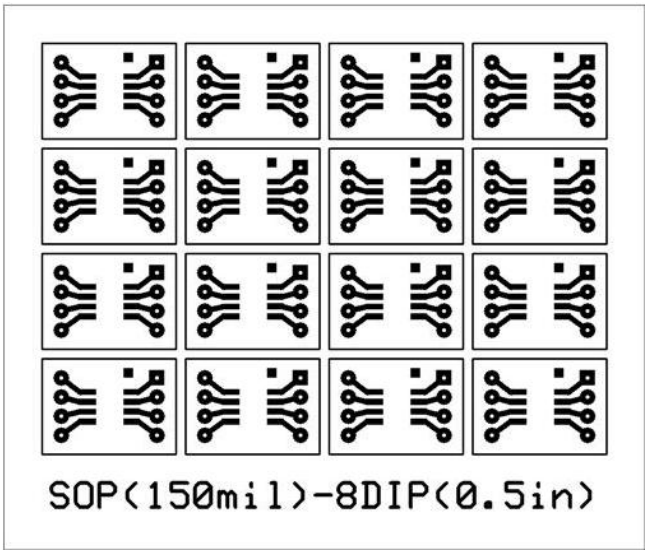
**How to solder and breadboard surface-mount components**

If you are able to make your own printed circuit boards (PCBs), then you probably build circuits which are complex enough to lay out on a breadboard before starting construction. If this describes you, then you have probably encountered surface-mount components, which pose two problems:

1. Being so small, surface-mount components are tricky to solder to a PC board, and
2. They are almost impossible to incorporate into a breadboard layout.

I have puttered around with circuits for many years and have always taken pains to buy DIP chips. They are big enough to handle and solder with ease. Increasingly, though, I find that some chips cannot be bought anywhere except in surface-mount packages.

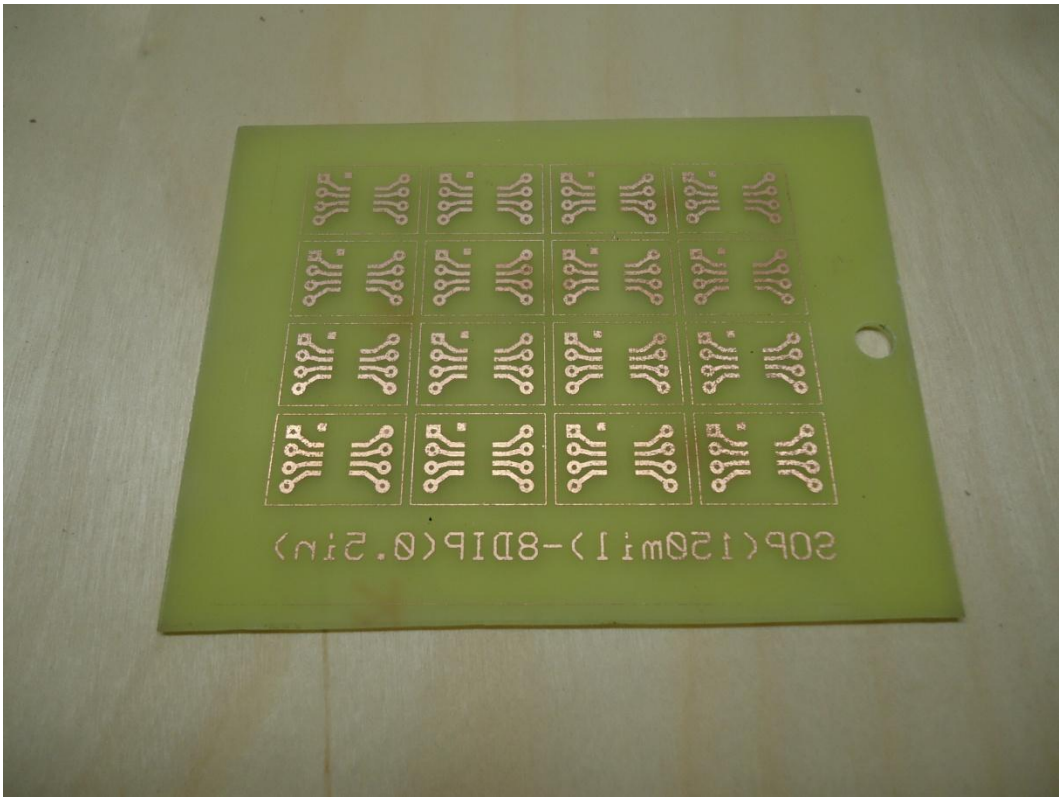
A typical surface-mount component is the Holtec HT9200 DTMF generator. They used to come as 8-pin DIPs, but no longer. Now, they come only in an 8-lead 150 mil SOP package. Using the PCB layout program of the ExpressPCB software (which can be downloaded from the internet for free), I laid out a small one-sided PCB. The board is 3.35 inches wide and 2.85 inches high. At 1:1 scale, the trace layer looks like this.



