DSD For Windows
Basic Setup Instructions

Version 1
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Overview

This tutorial will hopefully provide a clear and basic path to the setup and operation of the DSD For Windows software. I am not the software author, nor am I the person that ported it to Windows. Both have my heartfelt thanks for providing us with a great tool to play with, but a lot of confusion remains for new users. This document will try its best to provide a generic approach to achieving best results. While DSD will decode many types of digital radio communications, this tutorial is based on the decoding of MotoTrbo/DMR signals. However, it should serve to get DSD running for just about anything that the software will decode.

Prerequisites

1. A scanner or receiver with a discriminator tap. The speaker jack will not work. A record out jack will not work. It must be a discriminator tap. Check http://www.discriminator.nl for further information. Frankly, if you don't know what a discriminator tap is…this software probably isn't going to work for you! ☺
2. Said discriminator tap should have a resistor inline. I've used 10k ohm resistors with good luck. If the tap does not have a resistor, one can simply be built into a cable by splicing it into the positive (tip) side. 10k ohm resistors are available cheap at Radio Shack. Part #271-1126 works fine. Again this will not be a discussion as to how to add a discriminator tap to a scanner. Check the website mentioned in item #1.
3. A computer that has a sound card with a LINE IN jack. Microphone jacks "may" work, but the LINE IN is by far the preferred way to go.
4. Windows 7 or Windows XP. This tutorial is built on Windows 7. XP configuration will be a little different but the same principles apply.
5. At least a working knowledge of how to manipulate Windows sound properties and how to get to the "DOS" prompt.
6. Patience! It's almost certain that this program is not going to work "out of the box". It will require some slight to considerable tweaking. Like snowflakes, I've found that no two versions of DSD are alike!

Ready? Let's get started.

Windows Sound Properties

DSD uses the default sound recording device to receive data from a discriminator tapped scanner or receiver. You must set the sound card that you are using as an input as the default sound device. There are two ways to access Windows sound properties. One is to go to the Start button, select Control Panel, and then select sound.
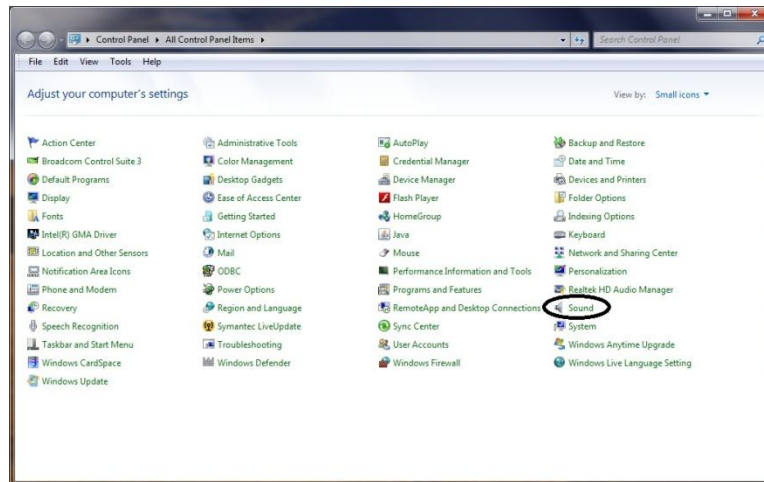

The second is to right click on the speaker icon in your system tray and then select Recording Devices. Remember, we are using Windows 7 in our examples. Windows XP will be different but based on the same methods. In either case the window shown below will appear.
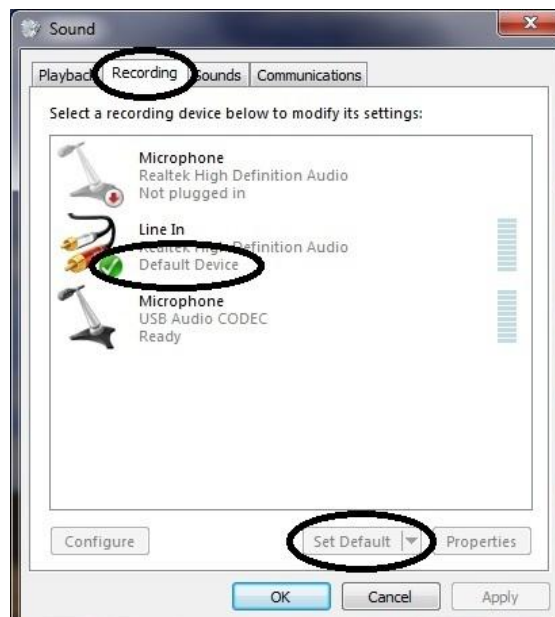

