A Microcontroller Based LED Display Board

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Abstract

A display screen of "ရတနာပုံ" is constructed by using the light emitting diodes. The display screen is controlled and driven by the PIC16F84A microcontroller via opto-couplers. The program source code is written in Pic Basic Pro language, compiled into Hex file with Microcode Studio IDE and embedded into PIC microcontroller using EPIC Programmer.

Key words: PIC16F84A microcontroller, Pic Basic Pro language.

Introduction

A display board is seen everywhere in our daily life. Department, building, street etc are identified by its display board. Light emitting diode operates with DC supply voltage and consumes less power than electric bulb. These features lead us to make the LED display board. The versatility of microcontroller is applied to control the illumination of character. The desired mode of illumination and time period is written in the source code. To make a good electrical isolation between microcontroller and LED display screen, opto-couplers are applied as an interface devices.

PIC Microcontroller

The microcontroller is simply a computer on a chip. It is one of the most important developments in electronics since the invention of the microprocessor itself. It is essential for the operation of devices such as mobile phones, DVD players, video cameras, and most self-contained electronic system (Martin Bates. 2006).

Microcontroller contains all the components required for a process system in one chip: a CPU, memory and I/O. A complete system can therefore be built using one MCU chip and a few I/O devices such as a keypad, display and other interfacing circuits (Nebojsa Matic. 2000).

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PIC16F84A is an 18-pin Enhanced FLASH/EEPROM 8-Bit Microcontroller. The special microcontroller features are:

- 10,000 erase/ write cycles Enhanced FLASH Program memory typical
- 10,000,000 typical erase/ write cycles EEPROM Data memory typical
- EEPROM Data Retention > 40 years
- In-Circuit Serial Programming™ (ICSP™)- via two pins
- Power-on Reset (POR), Power-up Timer (PWRT), Oscillator Start-up Timer (OST)
- Watchdog Timer (WDT) with its own On-Chip RC Oscillator for reliable operation
- Code protection
- Power saving SLEEP mode
- Selectable oscillator options

The pin diagram is shown in Figure (1).

(Microchip Technology Inc: 2001)

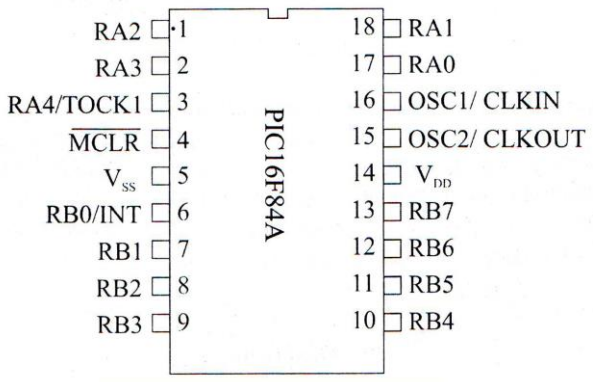

Fig.1 PIC16F84A

Optical Isolator

Optical isolator is designed to provide complete electrical isolation between an input circuit and an output circuit. The actual purpose of isolation is to provide protection from high-voltage transients, surge voltage or low-level noise that could possibly result in an erroneous output or damage to the device. Optical isolator also allows interfacing circuits with different voltage levels, different grounds and so on.

The input circuit is typically an LED, but the output circuit can take several forms such as the phototransistor shown in Figure (2).

When the input voltage forward-biases the LED, light transmitted to the phototransistor turns it on, producing current through the external load as shown in Figure (2) (Thomas L. Floyd, 1996).

