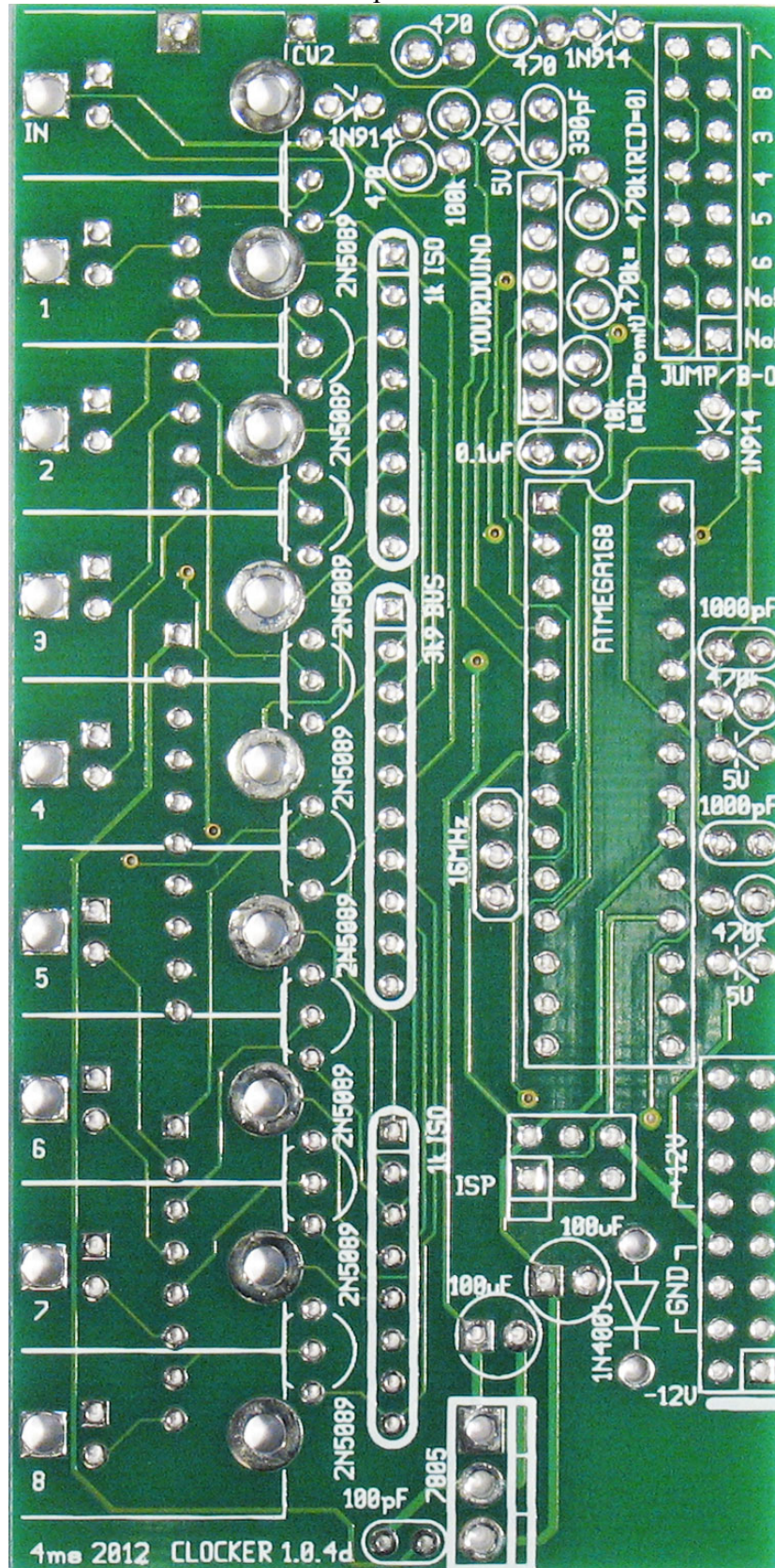


Rotating Clock Divider & Shuffling Clock Multiplier

Kit Builder's Guide for PCB v1.0.4

4mspedals.com



RCD and SCM

This guide is for building a Rotating Clock Divider (RCD) or Shuffling Clock Multiplier (SCM) from the 4ms kit. The circuits are nearly identical, except for some resistors (explained in Step 1). Also, there's different color LEDs and faceplate graphics, and the firmware on the ATMEGA168 chip is different.

Tools Needed:

- Soldering iron
- Flush snips
- Needlenose pliers

Step 1: Resistors

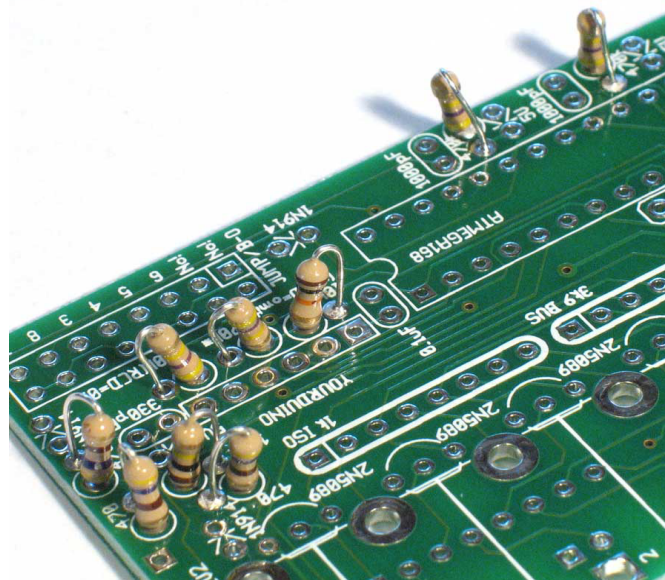
Insert and solder the resistors. After soldering, snip the leads nearly flush to the PCB (you'll be snipping the leads flush on all the components after soldering)

