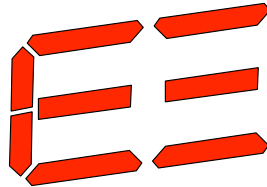


PEGGY 2.0: A LIGHT EMITTING PEGBOARD DISPLAY PANEL KIT

AN OPEN-SOURCE HARDWARE+SOFTWARE PROJECT
DESIGNED BY



Evil Mad Scientist Laboratories

*Making the World a Better Place,
One Evil Mad Scientist at a Time*

SUPPORT: [HTTP://WWW.EVILMADSCIENTIST.COM/FORUM/](http://www.evilmadscientist.com/forum/)



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KIT VERSION 2.0
MANUAL V. 2.0A

Intro + Tour

Hi, I'm Peggy!

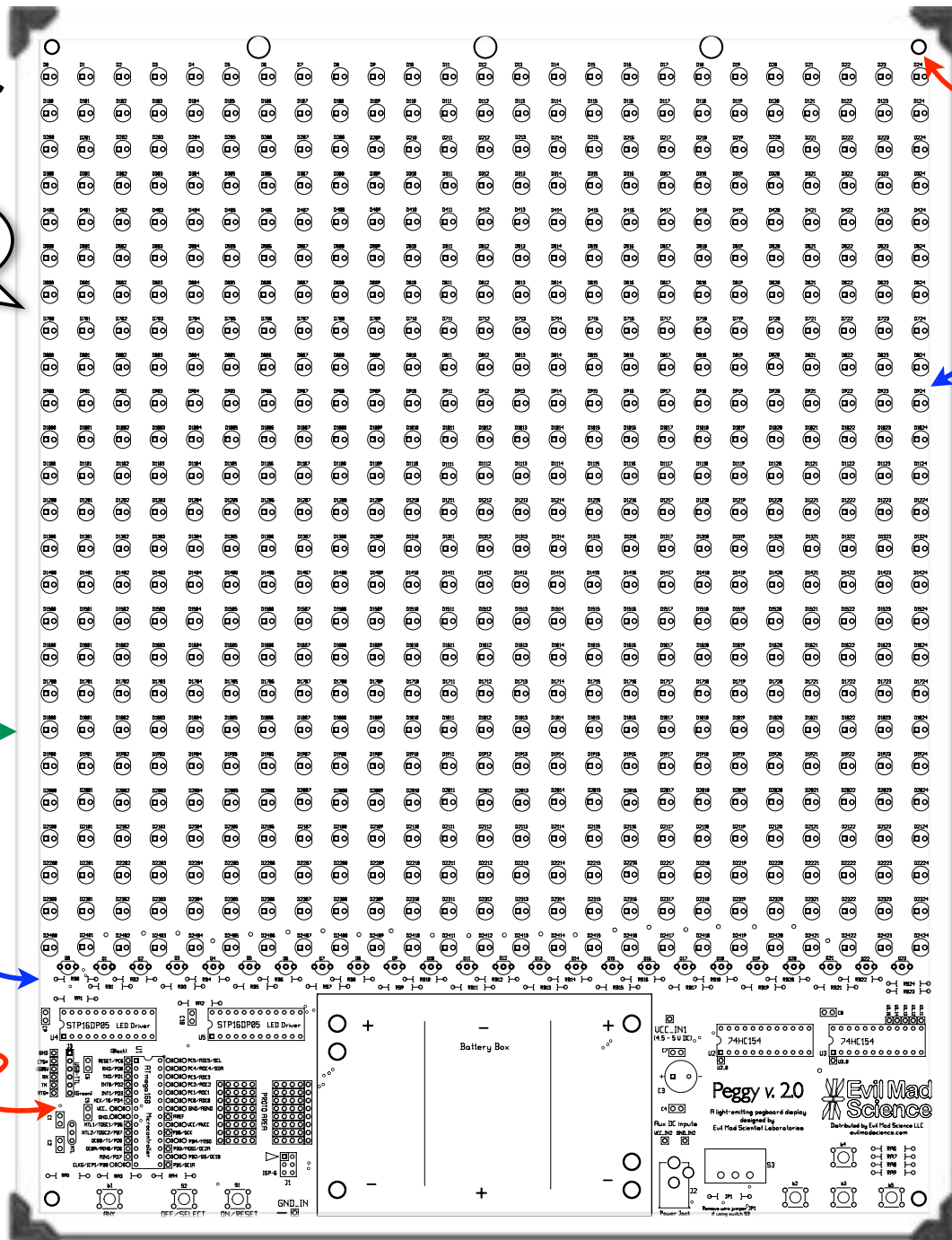
Peggy is a tough and versatile LED “pegboard” display that can drive a few or a lot of LEDs for almost any purpose. Peggy can run on batteries or external power. Peggy is programmable, open source and hackable. Peggy can be the one to figure out how to drive all your LEDs.

Printed circuit board:
Outline: 11.320" x 14.875"
(About 28.8 x 37.8 cm)

Transistors and resistors along
bottom edge of LED field.

CPU: ATmega168, a
type off AVR microcontroller

(Also: Programming interfaces,
places to put switches, and more.)



Mounting holes: Top center:
Hang it on a nail. Top 1/4 & 3/4:
hang it on a string.

Corner mounting holes are
0.141" in diameter and are
located 1/4x1/4" from each of the
corners.

LED Field: Peggy can fit up to 625
of your favorite LEDs in a big
rectangular grid. Each LED location
has room for a 10 mm LED, although
smaller 5 mm (T-1 3/4, "standard
size") and 3 mm LEDs will work just
as well.

