



## MCT-73 Morse Code Trainer Kit

## Introduction

Learn to send and receive Morse code anywhere with the MCT-73 Morse code trainer! Using the time-tested Koch/Farnsworth methods, the MCT-73 will efficiently walk you through the process of learning Morse code.

The MCT-73 is a rugged kit-built device that is housed in a beautiful aluminum alloy case. It's small (4¾" x 3¾" x 1½") and portable enough to take just about anywhere. With its long battery life (9 volt battery not included), onboard speaker and included earphones, you will be able to easily practice anywhere. Supply your own paddles or straight key and you'll be able to practice sending Morse code too. Since the MCT-73 uses a dedicated microcontroller, you will be able to send Morse code in a virtually lag-free environment unlike most web, computer, or smartphone training apps. An integrated red LED lamp gives visual feedback as you send and receive code as well.

The MCT-73 is an intermediate level kit designed to be built with a minimum of fuss. Built from all through-hole parts and using a custom-designed circuit board to give a little breathing room between components, it's meant to keep assembly as easy as possible.



## Tools and Supplies (Required)



Fine-gauge Wire Stripper



Wire Cutter



#1 Phillips Screwdriver



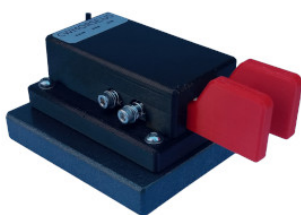
Soldering Iron



Solder



9 Volt Battery



Keyer/Paddles

## Tools and Supplies (Helpful)



Circuit Board Holder



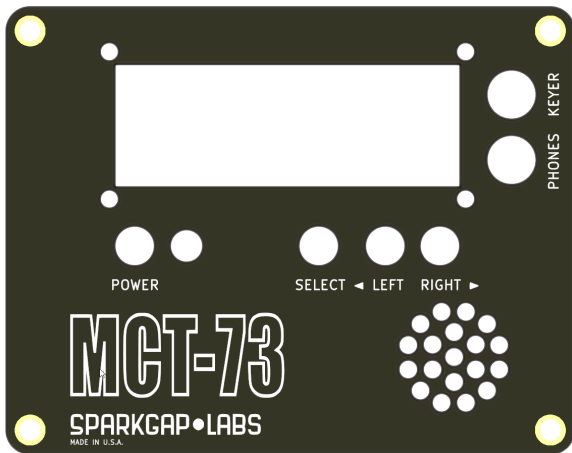
Magnification



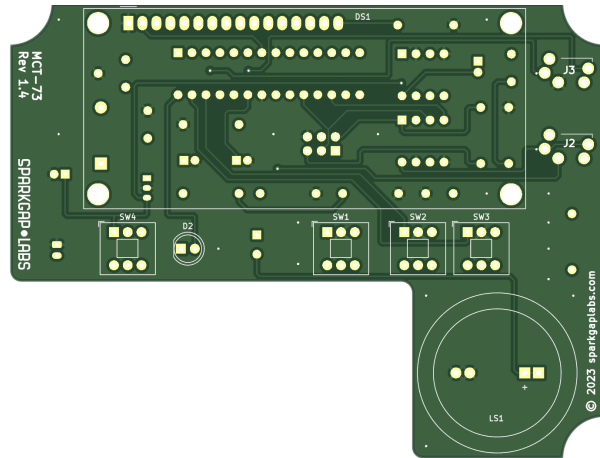
Multimeter



# Parts List



FP: Faceplate



PCB: Circuit Board

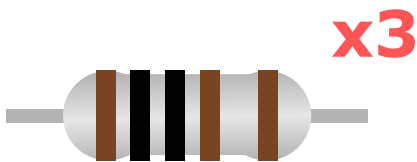


R1: 470Ω 1/4W 1% Resistor



R2, R5: 10kΩ 1/4W 1% Resistors

x2



R3, R4, R8: 1kΩ 1/4W 1% Resistors

x3



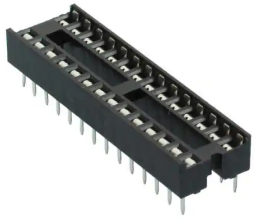
R6: 1.2kΩ 1/4W 1% Resistor



R7: 10Ω 1/4W 1% Resistor



D1: 1N5817 1A 20V Schottky Diode



**U2-SCKT:** 28 Pin  
DIP IC Socket

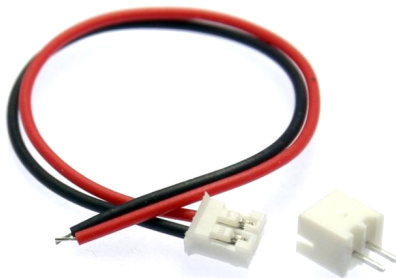


**x2**

**U3-SCKT, U4-SCKT:**  
8 Pin DIP IC Sockets



**J4:** 2x3 ISP Header



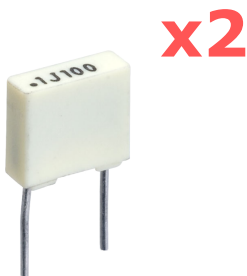
**BT1:** Battery Connector



**U1:** 78L05 +5V  
Regulator

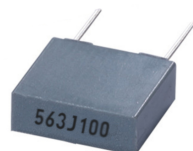


**RV1:** 5kΩ 0.1W  
Trimpot



**x2**

**C4, C6:** 0.1µF  
Capacitors



**C7:** 56nF  
Capacitor



**x2**

**C1, C3:** 0.47µF  
Capacitors



**C2:** 0.33uF  
Capacitor



**C5:** 10uF  
Capacitor



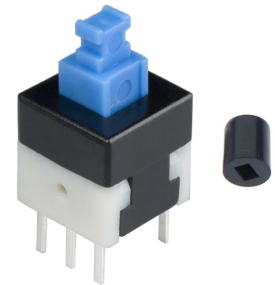
**C8:** 220uF 25VDC  
Capacitor



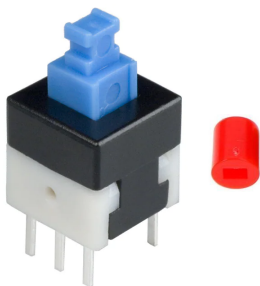
**D2, D2-SPCR:** 5mm  
Red LED w/ Spacer



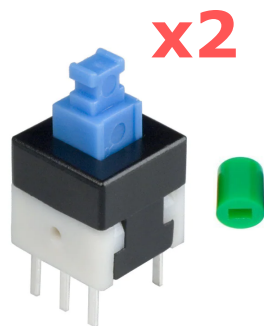
**J2, J3:** 3.5mm  
Vertical Stereo Jacks