Select the "Recording" tab as shown, and then check to see which device is set as default. As seen here, the Realtek High Definition Audio device in my PC is currently set as Default as shown by the green check box and the "Default Device" label. If this is the device I want to use for DSD I don't have to make any changes. However, if the need to make changes arises, you will simply click on the item that you

wish to set as default, and then click on the "Set Default" button that's circled at the bottom of the screen. The check mark you see and the default device wording should then be attached to your selected device. Click the Apply button to complete the change. Don't close this window yet though, as there are still changes to be completed.
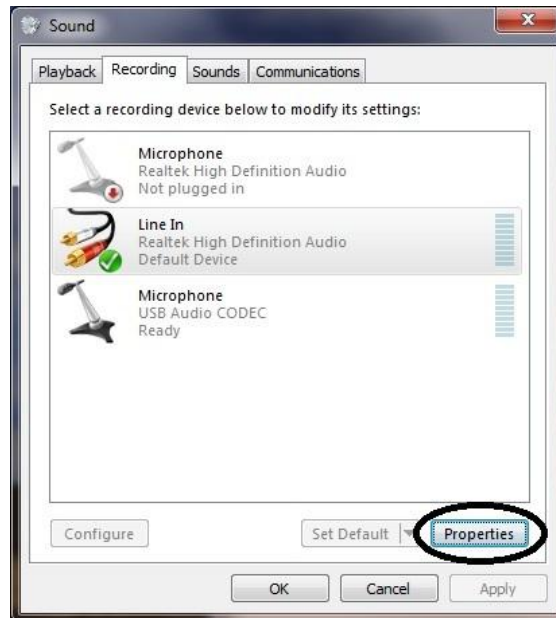

Now that you've selected your default device, it's now necessary to understand its basic operation and how it's going to effect your use of DSD. To manipulate the properties of your default device you will click on the Properties button which will present the following window.
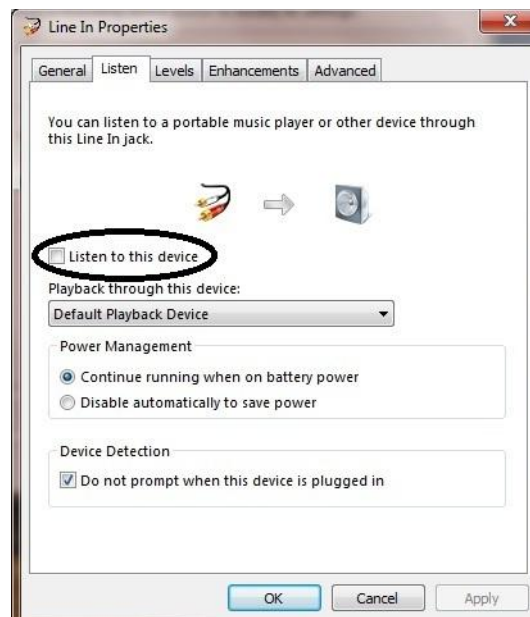
Discriminator taps contain unfiltered audio that can't be squelched. In other words, turning up the squelch circuit on your scanner or receiver may silence the radio speaker but it will have no effect on the discriminator tap. If you are hearing a rushing noise from your PC speakers, chances are that the box circled in the above photo is checked off. Simply click in the box to uncheck it. This will NOT affect the playback of the audio produced by the DSD software. DSD's audio output will always be played via the PC's default PLAYBACK device.

