CIRCLE 520 "BEEPER" FINDS CIRCUIT SHORTS

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This design offers a way to trace resistance in the milliohm range, right to a short between bridged traces beneath a solder mask *(see the figure)*. It simply translates resistance into an audible tone, which increases in pitch as the measured value approaches zero.

In the classic op-amp multivibrator (shown in the inset), oscillation frequency is determined not only by the R_1C_1 time constant, but also by the hysteresis set by the R_2/R_3 resistor ratio. A1 in the main figure, with current boosters Q1 and Q2, is this same configuration.

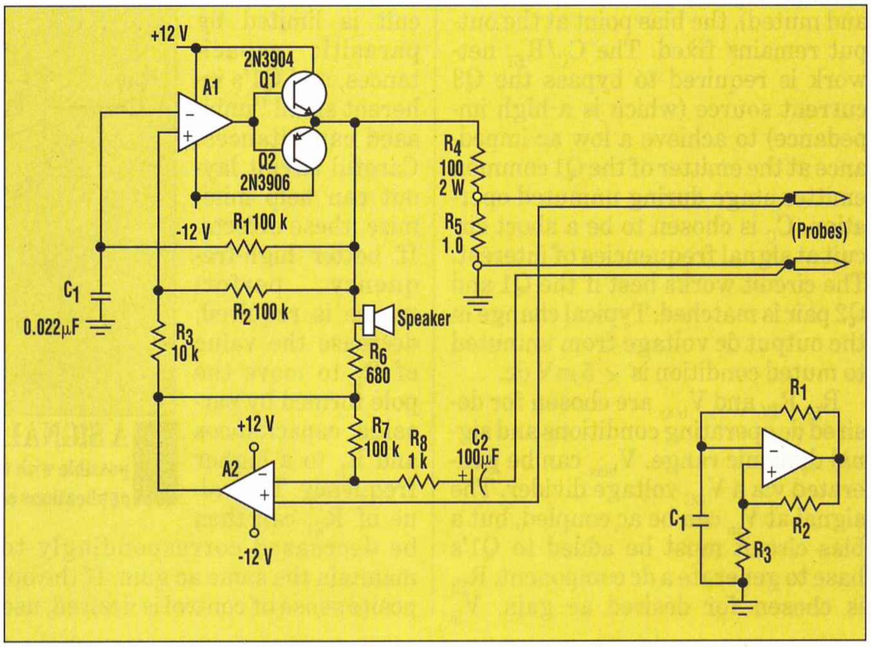
Assuming a virtual ground at the output of A2, free-run frequency is about 1 kHz—quite audible through a tiny 8-Ω speaker. Q1 and Q2 deliver a ±10-V squarewave to R_4, dumping a ±100 mA through a short circuit placed across the probe tips. R_5 ensure than open circuit voltage never exceeds ±0.1 V.

A2 monitors the voltage between the probes. The differential input must have its own separate path to the probe tips to eliminate test lead resistance from the measurement. Miniature "zip-cord" sold as loudspeaker wire makes a tidy two-conductor test lead.

When the probes are open, A2's gain equals the R_4/R_5 divider loss, and the output of both amplifiers is identical. This has two effects: First, hysteresis is greatly increased and frequency falls to a low growl, and secondly, the loudspeaker that bridges the two in-phase outputs is effectively silenced.

A dead short across the probe tips will return nothing to A2 and the circuit will squeal at its nominal 1-kHz rate. Anything less than a perfect short produces some output from A2, increasing multivibrator hysteresis and lowering the pitch. The circuit has so much "leverage," and the ear is so sensitive to pitch changes in this range, that it's easy to resolve minute resistance differences.

Any general-purpose op amp will suffice in this circuit—a couple of 741s or an equivalent dual. Again, two wires must be taken to each probe tip and soldered securely. Also, probes must make low-resistance contact with the circuit under test. The H.H. Smith #317 probe is ideal for this purpose. Its tip is a replaceable, old-fashioned steel phonograph needle that can pierce insulating layers and dig into oxidized solder joints.□



RESISTANCE BETWEEN BRIDGED TRACES can be translated into an audible tone with this circuit. The tone increases in pitch as the measured value approaches zero. The inset shows a classic op-amp multivibrator.

CIRCLE 521 MUTING CIRCUIT HAS LOW DC OFFSET

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A low dc-offset attenuator with a signal-muting function is useful in a number of signal-processing circuits *(see the figure)*. It's particularly suited to audio muting, as any dc shift manifests itself as an audible "pop" at the audio output.

The circuit operates as follows: The signal is input to V_{in} and a dc control voltage is applied to V_C. V_{bias} determines the desired bias point current. Assuming the following component and voltage values:

V_{CC} = 7.6 V dc
V_{bias} = 1 V dc
V_{in} = 1 V p-p, ac signal centered about 3.8 V dc bias
R_L = 2 kΩ
R_E = 200 Ω
R_{E1} = 2 kΩ

Q3 bias current is 1 mA, and dc output voltage is about 5.8 V with an ac gain of about –1. Q1 and Q2 form a