

# Design of LCD Electric Circuit Segments Basic on MSP430

Jian Huang

Xijing University, Xi'an 710123, China

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**Abstract.** Display device is very important equipment in the instrument. LED display have limited in complex driving circuit, high dissipation, big size. In order to resolve this problem, a segments LCD drive circuit is introduced, which based on ultra-low-power MSP430, using the built-in LCD controller, can drive the 160 segment LCD. The segments LCD's type is EDS826, it has 6 bits 8 segments LCD, display principle and 4-MUX driving methods of segments LCD is given in detail. It has design drive circuit and give software flow chart. The test results show that the device can clearly display letters and numbers, have low power dissipation, simplifies design of drive circuit, can be used in the instrument to display temperature, humidity and pressure message.

## Introduction

Code of LCD, or a liquid crystal screen, generally called pattern type LCD screen, each segment of the electrode includes 7 segments and a back electrode BP (or COM), you can display numbers and simple characters, digit and character corresponding to its corresponding [1-3]. Compared with the digital tube segment code, the price is basically the same, the performance and the driving principle is quite different. Compare to LED, it's display more clear, more realistic and has lower power consumption, the contents of the display will be more abundant. So it is often used as a display unit in the instrument and meter. Produced by TI company ultra low power MSP430 microcontroller, the built-in code segment LCD driver, is the best driver code segment LCD control unit, this paper focus on the principle and method for driving code segment LCD, and accordingly gives the hardware circuit design and software driver display program.

## Segment Code LCD Display Principle and Its MSP430 Liquid Crystal Driving Method

Liquid crystal display often has many parameters, but the driving parameters related to the only two: one is "bias", refers to the liquid crystal display / does not show and display the signal amplitude ratio; another is duty cycle that is ratio of each segment LCD display time and display cycle [2]. MSP430F4619 has its own segment LCD driver module, including four kinds of driving module, that is static type, 2-MUX type, 3-MUX type and 4-MUX type. MSP430F4619 by setting different COM to achieve the choice of driving mode, because designers often want to use the least pin to drive the LCD segment, and therefore more use of 4-MUX drive mode.

Among 4-MUX LCD driver mode, every four stroke in parallel with one common pin. As shown in Fig. 1, a, b, c, h share a root tube feet, d, e, f, g sharing another single pin, driving every digital only need 2 root segment drive pin (Fig. 1 driven by S0 and S1, number 2, driven by the S2 and S3.). 4-MUX LCD has 4 common COM3 to COM0 respectively, and the MCU connected to COM3 to COM0. In addition to V1 and V5, the 4-MUX mode driver waveform requires two intermediate voltage V2 and V4, generally by three equivalent value resistance R1, R2, R3 series making voltage divider.

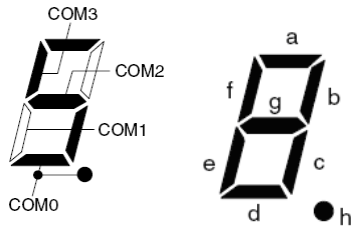


Figure 1. 4-MUX LCD define

## Drive Circuit Design

The driving hardware circuit mainly includes MSP430 and its peripheral circuit and liquid crystal EDS826 module. The EDS826 can display 6 digits, so MSP430 only need to select S0 ~ S11 pins. We can use the button to adjust the display contents of the LCD liquid crystal.

**MSP430 Introduce.** The main control unit is MSP430 single chip microcomputer, because the 430 single chip microprocessor is a high performance single chip microcomputer, its power consumption is low, the interface is rich, especially suitable for the main control unit in the instrument. Because MSP430 microcontroller internal LCD controller can automatically produce all the timing of LCD through the hardware, we only need to operate the LCD control register to select the LCD driver mode [4-6]. In software design, we need to write the display buffer, it can directly control the LCD light off or light on.

**LCD Module EDS826.** LCD module uses EDS826, it can display six digits one time, each figure and its corresponding segment code shown in Fig. 2, the LCD module using 4-MUX drive [7-8]. In the design of the hardware circuit, the actual connection diagram is shown in Fig. 3. EDS826 COM0~ COM3 connected to MSP430 COM0 ~ COM3, all other pins are connected in sequence to S0 ~ S11, according to 4-MUX driving principle, S0 and S1 driving the first tube, S2 and S3 driving the second tube, by analogy, S10, S11 drive the sixth tube. The relationship between the memory and the segment code referring to the front of this paper [7].

