Crossing Gate Controller

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Overview

This is the second crossing gate demo. It can operate in any one of three modes:

1) Single sequence demo (similar to the first crossing gate demo)
2) Continuous demo - the single demo repeated periodically (approx. two minutes)
3) Garage Door Opener mode - gate up / gate down using garage door "clicker".

The Crossing gate consists of a bell that rings continuously when +12VDC is applied, a pair of signal lights (automotive single filament red bulbs, 18-24 Watts) that operate alternately, and an (approximately 2HP) 12VDC motor with a common terminal and up and down terminals. There is an electromagnetic brake that is controlled through cam operated contacts, not through the controller.

The controller has six outputs. The first pair, using a +12VDC common, powers the motor. The second pair, using a +12VDC common alternately powers the two signal lights. The fifth output powers the bell. The sixth output is reserved to power an associated sound system. There are four dry contact inputs. The A5 input is used for the Garage Door Opener (GDO) input. The A4 input is used to initiate the demonstration sequence, and when remaining active perform the continuous periodic demo.. The other two inputs are currently unused.

The operational sequence is:

BEGIN: Wait for switch closure (either DEMO or GDO)

Time 0.0 Seconds	Turn on bell and one signal light (alternate lights at ½ second interval)
Time 2.0 Seconds	Power the "down" (left) motor terminal. Cam operated contact will remove power at limit of operation (approximately 3 seconds) .

IF in GDO mode, wait for GDO (A5) switch activation, ELSE continue

Time 8.0 Seconds	Remove power from "down" terminal (releasing electromagnetic brake, if connected).
Time 8.5 Seconds	Power the "up" (right) motor terminal. Cam operated contact will remove power at limit of operation (approximately 3 seconds) .
Time 12.0 Seconds	Remove all power

Wait 3 seconds

IF START DEMO (A4) switch is open, then go to BEGIN

Wait approximately two minutes, then go to BEGIN

Design Highlights

The processor is a MicroChip 16F684 which has 2K program memory, 128 bytes static RAM memory, 256 bytes of EEPROM memory, 12 I/O pins, a 10 bit A/D converter, and three timers. It can be on-board programmed using a MicroChip PICKit2 USB programmer interface (pin 1 on bottom).

The processor is intefaced to the power controllers using 4N26 OptoIsolators - the processor turns on an LED in the isolator with +5 VDC, and the optotransistor in the isolator turns on the +12VDC to activate the power control FET's.

The power control uses IRF1405 Automotive MOSFET's which have an on resistance of 0.0055 Ohms, can handle a peak current of over 160 Amps, and have built-in back EMF protection to 55V. Because of the large rating of the motor and the inertia of the mechanism, additional back EMF protection was added to the motor outputs using two 25A 100V diodes (two legs of a bridge) with 0.1uF capacitors. The other outputs have 1.0A 200V 1N4002 diodes with 0.01uF capacitors to protect against momentary spikes.

The Motor control FET's will be conducting 10A and dissipating 0.5W for three seconds for up, and the same for down. The lights and bell are approximately 2A dissipating 0.02W continuously. While these conditions do not normally require heat sinks, they were used as a precaution since the unit will be in the metal base compartment of the crossing signal, and could experience high ambient temperatures.

The control program is written in MicroChip Assembler using Timer0 to create the (approximately) one half second delay for timing the alternating of the lights and overall script timing. Since the cam operated limit contacts on the motor prevent motor over-run, it was not necessary to use any interrupts. No EEPROM is used. No A/D channels are used.

Detail Material

Processor Schematic

Power Control Schematic

Processor Specifications

Optoisolator Specifications

Power MOSFET Specifications

Assembly Program