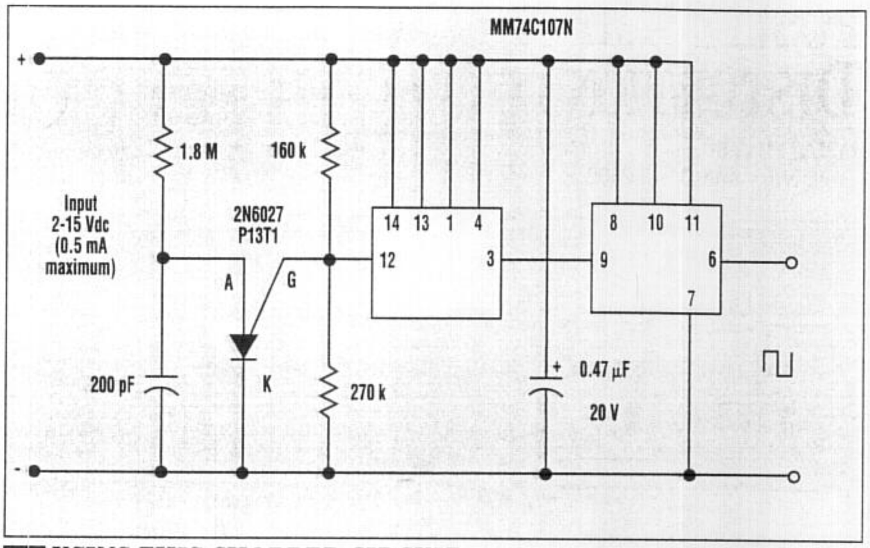

USING THIS CHOPPER CIRCUIT, any dc voltage source in the 2-to-15-V range can be chopped into a unipolar square wave with a peak amplitude that's nearly equal to the dc source voltage, thus creating a known ac voltage.

quency is around 400-500 Hz.

The chopper's unipolar square-wave output can be used to check the calibration accuracy of any scope or ac voltmeter, as long as the type of meter response and its internal coupling is known. The proper correction factors for the major meter-rectifier types and each kind of coupling is given *(see the table on p. 93)*.

Although you can set the dc source for the desired calibration voltage and multiply the meter reading by the correction factor, it's easier to set the dc source to the product of the desired ac voltage and a correction factor. For example, if you have an average-responding, rms-calibrated voltmeter (most common over the past 80 years) and want to check the calibration at 5 Vac, set the dc voltage source at $5.00 \times 1.8 = 9.00$ Vdc.□

CIRCLE 523

Calculate AC Watts With Voltmeter

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Measuring ac power doesn't necessarily require special equipment. In many cases, all that's needed is a high-input impedance ac voltmeter, followed by a few simple calculations.

The problem basically consists of determining the power factor of the load—the cosine of the phase angle between the voltage across the load and the load current. Using a simple circuit *(Fig. 1)*, that angle can be calculated quite simply.

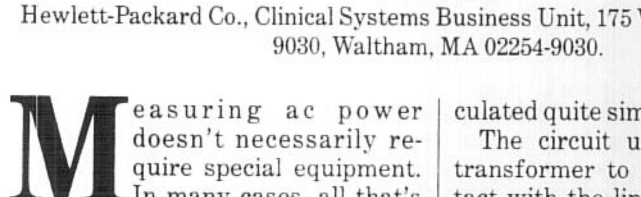
The circuit uses a 1:1 isolation transformer to prevent direct contact with the line. It is wise to proceed with caution whenever voltages of this magnitude are utilized in a test setup, even though the voltages that will be measured are usually below 1 V.

R_s is a current-sense resistor and R_r is a multi-turn potentiometer. The voltage across R_r is approximately 0.5% of the line voltage, which should be sufficient for most applications.

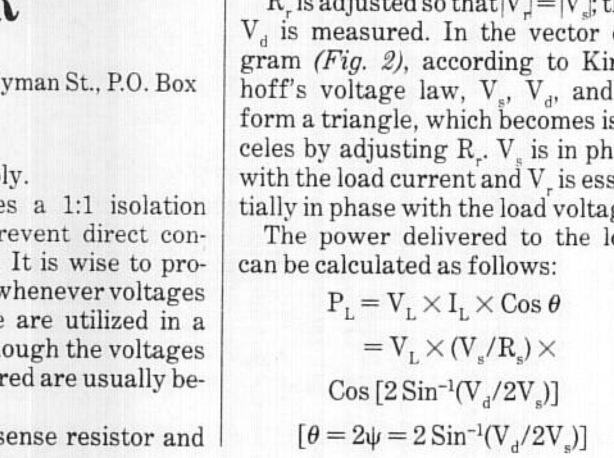
R_r is adjusted so that $|V_r| = |V_s|$; then V_d is measured. In the vector diagram *(Fig. 2)*, according to Kirchhoff's voltage law, V_s, V_d, and V_r form a triangle, which becomes isosceles by adjusting R_r. V_s is in phase with the load current and V_r is essentially in phase with the load voltage.

The power delivered to the load can be calculated as follows:

$$P_L = V_L \times I_L \times \cos\theta$$
$$= V_L \times (V_s/R_s) \times$$
$$\cos[2\sin^{-1}(V_d/2V_s)]$$
$$[\theta = 2\psi = 2\sin^{-1}(V_d/2V_s)]$$
□



1. THE LOAD'S power factor, which is the cosine of the phase angle between the voltage across the load and the load current, can be calculated simply with this circuit. A 1:1 isolation transformer is used to prevent direct contact with the line.



2. BY PROPERLY ADJUSTING R_r, the vector diagram of voltages V_s, V_d, and V_r forms an isosceles triangle, which simplifies the power calculation.