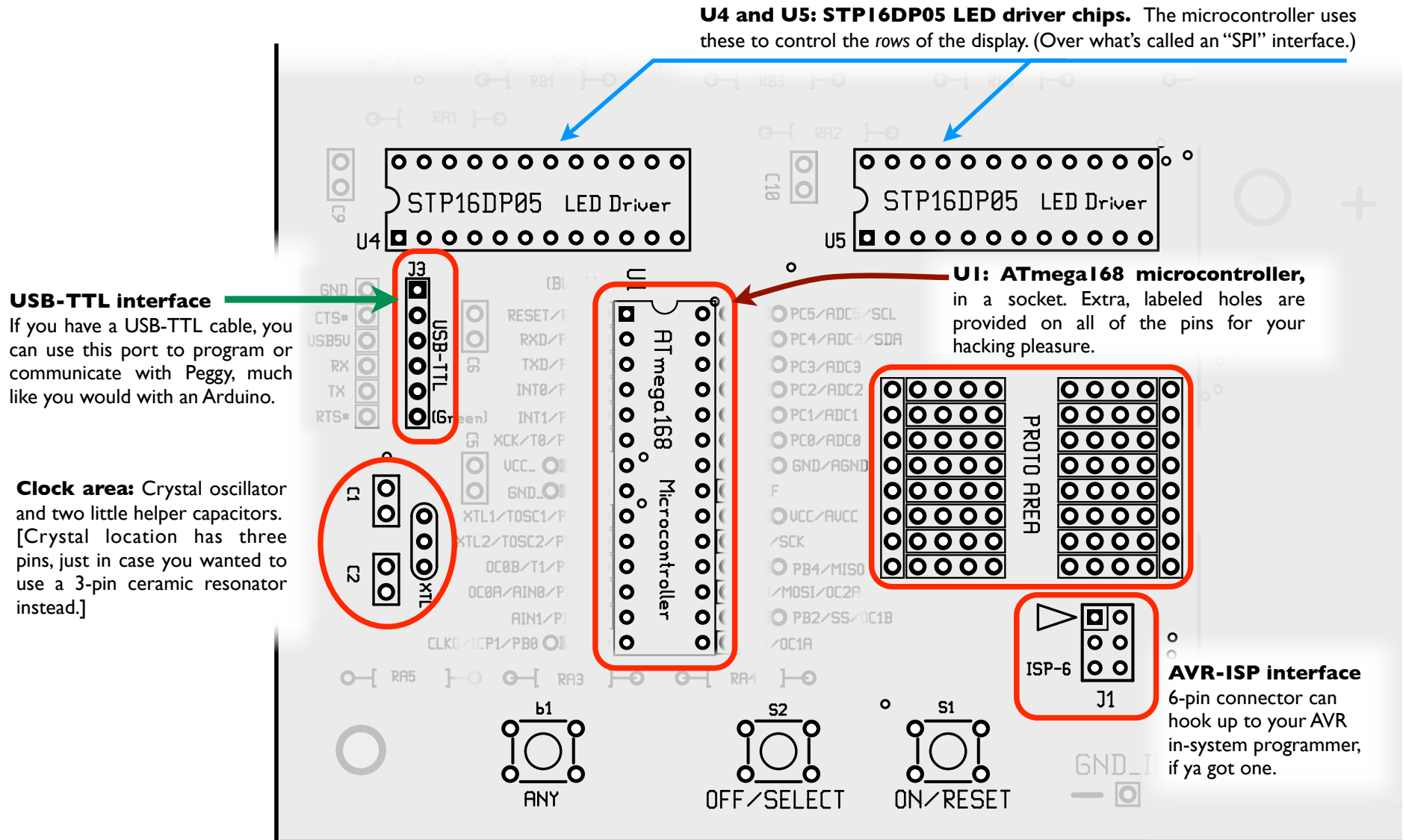
Each LED location is numbered by its
row and column location.



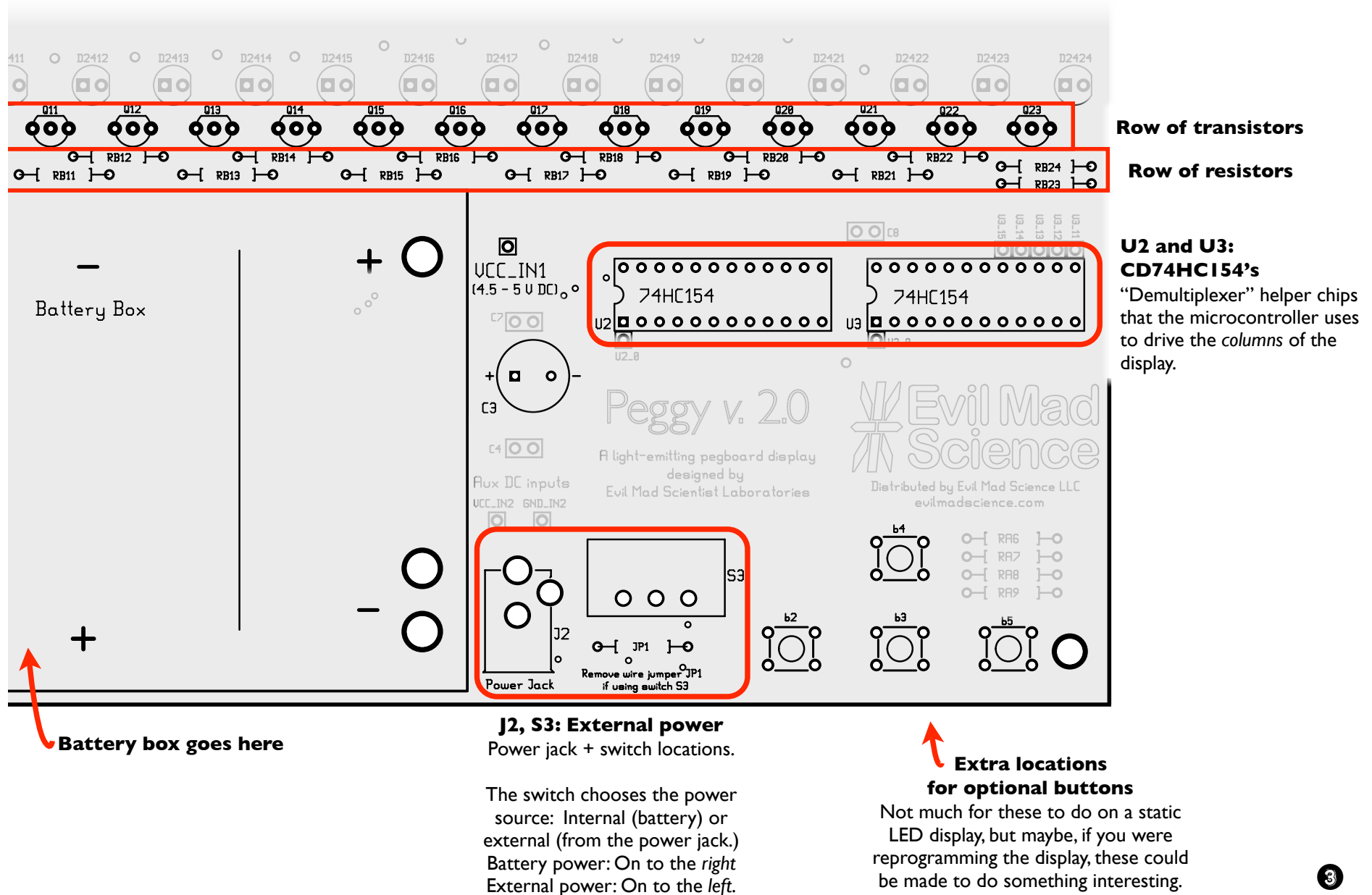
(US Quarter for scale)

Bottom center and right:
power management, optional
button locations, and chips that
peggy uses to address the LEDs.

Detailed tour: Lower left corner of board



Detailed Tour: Lower right end of board



What do you make of this?

Our standard assembly instructions, beginning on the next page, will produce a static “pegboard” display, that will light up LEDs in whichever locations you choose to install them, with near-uniform current applied to each LED.

They will be driven in an energy-efficient multiplexed arrangement, which makes an easy LED display when you put your LEDs in just the locations where you want them. Adding additional functionality, for example, turning on specific LEDs or making simple animation or a true interactive display, can be done by reprogramming the display through one of the two provided interfaces.

Hardware hackers may want to flip through the schematics (pages 13-15) before going further to see if inspiration strikes. A wide variety of hacks, mods, and improvements are possible; the circuitry was designed with hacking in mind. A prototype area is provided to add extra components and extra access holes have been added to allow direct access to the microcontroller pins.

If you do wish to reprogram the display...

two different types of external interface are supported.