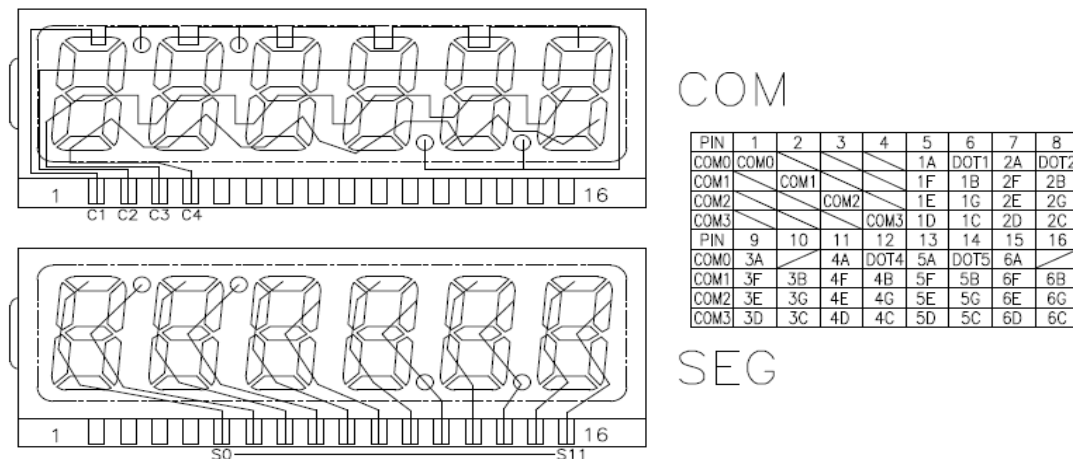


Figure 2. EDS826 pins

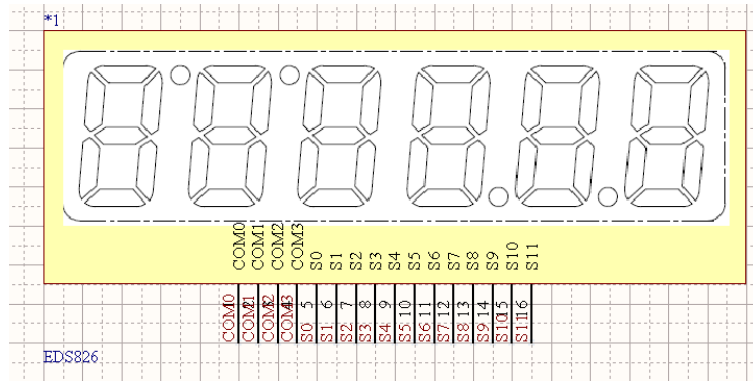


Figure 3. EDS826 connected to MCU

## Software Program

**Software Flow Chart.** Software flow chart as shown in Fig. 4, first initialization LCD, then according to the above macro definition to display 0 to 5, finally we can change the display numbers through the button.

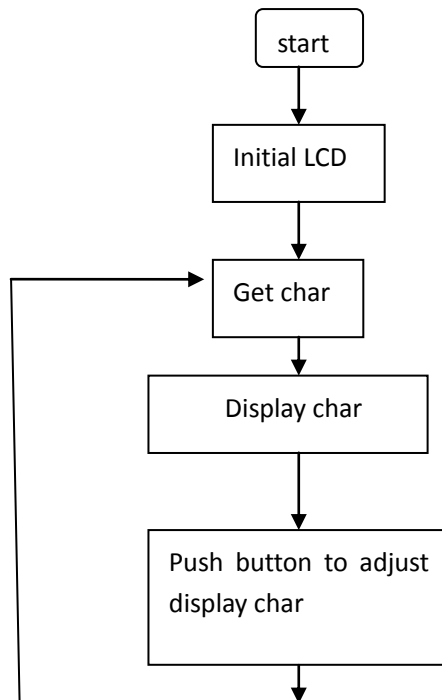


Figure 4. Software flow chart

**Part Code.** Code below can display number 0 to 5. Compiler development environment is IAR5.0.

```

LCDACTL = LCDON+LCD4MUX+LCDFREQ_128; // 4mux LCD,
LCDAPCTL0 = LCDS0+LCDS4+LCDS8; //Segments 0-11
for (i=1;i<7;i++)
{
    LCDMEM[i] = char_gen[i];
}
  
```

## Test Results

According to the above description, we design the hardware circuit and software program<sup>[9]</sup>, display the results as shown in Fig. 5 and Table 1



Figure 5. Display result

Table 1 The code of number 0~9

number	0	1	2	3	4	5	6	7	8	9
code	0afh	06h	6dh	4fh	0c6h	0cbh	0ebh	0eh	0ffh	0cfh

## Conclusion

This paper describes the principle and method of the segment code LCD in detail, using MSP430F4619 to drive the segment code LCD screen EDS826, drawing the schematic and the PCB board, using c language to program the code. Experimental results show that the digital 0 to 9 can be display clearly. According to the driving method [10], the LCD can be driven more segments, and can be used to display important information in the instrument and meter equipment.

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