DRAWING BOARD

Let's add an audible indicator to our logic probe.

ROBERT GROSSBLATT

The probe we've been designing can indicate circuit highs and lows but there are things we can do to make it better. One of the first things that comes to mind is to work out some way for us to have an audible indication from the logic probe.

Doing something like this is a good exercise. Remember that we currently have points in the circuit (the comparator outputs) that indicate whether a high or low is detected in the circuit.

There are a few ways you could use the extra pair of comparators we have for the audible indicator, but the easiest thing to do is just piggyback their inputs on the inputs of the first pair. That is shown in Fig. 1.

By adding some extra wire to our design, we now have two independent outputs that signal high and low levels in the circuit under test. Our next job is to figure out a way to make them work as triggers for an audio circuit.

The first thing we have to do is add some resistors to the outputs of the second set of comparators. That has to be done because, if you go through the data sheet for the 339 (or any member of that family), you'll see that the comparator output is an uncommitted open collector of an internal transistor. The resistors have to be added in this case just as you would for any transistor-based design.

All that's left for us to do so we can add an audio indicator to the circuit is figure out how we're going to actually generate the audio.

It's no big deal to build a tone generator out of a 555 but this application adds a new wrinkle. We want it to generate two different sounds—one to indicate that a low has been detected and the other to indicate a high.

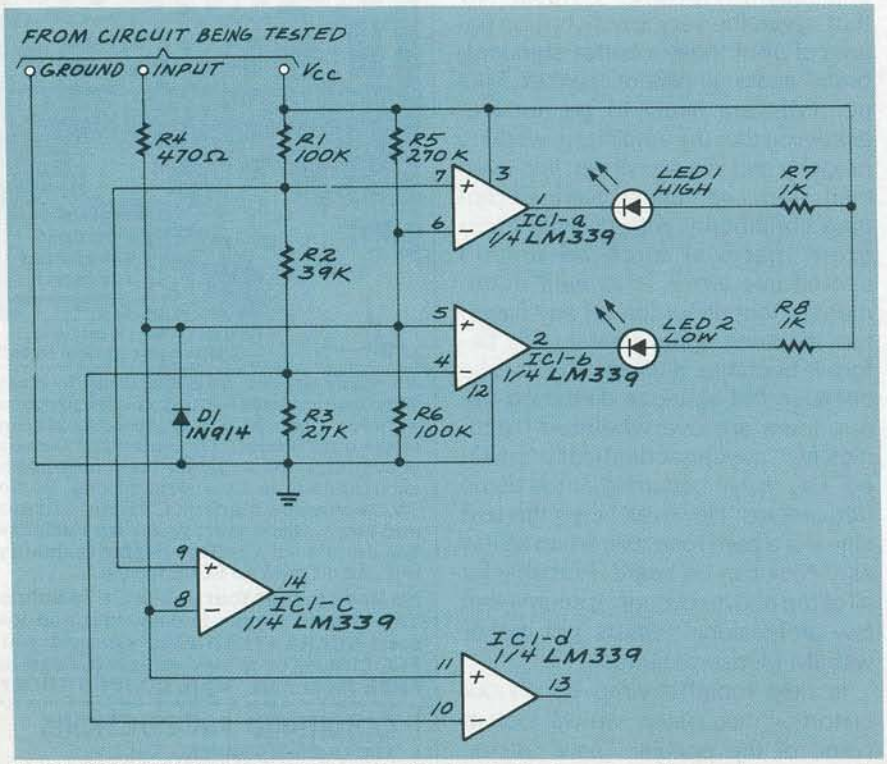

FIG. 1—YOU CAN ADD an audible indication to the logic probe without adding any extra silicon to the board; we'll use the other pair of comparators in the LM339.

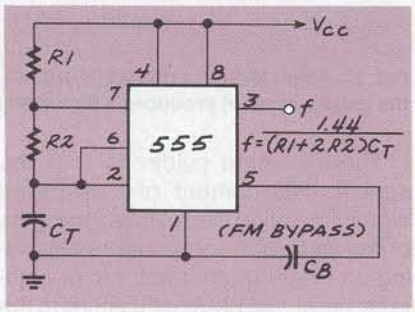

FIG. 2—THE FREQUENCY of the tone generator built from a 555 can be controlled by having the high outputs of the comparators supply the charging current for the 555's internal timing capacitor.

The frequency of a tone generator built from a 555 depends on three separate components as shown in Fig. 2. The trick to having the output frequency controlled by the two comparators is to have the high outputs of the comparators supply the charging current for the 555's internal timing capacitor. In normal 555 circuits, that current comes directly from the power supply, but in this case we can use a couple of steering diodes to put different resistors into the 555's timing chain and cause it to output two different frequencies.

The final version of the circuit is shown in Fig. 3. With the values shown in the schematic, the high frequency will be about 4 kHz and the low frequency will be about 500 Hz.