A 6-pin ISP interface (J1) lets you program the board using an in-system programmer, for example the USBtinyISP by Adafruit Industries. This interface is supported through the AVR-GCC toolchain

As a second option, the display can be programmed through the Arduino software environment (www.arduino.cc), using an FTDI USB-TTL serial interface cable, which attaches at location J3.

Assembly: First steps

1. Add resistor RA4

A 5.1 k resistor (Green-Brown-Red-Gold)

Implied procedure for components like this:

- Bend the leads of a resistor as shown
- Place it in the circuit board, at its location
- Solder the two pins from the back side
- Clip off extra leads on back side.



2. Add resistors RA1, RA2

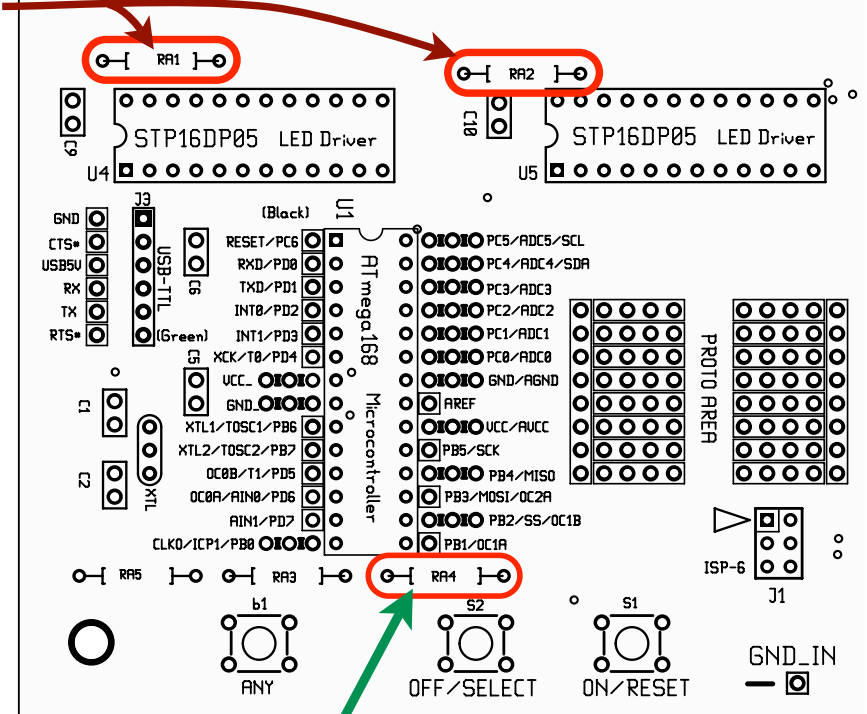
1.0 k resistor (Brown-Black-Red-Gold), installed in 2 places.

3. Add resistors RB0-RB24

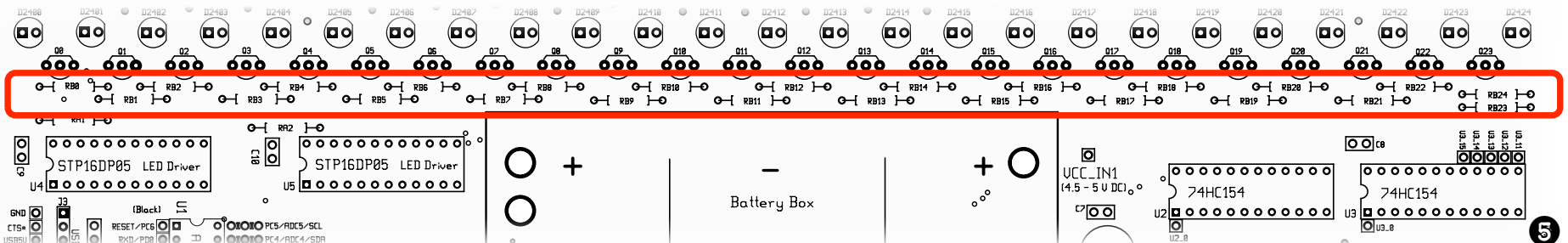
100 ohm resistors (Brown-Black-Brown-Gold) in a row of 25 that stretches across the board.

RA1, RA2

(Lower left corner of printed circuit board)



RA4



5

Assembly: Adding the sockets

4. Install socket for chip U1.

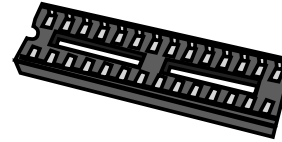
A 28-pin DIP socket (the *long* chip socket)

Orientation matters: Match the “half-moon” shape at one end of the socket to the one drawn on the circuit board.

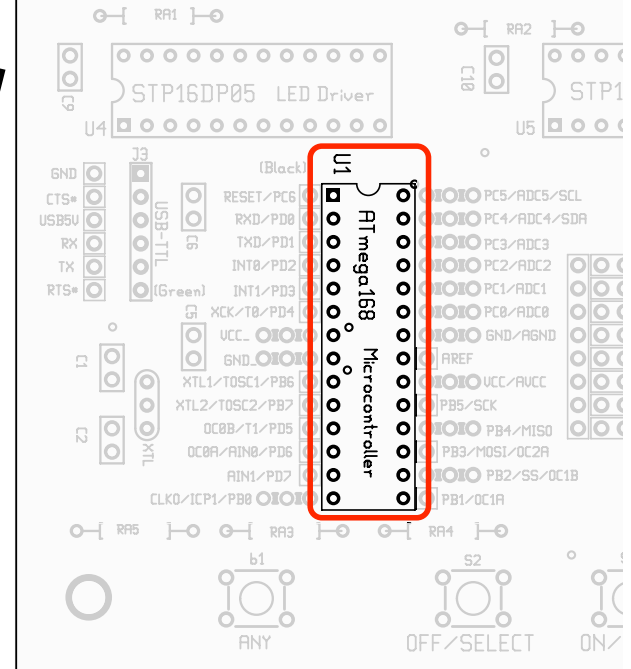
Tight fit: These sockets *snap* flush into place, so they stay put when you turn the board upside down to solder them.

Make sure that the orientation is correct, that every pin is in the right hole and then press uniformly and firmly to seat it.

Solder every pin of the socket in place.



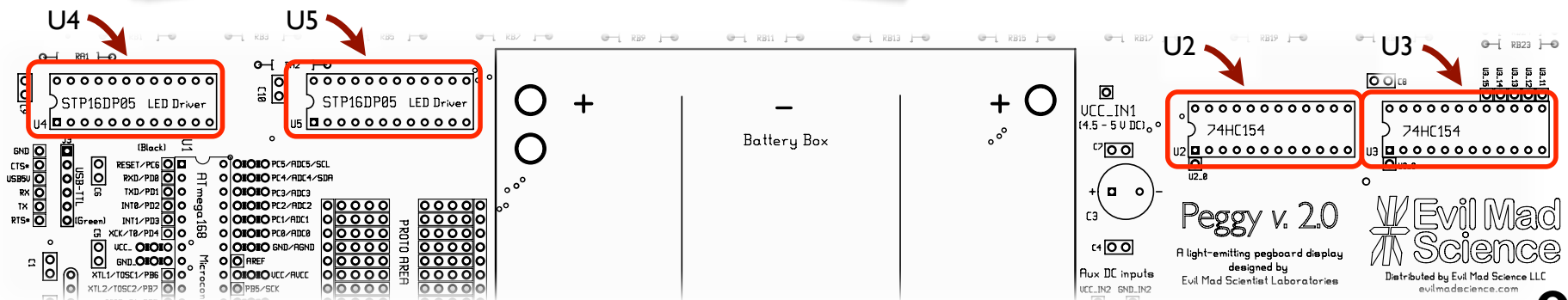
(Lower left corner of printed circuit board)



5. Install sockets for chips U2, U3, U4, and U5.

24-pin DIP sockets, installed in four locations

Follow the same procedure as in Step 5.



