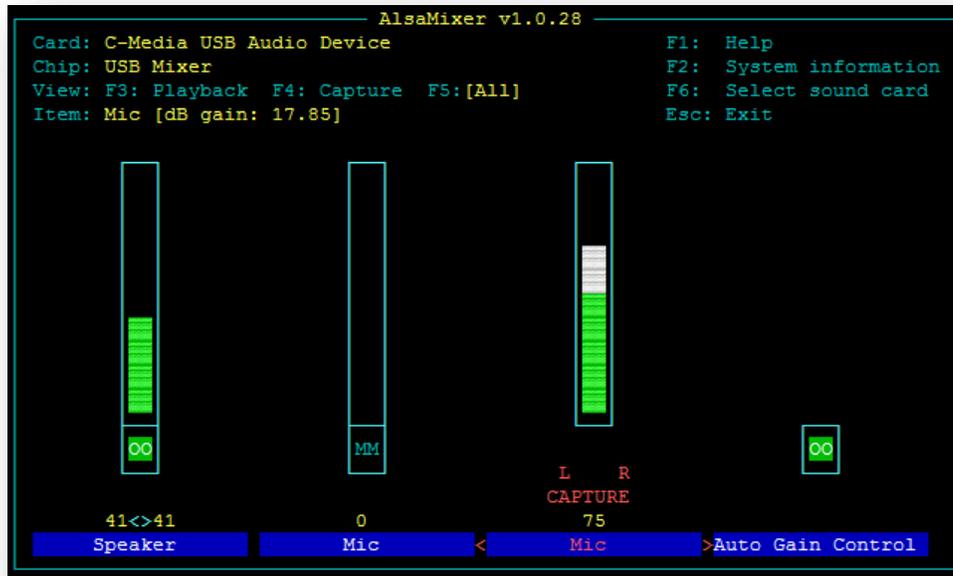
Figure 6-6 Adjust the capture gain

❒ Press the Escape-key when you are finished adjusting the capture gain.

❒   The spectrum display shows more than 20kHz of bandwidth. The audio that you hear has been digitally filtered using a 700Hz bandwidth filter. Figure 6-7 shows the SkyPi after tuning-in a prominent pulsed test tone. Signals in this portion of the spectrum display will be heard.

❒   Tune the receiver using the '*Tune +*' and '*Tune –*' buttons on the GUI. Adjust the tuning step using the '*Tuning Step Size*' slider near the lower left corner of the window.
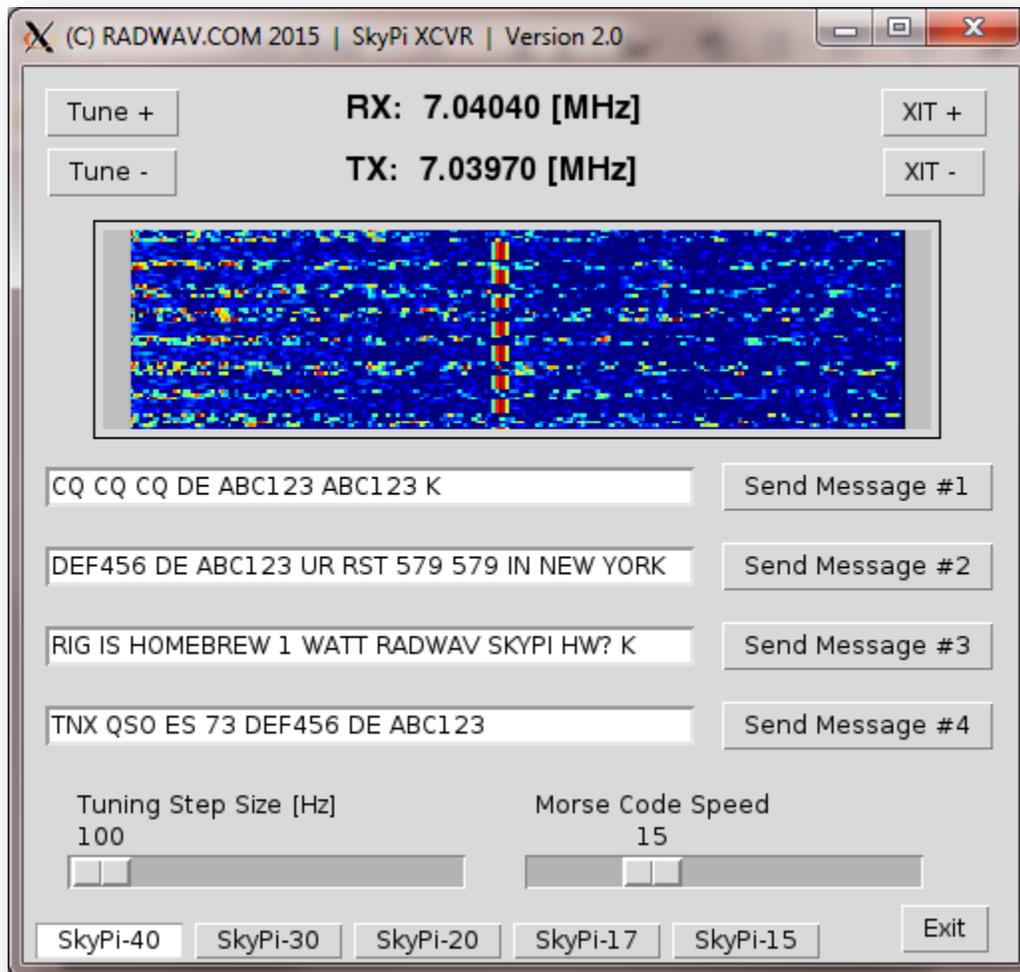
Figure 6-7 A test signal tuned to the audible frequency range is shown.

