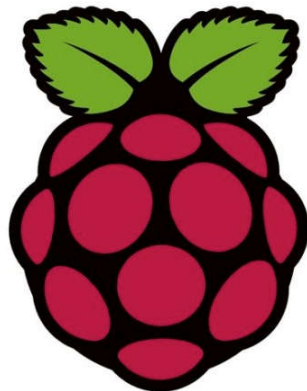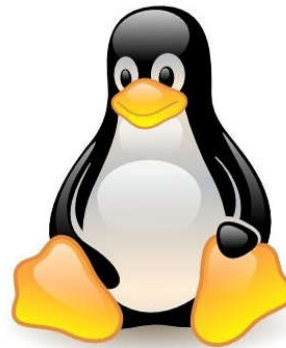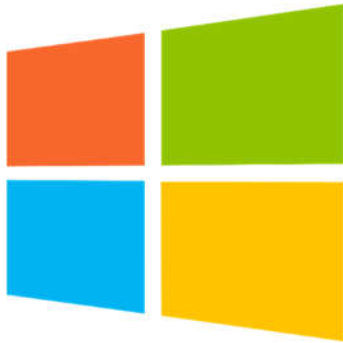# Software Manual
Easy LCD Interface (ELI®)

Version 1.01

FDI Future Designs, Inc.
Your Development Partner
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1.0 ELI Software Overview

ELI is Future Designs, Inc.'s family of long-life, plug-and-play embedded displays. ELI products are true modular embedded display solutions that require no engineering or lead-time. All ELI products are compatible with a wide range of single board computers including Raspberry Pi, BeagleBone Black and Windows-based units. FDI designed ELI as an embedded display option that requires minimal development time to help customers reach production quickly. Once a product is in production, FDI's 10-15 year ELI product availability guarantee helps ensure production schedules without the risk of expensive or time consuming redesigns. Learn more about ELI at TeamFDI.com/ELI.
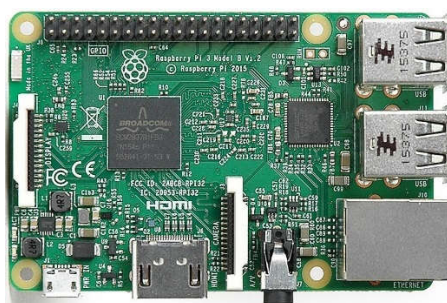
2.0 Raspberry Pi

Figure 1. Raspberry Pi 3

2.1 Introduction

The Raspberry Pi is the most popular line of Single Board Computers. ELI has been tested and shown to work well with every Raspberry Pi, from the Raspberry Pi Zero to the Raspberry Pi 3. Each Raspberry Pi provides a USB port and an HDMI port, which is all ELI requires from any SBC. While the Raspberry Pi doesn't have the capability to detect Extended Display Identification Data (EDID) from ELI (or any display), Raspberry Pi can be easily configured to work with ELI using a configuration file. Using configuration files and general setup and use of the Raspberry Pi will all be covered in this manual.

2.2 Cables and Connection Requirements for Raspberry Pi with ELI

All current ELI systems have been tested using the following components.

1) 12V DC +/- 5% 2A Power Supply to power the ELI
2) The following cables are required for connecting an ELI to a Raspberry Pi:
   a. (1) HDMI Cable Type A Male to Type A Male (Full size to Full size)
      Example PN: Molex PN: 0887689800, Digi-key PN: WM19083-ND

   b. (1) USB Cable, Mini-B to Full Size-A for Raspberry Pi to ELI (touch screen support)

   c. (1) Wall Adapter Power Supply 5V 2A DC USB Micro B (power for Raspberry Pi) such as the Sparkfun TOL 12890. You may also use an adapter such as the PSA05F-050Q with a USB Type A to Type B cable.

3) (1) 4GB SD Card to hold the operating system.
4) Win32 Disk Imager (http://www.sourceforge.net/projects/win32diskimager/)
5) (Optional) FDI Raspberry Pi disk image. The disk image will provide an introduction to ELI capabilities. Direct links to download the disk images are provided in Section 2.3 of this guide.

2.3   Raspberry Pi Software and Operating Systems Downloads

FDI has demo software that you can download for your Raspberry Pi. We keep this image up to date and can be found on the **Software** tab on any of our ELI Product Pages:

- Raspberry Pi Disk Image (Direct Download Link)

