Optoisolators slash cost of three-phase detector

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Optically coupled isolators replace transformers in a zero-voltage detector for synchronizing the firing of a thyristor in three-phase control applications, making this circuit cheaper, less bulky, and simpler than most competing designs. Moreover, the optoisolators eliminate the need for a low-pass filter, required in standard detectors for eliminating spurious zero-crossings caused by the thyristor's switching transients. They also provide high-voltage isolation and present much lower capacitive coupling to the circuit than a standard transformer, in fact presenting about as low a coupling as double-shielded types.

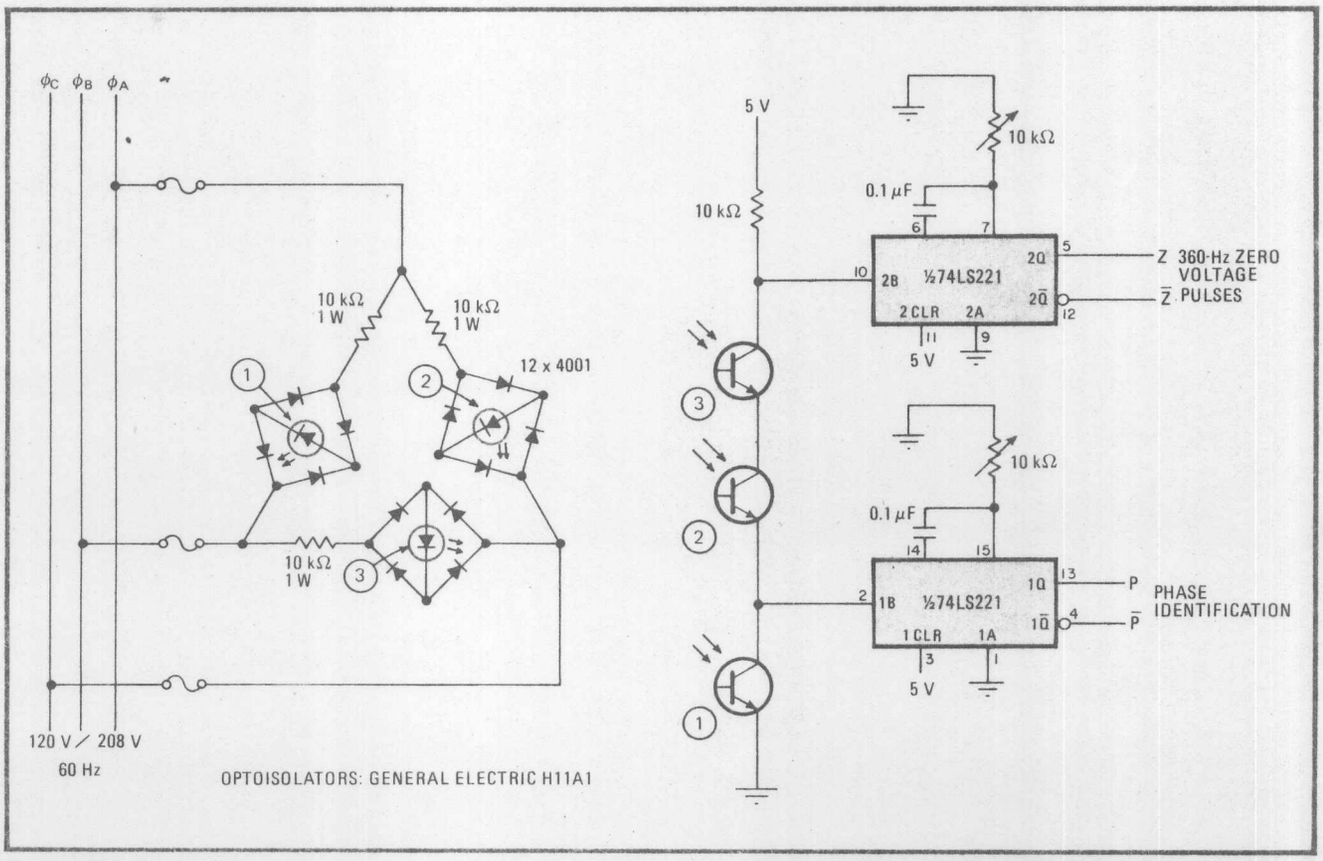
As shown in the figure, a light-emitting diode (contained in the GE H11A1 optoisolator) is inserted in each of three legs of a delta network. Each LED is wired to four standard diodes in a bridge arrangement, to enable it to respond to both polarities of the power-line input.

During most of the cycle, all phototransistors are on. At times when the voltage between any two lines is within 0.7 volt of zero, however, no current will flow through the LED connected across those lines. Therefore its corresponding phototransistor will be off, causing pin 2 of the 74LS221 one-shot to fire and a phase-identification pulse (P) to be generated twice every cycle.

In the case illustrated, the phototransistors are wired so that a pulse will be generated at the output each time the input voltage, as measured across ϕ_a and ϕ_b, passes through zero. Note that the one-shot should be adjusted so that the trailing edge of the output pulse corresponds to the actual zero-crossing point.

Identification pulses are also generated for all three phases collectively and these can be accessed, if required, at the zero-voltage pulse output, Z. These pulses occur three times as often as P.

Because at least one LED is conducting at any one time, no transient will normally be generated, so no low-pass filter is needed. Furthermore, the phototransistor's slow response of a few microseconds acts to suppress any transients that might occur near the zero-voltage points, thereby increasing the circuit's noise immunity. □



Economical. Three-phase, zero-voltage detector for synchronizing the firing of thyristors uses optoisolators in place of transformers to cut cost and bulk. Optocouplers provide circuit with high-voltage isolation and lower capacitive coupling than transformers.