The SCM has 9 resistors

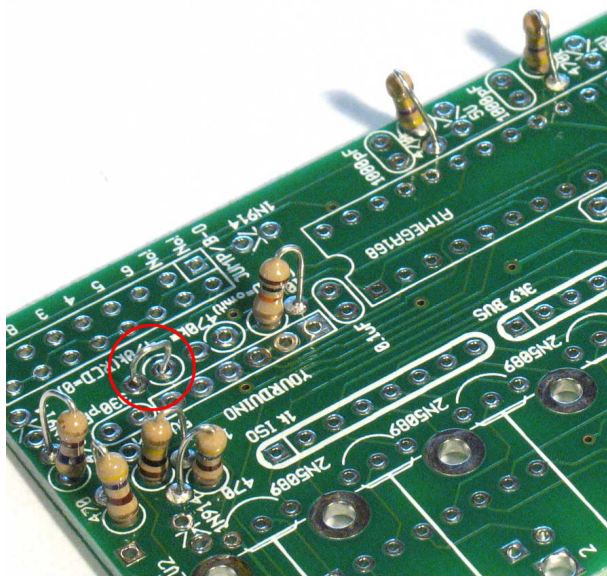
- 470 ohm x 3 (yellow purple brown)
- 10k x 1 (brown black orange)
- 100k x 1 (brown black yellow)
- 470k x 4 (yellow purple yellow) -- only x 2 for the RCD

The RCD is the same, except use only use two 470k resistors. Instead of the other 470k's, one is a jumper (labeled RCD=0), and one is completely omitted (labeled with *RCD=omit).

Be careful not to confuse 470k and 470. The 470k's have two yellow bands, while the 470's have one yellow band.



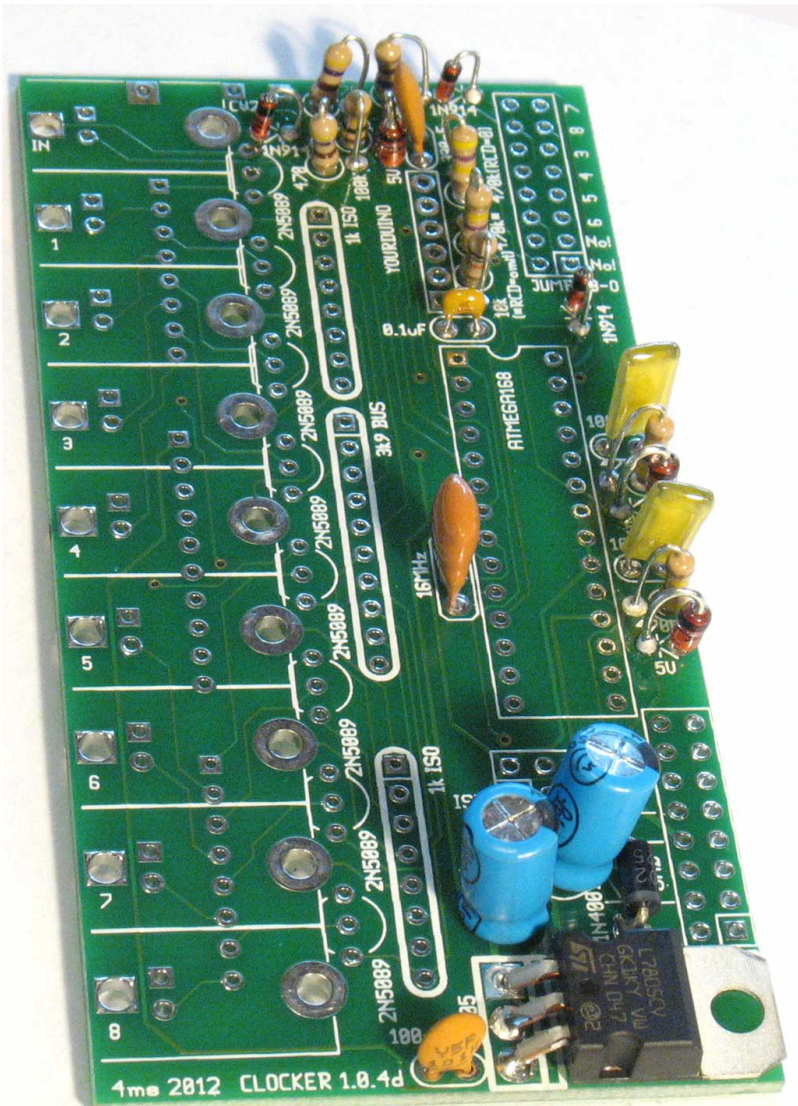
The 9 SCM Resistors



The 7 RCD resistors, plus one jumper wire (circled)

Step 2: Capacitors, Diodes, Crystal Resonator, Voltage Regulator

Careful! Many of these components must be orientated correctly before soldering!