The following screen is one you will have to refer back to often when you first start to configure DSD. It is the line in level and as shown above mine is set pretty low. We will discuss this further in the next few pages, but it is a critical part of configuring DSD successfully. For now, crank it down into this vicinity. Click the Apply button and then the OK button to leave the window. But remember, you'll almost certainly be back.
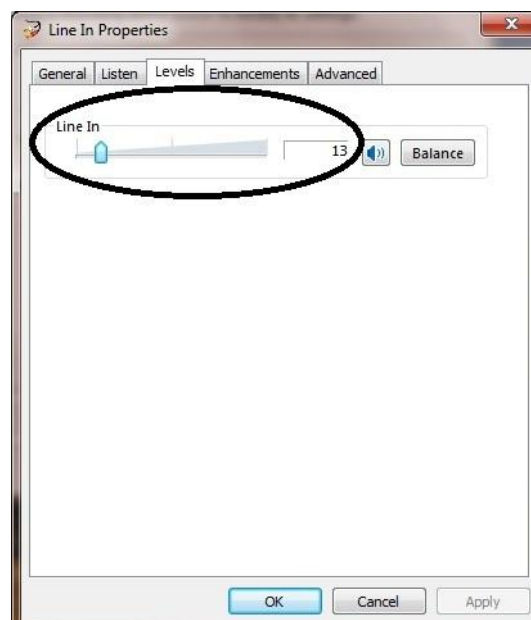
We have now completed the preliminary audio input setup for the use of DSD. At this point, if you haven't already, you'll need to power up your scanner or receiver. Again make sure that the discriminator tap of the scanner is connected to the LINE IN (preferably) of the device you selected as default. Tune the scanner or receiver to a frequency that you have confirmed has digital audio, and proceed to the next step of the tutorial. As a reminder, this tutorial is based on the reception of MotoTrbo/DMR type signals, but the general idea will be the same for whatever mode you're attempting to listen to.
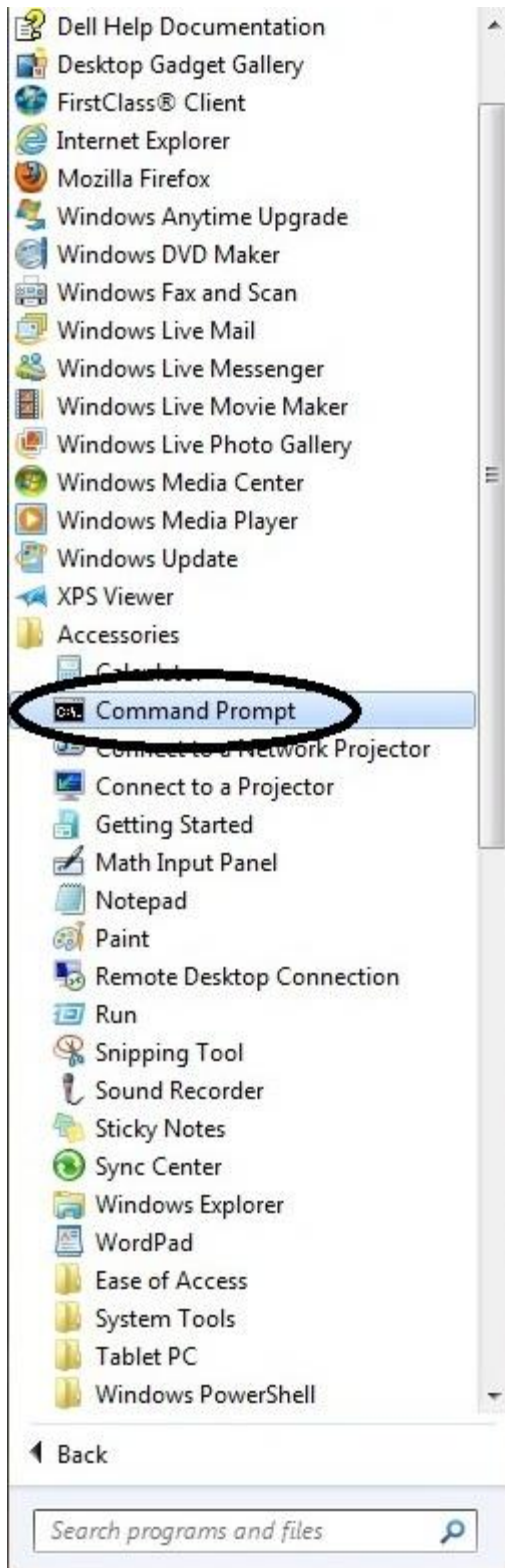
To enjoy the full scope of DSD software this tutorial is going to explain how to run the software from the PC's "Command Prompt". Those of you that were around in the MS-DOS days of PC operating systems will be familiar with this prompt. Those that weren't, fear not. Manipulating DSD from the command prompt is relatively simple and straightforward.

1. To get to the command prompt, click on the Start button that is normally located on the lower left of your screen.

2. Select the "All Programs" option. You can either hover over it or click on it to make it expand.

3. Scroll your way to the Accessories selection and do the same. You will then see Command Prompt as one of the selections, as shown to the left.

