Digital Dimmer Box

Submitted by: R. Hugo Vieira Neto and Francisco Eugenio Mauro

Abstract

The Digital Dimmer Box is intended for stage illumination in theaters. It is simple and inexpensive. Designed with a ZiLOG Z8 OTP microcontroller, the device is completely compatible with older analog dimmer boxes and supports 4400-Watt loads.

In stage illumination, dimming of each incandescent lamp is controlled by an analog voltage (ranging from 0 to 10 volts) and is supplied by a remote console.

To achieve linear perception, a dimmer box should exhibit a nonlinear response to the control voltage. Older dimmer boxes employ analog processing for the task of compensation. The digital approach uses a simple software look-up table concept to implement response compensation. As a result, a dedicated external analog circuit is not required.

The system control block uses the Z86E08 microcontroller running at 12 MHz. Some of the Z86E08's key features are:

- Onboard counter/timers with prescalers (generation of phase-control signals)

- Onboard analog comparators (AC line zero-crossing detection and control voltage acquisition)

- ROM space (implementation of one or more look-up tables for visual response compensation)

To implement the A/D converter, an R-2R network is mounted on port P2. The output is used as the reference voltage (pin P33) for the Z8's onboard analog comparators on port P3. The analog control voltage is connected to the first analog comparator input (pin P31) and the A/D conversion is completed by software using a successive approximation technique.

The counter/timer generates a time delay between the zero-crossing of the line voltage and the TRIAC's triggering pulse. As a result, power is delivered to the load. At 12 MHz, it is possible to achieve delays from 0 to 8.33 ms with the correct settings of the counter/timer prescaler, which corresponds to the phase-triggering range for an AC line frequency of 60 Hz.
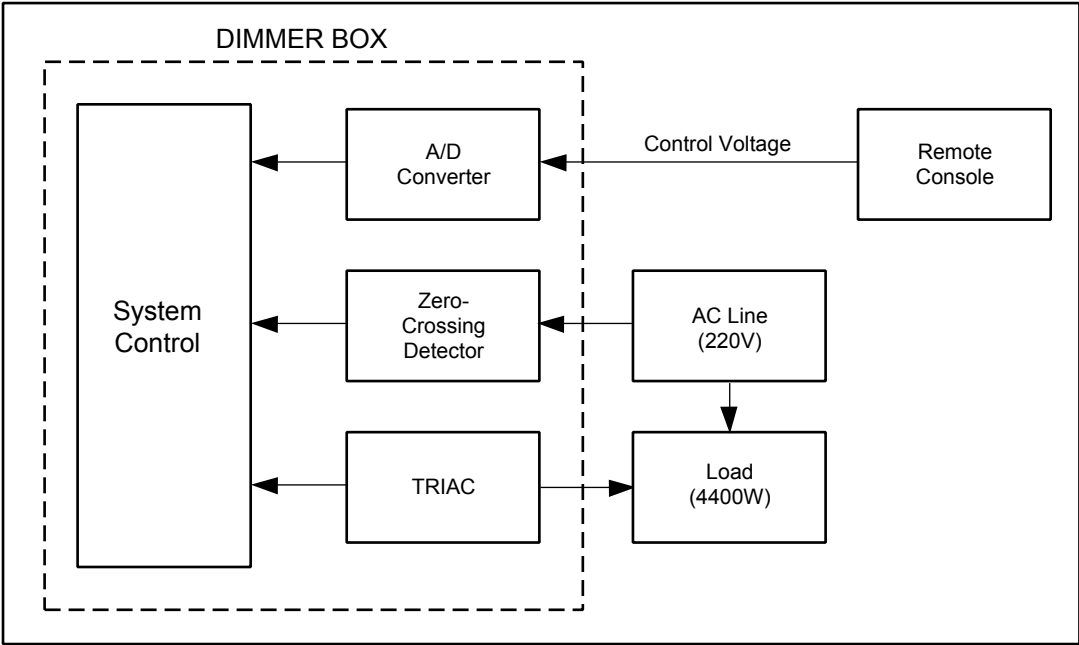
Figure 16. Digital Dimmer Box Block Diagram

Figure 17. Digital Dimmer Box Schematic Diagram