Insert and solder the 7 diodes. There's a white or black band on each diode that must go towards the tip of the arrow on the PCB. The 6 red diodes are bent 180° so they stand up with the black band up in the air.

- “Si” 1N914 diodes x 3 (smallest)
- “5V” 1N4733 Zener diodes x 3 (slightly larger red diodes, “4733”)
- 1N4001 diode x 1 (black)

Insert and solder the 7805 voltage regulator and the 16MHz crystal resonator. The resonator can go in either way, but the 7805 must bend over so that the text is up (see photo).

Insert and solder the 5 small capacitors. They can go in either way:

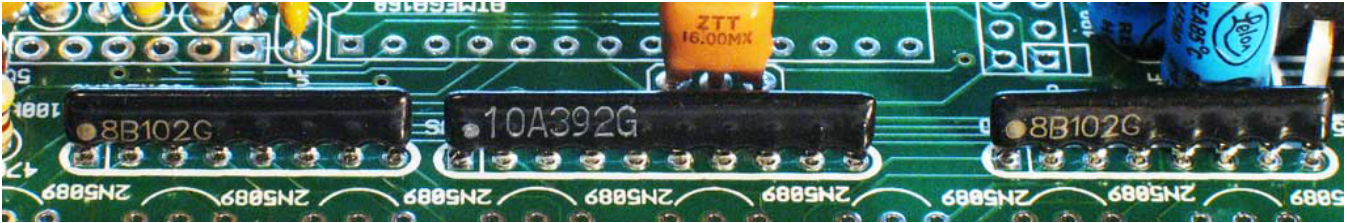
- 100pF (or 101) x 1
- 330pF (or 331) x 1
- 1000pF (or 102) x 2
- 0.1uF (or 104) x 1

Insert and solder the two 100uF caps. One side of the cap is marked with a black or white stripe: this is the negative and it goes in the round hole. The positive lead is longer, and it goes in the square hole.

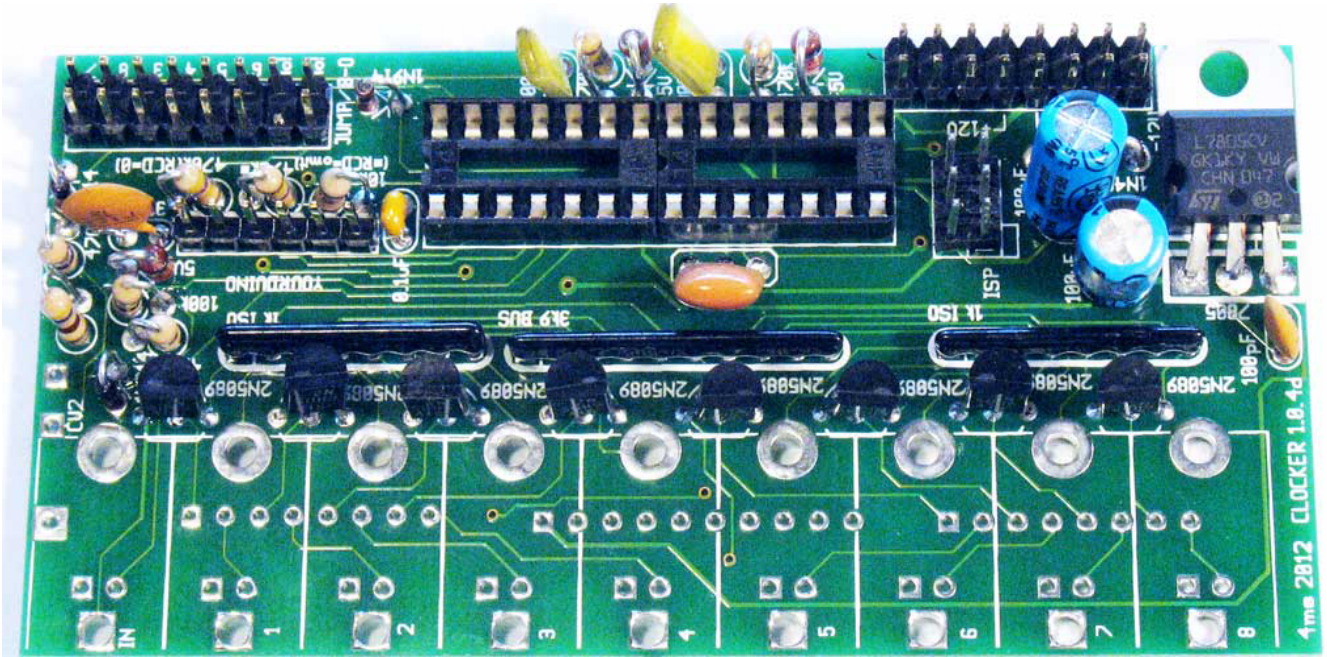
Step 3: Top Resistor Arrays

Insert and solder the three resistor array on the top of the PCB. The dot on each array must line up with the square hole on the PCB (see photo)

- 1k isolated 8-pin array x 2 (“8B102G”)
- 3k9 bussed 10-pin array x 1 (“10A392G”)



Step 4: IC Sockets, Header pins, and Transistors



Insert and solder the two 14-pin IC sockets. The notch in the sockets points towards the top of the board (there is a matching notch drawn on the PCB, too).