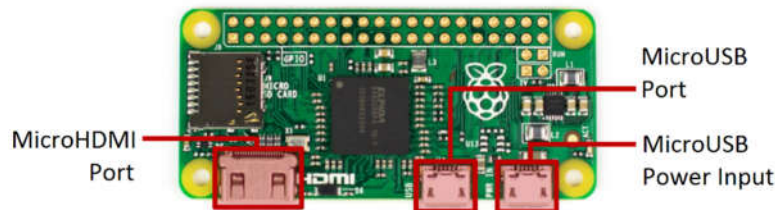### 2.4 Raspberry Pi Startup Procedure

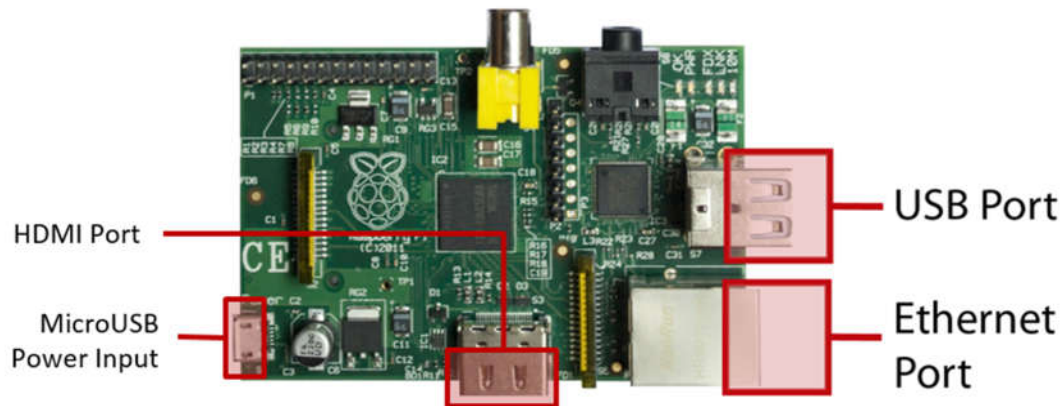Figure 2. Raspberry Pi Zero Connections

Figure 3. Raspberry Pi Model B Connections
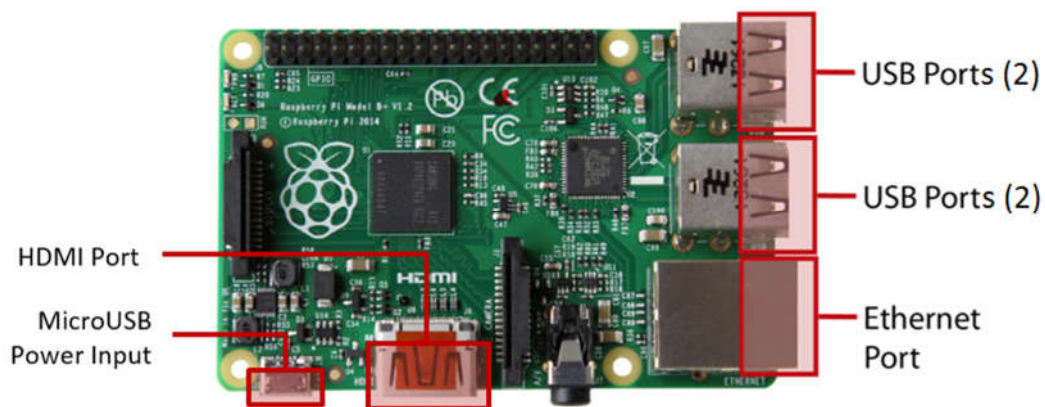
Figure 4. Raspberry Pi Model B+ Connections
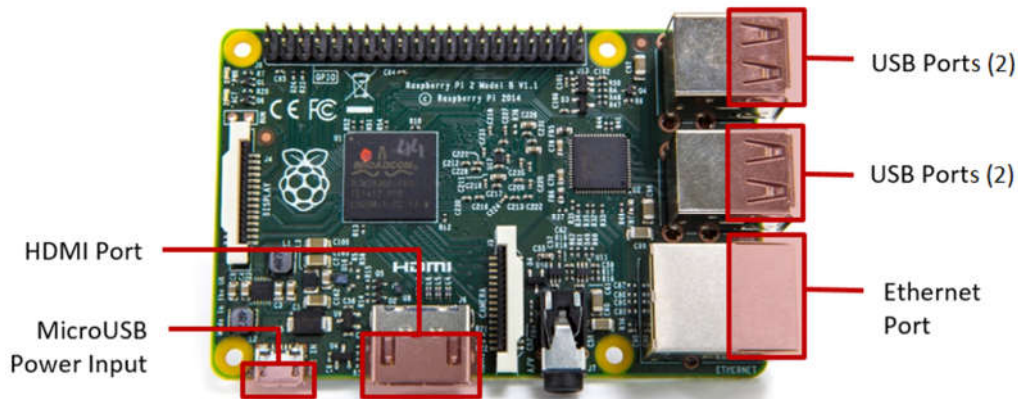
Figure 5. Raspberry Pi 2 Model B Connections
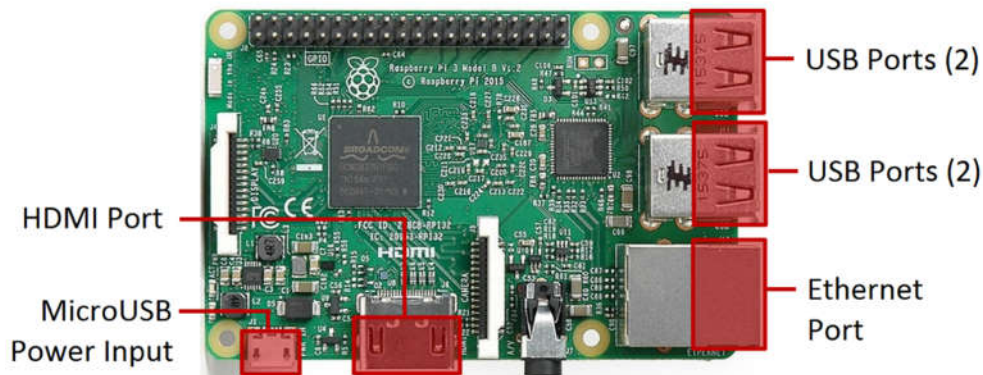
Figure 6. Raspberry Pi 3 Model B Connections

Step 1: Format Raspberry Pi with an ELI Compatible Operating System
Raspberry Pi does not have an onboard EMMC. Consequently, before you boot a Raspberry Pi you must first format a microSD card and write an operating system image to it. FDI recommends using the preconfigured disk images provided in Section 2.3 for this requirement. The FDI preconfigured disk images will familiarize you with ELI and its capabilities.