**SW4:** Latching DPDT  
Switch



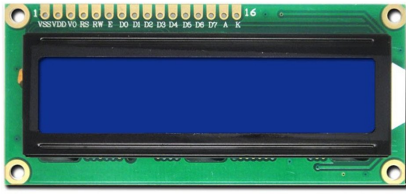
**SW1:** Momentary DPDT  
Switch



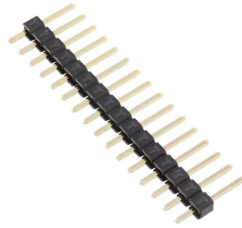
**SW2, SW3:** Momentary  
DPDT Switches



**LS1:** PC Board  
Mount Speaker



**DS1:** Blue 16x2 LCD Display



**DS1-HDR:** 16 Pin LCD Header



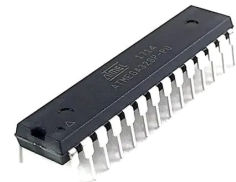
**SCREW:** M3x20mm Pan Head Machine Screws



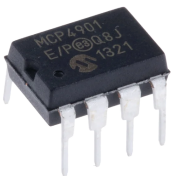
**SPACER:** M3x5mm ABS Spacers



**NUT:** M3 Hex Nuts



**U2:** ATmega168A Microcontroller



**U3:** MCP4901 8-Bit Single Output DAC



**U4:** LM386/JRC386 Audio Amplifier



**BT1-CLIP:** 9V Battery Clip



**ENC:** Diecast Aluminum Enclosure



**FT:** Adhesive Feet



**TSCREW:** Knurled Thumb Screws



**BTACK:** Reusable Adhesive



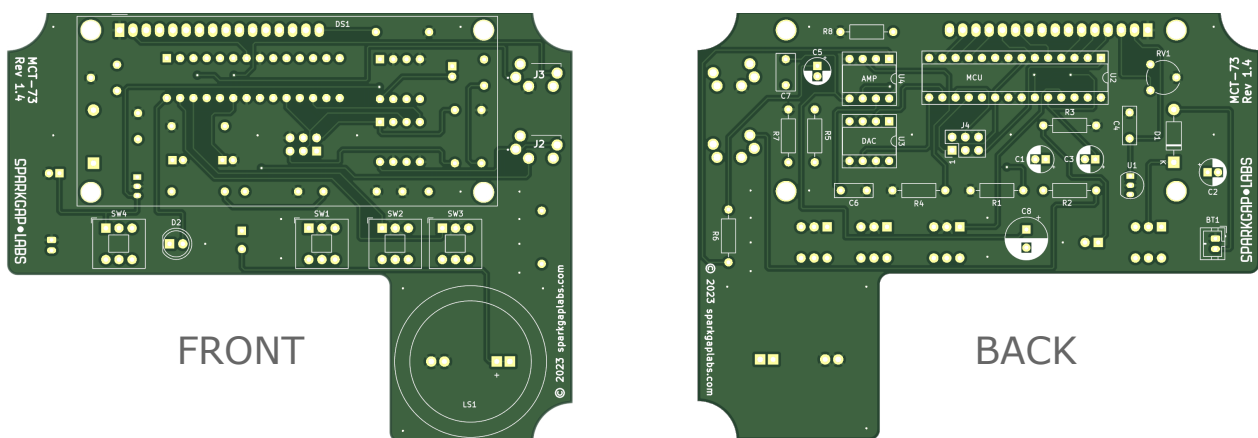
**PHONES:** Stereo Earphones



# Assembly

The MCT-73 kit is an intermediate level kit and requires basic soldering skills. There are many good soldering instruction guides and videos available on the internet. If you are just starting out or need a refresher, start there. A very popular guide is the "Soldering is Easy" guide by Mitch Altman, Andie Nordgren, and Jeff Keyzer, available at <http://mightyohm.com/soldercomic>.

The MCT-73 is built on a two-sided/two-layered circuit board. Almost all components are installed on the back of the circuit board while buttons, jacks, speaker, and LCD display are installed on the front. When in doubt, look for the white silkscreen outlines of the components on the circuit board. You should always install components on the side that shows their corresponding silkscreen. Besides taking the normal care to install orientation-specific components in the correct orientation, making clean and non-shorting solder joints, and soldering components level and snug against the circuit board, there isn't anything particularly difficult about assembly. Perhaps the one exception is the installation of the LCD display. Once it is installed on the front of the circuit board, components on the back of the circuit board will no longer be accessible. So, take care that all other components are installed correctly before installing the LCD display.



As you read these assembly instructions, look for these symbols calling out the following:



A tip or hint to make assembly easier.



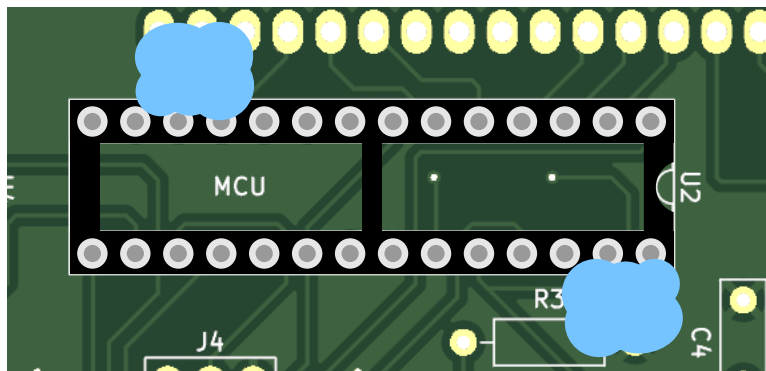
These components are orientation-specific. Take care to install them correctly.

