CONTENTS

1. Record of Revision

Revision	Comment	Date	Page
0	RA=33R	2009.4.16	ALL

2.Precautions in use of LCM

2.1Use Modules

1. When modules switch on or off, after accessing positive supply power with 5±0.5 voltage ,then input signal levels, if signal levels input before supply power becomes stable or switches off, IC circuits off, modules will be damaged , as a result , modules will be damaged.
2. Dot matrix modules are high path –number LCDs, they are largely related to the contrast ,view angle ,driving voltage when displaying , so you should adjust it to get best contrast and view angle, if it is too high , not only displays are effected, but also let life shorted.
3. When using under regulated working temperature below, the display responsiveness it too slow, when using under regulated temperature above, whole display surface turns dark, this is not damaged, when the temperature returns normal, all displays become normal

2.2.Module storage

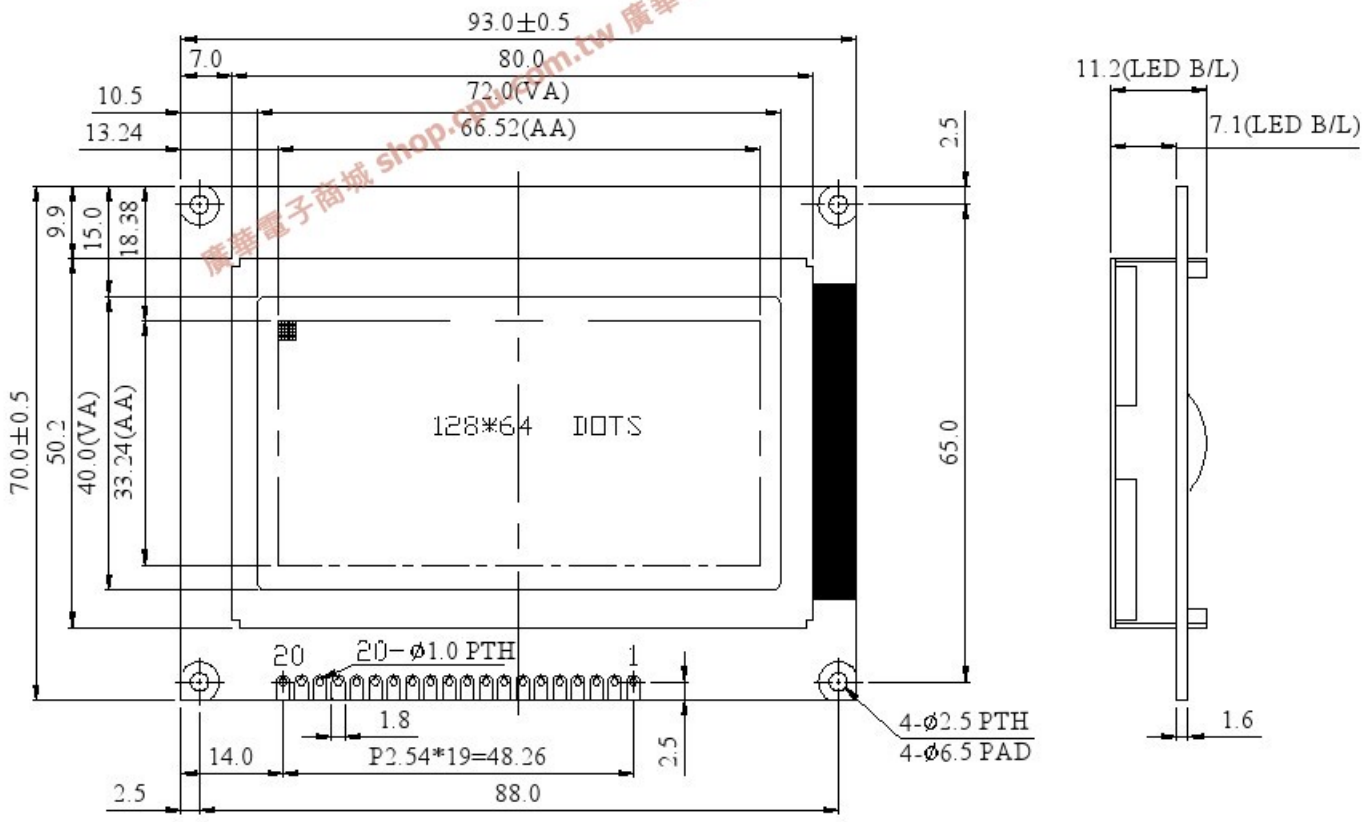
1. Storaging temperature:-30~+80℃
2. Place in dark sites to avoid strong lights
3. Don't place other thing on their surfaces
4. Packaged in polyer materials (with anti-static electricity layers) and sealed

2.3.Soldering

1. Iron head temperature: 280±10℃
2. Soldering time: <3-4S
3. Soldering material: eutectic nature, low melting point
4. Don't use acid solder
5. Soldering don't repeat above 3 times

3. Mechanical Specifications

Item	Value	Unit
Number of dots	128X64	Dot
Dot size	0.48X0.48	MM
Dot pitch	0.52X0.52	MM
Module dimension	93.0(W)X70.0(H)X11.2(T)	MM
View Area	72.0x40.0	
Effective display area	66.52(W)X33.24(H)	MM
Duty	1/64	-
Bias	1/9	-
Viewing direction	6 O'clock	-
Lcd type	STN,GRAY,Positive	-



4.Backlight Characteristic

The LCD Module with backlight

4.1 Maximum Ratings

Item	Symbol	Conditions	Min.	Max.	Unit
Forward current	I_F	T_A=25°C	30	80	mA
Reverse voltage	V_R	T_A=25°C	-	8	V
Power dissipation	P_O	T_A=25°C	-	1	W
Operating Temperature	T_{OPR}	-	-20	70	°C
Storage temperature	T_{STG}	-	-30	80	°C

4.2 Electrical Ratings

Item	Symbol	Condition	Min.	Typ.	Max.	Unit
Forward voltage	V_F	I_F=60mA	3.5	5.0	5.3	V
Reverse current	I_R	V_R=8V	-	-	1	mA
Luminous intensity	I_V	I_F=60mA		100	-	cd/m^2
Wavelength	λp	-				nm
Color	WHITE					

K

A

5. Absolute Maximum Ratings

Item	Symbol	Conditions	Min.	Max.	Unit
Power supply Voltage	VDD	-	-0.3	7.0	V
LCD drive Supply voltage	VDD-VEE	-	-	19.0	V
Input voltage	VIN	-	-0.3	VDD+0.3	V
Output voltage	Vo		-0.3	VDD+0.3	V
Operating temperature	TOPR	-	-20	70	°C
Storage temperature	TSTG	-	-30	80	°C
Static electricity	Be sure that you are grounded when handing LCM				

Notes: 1. Exceeding the absolute maximum ratings may cause permanent damage to the device. Functional operation under these conditions is not implied.

6. DC Electrical Characteristics

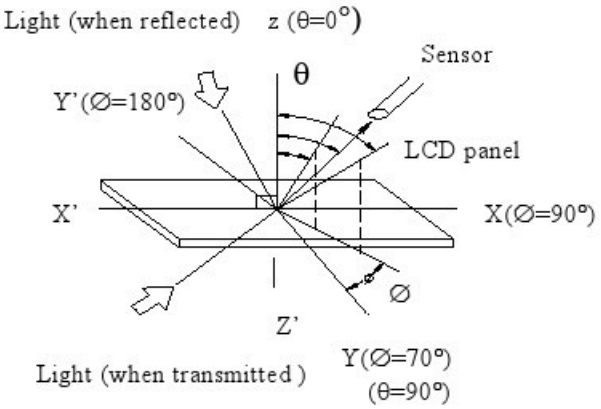
Item	Symbol	Condition	Min.	Typ.	Max.	Unit
Logic Supply voltage	VDD	-	4.0	5.0	5.5	V
"H" input voltage	VIH	-	0.7VDD	-	VDD	V
"L" input voltage	VIL	-	Vss	-	0.3VDD	V
"H" output voltage	VOH	-	VDD-0.4			
"L" output voltage	VOL	-	0	-	0.4	
Supply current for LCD	IDD	VDD=5V		5.0		mA
Supply current for LED	ILED	VDD=5V		60.0		mA

7. Optical Characteristics

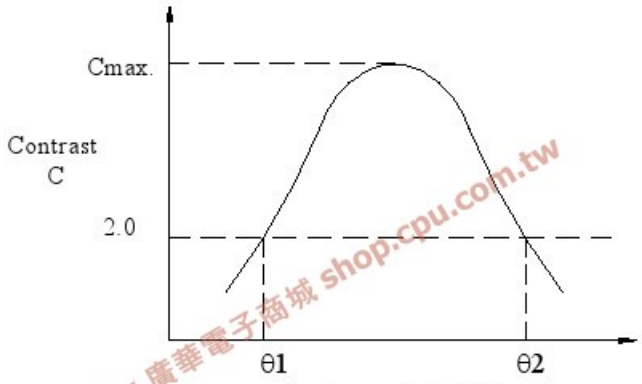
1/64 duty, 1/9 bias, Ta=25°C

Item	Symbol	Conditions	Min.	Typ.	Max	Reference
Viewing angle	θ	C≥2.0,∅=0°C	30°	-	-	Notes 1 & 2
Contrast	C	θ=5°, ∅=0°	2	3	-	Note 3
Response time(rise)	ton	θ=5°, ∅=0°	-	170ms	260ms	Note 4
Response time(fall)	toff	θ=5°, ∅=0°	-	250ms	380ms	Note 4

Note 1: Definition of angles θ and ∅



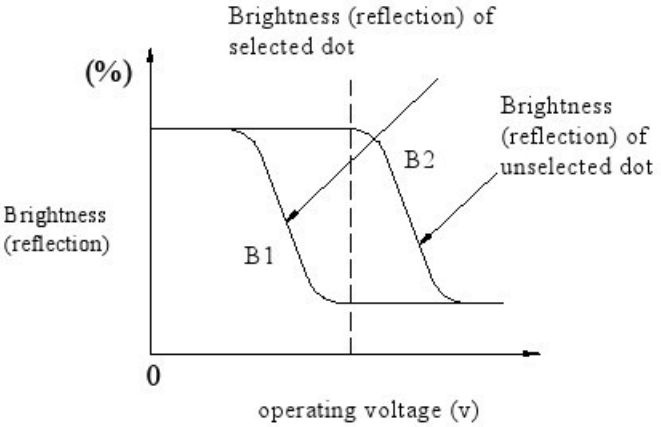
Note 2: Definition of viewing angles θ1 and θ2



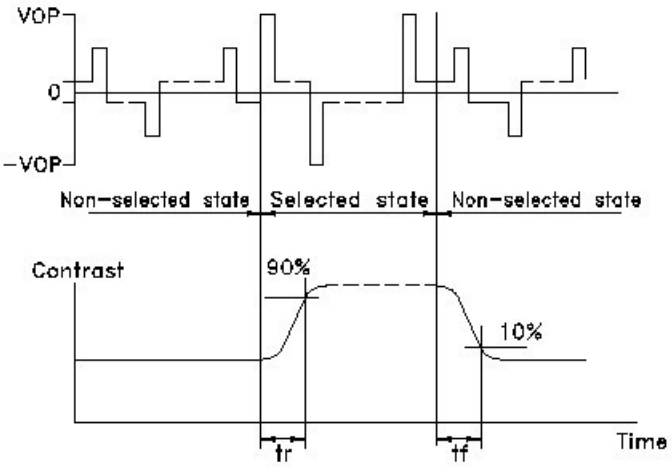
Note : Optimum viewing angle with the naked eye and viewing angle θ at Cmax. Above are not always the same

Note 3: Definition of contrast C

$$C = \frac{\text{Brightness (reflection) of unselected dot (B2)}}{\text{Brightness (reflection) of selected dot (B1)}}$$



Note 4: Definition of response time



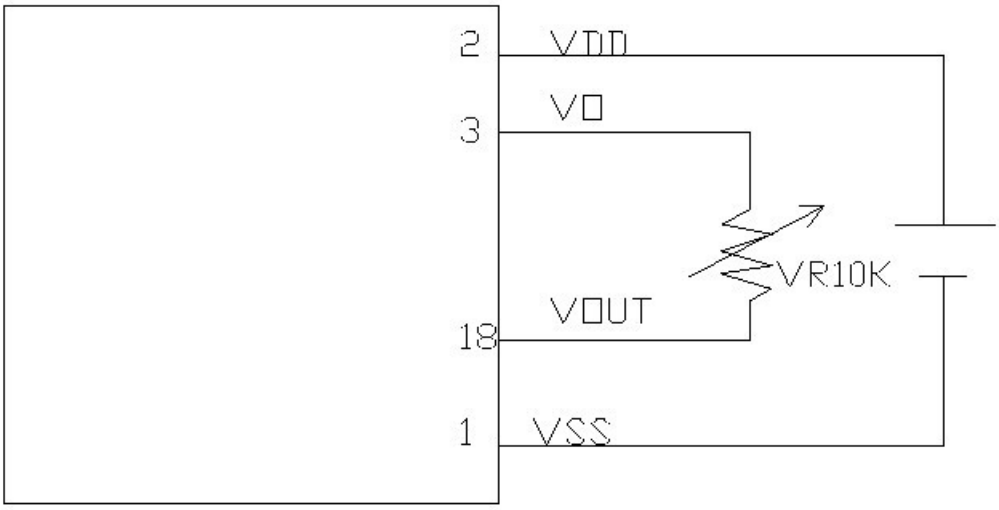
Note: Measured with a transmissive LCD panel which is displayed 1 cm^2

V_{OPR} : Operating voltage
t_{ON} : Response time (rise)
f_{FRM} : Frame frequency
t_{OFF} : Response time (fall)

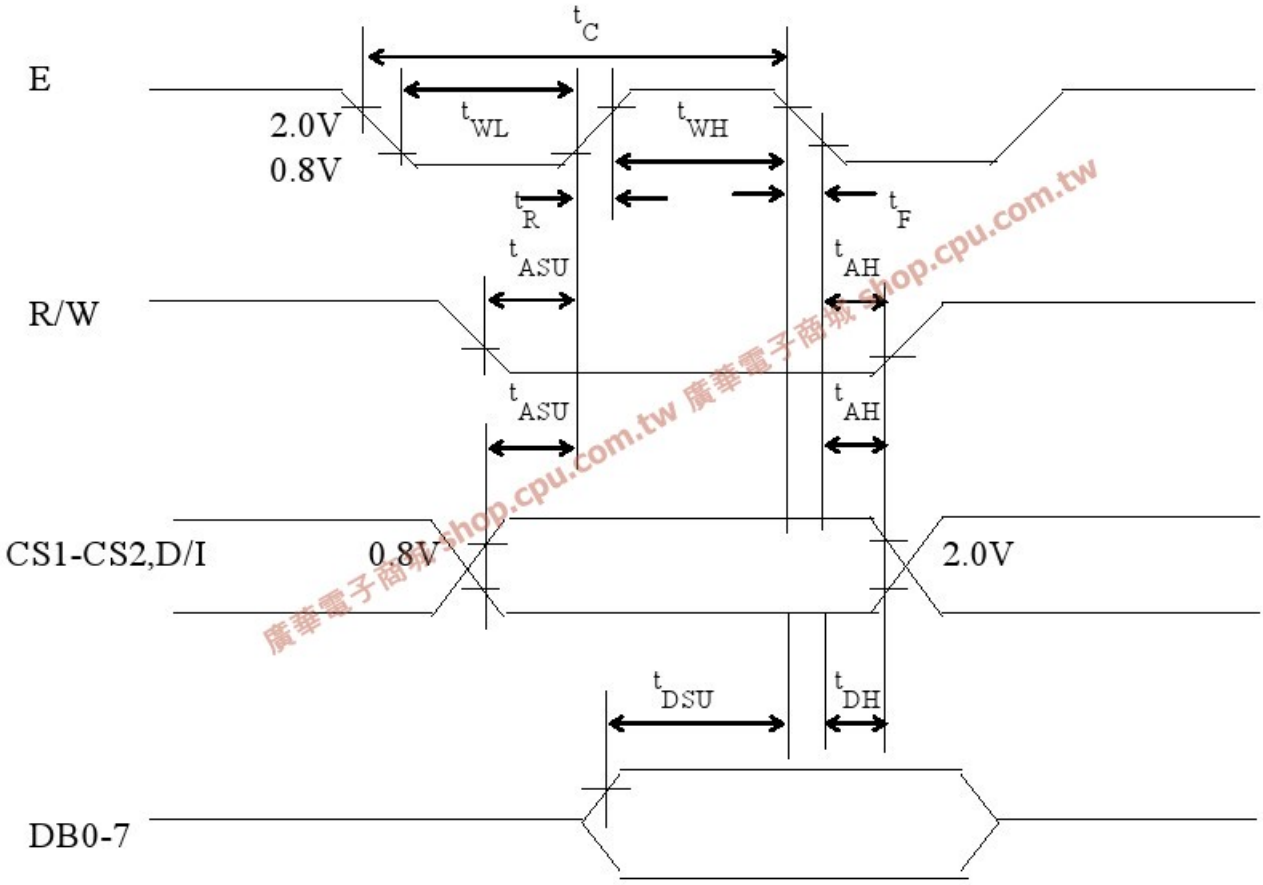
8. Interface Pin Description

Pin No	Symbol	I/O	Function
1	Vss	-	Signal ground (GND)
2	Vdd	-	Power supply for logic (+5V)
3	Vo	-	Operating voltage for LCD (variable)
4	D/I	I	"L" is instruction , "H" is data
5	R/W	I	Data read & write
6	E	I	Enable signal
7-10.	DB0~DB3	I/O	Four low order bi-directional three-state data bus lines. Used for data transfer between the MPU and the LCD module.
11-14	DB4~DB7	I/O	Four high order bi-directional three-state data bus lines. Used for data transfer between the MPU and the LCD module. DB7 can be used as a busy flag.
15	CS1	I	Chip1 enable (segment 1 to segment 64),Active high
16	CS2	I	Chip2 enable (segment 65 to segment 128),Active high
17	RST	I	Reset signal ,Active high(80-series MPU),Active low(68-series MPU),
18	Vout	-	Negative voltage out
19	A	-	LED backlight drive voltage V+ DC5.0V
20	K	-	LED backlight drive voltage Ground 0V

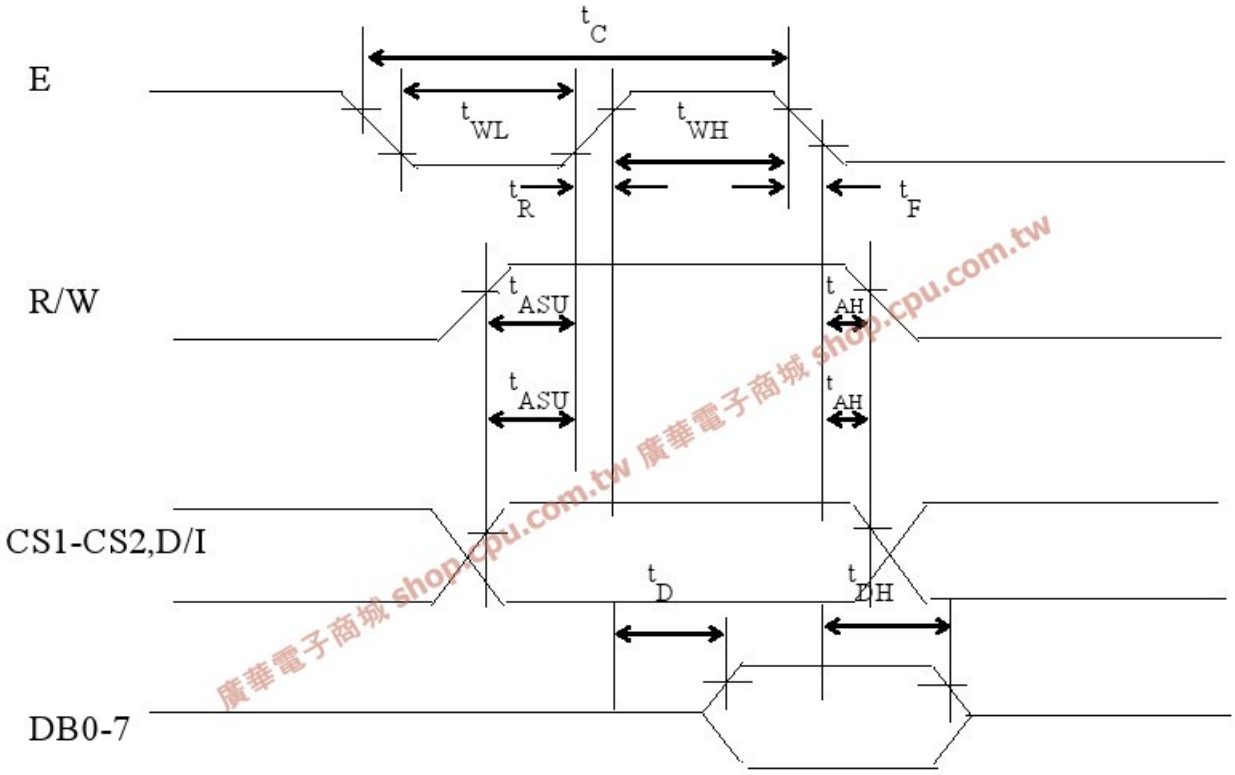
8.2 Power Supply For LCD



9. Timing Characteristics



MPU write timing



MPU read timing

•MPU Bus Read/Write (80-family MPU)

VDD=+5V±10%,VSS=0V,Ta=25°C

Characteristic	Symbol	Min.	Typ	Max	Unit	Characteristic	Symbol	Min.	Typ	Max	Unit
E Cycle	tC	1000	-	-	ns	E Cycle	t_{AH8}	-	10	-	ns
E High Level Width	tWH	450	-	-	ns	E High Level Width	t_{AW8}	-	20	-	ns
E Low Level Width	tWL	450	-	-	ns	E Low Level Width	t_{CYC8}	-	1000	-	ns
E Rise Time	tR	-	-	25	ns	Control pulse width	t_{CC}	-	200	-	ns
E Fall Time	tF	-	-	25	ns	Data setup time	t_{DS8}	-	80	-	ns
Address Set-Up time	tASU	140	-	-	ns	Data hold time	t_{DH8}	-	10	-	ns
Address Hold Time	tAH	10	-	-	ns	RD access time	t_{ACC8}	CL=100 PF	-	90	ns
Data Set-Up Time	tSU	200		-	ns	Output disable time	t_{CH8}		10	60	ns
Data Delay Time	tD	-	-	320	ns						
Data Hold Time (Write)	tDHW	10	-	-	ns						
Data Hold Time (Read)	tDHR	20	-	-	ns						

10. Display Command

COMMANDS Summary

Instructions	Code										Functions	
	R/W	D/I	DB7	DB6	DB5	DB4	DB3	DB2	DB1	DB0		
Display on/off	0	0	0	0	1	1	1	1	1	1/0	Controls display on/off. RAM data and internal status are not affected.	
Display start line	0	0	1	1	Display start line (0-63)						Specifies the RAM line displayed at the top of the screen.	
Set Page (x address)	0	0	1	0	1	1	1	Page (0-7)			Sets the page (X address) of RAM at the page (X address) register.	
Set Y address	0	0	0	1	Y address (0-63)						Sets the Y address in the Y address in the counter.	
Status read	1	0	Busy	0	ON/ OFF	Reset 0		0	0	0	Reads the status. Reads 1: Reset 0: Normal ON/OFF 1: Display off 0: Display on Busy 1: Internal operation 0: Ready	
Write display data	0	1	Write data								Writes data DB0 (LSB) to DB7 (MSB) on the data bus into display RAM.	Has access to he address of the display RAM specified in advance. After the access, Y address is increased by 1.
Read display data	1	1	Read data								Reads data DB0 (LSB) to DB7 (MSB) from the display RAM to the data bus.	

Display On/Off

	R/W	D/I	DB7							DB0
Code	0	0	0	0	1	1	1	1	1	D
			MSB							LSB

The display data appears when D is 1 and disappears when D is 0. Though the data is not on the screen with D=0, it remains in the display data RAM. Therefore, you can make it appear by changing D=0 into D=1.

Display Start Line

	R/W	D/I	DB7							DB0
Code	0	0	1	1	A	A	A	A	A	A
			MSB							LSB

Z address AAAAAA (binary) of the display data RAM is set in the display start line register and displayed at the top of the screen. Figure 1 shows examples of display (1/64 duty cycle) when the start line=0-3. When the display duty cycle is 1/64 or more (ex. 1/32, 1/24 etc.), the data of total line number of LCD screen, from the line specified by display start line instruction, is displayed.
See figure 1.

Set page (X address)

	R/W	D/I	DB7							DB0
Code	0	0	1	0	1	1	1	A	A	A
			MSB							LSB

X address AAA (binary) of the display data RAM is set in the X address register. After that, writing or reading to or from MPU is executed in this specified page until the next page is set. See figure 2.

Set Y Address

	R/W	D/I	DB7							DB0
Code	0	0	0	1	A	A	A	A	A	A
			MSB							LSB

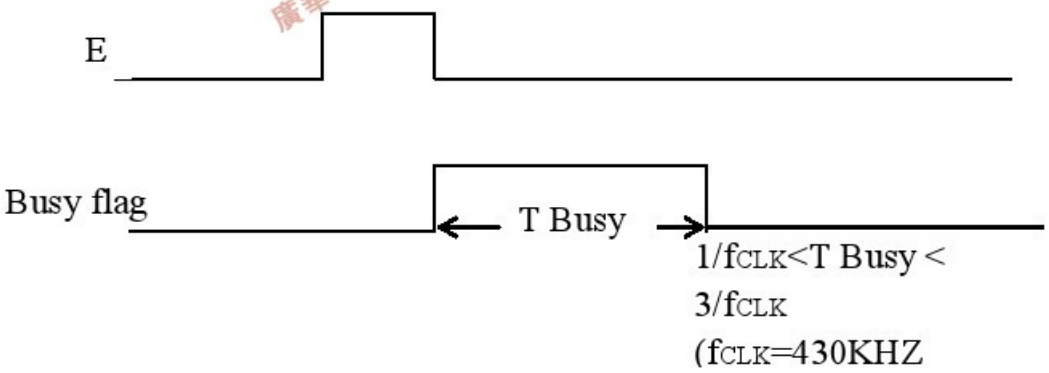
Y address AAAAAA (binary) of the display data RAM is set in the Y address Counter. After that, Y address counter is increased by 1 every time the data is written or read to or from MPU.

Status Read

	R/W	D/I	DB7							DB0
Code	1	0	BUSY	0	ON/OFF	REST	0	0	0	0
			MSB							LS

• Busy

When busy is 1, the LSI is executing internal operations. No instructions are accepted while busy is 1, so you should make sure that busy is 0 before writing the next instruction.



• ON/OFF

Shows the liquid crystal display conditions: on condition or off condition.

When on/off is 1, the display is in off condition.
When on/off is 0, the display is in on condition.

• RESET

RESET=1 shows that the system is being initialized. In this condition, no instructions except status read can be accepted.

RESET=0 shows that initializing has finished and the system is in the usual operation condition.

Write Display Data

	R/W	D/I	DB7							DB0
Code	0	1	D	D	D	D	D	D	D	D
			MSB							LSB

Write 8-bit data DDDDDDDD (binary) into the display data RAM. Then Y address is increased by 1 automatically.

Read Display Data

	R/W	DI	DB7							DB0
Code	1	1	D	D	D	D	D	D	D	D
			MSB							LSB

Reads out 8-bit data DDDDDDDD (binary) from the display data RAM. Then Y address is increased by 1 automatically.

One dummy read is necessary right after the address setting. For details, refer to the explanation of output register in "Function of Each Block".

11. Display Data RAM Addressing

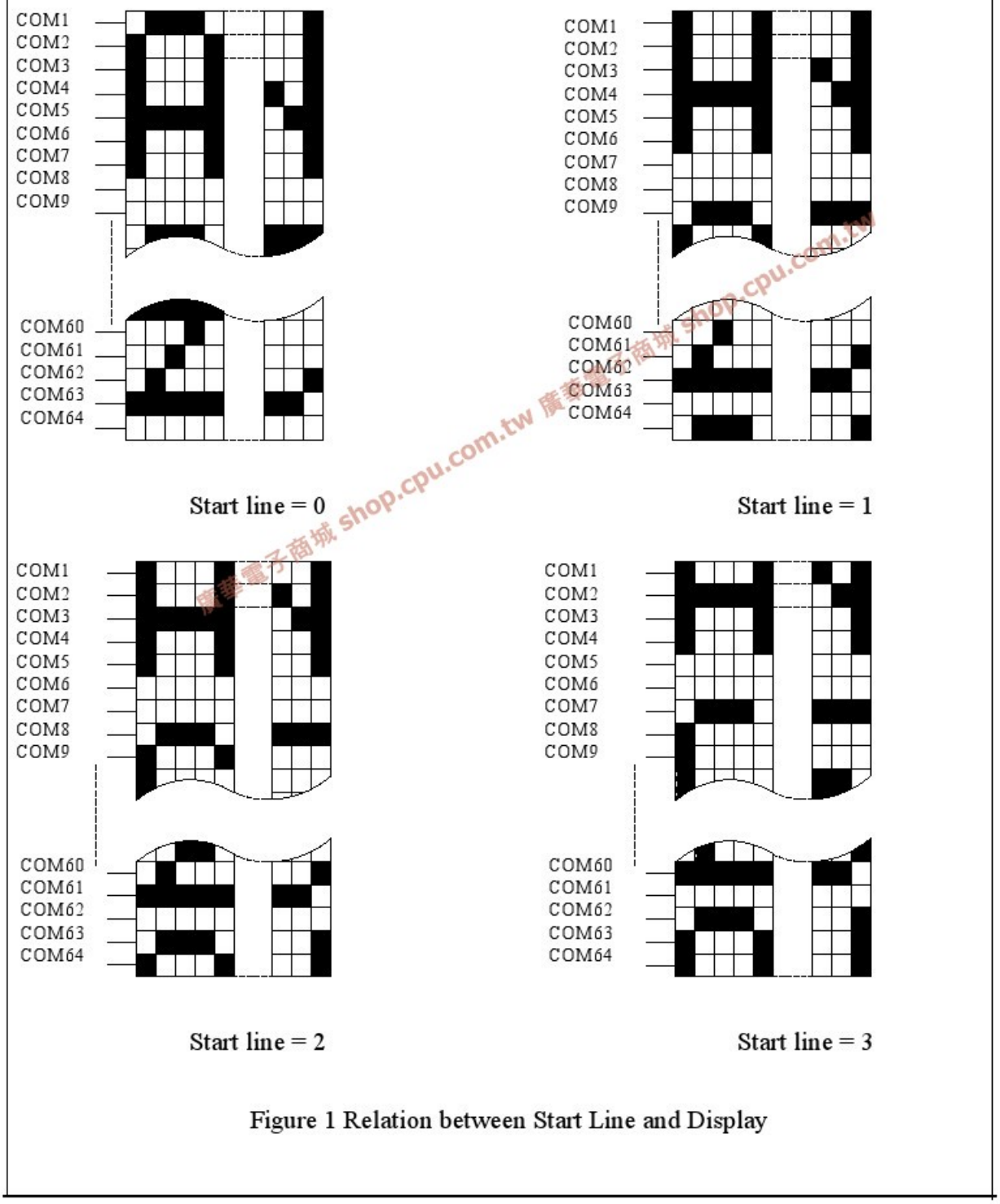


Figure 1 Relation between Start Line and Display

Y address

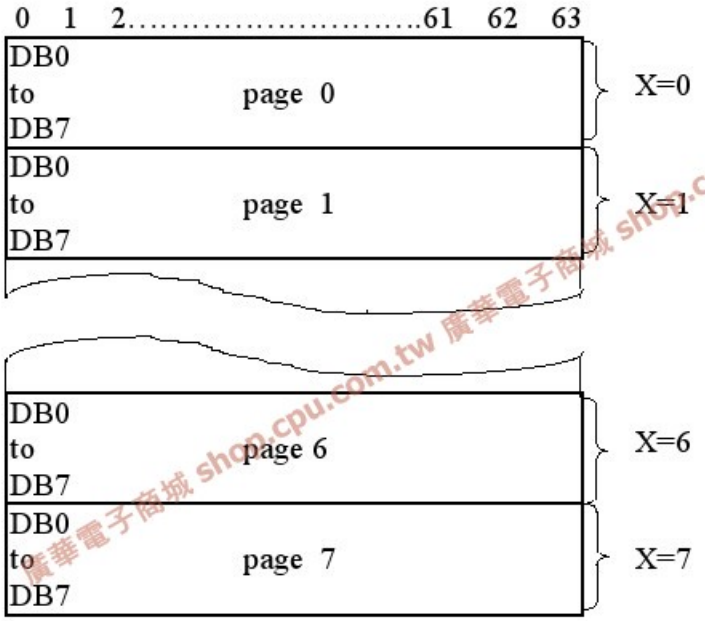


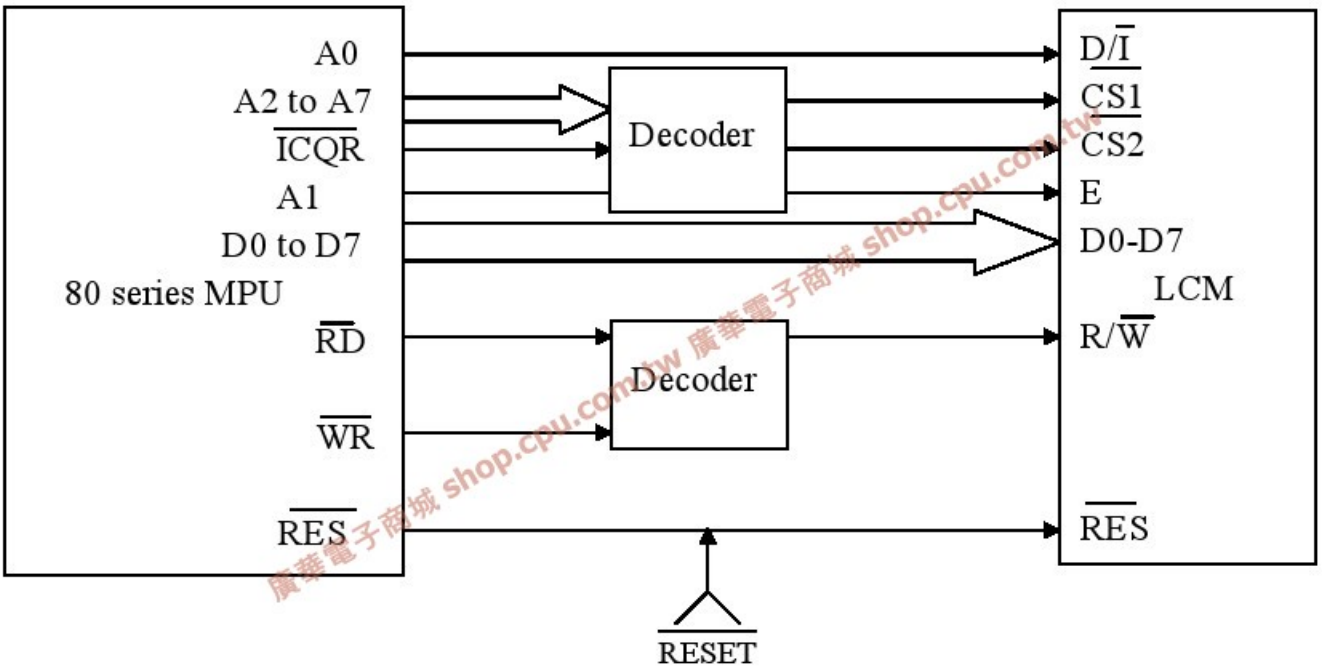
Figure 2 Address Configuration of Display Data RAM

Note: "128*64" consist of 2 "64*64"

CS1⇒ Chip enable for left 64*64 (segment1 to segment 64)

CS2⇒ Chip enable for right 64*64 (segment 65 to segment 128)

12. Interface to MPU



13.Quality Assurance

<table>
<tr><th>NO.</th><th>Parameter</th><th>Criteria</th></tr>
<tr><td>1</td><td>Black or White spots</td><td>
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Dimension</th><th colspan="2">Acceptable Number</th><th rowspan="2">Class Of Defects</th><th rowspan="2">Acceptabl Level</th></tr>
<tr><th>A</th><th>B</th></tr>
<tr><td>D＜0.15</td><td>*</td><td>*</td><td rowspan="4">Minor</td><td rowspan="4">2.5</td></tr>
<tr><td>0.15≦D≦0.2</td><td>4</td><td>4</td></tr>
<tr><td>0.2≦D≦0.25</td><td>2</td><td>2</td></tr>
<tr><td>D≦0.3</td><td>0</td><td>1</td></tr>
</table>
D=(Long + Short)/2 *: Disregard
</td></tr>
<tr><td>2</td><td>Scratch, Substances</td><td>
<table>
<tr><th rowspan="2">Zone
X(mm) Y(mm)</th><th colspan="2">Acceptable Number</th><th rowspan="2">Class Of Defects</th><th rowspan="2">Acceptabl Level</th></tr>
<tr><th>A</th><th>B</th></tr>
<tr><td>*</td><td>0.04≧W</td><td>*</td><td>*</td><td>Minor</td><td>2.5</td></tr>
<tr><td>3.0≧L</td><td>0.06≧W</td><td>4</td><td>4</td><td rowspan="3"></td><td rowspan="3"></td></tr>
<tr><td>2.0≧L</td><td>0.08≧W</td><td>2</td><td>3</td></tr>
<tr><td>—</td><td>0.1＜W</td><td>0</td><td>1</td></tr>
</table>
X: Length Y: Width *: Disregard
Total defects should not exceed 4/module
</td></tr>
<tr><td>3</td><td>Air Bubbles (between glass & polarizer)</td><td>
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<tr><th rowspan="2">Zone
Dimension</th><th colspan="2">Acceptable Number</th><th rowspan="2">Class Of Defects</th><th rowspan="2">Acceptabl Level</th></tr>
<tr><th>A</th><th>B</th></tr>
<tr><td>D≦0.15</td><td>*</td><td>*</td><td rowspan="3">Minor</td><td rowspan="3">2.5</td></tr>
<tr><td>0.15＜D≦0.25</td><td>2</td><td>*</td></tr>
<tr><td>0.25＜D</td><td>0</td><td>1</td></tr>
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*: Disregard
Total defects shall not excess 3/module.
</td></tr>
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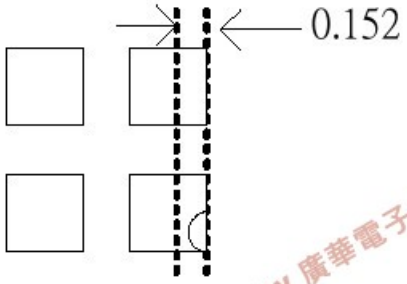
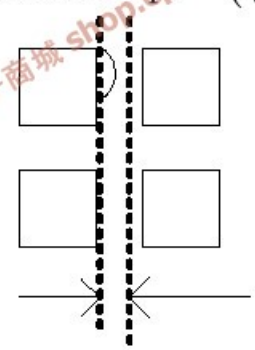
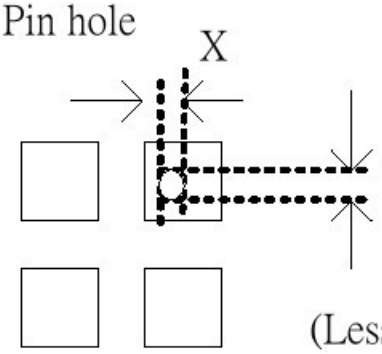
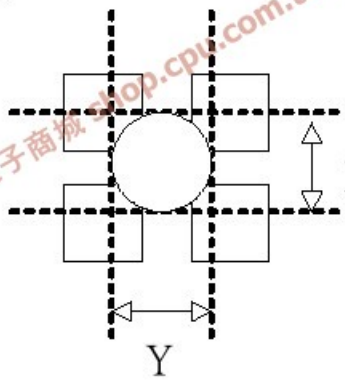
4	Uniformity	(1) Pixel shape (with Dent)  (2) Pixel shape (With Projection)  (3) Pin hole  (Less than 0.1mm is no counted) (4)Deformation  Total acceptable number : 1/pixel,5/cell

14. Reliability

■Content of Reliability Test

Environmental Test				
No.	Test Item	Content of Test	Test Condition	Display
1	High Temperature storage	Endurance test applying the high storage temperature for a long time.	70℃ 200hrs	No damage
2	Low Temperature storage	Endurance test applying the high storage temperature for a long time.	-20℃ 200hrs	No damage
3	High Temperature Operation	Endurance test applying the electric stress (Voltage & Current) and the thermal stress to the element for a long time.	50℃ 200hrs	No damage
4	Low Temperature Operation	Endurance test applying the electric stress under low temperature for a long time.	0℃ 200hrs	No damage
5	High Temperature/ Humidity Storage	Endurance test applying the high temperature and high humidity storage for a long time.	50℃,90%RH 96hrs	No damage
6	High Temperature/ Humidity Operation	Endurance test applying the electric stress (Voltage & Current) and temperature / humidity stress to the element for a long time.	40℃,90%RH 96hrs	No damage
7	Temperature Cycle	Endurance test applying the low and high temperature cycle. -10℃ 25℃ 50℃ 30min 5min 30min 1 cycle	-10℃/50℃ 10 cycles	No damage
Mechanical Test				
8	Vibration test	Endurance test applying the vibration during transportation and using.	10~22Hz→1.5mmp-p 22~500Hz→1.5G Total 0.5hrs	No damage
9	Shock test	Constructional and mechanical endurance test applying the shock during transportation.	50G Half sign wave 11 msedc 3 times of each direction	No damage
10	Atmospheric pressure test	Endurance test applying the atmospheric pressure during transportation by air.	115mbar 40hrs	No damage
Others				
11	Static electricity test	Endurance test applying the electric stress to display surface	VS=2kV 1 time	No damage

***Supply voltage for logic system=5V.