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Preface

Introduction
This is the official Out of the Box uPAD Proto Base assembly guide. It includes all the required information of tools, technique and process to fully assemble the uPad Proto Base. It is highly suggested that this guide is read in full to assure quick and proper assembly. If there are any questions that this guide does not address, please feel free to contact Out of the Box.

Required Tools
While there may be alternatives for some of the items listed, it is highly suggested that all tools are collected before starting assembly.

Flux Pen
Flux is a very important tool for soldering. It prevents beading of the solder and helps it flow cleanly into the part. It also provides thermal stability and will clean the solder. Use it sparingly as less is more with flux and cleaning it off the board can be a hassle.

Soldering Iron
Tin the tip of your soldering iron. This will help heat transfer and extend the life of the tip. Tinning can be accomplished by heating up the iron and applying a small amount of solder to the tip. A heavily oxidized or corroded iron tip will resist tinning. If this is the case consider replacing your iron tip.

Solder
Solder comes in a variety of thicknesses, alloys, and cores. For assembling the uPAD Proto Base you may choose any variety you like other than acid core, which is hazardous to electronics. For this application leaded solder with a medium thickness of (~.032”) is recommended.

Diagonal Cutters
Diagonal cutters are used for cutting the leads of components close to the board preventing potential shorts. They may also be useful for cutting single row headers to the proper length, and snipping wire wrap.

#1 Phillips Head Screwdriver
Though not required, a #1 Phillips head screwdriver will ease the installation of the LCD and uPAD to the uPAD Proto Base.
Solder Wick
Solder wick is used to remove excess solder when a mistake is made.

Needle Nose Pliers
A small pair of needle nose pliers will aid in holding components to be soldered, as well as the nuts affixing the LCD and uPAD.

Soldering
Prior soldering experience is preferable but not required to complete the uPAD Proto Base. The recommended soldering temperature range is from 615˚ to 650˚. Routinely clean and tin the tip of the iron when in use. Use of a metal mesh to clean the tip is recommended over a wet sponge. Water both shocks the iron tip with a steep drop in temperature, and it oxidizes the iron tip. When tinned the iron tip should merely be coated lightly with solder.

Once the tip is prepared, the component leads must be prepared as well. For through-hole soldering, components should be placed into the board. For components such as resistors or capacitors bending of the leads as shown in Figure 1 will help to retain the component for soldering.

Once in place, gently apply a small amount of flux between the solder pad and component’s leads. Thereafter soldering can commence.
Reference the figure below for all of the basics of proper soldering. Please read all of the captions before continuing.

When soldering, use the area just before the tip of the iron. This will increase the surface area and therefore heat transfer. Apply this area of to the junction of the component lead and the applicable circuit board pad. Solder should be applied to the opposite side of the lead/pad junction rather than the iron to insure the solder bonds properly. Solder will flow towards the heat. Applying solder to the tip will result in solder flowing just into the tip. By applying it to the opposite side, it will flow through the joint. The end result of the solder joint should resemble a Hersey’s Kiss (as shown in Figure 2 A), as opposed to B-D). Joint E is reflective of too much solder, requiring reworking to fix the unintended short. Fluxing the short and dragging the iron between the pins often fixes the short. If the problem still persists use solder braid to wick away excess solder.

**Desoldering**

Trim the wick so that it is pristine. Then flux it and the joint in question. Apply the fluxed braid to the joint, and place the soldering iron tip on top. The braid will wick away excess solder. From the joint.

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**Figure 2: DOs and DON'Ts of soldering (Source SparkFun.com)**

- **Don't**: Use the very tip of the iron.
  - **Do**: Use the side of the tip of the iron, “The Sweet Spot.”

- **Do**: Touch the iron to the component leg and metal ring at the same time.

- **Do**: While continuing to hold the iron in contact with the leg and metal ring, feed solder into the joint.

- **Don't**: Glob the solder straight onto the iron and try to apply the solder with the iron.

- **Do**: Use a sponge to clean your iron whenever black oxidation builds up on the tip.
Assembly

The assembly process is broken down into separate steps. These steps are based on the sequence of labs the Proto Base is designed to implement. It is very important that these steps are followed in order and that the assembler does not go further ahead than instructed.

For each part of the assembly process, Out of the Box recommends the use of flux when soldering and an iron temperature of 615° to 650° F. When soldering a multi-pin header, initially solder just one pin. Before proceeding to solder the remaining pins, ensure proper placement. If needed adjustments can be made by melting the joint. Then when satisfied the remaining pins should be soldered. Finally pay close attention to which side of the board the components should be soldered to.

Module 1

Figure 3: Bare Proto Base without uPad (TOP of board)

Above is the bare top of the Proto Base with the uPAD removed. The components that are to be soldered in this module are highlighted in red and blue. Red components are soldered to the pads on the top of the board, and blue components are soldered to the bottom of the board. For headers red means the long portion of the pins will point out of the bottom of the board, and blue ones will point out the top.

Step 0: Breaking Headers to Size

In order to do the following steps you will need to break apart some of the headers in your kit accordingly. These headers will be used for the steps to follow. Make sure to hold onto all of your extra 40 pin headers and partial headers.
1. Break one of your 40 pin headers into 10x 4 pin headers
2. Break two of your 40 pin headers into 5x 8 pin headers each
3. Break one of your 40 pin headers into 3x 6 pin headers and 2x 11 pin headers.
4. Break one of your 40 pin headers into 6x 5 pin headers and 1x 10 pin header.

Step 1: PORTB/ANALOG Headers

Figure 4: Location of PORTB/ANALOG Headers

Flux the hole closest to the label AFE7 on the top of the board, and insert a 4 pin header from the bottom of the board.

Figure 5: Top of Proto Base with header in PORTB/ANALOG section

Load up your soldering iron with solder, and apply it to the AFE7 pin you fluxed previously. This will tack the 4 pin header to the board just like Figure 5 above.
With only a single pin tacked, determine whether the header is soldered sufficiently, i.e. it is perpendicular to the board. Doing so is particularly critical for this set of headers since they will be used with jumpers. So take caution before proceeding to solder the full row. Repeat these steps for the other 2 headers to complete this part of the assembly.

**Step 2: I/O Headers**

Following the same procedures for tracking down and testing for perpendicularity of the headers in step one, solder the headers highlighted in Figure 8.
**Step 3: Power Headers**

Solder the headers highlighted in Figure 9.

**Figure 9: Power Header Locations**

**Step 4: JTAG Header**

Solder the headers highlighted in Figure 10. Notice the highlight color is blue meaning that the headers will be soldered to the bottom of the board, and the long side will point out of the top of the board.

**Figure 10: JTAG Header Location**
Step 5: MCU/CPLD Header

Figure 11: MCU/CPLD Header Location

Solder the headers highlighted in Figure 11.

Step 6: CPLD Socket

Figure 12: CPLD Socket

Solder the CPLD socket highlighted above. As the color indicates the socket will be soldered to the bottom of the board, and the plastic portion of the socket will sit on top of the board.