- 14-pin socket x 2

Insert and solder the 8 transistors, making sure the flat side faces the edge of the board (towards the jacks).

- 2N5089 transistor x 8

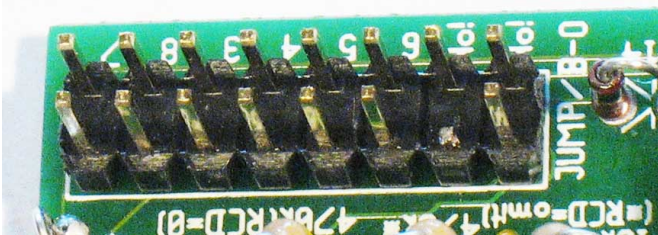
Insert and solder the header pins:

- 16-pin header x 2 (for RCD one is 2x6, see note below)
- 2x3 header x 1
- 1x6 header x 1

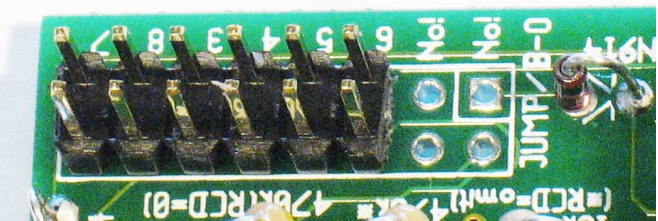
Breakout header pins (top right corner 16-pin header)

For the SCM, snip off the pin on the left column, second one up (next to the white box on the PCB). This is so that you don't accidentally put a jumper there.

For the RCD, omit the bottom two rows of header pins. They have no purpose on an RCD. If you already put them on, it's OK, but just remember not to put a blue jumper on those pins.

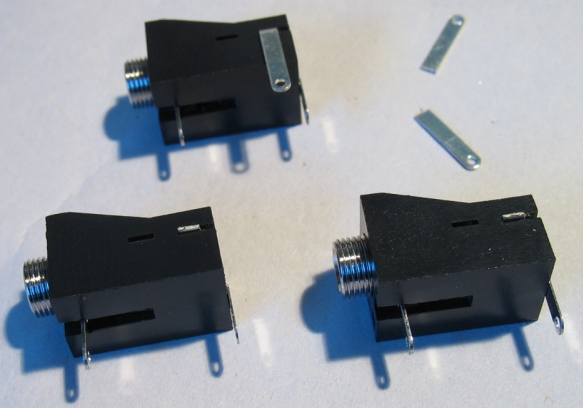


SCM 16-pin breakout header (note one pin is snipped)

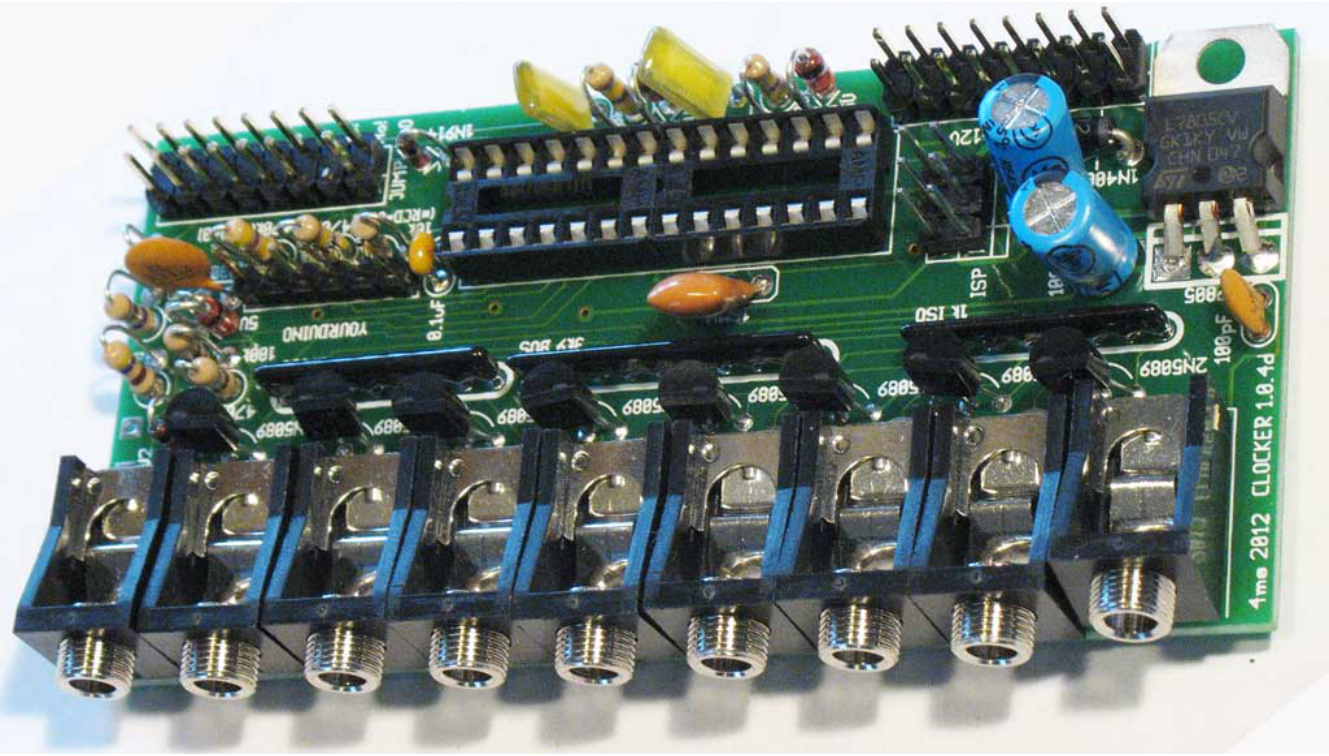


RCD 16-pin breakout header (note 4 pins are omitted)