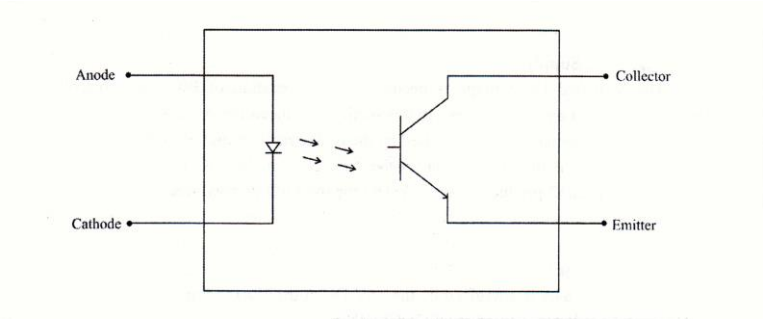

Fig.2 Opto-coupler

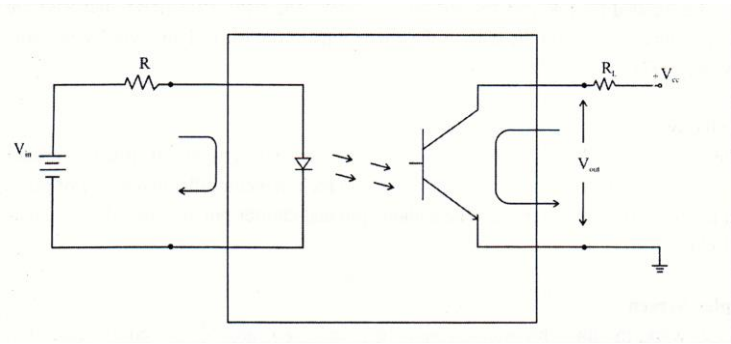

Fig.3 Opto-coupler connected to an external load

Design and Construction

"A Microcontroller Based LED Display Board" is composed of the following section

(i) Regulated Power Supply

(ii) PIC Microcontroller

(iii) Optical Isolator

(iv) LED Display Screen.

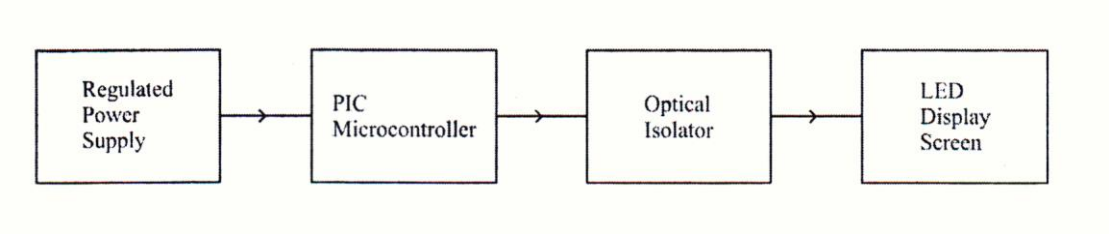

Fig.4 Block diagram of "A Microcontroller Based LED Display Board"

Regulated Power Supply

The regulated DC voltage is needed for the operation of PIC microcontroller and illumination of light emitting diodes. In this section, the incoming AC 220V, 50 Hz is stepped down by the transformer and then rectified by the bridge rectifier and filtered by the capacitors. The IC voltage regulator 7805 produces the +5V DC for the PIC microcontroller and IC voltage regulator 7812 produces the +12V DC for the LED display screen (Tomas L. Floyd. 1996).

PIC Microcontroller

The PIC16F84A is energized by the +5V DC at the V_{DD} and grounded at the V_{SS}. The 4 MHz crystal oscillator is fixed at OSC1/CLKIN and OSC2/CLKOUT. The crystal oscillator is tied to +5V DC via 0.1 μF capacitor and grounded by two 22 pF capacitors. $\overline{\text{MCLR}}$ is tied to +5V DC and grounded by 1 K resistor and micro switch. The RB0, RB1, RB2, and RB3 are used as output pins which send the data to the anode pins of optical isolators via 1 K resistors (Fred Stevens. 1997).

Optical Isolator

The opto-couplers EL817 are used as interfacing elements between PIC microcontroller and LED display screen. The anode pin is connected to the microcontroller and collector pin is connected to the LED display screen. The cathode pin and emitter pin are grounded (Thomas L. Floyd. 1996).

LED Display Screen

In this work, the four characters namely "ရ", "တ", "နာ" and "ပုံ" are constructed. For the first character of "ရ", fifteen LEDs are connected in parallel array. For the second character, "တ" is formed by fourteen LEDs and third and fourth characters of "နာ" and "ပုံ" are formed by fifteen LEDs respectively.