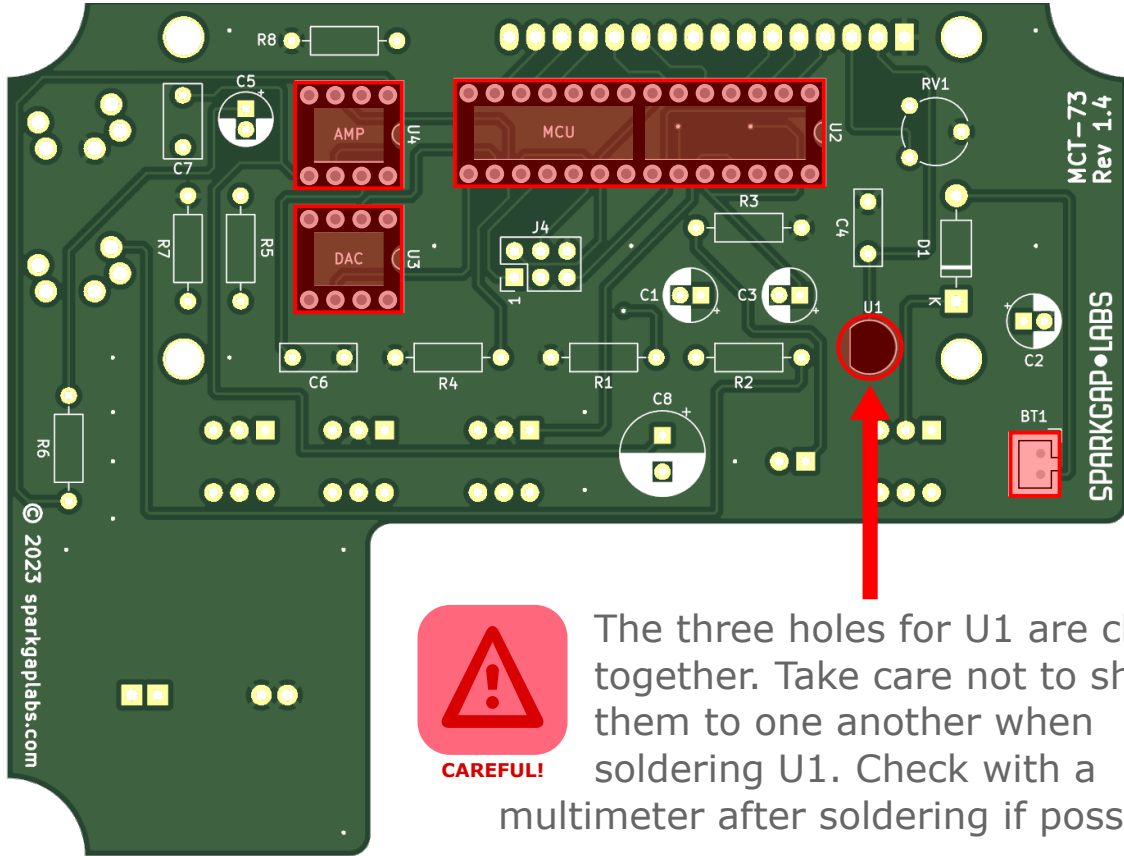


The installation of these components are particularly tricky or can cause problems if not installed in a certain way or order.



A small amount of Blu Tack® reusable adhesive has been included with this kit. Use it to hold components securely in place while soldering them (remove it after soldering the component, of course). It can be broken into several pea-sized pieces so you can hold multiple components at once or hold a component securely from multiple points. It's highly recommend to use it for most/all components to make assembly easier and to ensure components are squarely soldered to the circuit board. As several of the components need to line up with holes in the faceplate, precise positioning of some components is very important.



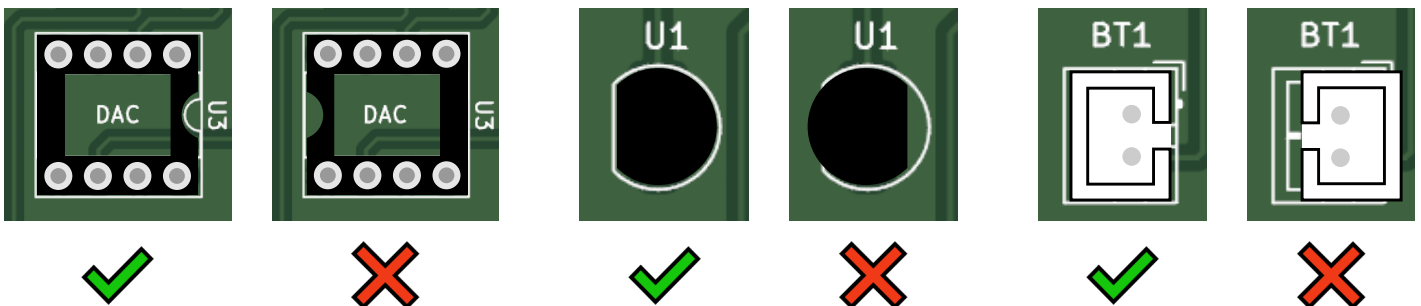


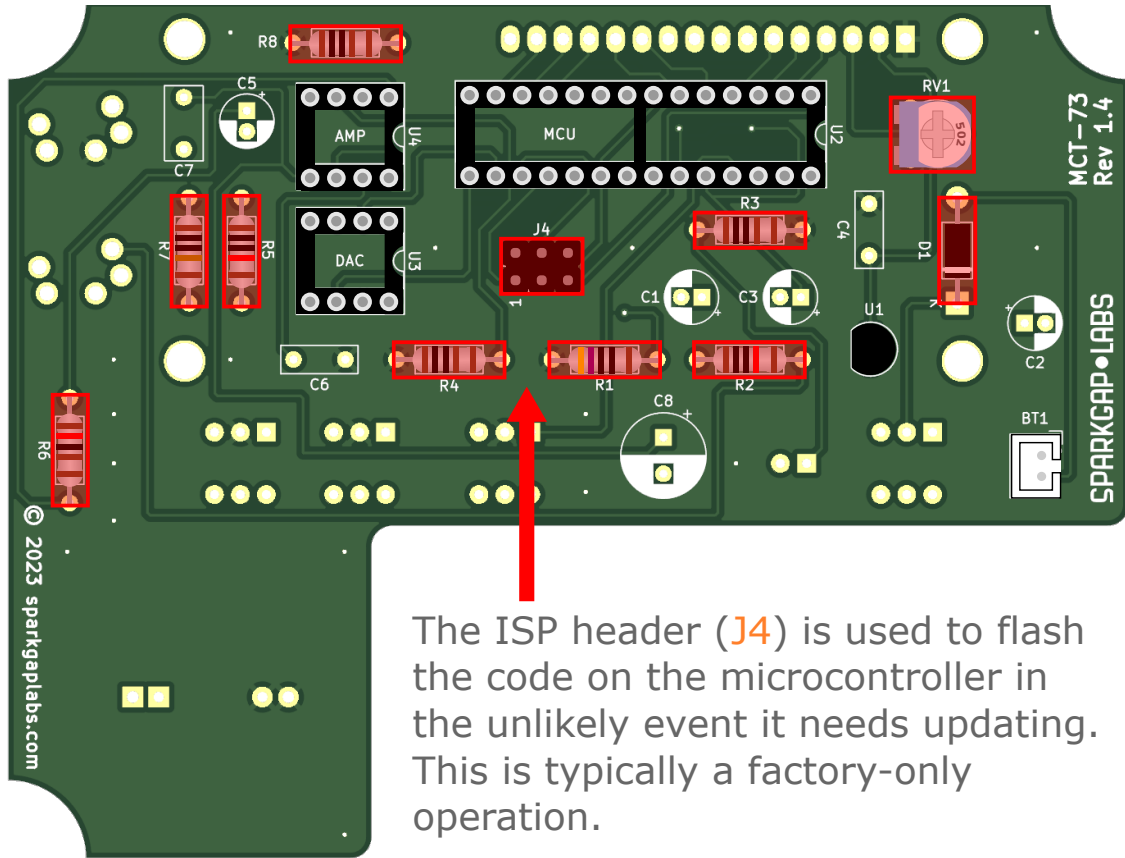
**1**  
STEP 1

Working on the back of the circuit board, install the three IC sockets (U2, U3, and U4), the +5V regulator (U1), and the male, 2-pin connector (BT1). The ICs that go into U2-U4 will be installed later.

**ORIENTATION**

All these components have a required orientation. Note the notches on U2-U4, the flat spot on U1, and the notch on BT1. Use the white silkscreen printing on the circuit board as a guide.