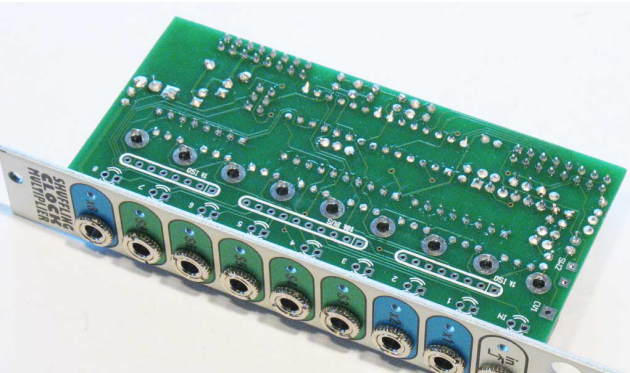
Step 5: Jacks



Break off the side tab on the 9 large jacks (see photo on left). Just bend it back and forth once or twice and it should break off easily.

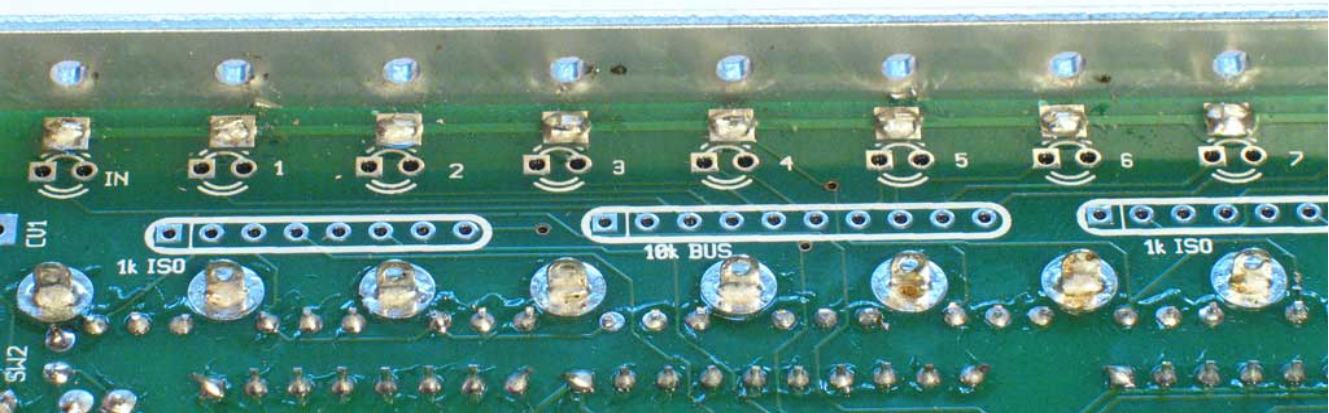


Insert the jacks into the PCB, but **do not solder them yet!**



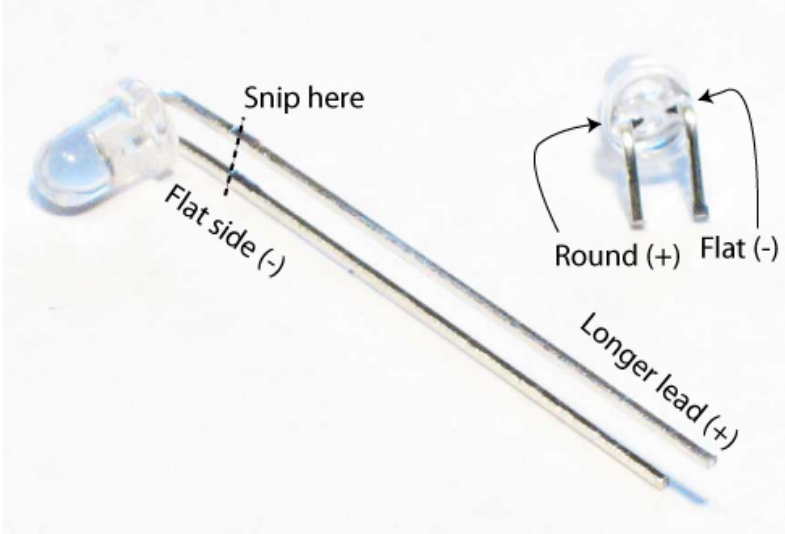
Loosely place the faceplate on the jacks, making sure the top two empty holes go towards the top of the PCB.

Put the nuts on the jacks loosely, and then go back and tighten them all down. To avoid scratching the faceplate, use a nut driver tool, or pliers with the tips wrapped in masking tape.



Now solder the jacks, and snip the tips of the ground leads flush with the PCB.