Result and Discussion

The display board is constructed to display "ရတနာပုံ" by using the light emitting diodes. There are three modes of display in this work. The first one is turning on and off of each character with 0.5 second interval. In this mode, "ရ", "တ", "နာ" and "ပုံ" are lit for 0.5 second and turned off 0.5 second. In second mode, each character is illuminated successively without turning off the previous one. The third mode is displaying all the characters simultaneously and turning off them simultaneously. These three modes are repeated as long as power is supplied.

It is found that the display board operates as the microcontroller was programmed. The illumination of the LEDs is quite enough to see the characters clearly. Therefore the result is satisfactory and the circuit is reliable.

Conclusion

"A Microcontroller Based LED Display Board" is designed and constructed by using PIC16F84A microcontroller and light emitting diodes and some electronic components. The circuit is simple and its performance is satisfactory. In this work, only four characters are used. The display board of more characters can be modified by a little change in program, expansion in display screen and circuit.

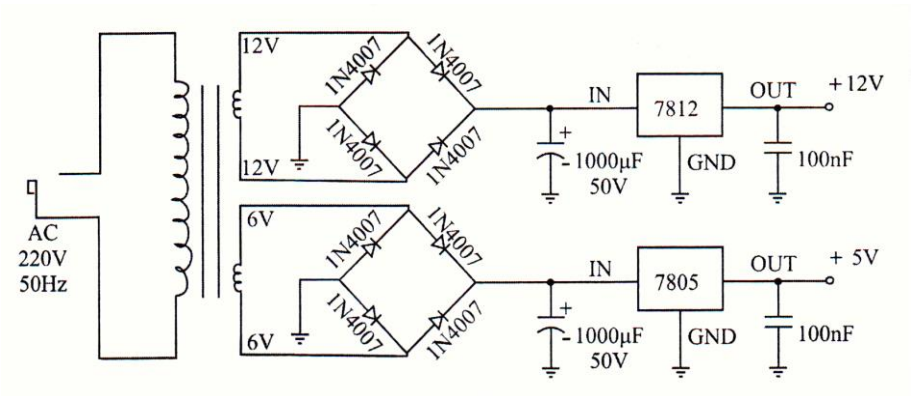

Fig.5 Regulated power supply circuit

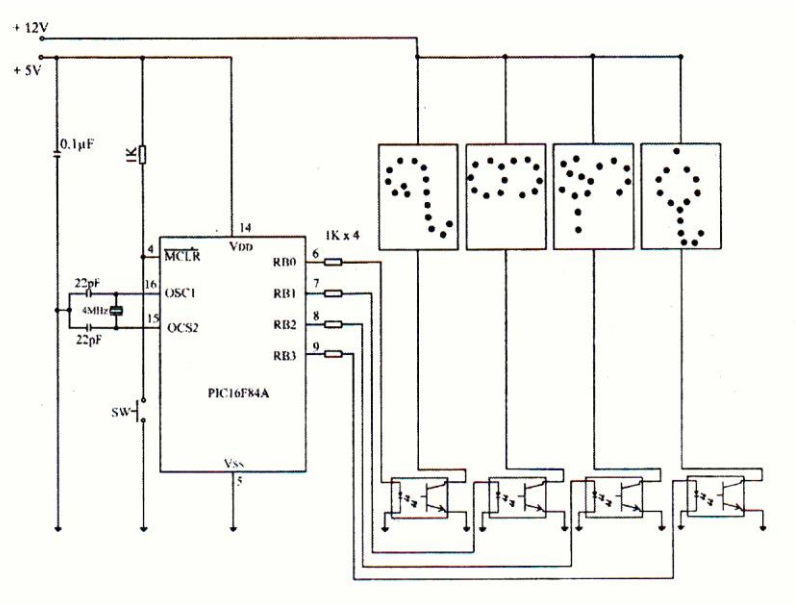

Fig.6 Circuit diagram of "A Microcontroller Based LED Display Board"

Fig.7 Preparation for writing the program into PIC microcontroller

Fig.8 Display of “ရတနာပုံ”

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