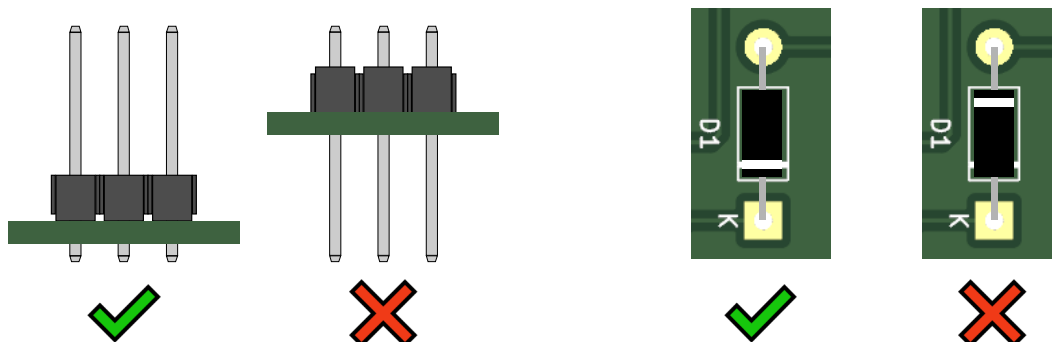


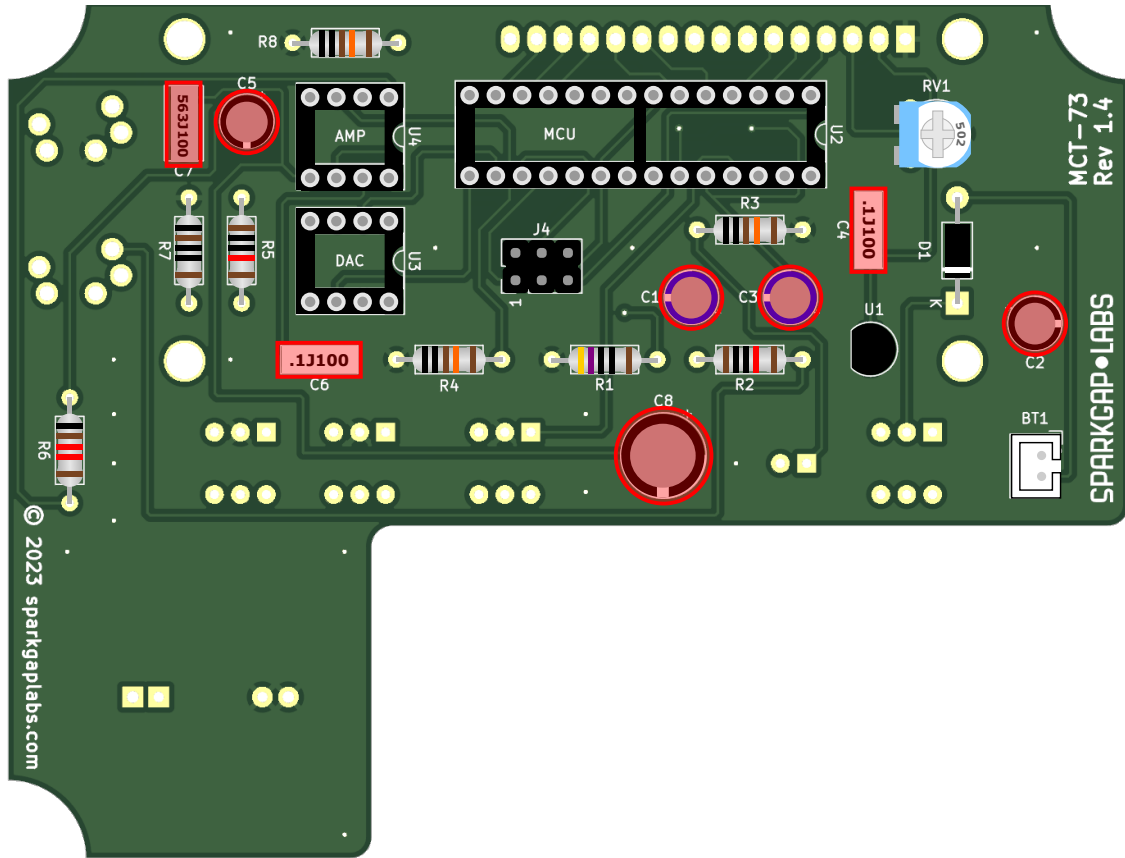
**2**  
STEP 2

Still working on the back of the circuit board, install the ISP header (J4), the eight resistors (R1-R8), the diode (D1), and the trimpot (RV1).

**ORIENTATION**

Solder the short pins of the J4 header to the circuit board, not the long pins. Align the band on the end of the D1 diode with the band shown on its corresponding silkscreen footprint.