If you have your own software ready for the Raspberry Pi, complete the following steps:
1. Format the 4GB microSD to FAT (Note: not FAT32) :
    a. Open a command prompt in Administration mode
        i. Click the Windows Start button.
        ii. Type "cmd"
        iii. Right-click "cmd.exe" and select "Run as Administrator"

     b. Type the following commands:
        i. *diskpart*
       ii. *list disk*
     c. Reference Diskpart to find your microSD card. The size field is a helpful aid to determining the microSD card number.

Figure 7. Diskpart: list of disks

     d. Select the disk number by typing the command: *select disk 1* (Note: Replace "1" with the disk number determined by step c.)
     e. Type the following commands:
        i. *clean*
       ii. *create partition primary*
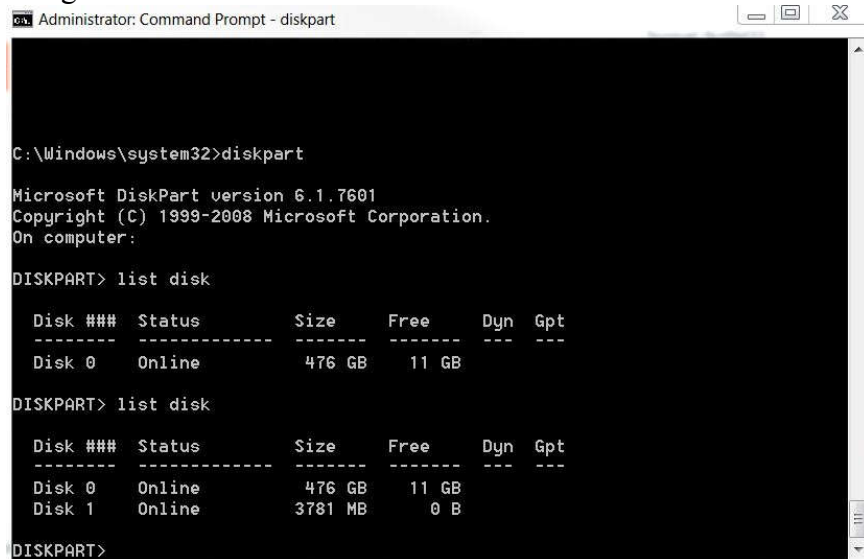   iii. *active*
      iv. *format fs=fat*   (Note: This may take up to 20 minutes.)
       v. *assign letter=f* (Note: Replace "f" with any letter that is not occupied by the computer you are using to format the device.)
      vi. *exit*

2. Unzip the contents of the downloaded image into a safe location on your computer.
3. Write the newly downloaded OS to the disk.
     a. Open up Win32 Disk Imager. This can be downloaded from the following website: http://sourceforge.net/projects/win32diskimager/
     b. Set "Device" to the microSD card.
     c. Navigate to the folder for the Raspberry Pi device on your computer and locate

the ".img" file you downloaded.
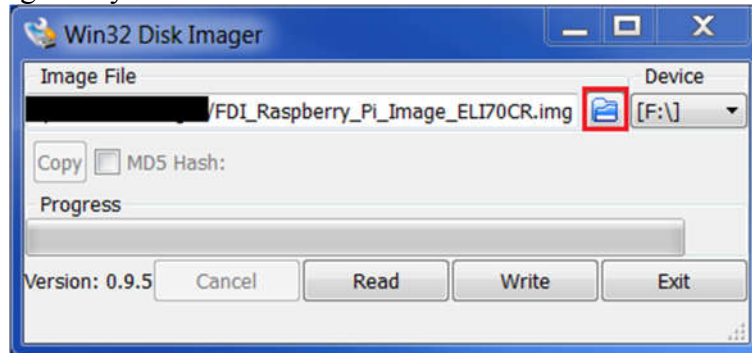
Figure 8. Win32 Disk Imager

       d. Click <Write>.

4. After Win32 Disk Imager is done writing the disk image to the microSD card, eject the microSD card from your computer
5. Insert the microSD card into the Raspberry Pi microSD card socket.

Step 2: Boot the Raspberry Pi

1. Connect the HDMI cable and USB cable from the Raspberry Pi to the ELI board.
2. Power on the ELI with a 12VDC +/- 5% 2A power supply.
3. Connect the USB to microUSB Cable to the Raspberry Pi Micro USB power slot. Then, connect the Type A USB end to either a computer or a USB wall adapter.
4. The ELI unit will power on automatically and display the boot sequence for Raspberry Pi.
5. Connect a keyboard and mouse or use the ELI touch screen to complete initial setup of your Raspberry Pi image.

   Note: If you are using a copy of Raspbian that is not compatible with the FDI Disk Image, you must complete the additional steps provided in Section 26: Installing your own Raspbian Image.

6. Your ELI unit is now properly connected for basic operation. Proceed with the software installation.

2.5 Using Raspberry Pi Demonstration Software on ELI
Use the demos and videos in the ELI Launcher GUI to familiarize yourself with the capabilities of ELI. You can exit to the normal Raspbian desktop by tapping <Exit>.

2.6 Installing your own Raspbian Image on ELI

To facilitate the process of installing a disk image on Raspberry Pi devices, a keyboard and mouse will be required. The keyboard and mouse will not be required to operate your device after these steps are complete.

1. On your PC, download a copy of Raspbian from this website: http://www.raspberrypi.org/downloads/
2. Write the image onto a microSD card using a disk imager program such as Win32 Disk Imager.
3. Refer to Section 2.4 and follow Step 1 and Step 2. Use the Raspbian image instead of the Demo image.
4. Download the appropriate FDI "config.txt" file. Pay special attention to make sure the model is correct.
   a) ELI43-Cx (Direct Download Link)
   b) ELI70-CR (Direct Download Link)
   c) ELI70-IxHW (Direct Download Link)
   d) ELI101-CP (Direct Download Link)
   e) ELI121-CR (Direct Download Link)
5. Copy the config.txt file into the "boot" directory on the microSD card, replacing the existing file.
6. Eject the microSD card from the PC.
7. Insert the microSD card into the Raspberry Pi microSD card socket.
8. Plug in a USB keyboard and USB mouse into the Raspberry Pi.
9. Connect Ethernet cable to the Raspberry Pi and to an internet source. If you are using a Raspberry Pi 3 you may utilize its onboard wifi.
10. Allow the Raspbian image to boot to the setup screen. Then complete the following:
    a) Config Page
       i. Select "Expand Filesystem"
       ii. Select "Enable boot to Desktop/scratch"
       iii. On the second page, select "Desktop, login as user 'pi'"
       iv. Select "Finish"
    b) Reboot the Device
11. After the device boots, update the image. Open up "LXTerminal" located at the top left of the Raspberry Pi desktop.
12. Type the following commands:
    a) *sudo apt-get upgrade*
    b) *sudo apt-get update*
    c) When this is finished, reboot the device.

NOTE: This process can take up to 30 minutes depending on your internet connection.

13. Update your keyboard to your appropriate country. This part of the guide will be for US only. (**Note:** This is not necessary for those living in the UK).

a) Type the following command: *sudo dpkg-reconfigure keyboard configuration*

b) 1st page: Select "Generic 105k (Intel) PC"

c) 2nd page: Select "Other"

d) 3rd page: scroll down to English (US)

e) 4th page: scroll to the top and select English (US)

f) 5th page: set to the default for keyboard layout

g) 6th page: no compose key

h) 7th page: It is NOT recommended to use the "control+alt+backspace" to turn off xserver. xserver runs the GUI for the Raspberry Pi. Turning xserver off will disable all GUI functions until it is turned back on.

i) Reboot the device. The shift+3 will now properly display the # sign.

14. Download the calibration software to calibrate the touchscreen.

a) Type the following commands in the terminal:

i. *wget http://adafruit-download.s3.amazonaws.com/xinput-calibrator_0.7.5-1_armhf.deb*

ii. *sudo dpkg –I –B xinput-calibrator_0.7.5.1_armhf.deb*

iii. Now you can calibrate at any pint by typing: *xinput_calibrator*

iv. *xinput_calibrator*

v. Go through the calibration steps.

b) After calibration the desktop will display text similar to that shown in Figure 9:

Figure 9. Making Calibration Permanent Snippet

c) Copy everything starting with the line, *Section "InputClass"*, through *EndSection* into the end of the following file: /etc/X11/xorg.conf.d/99-calibration.conf

d) Reboot the device. Using a stylus, tap around the device to confirm that it has been properly calibrated.

2.7 Other Software for Raspbian that may be helpful

FDI recommends the following software programs as a supplement to those required to run Raspberry Pi with ELI.

1. **Libre Office** is an open source office suite that lets you view and edit .ppt, .doc, and .xls documents. FDI recommends this software to display slideshow presentations on ELI. Libre Office cannot use any files with a .***x extension (.pptx, .docx). Therefore, files for transfer to the Raspberry Pi for display on ELI must be in Office 95-2003 format (.ppt, .doc, .xls).
   a. To install Libre Office, type the following command into the Raspberry Pi terminal: *sudo apt-get libreoffice*
   b. Libre Office will appear in the Home->Office section of your start menu.
   c. To write a scripts that will instruct the Raspberry Pi to open PowerPoint slides in slideshow mode only, type the following commands into the terminal:
      i. #!/bin/bash
      ii. libreoffice –show /directory/of/powerpoint/name_of_slideshow.ppt
2. **OMX Player** is a media player that is built into the Raspberry Pi and can run media through the command line. It is hardware accelerated; taking advantage of the small GPU present on Raspberry Pi devices. To play videos by default there are a few changes that must be done. To complete these changes follow these steps:
   a. From a computer, download the following file then copy it over to the Raspberry Pi /home/pi directory:
      http://www.raspberrypi.org/forums/download/file.php?id=6086
   b. Type the following commands into the terminal:
      i. *sudo tar –xf omxplayer-helper-scripts.tar –directory=/usr/share/applications/ --overwrite*
      ii. *sudo apt-get install –f wmctrl*
   c. Using a mouse, right-click on any mp4 that you have on the computer desktop.
      i. Select "Open With"
      ii. Checkmark "Set selected application as default action for this file type"
      iii. Go to "Installed Applications->Sound & Video->OMXPlayer"
      iv. Click "OK"
         Note: A mouse or touch input will not work with the OMXPlayer because it uses its own window server.
3. **Florence Virtual Keyboard** is a small program that runs in the foreground while open and provides any program to open as though it were an actual keyboard.
   a. Install Florence Virtual Keyboard by typing the following command into the terminal: *Sudo apt-get install Florence*
   b. Open Florence Virtual Keyboard from the following location: Home->Universal Access->Florence Virtual Keyboard

