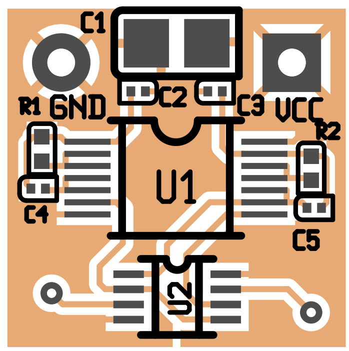
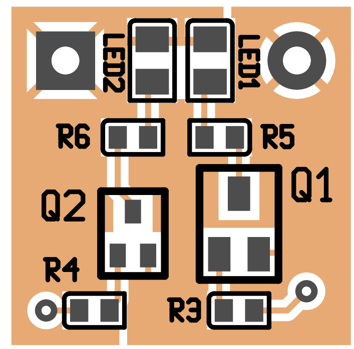
SMD Soldering Challenge Instructions

The purpose of the SMD (Surface Mount Device) Soldering Challenge is to provide people the opportunity to get some experience with smaller surface mount devices, so as to decide for themselves how small a part they feel comfortable working with on future projects. Each kit contains a sample of many tiny SMD parts. The schematics and layout were done with gEDA and PCB. Please read all these instructions before beginning.

Note: the purpose of this kit is the soldering, not the results. I designed a circuit that happens to work if all goes well, but I don't guarantee it. There are all sorts of things that can go wrong from the time the parts get here (my house) to the time you finish the circuit.

RefDes	Qty	Footprint	Notes	Pitch
C2-5	2	01005	0.01uF	0.50
R1,R2	2	0201	100kΩ	1.00
R3-4	4	0402	1kΩ	2.00
R5-6	2	0402	150Ω	2.00
LED1-2	2	0603	Red LED	3.00
C1	1	0805	1uF	4.00
Q2	1	SOT-416	NPN	0.50
Q1	1	SOT-323	NPN	0.65
U1	1	tvsop-14	Hex Inv	0.40
U2	1	US-8	Dual XOR	0.50





Populate either C2 or C4, but not both. Populate either C3 or C5, but not both. C2 and C3 yield about 2kHz, C4 and C5 about 400Hz. R5 and R6 may be either 150Ω or 1000Ω ohms. **V_{CC} is +3 to +5 VDC.**

To help you figure out which parts are which, I color coded the ones on paper tape. The colors are: purple is 0.01uF, orange is 100K, green is 150Ω, and blue is 1kΩ. The rest of the components are in plastic tape and should be unique enough to tell which is which. Note that the slightly larger transistor is the SOT-323 one. The smaller one is the SOT-416, which is about the same size as a SOT-523 or SC-75.

If you look carefully inside the LEDs, you'll notice a black spot. The black spot goes toward the edge of the board. The only other parts that are polarized are the two ICs. Pin 1 is marked with an embossed circle on the chips. Note that pin 1 is closest to **GND** on both ICs - **the silkscreen for U2 is incorrect on the board**. The photo above shows the correct silkscreen for U2. You will have two 0402 resistors left when you're done.