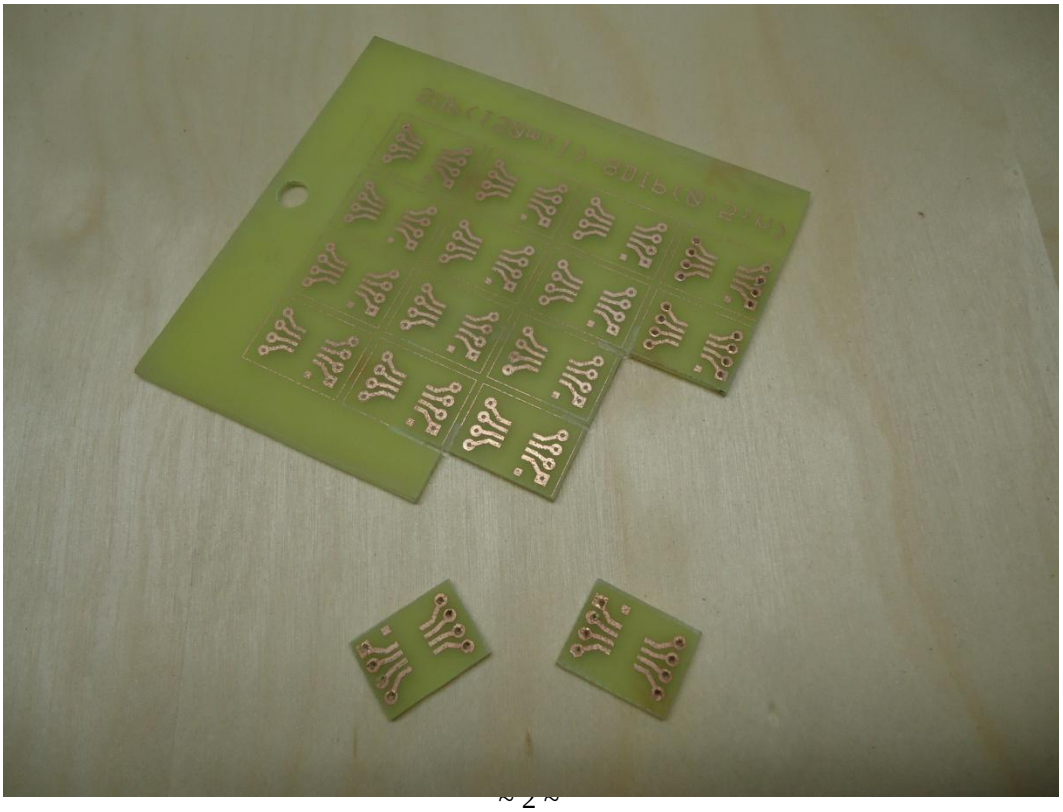

The board contains 16 identical "holders". One surface-mount chip is to be soldered onto each "holder", which provides a DIP-like pinout for easy soldering. I say DIP-like, because the two columns of pins are 0.5-inch apart instead of the normal 0.3-inch separation. Other points about this board:

1. There is no silkscreen layer. For convenience, I put everything onto the copper trace layer. This means that the descriptive title will appear backwards after the board is etched. Even so, it will serve its purpose of reminding you later what is on the board.
2. The rectangles around each holder are guidelines for using a hacksaw to cut off individual holders when they are needed.
3. I have placed a small square dot near the pad to which pad #1 of the surface-mount component will be soldered. Similarly, I have identified pin #1 of the DIP-like columns with a square pad. Of course, this is the reverse of the normal DIP pin #1 because the surface-mount component is on the trace-side of the board.