2.8 Troubleshooting Raspberry Pi with ELI

FDI recommends the following workarounds for common Raspberry Pi troubleshooting issues:

1. Calibration of the touch screen:
   When the ELI touch screen is completely out of calibration, take these steps:
   a. Plug in a keyboard and mouse
   b. Open up LXTerminal
   c. Type the following command: *xinput_calibrator*
   d. Follow the calibration steps
   e. Copy everything starting with the line, *Section "InputClass"*, through *EndSection* into the end of the following file: /etc/X11/xorg.conf.d/99-calibration.conf
   f. Reboot the device.

2. Incorrect resolution on the screen:
   The Raspberry Pi is forced to accept a specific EDID and is therefore forced into a resolution. If the Raspberry Pi device is running Raspbian but is displaying an incorrect resolution, take these steps:
   a. Turn off the device
   b. Remove the microSD card and insert it into your computer.
   c. Download our up-to-date config file. (Refer Section 2.6: Installing your Own Raspbian Image on ELI, step 4.)
   d. Replace the exiting config.txt by moving the updated config file onto the boot directory of the microSD card.
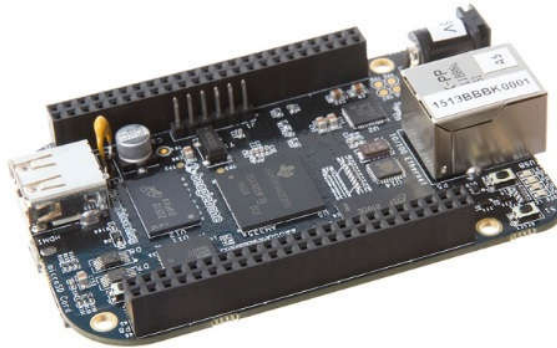
3.0 BeagleBone Black

Figure 10. BeagleBone Black Rev. C

3.1 Introduction

The Beaglebone Black is one of the most popular Single Board Computers. Unlike the Raspberry Pi, the Beaglebone Black does support Extended Display Identification Data (EDID). This means that you can plug a Beaglebone Black into any ELI unit and it will work without any further configuration required. The Beaglebone Black has a microHDMI port, so you will either need a microHDMI cable to Full Size HDMI cable, or an equivalent adapter. The Beaglebone Black also has a single USB port, but that is all ELI requires for the touch screen. The Beaglebone Black also has an onboard eMMC, this means a disk image can be written to the device itself instead of always using a microSD card.

3.2 Cables and Connection Requirements for BeagleBone Black with ELI

All ELI systems have been tested using the following setup.

1. 12VDC +/- 5% 2A Power Supply to power ELI
2. (1) HDMI Type A Male to Type D Male (Full Size to Micro Size)
3. (2) USB Cables, Mini-B to Full Size-A
   a. One USB cable for BeagleBone Black to ELI (Touch Screen Support)
   b. One USB cable for BeagleBone Black to PC (Power and Console for BeagleBone Black)
   c. An optional AC to USB Adapter such as the PSA05F-050Q (Link) may be used to supply the ELI board with additional power than what the computer can provide.
4. To use a desktop PC as a console, download the BeagleBone Black USB network drivers here: http://beagleboard.org/getting-started#step2
5. **BeagleBone Black works out of the box with ELI.**

3.3 BeagleBone Black Startup Procedure

Note: This demonstration is for a BeagleBone Black out of the box with no changes to the EMMC internal storage. It will drive the ELI without any software changes, downloads, or modifications to the BeagleBone Black.
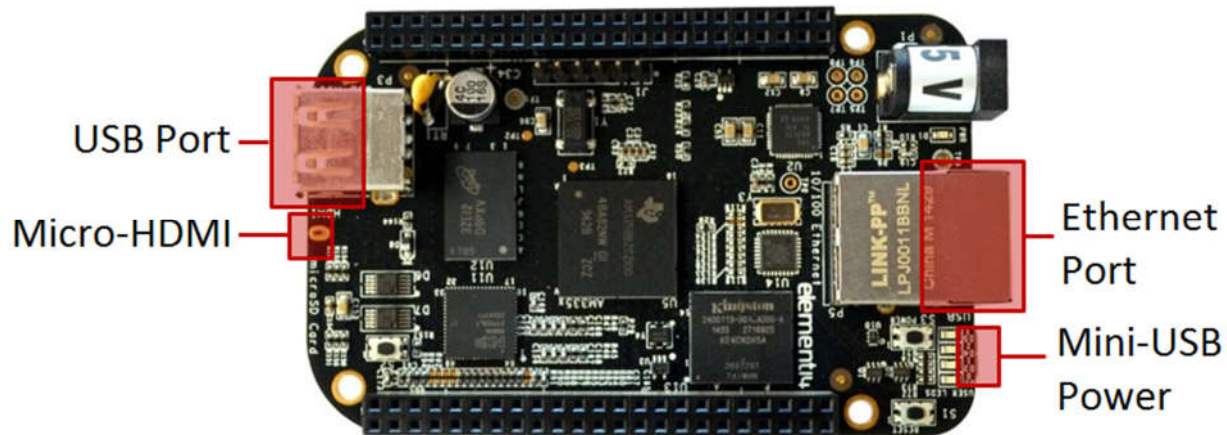