4. Click once on Command Prompt, and a window with a black background will open as shown on the next page.

Here we are at the system's command prompt:

```
Administrator: Command Prompt
Microsoft Windows [Version 6.1.7601]
Copyright (c) 2009 Microsoft Corporation.  All rights reserved.

U:\>c:

C:\>cd dsd4winv2

C:\dsd4winv2>_
```

This tutorial assumes that you have DSD installed in a folder on your systems C: drive. You have to PATH your way to the folder that contains the DSD software. In the case above my DSD installation is in a folder called dsd4winv2. Note how I have pathed my way to that location. Normally you should already find yourself at the C:\> prompt. In this case I had to switch to my C drive by typing c: <enter> at the prompt. I then had to CD (change directory) to the folder dsd4winv2 by typing cd dsd4winv2. I am now at the command prompt in the folder from which I need to run DSD. As stated at the outset this tutorial assumes that you have a working knowledge of how to work from the command prompt. Other than this short segment it will not cover anything further along those lines.

DSD can now be run from the command prompt. However, there are many command line "switches" that can tell DSD to undertake specific tasks, try to decode only certain modes, decode those modes in either positive or negative polarity (a VERY important part of running the program), and even record all intercepted voice traffic to an audio file for later review. If this sounds daunting it really is not. The next screenshot will show all options of DSD. Let's have a look.

```
 Administrator: Command Prompt                                       ─  □  ✕

C:\dsd4winv2>dsd -h
Digital Speech Decoder 1.4.1
mbelib version 1.2.3

Usage:
  dsd [options]              Live scanner mode
  dsd [options] -r <files>   Read/Play saved mbe data from file(s)
  dsd -h                     Show help

Display Options:
  -e                 Show Frame Info and errorbars (default)
  -pe                Show P25 encryption sync bits
  -pl                Show P25 link control bits
  -ps                Show P25 status bits and low speed data
  -pt                Show P25 talkgroup info
  -q                 Don't show Frame Info/errorbars
  -s                 Datascope (disables other display options)
  -t                 Show symbol timing during sync
  -v <num>           Frame information Verbosity
  -z <num>           Frame rate for datascope

Input/Output options:
  -i <device>   Audio input device (default is /dev/audio)
  -o <device>   Audio output device (default is /dev/audio)
  -d <dir>      Create mbe data files, use this directory
  -g <num>      Audio output gain (default = 0 = auto)
  -n            Do not send synthesized speech to audio output device
  -w <file>     Output synthesized speech to a .wav file

Scanner control options:
  -B <num>      Serial port baud rate (default=115200)
  -C <device>   Serial port for scanner control (default=/dev/ttyUSB0)
  -R <num>      Resume scan after <num> TDULC frames or any PDU or TSDU

Decoder options:
  -fa           Auto-detect frame type (default)
  -f1           Decode only P25 Phase 1
  -fd           Decode only D-STAR* (no audio)
  -fi           Decode only NXDN48* (6.25 kHz) / IDAS*
  -fn           Decode only NXDN96 (12.5 kHz)
  -fp           Decode only ProVoice*
  -fr           Decode only DMR/MOTOTRBO
  -fx           Decode only X2-TDMA
  -ma           Auto-select modulation optimizations (default)
  -mc           Use only C4FM modulation optimizations
  -mg           Use only GFSK modulation optimizations
  -mq           Use only QPSK modulation optimizations
  -u <num>      Unvoiced speech quality (default=3)
  -xx           Expect non-inverted X2-TDMA signal
  -xr           Expect inverted DMR/MOTOTRBO signal

  * denotes frame types that cannot be auto-detected.

Advanced decoder options:
  -A <num>      QPSK modulation auto detection threshold (default=26)
  -S <num>      Symbol buffer size for QPSK decision point tracking
                (default=36)
  -M <num>      Min/Max buffer size for QPSK decision point tracking
                (default=15)

C:\dsd4winv2>
```

To see a list of all available commands that DSD offers, type dsd –h as shown above. You will see the information in the above screen appear. Note that there are numerous decoder options. These switches added to the command line allow you to change polarities if necessary and limit DSD to decoding only certain formats of digital audio. Under the Input/Output options you'll notice that the –w switch allows you to record to a .wav file. We'll cover this more towards the end of the tutorial.

