

# TONAL VOLTMETER

*This circuit gives an audible indication of voltage levels.*

MOST VOLTMETERS HAVE A DIGITAL or analog moving-needle display to indicate the voltage being measured. However, the tonal voltmeter, or TVM presented here emits a tone that changes in pitch according to changes in the voltage being measured. While this is no substitute for the accuracy of a digital display, it can give a quick, relative indication of a voltage value without the user having to stop and look at a display.

The TVM is a great time-saver when performing quick voltage-level checks as normally done with a logic probe. If one regularly repairs or tests many of the same circuits, a tonal pattern of the various test points will soon be recognized. Then, any voltage reading that generates an unfamiliar tone will immediately be suspected as an indication of a possible problem that can then be investigated in greater detail with more sophisticated test equipment. The TVM is also a great way to find voltage peaks or nulls when making circuit adjustments. The simple circuit's main limitation is that the input voltage to be measured cannot be greater than the TVM circuit's supply voltage.

## Circuitry

A schematic of the TVM circuit is shown in Fig. 1. The circuit is based on a CD4046B phase-locked loop (PLL) IC with a built-in voltage-controlled oscillator (VCO). The frequency of the VCO is determined by the voltage at pin 9, capacitor C1 between pins 6 and 7, potentiometer R1 at pin 11, which sets the maximum frequency, and potentiometer R2 at pin 12, which sets the TVM's minimum frequency.

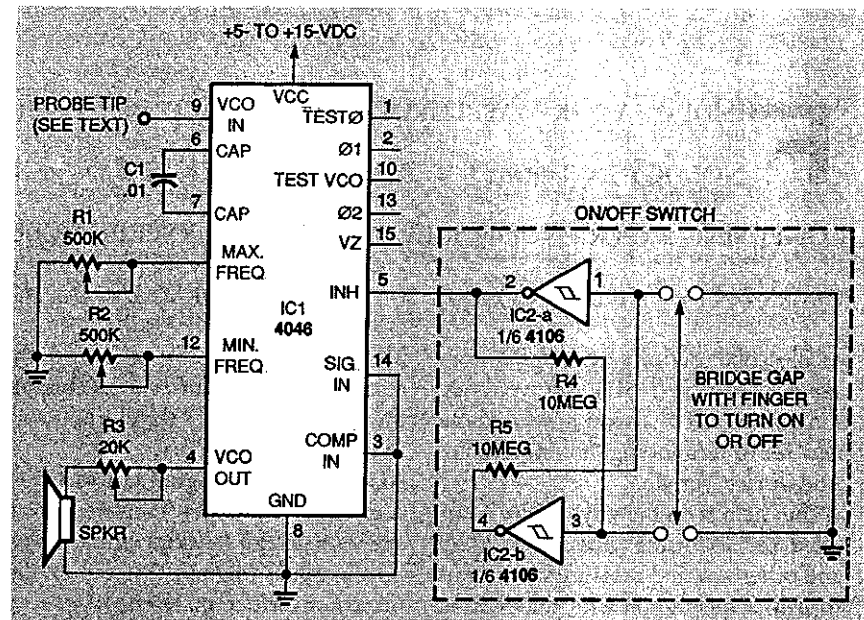


FIG. 1—TVM SCHEMATIC. The frequency of the VCO contained within IC1 is determined by the voltage at pin 9, C1, R1, and R2.

meter R1 at pin 11, which sets the maximum frequency, and potentiometer R2 at pin 12, which sets the TVM's minimum frequency.

The VCO output, which appears at pin 4, is normally fed back into the comparator input at pin 3. However, in this circuit, the VCO output drives a speaker directly. The VCO operates while the inhibit line (INH) at pin 5 is held logic low, and it turns off when INH is logic high.

A touch switch consisting of two Schmitt-trigger inverters (IC2-a and -b) turns the circuit on and off to conserve power when the TVM is not being used. The touch switch can be replaced with a standard SPST switch, if so desired. This is recommended if you don't have a Schmitt-trigger inverter and don't want to purchase one.

The TVM emits a low tone

when reading a logic low. As voltage input increases, the tone pitch increases until the input voltage reaches a logic high. As the voltage input decreases, the pitch decreases.

## Construction

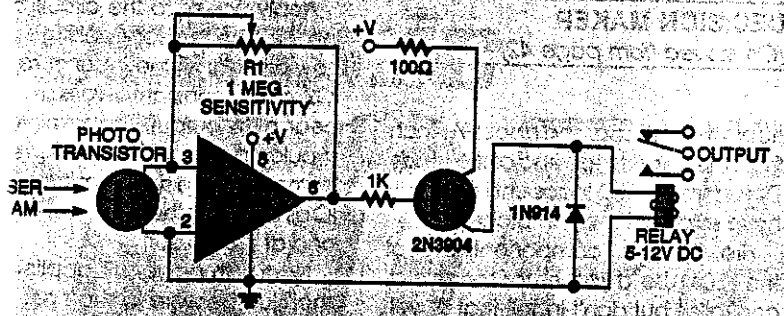
The circuit is simple enough for point-to-point wiring on perforated construction board; no foil pattern is available. As mentioned before, a standard switch can replace the touch switch. If you use the touch switch, bring the two touch points shown in Fig. 1 (IC2 pins 1 and 6) to the outside of the enclosure you use and connect them to any pair of conductive pads. Leave a gap between the pads that you can bridge with your finger.