Figure 11. BeagleBone Black Connections

1. Connect the HDMI cable and USB Cable from the BeagleBone Black to the ELI Board.
2. Power on ELI with a 12VDC +/- 5% 2A power supply.
3. Connect the USB Cable from the BeagleBone Black Mini-USB to the PC or USB wall adapter.
4. The ELI will power on and display the BeagleBone Black boot sequence. After the boot sequence is complete, complete the touch screen calibration steps by following the prompts on the display. When touch screen calibration is complete the the device will boot to the GUI desktop.
5. The ELI is now properly connected and basic operations of ELI and the BeagleBone Black are available.

3.4 Communicating with your BeagleBone Black

It is highly important to have an easy way to communicate with your BeagleBone Black to make software changes or updates. There are two ways of doing this; (1) A simple USB HUB will allow you to connect keyboard, mouse, and any other device needed, or (2) using the built in USB -> Ethernet drivers for windows to communicate remotely to your BeagleBone Black over the miniUSB used to power the device.

Steps for setting up PuTTY for your BeagleBone Black
1. Download PuTTY: http://the.earth.li/~sgtatham/putty/latest/x86/putty.exe
2. Open a terminal window on the BeagleBone Black.
3. Type the following command into the terminal: *"ifconfig"*.
4. Scroll to "usb0"
5. Make note of the IP Address beside "inet addr:" This is the IP Address of the BeagleBone Black.
6. Set up Putty to look like Figure 14. (Note: Replace the IP Address with the IP Address of your BeagleBone Black.)
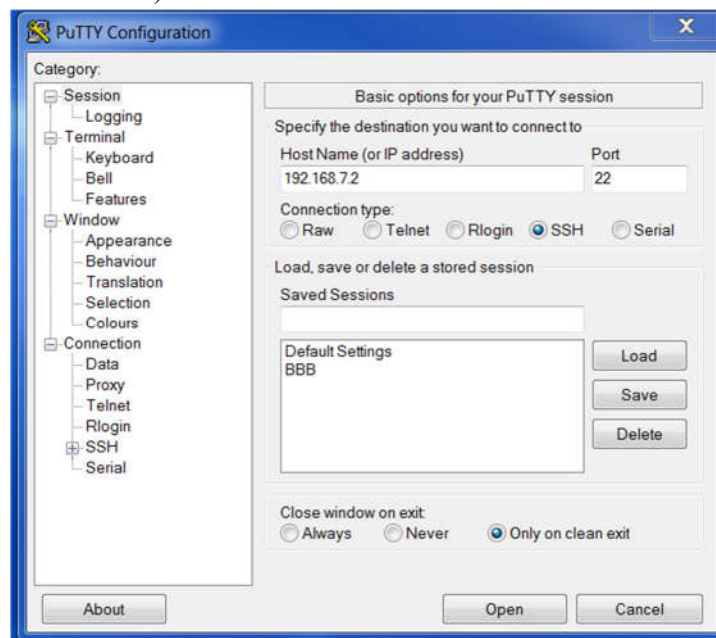
Figure 12. PuTTY Configuration