Step 6: LEDs (dry insert)



The LEDs must be bent 90 degrees at the head, and then snipped. The place to snip is at the top of where the leads have little bumps. If in doubt, snip a little bit at a time, you can always snip more (but can't un-snip!)

Bend each LED so that if you hold it with the head pointing to the left and the long lead closest to you, then the leads should be bent downwards (see photo on left). You know you did it right if you can insert the LED into the PCB and the positive (+) lead goes in the square hole.

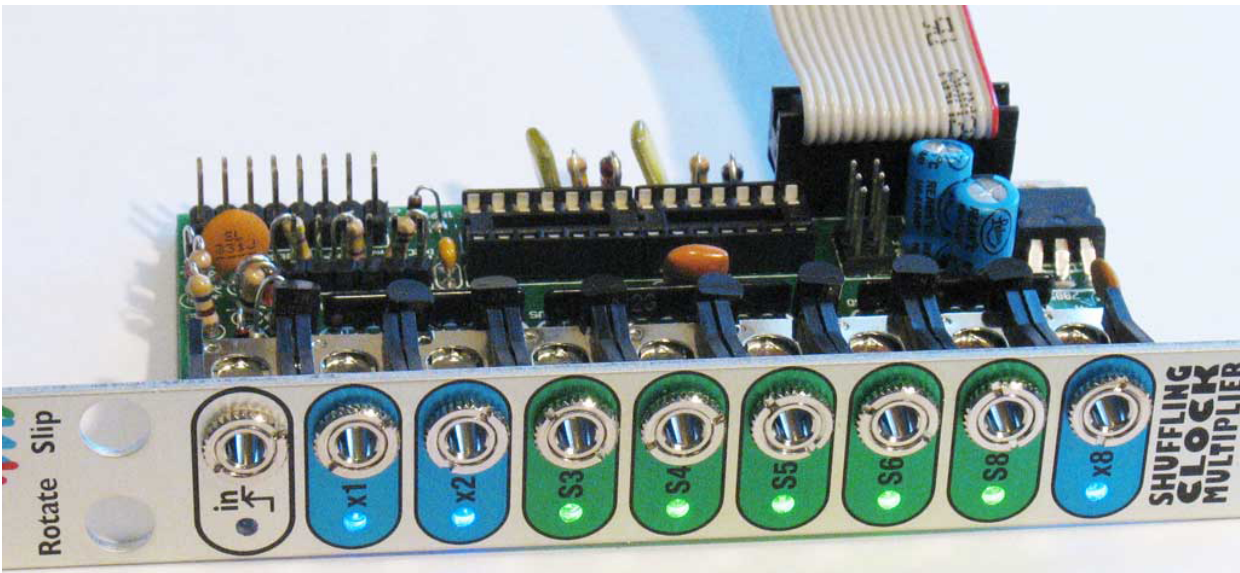
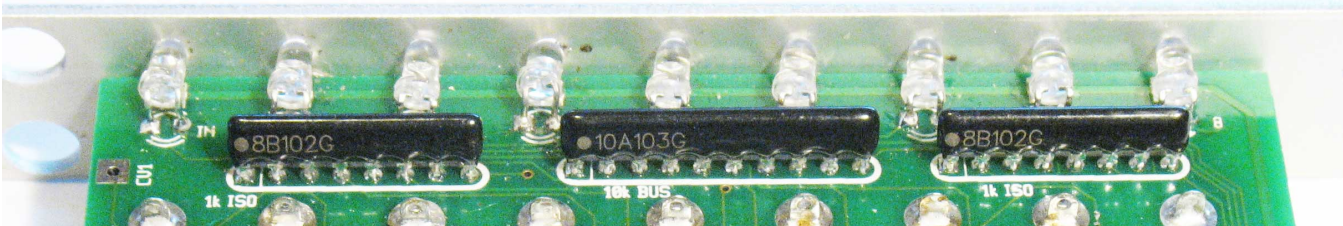
Do the LEDs one at a time, so you don't forget what color each one is. After bending each one, immediately insert it into the board and make sure the positive is in the square hole (flat side of the LED is above the round hole). If you bent it at the head and got a good 90 degree angle, the head should snap snug into the hole in the faceplate.

Don't solder the LEDs yet!

Step 7: Bottom Resistor Arrays

Insert and solder the three resistor array on the bottom of the PCB. The dot on each array must line up with the square hole on the PCB (see photo). The arrays will stand up a bit because of the jacks on the other side. **Solder them from the same side they're mounted on** (it may help to bend them over to solder).

- 1k isolated 8-pin array x 2 ("8B102G")
- 10k bussed 10-pin array x 1 ("10A103G")



