Notch filter and meter measure power-line harmonics

by Henno Normet
Diversified Electronics Inc., Leesburg, Fla.

Valid measurements of core loss in power-line transformers and various other magnetic devices require total harmonic distortion (THD) levels under specified limits—usually 3%. This inexpensive circuit determines the THD present in a 60-hertz waveform, over the range of 0 to 10%. Here, a notch filter is used to eliminate the voltage source's 60-Hz fundamental component, allowing an ac voltmeter to measure the remaining harmonic components.

The adjustable-Q Wien-bridge notch filter discussed in a previous article[1] proved to be best adapted for this application. Resistors R_{11} and R_{12} of the bridge (see shaded portion of figure) are selected to give the notch filter a Q of 10. The resulting null is sharp enough to pass a 180-Hz signal without attenuation, the lowest harmonic to appear as a component of distortion.

Component selection for the rest of the filter is also important to the achievement of good notch depth. C_1 and C_2 should be matched within 1%, and high-accuracy resistors used where indicated by asterisks. Metal-film resistors and polycarbonate capacitors help keep frequency drift and aging to a minimum.

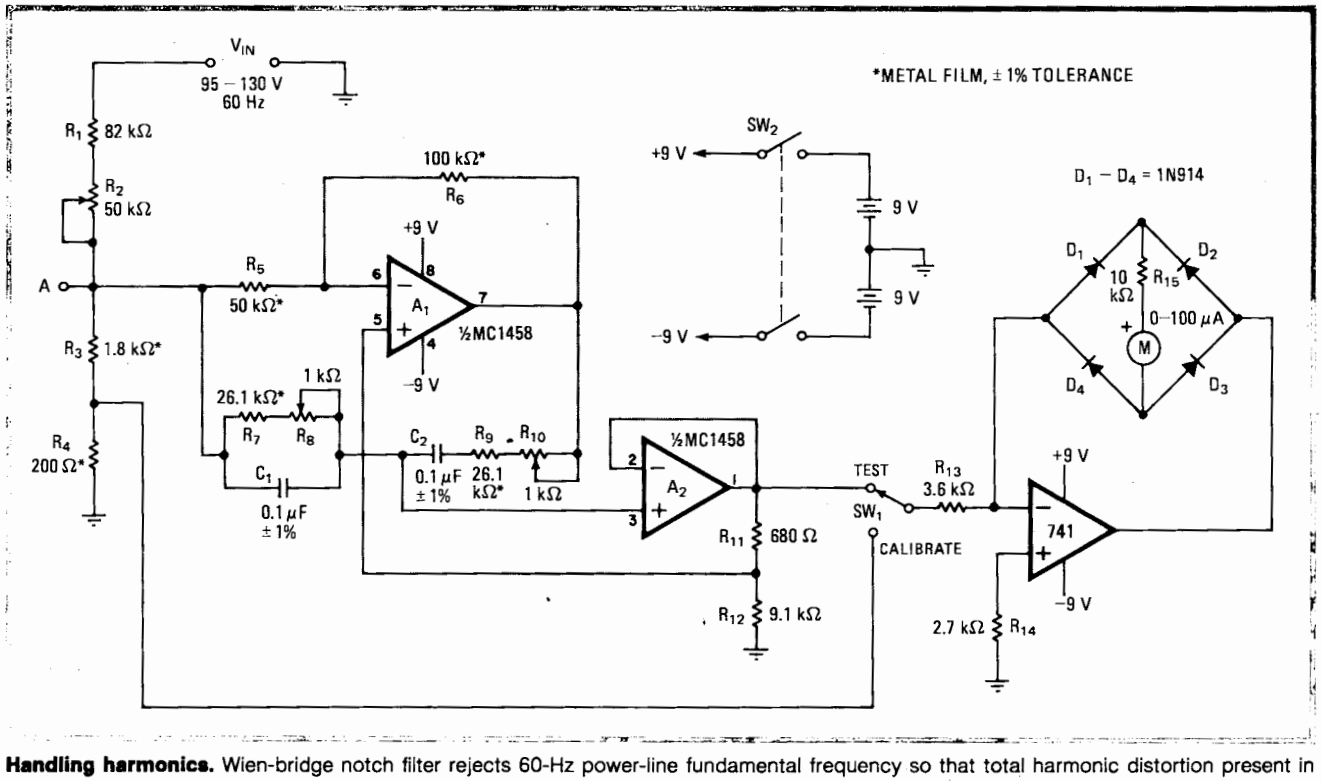
For initial balancing of the bridge, a low-distortion 2-V signal at 60 Hz is applied at point A. With SW_1 in the test position, R_8 and R_{10} are adjusted for a zero reading on the meter, M. If an audio oscillator is not available as a signal source, full line voltage may be applied to the input terminals, in which case R_8 and R_{10} are adjusted for a minimum reading on the meter.

In operation, SW_1 is first placed in the calibrate position and line voltage applied at the circuit input, V_{in}. R_2 is then adjusted for a maximum (full-scale) reading.

The switch is then placed in the test position, whereupon the input signal passes through the notch filter. Percent of THD may then be read directly. Note that the accuracy of the reading depends upon the accuracy of the 10:1 voltage divider, R_3 and R_4.

The definition of THD requires that both the calibration and measurement procedure be carried out with a root-mean-square-responding meter. However, in the 0–10% distortion range, a less costly average-responding meter will provide 10% accuracy, which is acceptable in most applications. □

References
1. "Wien bridge and op amp select notch filter's bandwidth", *Electronics*, Dec. 7, 1978, p. 124.



Handling harmonics. Wien-bridge notch filter rejects 60-Hz power-line fundamental frequency so that total harmonic distortion present in signal can be measured. Meter measures THD over 0-to-10% range. An rms-responding meter should be used, but an average-responding meter is acceptable. Results are displayed in percent, with an accuracy directly proportional to the tolerance of resistors in divider R_3–R_4.