



Following Schedule (Updated)

- 12/23:
 - Exercise for Lab 5
 - Announcement of Lab 6
- 12/30
 - 畢業專題展
- 1/6
 - Exercise for Lab 6
 - Announcement of Final Project
- 1/13
 - Exercise for Lab 6
 - Demo of Final Project
- 1/20
 - Demo of Final Project

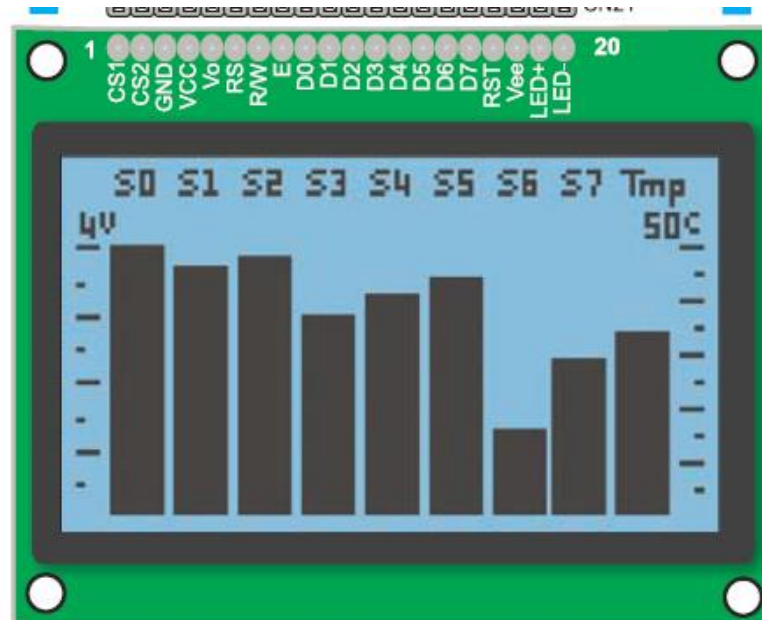
Lab 06



Graphics-LCD Display

Your Task

- Draw a still image on the graphics LCD
- Bonus: show some animation



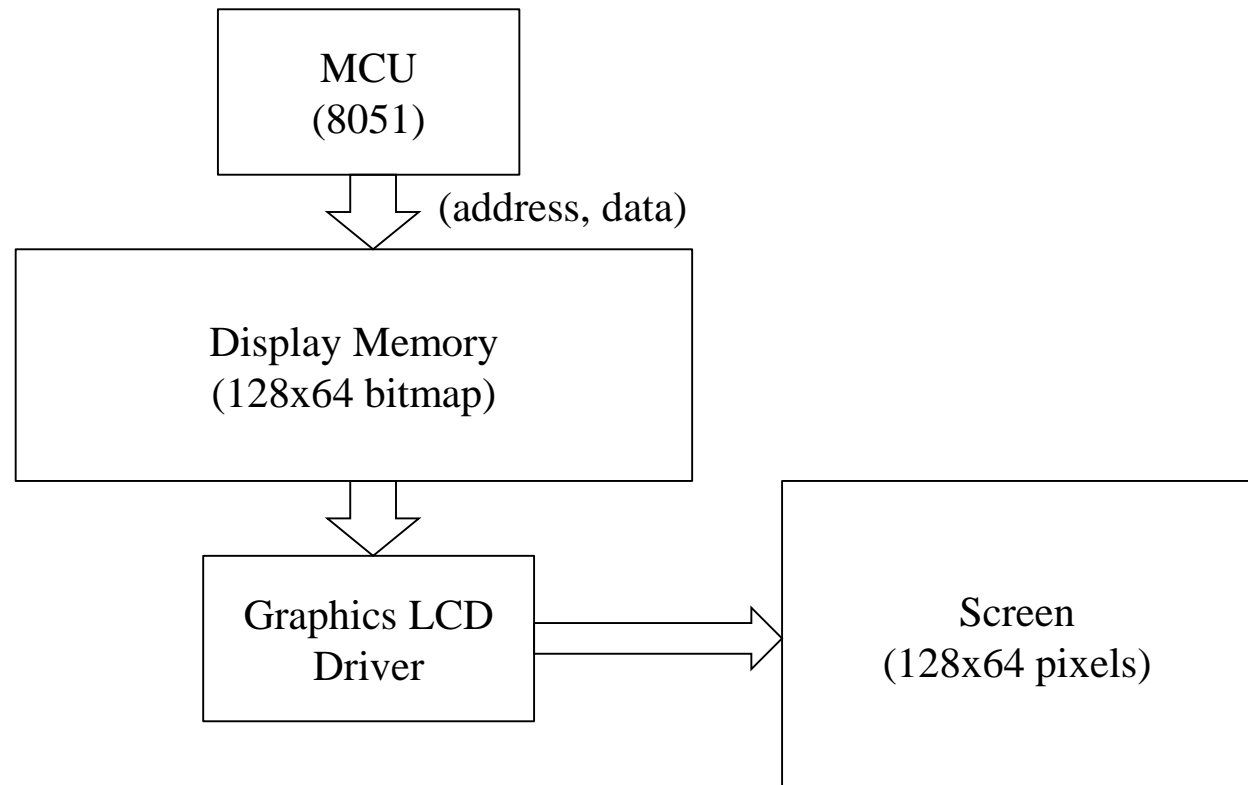


General Scheme to Control Graphics LCD

Fill the image bitmap into the display
memory

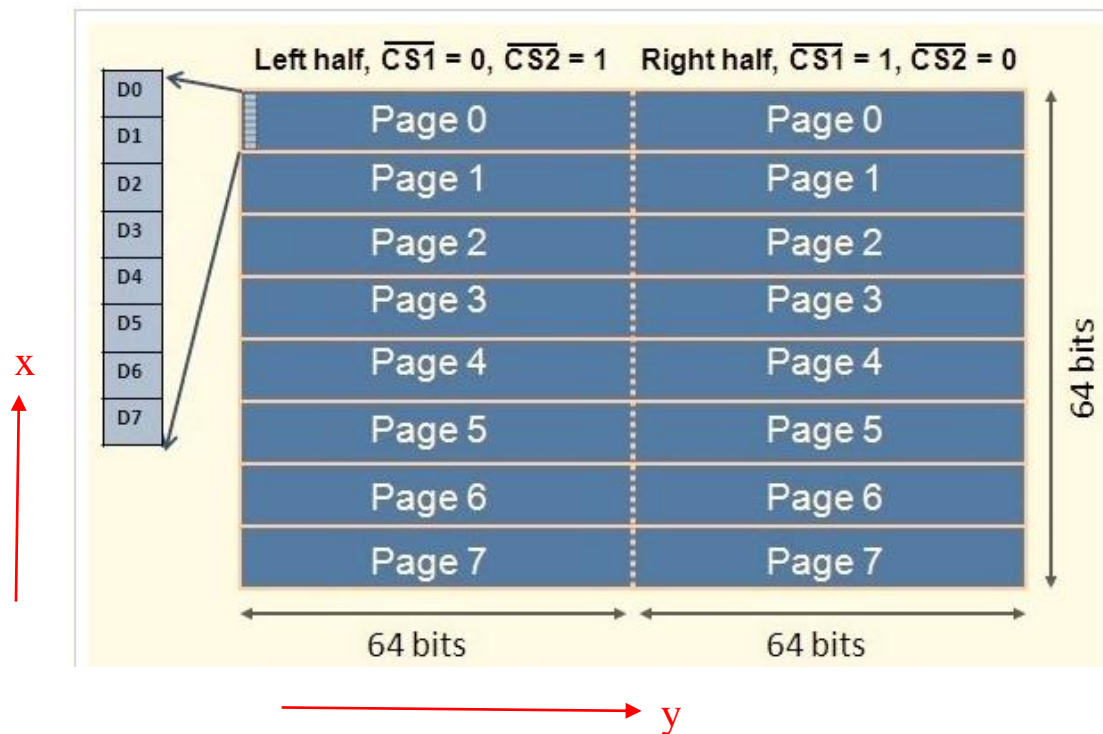
The control scheme

- Fill-in the bitmap into the display memory



Detailed look of the control scheme

- Fill the 0-1 bitmap into two-dimensional array
- But each time we fill 8-bit for 8 pixels on the x-axis





Signal Interface to Fill the Image Memory

And the timing

-



Figure 19-3: GLCD display connection schematic

- RS: register select
 - 0: command
 - 1: data
- RW: read/write select
 - 0: write
 - 1: read
- E: latch enable
- DB [7:0]
 - the 8-bit data/command
- CS1, CS2: select left/right half
- #include "C8051F040.h"
- #include "glcd.h"