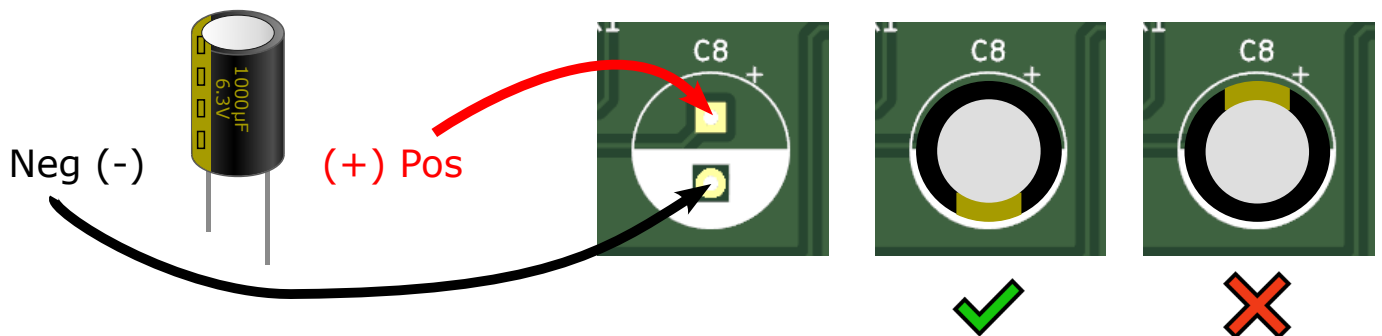


**3**  
STEP 3

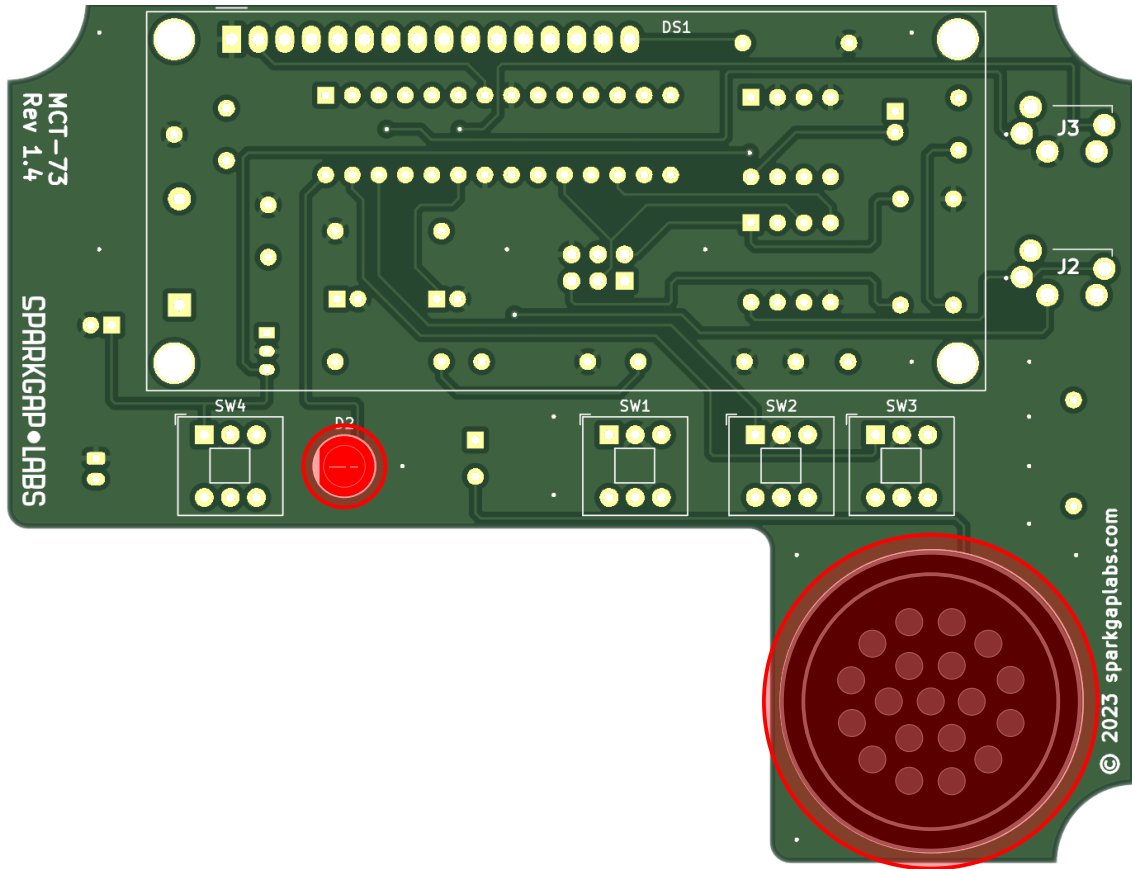
To finish the back of the circuit board, first install the three box-type capacitors (C4, C6, C7), followed by the five electrolytic capacitors (C1-C3, C5, C8).

**ORIENTATION**

Electrolytic capacitors (C1-C3, C5, C8) are orientation-specific. The stripe on their side (and their shorter lead) indicates their negative lead which must be aligned with the solid white half-circle printed on the circuit board.







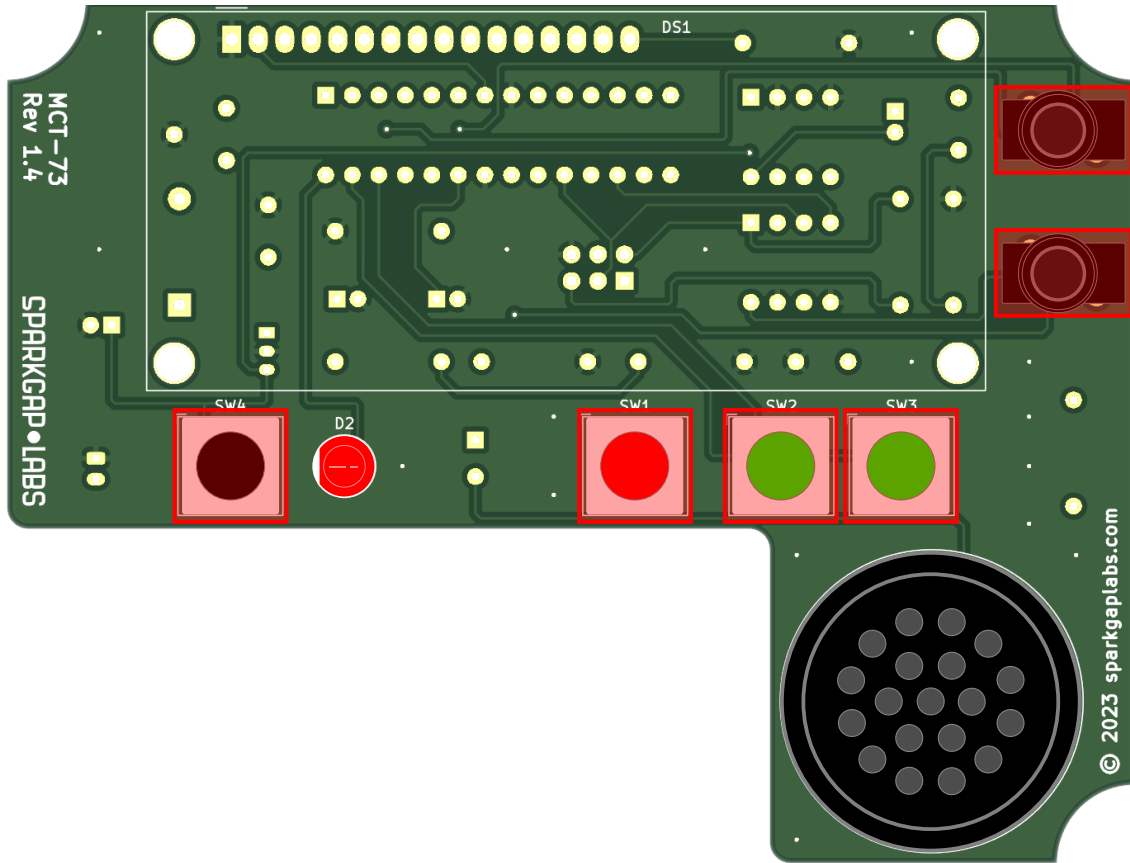
**4**  
STEP 4

On the front of the circuit board, install the LED and its spacer (D2, D2-SPCR) and the PC Speaker (LS1). Note that D2-SPCR has two lead holes unlike the 8 similarly looking SPACER components. The two lead holes should face upwards.

**ORIENTATION**

Ensure the speaker's "+" marking on its back is aligned with the "+" on the circuit board. The flat side of the LED (and its shorter lead) indicates its negative lead which must match its corresponding silkscreen footprint.