Assembly: Next steps

6. Add crystal oscillator XTL

A shiny steel can. The two pins go in the outer two holes of location XTL; ignore the middle hole.

(Orientation: Either way.)

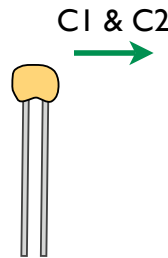


7. Install capacitors C1 & C2

18 pF ceramic caps, 2 places.

(Orientation: Either way.)

[The labels on these tiny capacitors are not useful; these are the two little caps attached together.]



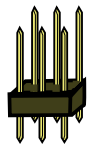
8. Add tactile button switches S1 and S2

Match the parts to the drawing on the circuit board.

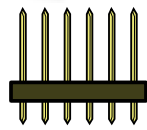
Orientation: pins stick out on left and right sides, *not* top and bottom.



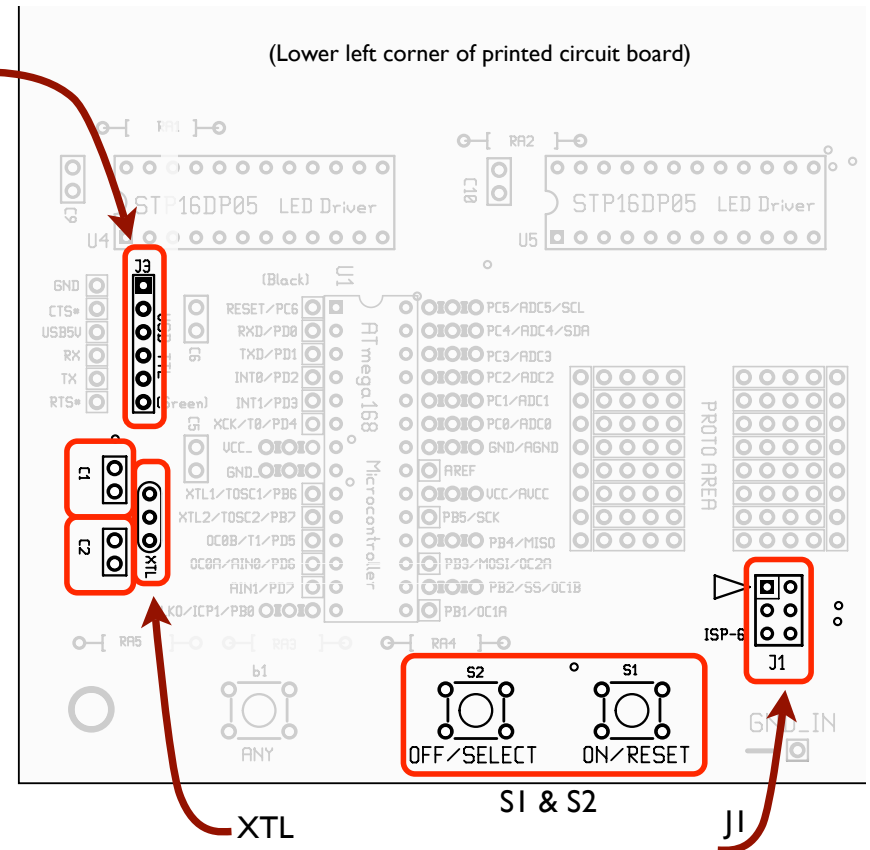
Solder all four pins of each switch.



6-pin DIL (2x3)
header (J1)



6-pin SIL (1x6)
header (J3)



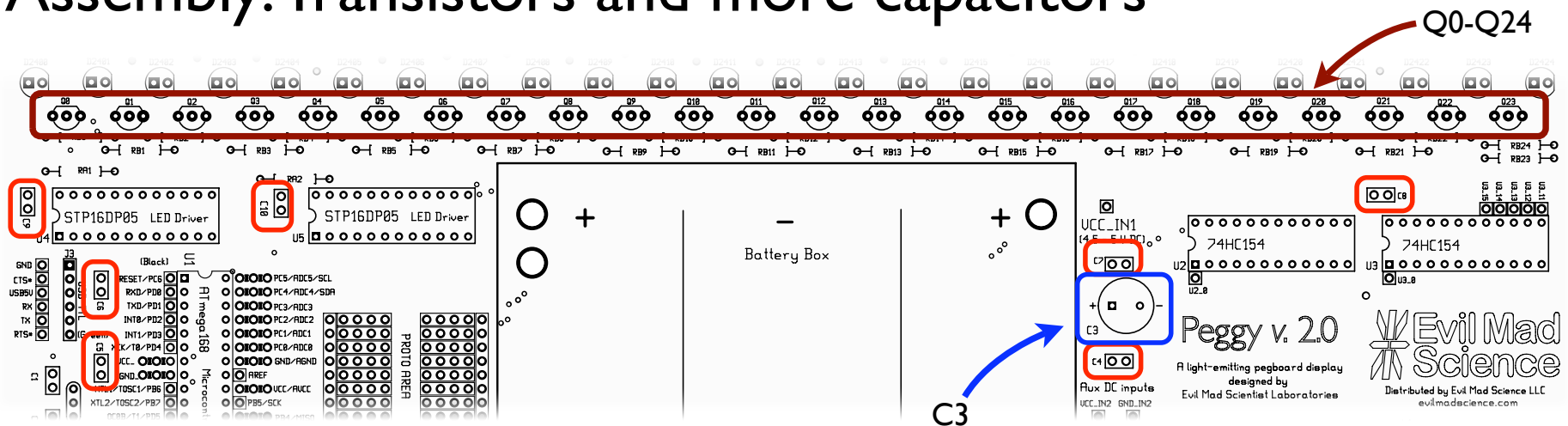
9. (Optional) Add headers J1 and/or J3

These connectors are only needed if you plan to reprogram your Peggy with an external interface.

J1: a 6-pin DIL header for use with an AVR-ISP programmer
J3: a 6-pin SIL header for use with a USB-TTL cable

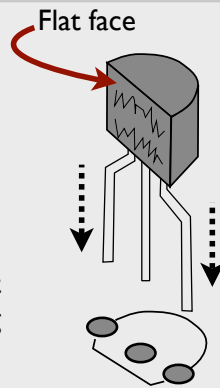
Tight fit: These headers sit snugly in the holes so that they stay in place when you turn the board upside down to solder them. Press firmly to seat them.

Assembly: Transistors and more capacitors



10. Add transistors Q0-Q24.
2N5401 transistors,
installed in 25 places.

Orientation matters. Match the flat face of the transistors to the drawing on the board.