7. Click Open.
8. The first time you connect to this device, you will get a security alert. Click "Yes" on pop up screen and continue.
9. You will see the prompt displayed in Figure 15.
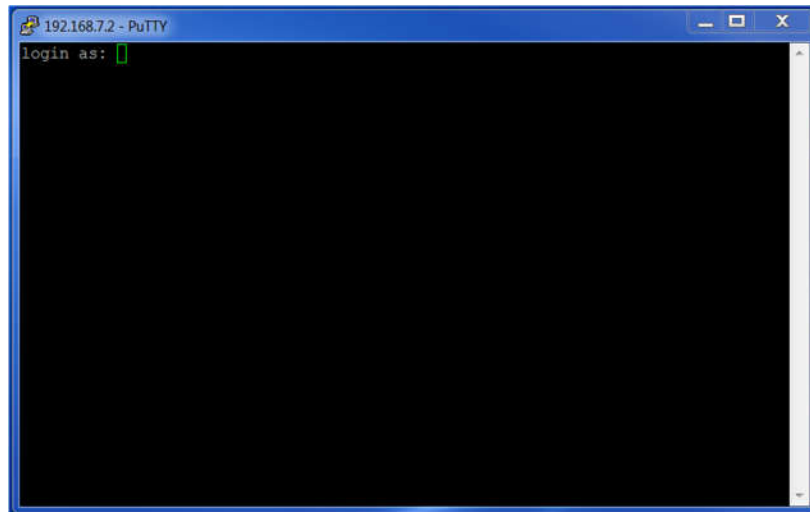
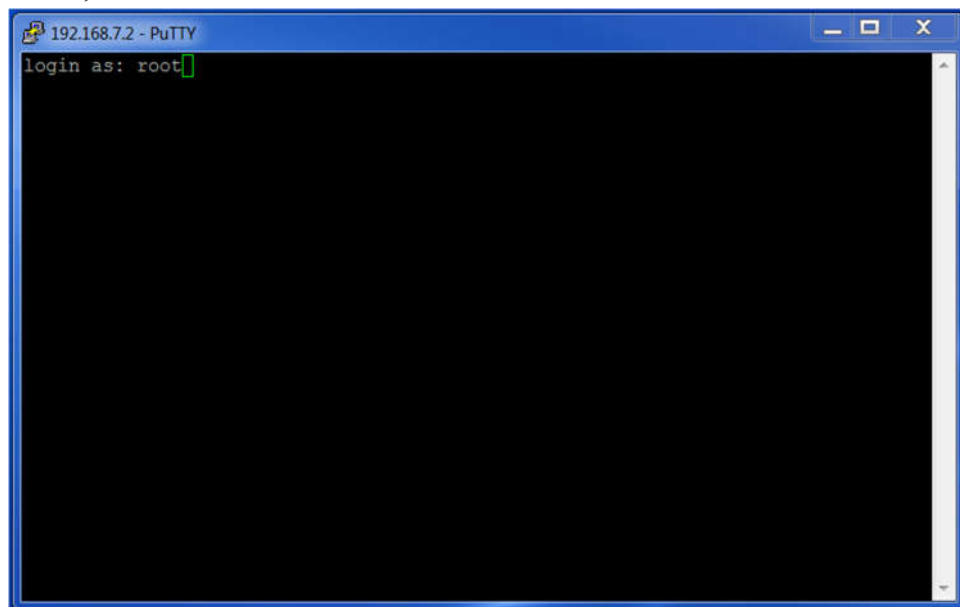Figure 13. PuTTY Terminal

10. Type *"root"*, then hit enter.

Figure 14. PuTTY Terminal

11. You are now logged into the BeagleBone Black device. Commands entered in the LXTerminal can also be enetered in the PuTTY Terminal.

3.5 Updating the Factory BeagleBone Black

The Debian Wheezy distribution of Linux is the basic operating system that comes on all BeagleBone Black devices as of the Rev C release in March 2014. A few bits of software are recommended. Most of these software recommendations can be found using an apt-get call. You may also use these instructions for installation. Shell commands are identified by *italics*. To begin the installation process, plug the ELI Board into your BeagleBone Black, and power them on.

1. Connect to your BeagleBone Black through your preferred method described in section 3.4: Startup Procedure.
2. Type the following command: *sudo apt-get update*
3. Type the following command: *sudo apt-get upgrade*
4. Reboot the BeagleBone Black.

3.6 Other Software for Debian that may be helpful

FDI recommends the following software programs as a supplement to those required to run BeagleBone Black with ELI.

1. **Libre Office** is an open source office suite that lets you view and edit .ppt, .doc, and .xls documents. FDI recommends this software to display slideshow presentations on ELI. Libre Office cannot use any files with a .***x extension (.pptx, .docx). Therefore, files for transfer to the Raspberry Pi for display on ELI must be in Office 95-2003 format (.ppt, .doc, .xls).
   a. Open up a command terminal LXTerminal, or log into the device through a remote connection on your desktop.
   b. Type the following: *sudo apt-get install libreoffice.*
   c. After Libre Office installs the following programs will be in your Home->Office tab: Base (Database), Calc (Excel), Draw (Publisher), Impress (PowerPoint), and Writer (Word)
   d. To write a scripts that will instruct the Raspberry Pi to open PowerPoint slides in slideshow mode only, type the following commands into the terminal:
      i.   #!/bin/bash
      ii. libreoffice –show /directory/of/powerpoint/name_of_slideshow.ppt
2. **Xine Media Player** is an open source media player that works with the BeagleBone Black. Note: Due to the hardware limitations, BeagleBone Black can only play a maximum of 480p at 15fps on media players available for BeagleBone Black. Use a lower resolution if your project requires more than 15fps.

a. Open up a command terminal LXTerminal or log into the device through a remote connection on your desktop.

b. Type the following: *sudo apt-get install xine-ui*

c. Xine is a plug and play media player for BeagleBone Black devices. However, because BeagleBone Black does not have a dedicated graphics chip, videos will be have a lower frame rates than the desktop presentation. Xine will demonstrate the capabilities of the BeagleBone Black, and is the media player FDI recommends for use with ELI boards connected to BeagleBone Black devices.