For now though, we'll assume that we have an unknown MotoTrbo signal and we want to try to decode it. We'll simply type dsd at the prompt and then press the ENTER key to get started.

```
Administrator: Command Prompt

C:\dsd4winv2>dsd -xr
Digital Speech Decoder 1.4.1
mbelib version 1.2.3
Expecting inverted DMR/MOTOTRBO signals.
Audio In/Out Device: /dev/dsp
Sync:  -DMR        mod: GFSK inlvl:  3% [SLOT0]  slot1   VOICE e:====R======T===
====R====E=====T===
Sync:  -DMR        mod: QPSK inlvl:  4%  SLOT0  [SLOT1]  VOICE e:==T==========E==
========E===============R====R======R=
Sync:  -DMR        mod: QPSK inlvl:  6%  SLOT0  [SLOT1]  VOICE e:=======R====R===
====R===R===============R=========
Sync:  -DMR        mod: QPSK inlvl:  7%  SLOT0  [SLOT1]  VOICE e:====T====R======
=T=======R==========R======R====R=======R===
Sync:  -DMR        mod: GFSK inlvl:  6%  SLOT0  [SLOT1]  VOICE e:====R===========
=E=E======R=======E========E=====R==
Sync:  -DMR        mod: GFSK inlvl:  6%  SLOT0  [SLOT1]  VOICE e:=====E=====R=====
=E=======E=========E=======E===
Sync:  -DMR        mod: GFSK inlvl:  6%  SLOT0  [SLOT1]  VOICE e:====E===========
===================
Sync:  -DMR        mod: GFSK inlvl:  6%  SLOT0  [SLOT1]  VOICE e:===E=====R===E==
=====E========R===E=======R========
Sync:  -DMR        mod: GFSK inlvl:  6% [SLOT0]  SLOT1   VOICE e:======T====R====
=R====R====R=========R===E=======E======
Sync:  -DMR        mod: GFSK inlvl:  6%  SLOT0  [SLOT1]  VOICE e:====E=========E
=========E===========E=======E=====
Sync:  -DMR        mod: GFSK inlvl:  6%  SLOT0  [SLOT1]  VOICE e:====E=======R==
=================R===============R
Sync:  -DMR        mod: GFSK inlvl:  6%  SLOT0  [SLOT1]  VOICE e:=========R======
==R=========R===E========R=======E========R
Sync:  -DMR        mod: GFSK inlvl:  6%  SLOT0  [SLOT1]  VOICE e:===E========R===
E============R===R=========R====T======T==
Sync: (-DMR)       mod: QPSK inlvl:  7% [SLOT0]  SLOT1   VOICE e:========R======
================R=================R
Sync: no sync
Sync:  -DMR        mod: GFSK inlvl:  6%  slot0  [SLOT1]  VOICE e:===============
===================
Sync:  -DMR        mod: GFSK inlvl:  6%  SLOT0  [SLOT1]  VOICE e:===============
======R=====T====R==========R
Sync:  -DMR        mod: GFSK inlvl:  6%  SLOT0  [SLOT1]  VOICE e:====R========R=
=E=================R==============
Sync:  -DMR        mod: GFSK inlvl:  6%  SLOT0  [SLOT1]  VOICE e:=========E=====
===R==============R====E========R
Sync:  -DMR        mod: GFSK inlvl:  6%  SLOT0  [SLOT1]  VOICE e:===============
R============R===E======R=======R
Sync: (-DMR)       mod: QPSK inlvl:  6% [SLOT0]  SLOT1   VOICE e:=========R====R
=====R=========R=====R==========R====R======
Sync:  -DMR        mod: C4FM inlvl:  7%  SLOT0  [SLOT1]  VOICE e:=======E========
==E=========E=========E======
Sync:  -DMR        mod: GFSK inlvl:  6% [SLOT0]  SLOT1   VOICE e:=====E=========
E==============E=============R==E====R====R===R
Sync:  -DMR        mod: GFSK inlvl:  7% [SLOT0]  SLOT1   VOICE e:====R=E=======E
==========E==========E==========E==========E=====
Exiting.

C:\dsd4winv2>
```

The above screen, and the accompanying "garbled voice" sounds will be one of the biggest "problems" a new user of DSD will encounter. **If you are seeing something similar to the above and hearing what sounds like constant garbled voice while trying to decode MotoTrbo/DMR, you have DSD running in the wrong polarity.** Simply end the program by holding down the CTRL key and pressing the letter C. This will return you to the command prompt as shown at the bottom. The only modes where receive polarity can be changed are MotoTrbo/DMR or X2-TDMA. DSD WILL work one way or the other. If you're seeing the above, use the command line switches –xr or –fr to change polarity. Note above how there is a MINUS (-) sign to the left of DMR. You will want to type **dsd –fr** at the command line to restart DSD and have it look for only positive polarity MotoTrbo/DMR signals.