11. Install capacitor C3

1000 uF electrolytic cap

Orientation matters. The NEGATIVE side of the capacitor is marked with a broad white stripe. Solder it with this negative side towards "-" on the circuit board.



12. Install capacitors C4 through C10

0.1 uF ceramic caps installed in 7 locations

(Orientation: Either way.)
Again, the labels are tiny. If your eyes are very good, you *might* be able to make out the legend "104."



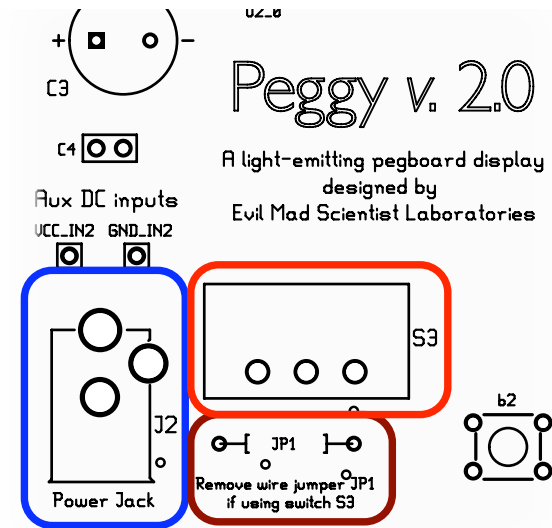
Assembly: Switch + Chips

13. Install power switch S3

High-power slider switch in one location.

S3 only fits loosely into its holes; you will need to rest the board on it or hold it manually while you solder it in place.

Location for external optional power jack



Peggy v. 2.0

A light-emitting pegboard display
designed by
Evil Mad Scientist Laboratories

14. Add microcontroller U1

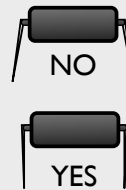
The ATmega168 chip goes in the 28-pin socket from step 4.

Orientation— *very important*— Half-moon end of chip matches that of socket and the drawing on the circuit board

If necessary, bend the leads of the chip to straight up and down before inserting the chip into the socket. Do not bend them by hand; bend all pins on one side at a time by pushing them against a hard flat surface.

The chip goes into the socket with firm, even pressure.

From end of chip:



JP1 is an optional location to “hotwire” across the switch to run permanently off of battery power or other power applied to the Aux DC inputs. In normal usage, it should be left empty.

(Adding your own external power? Make sure it's 4.5 - 5 V DC, well regulated, protected, and capable of sourcing at least 600 mA.)

15. Install chips U2 and U3

Press two CD74HC154 chips into their sockets

Follow the guidelines from step 14; orientation is very important. As usual, match the half-moon end to the half-moon end on the socket and board.

16. Install chips U4 and U5

Press two STPI6DP05 chips into their sockets

(You should know the routine by now!)

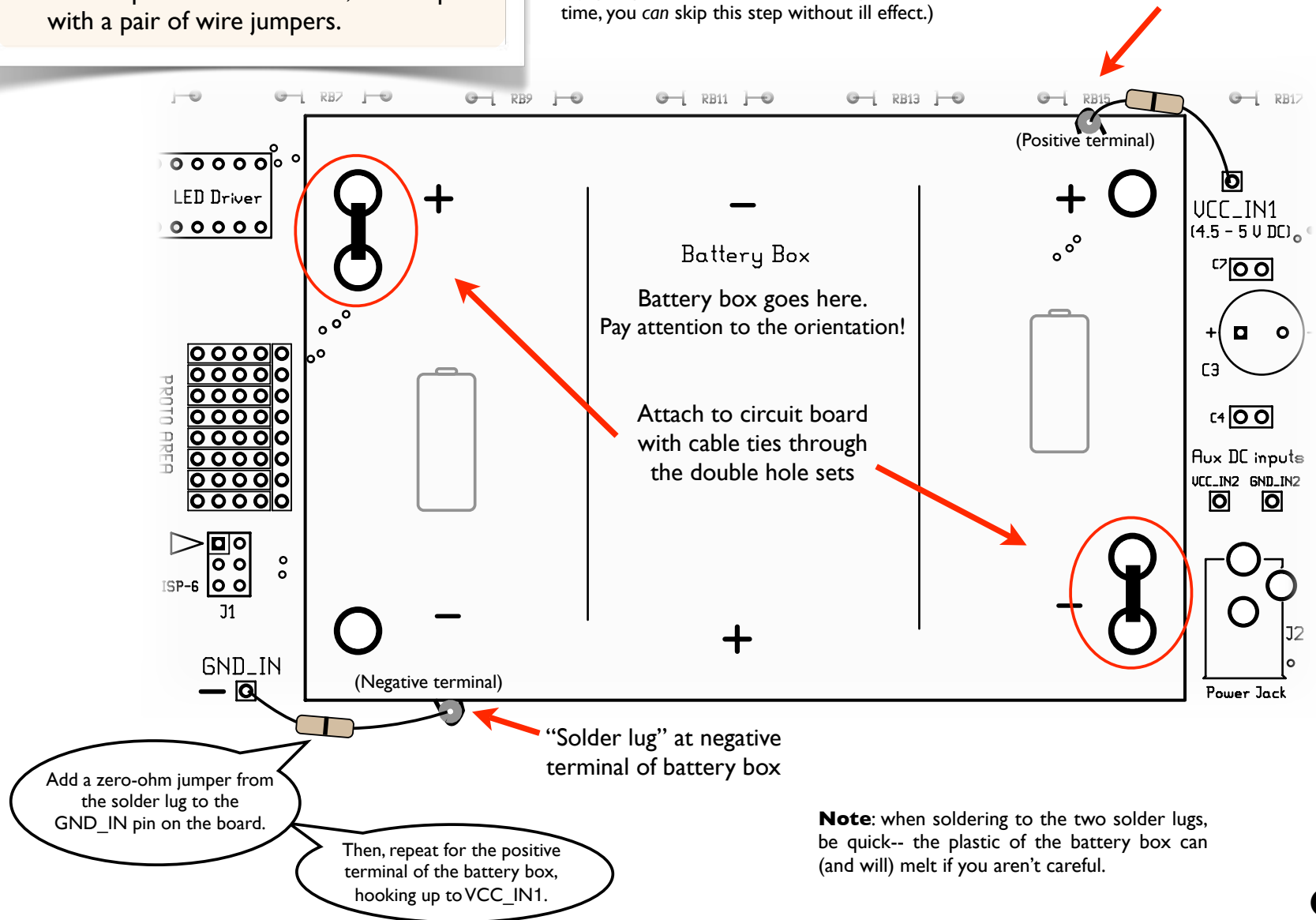
Install Battery Box

17. Add battery box

Held in place with cable ties, wired up with a pair of wire jumpers.

(Note: If you have an alternate power source, e.g., you plan to run from an AC adapter all the time, you can skip this step without ill effect.)

