Measure power-line distortion with a mixed-signal-THD analyzer

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Because of the performance of compressors and other inductive loads, it becomes more important to monitor the distortion on a power line. With alternative power sources, such as wind or solar, a distorted 60-Hz sine wave is more likely to be present. To measure this distortion, you can use a mixed-signal-THD (total-harmonic-distortion) analyzer to monitor the fundamental frequency amplitude and the second-, third-, fourth-, and fifth-harmonic content of the input signal. The analyzer, from Mixed Signal Integration includes five bandpass filters and two op amps. The op amps provide gain and continuous-time filtering. The analyzer also has digital-gain control for measurements in which the input amplitude is 10 or 20 dB lower than nominal: 2V p-p. The outputs of the analyzer are analog. Depending on the display that an application requires, you could tie the outputs to a bar-code interface, such as the LM3915 for 3-dB steps, or interface them with a multiplexer on a microcontroller for a digital readout.

Figure 1 shows the connections of the analyzer to the mains supply. A “wall-wart” transformer reduces the 120V mains voltage to 9Vac. This transformer provides 1500V isolation from primary to secondary and has low-distortion performance. The resistors in the divider act as fuses in case of a large surge voltage, and they reduce the voltage you apply to the analyzer. The back-to-back diode clamp protects the analyzer during momentary overvoltage conditions. In addition, a 220V MOV (metal-oxide varistor) across the transformer’s primary protects the transformer. The analog ground centers on 2.5V and is derived from a 100-kΩ resistor-divider network. A 0.1-µF capacitor provides ac filtering. A 74HC4060 operates at 15.360 MHz; the divide-by-4096 (Q12) output connects to the analyzer’s input-clock signal and supplies the clock for the device’s switched-capacitor filters.