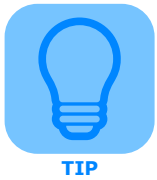




## 5

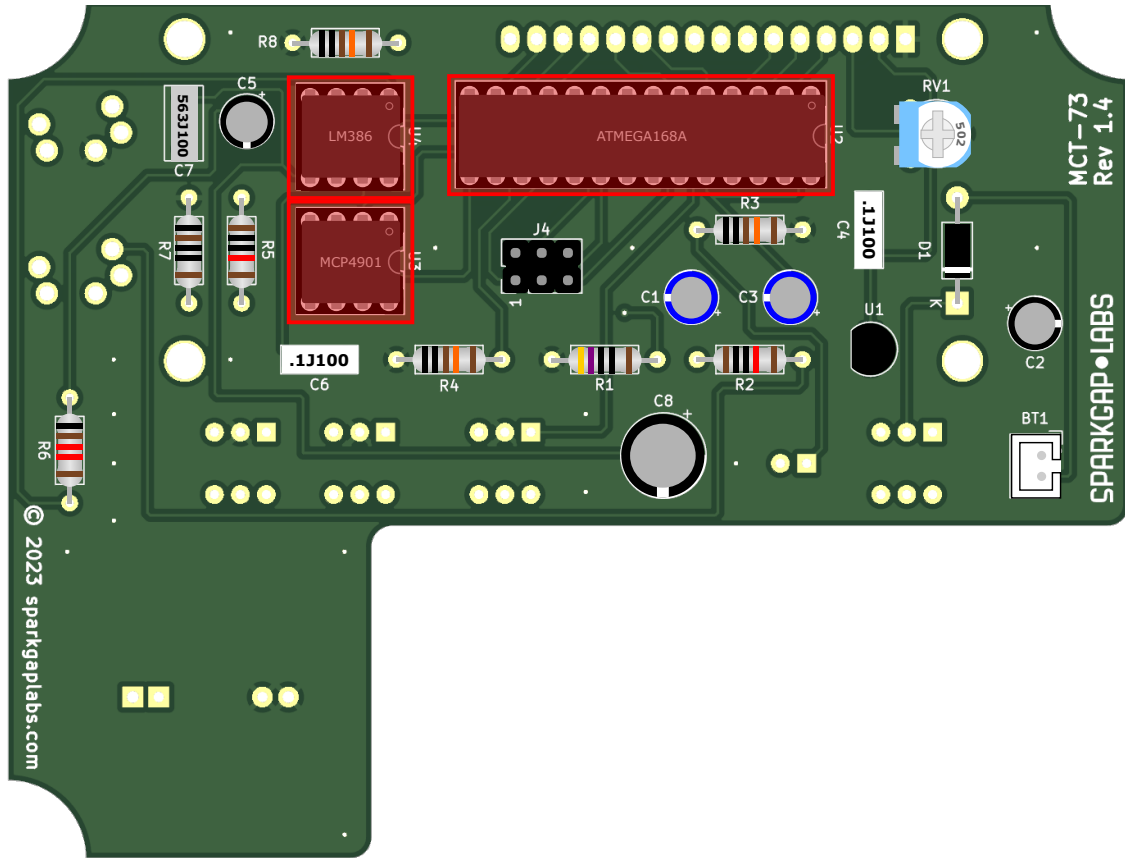
STEP 5

Continuing on the front of the circuit board, install the switches (**SW1-SW4**) and the 2 stereo jacks (**J2, J3**). Ensure that SW4 is the latching power switch by pressing it and seeing that it latches.



TIP

Make sure these components are square and flush with the circuit board so they line up well with the holes in the faceplate. Blu Tack® can help hold these components in place when soldering.

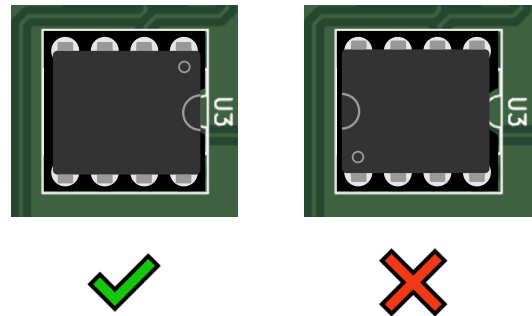
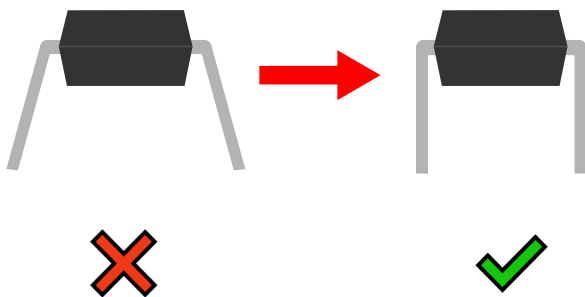


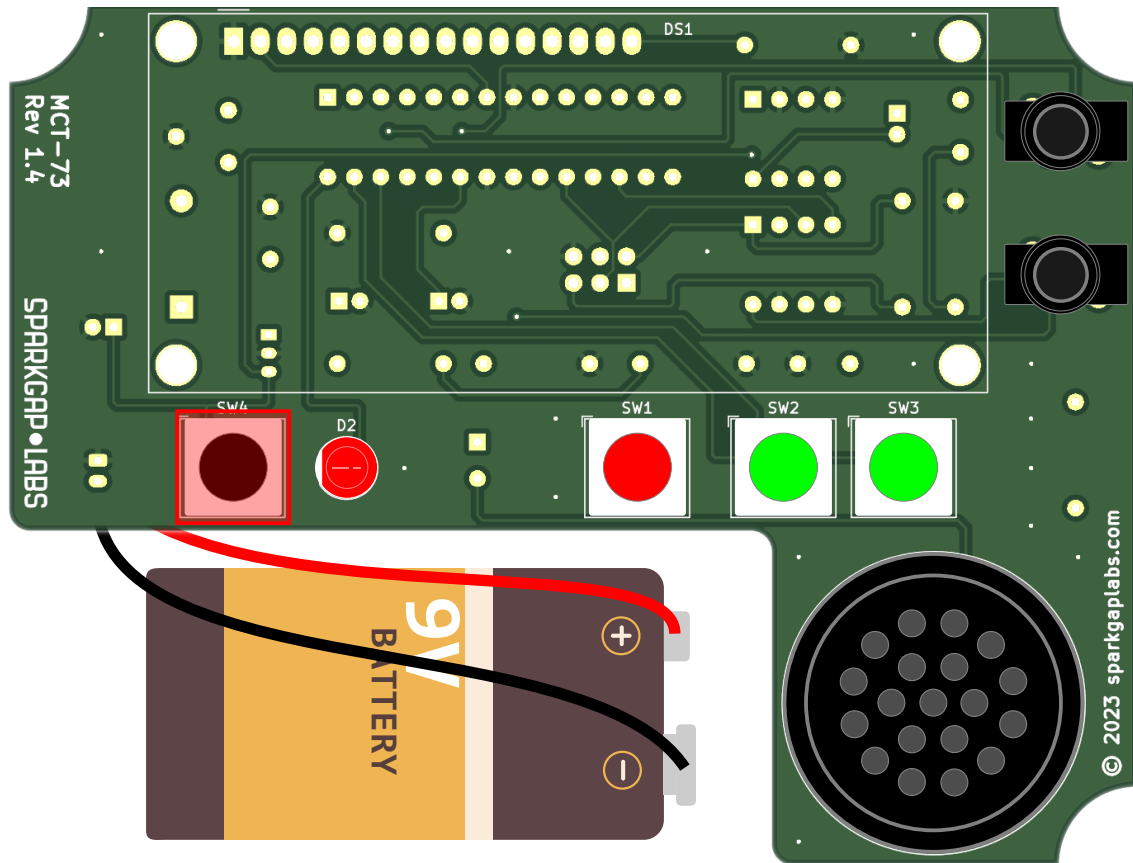
**6**  
STEP 6

Very carefully squeeze the pins of the ICs (U2-U4) together so they are vertical as shown below. Then, very carefully insert them into their corresponding sockets. The pins are very thin and this step is tricky. Take your time!