Since we've now got a circuit that can generate two different tones depending on whether a high or low is presented to the input, it would be a shame not to be able to set things up so the probe could be used as a tone source as well.

If you study the switch arrangement shown in Fig. 4, you'll see that S1 switches the circuit from a logic probe to a tone generator by force feeding either a high or low voltage (via S2) to the input and routing the speaker output to the probe tip. When you use the circuit as a tone generator, the speaker will be disconnected, but you'll be able to see

which frequency you've selected because the LED's still work.

The logic probe/tone generator we've been designing is a really good addition to your collection of test gear. I've been using it for years and have gone so far as to lay out a PC board for it. I'll clean up the artwork and put it in next month's column.

It's well worth building because, when you get familiar with the circuit, you'll find that it even gives you useful information when you connect the probe to clock lines. There's no way you'll be able to measure the frequency but the audio from the probe will bear a proportional relationship to the frequency and duty cycle. **R-E**

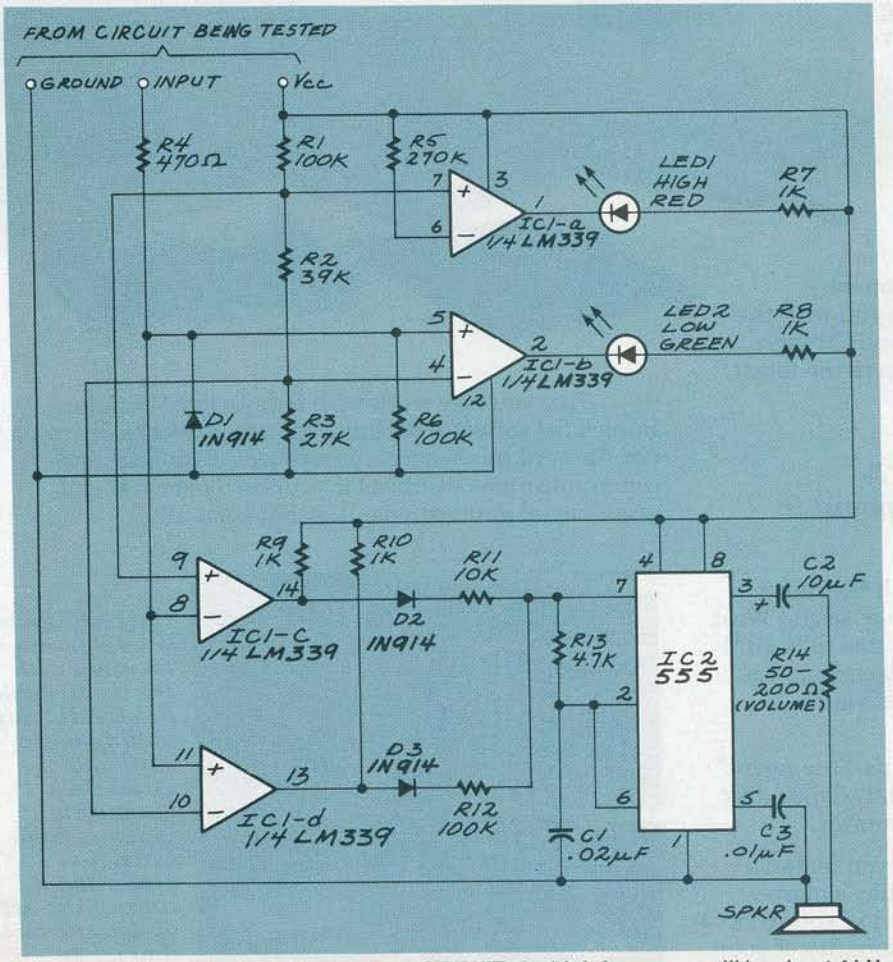

FIG. 3—IN THE FINAL VERSION OF THE CIRCUIT, the high frequency will be about 4 kHz and the low frequency will be about 500 Hz.

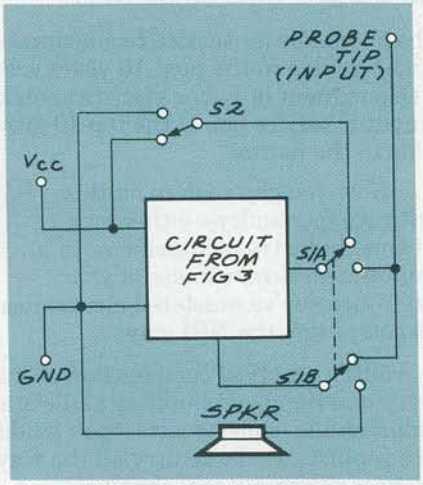

FIG. 4—WE CAN SET UP THE PROBE so that it can also be used as a tone generator; S1 switches the circuit from a logic probe to a tone generator by force feeding either a high or low voltage (via S2) to the input and routing the speaker output to the probe tip.