

Electrical Engineering 434

DSP Hardware Lab

Names: _____

This assignment is a team exercise, with two people per team. Follow this worksheet (one form per team), and turn in your answers by **COB lesson 13**. Each person should upload this worksheet to GradeScope to be graded. The files mentioned below can be found on the 434 Teams channel, under Files→L12 DSP Hardware Lab

In these instructions, when it says “draw what you see” you can either try to hand draw what you see **or take screenshots and cut-n-paste them into this worksheet.**

1. Introduction

In this lab you will use the WinDSK8 application that runs real-time DSP applications on the Texas Instruments OMAP LCDK L138 board. When you plug in the LCDK, you should see a green LED on. If not, it doesn't have power. Make sure the power is connected to the port that says 5V, and the USB is plugged into the USB port. See picture on last page.

2. Reflash the LCDK [**you probably can skip this step**]

If the board has not been reflashed, follow the instructions in “Reflashing Correctly.pdf” or copy “Reflashing LCDK for winDSK8.zip” and follow “Reflashing the LCDK for winDSK8.pdf”

3. Install WinDSK8 on your Laptop

Install WinDSK8 using [winDSK8_installer_2_0_2_0.exe](#) on the K:drive

The original came from http://rt-dsp.com/2nd_ed/winDSK/winDSK8.html → [here](#)

4. Configure WinDSK8 on your Laptop

- Open WinDSK8
- In the upper right dropdown, set
 - DSP: LCDK (OMAP)
 - Input Source: Line In
 - COM Port: COM4 (or whatever com port it is initialize to in devices)
 - Click “Rescan COM Ports”

5. Confidence Test

- Open WinDSK8
- Click Confidence Test and then “Run All Tests”

6. WinDSK8 HELP

- See the **help** button. This is your **friend**, especially when you want to know what an application is and how it works. Cadet Duffy says “they should basically have this help window open always”

7. TalkThru

- Plug a laptop, ipod, mp3 player, smart phone, or other sound generating device into the board using the supplied cable. On the board, the two black jacks that are stacked are the audio ports (next to the yellow video port). The top port is “audio in” (plug in your laptop using an aux cable) and the bottom port is “audio out” (plug in your headphones). Also, you may have to crank the volume way up.
- On your laptop play an audio test tone, like 440 Hz, from a website like <https://www.szynalski.com/tone-generator/> and/or play a song with horns like Louis Armstrong “La Vie En Rose”
- Set the Sample Rate to **8.0 KHz**. Click on **TalkThru**. You should hear sound. If not, get your instructor.
- **Effective Fs:** Click **Use Anti-Imaging Filter**. Lower the F_s until you hear a change in the sound quality.
 - **Question 0:** What is this value of F_s for Louis Armstrong versus the 440 Hz?
 - **Question 1:** What caused this change in the quality of the sound?
- **Anti-Imaging Filter:** Reset F_s to 8.0 KHz, play 440Hz and compare what you hear by clicking and unclicking **Use Anti-Imaging Filter**.
 - **Question 2:** What caused this change in the quality of the sound?
- **Quantization:** Set Sample Rate up to 96000 Hz (close talk-thru, change Sample Rate on main window, re-enter talk-thru). Lower the number of bits until you hear a change in the sound quality.
 - **Question 3:** What is the number of bits for Louis Armstrong versus the 440 Hz?
 - **Question 4:** What caused this change in the quality of the sound?
- **Invert Spectrum:** Restore settings, click **Use Anti-Imaging Filter**, and set Effective F_s to 8 KHz. Click **invert spectrum**.
 - **Question 5:** Hear any change? What has happened to your audio signal? [help will tell how this is implemented; however, you need to explain what it does to the signal]

8. O'Scope

- Switch the audio cable from your Ipad audio-out to your laptop audio-out.
- To test the O'scope function, you will create a sound using MATLAB. Copy the "[gen_tones_long.m](#)" file to the MATLAB work directory. Run matlab:

```
>> x = gen_tones_long(N); % where N is the number of samples  
% let N=10*48000 for 10 seconds of sound  
% To play the sound to the DSK board (assuming the cable is hooked up)  
>> soundsc(x, 48000);
```

- Click on Function-> **Oscope/Analyzer**. Play the sound.

□ **Question 6:** Explain and draw what you see. What does this display plot?

- Click on Codec Settings to change the Fs to 8 KHz.
Click on Function->**Spectrum Analyzer** and Display->**Logarithmic** and play the sound

□ **Question 7:** Explain and draw what you see. What does this display plot? How is it probably implemented?

□ **Question 8:** Change the windowing used. See any changes?

- Click on Display->**Waterfall** and play the gen_tones_long sound
 - **Question 9:** Explain and draw what you see. What does this display plot? How is it implemented? Is there a difference between the left and the right channel?

• Now you will test these displays with a “chirp” signal (often used in RADAR applications). Download the “[chirp2.m](#)” file to the MATLAB work directory. Run matlab:

```
>> x = chirp2(N); % where N is the number of samples
```

```
% let N= 25*8000/5 for 25 seconds of sound
```

```
% To play the sound to the DSK board (assuming the cable is hooked up)
```

```
>> soundsc(x, 8000);
```

- Click on Function-> **Oscilloscope**; Display->**Scope**; **Linear**. Play the sound.
 - **Question 10:** Explain and draw what you see.

- Click on Function-> **Spectrum Analyzer** and Display->**Scope; Logarithm** and play the sound

□ **Question 11:** Explain and draw what you see.

- Click on Display->**Waterfall** and play the sound

□ **Question 12:** Explain and draw what you see.

- Now you will test the Waterfall display with the Louis Armstrong song
 - Click on Display->**Waterfall** and play the sound
 - **Question 13:** Explain and draw what you see. What is the difference on the Waterfall display when a horn like the trumpet is played versus a percussive instrument like the piano?

9. Try out another function in WinDSK8
such as Audio Effects, Graphic Equalizer, Karplus-Strong String
Algorithm, Guitar Synthesizer, DTMF Generator, Vocoder

- See the Help utility, especially the block diagrams, to see how they work
- For one of these functions, tell me what it does, how it works, something you learned...

Power
Supply

Audio-in (top)
From Laptop

USB Cable to
WinDSK Laptop