**ORIENTATION**

Align the notch (or pin-1 dot) on the IC to the notch on the IC socket for all ICs (U2-U4). See below for an example.



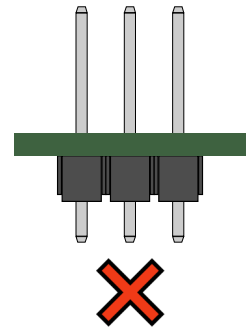
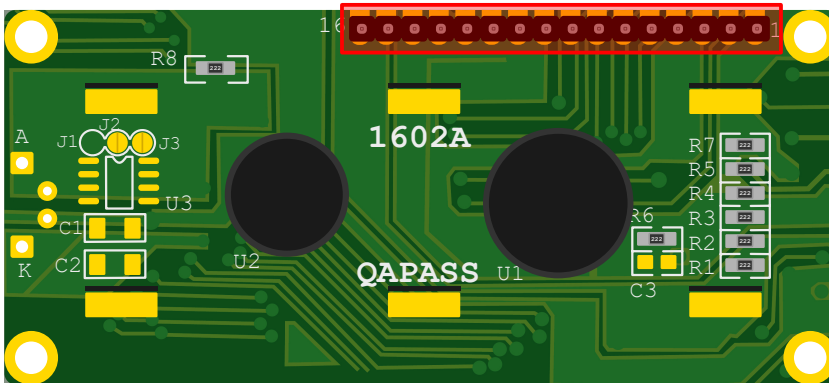
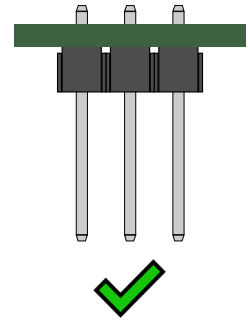
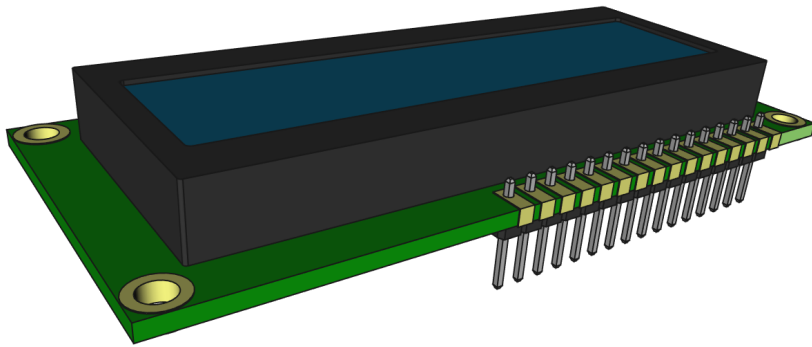


**7**  
STEP 7

If needed, strip some of the insulation from the end of the red and black wires on the wiring harness (BT1) and "tin" the exposed wires with a thin coating of solder. Plug the wiring harness into the BT1 connector on the back of the circuit board. Ensure the black power button (SW4) is latched down in the "on" position. Hold the black wire to the negative terminal of a 9 volt battery and then momentarily hold the red wire to the positive terminal of the battery. You should hear a short beep from the speaker and the red LED should flash once. If not, do not proceed with the LCD display installation. Once installed, the display blocks access to the components on the back. So, the time to fix any issues is now.

**CAREFUL!**

If you did not hear a beep, check all your solder joints, check the orientation of all the components, and ensure no components are shorting with themselves or other components. Also make sure the black power button (SW4) is in the latched position and that you are touching the two wires to the correct battery terminals. Once you do hear the beep and see the red LED flash once, proceed to Step 8.