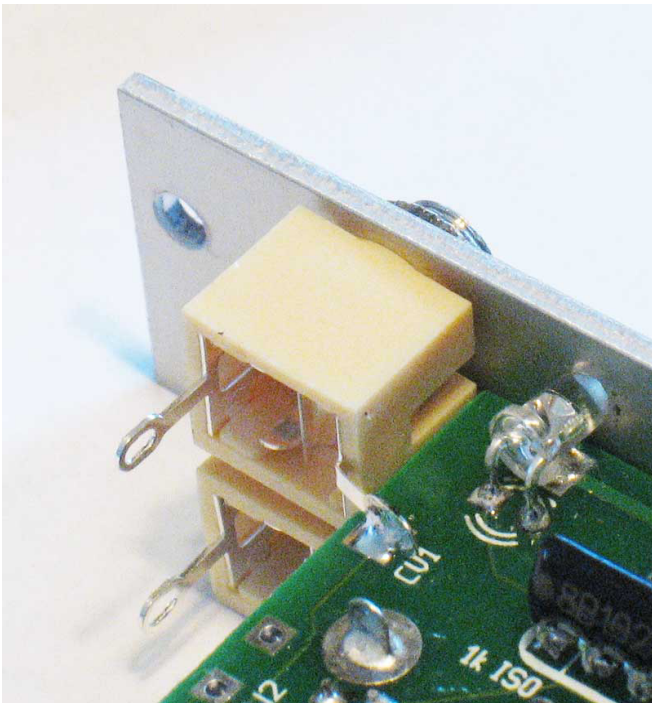
Now, check your LED colors before soldering them. Plug in a standard Doepfer 16-pin power connector to the header pins on your board. All the LEDs except the top one should light up. Verify you like the colors, or switch LEDs if you don't.

If an LED doesn't light up, it might be loose, so wiggle it. If it lights for even a millisecond, that's OK, it will stay lit once you solder it. If it still doesn't light, verify that the positive lead is in the square hole (flat side of LED is above the round hole). If not, remove power, remove the LED, bend the leads the other way, and try again.

Once 8 LEDs are lighting up, unplug power and **solder them from the same side they're mounted on.**

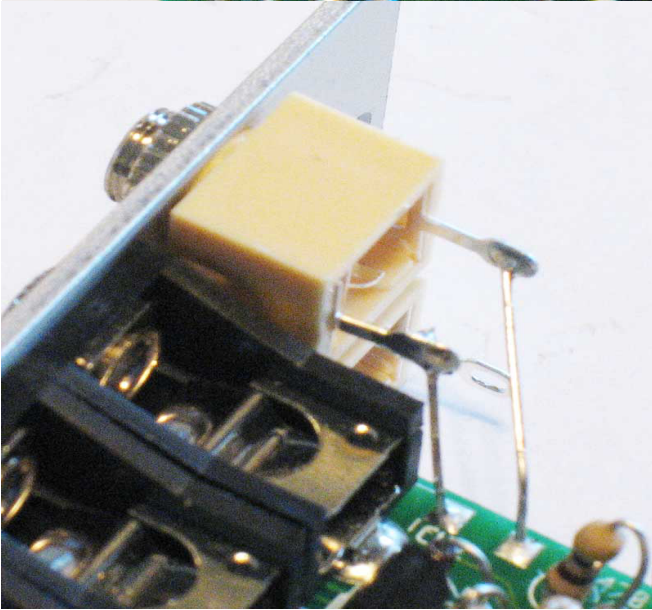
Step 8: Small jacks

Mount the two small jacks into the two top holes on the faceplate. Orient them so that the ground tab is pointing up and the spring is at the bottom.



Bend the tab over on the left jack (“Rotate”) so that it hits the CV1 pad on the PCB. Solder it to the pad.

You may snip the ground tab off if you wish, as the photo shows.

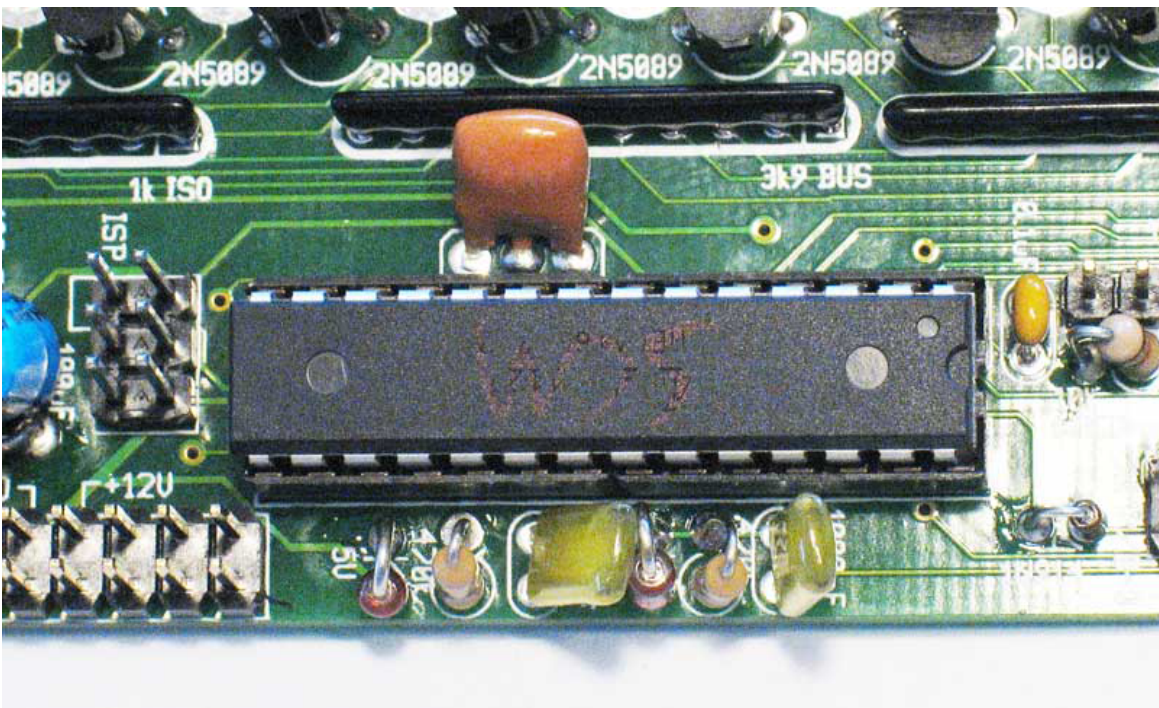


Solder two wires from the right jack (“Reset” on the RCD, or “Slip” on the SCM) to the CV2 and JACKSW pads on the PCB. The signal tab (lower) goes to CV2 and the switch tab (upper) goes to SW2 (labeled on the back of the PCB)