Soldering Tips

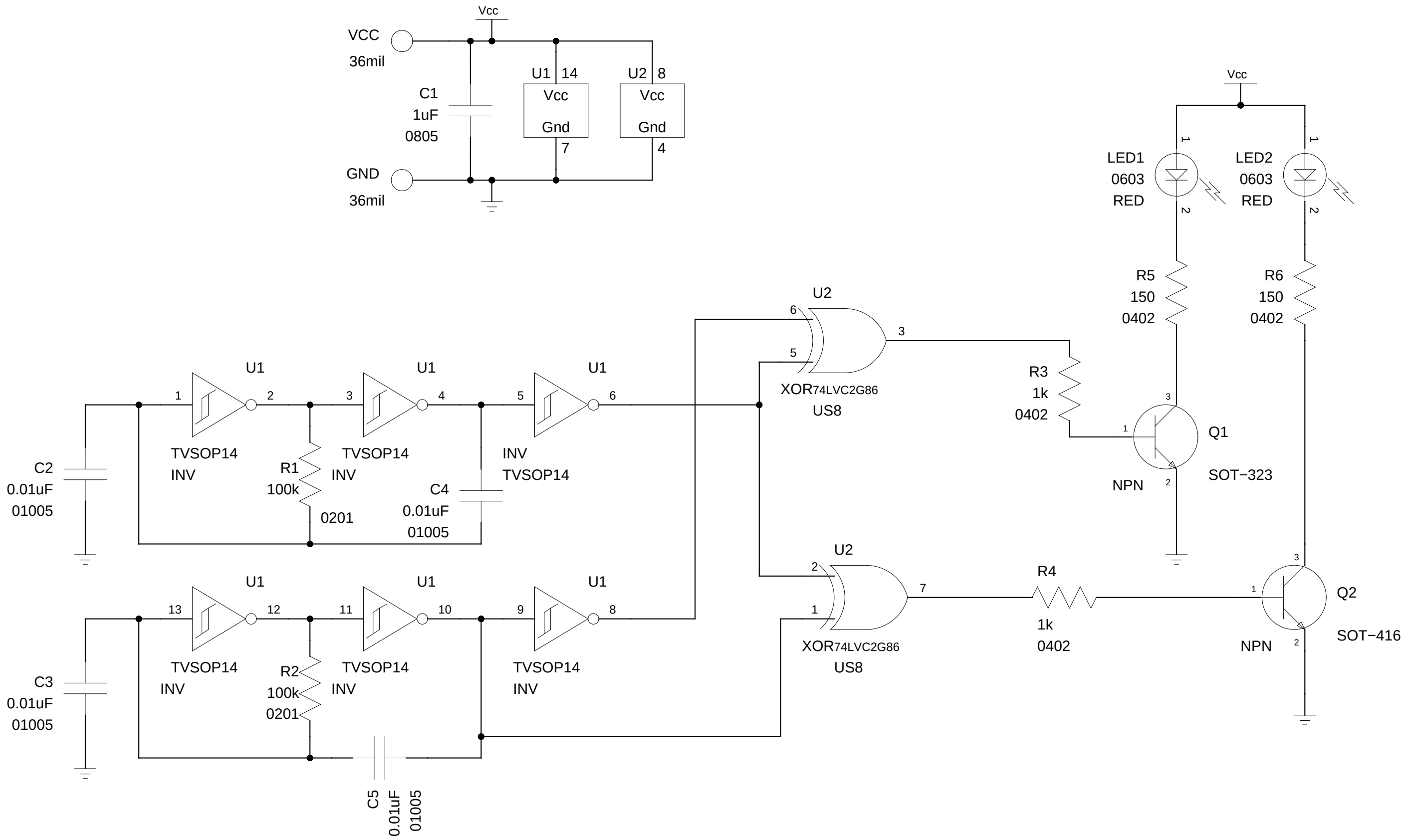
The board is pre-tinned with 63/37 solder. A small amount of flux will help the parts stick to the board, otherwise the parts tend to move around a lot before you can get them soldered down. I find it's easiest to pre-solder one of the pads for a part, then use pointy tweezers to hold the part while I melt the soldered pad. Move the part into the solder, then remove the iron. After the solder cools, solder the other pad(s).

WARNING: The tiny parts are very prone to vanishing. Be careful picking them up with tweezers, as one slip can propel the parts across the room. Also, don't sneeze, close windows, shut off fans, etc. I'm not kidding.

Since the purpose of this kit is to experience soldering these small parts, feel free to remove and resolder them as many times as you like (until something breaks, that is ;). I designed this kit to be inexpensive enough that you won't mind if it breaks.

I use some legs from an old wire-wrap IC socket as the power leads. I place the board on a solderless breadboard and push the legs through the board into the breadboard, then solder it, and cut off the excess. The holes are positioned such that this works. I use a 9v battery and an old 7805 to power the board.

As for seeing the parts, I use a magnifying visor. 2.5x (5 diopter) is good for most of the parts, but 3.75x (10 diopter) is useful for the three smallest sizes.



Theory of Operation

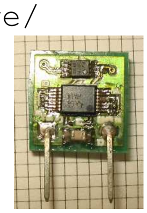
U1 is configured as a pair of oscillators. The configuration of each oscillator depends on which capacitor location is populated. U2 compares the two signals and emits an “in phase” and “out of phase” signal. These two signals drive the LEDS through the two transistors. If the two oscillators are running at nearly, but not exactly, the same frequency, each phase signal will slowly change from “mostly off” to “mostly on”, causing the two LEDs to slowly “throb” back and forth (rather than the usual blinking a single oscillator would cause). Note that, due to injection locking, once the two oscillators are nearly in phase, they may lock together and one LED will remain on and the other off. I find that poking at the circuit with a 1kΩ resistor tied to ground can sometimes kick the two oscillators out of lock for a few seconds, especially if you touch the feedback lines of the oscillators. Also, mine only lock at +5 V_{CC} but not at +3 V_{CC}.

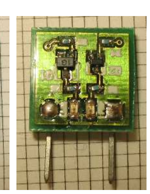
If you configure the two oscillators for different frequencies, both LEDs will light. An oscilloscope will show a non-uniform square wave driving each LED.

For More Information

The SMD challenge board has been discussed on the gEDA users list. The list archives contain a lot of useful information about how the board was designed, along with a history of this project. Also, you can get more information and download the project's design files from my web site:

`http://www.delorie.com/pcb/smd-challenge/`





Enjoy your board, and good luck!

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Colophon

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