



TM57 Series

TM57FLA80 DEMO CODE
FOR LCD FUNCTION

Application Note

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discontinue this product without notice.**

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PRODUCT NAME

TM57 Series IC

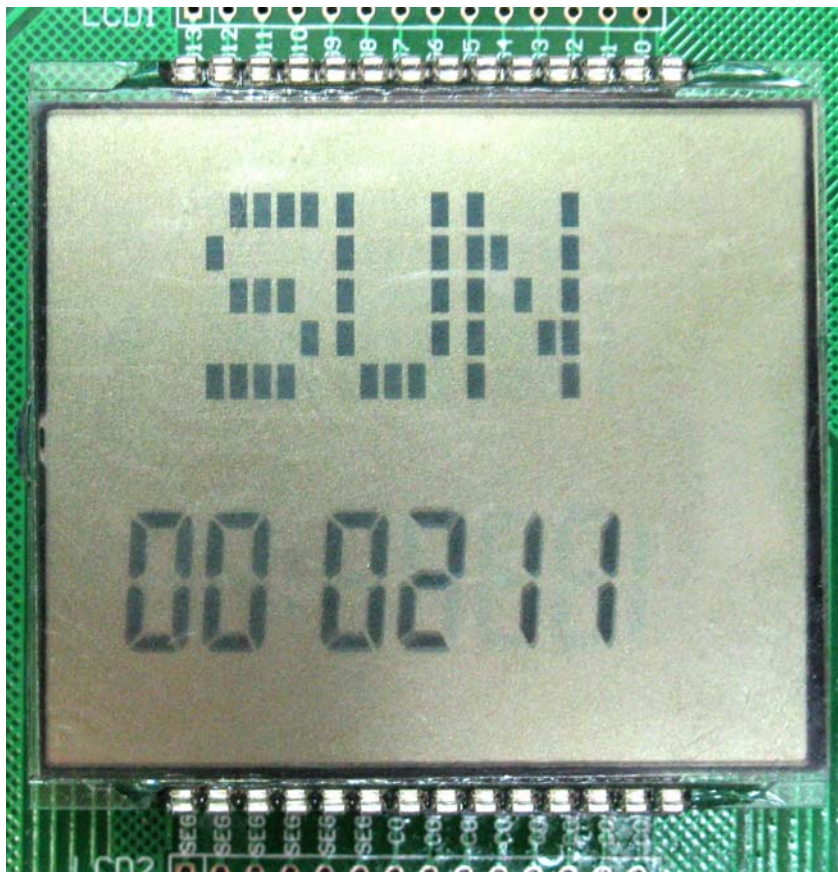
TITLE

TM57FLA80 DEMO CODE FOR LCD FUNCTION

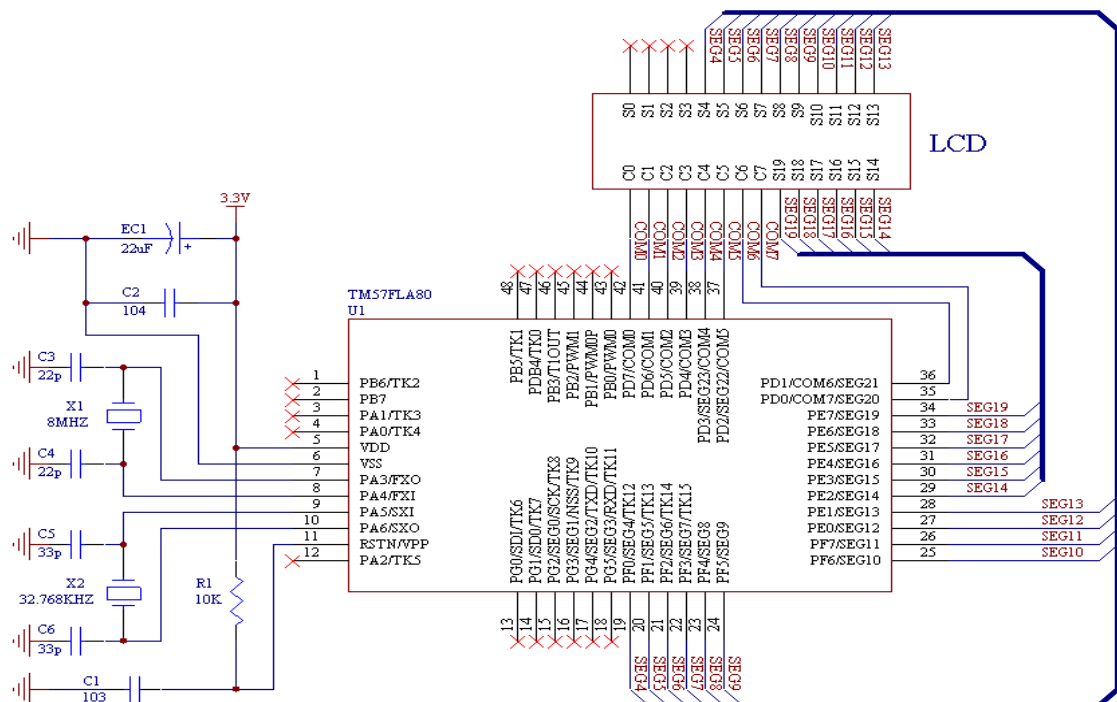
APPLICATION NOTE

01. Introduction to DEMO functions

1. To get the detail of the DEMO program, please refer to TM57FLA80_LCD.ASM
2. Illustration to DEMO functions (as shown in the following pictures)
 - 1) Display “SUN” letters.
 - 2) Display the time under “SUN” letters, which includes Hours(00~23), Minutes(00~59), Seconds(00~59). The displayed data will change with time. The LCD parameters used are 1/8 Duty ,1/3 Bias, the working voltage is 3.0V



3. Circuit Diagram



02. LCD initialization set up method

1. Set up the base LCD driving clock

The base LCD driving clock is related to TM2. The user can set it up in the TM2CTRL register. The address of TM2CTRL is R area 0DH.

First, select the clock source of TM2. If BIT4 of TM2CTRL is set to 1, the clock source of TM2 will be Fosc/128(Fosc is the system clock); otherwise, if it is zero, the clock source will be the system sub-clock.

Then, select the clock sub-frequency of LCD. There are 4 possible selections, which are controlled by the two bits, BIT[1:0], of TM2CTRL:

BIT[1:0]=00	128
BIT[1:0]=01	64
BIT[1:0]=10	32
BIT[1:0]=11	16

For example, let us assume the clock source of TM2 is the system sub-clock and the frequency of the system sub-clock is 32.768Hz, the DUTY of LCD is 1/8, the scanning frequency customer wants to use is 32Hz, i.e. the time to scan LCD for one cycle is 31.25ms. According to formula:

(the time to scan LCD for one cycle) = $2 \times [(1 / \text{frequency of the system sub-clock}) \times (\text{LCD clock sub-frequency})] \div (\text{DUTY of LCD})$

We get:

$$\begin{aligned}
 & (\text{LCD clock sub-frequency}) \\
 &= (\text{the time to scan LCD for one cycle}) \\
 &\quad \times (\text{DUTY of LCD}) \times (\text{frequency of the system sub-clock}) \div 2 \\
 &= (31.25 \times 0.001) \times (1/8) \times (32.768 \times 1000) \div 2 \\
 &= 64
 \end{aligned}$$

Then, BIT[1:0] of TM2CTRL = 01. The instructions to execute are as follows:

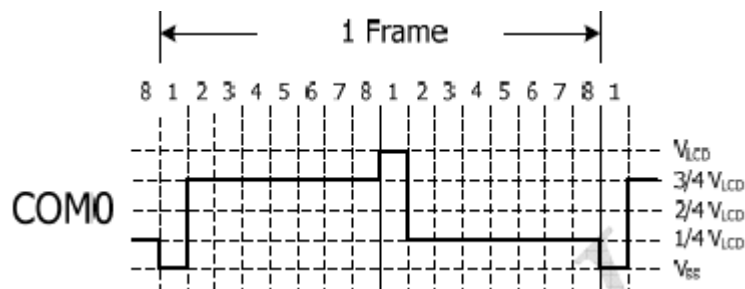
```

movlw    TIMER2CLK_subClock    ;b' 00000000'
iorlw    LCDCLK_64              ;b' 00000001'
movwrr   TM2CTRL

```

The following is the waveform of the COM0 port. The Frame time in Figure 1 is the time to scan LCD for one cycle, i.e. 31.25ms. The time of each grid represents the base LCD driving clock, i.e.

$$\begin{aligned}
 & (1 / \text{frequency of the system sub-clock}) \times ((\text{LCD clock sub-frequency})) \\
 &= 1.953125 \text{ ms}
 \end{aligned}$$



2. Select appropriate COM and SEG ports

The selection of COM and SEG ports is related to the three bits, BIT[6:4], of the LCD_PU register(R area 0Ah). The user can set the corresponding parameters based on the following table.

BIT[6:4]=000	LCDpin_use_NO	;b'00000000'
BIT[6:4]=001	LCDpin_use_com[0~3]andseg[20~23]	;b'00010000'
BIT[6:4]=010	LCDpin_use_com[0~7]andseg[16~19]	;b'00100000'
BIT[6:4]=011	LCDpin_use_com[0~7]andseg[12~19]	;b'00110000'
BIT[6:4]=100	LCDpin_use_com[0~7]andseg[8~19]	;b'01000000'
BIT[6:4]=101	LCDpin_use_com[0~7]andseg[4~19]	;b'01010000'
BIT[6:4]=110	LCDpin_use_com[0~7]andseg[2~19]	;b'01100000'
BIT[6:4]=111	LCDpin_use_com[0~7]andseg[0~19]	;b'01110000'

For example, we want to use COM0~COM7 and SEG4~SEG19. Because there is no need to use pull up, all the pull up resistors on the PD, PE, PF, PG ports for the corresponding COMs and SEGs will be forbidden. This way, we can execute the following instructions to achieve the effect:

```
movlw LCDpin_use_com[0~7]andseg[4~19]    ;b'01010000'
iorlw  PDU_Disable                        ;b'00000001'
iorlw  PEPU_Disable                       ;b'00000010'
iorlw  PFPU_Disable                       ;b'00000100'
iorlw  PGPU_Disable                       ;b'00001000'
movwr LCD_PU
```

3. Clear the LCD display RAM

The addresses of LCD display RAM are in R area 20H~33H, a total of 20 registers. The purpose to clear these 20 registers is to set the LCD initialization state into all off mode. Please refer to the LCDINIT subroutine in the DEMO program for the instructions.

4. Enable LCD and set appropriate DUTY, BIAS, and LCDBRIT

This configuration is related to the LCDCTRL register at address, R area 11H. The following is the description for each bit of this register.

BIT[7] controls the ON/OFF of LCD:1=LCD ON, 0= OFF.