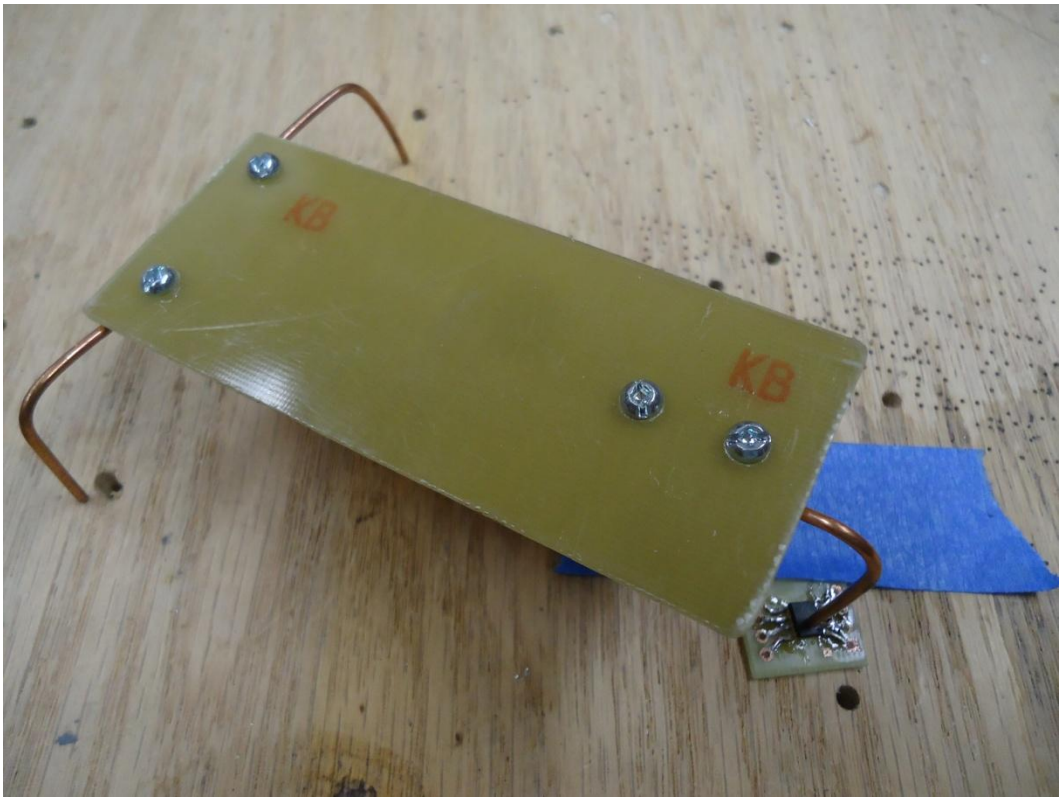
The following photograph shows the PCB after it has been etched. I used the hole on the right-hand side to reeve through a supporting wire to hold the board upright within the etching solution.



The next photograph shows that I have sawn out two of the holders. If you look carefully, you can see that I have drilled out the DIP pin holes.



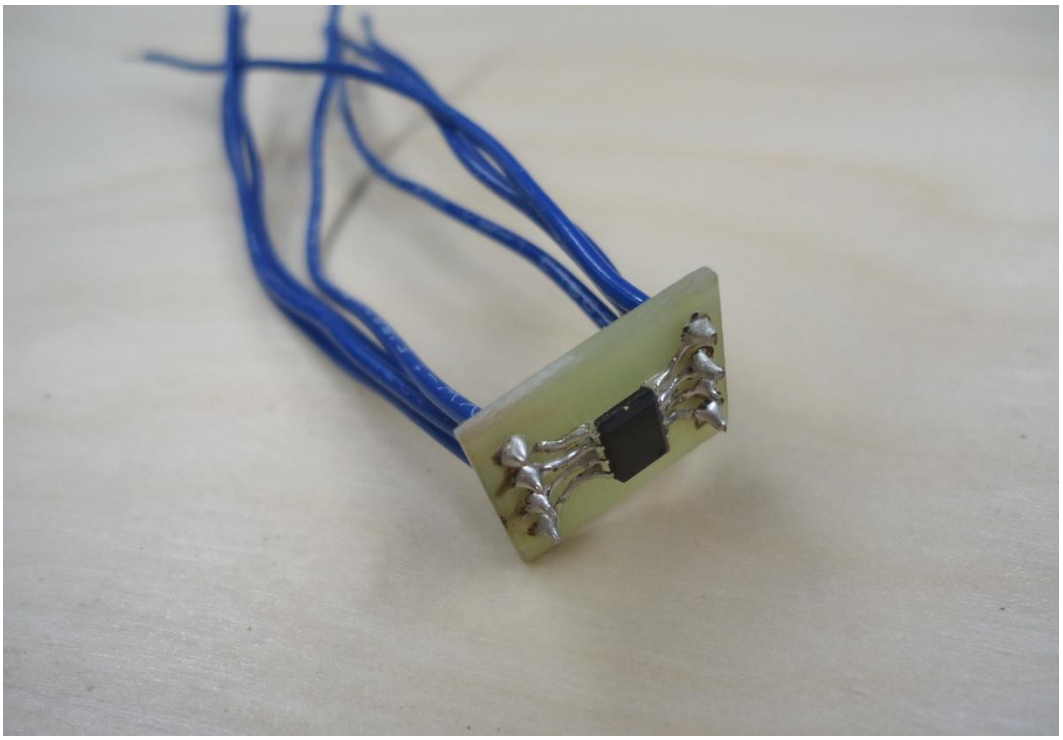
The next step is to solder the surface-mount component onto its pads. The following photograph shows the three-legged tool I use to help. I call it a whale[1]. One leg is placed on the top of the surface-mount component. The other two legs sit on the worktable. Note that I have used a piece of tape to keep the holder from sliding around.