Tip: When you tune some signals might appear to move in opposite directions. This simple receiver has an image response. The primary signal will increase in tone frequency when you increase the receiver frequency. The image will move in the opposite direction. Knowing this will help you to answer strong CQ's on the correct frequency. Make sure you are tuned to the primary signal before answering a CQ so that the other station can hear you.

❏ To exit the application, click on "Exit" in the lower right corner of the GUI. The program will exit.

❏ To restart the program, make sure you are in the correct directory and type:

```
pi@raspberrypi ~/Documents/radwav/cwVer2_1 $ python radwavCw2_1.pyc
```

7   Activity: CW Reverse Beacon Network

❒   In the SkyPi CW application, replace the call sign 'ABC123' with your call sign in the Message #1 box.

❒   Tune to a quiet frequency, and make sure you only transmit on frequencies permitted by your license. Click "Send Message #1". While the message is sent, you can see the SkyPi LED's flash Morse Code as the message is sent. Normally you will not hear anything; there is no side-tone.

❒   Using a web browser, visit http://www.reversebeacon.net/main.php

❒   Click on Show/Hide My Filters. Click on the band of your SkyPi.

❒   Click on Search Spot by Callsign. Enter your callsign, select 'DX', and click Search.

❒   If you have been spotted, congratulations! Often it is not this easy. You may need to try multiple times and also at different times of the day.

❒   Once you are spotted, send your farthest report using the comment form in the lower right part of http://www.radwav.com/making-waves.html Indicate this is a CW Reverse Beacon since there are SkyPi records for each type of contact.

8   Activity: Two-way CW QRP

❒   Make sure you enter your call sign in the SkyPi CW application Message Box #1.

❒   Update the other boxes with information that you would likely want to send.

❒   Tune to a clear, and legal, frequency. Click "Send Message #1" to call CQ.

❒   Wait for a response. If there is no response, try calling CQ again. You might find that different times of day work better or worse depending on which SkyPi band you are using.

❒   When there is a response, replace 'DEF456' in Message Box #2 with the station that just called you. Also, update the RST, if necessary, in Message Box #2. Then click "Send Message #2"

❒   While the message is sent, you can see the SkyPi LED's flash Morse code as the message is sent. Normally you will not hear anything; there is no side-tone. You may adjust the Morse code speed by using the GUI slider.

❒   Once you complete a two-way contact, send your farthest report using the comment form in the lower right part of http://www.radwav.com/making-waves.html Indicate this is a CW Two-way contact since there are SkyPi records for each type of contact.

9   Feedback: Share Success, Problems, and Suggestions

If you encounter problems, discover errors, or have any comments, please let us know by e-mail to sales@radwav.com

Generally, RadWAV Customer Care will respond to you in one business day or less. Thank you for sharing your experiences.