BIT[6:5] control the DUTY of LCD

BIT[6:5] =00 static

BIT[6:5] =01	1/3duty
BIT[6:5] =10	1/4duty
BIT[6:5] =11	1/8duty

BIT[4:3] control the BIAS of LCD:

BIT[4:3]=00	1/2bias
BIT[4:3]=01	1/3bias
BIT[4:3]=1x	1/4bias

BIT[2:0] control the LCDBRIT of LCD:

BIT[2:0] =000	LCDBrightness_(12Div20)VDD ;b'00000000'
BIT[2:0] =001	LCDBrightness_(12Div19)VDD ;b'00000001'
BIT[2:0] =010	LCDBrightness_(12Div18)VDD ;b'00000010'
BIT[2:0] =011	LCDBrightness_(12Div17)VDD ;b'00000011'
BIT[2:0] =100	LCDBrightness_(12Div15)VDD ;b'00000100'
BIT[2:0] =101	LCDBrightness_(12Div14)VDD ;b'00000101'
BIT[2:0] =110	LCDBrightness_(12Div13)VDD ;b'00000110'
BIT[2:0] =111	LCDBrightness_VDD ;b'00000111'

The user can select a corresponding value to fill the LCDCTRL register based on the specific requirement. For example, The instructions to set DUTY, BIAS, LCDBRIT of LCD to 1/8duty, 1/3bias, working voltage 3.0V((12/13)*3.3) and enable LCD are as follows:

```
movlw    LCD_Enable           ; b'10000000'
iorlw    Duty_1Div8           ; b'01100000'
iorlw    Bais_1Div3           ; b'00001000'
iorlw    LCDBrightness_(12Div13)VDD ; b'00000110'
movwr    LCDCTRL
```

03. Configuration of the LCD display RAM

1. The relationship between the Display RAM and the COMs and SEGs

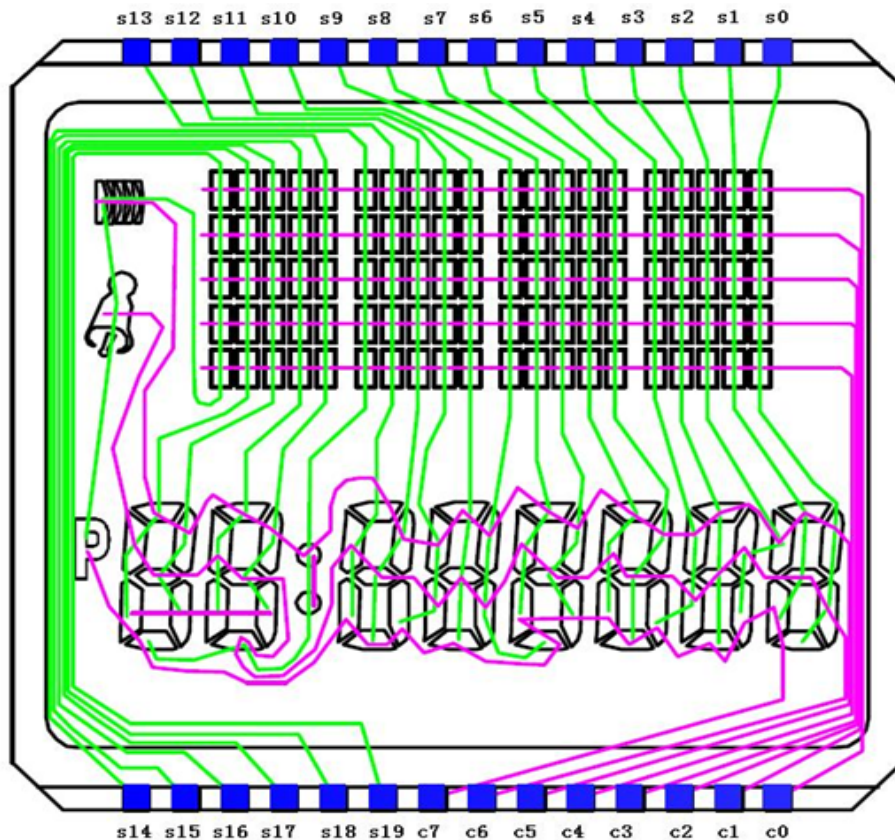
8 COM	COM7	COM6	COM5	COM4	COM3	COM2	COM1	COM0
R-Plane 20	SEG0	SEG0	SEG0	SEG0	SEG0	SEG0	SEG0	SEG0
21	SEG1	SEG1	SEG1	SEG1	SEG1	SEG1	SEG1	SEG1
22	SEG2	SEG2	SEG2	SEG2	SEG2	SEG2	SEG2	SEG2
23	SEG3	SEG3	SEG3	SEG3	SEG3	SEG3	SEG3	SEG3
24	SEG4	SEG4	SEG4	SEG4	SEG4	SEG4	SEG4	SEG4
25	SEG5	SEG5	SEG5	SEG5	SEG5	SEG5	SEG5	SEG5
26	SEG6	SEG6	SEG6	SEG6	SEG6	SEG6	SEG6	SEG6
27	SEG7	SEG7	SEG7	SEG7	SEG7	SEG7	SEG7	SEG7
28	SEG8	SEG8	SEG8	SEG8	SEG8	SEG8	SEG8	SEG8
29	SEG9	SEG9	SEG9	SEG9	SEG9	SEG9	SEG9	SEG9
2a	SEG10	SEG10	SEG10	SEG10	SEG10	SEG10	SEG10	SEG10
2b	SEG11	SEG11	SEG11	SEG11	SEG11	SEG11	SEG11	SEG11
2c	SEG12	SEG12	SEG12	SEG12	SEG12	SEG12	SEG12	SEG12
2d	SEG13	SEG13	SEG13	SEG13	SEG13	SEG13	SEG13	SEG13
2e	SEG14	SEG14	SEG14	SEG14	SEG14	SEG14	SEG14	SEG14
2f	SEG15	SEG15	SEG15	SEG15	SEG15	SEG15	SEG15	SEG15
30	SEG16	SEG16	SEG16	SEG16	SEG16	SEG16	SEG16	SEG16
31	SEG17	SEG17	SEG17	SEG17	SEG17	SEG17	SEG17	SEG17
32	SEG18	SEG18	SEG18	SEG18	SEG18	SEG18	SEG18	SEG18
33	SEG19	SEG19	SEG19	SEG19	SEG19	SEG19	SEG19	SEG19

the relationship chart between the Display RAM and COM and SEG

The relationship between the Display RAM and the COMs and SEGs is shown in the chart above. For example, the register 20H in the chart controls SEG0 and the 8 bits of 20H, BIT7~BIT0, control COM7~COM0 respectively. i.e. in order to turn on the point intersecting COM7 and SEG0 in the LCD panel diagram, set BIT7 of 20H to 1. Of course, if turning off is desired, clear the bit. Follow the same procedure to configure all other points.

2. Programming the LCD interface function

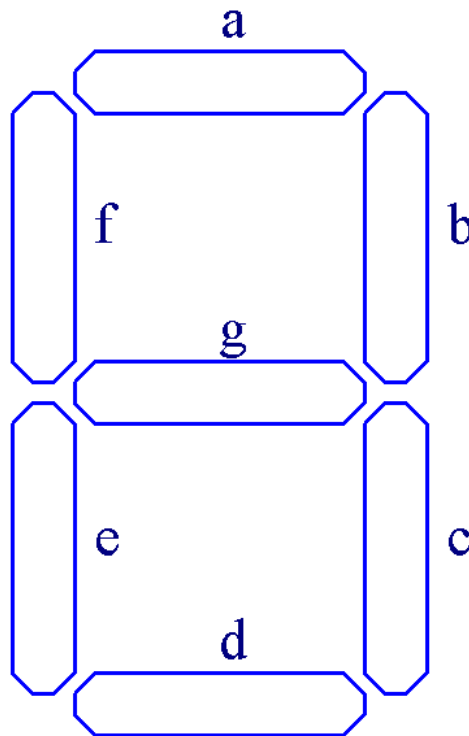
In order to facilitate programming, turning on LCD usually requires the composing of corresponding interface function based on the specifics of the panel diagram. Here, a LCD panel diagram as shown below will be used as an example to illustrate how to compose a subroutine for displaying letters using a 7 segment numeric code display. S in the panel diagram represents SEG(e.g. s0 represents SEG0), C represents COM(e.g. c0 represents COM0).



LCD panel Diagram

1) 7 segment numeric code display subroutine

A numeric code tube is made of 7 segments, “a” “b” “c” “d” “e” “f” “g”. Therefore, it is called a 7 segment numeric code tube. Their corresponding positions are shown in the following diagram:



There are 8 “7 segment numeric code tubes” in the LCD panel diagram in total. Here, only the leftmost numeric code tube will be illustrated; the other 7 can be deduced by the user following similar procedures.

First, identify the positions of these 7 points. i.e. which intersection points of SEG and COM correspond to these 7 points respectively. Then, calculate their corresponding letter positions in the Display RAM area. The results are as follows:

point	intersection	RAM position
a	s18 and c5	BIT5 of 32H
b	s17 and c5	BIT5 of 31H
c	s17 and c7	BIT7 of 31H
d	s14 and c7	BIT7 of 2eH
e	s18 and c7	BIT7 of 32H
f	s18 and c6	BIT6 of 32H
g	s17 and c6	BIT6 of 31H

As such, when this 7 segment numeric code tube is going to display 0, abcdef should be turned on and g turned off. The following is the on/off states of a~g points when displaying 0:

a	s18 and c5	BIT5 of 32H =1
b	s17 and c5	BIT5 of 31H =1
c	s17 and c7	BIT7 of 31H =1
d	s14 and c7	BIT7 of 2eH =1
e	s18 and c7	BIT7 of 32H =1
f	s18 and c6	BIT6 of 32H =1
g	s17 and c6	BIT6 of 31H =0

Once these problems are clarified, programming becomes rather easy. As for the details of the program, please refer to the subroutine nSMG_Dis_1 in the DEMO program.