“Solder lug” at positive terminal of battery box



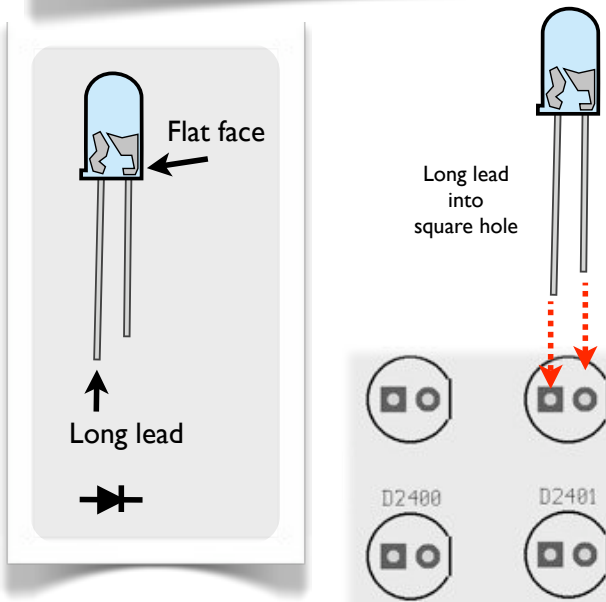
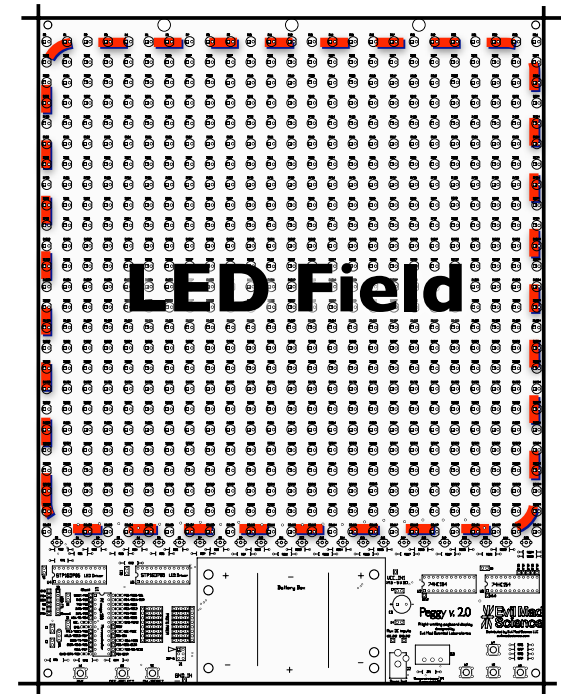
Assembly: Adding LEDs

18. Add LEDs to the LED field.

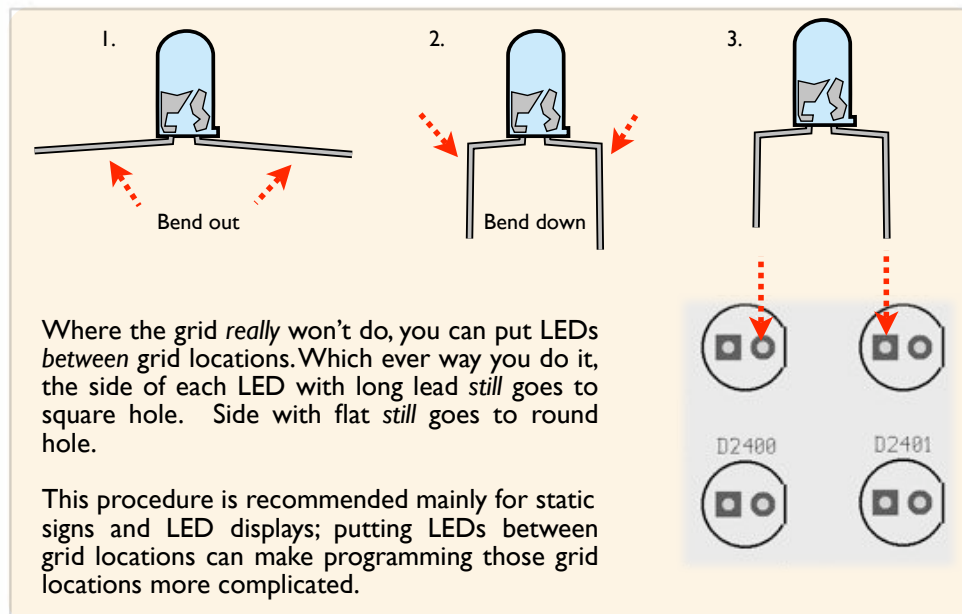
The board accommodates up to 625 LEDs in standard sizes up to 10 mm. 3 mm, 5 mm, and 8 mm LEDs will work just fine. Put them where you like, or everywhere.

For standard types of LEDs, the long lead goes in the square hole (the one on the left), and the flat face of the LED package matches the drawing on the circuit board.

For reference, each LED location is labeled DXXYY, where XX is the row number and YY is the column number. If you do not fill all the holes and wish to blacken the unused labels, a black permanent marker works well.

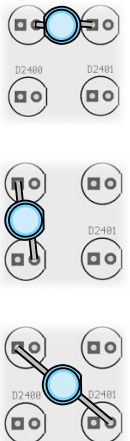


Alternative build idea: put all the LEDs on the back side of the circuit board for truly bare background. In this scheme, the long lead *still* goes in the square hole.



Where the grid *really* won't do, you can put LEDs *between* grid locations. Which ever way you do it, the side of each LED with long lead *still* goes to square hole. Side with flat *still* goes to round hole.

This procedure is recommended mainly for static signs and LED displays; putting LEDs *between* grid locations can make programming those grid locations more complicated.



Wrapping it up!

Last step: Add the rubber feet

Attach one rubber foot in each corner on the back side of the circuit board, and a couple closer to the middle, to protect against bending when you press buttons-- make sure that the circuit board lies flat on these bumpers, not on wire leads.

The feet will help to avoid accidental short circuits, as well as protect your wall if you hang it up by a hook or string.

An open-source project

The hardware and software designs used in this project are being released under an open-source license. For more information, please see:

