GENERAL RADIO COMPANY

engineering department

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Diode improves voltmeter's linearity and stability

The simple addition of a diode in series with the meter element of a voltmeter circuit improves its sensitivity, temperature response and linearity. In addition, the diode provides for overload protection.

A commonly used peak-reading voltmeter circuit containing a small input capacitor, C_1, a rectifying diode, CR_1, a sensitivity-setting resistor, R_1, an RF bypass, C_2, and a meter, M, appears in Fig. 1a. In some cases, the bypass capacitor is replaced by a dc amplifier. The circuit exhibits a lack of sensitivity at low voltages because of the offset voltage of the diode (about 0.3 volt for a germanium diode, 0.7 volt for silicon).

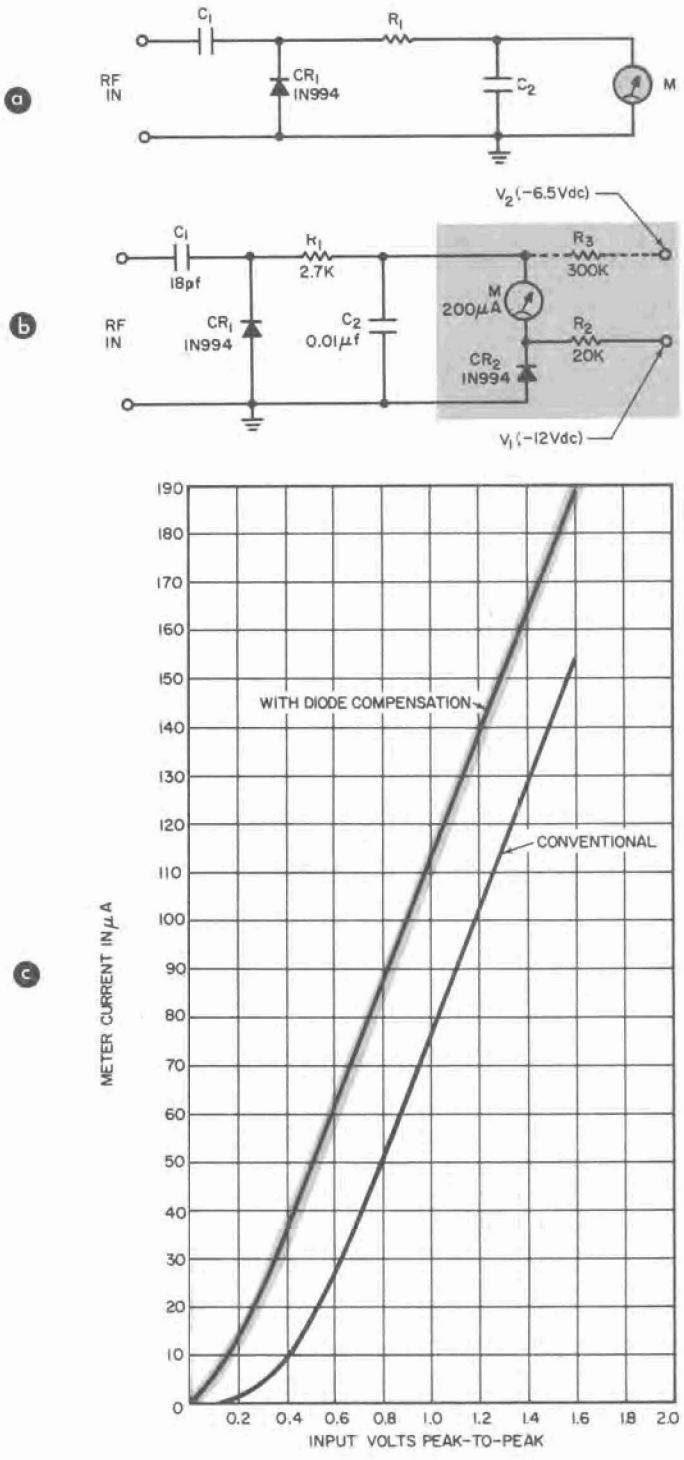
An ideal battery in series with the diode to buck out the offset voltage would improve the low-level sensitivity. This can be accomplished by the connection of another diode, CR_2, as shown in Fig. 1b. This diode is forward biased by resistor R_2 and bias voltage V_1 and has a voltage drop approximately equal to its offset voltage. As far as the dc circuit is concerned, CR_2 is in series with CR_1, R_1 and the meter. In overcoming the offset voltage of CR_1, it produces a slight forward current.

This simple change provides two additional features:

- If two similar diodes are used, their offset-voltage temperature coefficients (about -2 mv/°C) will be almost equal, and the zero drift of the metering circuit will be temperature compensated.

- The proper choice of R_2 and V_1 sets an upper limit to the meter current. If the meter current attempts to exceed the initial current through CR_2, this diode opens, and the large resistor R_2 is then in series with R_1 and the meter, reducing further current increase.

The meter's zero-offset caused by the small forward current in CR_1 can be corrected by adding a resistor, R_3, and a voltage, V_2 (shown by broken lines in Fig. 1b).



Conventional voltmeter circuit (a) exhibits nonlinearities at low input voltages. The addition of a diode network (b) results in improved linearity, thermal stability and sensitivity, as shown by the comparison of output curves (c).

Fig. 1c exhibits the comparison of the performance of both circuits at 250 Mc. Note the improved sensitivity of the new circuit for input voltages below 0.4 volt. If the curves were continued, the meter current for the new circuit would level off at about 600 μa, thereby protecting the meter.

Harold T. McAleer

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GENERAL RADIO COMPANY
WEST CONCORD, MASSACHUSETTS 01781

*NEW ENGLAND: 22 Baker Avenue
West Concord, Massachusetts 01781

*METROPOLITAN NEW YORK: 845 Broad Avenue
Ridgefield, New Jersey 07657

PHILADELPHIA: Fort Washington Industrial Park
Fort Washington, Pennsylvania 19034

*WASHINGTON and BALTIMORE: 11420 Rockville Pike
Rockville, Maryland 20852

ORLANDO: 113 East Colonial Drive
Orlando, Florida 32801

SYRACUSE: Pickard Building, East Molloy Road
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CLEVELAND: 5579 Pearl Road
Cleveland, Ohio 44129

*CHICAGO: 9440 W. Foster Avenue
Chicago, Illinois 60656

*DALLAS: 2600 Stemmons Freeway, Suite 210
Dallas, Texas 75207

*LOS ANGELES: 1000 North Seward Street
Los Angeles, California 90038

SAN FRANCISCO: 626 San Antonio Road
Mountain View, California 94040

MONTREAL: 1255 Laird Boulevard
Town of Mount Royal, Quebec, Canada

*TORONTO: 99 Floral Parkway
Toronto 15, Ontario, Canada

*Repair services are available at these offices.

GENERAL RADIO COMPANY (Overseas), 8008 Zurich, Switzerland
GENERAL RADIO COMPANY (U.K.) LIMITED, Bourne End, Buckinghamshire, England
Representatives in Principal Overseas Countries

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