2) Letter display subroutine

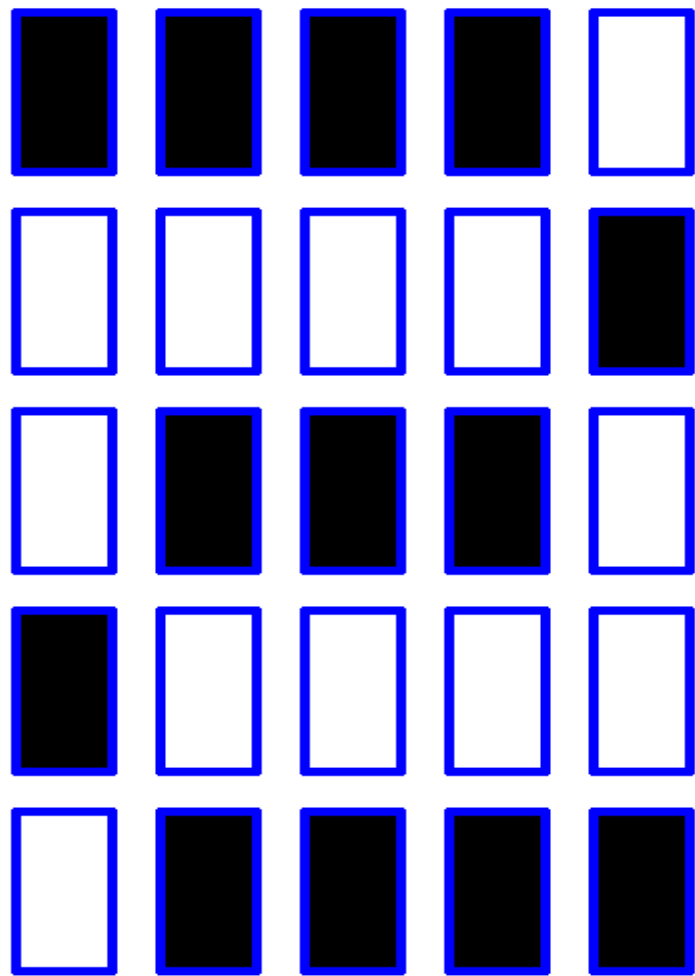
A0	B0	C0	D0	E0
A1	B1	C1	D1	E2
A2	B2	C2	D2	E3
A3	B3	C3	D3	E4
A4	B4	C4	D4	E5

The above diagram is the position coding map for points corresponding to a letter matrix. Here, we will use the leftmost matrix on the LCD panel diagram as an example to illustrate the programming process to assemble a letter subroutine.

The above diagram is the position coding map for points corresponding to a letter matrix. Here, we will use the leftmost matrix on the LCD panel diagram as an example to illustrate the programming process to assemble a letter subroutine.

point	intersection	RAM position
A0	s19 and c0	BIT0 of 32H
A1	s19 and c1	BIT1 of 32H
A2	s19 and c0	BIT2 of 32H
A3	s19 and c3	BIT3 of 32H
A4	s19 and c4	BIT4 of 32H
B0	s18 and c0	BIT0 of 31H
B1	s18 and c1	BIT1 of 31H
B2	s18 and c0	BIT2 of 31H
B3	s18 and c3	BIT3 of 31H
B4	s18 and c4	BIT4 of 31H
C0	s17 and c0	BIT0 of 30H
C1	s17 and c1	BIT1 of 30H
C2	s17 and c0	BIT2 of 30H
C3	s17 and c3	BIT3 of 30H
C4	s17 and c4	BIT4 of 30H
D0	s16 and c0	BIT0 of 2fH
D1	s16 and c1	BIT1 of 2fH
D2	s16 and c0	BIT2 of 2fH
D3	s16 and c3	BIT3 of 2fH
D4	s16 and c4	BIT4 of 2fH
E0	s15 and c0	BIT0 of 2fH
E1	s15 and c1	BIT1 of 2fH
E2	s15 and c0	BIT2 of 2fH
E3	s15 and c3	BIT3 of 2fH
E4	s15 and c4	BIT4 of 2fH

Now, if displaying S is desired, the lights up portion based on the shape characteristic of this letter should be the black out portion in the following Figure as shown:



Hence, the states for points, A0~A4, B0~B4, C0~C4, D0~D4, E0~E4, are obtained as follows:

point	intersection	RAM position
A0	s19 and c0	BIT0 of 32H =1
A1	s19 and c1	BIT1 of 32H =0
A2	s19 and c0	BIT2 of 32H =0
A3	s19 and c3	BIT3 of 32H =1
A4	s19 and c4	BIT4 of 32H =0
B0	s18 and c0	BIT0 of 31H =1
B1	s18 and c1	BIT1 of 31H =0
B2	s18 and c0	BIT2 of 31H =1
B3	s18 and c3	BIT3 of 31H =0
B4	s18 and c4	BIT4 of 31H =1
C0	s17 and c0	BIT0 of 30H =1

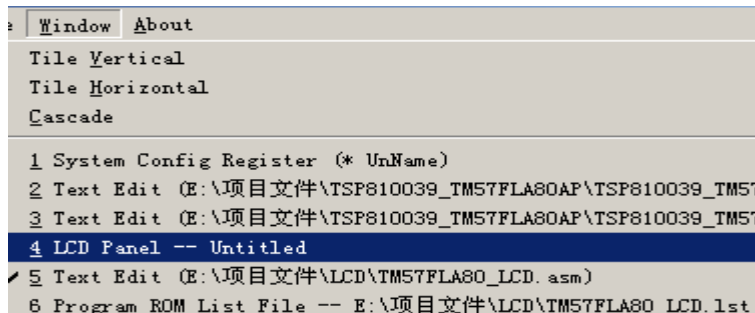
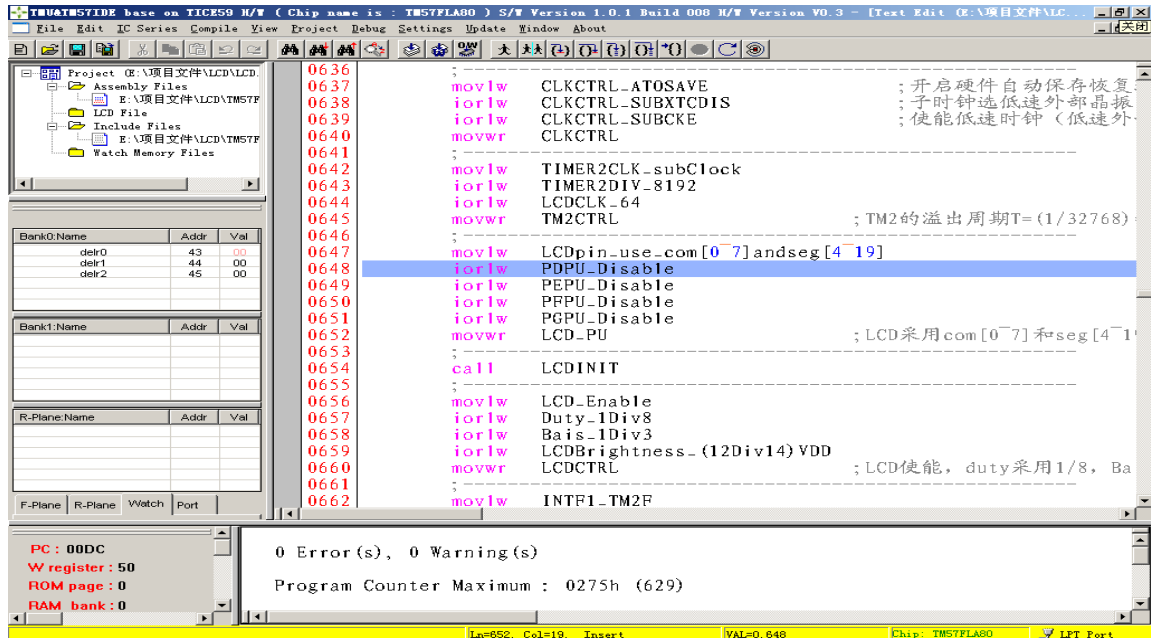
C1	s17 and c1	BIT1 of 30H =0
C2	s17 and c0	BIT2 of 30H =1
C3	s17 and c3	BIT3 of 30H =0
C4	s17 and c4	BIT4 of 30H =1
D0	s16 and c0	BIT0 of 2fH =1
D1	s16 and c1	BIT1 of 2fH =0
D2	s16 and c0	BIT2 of 2fH =1
D3	s16 and c3	BIT3 of 2fH =0
D4	s16 and c4	BIT4 of 2fH =1
E0	s15 and c0	BIT0 of 2fH =0
E1	s15 and c1	BIT1 of 2fH =1
E2	s15 and c0	BIT2 of 2fH =0
E3	s15 and c3	BIT3 of 2fH =0
E4	s15 and c4	BIT4 of 2fH =1

As such, when displaying S is desired, simply configure the states of these 25 points according to the above description. From this point on, please refer to the `WRITE_dat_1` subroutine in the `DEMO` program for the details of the latter part of the program.

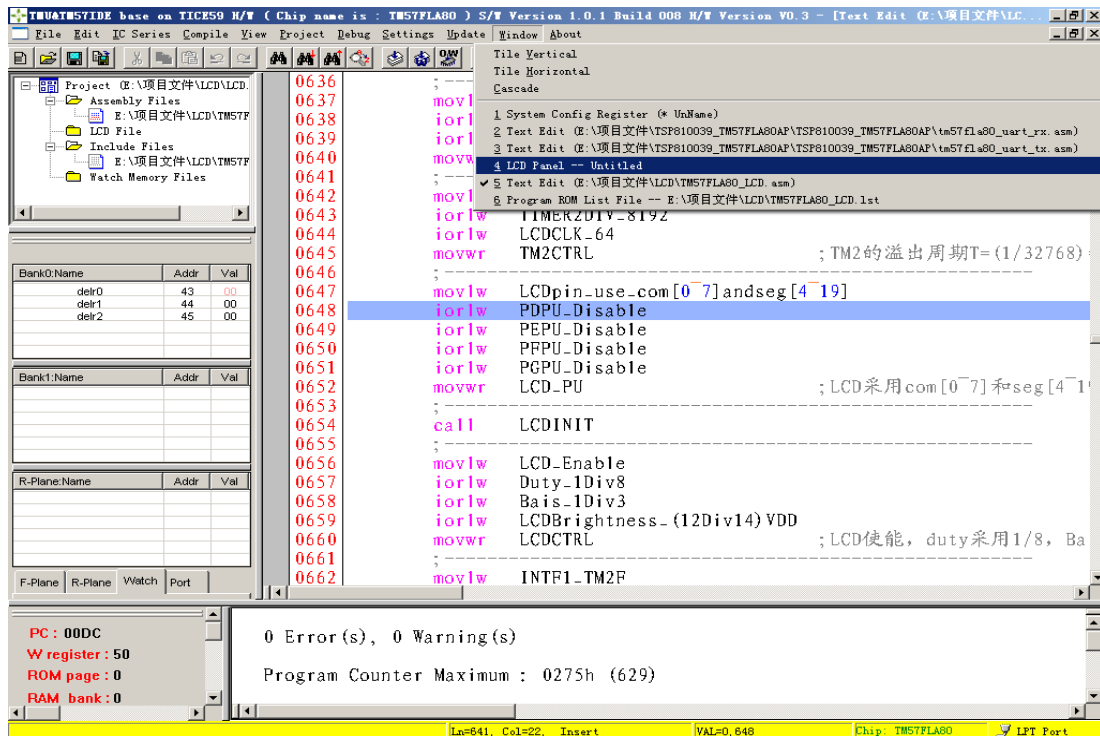
04. The production and the usage instruction of the LCD analog panel diagram

