Transistor probe simplifies solid-state gaussmeter

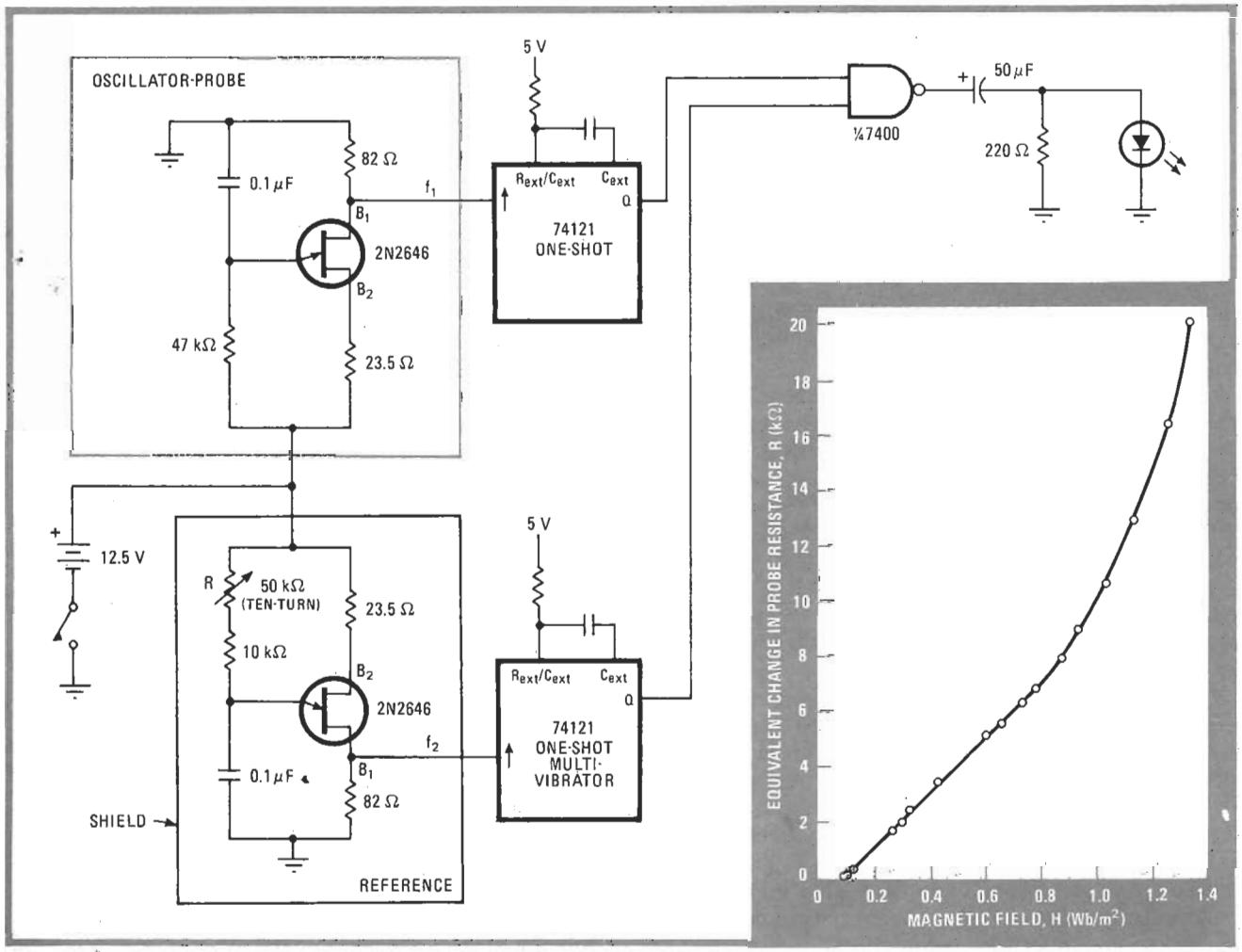
by Shanker Lal Agrawal and Rama Swami
Banaras Hindu University, Department of Physics, Varanasi, India

As a result of the subatomic energy exchanges that take place in many semiconductors because of particle-wave interaction, the electrical characteristics of the unijunction-transistor oscillator can be significantly changed by an external magnetic field. This property makes the low-cost unijunction transistor ideal for use as a probe in a gaussmeter or other flux-measuring instrument. Although it is not as linear, is not as easily calibrated, and does not provide the readout precision of some of the more elegant designs,[1] this circuit is simpler, just as sensitive, and virtually as accurate.

As shown, the gaussmeter is based on the comparator technique, wherein the frequency of the relaxation oscillator-probe is matched against a reference whose nominal frequency is about 400 hertz. Both generate positive-going spikes, which are lengthened by the pulse-stretching 74121 one-shot multivibrators. The NAND gate serves as a digital comparator, turning off the light-emitting diode when frequency $f_1 = f_2$.

In operation, the frequency of the reference oscillator is adjusted by resistor R until f_2 equals the free-running (free-field) frequency of the probe. Placing the oscillator-probe within the field to be measured will cause its frequency to change; potentiometer R in the reference must then be adjusted until the difference between f_1 and f_2 is minimized. The change in resistance of R from its nominal position may then be related to the strength of the magnetic field with the aid of the unit's individual calibration curve, which is shown at the right side of the figure.

As for calibration, at least three standard magnets will



Flux finding. The low cost of the rudimentary unijunction transistor, which is sensitive to externally applied magnetic fields, makes it ideal for use in comparison-type gaussmeters. The circuit range is 0 to 1.5 Wb/m², with circuit response linear to 1.0 Wb/m².

be required over the range of 0 to 1.5 weber per square meter, which is the range of the instrument. The circuit response is not likely to be linear above 1.0 wb/m^2, and depending on the particular UJT used, the standard-marker points will vary considerably as a function of R. Still, the circuit will hold calibration and will serve well in most general-purpose applications. □

References

1. Henno Normet, "Hall-probe adapter converts DMM into gaussmeter," *Electronics*, Jan. 3, 1980, p. 179.