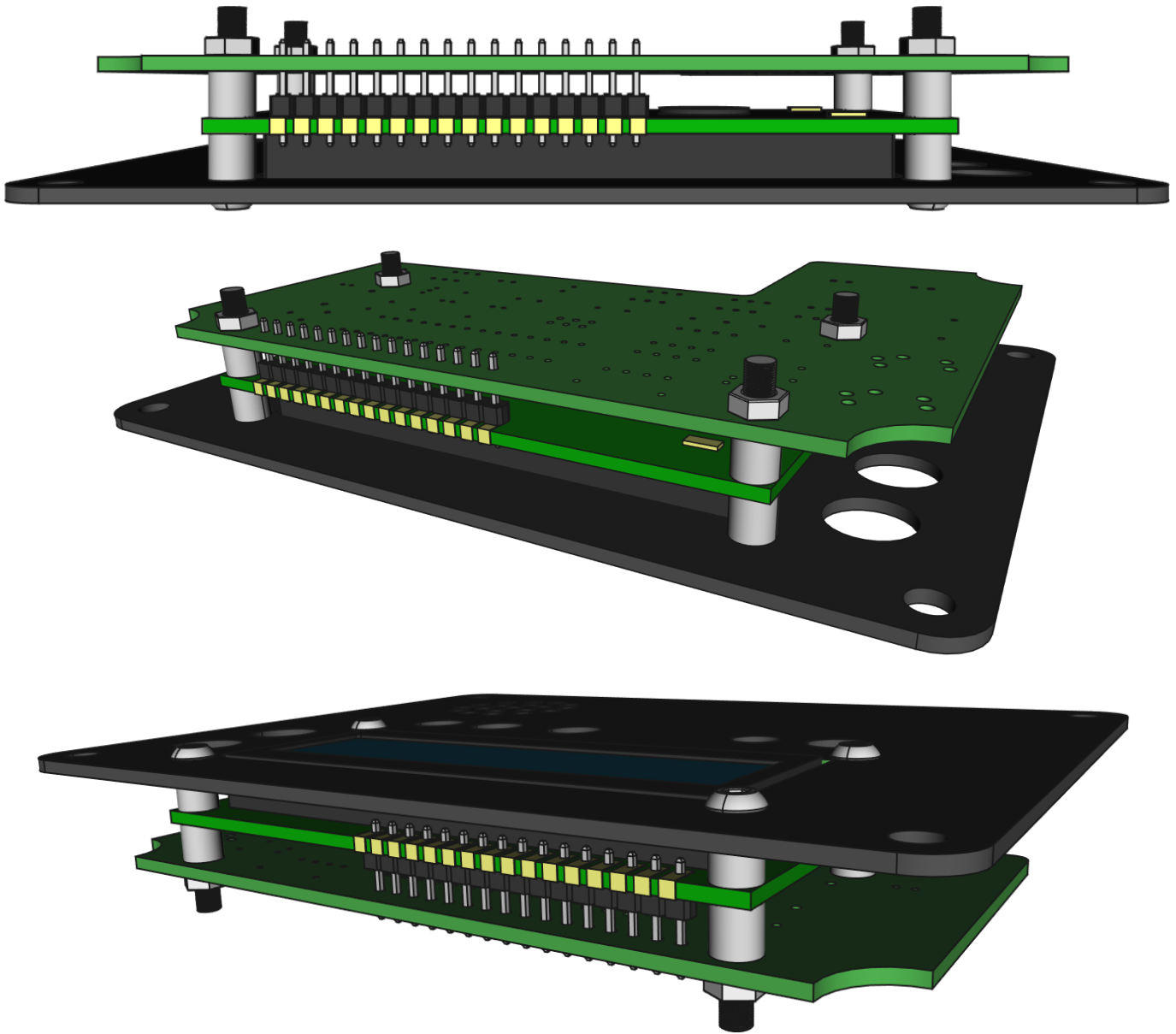


# 8

## STEP 8

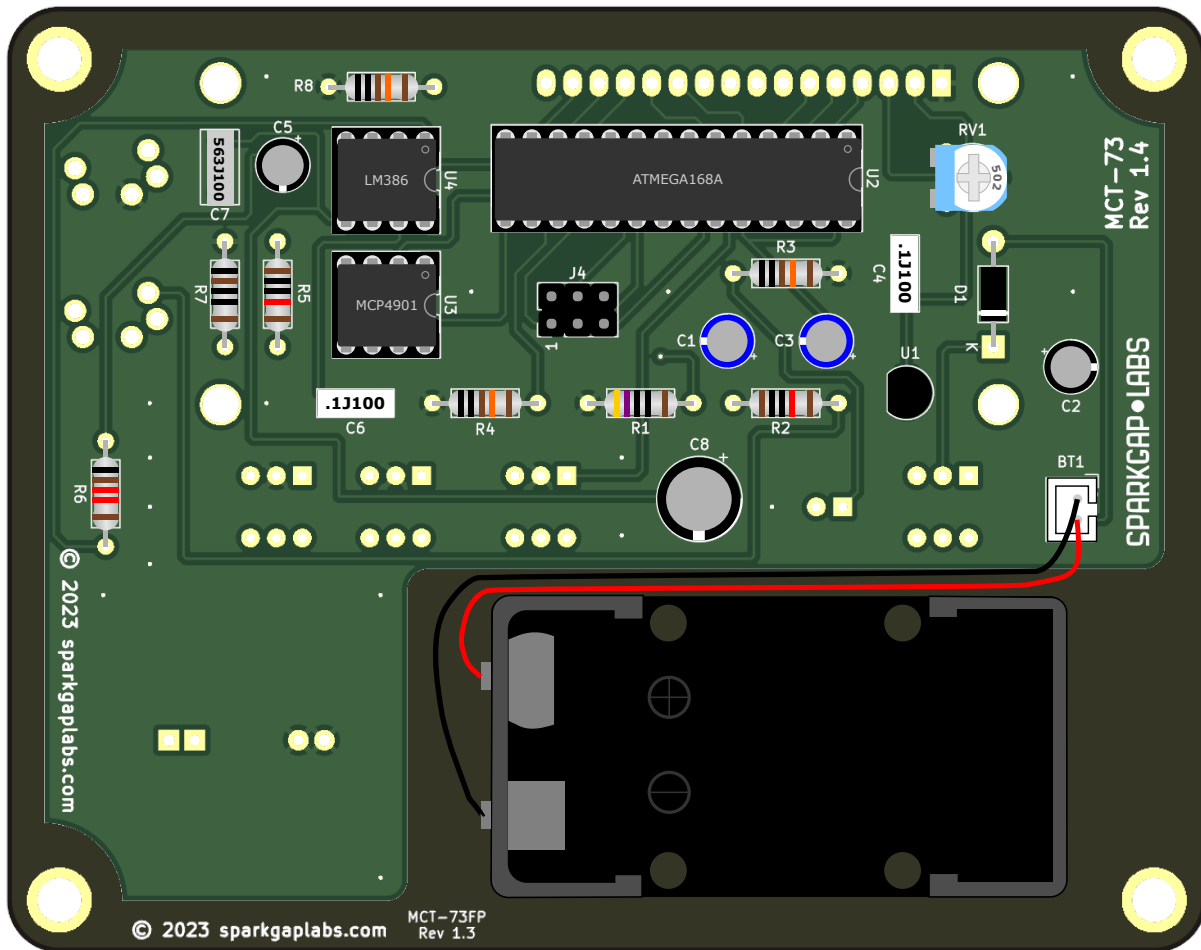
Solder the 16-pin **DS1-Header** on the back of the LCD display (**DS-1**). Make sure you are soldering the shorter part of the header pins as shown above. It is important that you solder the header flush and square on the display. Using Blu Tack® to securely hold the header while soldering is a good way to ensure this.





**9**  
STEP 9

Place the faceplate (FP) face-down on a non-abrasive surface with a SCREW inserted into each of the 4 corner holes with the screws pointing upwards. Place a SPACER on each of the screws. Slide the DS1/DS1-Header assembly on to the screws with the display facing downwards. Place a second SPACER on each of the screws. Slide the populated PCB on to the screws with the speaker (LS1) facing downwards towards the speaker holes in the faceplate. Place a NUT on each of the screws and tighten. Refer to the above images to determine proper installation. Finally, solder the 16 DS1-Header pins on the back of the PCB.



**10**  
STEP 10

Solder the red wire of the wiring harness (**BT1**) to the positive (+) terminal and the black wire to the negative (-) terminal of **BT1-CLIP**. Peel the backing off the adhesive tape on BT1-CLIP and attach it to the faceplate (**FP**) as shown above. Insert a 9V battery into BT1-CLIP. You can now power-up the MCT-73 by pressing and latching the black power button. You should hear a short beep and the LCD display should turn on. Use a small screwdriver to adjust the display's contrast by carefully turning the trimpot (**RV1**).



**11**

STEP 11

Apply the four adhesive feet (**FT**) to the bottom of the enclosure (**ENC**). Place the whole MCT-73 assembly into the enclosure and secure it with the four thumbscrews (**TSCREW**) as shown above. Your MCT-73 is now complete! View or download operating instructions at <https://sparkgaplabs.com/support>.



**CAREFUL!**

The threaded holes in the enclosure have been deburred with a tap and all thumbscrews have been verified to fully engage with the enclosure before shipment. However, due to variations in the casting process, the thumbscrews may occasionally bind up upon insertion. If this happens, don't force them. Rather, back them out and try again until they easily and fully engage with the threaded holes in the enclosure. Also, insert all four thumbscrews (most of the way) before tightening down any of them. This will allow the four holes in the faceplate to lineup with the thumbscrews before tightening.