Starting Grid Lights

A project to make motor-racing starting lights using a PICAXE microprocessor

INTRODUCTION

This document describes the design and construction of a panel of lights, such as those used at the start of a motor-race.

SPECIFICATION

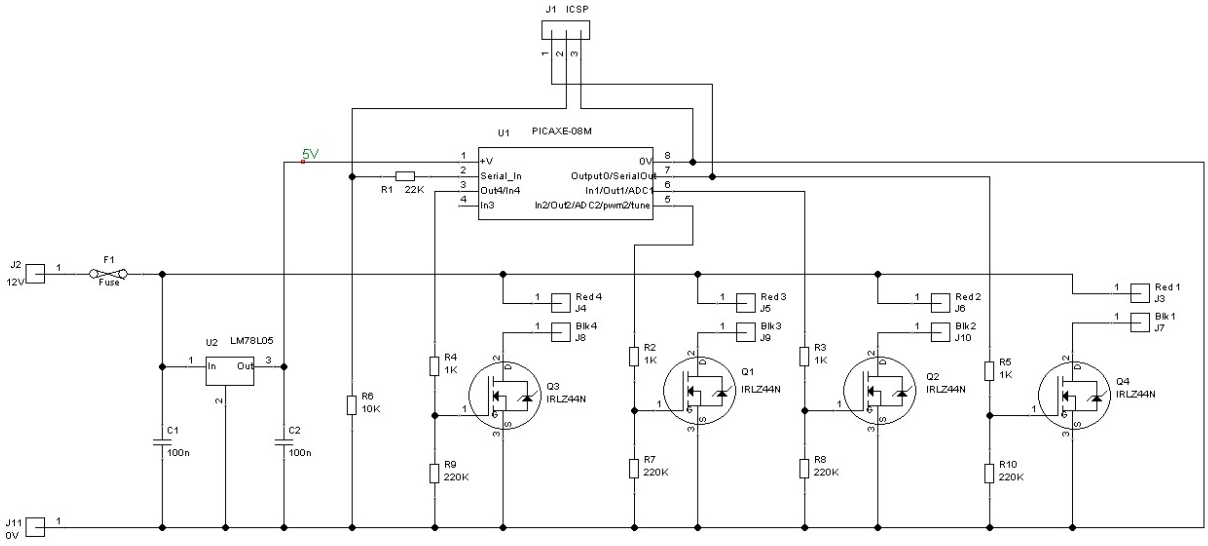
The project was to construct a set of lights, such as could be used at the start of a motor race.

For the lights, it was decided to use 4 pairs of 12V LED lamps, as used for rear lights on some cars.

It was required that the pairs of lights would turn on and off or flash in a particular sequence. As the exact sequent and timing was difficult to specify at the outset, it was decided to make the whole thing programmable so that the sequence could be 'tweeked' to achieve the desired effect.

CIRCUIT DESIGN

The circuit is as shown. The circuit shows only the components mounted on the circuit board. The LED lamps were mounded on the front panel and connected to the circuit board by fly-leads.



The main parts to the circuit are:

1. Microprocessor.
2. Output drivers (MOSFETs).
3. In-Circuit Serial Programming Interface.
4. Power Supply

MICROPROCESSOR

The heart of the device is a PICAXE Microprocessor. This is a complete 'computer on a chip'. For this project the 8-pin version (PICAXE-08M) provided sufficient I/O ports.

OUTPUT DRIVERS

Each pair of LED lamps were wired in parallel, and connected to the terminals marked Red1/Black1 etc. The LED lamps have their own current limiting resistors built in, so they were not needed in this circuit.

The PICAXE is not capable of driving the LEDs directly, so MOSFETs are used as drivers. They are connected in Common Source mode. With a PICAXE I/O pin low (0V), there is no charge on the MOSFET Gate, so it presents a very high resistance between the Drain and Source and no current flows. But when an I/O pin goes high (+5V) the charge present on the Gate allows a large current to flow between the Drain and Source of the MOSFET, thus drawing current through the LED and illuminating it. This configuration allows the PICAXE to operate at 5V while the LEDs are using the 12V supply.

IN-CIRCUIT SERIAL PROGRAMMING INTERFACE

When working with microprocessors it is always useful to be able to re-program them without physically unplugging them from the circuit. The PICAXE chip can be re-programmed in-circuit by providing a connection know as the in-circuit serial programming (ICSP) interface. The fact that pin 7 is used for both the ICSP and output does not matter; programming is not affected by the ICSP signal also going to the gate of the MOSFET. The LED 1 flashes during programming, but this is not a problem.

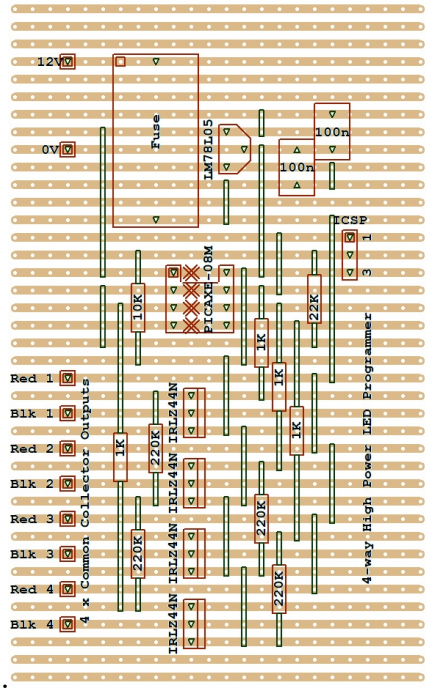
POWER SUPPLY

The system is designed to work from a 12V supply, either a battery or mains adapter. The maximum current drawn was found to be just under 2 amps.

The PICAXE requires a stabilised 5V supply, which is provided by the LM8085 voltage regulator and capacitors C1 and C2.

CIRCUIT BOARD

The circuit is build on a piece of stripboard. laid out thus:



PICAXE PROGRAMMING

The PICAXE chip was programmed using the PICAXE Editor 6 package. The chosen language was Blockly.

After some experiments, the final sequence settled on was as follows:

- Turn all lights on. Pause for 1 second.
- Turn them off in sequence, from 1 to 4, with a 1 second delay between each.
- Flash them all 5 times with a 150 ms on/off period.
- Pause for 1 second and repeat from beginning.

The finished program looks like this: