嵌入式系統設計作業-2
紅外線解碼器

溫進坤

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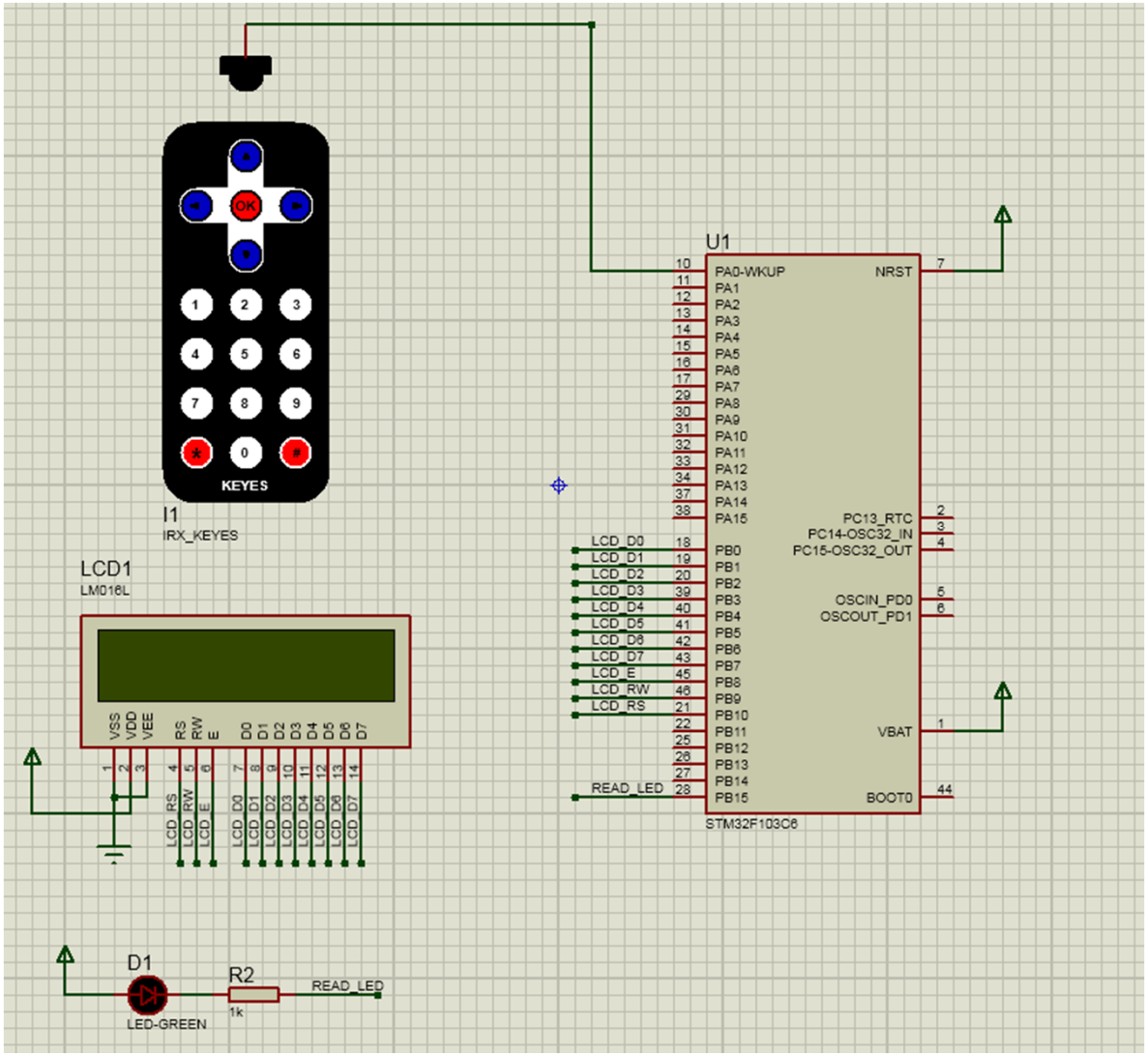
作業題目

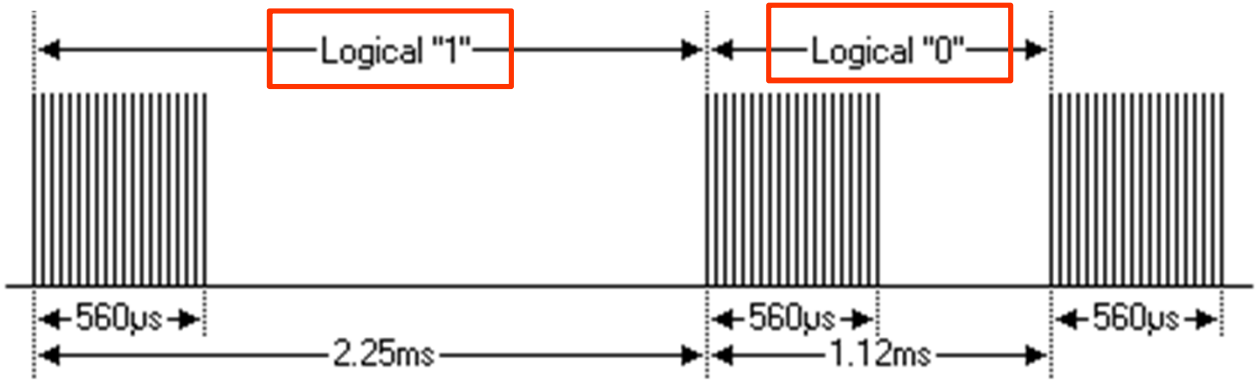
- 開機後LCM第一行顯示”NTUST IR DECODER”，第二行不顯示任何字元。
- 當接收到IR資料後，資料顯示在LCM第二行上，同時LED亮起並維持200ms後關閉
- LCM第二行置中顯示為”XX-YY-ZZ-UU”，其中XX為第一個Byte，YY為第二個Byte，ZZ為第三個Byte，UU為第四個Byte，顯示16進位值。
- CPU工作頻率為72MHz
- 不能有漏IR資料情形，或讀錯IR資料的狀況。
- 必須使用中斷方式解讀IR訊號。

執行畫面

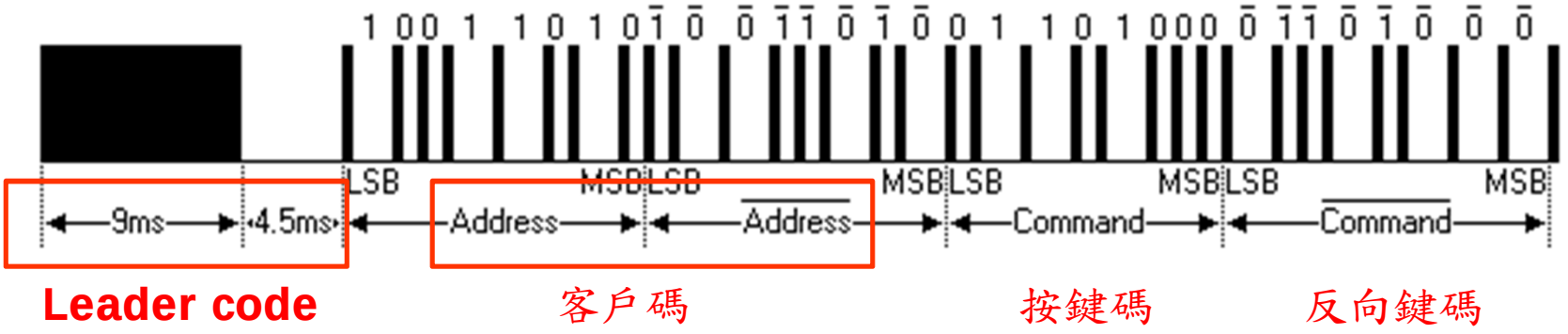

OK
KEYES
I1
IRX_KEYES
LCD1
LM016L
VSS
VDD
VEE
RS
RW
E
D0
D1
D2
D3
D4
D5
D6
D7
LCD_RS
LCD_RW
LCD_E
LCD_D0
LCD_D1
LCD_D2
LCD_D3
LCD_D4
LCD_D5
LCD_D6
LCD_D7
U1
PA0-WKUP
PA1
PA2
PA3
PA4
PA5
PA6
PA7
PA8
PA9
PA10
PA11
PA12
PA13
PA14
PA15
PB0
PB1
PB2
PB3
PB4
PB5
PB6
PB7
PB8
PB9
PB10
PB11
PB12
PB13
PB14
PB15
NRST
PC13_RTC
PC14-OSC32_IN
PC15-OSC32_OUT
OSCIN_PD0
OSCOUT_PD1
VBAT
BOOT0
READ_LED
STM32F103C6
D1
LED-GREEN
R2
1k
READ_LED

IR NEC Protocol

- Logical ”1”：由0.56ms載波和 1.69ms space 組成
- Logical ”0”：由0.56ms載波和 0.56ms space 組成

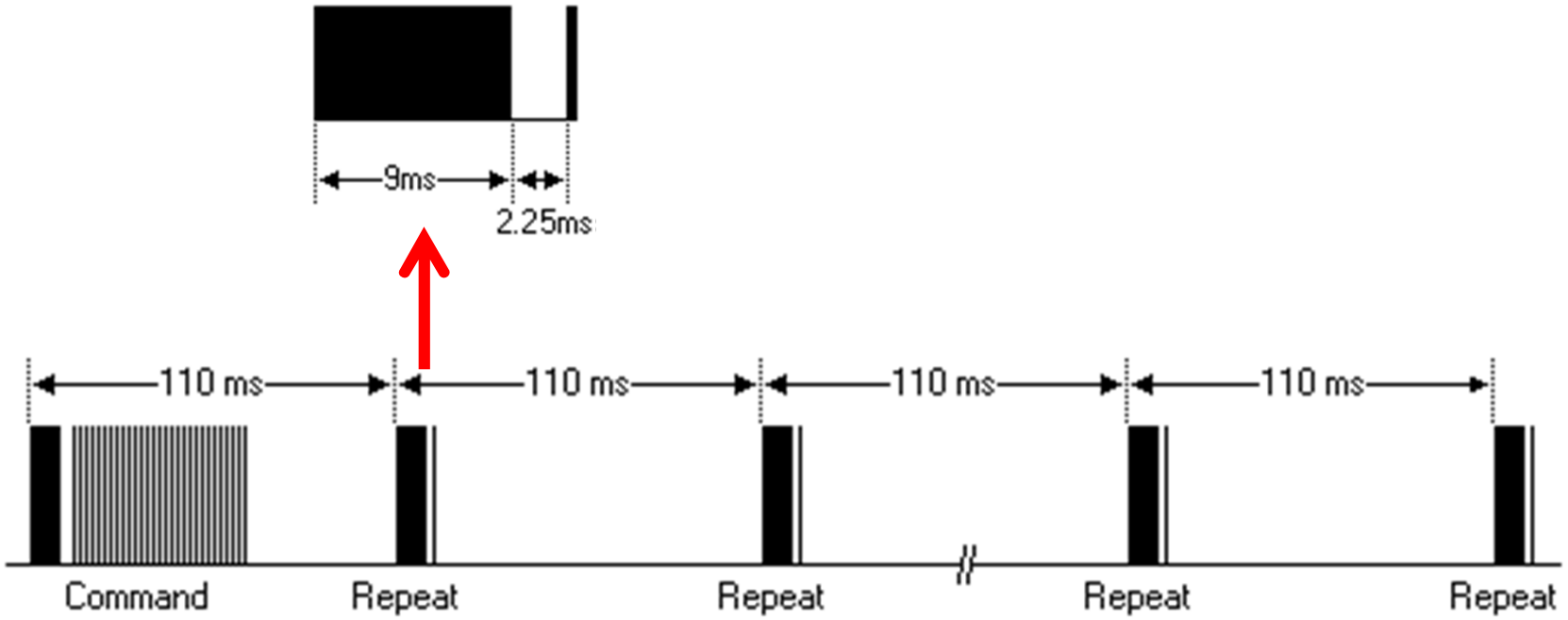


- Leader code ：由9ms載波和 4.5ms space 組成



IR NEC Protocol..

- Repeat code 由9ms載波和 2.25ms space 組成，每間隔 110ms傳送一次

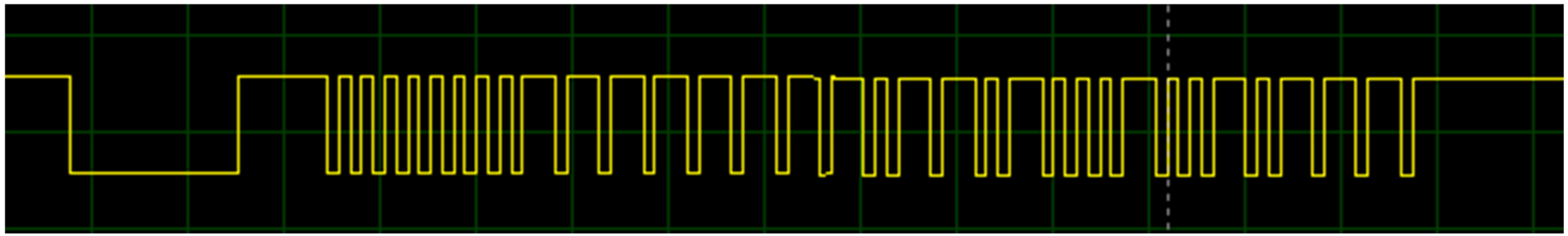


IR搖控器客戶/按鍵碼

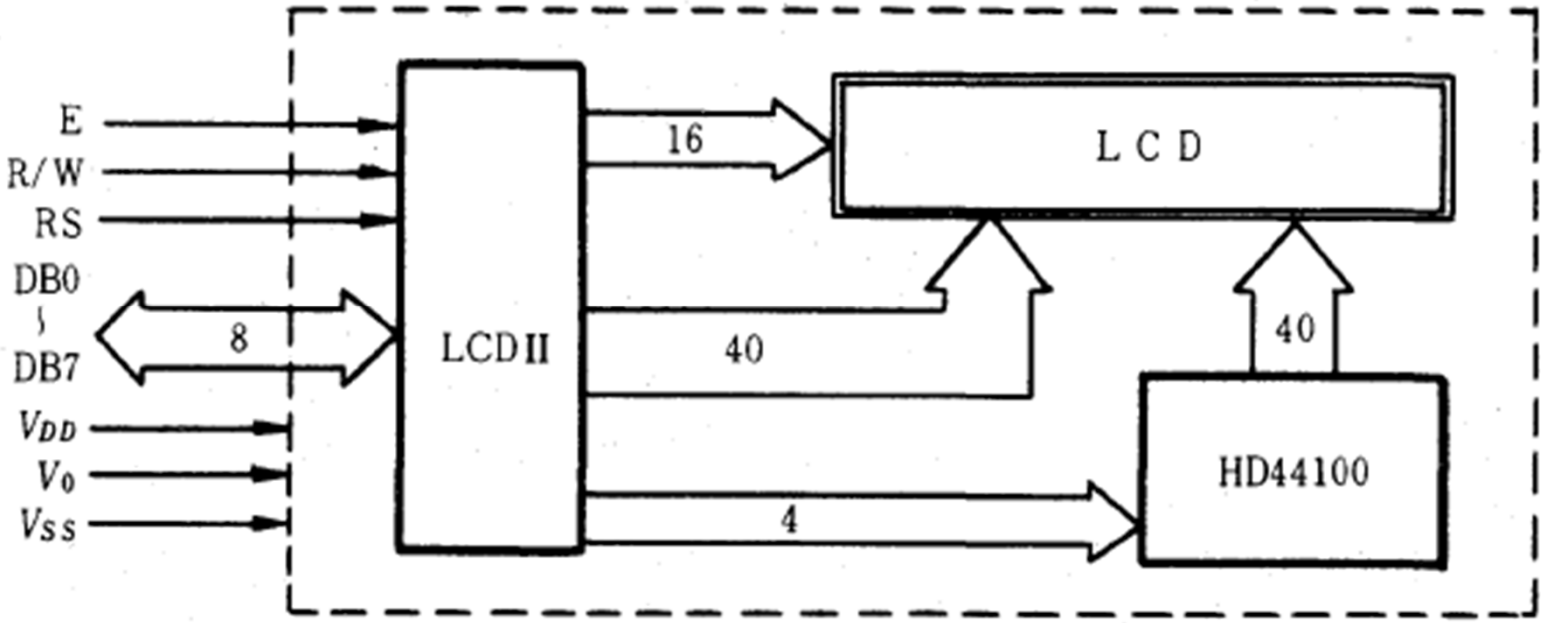
遙控按鍵	客戶碼	客戶碼	鍵碼	反向鍵碼
*	00	FF	42	BD
#	00	FF	4A	B5
0	00	FF	52	AD
1	00	FF	16	E9
2	00	FF	19	E6
3	00	FF	0D	F2
4	00	FF	0C	F3
5	00	FF	18	E7
6	00	FF	5E	A1
7	00	FF	08	F7
8	00	FF	1C	E3
9	00	FF	5A	A5
OK	00	FF	40	BF
Up	00	FF	46	B9
Dn	00	FF	15	EA
Left	00	FF	44	BB
Right	00	FF	43	BC

IR-KEY[1]接收波形

接收的資料：**0x00，0xFF，0x16，0xE9**

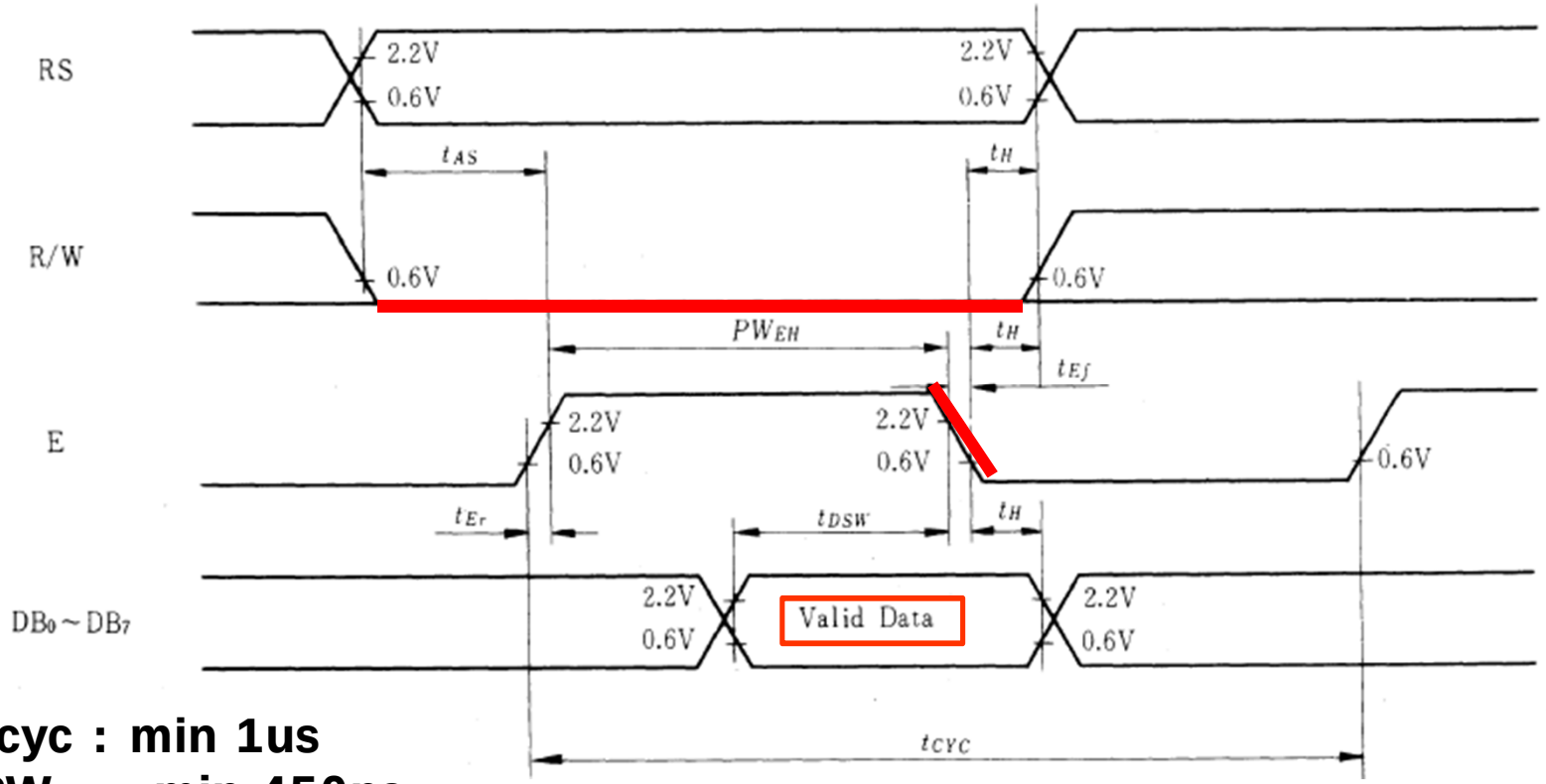


LM016L Block Diagram



- **E : Chip Enable (H , H -> L)**
- **RS : H:Data , L:Instruction Code**
- **R/W : H:Read , L:Write**
- **DB0-DB7 : Bidirection Data Bus**

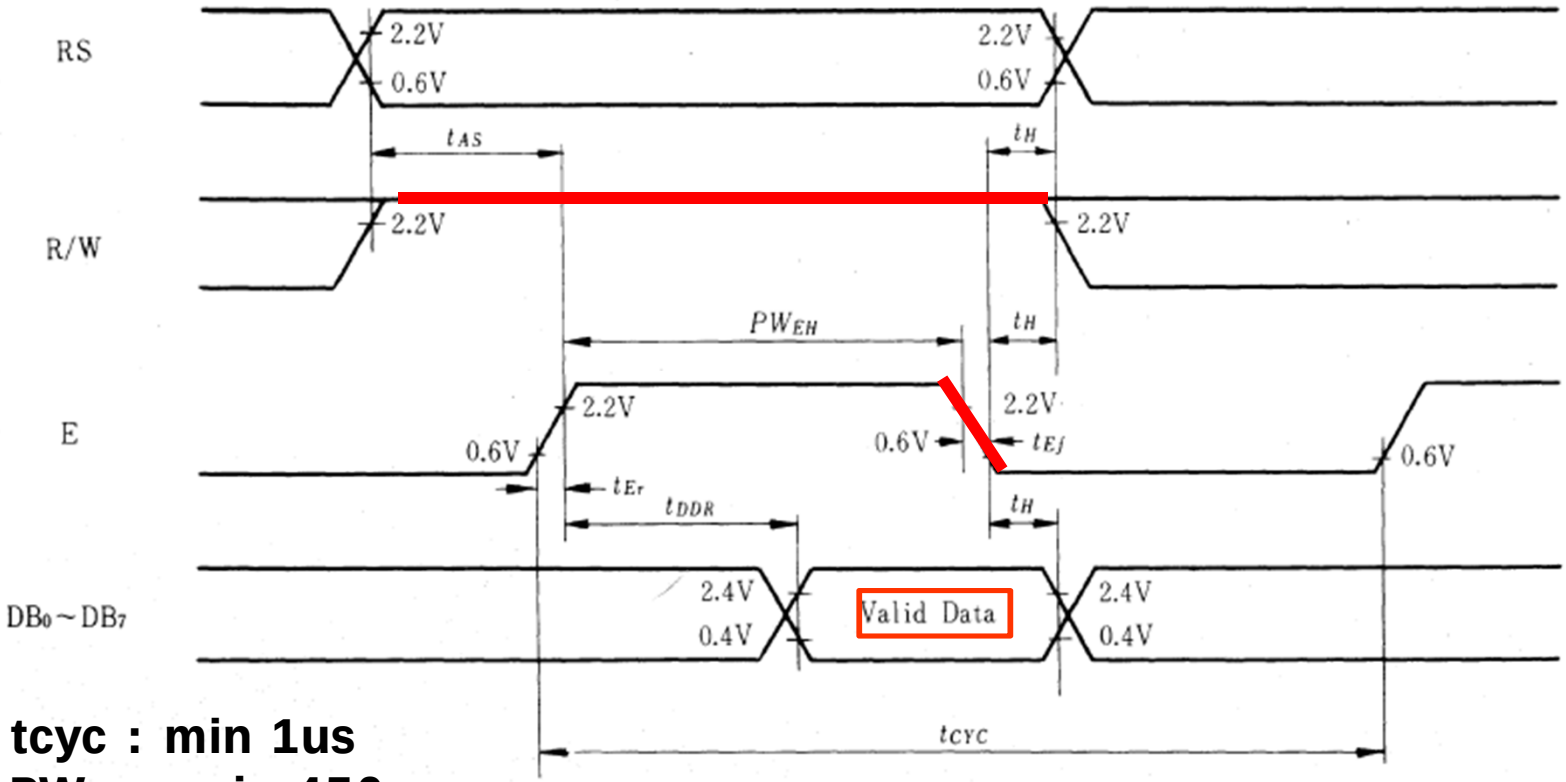
LM016L Interface Timing - Write



tcyc : min 1us
PW_{EH} : min 450ns
tDSW : min 195ns

MCU Write Data to LCM

LM016L Interface Timing - Read



tcyc : min 1us
PW_{EH} : min 450ns
tDSW : min 195ns

MCU Read Data From LCM

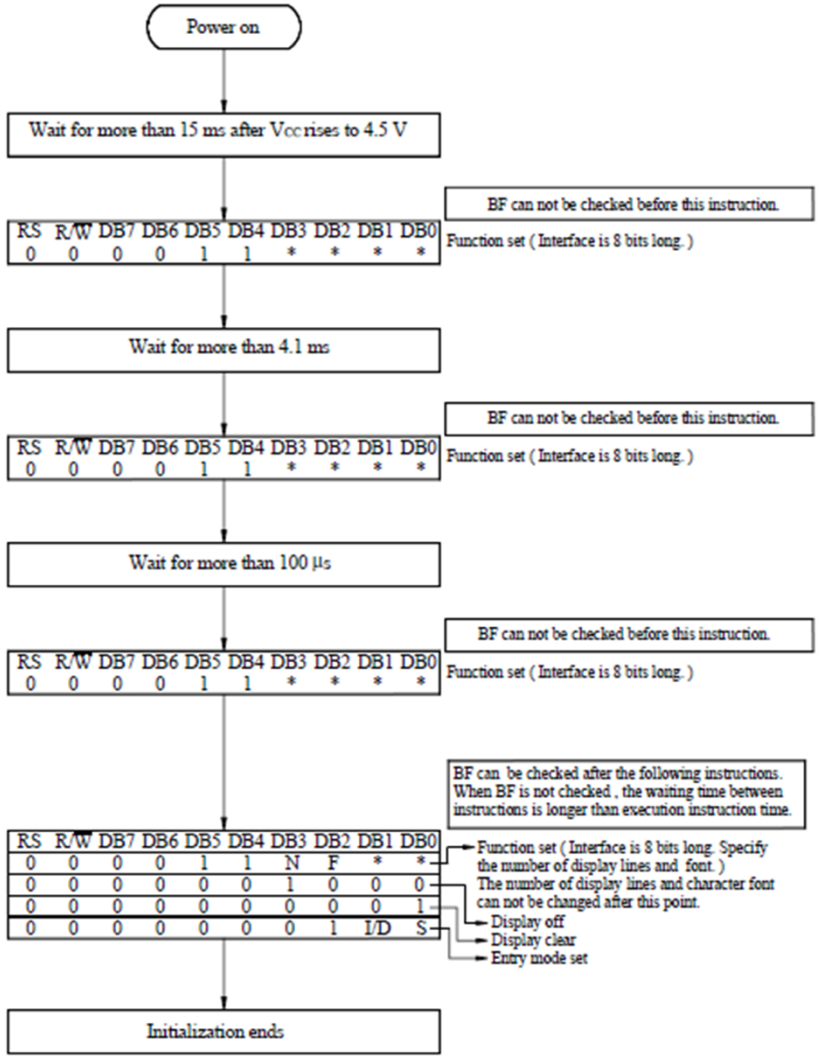
LM016L Instruction Table

Instruction	Instruction Code										Description	Execution time (fosc=270Khz)
	RS	R/W	DB7	DB6	DB5	DB4	DB3	DB2	DB1	DB0		
Clear Display	0	0	0	0	0	0	0	0	0	1	Write "00H" to DDRAM and set DDRAM address to "00H" from AC	1.53ms
Return Home	0	0	0	0	0	0	0	0	1	–	Set DDRAM address to "00H" from AC and return cursor to its original position if shifted. The contents of DDRAM are not changed.	1.53ms
Entry Mode Set	0	0	0	0	0	0	0	1	I/D	SH	Assign cursor moving direction and enable the shift of entire display.	39 μs
Display ON/OFF Control	0	0	0	0	0	0	1	D	C	B	Set display (D), cursor (C), and blinking of cursor (B) on/off control bit.	39 μs
Cursor or Display Shift	0	0	0	0	0	1	S/C	R/L	–	–	Set cursor moving and display shift control bit, and the direction, without changing of DDRAM data.	39 μs
Function Set	0	0	0	0	1	DL	N	F	–	–	Set interface data length (DL:8-bit/4-bit), numbers of display line (N:2-line/1-line)and, display font type (F:5×11 dots/5×8 dots)	39 μs
Set CGRAM Address	0	0	0	1	AC5	AC4	AC3	AC2	AC1	AC0	Set CGRAM address in address counter.	39 μs
Set DDRAM Address	0	0	1	AC6	AC5	AC4	AC3	AC2	AC1	AC0	Set DDRAM address in address counter.	39 μs
Read Busy Flag and Address	0	1	BF	AC6	AC5	AC4	AC3	AC2	AC1	AC0	Whether during internal operation or not can be known by reading BF. The contents of address counter can also be read.	0 μs
Write Data to RAM	1	0	D7	D6	D5	D4	D3	D2	D1	D0	Write data into internal RAM (DDRAM/CGRAM).	43 μs
Read Data from RAM	1	1	D7	D6	D5	D4	D3	D2	D1	D0	Read data from internal RAM (DDRAM/CGRAM).	43 μs

DDRAM : Display RAM
CGRAM :Character RAM

LM016L – Power On Init

8 Bit Interface



計分方式

1. 程式完成後，將所有程式檔案壓縮7z檔後，將檔案命名為作業題目號碼_學號，上傳至Moodle[繳交作業]。(檔名:HW2_學號.7z)
2. 助教會每週下載全部作業程式，檢查功能是否正確，並將檢查結果放上公布欄，若有錯誤需自行修正問題後，再重新上傳檔案。
3. 上傳截止時間後，將無法再上傳程式，未上傳程式該次作業為0分計算。
4. 計分標準依完成順序及程式內容給分，若發現程式有互相抄襲狀況，該兩人分數皆為0分。

參考資料

- **LM016L-Hitachi.pdf**