Once you've done that, when you receive a signal you should see something that looks like the above. But, some tweaking is likely going to be necessary. Note that you are now decoding +DMR. Of more importance though note the percentage level to the right of the inlvl: display. This percentage level is **NOT** the level of success; it is the level of **audio input**. I have found in just about every DSD For Windows install I have done that my best results have been achieved by having an audio input level of 6 to 7 percent. This is where you will go back to the below screen and tweak your input level. This of course can be done while the program is running.
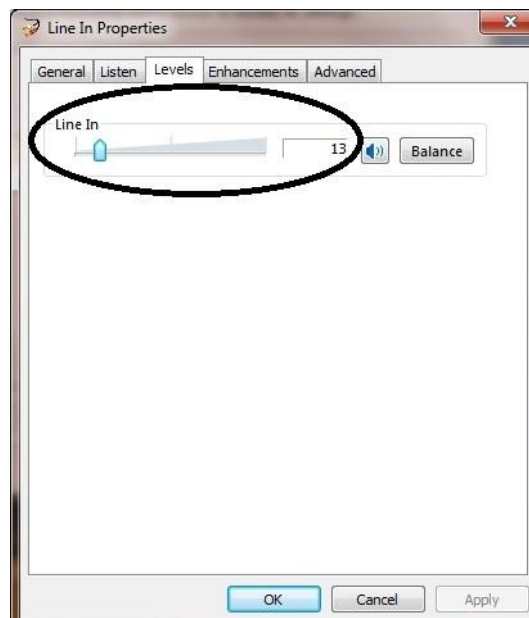
Simply slowly manipulate the slider left and right until you achieve that 6-7 percent. It may be different on your PC, but on over 6 configurations on different PC's that's always been the sweet spot for me.

That magical decoded voice is going to be heard sooner or later. With MotoTrbo/DMR you may notice a lot of data scrolling but no voice heard. This appears to be common with this type of system. I have no other experience with this protocol; I'm sure someone with knowledge of it could explain exactly what's going on here. When you hear voice though, you'll see it on the screen as well, as shown below.

Let the audio tweaking continue! Notice the VOICE indicator to the right of the above screenshot. The less equal signs that show to the right of the e:, the better the decode quality will be. I am doing pretty well with this transmission but I probably could be doing a little bit better. Suffice to say that as I see a display like this I am hearing reasonably good quality digital voice through my PC speakers. Use that previously shown slider to further tweak your audio input level until you have as few ===='s as possible.

You've done it! You're decoding using DSD…pretty neat, huh? Now you can get into some more sophisticated options such as recording audio to a file for unattended monitoring and later playback.

Note with the above I'm running DSD to decode just positive polarity MotoTrbo/DMR signals and I'm saving all of the audio to a file named 011712.wav. This file will be saved directly into the DSD folder where I can double click on it from My Computer or Windows Explorer and have it open in my default audio playback program.

<u>**Occasional Audio "Oddities"**</u>

From time to time you may notice a brief "blurb" of unintelligible audio emanating from your PC's speakers. This seems to be a normal trait of DSD, and it will almost always appear in conjunction with a "non-standard" display on the screen. For example, despite the fact that I'm telling DSD to decode only positive polarity MotoTrbo/DMR it may suddenly show a P25 signal, or an X2-TDMA signal. These are "phantom artifacts" for lack of a better description. You'll notice them as well if you play back your audio file. No worries, the real audio will be recorded fine and you'll certainly hear it clearly if you've reached this point of the tutorial successfully.

<u>**A Little More on Discriminator Taps**</u>

Some receivers are equipped out of the box with discriminator taps. I have used an Icom IC-R1500 receiver with great success with DSD. But, every scanner I have built a tap into has had the aforementioned 10k ohm resistor built in. Straight taps have not worked for me very well, but if you're not sure spend the $2.00 or so at Radio Shack and build an external cable with one built into the "hot" side. From what I've seen this works just as well as having the resistor on board, and unless I'm sadly mistaken it can't hurt anything being inline.

Disclaimer

As always, any modifications are done at your own risk and peril and shan't be laid at the feet of yours truly or the DSD creators (heck, you won't find them anyway! ☺)

Conclusion

I hope this has served in some small way to help some of you get started on this project. I will continue to partake in the threads at Radio Reference and at my website pertinent to DSD, but I'm not available for "support". This tutorial in most cases should get you started. Best of luck, and enjoy!

Oh, one more thing. This document can be freely distributed to all corners of the planet and beyond, just be kind and list Scott from Scan New England as its source, and of course give plenty of love to the creator of the software, and the fine gentleman that ported it to Windows. Thanks!