The whale itself is a piece of phenolic board. Any small piece of PC board, or something similar, will do. The legs are made from heavy copper wire, bent into shape and secured to the board with a couple of little bolts. The whale by itself will not be heavy enough to hold everything in place while you solder the surface-mount component to the holder. Remedy this by placing any handy object(s) on top of the board. When I soldered the Holtec HT9200 to this holder, I used a couple of pliers. See the following photograph of the setup.

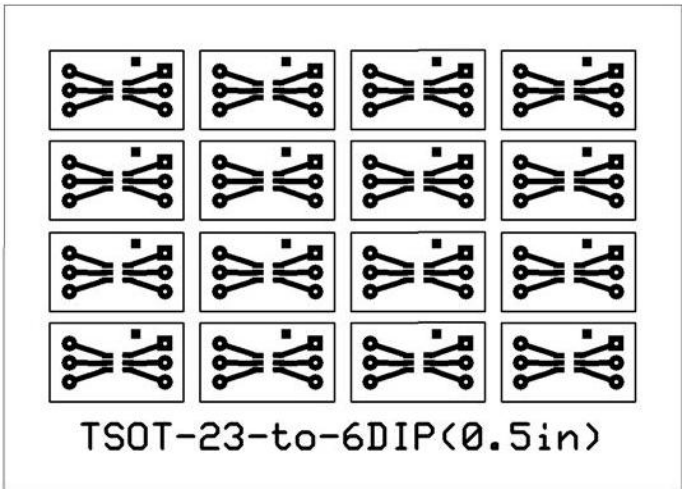
[1] Olden-day people like me remember a time before computers and printers. People could still draw nice looking text on a piece of paper. They used something like a pantograph, with a drawing pen on one end and a stylus on the other. The shapes of the letters were engraved into a plastic strip. When the stylus was moved along the engraved grooves, the pen drew the corresponding shape on the paper. With care and practice, the results could be very good. To prevent it from moving, the plastic strip was held down by heavy weights at either end. These weights were three-legged. One leg was placed into a depression at the end of the strip, the other two legs sat on the paper. These weights were called "whales". My whale does exactly the same job.


As is always the case, it will be easier to solder the surface-mount component onto the holder if you first tin the pads with a bit of solder. The final step, soldering eight pieces of hookup wire into the DIP holes, is easy. The result looks like this.



Once the component has been mounted in this way, it can easily be used in a breadboard layout. After testing, the wires can be cut short and the entire holder assembly soldered into a printed circuit board just like a DIP chip. This eliminates the kind of foul-up I have sometimes encountered, of ruining the traces on a perfectly good PCB while trying to solder a surface-mount component into place. Better to ruin a simple holder than a whole PCB.

The second surface-mount component I etched holders for was an LT6650 400mV reference voltage chip. It comes only in an SOT-23 package. The following figure shows the one-sided PCB with 16 holders which map a 6-pad SOT-23 into a 6-pin half-inch wide DIP. The board in this case is 3.55 inches wide and 2.5 inches high. (For the LT6550, only five of the pads/pins are used.)

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(An e-mail setting out errors or omissions would be appreciated.)