Use some of the leads you snipped off after soldering the resistors or capacitors in earlier steps.

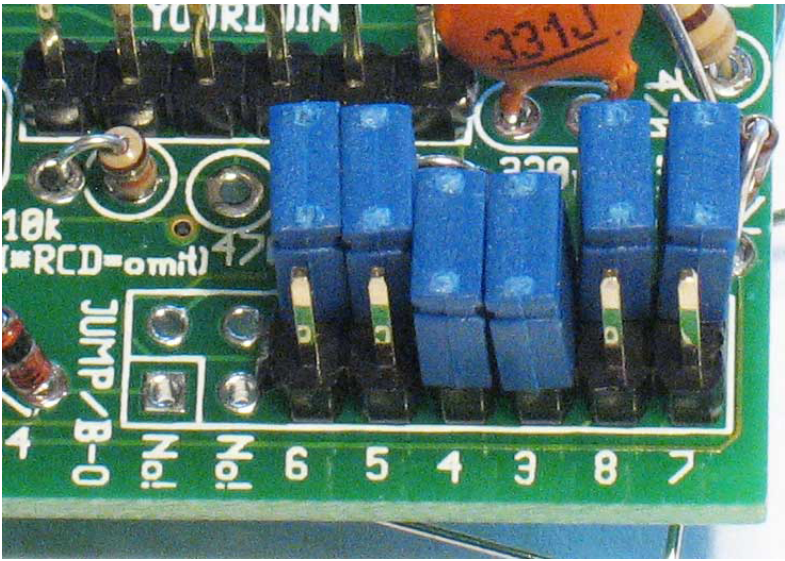
Step 9: AVR Chip

Now that we're done soldering, it's safe to insert the chip into the socket! It's very important to 1) not bend any pins, 2) be gentle when inserting it, and 3) line up the notch on the chip with the notch on the socket (notch points towards the top of the PCB).

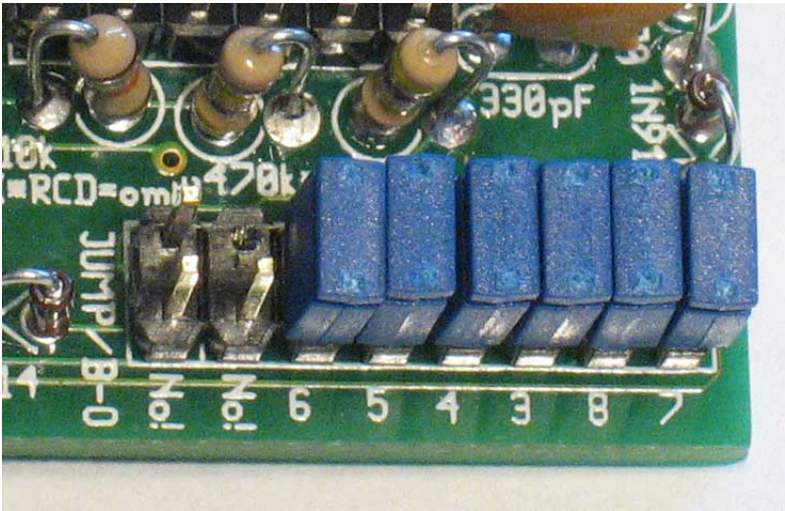


Step 9: Jumpers: Home Free!

Insert the jumpers as shown. The jumpers are necessary for the SCM to function without a breakout, but for the RCD you may put jumpers on and off as you wish. The suggested default setting is shown.



RCD jumpers



SCM jumpers

Refer to the RCD and SCM manuals for an explanation of the jumper's functionality

Fire it up!

... But first, take a short break. Really. Come back to the project with a clear head and look everything over carefully. Look for badly soldered joints (solder not going all the way around the lead, or not making a perfect hershey-kiss shaped mound). Look for backwards diodes, capacitors, transistors, and resistor arrays. Make sure the notch on the chip points towards the top of the unit. You already tested your LEDs, but check to make sure they have not been bent and are shorting to the board. Check your wiring on the small jacks, make sure the wires aren't touching anything.

OK? Ready? Feeling good? Fire it up! Plug in the power cable, red stripe (-12 or -15V) down. If it's an SCM, the eight output lights should start blinking, but the top light won't blink unless you feed it a clock. If it's an RCD, nothing should happen: no signs of life until you feed it a clock signal. When you give the RCD a clock, the jacks should all light up in sequence. If it doesn't work, power it down immediately and feel if anything is getting hot. Check around, you can find your mistakes if you hunt for them. Once you get it working... enjoy!

Congrats!!