1. The production of the LCD analog panel diagram

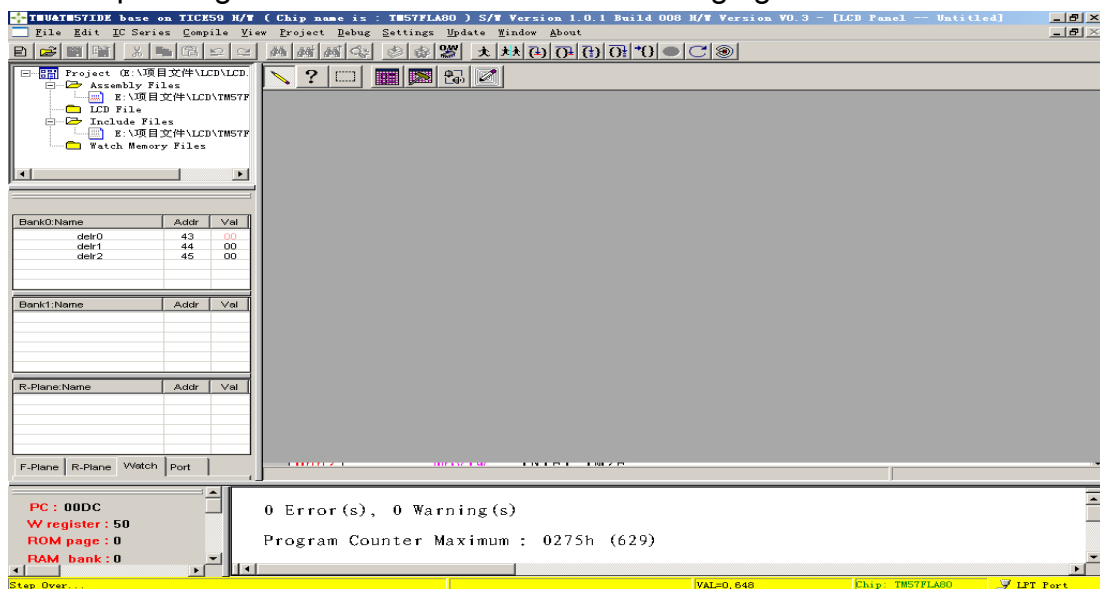
1) Open the engineering interface as shown in the following Figure:




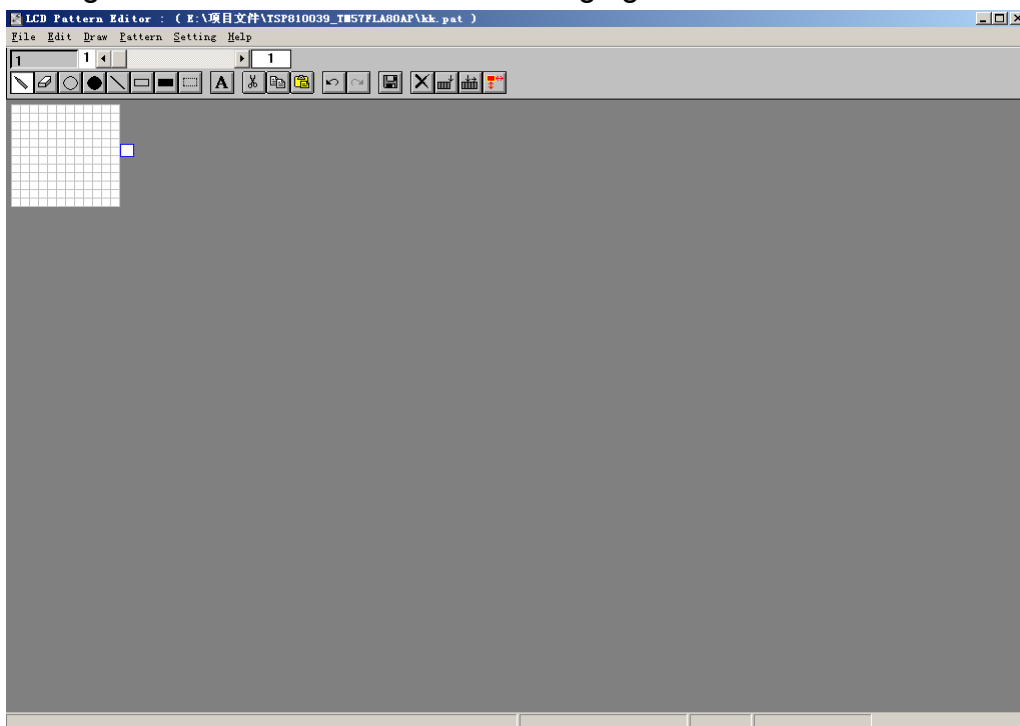
2) Select using the left mouse button, as shown in the following figure:




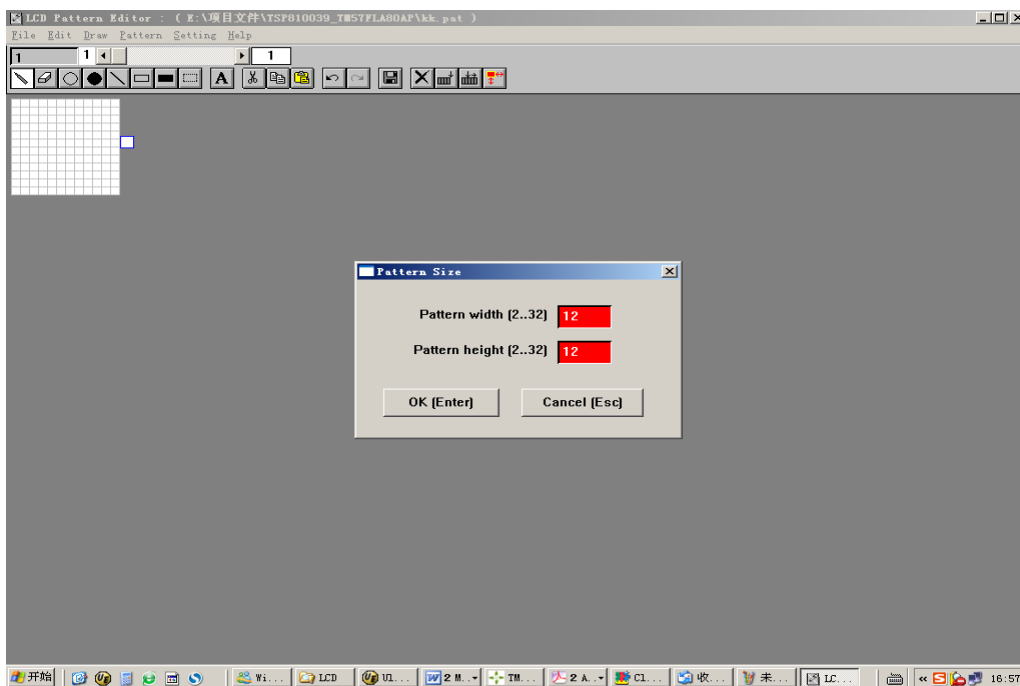
3) Then, single click on the left mouse. The engineering interface will open the LCD Panel operating interface as shown in the following figure:




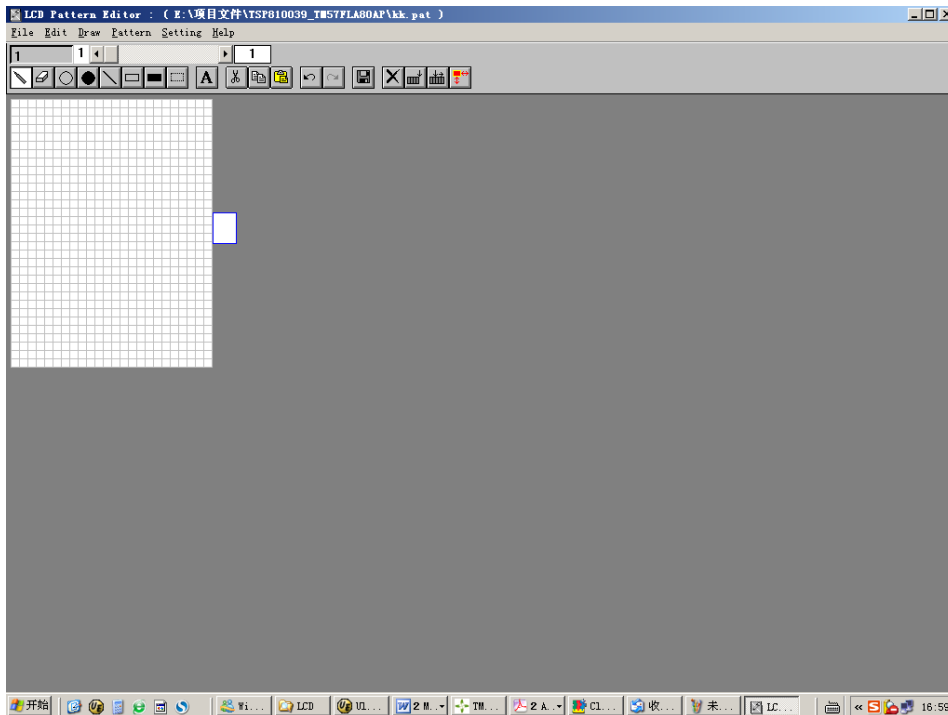
- 4) Single click on the  button using mouse and enter the LCD Panel library editing interface as shown in the following figure:




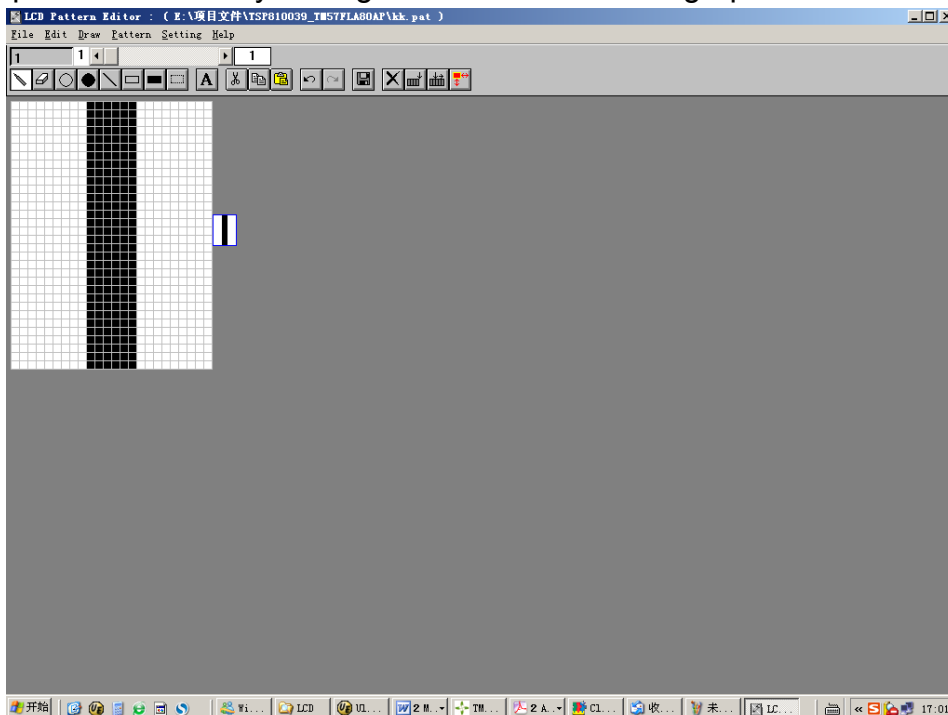
- 5) Single click on the  button using the mouse and a dialog box pops up as follows:





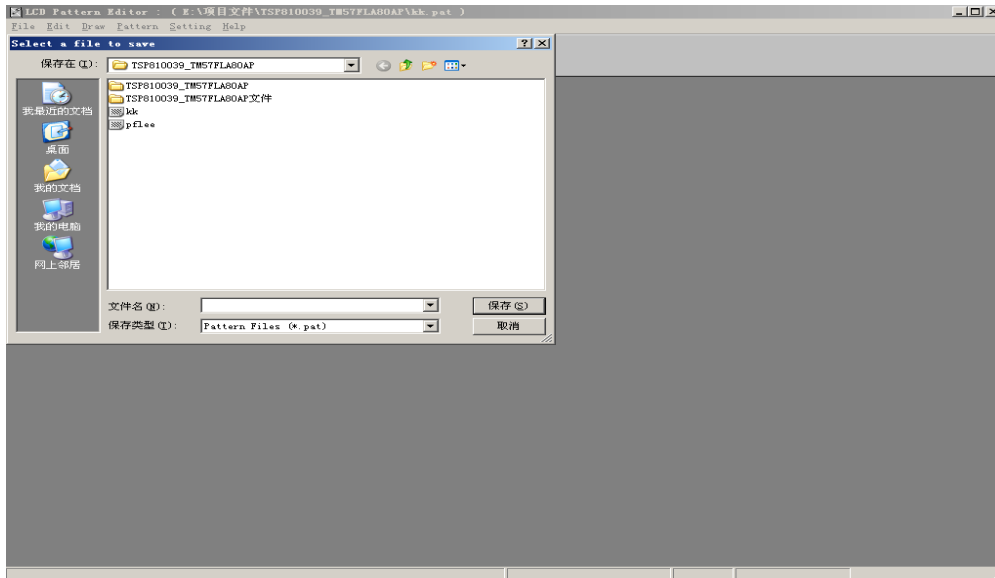
- 6) Change the grid data of width and height in the dialog box to 24 and 32 respectively. Then, Single click on the  button. Observe the change of the interface as shown in the following figure:






- 7) Single click on the  button using the mouse. The user can edit the required graphics in the library editing interface. The edited graphic is as follows:

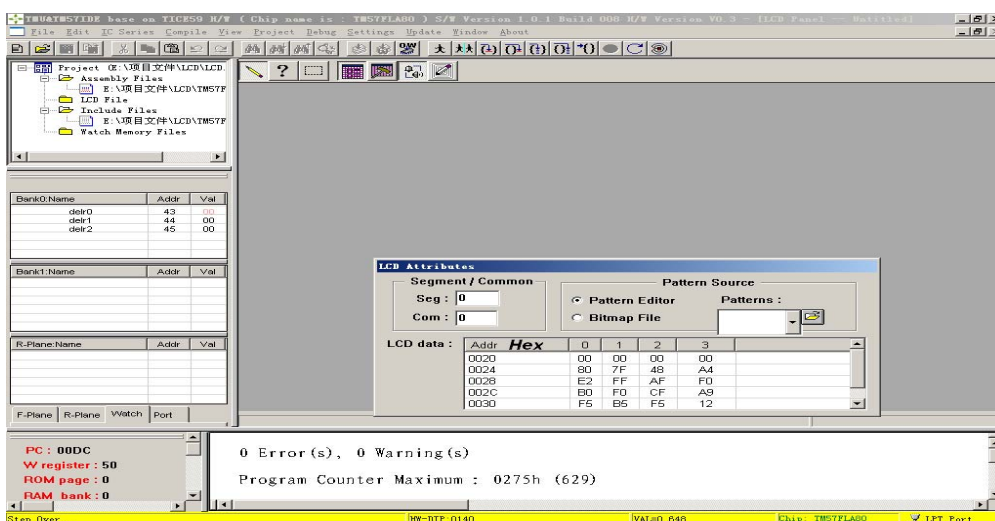


- 8) Single click on the  save button in the editing interface. Then, the drawn graphics will be saved. If this is the first time edit, a dialog box as follows will pop up after single clicking on the  save button:

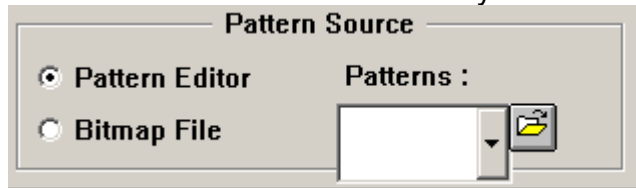


- 9) Select the file saving path and file name in the above dialog box. After single clicking "Save," the drawn graphics will be saved in the generated file.
- 10) If another graphic needs to be drawn, simply single click on the  button using the mouse and repeat steps 7, 8, 9. Of course, if deleting a graphic is needed, simply click on the  button once.

- 11) Single click on the  button. A dialog box pops up as follows:



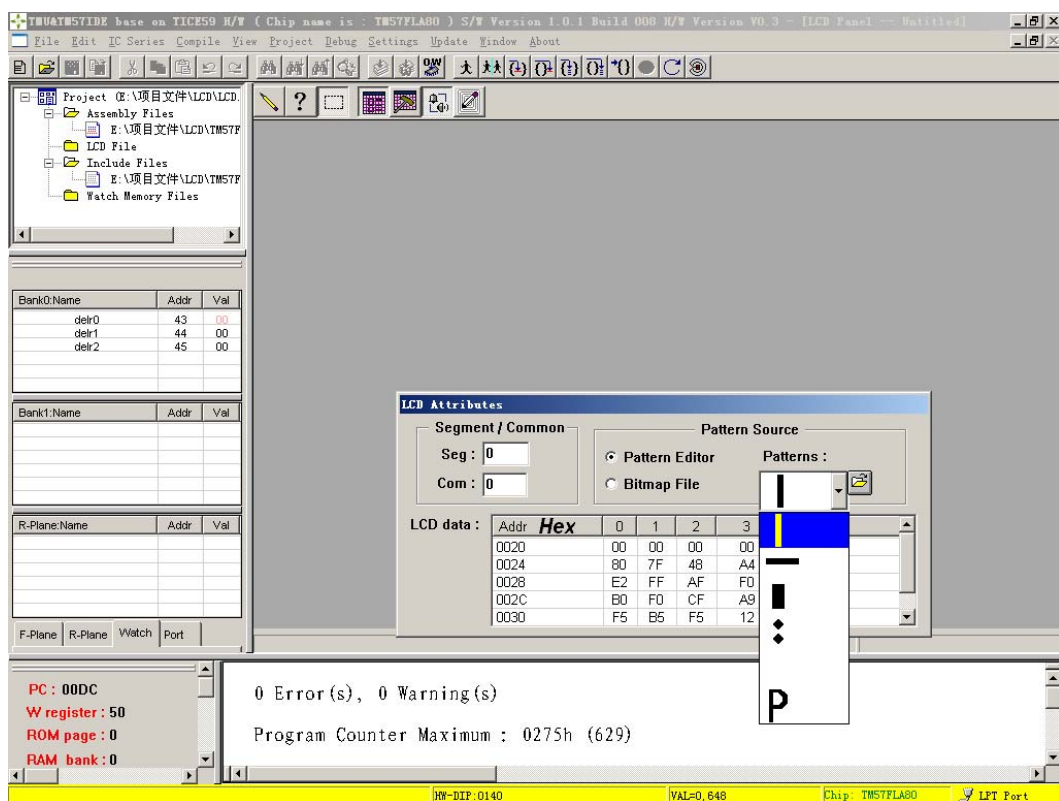
- 12) Select Pattern Editor so that it stays in the state as shown in the figure.




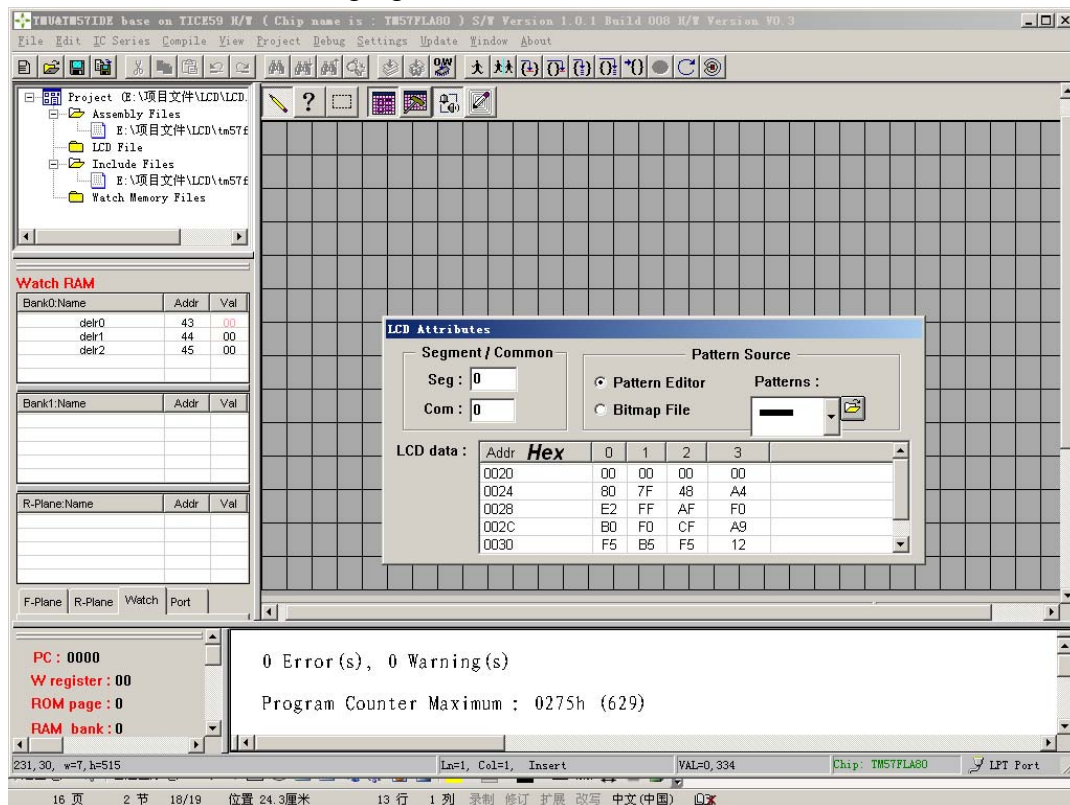
, Then, single click on the  button to load the graphics file saved previously into the editor. If there is

graphics in the loaded file, it will show in  on the left of .

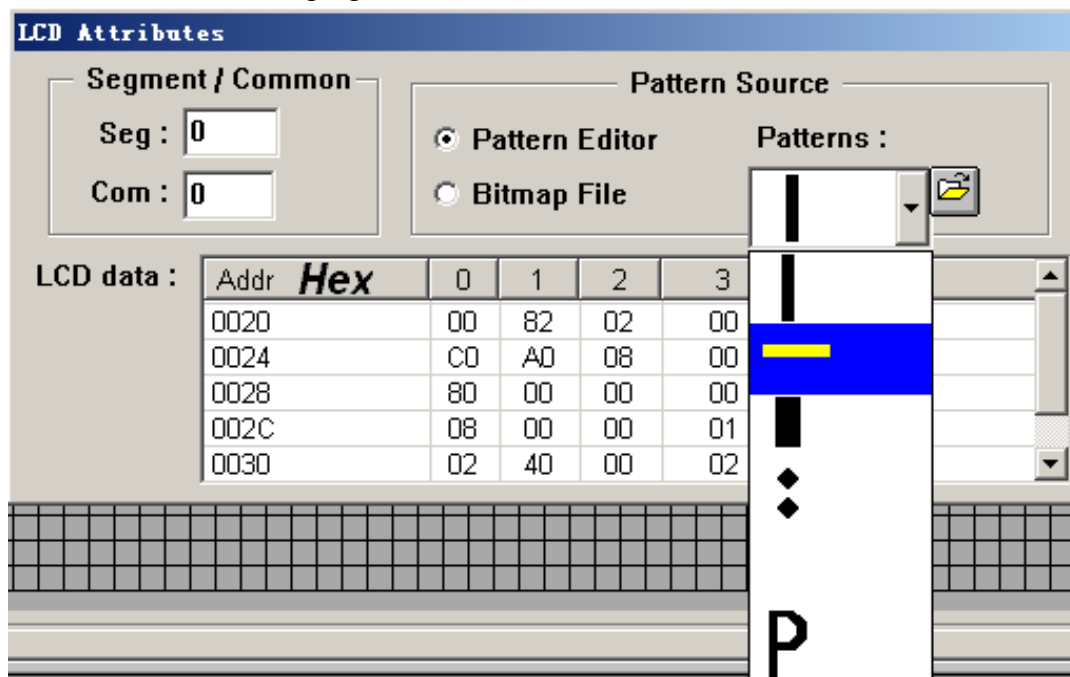
Single click on the  button to navigate as shown in the following figure:




- 13) Single click on the  button so that the editing area will enter the grid state as shown in the following figure:

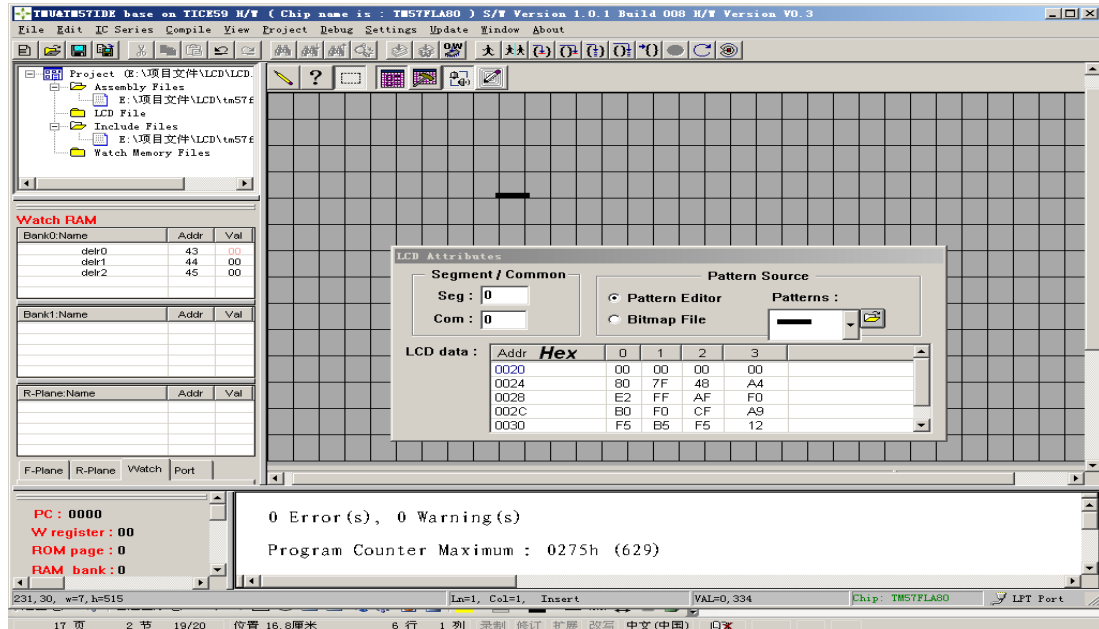



- 14) Single click on the  button under Patterns to select the desired graphics as shown in the following figure:

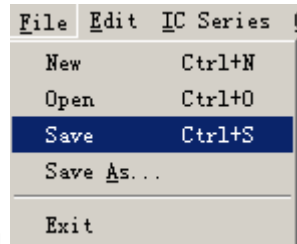



15) Single click on the left mouse to select the graphics.

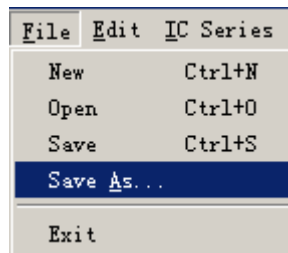
16) Single click on the  button so that the icon will be marked as "Selected.". Single click on the left mouse at an appropriate location on the grid area and put the selected graphics on the grid area as shown in the following figure.



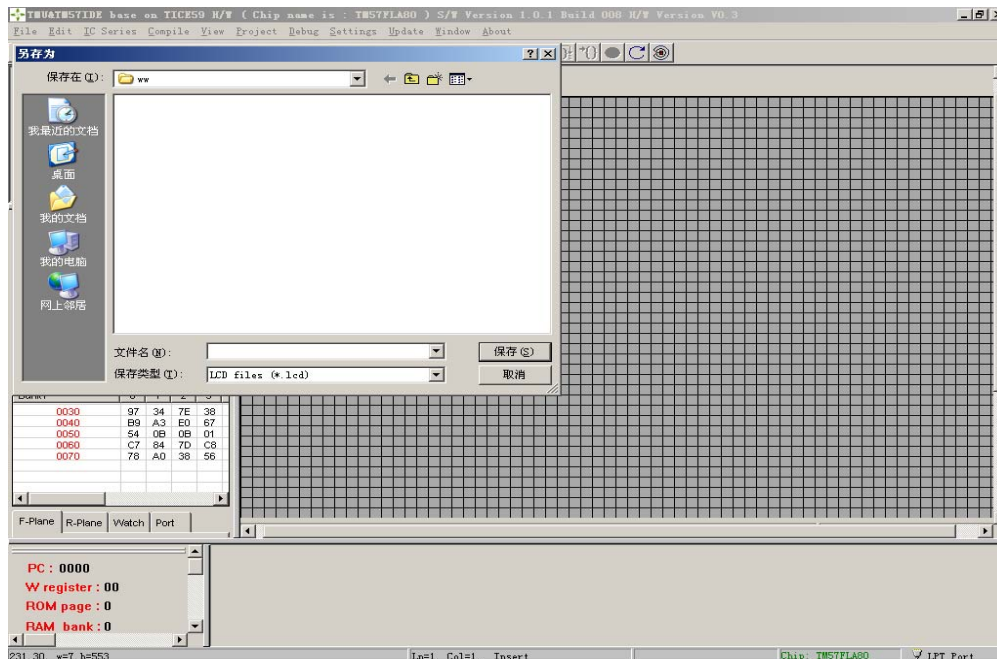
17) If adjusting the position of this graphic is required, single click on the  button. Then, move the cursor to the top of the graphic need to be adjusted. The shape of the cursor will turn into a graphic with 4 outward arrows, which indicates that the graphics is in a state that can be dragged. Click on the left mouse and hold and drag the graphic to the desired position. Then, release the cursor and the position of the graphic is adjusted.



- 18) Single click on  to save the built LCD analog panel diagram. If this is a first time save, a dialog box as shown in following figure pops up.

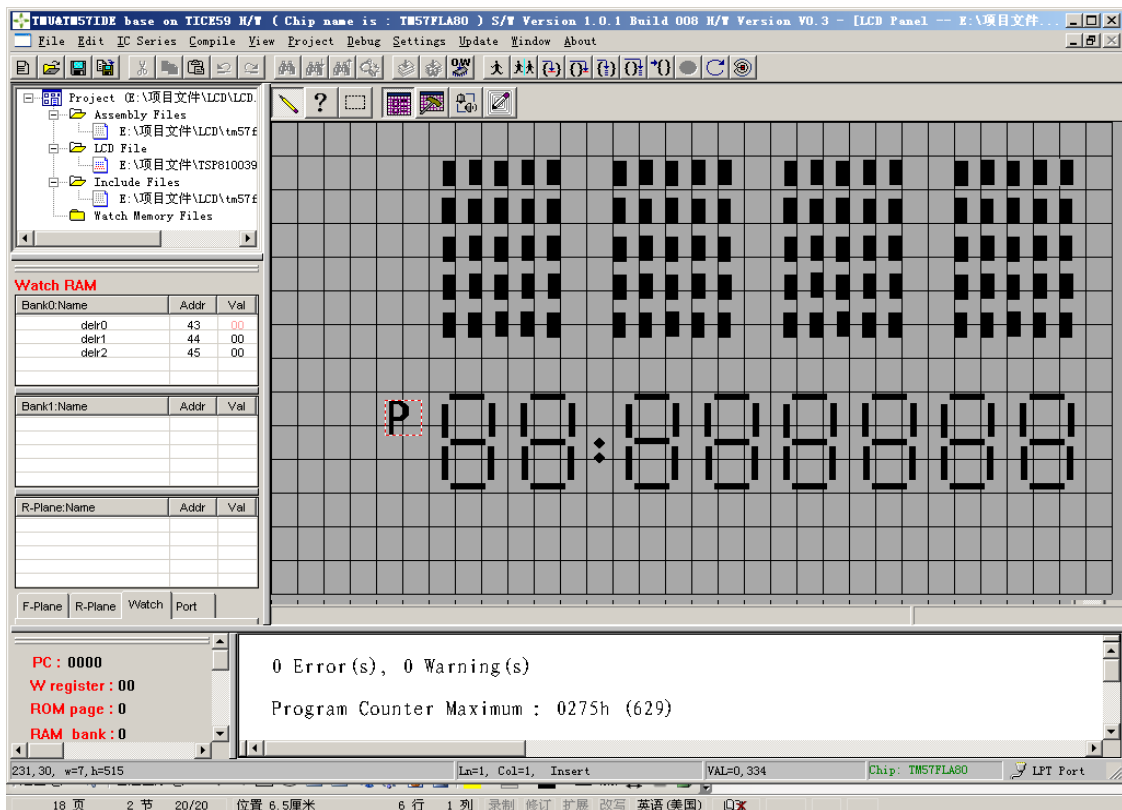



Of course, if click on , the following dialog box will pop up always.




The path and file name to save the LCD analog panel diagram can be selected in the dialog box. Then, click on the “Save” button to save the built LCD analog panel diagram.

- 19) Repeat steps 14~18 to arrange the grid area into the layout as shown in the following figure.



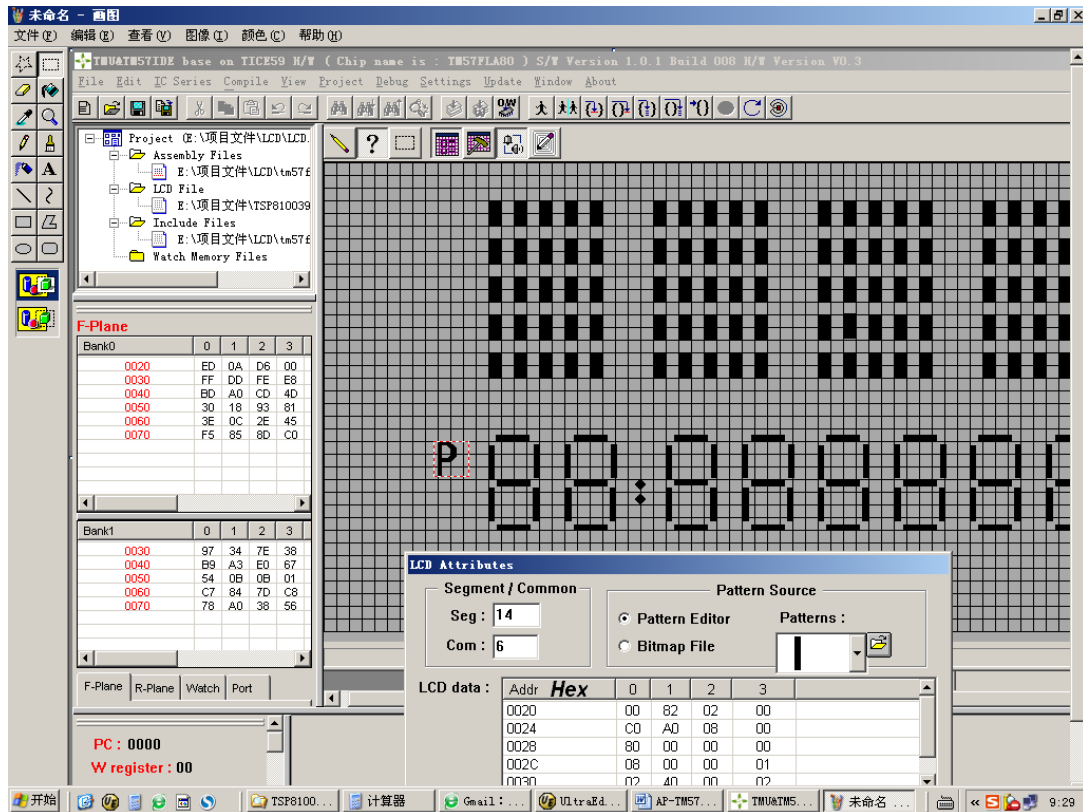
- 20) single click on the  button so that it is marked as selected. Move the cursor to the top of "P" and single click on the left mouse. The letter "P" will display



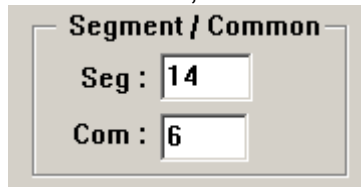
. Then, Double click on  using the left mouse or single click on the



button directly. The screen will display the following state:



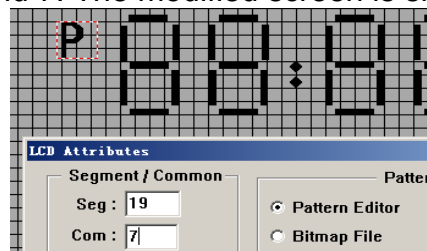
At this time, the data on the right of Seg and Com in the option box,



, are the corresponding SEG and COM values to the



letter, **P**. According to the LCD panel diagram, we change these two values to 19 and 7. The modified screen is shown as follows:



As such, the SEG and COM properties of letter, **P**, are adjusted.

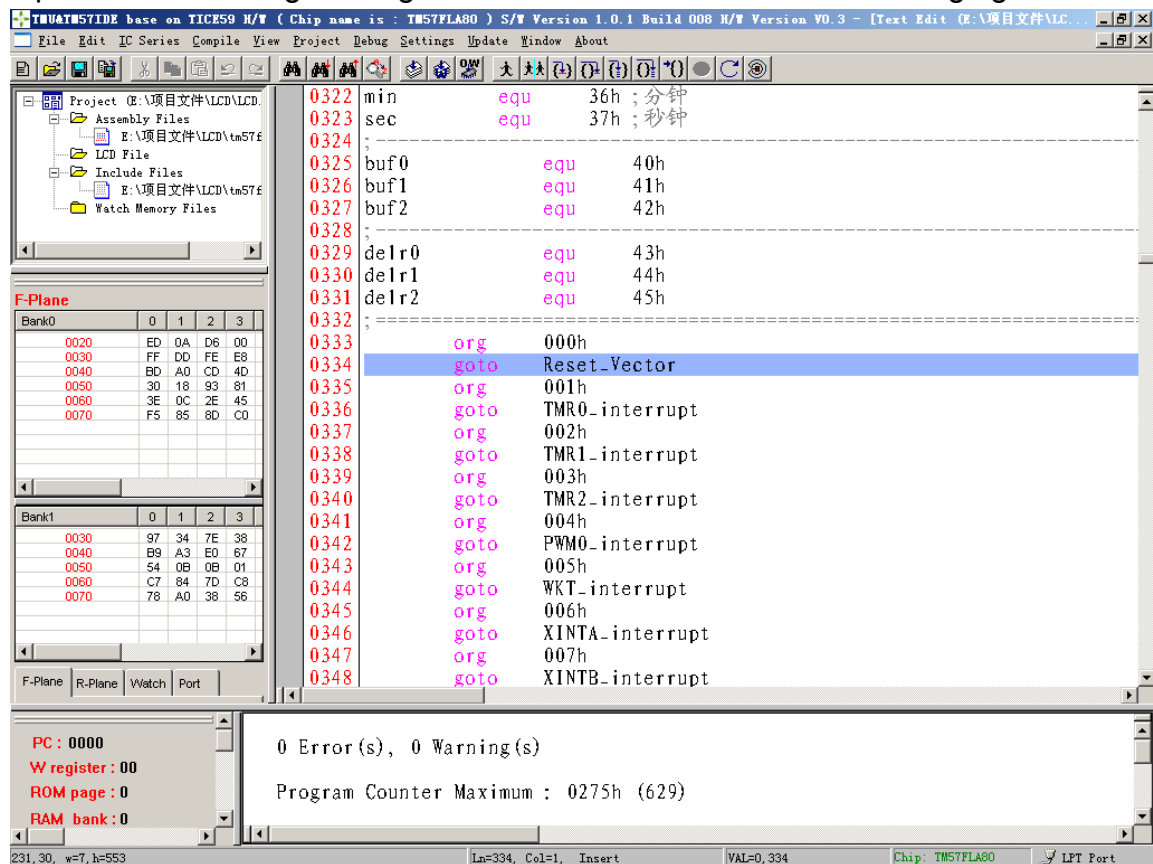
- 21) Repeat the action of the 20th step to set up the corresponding Seg and Com values of the remaining 24 black graphics in the grid area.

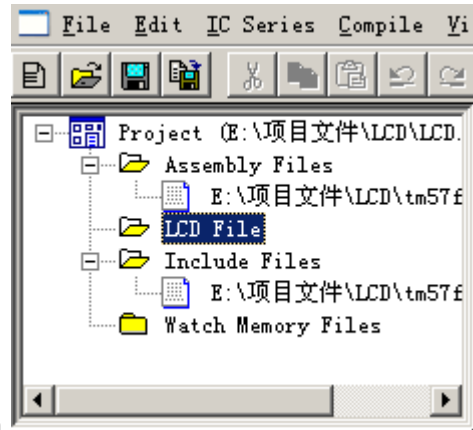


At last, single click on the button to exit the property editing state. This way, a complete LCD analog panel diagram is built.