<http://www.evilmadscientist.com/article.php/peggy2>

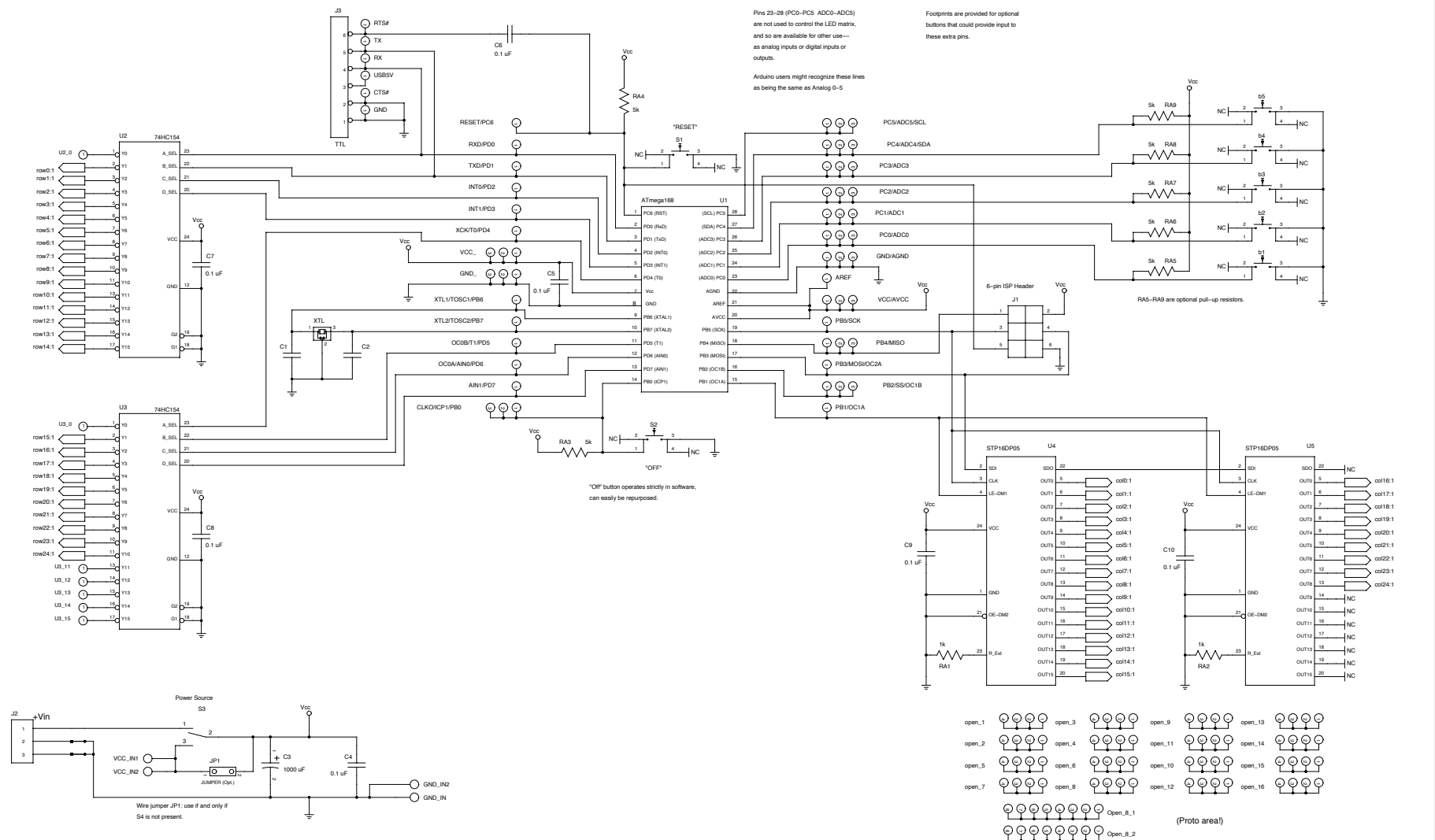
Example firmware is available for download, and we'd love to see what you can do with it!

Got pictures?

If you have interesting pictures or video of things built using this kit or the hardware or software designs, we'd love to see them in the Evil Mad Science Auxiliary:

<http://www.flickr.com/groups/evilmadscience/>

Schematics: Page 1 of 3



STANDARD BATTERY-ONLY OPTION: 4.5 V DC

Install Wire Jumper JP1.

S4 and J2 are optional.

(continued from page 6)

OPTIONAL POWER SUPPLY

Remove (snip out) JP1.

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"Peggy" version 2.0

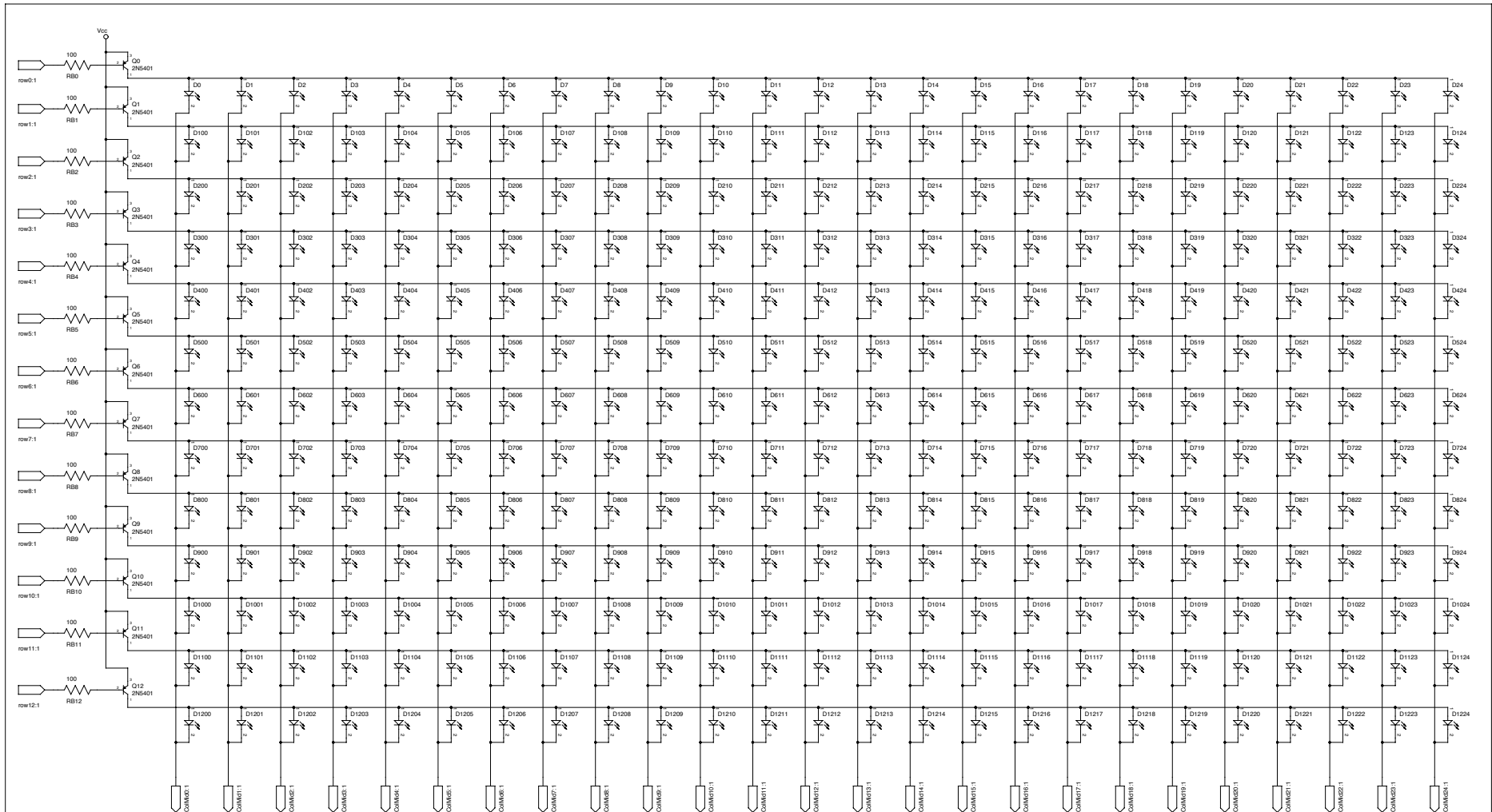
TITLE A light-emitting pegboard display panel

FILE:	LEDdisp_X.sch
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REVISION