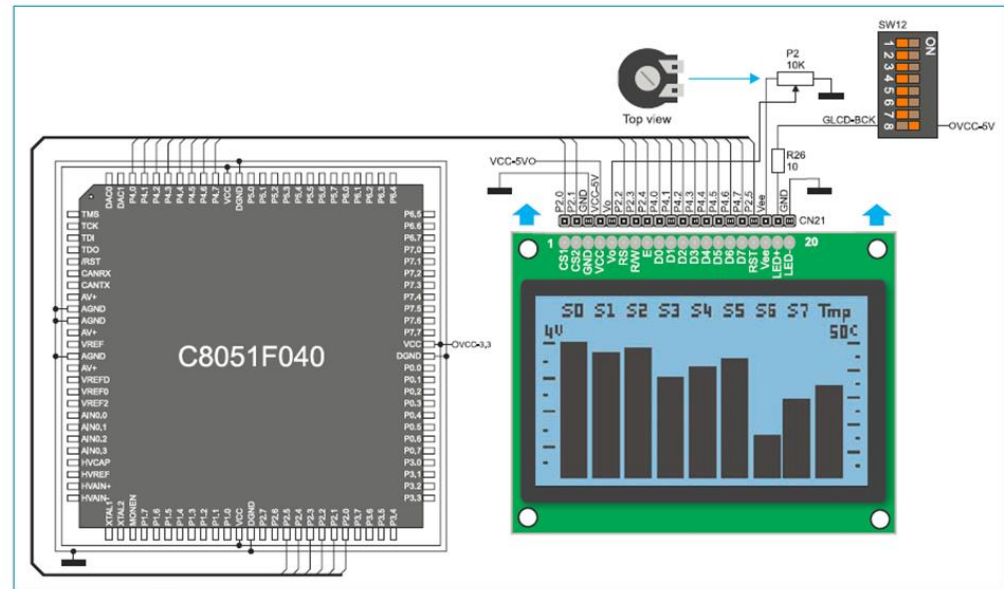


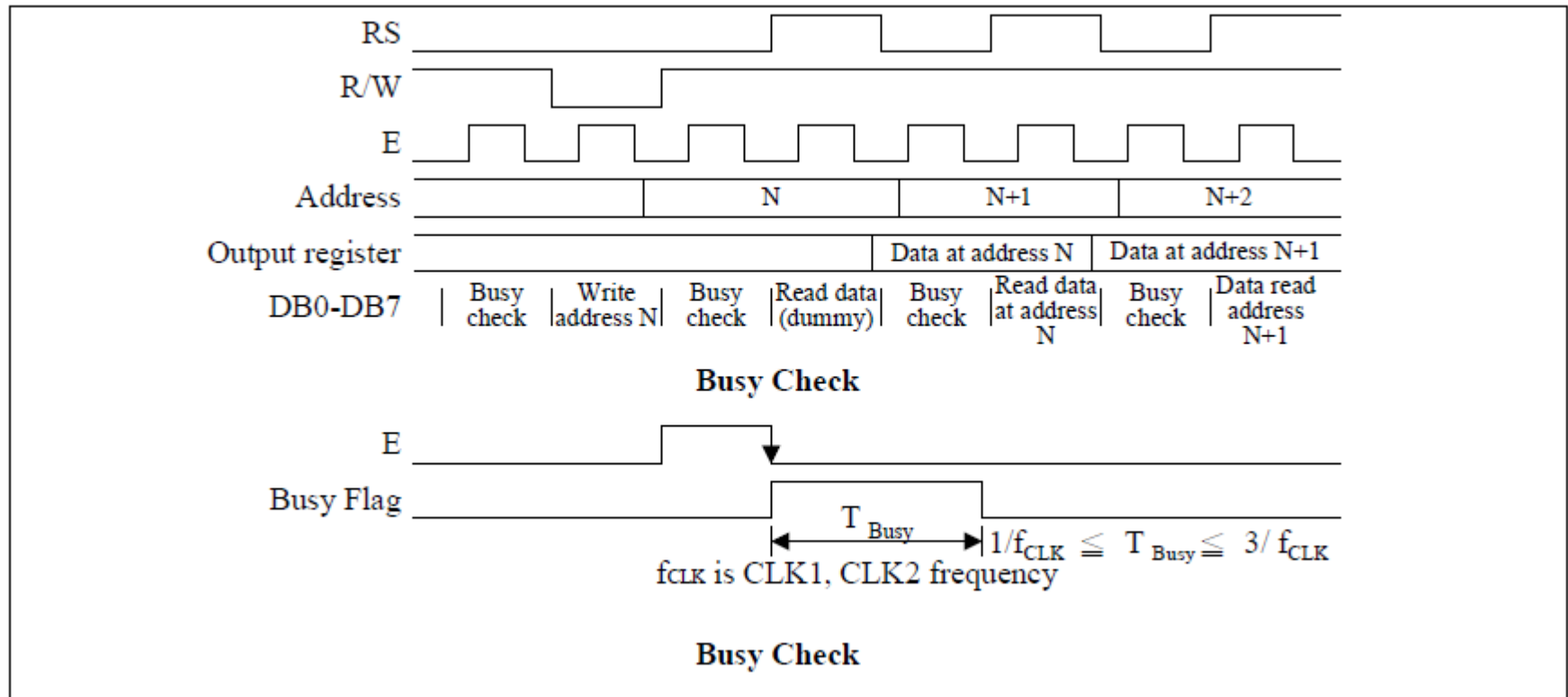
Figure 19-3: GLCD display connection schematic