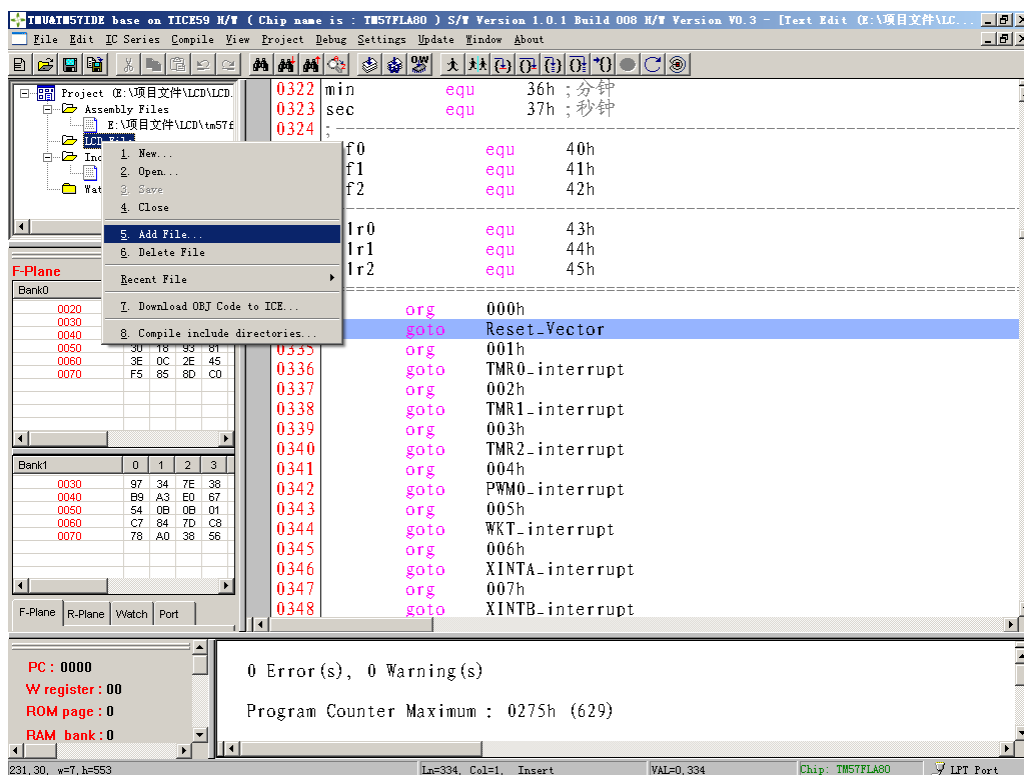
2. The usage instruction of the LCD analog panel diagram

- 1) Open the ICE59 engineering environment as shown in the following figure:

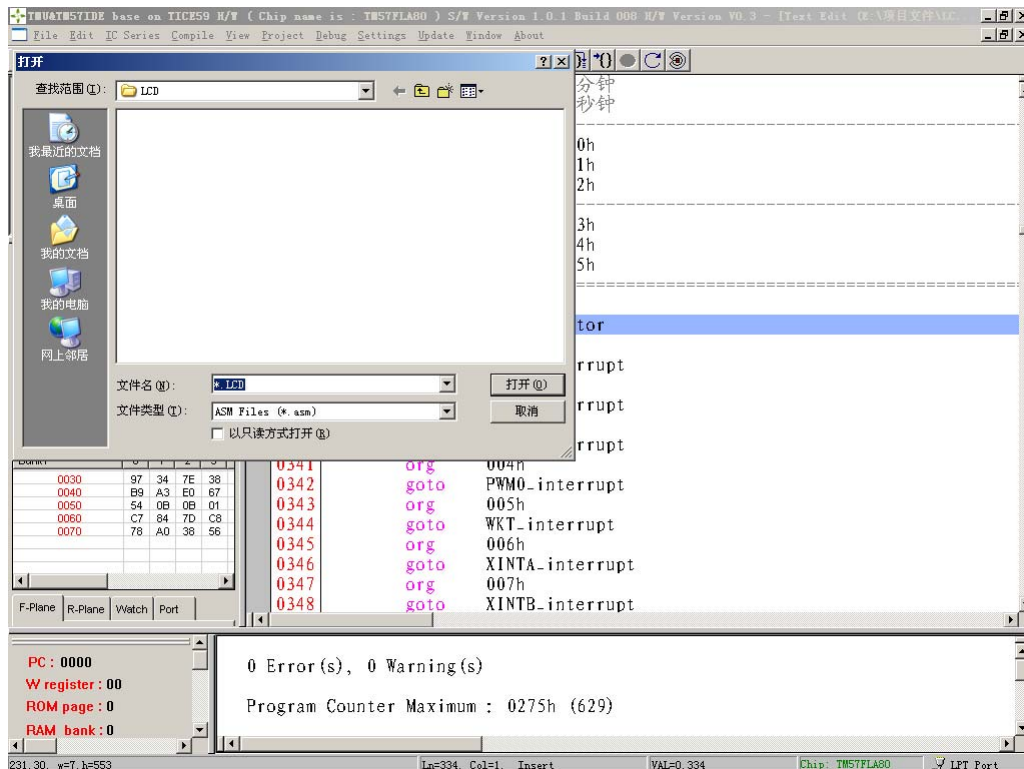




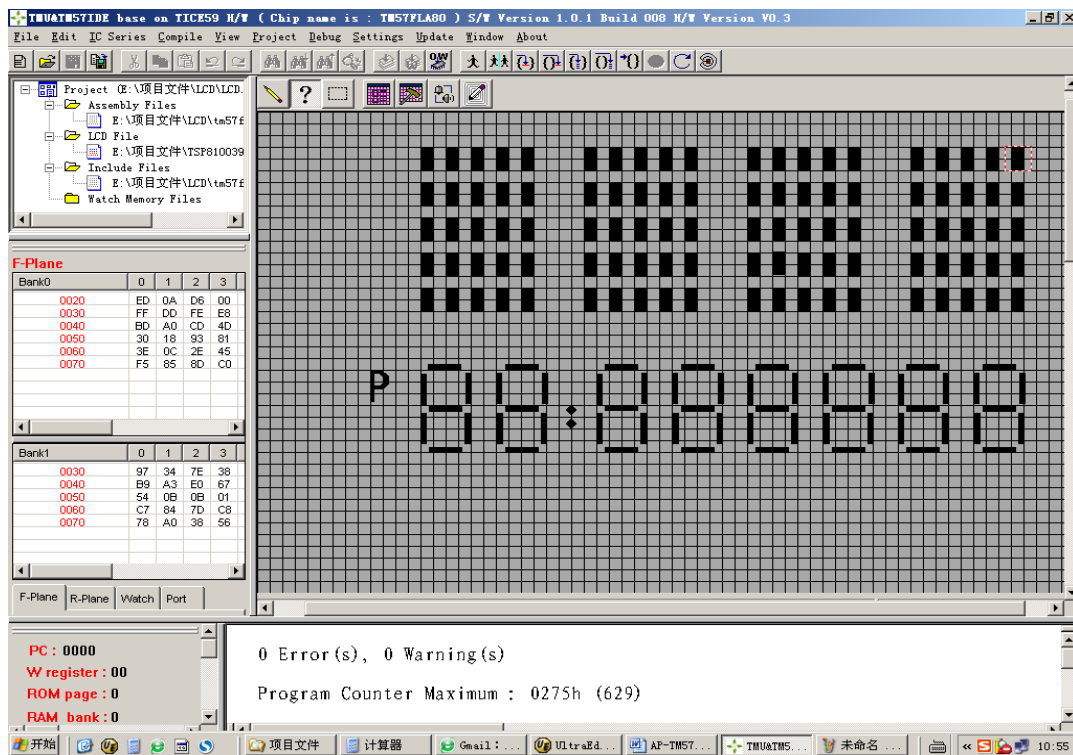
- 2) Single click on LCD file in the Project Explorer using the mouse. Then, single click the right mouse as shown in the following figure:



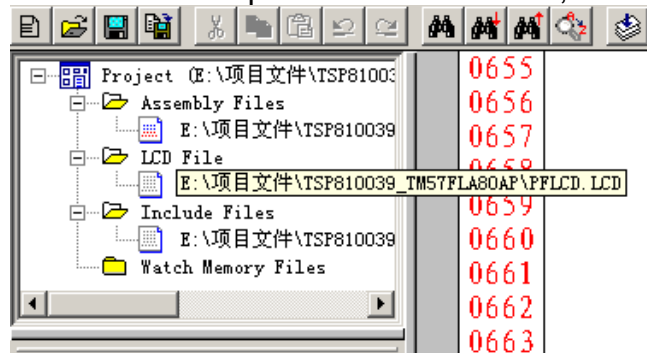
- 3) Move the cursor to the “5 Add File” button and click once; a dialog box as shown in the following figure pops up:



- 4) Load the LCD analog panel diagram built before into the engineering environment and open it up as shown in the following:

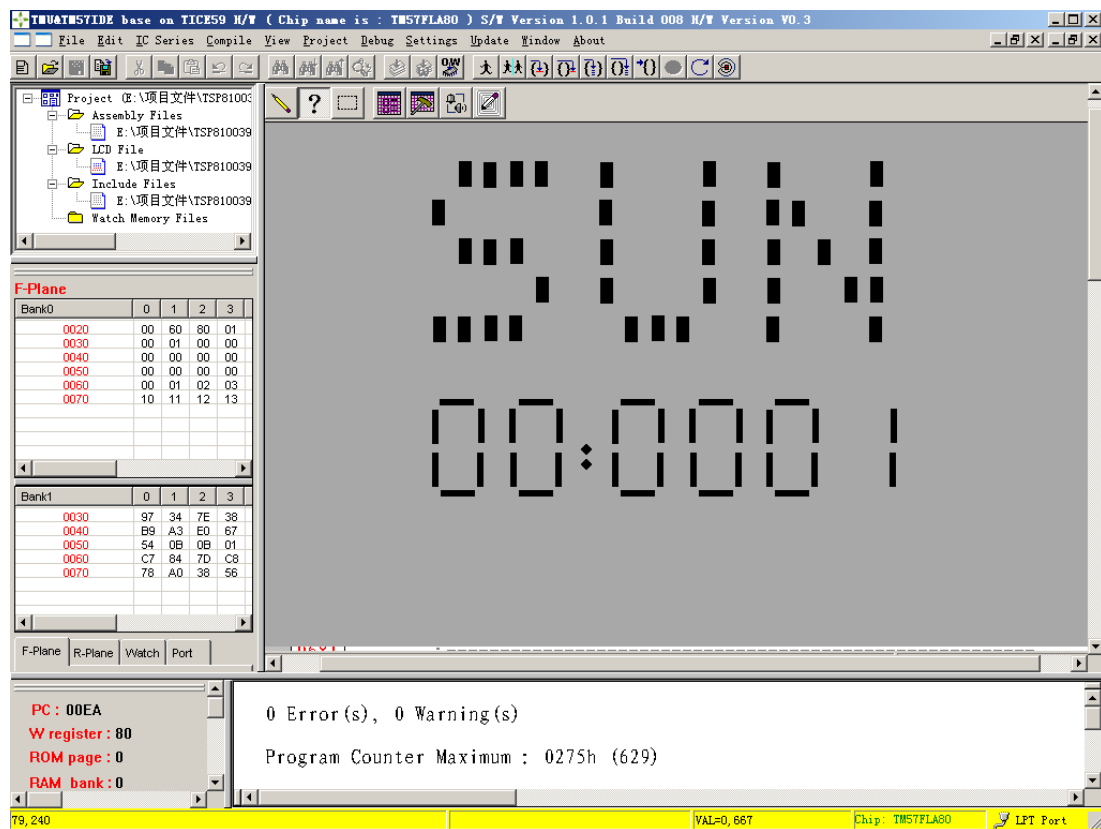


- 5) Execute the engineering software after it was compiled and downloaded, then



pause. Double click the LCD file.

to open The LCD analog panel diagram displays as follows:



Note: the LCD analog panel diagram can only update its display when the execution of the program stops. **It will not update display during the execution of the program.**