3. **GPicView** is a fairly low weight image viewer that allows you to display basic images and image slide shows.

a. Open up a command terminal LXTerminal, or log into the device through a remote connection on your desktop.

b. Type the following:*sudo apt-get install gpicview*

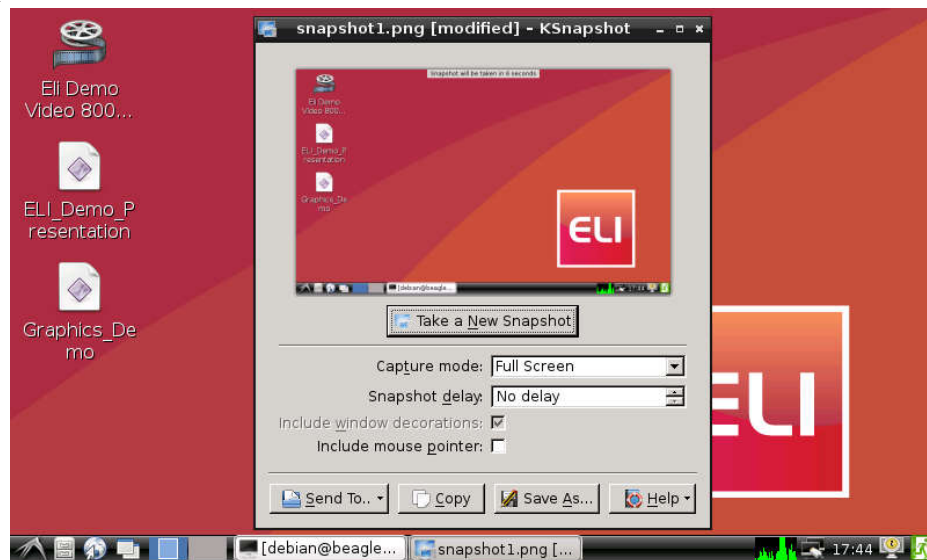4. **KSnapshot** is robust screenshot capture software that allows you to capture your desktop.

Figure 15. KSnapShot

a. Open up a command terminal LXTerminal or log into the device through a remote connection on your desktop.

b. Type the following: *sudo apt-get install ksnapshot*

c. To open KSnapShot tap Home > Graphics > KSnapshot.

d. Adjust the area of your desktop that you would like to capture and the snapshot delay time. Snapshot delay time is the time between when you tap the "Take a New Snapshot" and when the actual screenshot happens.

5. **<u>Florence Virtual Keyboard</u>** is a small program that runs in the foreground while open and provides any program to open as though it were an actual keyboard.

a. Open up a command terminal LXTerminal or log into the device through a remote connection on your desktop.

b. Type the following: *sudo apt-get install florence*

c. Open Florence Virtual Keyboard from the following location: Home->Universal Access->Florence Virtual Keyboard

3.7 Troubleshooting BeagleBone Black with ELI

FDI recommends the following workarounds for common BeagleBone Black troubleshooting issues:

1. Calibration of the touch screen:

When the ELI touch screen is completely out of calibration, take these steps:

a. Plug in a keyboard and mouse

b. Open up LXTerminal

c. Type the following command: xinput_calibrator

d. Follow the calibration steps

e. Copy everything starting with the line, *Section "InputClass"*, through *EndSection* into the end of the following file: /etc/X11/xorg.conf.d/99-calibration.conf

f. Reboot the device.

2. Incorrect resolution on the Screen:

An ELI display may be in the wrong resolution if any of the following have happened:

- At boot up the cursor is off-centered after boot, you can't see most of our

- A portion of the ELI logo on the desktop is out of frame

- All or port of the taskbar is hidden,

- The desktop displays a large amount of black space

To troubleshoot incorrect resolution take these steps:

a. Shutdown the BeagleBone Black device.

b. Turn off power to the ELI board
c. Unplug both ends of the HDMI cable from both the ELI board and the BeagleBone Black.
d. Plug in the ELI board's end of the HDMI cable, making sure it is fully seated into the slot.
e. Plug in BeagleBone Black's end of the HDMI Cable. Ensure the cable is fully seated into the slot by pressing it firmly into the BeagleBone Black.

Note: If these steps do not resolve your resolutions issue, check the BeagleBone black by connecting to to a with a different display, such as a computer monitor, to verify the device uses the correct resolution with that. If so, there is a possibility that the BeagleBone Black's HDMI port is faulty.

4.0 Support

4.1 Where to Get Help
Online technical support is available at http://www.teamfdi.com/support/.

4.2 Useful Links
- Raspberry Pi Home Page: https://www.raspberrypi.org/
- BeagleBone Black Home Page: http://beagleboard.org/black
- Sparkfun TOL 12890: https://www.sparkfun.com/products/12890
- PSA05F USB Power Adapter: http://www.digikey.com/product-detail/en/phihong-usa/PSA10F-050Q(S)/993-1194-ND/3523664

4.3 Useful FDI Links
- Future Designs, Inc. Forums: http://www.teamfdi.com/forum
- ELI70-CR Product Page: http://www.teamfdi.com/product-details/eli70-cr/
- ELI70-IRHW Product Page: http://www.teamfdi.com/product-details/eli70-irhw/
- ELI43-CP Product Page: http://www.teamfdi.com/product-details/eli43-cp/
- ELI43-CR Product Page: http://www.teamfdi.com/product-details/eli43-cr/
- ELI101-CPW Product Page: http://www.teamfdi.com/product-details/eli101-cpw/
- ELI121-CRW Product Page: http://www.teamfdi.com/product-details/eli121-crw/