List of commands

Instruction	RS	R/W	DB7	DB6	DB5	DB4	DB3	DB2	DB1	DB0	Function
Display on/off	L	L	L	L	H	H	H	H	H	L/H	Controls the display on or off. Internal status and display RAM data is not affected. L:OFF, H:ON
Set address (Y address)	L	L	L	H	Y address (0-63)						Sets the Y address in the Y address counter.
Set page (X address)	L	L	H	L	H	H	H	Page (0-7)			Sets the X address at the X address register.
Display Start line (Z address)	L	L	H	H	Display start line (0-63)						Indicates the display data RAM displayed at the top of the screen.
Status read	L	H	Busy	L	On/Off	Reset	L	L	L	L	Read status. BUSY L: Ready H: In operation ON/OFF L: Display ON H: Display OFF RESET L: Normal H: Reset
Write display data	H	L	Write data								Writes data (DB0: 7) into display data RAM. After writing instruction, Y address is increased by 1 automatically.
Read display data	H	H	Read data								Reads data (DB0: 7) from display data RAM to the data bus.

Timing diagram to send command/data

- Notice the latch trigger on E
- Has to check for busy





Example to Set Start Line

```
void
Set_DisplayStartLine (char z)
{
    char P2_cword, P4_cword;

    ///prepare control words
    P2_cword = P2_CWORD_TEMPLATE;
    P2_cword = P2_cword & (~P2_RS);           //clear RS bit
    P2_cword = P2_cword & (~P2_RW);          //clear RW bit
    P4_cword = P4_Set_Zaddr_TMPL;
    P4_cword = P4_cword | (z & 0x3f);

    ///flush out control signals
    while (GLCD_IsBusy());
    GLCD_Write (P2_cword, P4_cword);
} //end of function Set_DisplayStartLine
```



Example to Check Busy

```
int
GLCD_IsBusy ()
{
    char status;

    status = GLCD_ReadStatus ();
    if (status & P4_Busy)
        return 1;
    else
        return 0;
} //end of function GLCD_IsBusy
```



Example to Read LCD Status

```
char
GLCD_ReadStatus ()
{
    char P2_cword;
    char status;

    P2_cword = P2_CWORD_TEMPLATE;
    P2_cword = P2_cword & (~P2_RS);
    P2_cword = P2_cword | (P2_RW);
    status = GLCD_Read (P2_cword);

    return status;
} //end of function GLCD_ReadStatus
```



Example to Do GLCD Read (1/2)

```
char
GLCD_Read (char P2_cword)
{
    char status;
    char P2_cword_rep;

    P2_cword_rep = P2_cword;
    set_GLCD_ReadMode ();
    GLCD_delay ();

    P2_cword_rep = P2_cword_rep & (~P2_E);           //clear E bit
    P2 = P2_cword_rep;
    GLCD_delay ();
```



Example to Do GLCD Read (2/2)

```
P2_cword_rep = P2_cword_rep | P2_E;           //set E bit
```

```
P2 = P2_cword_rep;
```

```
GLCD_delay ();
```

```
status = P4;
```

```
P2_cword_rep = P2_cword_rep & (~P2_E);       //clear E bit
```

```
P2 = P2_cword_rep;
```

```
GLCD_delay ();
```

```
return status;
```

```
}//end of function GLCD_Read
```




Pseudo Code of the General Control Sequence

- Convert each **part** to a sequence of accesses to ports P2 and P4

```
do {  
    read status;  
} while (status==busy);
```

```
Set address x;  
Set address y;  
Write bitmap A;
```



Grading

- Basic: (80%)
 - “Draw” some still image
- Optional: (animation)
 - Move the pattern horizontally (+10%)
 - Move the pattern vertically (+20%)
- But this time you have to start from scratch



Pre-Lab Questions

- Q1: how to enable port P4 for input and output?
- Q2: write a C function to set 8-bit bitmap on address (x, y)
 - Draw (char x, char y, char bitmap)
- Q3: find a tool to generate the bitmap of your image
 - Please google!



Lab06 Study Report

- File name: Bxxxxxxx-MCE-Lab6-Study
- File type: PDF only
- The requirements of report
 - Summarize the content of this slide set
 - Provide your plan for this lab exercise
 - No more than one A4 page
 - Grading: 80 ± 15
- Deadline: 2022/1/5 23:00 (不收遲交)
- Upload to e-learning system



Lab06 Lab Exercise Report

- File name: Bxxxxxxx-MCE-Lab6-Result
- File type: PDF only
- The requirements of report
 - Summarize the problems and results you have in this exercise
 - Some screen shots or some code explanation can be provided
 - No more than two A4 pages
 - Grading: 80 ± 15
- Deadline: 2022/1/19 23:00 (不收遲交)
- Upload to e-learning system