DRAWN BY: Windell H. Oskay

Schematics: Page 2 of 3



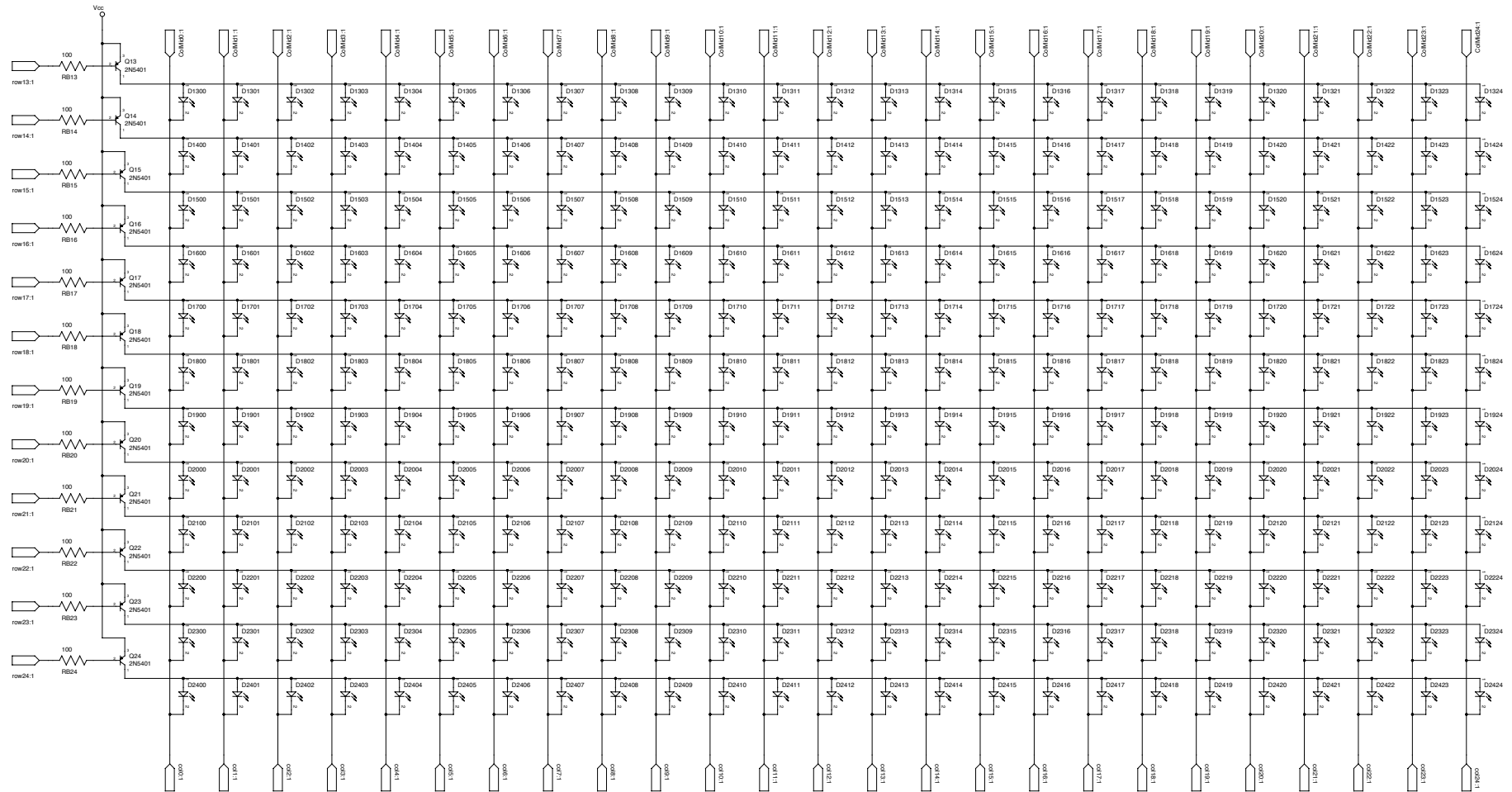
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"Peggy" version 2.0		
TITLE: A light-emitting pegboard display panel		
FILE: LEDdisp_X.sch	REVISION: B	
PAGE: 2 of 3	DRAWN BY: Wendell H. Oskey	

Schematics: Page 3 of 3



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"Peggy" version 2.0		
A light-emitting pegboard display panel		
FILE: LEDdisp_X.sch	REVISION: B	
PAGE: 3 OF 3	DRAWN BY: Wendell H. Oskay	

Peggy v 2.0:A light emitting pegboard designed by Evil Mad Scientist Laboratories

Bill of Materials, with part numbers from Digi-Key where applicable.

Line	Designation	Value	Type	Digi-Key#	QTY
1	PCB	Peggy 2.0		N/A	1
2	RA4	5.1 k	Resistor, 1/4 W	5.1KQBK-ND	1
3	RA1, RA2	1k	Resistor, 1/4 W	1.0KQBK-ND	2
4	RB0-RB24	100 ohm	Resistor, 1/4 W	100QBK-ND	25
5	U1 (Socket)	28-pin DIP socket		3M5480-ND	1
6	U2,U3,U4,U5 (Sockets)	24-pin DIP socket		3M5478-ND	4
7	XTL	16 MHz	oscillator crystal	631-1108-ND	1
8	C1,C2	18 pF	Capacitor, ceramic	BC1004CT-ND	2
9	S1, S2	Tactile Burton Switch		SW400-ND	2
10	J1	6-pin DIL header	ISP connector	WM126806-ND	1
11	J3	6-pin SIL header	TTL Connector		1
12	Q0-Q24	2N5401	Transistor	2N4401D26ZTR-ND	25
13	C3	1000 uF, 10 V	Cap., electrolytic	P5127-ND	1
14	C4-C10	0.1 uF	Capacitor, ceramic	BC1148CT-ND	7
15	S3	high-power slider, SPDT		CKC5107-ND	1
16	U1	ATmega168-20PU Microcontroller (pre-programmed in kits)		ATMEGA168-20PU-ND	1
17	U2,U3	CD74HC154EN		296-9181-5-ND	2
18	U4, U5	STP16DP05B1R LED driver			2
19	Battery Box	3 x D cell		BH3DL-ND	1
20	Cable Ties	Cable ties, 4.5"x0.1", black		RP202C-ND	2
21	Battery box leads	Zero-ohm jumpers (Wires that look like resistors with one black stripe.)		0.00QBK-ND	2
22	DXXYY	Through-hole LEDs. 3mm, 5mm or 10 mm-- not included with kit.		N/A	up to 625
23	Rubber feet	McMaster Carr 95495K66		N/A	6
-	All others	Leave empty or hack things in, at your discretion.			

Optional extra button set					
1	b1,b2,b3,b4,b5	Tactile Button Switches (optional)	SW400-ND		up to 5

Optional Power adapter kit: US					
1	Power adapter: US	4.5 V DC regulated, 1 A, 1.3 mm plug	T976-P7P-ND		Opt.
2	J2	1.3 mm power jack, US power jack	CP-035D-ND		Opt.

Optional Power adapter kit: International					
1	Power adapter: Int'l	5 V DC regulated, 1.2 A, 2.1 mm plug	T946-P5P-ND		Opt.
2	J2	2.1 mm power jack, Int'l power jack	CP-002AH-ND		Opt.