A probe for the VCO input can be made from a ball-point pen

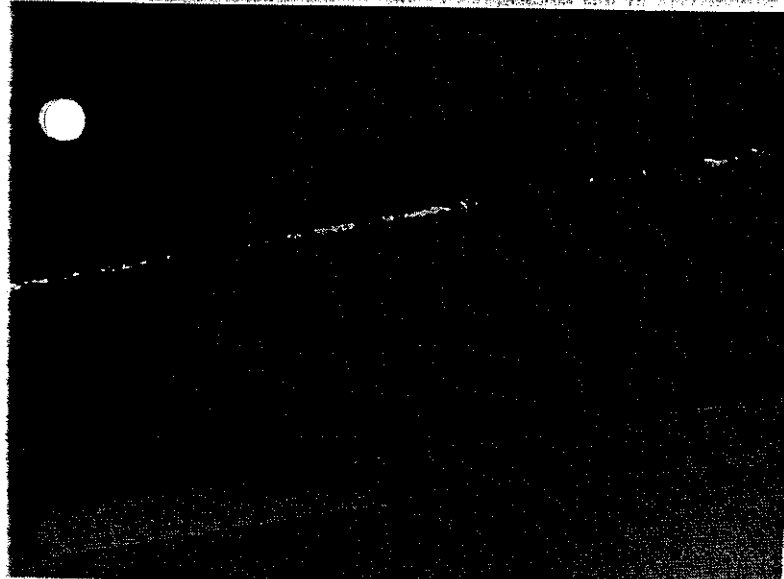
*Continued on page 79*

## PARTS LIST

- R1, R2—500,000 ohms, potentiometer
- R3—20,000 ohms, potentiometer
- R4, R5—10 megohms
- C1—0.01  $\mu$ F, ceramic disc
- IC1—CD4046B CMOS phase-locked loop, Harris or equiv.
- IC2—CD4106B CMOS hex Schmitt trigger, Harris or equiv.
- 8-ohm speaker, probe body and tip (see text), shielded cable, 5-volt power supply, enclosure, solder



—FOR GREATER SENSITIVITY, add a low-noise op-amp to the relay circuit.



—USE A LASER BEAM TO DETECT high and low spots across a wood plank. The beam appears in this photo as a white streak across the board.

...fing the Mylar out of the laser and activating the alarm. These are just a few ideas along the lines of security. I am sure you could come up with even more.

**Construction and surveying**  
 The construction industry where lasers are used extensively is building construction and landscape landscaping. The laser provides the most perfect straight edge, as the beam is extremely true even at long distances. Leveling soil beds or foundations, laying straight pipelines, fences and/or walls in line, marking boundaries, and verifying levels on roofs and other structural elements are all areas where construction workers use lasers to provide more accurate results. One experiment that demonstrates the principle of using the laser is to test the straightness of a piece of wood (see Fig. 5). Shine the laser on the wood so the edge of the beam directly illuminates the edge of

the plank. A bright red line will appear wherever it encounters the same level. That will indicate the "high" level of the surface. Now, introduce smoke, fog, or even a mist of fine powder (talc), and the full beam will become visible, pointing out the "low" level of the surface. A quick comparison will disclose how straight that piece of wood really is. Use the same technique to check walls, roofs, foundations, or any other section of a structure.

You can apply the same principle to ensure a correct angle across a wide section of wood that is to be cut. Measure the piece for the leading cut. Start the beam at that point and, with the help of a protractor, align the beam to the correct angle. On the far side, place a piece of cardboard against the edge of the wood and mark where the spot hits. By connecting the two markings, the guideline for the properly angled cut is also marked. **EN**

## TONAL VOLTMETER

*continued from page 61*

case with the ink cartridge removed. The probe tip can be any sharpened length of metal wire, such as a wire-wrap IC socket pin or small nail. Make the connection between the probe and pin 9 of IC1 with a length of shielded cable.

Any 5-volt DC supply is suitable for this project, either batteries or an AC adapter. Use whatever power supply is most convenient and least expensive for you. Mount the finished circuit in an enclosure that will protect it and you are done.

To adjust the two potentiometers in the circuit, first ground the probe tip and adjust R2 for the lowest tone desired. Then connect the probe tip to +5 volts and adjust R1 for highest tone desired. Adjust R3 to increase or decrease the speaker volume if necessary. **Q**

## "YOUR FREE CATALOG KNOCKED MY SOCKS OFF"

We get that sort of comment all the time. People are impressed that our free Consumer Information Catalog lists so many free and low-cost government booklets. There are more than 200 in all, containing a wealth of valuable information.

Our free Catalog will very likely impress you, too. But first you have to get it. Just send your name and address to:

**Consumer Information Center  
 Department KO  
 Pueblo,  
 Colorado  
 81009**



A public service of this publication and the Consumer Information Center of the U. S. General Services Administration